PHYSICS ERRORLESS PREPARATION

Based on Latest Pattern-2025

TOPIC WISE BOOK
PART -2

CHAPTER 14 COVERED WITH 52 TOPIC

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PHYSICS FOR NEET/JEE

Dedicated to
My Son Riyansh Gautam whose time I stole to write this one

Indispensable for NEET/JEE Preparation on latest pattern

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INDEX

Topic 53: Charges & Coulomb's Law

1) Point charges +4q, –q and +4q are kept on the X - axis at points x = 0, x = a and x = 2a respectively. Then:

(a) only –q is in stable equilibrium

(b) none of the charges is in equilibrium

(c) all the charges are in unstable equilibrium

(d) all the charges are in stable equilibrium

2) When air is replaced by a dielectric medium of force constant K ,the maximum force of attraction between two charges, separated by a distance

(a) decrease K – times

(b) increases K – times

(c) remains unchanged

(d) becomes $\frac{1}{K^2}$ times

3) An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The Coulomb force $\vec{F}$ between the two is

(a) $K\frac{e^2}{r^3}\vec{r}$

(b) $K\frac{e^2}{r^2}\hat{r}$

(c) $-K\frac{e^2}{r^3}\hat{r}$

(d) $-K\frac{e^2}{r^3}\vec{r}$

$\left(\text{where } K = \frac{1}{4\pi\varepsilon_0}\right)$

4) Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge of an electron)

(a) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$

(b) $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$

(c) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$

(d) $\frac{4\pi\varepsilon_0 Fd^2}{q^2}$

5) Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is:

(a) 2×10^{-2} C

(b) 3×10^{-2} C

(c) 4×10^{-2} C

(d) 1×10^{-2} C

6) A charge 'q' is placed at the centre of the line joining two equal charges 'Q'. The system of the three charges will be in equilibrium if 'q' is equal to

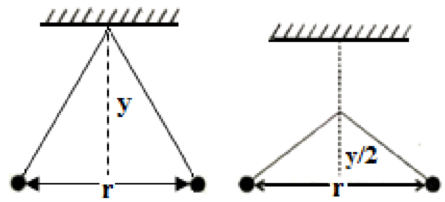
(a) Q/2

(b) –Q/4

(c) Q/4

(d) –Q/2

7) Two pith balls carrying equal charges are suspended from a common point by strings of equal length. The equilibrium separation between them is r. Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now become



(a) $\left(\frac{r}{\sqrt[3]{2}}\right)$

(b) $\left(\frac{2r}{\sqrt{3}}\right)$

(c) $\left(\frac{2r}{3}\right)$

(d) $\left(\frac{r}{\sqrt{2}}\right)^2$

8) Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance d ($d \ll l$) apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then v varies as a function of the distance x between the spheres as:

(a) $v \propto x^{1/2}$

(b) $v \propto x$

(c) $v \propto x^{-1/2}$

(d) $v \propto x^{-1}$

9) Suppose the charge of a proton and an electron differ slightly. One of them is –e, the other is (e + Δe). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen m_h = 1.67×10^{-27} kg]

(a) 10^{-23} C

(b) 10^{-37} C

(c) 10^{-47} C

(d) 10^{-20} C

10) If a charge q is placed at the centre of the line joining two equal charges Q such that the system is in equilibrium then the value of q is

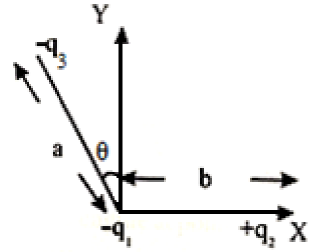
(a) Q/2

(b) –Q/2

(c) Q/4

(d) –Q/4

11) Three charges $-q_1$, $+q_2$ and $-q_3$ are place as shown the figure. The x - component of the force on $-q_1$ is proportional to



(a) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$

(b) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$

(c) $\frac{q_2}{b^2} + \frac{q_3}{a^2} \cos\theta$

(d) $\frac{q_2}{b^2} - \frac{q_3}{a^2} \sin\theta$

12) Two spherical conductors B and C having equal radii and carrying equal charges on them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that B but uncharged is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is

(a) F/8

(b) 3F/4

(c) F/4

(d) 3F/8

13) If g_E and g_M are the accelerations due to gravity on the surfaces of the earth and the moon respectively and if Millikan's oil drop experiment could be performed on the two surfaces, one will find the ratio $\frac{\text{electronic charge on the moon}}{\text{electronic charge on the earth}}$ to be

(a) g_M / g_E

(b) 1

(c) 0

(d) g_E / g_M

14) A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then Q/q equals:

(a) –1

(b) 1

(c) $-\frac{1}{\sqrt{2}}$

(d) $-2\sqrt{2}$

15) Two identical charged spheres suspended from a common point by two massless strings of length l are initially a distance d ($d \ll l$) apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result charges approach each other with a velocity v. Then as a function of distance x between them,

(a) $v \propto x^{-1}$

(b) $v \propto x^{1/2}$

(c) $v \propto x$

(d) $v \propto x^{-1/2}$

16) Two balls of same mass carrying equal charge are hung from a fixed support of length l. At electrostatic equilibrium, assuming that angles made by each thread is small, the separation, x between the balls is proportional to:

(a) l

(b) l^2

(c) $l^{2/3}$

(d) $l^{1/3}$

17) Two charges, each equal to q, are kept at x = –a and x = a on the x - axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement ($y \ll a$) along the y-axis, the net force acting on the particle is proportional to

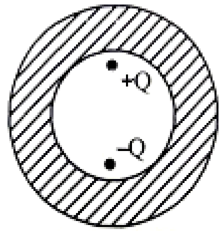
(a) y^2

(b) –y

(c) $\frac{1}{y}$

(d) $-\frac{1}{y}$

18) Shown in the figure are two point charges +Q and –Q inside the cavity of a spherical shell. The charges are kept near the surface of the cavity on opposite sides of the centre of the shell. If σ_1 is the surface charge on the inner surface and Q_1 net charge on it and σ_2 the surface charge on the outer surface and Q_2 net charge on it then:



(a) $\sigma_1 \neq 0, Q_1 = 0$

$\sigma_2 = 0, Q_2 = 0$

(b) $\sigma_1 \neq 0, Q_1 = 0$

$\sigma_2 \neq 0, Q_2 = 0$

(c) $\sigma_1 = 0, Q_1 = 0$

$\sigma_2 = 0, Q_2 = 0$

(d) $\sigma_1 \neq 0, Q_1 \neq 0$

$\sigma_2 \neq 0, Q_2 \neq 0$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	a	d	c	b	b	a	c	b	d
11	12	13	14	15	16	17	18		
b	d	b	d	d	d	a	c		

Topic 54: Electric Field, Electric Field Lines & Dipole

1) There is an electric field E in x – direction. If the work done on moving a charge of 0.2 C through a distance of 2m along a line making an angle of 60° with x – axis is 4J, then what is the value of E?

(a) 3 N/C
(b) 4 N/C
(c) 5 N/C
(d) 20 N/C

2) An electric dipole, consisting of two opposite charges of 2×10^{-6} C each separated by a distance 3 cm is placed in an electric field of 2×10^{5} N/C. Torque acting on the dipole is

(a) 12×10^{-1} Nm
(b) 12×10^{-2} Nm
(c) 12×10^{-3} Nm
(d) 12×10^{-4} Nm

3) The formation of a dipole is due to two equal and dissimilar point charges placed at a

(a) short distance
(b) long distance
(c) above each other
(d) none of these

4) Intensity of an electric field (E) depends on distance r, due to a dipole, is related as

(a) $E \propto \frac{1}{r}$
(b) $E \propto \frac{1}{r^2}$
(c) $E \propto \frac{1}{r^3}$
(d) $E \propto \frac{1}{r^4}$

5) From a point charge, there is a fixed point A. At A, there is an electric field of 500 V/m and potential difference of 3000 V. Distance between point charge and A will be

(a) 6 m
(b) 12 m
(c) 16 m
(d) 24 m

6) A point Q lies on the perpendicular bisector of an electrical dipole of dipole moment p. If the distance of Q from the dipole is r (much larger than the size of the dipole), then the electric field at Q is proportional to

(a) p^{-1} and r^{-2}
(b) p and r^{-2}
(c) p^2 and r^{-3}
(d) p and r^{-3}

7) A hollow insulated conduction sphere is given a positive charge of 10 μC. What will be the electric field at the centre of the sphere if its radius is 2 meters?

(a) zero
(b) 5 μCm^{-2}
(c) 20 μCm^{-2}
(d) 8 μCm^{-2}

8) A semi – circular arc of radius 'a' is charged uniformly and the charge per unit length is λ. The electric field at the centre of this arc is

(a) $\frac{\lambda}{2\pi\varepsilon_0 a}$

(b) $\frac{\lambda}{2\pi\varepsilon_0 a^2}$

(c) $\frac{\lambda}{4\pi^2\varepsilon_0 a}$

(d) $\frac{\lambda^2}{2\pi\varepsilon_0 a}$

9) If a dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$, then torque acting on it is given by

(a) $\vec{\tau} = \vec{p} . \vec{E}$

(b) $\vec{\tau} = \vec{p} \times \vec{E}$

(c) $\vec{\tau} = \vec{p} + \vec{E}$

(d) $\vec{\tau} = \vec{p} - \vec{E}$

10) The electric intensity due to a dipole of length 10 cm and having a charge of 500 μC, at a point on the axis at a distance 20 cm from one of the charges in air, is

(a) 6.25×10^7 N/C

(b) 9.28×10^7 N/C

(c) 13.1×10^{11} N/C

(d) 20.5×10^7 N/C

11) Three point charges +q, –q and +q are placed at points (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are

(a) $\sqrt{2}$qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(b) qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(c) $\sqrt{2}$qa along +ve x direction

(d) $\sqrt{2}$qa along +ve y direction

12) A thin conducting ring of radius R is given a charge +Q. The electric field at the centre O of the ring due to the charge on the part AKB of the ring E. The electric field at the centre due to the charge on the part ACDB of the ring is

(a) E along KO

(b) E along OK

(c) 2E along KO

(d) 3E along OK

13) The mean free path of electrons in a metal is 4×10^{-8}m. The electric field which can give on an average 2eV energy to an electron in the metal will be in units of V/m

(a) 5×10^{-11}

(b) 8×10^{-11}

(c) 5×10^{7}

(d) 8×10^{7}

14) The electric field at a distance $\frac{3R}{2}$ from the centre of a charged conducting spherical shell of radius R is E. The electric field at a distance $\frac{R}{2}$ from the centre of the sphere is

(a) $\frac{E}{2}$

(b) zero

(c) E

(d) $\frac{E}{4}$

15) The electric potential V at any point (x, y, z), all in metres in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) in volt/meter is

(a) 8 along positive X – axis

(b) 16 along negative X – axis

(c) 16 along positive X – axis

(d) 8 along negative X – axis

16) An electric dipole of moment 'p' is placed in an electric field of intensity 'E'. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when = 90°, the torque and the potential energy of the dipole will respectively be:

(a) pE sin θ, –pE cos θ

(b) pE sin θ, –2pE cos θ

(c) pE sin θ, 2pE cos θ

(d) pE cos θ, –pE cos θ

17) An electric dipole of dipole moment p is aligned parallel to a uniform electric field E. The energy required to rotate the dipole by 90° is

(a) pE^2

(b) p^2E

(c) pE

(d) infinity

18) A charged oil drop is suspended in a uniform field of 3×10^4 v/m so that it neither falls nor rises. The charge on the drop will be (Take the mass of the charge = 9.9×10^{-15} kg and g = 10 m/s^2)

(a) 1.6×10^{-18} C

(b) 3.2×10^{-18} C

(c) 3.3×10^{-18} C

(d) 4.8×10^{-18} C

19) Four charges equal to –Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium the value of q is

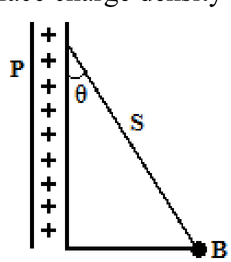
(a) $-\frac{Q}{2}(1 + 2\sqrt{2})$

(b) $\frac{Q}{4}(1 + 2\sqrt{2})$

(c) $-\frac{Q}{4}(1 + 2\sqrt{2})$

(d) $\frac{Q}{2}(1 + 2\sqrt{2})$

20) A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to



(a) cot θ

(b) cos θ

(c) tan θ

(d) sin θ

21) Two point charges +8q and –2q are located at x = 0 and x = L respectively. The location of a point on the x - axis at which the net electric field due to these two point charges is zero is

(a) $\frac{L}{4}$

(b) 2L

(c) 4L

(d) 8L

22) Two spherical conductors A and B of radii 1mm and 2mm are separated by a distance of 5cm and are uniformly charged. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of the spheres A and B is

(a) 4 : 1

(b) 1 : 2

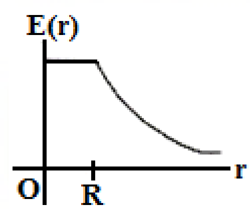
(c) 2 : 1

(d) 1 : 4

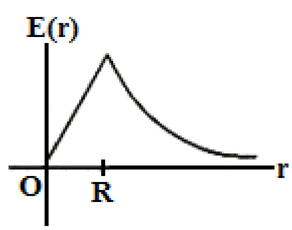
23) A thin spherical shell of radius R has charge Q spread uniformly over its surface. Which of the following graphs most closely represents the electric field E(r) produced by the shell in the range $0 \leq r < \infty$, where r is the distance from the centre of the shell?

(a)

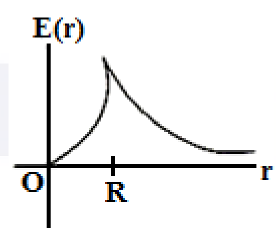
(b)



(c)



(d)



24) Let $\rho(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'P' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is:

(a) $\frac{Q}{4\pi\epsilon_0 r_1^2}$

(b) $\frac{Q r_1^2}{4\pi\epsilon_0 R^4}$

(c) $\frac{Q r_1^2}{3\pi\epsilon_0 R^4}$

(d) 0

25) This question contains Statement –1 and Statement – 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1: For a charged particle moving from a point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q.

Statement – 2: The net work done by a conservative force on an object moving along a closed loop is zero.

(a) Statement – 1 is true, Statement – 2 is true; Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is true; Statement – 2 is not the correct explanation of Statement – 1.

(c) Statement – 1 is false, Statement – 2 is true.

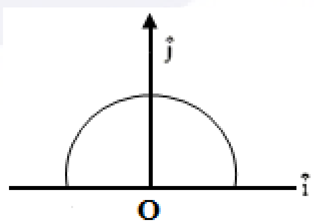
(d) Statement – 1 is true, Statement – 2 is false.

26) Let there be a spherically symmetric charge distribution with charge density varying as $\rho(r) = \rho_0 \left(\frac{5}{4} - \frac{r}{R}\right)$ upto r = R, and $\rho(r) = 0$ for $r > R$, where r is the distance from the origin. The electric field at a distance r ($r < R$) from the origin is given by

(a) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$ (b) $\frac{4\pi\rho_0 r}{3\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$

(c) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$ (d) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$

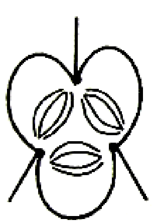
27) A thin semi- circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is

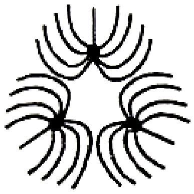


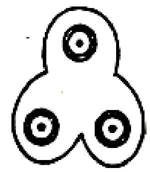
(a) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (b) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$

(c) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$ (d) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

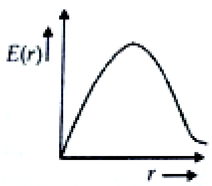
28) Three positive charges of equal value q are placed at vertices of an equilateral triangle. The resulting lines of force should be as in

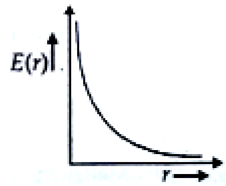
(a)  (b)

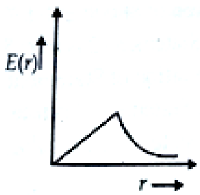
(c) 

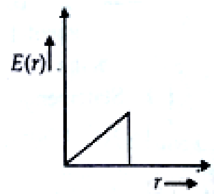
(d) 

29) In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be:

(a) 

(b) 

(c) 

(d) 

30) A liquid drop having 6 excess electrons is kept stationary under a uniform electric field of $25.5 kVm^{-1}$. The density of liquid is 1.26×10^3 kg m^{-3}. The radius of the drop is (neglect buoyancy).

(a) 4.3×10^{-7}m

(b) 7.8×10^{-7}m

(c) 0.078×10^{-7}m

(d) 3.4×10^{-7}m

31) The surface charge density of a thin charged disc of radius R is σ. The value of the electric field at the centre of the disc is $\frac{\sigma}{2\epsilon_0}$. What respect to the field at the centre, the electric field along the axis at a distance R from the centre of the disc:

(a) reduces by 70.7%

(b) reduces by 29.3%

(c) reduces by 9.7%

(d) reduces by 14.6%

32) The magnitude of the average electric field normally present in the atmosphere just above the surface of the Earth is about 150 N/C, directed inward towards the centre of the Earth. This gives the total net surface charge carried by the Earth to be: (Given $\varepsilon_0 = 8.85 \times 10^{-12} C^2/N - m^2$, $R_E = 6.37 \times 10^6$ m)

(a) +670kC

(b) –670kC

(c) –680kC

(d) +680kC

33) A spherically symmetric charge distribution is characterized by a charge density having the following variations:

$\rho(r) = \rho_0 \left(1 - \frac{r}{R}\right)$ for $r < R$

$\rho(r) = 0$ for $r \geq R$

Where r is the distance from the centre of the charge distribution ρ_0 is a constant. The electric field at an internal point ($r < R$) is:

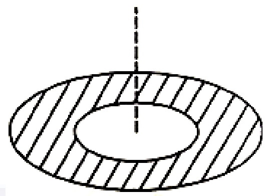
(a) $\frac{\rho_0}{4\varepsilon_0}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

(b) $\frac{\rho_0}{\varepsilon_0}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

(c) $\frac{\rho_0}{3\varepsilon_0}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

(d) $\frac{\rho_0}{12\varepsilon_0}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

34) A thin disc of radius b = 2a has a concentric hole of radius 'a' in it (see figure). It carries uniform surface charge 'σ' on it. If the electric field on its axis at height 'h' ($h \ll a$) from its centre is given as 'Ch' then value of 'C' is:



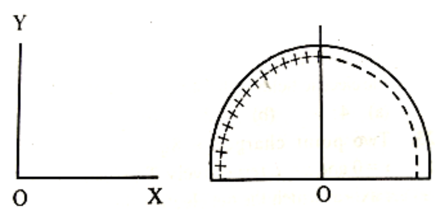
(a) $\frac{\sigma}{4a\epsilon_0}$

(b) $\frac{\sigma}{8a\epsilon_0}$

(c) $\frac{\sigma}{a\epsilon_0}$

(d) $\frac{\sigma}{2a\epsilon_0}$

35) A wire of length L (=20 cm), is bent into a semicircular arc. If the two equal halves of the arc were each to be uniformly charged with charges $\pm Q$,[$|Q| = 10^3\varepsilon_0$ Coulomb where ε_0 is the permittivity (in SI units) of free space] the net electric field at the centre O of the semicircular arc would be :



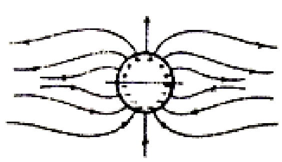
(a) $(50 \times 10^3$ N/C)$\hat{j}$

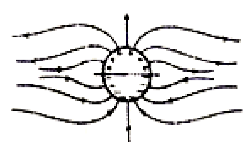
(b) $(50 \times 10^3$ N/C)$\hat{i}$

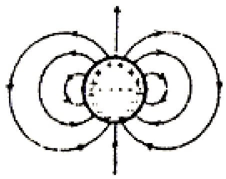
(c) $(25 \times 10^3$ N/C)$\hat{j}$

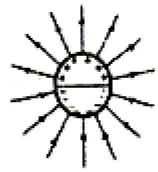
(d) $(25 \times 10^3$ N/C)$\hat{i}$

36) A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge –σ in the lower half. The electric field lines around the cylinder will look like figure given in: (figures are schematic and not drawn to scale)

(a) 

(b) 

(c) 

(d) 

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	c	a	c	a	d	a	a	b	a
11	12	13	14	15	16	17	18	19	20
a	b	c	b	d	a	c	c	b	c
21	22	23	24	25	26	27	28	29	30
b	c	a	b	a	a	c	c	c	b
31	32	33	34	35	36				
a	c	b	a	d	c				

Topic 55: Electric Flux & Gauss's Law

1) A point charge +q is placed at mid point of a cube of side 'L'. The electric flux emerging from the cube is

(a) $\frac{q}{\varepsilon_0}$

(b) $\frac{6qL^2}{\varepsilon_0}$

(c) $\frac{q}{6L^2\varepsilon_0}$

(d) zero

2) A charge Q is placed at the corner of a cube. The electric flux through all the six faces of the cube is

(a) $Q/3\varepsilon_0$

(b) $Q/6\varepsilon_0$

(c) $Q/8\varepsilon_0$

(d) Q/ε_0

3) A charge QμC is placed at the centre of a cube, the flux coming out from any surface will be

(a) $\frac{Q}{6\varepsilon_0} \times 10^{-6}$

(b) $\frac{Q}{6\varepsilon_0} \times 10^{-3}$

(c) $\frac{Q}{24\varepsilon_0}$

(d) $\frac{Q}{8\varepsilon_0}$

4) A charge q is located at the centre of a cube. The electric flux through any face is

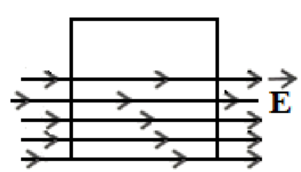
(a) $\frac{q}{6(4\pi\varepsilon_0)}$

(b) $\frac{2\pi q}{6(4\pi\varepsilon_0)}$

(c) $\frac{4\pi q}{6(4\pi\varepsilon_0)}$

(d) $\frac{\pi q}{6(4\pi\varepsilon_0)}$

5) A square surface of side L metres is in plane of the paper. A uniform electric field $\vec{E}$ (volt/m), also in the plane of the paper, is limited only to the lower half of the square surface (see figure). The electric flux in SI units associated with the surface is



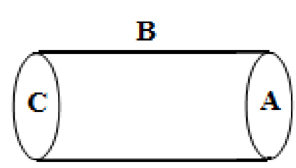
(a) $EL^2/2$

(b) zero

(c) EL^2

(d) $EL^2/(2\varepsilon_0)$

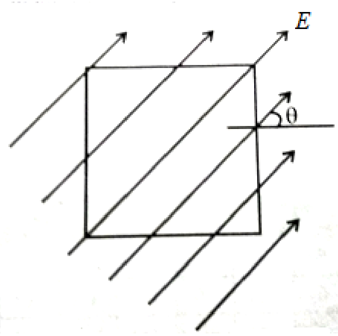
6) A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of voltmeter associated with the curved surface B, the flux linked with the plane surface A in units of voltmeter will be



(a) $\frac{q}{2\varepsilon_0}$ (b) $\frac{\phi}{3}$

(c) $\frac{q}{\varepsilon_0} - \phi$ (d) $\frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$

7) A square surface of side L meter in the plane of the paper is placed in a uniform electric field E (volt/m) acting along the same plane at an angle θ with the horizontal side of square as shown in Figure. The electric flux linked to the surface, in units of volt. m, is



(a) EL^2 (b) $EL^2 \cos\theta$

(c) $EL^2 \sin\theta$ (d) zero

8) A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

(a) increase four times (b) be reduced to half

(c) remain the same (d) be doubled

9) What is the flux through a cube of side 'a' if a point charge of q is at one of its corner:

(a) $\frac{2q}{\varepsilon_0}$ (b) $\frac{q}{8\varepsilon_0}$

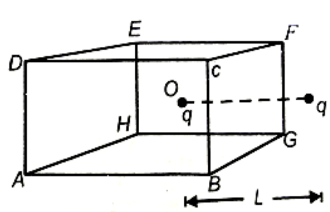
(c) $\frac{q}{\varepsilon_0}$ (d) $\frac{q}{2\varepsilon_0}$

10) The electric field in a certain region is acting radially outward and is given by E = Aa. A charge contained in a sphere of radius 'a' centred at the origin of the field, will be given by

(a) $A\,\varepsilon_0\,a^2$ (b) $4\,\pi\varepsilon_0\,Aa^3$

(c) $\varepsilon_0\,Aa^3$ (d) $4\,\pi\varepsilon_0\,Aa^2$

11) A charged particle q is placed at the centre O of cube of length L (A B C D E F G H). Another same charge q is placed at a distance L from O. Then the electric flux through ABCD is



(a) $q/4\pi\epsilon_0 L$

(b) zero

(c) $q/2\pi\epsilon_0 L$

(d) $q/3\pi\epsilon_0 L$

12) If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2 , the electric charge inside the surface will be

(a) $(\phi_2 - \phi_1)\varepsilon_0$

(b) $(\phi_1 - \phi_2)/\varepsilon_0$

(c) $(\phi_2 - \phi_1)/\varepsilon_0$

(d) $(\phi_1 - \phi_2)\varepsilon_0$

13) An electric dipole is placed at an angle of 30° to a non - uniform electric field. The dipole will experience

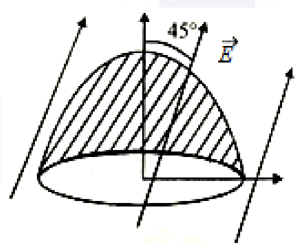
(a) a translational force only in the direction of the field

(b) a translational force only in the direction normal to the direction of the field

(c) a torque as well as a translational force

(d) a torque only

14) The flat base of a hemisphere of radius a with no charge inside it lies in a horizontal plane. A uniform electric field $\vec{E}$ is applied at an angle $\frac{\pi}{4}$ with the vertical direction. The electric flux through the curved surface of the hemisphere is



(a) $\pi a^2 E$

(b) $\frac{\pi a^2 E}{\sqrt{2}}$

(c) $\frac{\pi a^2 E}{2\sqrt{2}}$

(d) $\frac{(\pi+2\pi a)^2 E}{(2\sqrt{2})^2}$

15) Two point dipoles moment $\vec{p}_1$ and $\vec{p}_2$ are at a distance x from each other and $\vec{p}_1 \parallel \vec{p}_2$. The force between the dipole is:

(a) $\frac{1}{4\pi\varepsilon_0}\frac{4p_1p_2}{x^4}$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{3p_1p_2}{x^3}$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{6p_1p_2}{x^4}$

(d) $\frac{1}{4\pi\varepsilon_0}\frac{8p_1p_2}{x^4}$

16) The electric field in a region of space is given by, $\vec{E} = E_0\hat{i} + 2E_0\hat{j}$ where $E_0 = 100$ N/C. The flux of the field through a circular surface of radius 0.02 m parallel to the Y–Z plane is nearly:

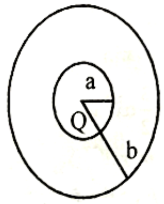
(a) 0.125 Nm^2/C

(b) 0.02 Nm^2/C

(c) 0.005 Nm^2/C

(d) 3.14 Nm^2/C

17) The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), have volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is:



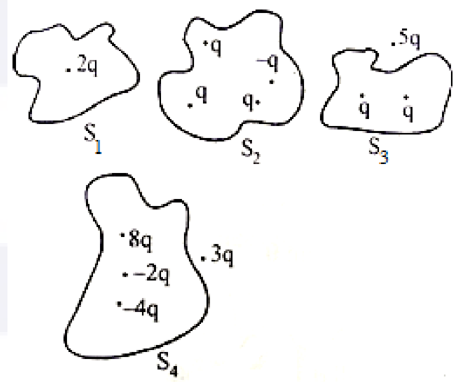
(a) $\frac{2Q}{\pi\ (a^2 - b^2)}$

(b) $\frac{2Q}{\pi\ a^2}$

(c) $\frac{Q}{2\pi\ a^2}$

(d) $\frac{Q}{2\pi\ (b^2 - a^2)}$

18) Four closed surfaces and corresponding charge distributions are shown below.



Let the respective electric fluxes through the surfaces be Φ_1, Φ_2, Φ_3, and Φ_4. Then:

(a) $\Phi_1 < \Phi_2 = \Phi_3 > \Phi_4$

(b) $\Phi_1 > \Phi_2 > \Phi_3 > \Phi_4$

(c) $\Phi_1 = \Phi_2 = \Phi_3 = \Phi_4$

(d) $\Phi_1 > \Phi_3$; $\Phi_2 < \Phi_4$

19) An electric dipole has a fixed dipole moment $\vec{p}$ which makes angle θ with respect to x - axis. When subjected to an electric field $\vec{E}_1 = E\hat{\imath}$, it experiences a torque $\vec{T}_1 = \tau\hat{\imath}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3E_1}\hat{\jmath}$ it experiences torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is

(a) 60°

(b) 90°

(c) 30°

(d) 45°

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	d	a	c	b	d	d	c	b	b
11	12	13	14	15	16	17	18	19	
b	a	c	b	c	a	c	c	a	

Topic 56: Electrostatic, Potential & Equipotential Surfaces

1) A hollow metal sphere of radius 10 cm is charged such that the potential on its surface is 80 V. The potential at the centre of the sphere is

(a) zero (b) 80 V

(c) 800 V (d) 8 V

2) A solid spherical conductor is given a charge. The electrostatic potential of the conductor is

(a) constant throughout the conductor

b) largest at the centre

(c) largest on the surface

(d) largest somewhere between the centre and the surface

3) The electric potential at a point in free space due to a charge Q coulomb is $Q \times 10^{11}$ volts. The electric field at that point is

(a) $4\pi\varepsilon_0 Q \times 10^{22}$ volt/m (b) $12\pi\varepsilon_0 Q \times 10^{20}$ volt/m

(c) $4\pi\varepsilon_0 Q \times 10^{20}$ volt/m (d) $12\pi\varepsilon_0 Q \times 10^{22}$ volt/m

4) The electric potential at a point (x, y, z) is given by $V = -x^2y - xz^3 + 4$. The electric field $\vec{E}$ at that point is

(a) $\vec{E} = \hat{i}\,2xy + \hat{j}\,(x^2 + y^2) + \hat{k}\,(3xz - y^2)$ (b) $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$

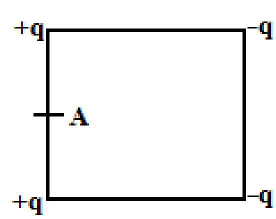
(c) $\vec{E} = \hat{i}\,(2xy - z^3) + \hat{j}\,xy^2 + \hat{k}\,3z^2x$ (d) $\vec{E} = \hat{i}\,(2xy + z^3) + \hat{j}\,x^2 + \hat{k}\,3xz^2$

5) Three concentric spherical shells have radii a, b and c (a < b < c) and have surface charge densities σ, −σ and σ respectively. If V_A, V_B and V_C denotes the potentials of the three shells, then for c = a + b, we have

(a) $V_C = V_B \neq V_A$ (b) $V_C \neq V_B \neq V_A$

(c) $V_C = V_B = V_A$ (d) $V_C = V_A \neq V_B$

6) Four electric charges +q, +q, –q and –q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charges +q and +q, is



(a) $\frac{1}{4\pi\epsilon_0}\frac{2q}{L}(1+\sqrt{5})$

(b) $\frac{1}{4\pi\epsilon_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$

(c) $\frac{1}{4\pi\epsilon_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$

(d) zero

7) Four point charges –Q, –q, 2q and 2Q are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is:

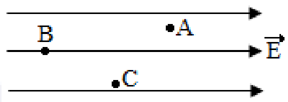
(a) $Q = -q$

(b) $Q = -\frac{1}{q}$

(c) $Q = q$

(d) $Q = \frac{1}{q}$

8) A, B and C are three points in a uniform electric field. The electric potential is



(a) maximum at B

(b) maximum at C

(c) same at the all three points A, B and C

(d) maximum at A

9) A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the centre of the sphere respectively are:

(a) Zero and $\frac{Q}{4\pi\varepsilon_0 R^2}$

(b) $\frac{Q}{4\pi\varepsilon_0 R}$ and zero

(c) $\frac{Q}{4\pi\varepsilon_0 R}$ and $\frac{Q}{4\pi\varepsilon_0 R^2}$

(d) Both are zero

10) In a region, the potential is represented by V(x, y, z) = 6x – 8xy − 8y + 6yz, where V is in volts and x, y, z are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1, 1) is:

(a) $6\sqrt{5}$ N

(b) 30 N

(c) 24 N

(d) $4\sqrt{35}$ N

11) If potential (in volts) in a region is expressed as V(x, y, z) = 6xy – y + 2yz, the electric field (in N/C) at a point (1, 1, 0) is:

(a) $-(6\hat{\imath} + 5\hat{\jmath} + 2\hat{k})$

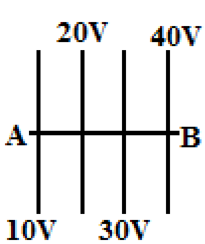
(b) $-(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$

(c) $-(6\hat{\imath} + 9\hat{\jmath} + \hat{k})$

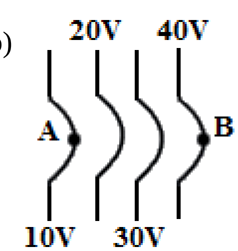
(d) $-(3\hat{\imath} + 5\hat{\jmath} + 3\hat{k})$

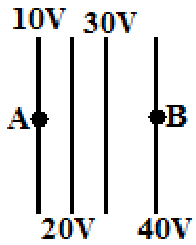
12) The diagrams below show regions of equipotentials.

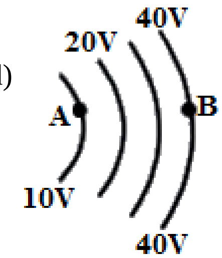
(a)



(b)



(c) 

(d) 

A positive charge is moved from A to B in each diagram.

(a) In all the four cases the work done is the same

(b) Minimum work is required to move q in figure (a)

(c) Maximum work is required to move q in figure (b)

(d) Maximum work is required to move q in figure (c)

13) A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P, a distance $\frac{R}{2}$ from the centre of the shell is

(a) $\frac{2Q}{4\pi\varepsilon_0 R}$

(b) $\frac{2Q}{4\pi\varepsilon_0 R} - \frac{2q}{4\pi\varepsilon_0 R}$

(c) $\frac{2Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 R}$

(d) $\frac{(q+Q)^2}{4\pi\varepsilon_0 R}$

14) Two thin wire rings each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are +q and –q. The potential difference between the centres of the two rings is

(a) $\frac{q}{2\pi\epsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

(b) $\frac{qR}{4\pi\epsilon_0 d^2}$

(c) $\frac{q}{4\pi\epsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

(d) zero

15) The potential at a point x (measured in μm) due to some charges situated on x - axis is given by V(x) = $20/(x^2 - 4)$ volt. The electric field E at x = 4μm is given by

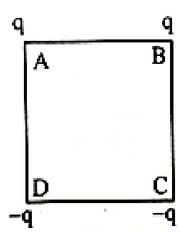
(a) (10/9) volt/μm and in the +ve x direction

(b) (5/3) volt/μm and in the –ve x direction

(c) (5/3) volt/μm and in the +ve x direction

(d) (10/9) volt/μm and in the –ve x direction

16) Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then



(a) $\vec{E}$ changes, V remains unchanged

(b) $\vec{E}$ remain unchanged, V changes

(c) both $\vec{E}$ and V changes

(d) $\vec{E}$ and V remains unchanged

17) An electric charge $10^{-3}\mu C$ is placed at the origin (0, 0) of X - Y co-ordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2, 0)respectively. The potential difference between the points A and B will be

(a) 4.5 volts

(b) 9 volts

(c) zero

(d) 2 volt

18) The electrostatic potential inside a charge spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre and a, b are constants. Then the charge density inside the ball is:

(a) $-6a\varepsilon_0 r$

(b) $-24\pi a\varepsilon_0$

(c) $-6a\varepsilon_0$

(d) $-24\pi a\varepsilon_0 r$

19) The electric potential V(x) in a region around the origin is given by $V(x) = 4x^2$ volts. The electric charge enclosed in a cube of 1m side with its centre at the origin is (in coulomb)

(a) $8\varepsilon_0$

(b) $-4\varepsilon_0$

(c) 0

(d) $-8\varepsilon_0$

20) A charge of total amount Q is distributed over two concentric hollow spheres of radii r and R (R > r) such that surface charge densities on the two spheres are equal. The electric potential at the common centre is

(a) $\frac{1}{4\pi\varepsilon_0}\frac{(R-r)Q}{(R^2+r^2)}$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{(R+r)Q}{2(R^2+r^2)}$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{(R+r)Q}{(R^2+r^2)}$

(d) $\frac{1}{4\pi\varepsilon_0}\frac{(R-r)Q}{2(R^2+r^2)}$

21) A point charge of magnitude $+1\mu C$ is fixed at (0, 0, 0). An isolated uncharged spherical conductor, is fixed with its centre at (4, 0, 0). The potential and the induced electric field at the centre of the sphere is:

(a) 1.8×10^5V and -5.625×10^6V/m

(b) 0V and 0V/m

(c) 2.25×10^5V and -5.625×10^6V/m

(d) 2.25×10^5V and 0V/m

22) Two small equal point charges of magnitude q are suspended from a common point on the ceiling by insulating mass less strings of equal lengths. They come to equilibrium with each string making angle θ from the vertical. If the mass of each charge is m, then the electrostatic potential at the centre of line joining them will be $\left(\frac{1}{4\pi\epsilon_0} = k\right)$.

(a) $2\sqrt{k\,mg\tan\theta}$

(b) $\sqrt{k\,mg\tan\theta}$

(c) $4\sqrt{k\,mg/\tan\theta}$

(d) $\sqrt{k\,mg/\tan\theta}$

23) Consider a finite insulated, uncharged conductor placed near a finite positively charged conductor. The uncharged body must have a potential:

(a) less than the charged conductor and more than at infinity.

(b) more than the charged conductor and less than at infinity.

(c) more than the charged conductor and more than at infinity.

(d) less than the charged conductor and less than at infinity.

24) Assume that an electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at x = 2m is:

(a) 120J/C

(b) −120J/C

(c) −80J/C

(d) 80J/C

25) An electric field $\vec{E} = (25\hat{\imath} + 30\hat{\jmath})\ NC^{-1}$ exists in a region of space. If the potential at the origin is taken to be zero then the potential at x = 2m, y = 2m is

(a) −110 J

(b) −140 J

(c) −120 J

(d) −130 J

26) A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{2}, \frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2 R_3 and R_4 respectively. Then

(a) $R_1 = 0$ and $R_2 < (R_4 - R_3)$

(b) $2R = R_4$

(c) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

(d) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

27) The potential (in volts) of a charge distribution is given by

$V(z) = 30 - 5z^2$ for $|z| \leq 1m$

$V(z) = 35 - 10\,|z|$ for $|z| \geq 1m$.

V(z) does not depend on x and y. If this potential is generated by a constant charge per unit volume ρ_0 (in units of ε_0) which is spread over a certain region, then choose the correct statement.

(a) $\rho_0 = 20\varepsilon_0$ in the entire region

(b) $\rho_0 = 10\varepsilon_0$ for $|z| \leq 1m$ and $p_0 = 0$ elsewhere

(c) $\rho_0 = 20\varepsilon_0$ for $|z| \leq 1m$ and $p_0 = 0$ elsewhere

(d) $\rho_0 = 40\varepsilon_0$ in the entire region

28) Within a spherical charge distribution of charge density ρ(r), N equipotential surfaces of potential V_0, $V_0 + \Delta V$, $V_0 + 2\Delta V$, …….. $V_0 + N\Delta V$ $(\Delta V > 0)$, are drawn and have increasing radii $r_0, r_1, r_2, \ldots\ldots r_N$ respectively. If the difference in the radii of the surfaces is constant for all values of V_0 and ΔV then:

(a) ρ(r) = constant

(b) $\rho(r) \propto \frac{1}{r^2}$

(c) $\rho(r) \propto \frac{1}{r}$

(d) $\rho(r) \propto r$

29) There is a uniform electrostatic field in a region. The potential at various points on a small sphere centred at P, in the region, is found to vary between in the limits 589.0 V to 589.8 V. What is the potential at a point on the surface whose radius vector makes an angle of 60°with the direction of the field?

(a) 589.5 V

(b) 589.2 V

(c) 589.4V

(d) 589.6 V

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	a	a	d	d	c	a	a	b	d
11	12	13	14	15	16	17	18	19	20
a	a	c	a	a	a	c	c	c	c
21	22	23	24	25	26	27	28	29	
c	c	a	c	a	a	b	c	c	

Topic 57: Electric Potential Energy & Work Done in Carrying a Charge

1) A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is

(a) qEy^2 (b) qE^2y

(c) qEy (d) q^2Ey

2) Each corner of a cube of side *l* has a negative charge, –q. The electrostatic potential energy of a charge q at the centre of the cube is

(a) $-\frac{4q^2}{\sqrt{2}\pi\varepsilon_0 l}$ (b) $\frac{\sqrt{3}q^2}{4\pi\varepsilon_0 l}$

(c) $\frac{4q^2}{\sqrt{2}\pi\varepsilon_0 l}$ (d) $-\frac{4q^2}{\sqrt{3}\pi\varepsilon_0 l}$

3) A bullet of mass 2 g is having a charge of 2μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s?

(a) 50 V (b) 5kV

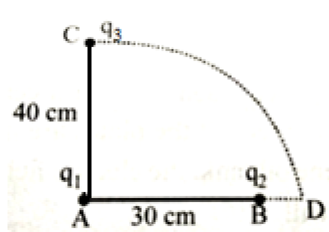
(c) 50kV (d) 5V

4) An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively

(a) q.E and max. (b) 2q.E and min.

(c) q.E and p.E (d) zero and min.

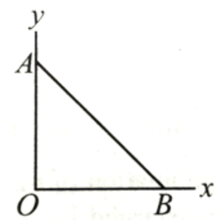
5) Two charges q_1 and q_2 are placed 30 cm apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius 40 cm from C to D. The change in the potential energy of the system is $\frac{q_3}{4\pi\epsilon_0}k$, where k is



(a) $8q_1$ (b) $6q_1$

(c) $8q_2$ (d) $6q_2$

6) As per the diagram, a point charge +q is placed at the origin O. Work done in taking another point charge –Q from the point A [coordinates (0, a)] to another point B [coordinates (a, 0)] along the straight path AB is



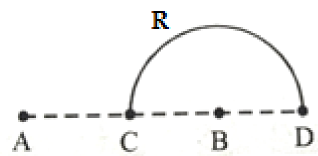
(a) zero

(b) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

(c) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right).\frac{a}{\sqrt{2}}$

(d) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

7) Charges +q and –q are placed at points A and B respectively which are a distance 2L apart, C is the midpoint between A and B. The work done in moving a charge +Q along the semicircle CRD is



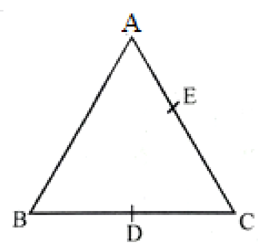
(a) $\frac{qQ}{2\pi\varepsilon_0 L}$

(b) $\frac{qQ}{6\pi\varepsilon_0 L}$

(c) $-\frac{qQ}{6\pi\varepsilon_0 L}$

(d) $\frac{qQ}{4\pi\varepsilon_0 L}$

8) Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is



(a) $\frac{3qQ}{8\pi\epsilon_0 a}$

(b) $\frac{qQ}{4\pi\epsilon_0 a}$

(c) zero

(d) $\frac{3qQ}{4\pi\epsilon_0 a}$

9) The potential energy of particle in a force field is $U = \frac{A}{r^2} - \frac{B}{r}$, where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is:

(a) B /2A

(b) 2A /B

(c) A /B

(d) B /A

10) On moving a charge of 20 coulomb by 2 cm, 2J of work is done, then the potential difference between the points is

(a) 0.1 V

(b) 8 V

(c) 2 V

(d) 0.5 V

11) A charged particle ‘q’ is shot towards another charged particle ‘Q’ which is fixed, with a speed ‘v’. It approaches ‘Q’ upto a closest distance r and then returns. If q were given a speed of ‘2v’ the closest distances of approach would be

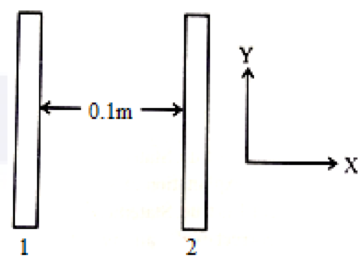
(a) r/2

(b) 2r

(c) r

(d) r/4

12) Two insulating plates are both uniformly charged in such a way that the potential difference between them is $V_2 - V_1 = 20$ V. (i.e., plate 2 is at a higher potential). The plates are separated by d = 0.1m and can be treated as infinitely large. An electron is released from rest on the inner surface of plate 1. What is its speed when it hits plate 2? ($e = 1.6 \times 10^{-19}$C, $m_e = 9.11\times 10^{-31}$ kg)



(a) 2.65×10^6m/s

(b) 7.02×10^{12}m/s

(c) 1.87×10^6m/s

(d) 32×10^{-19}m/s

13) Two points P and Q are maintained at the potentials of 10V and –4V, respectively. The work done in moving 100 electrons from P to Q is:

(a) 9.60×10^{-17}J

(b) -2.24×10^{-16}J

(c) 2.24×10^{-16}J

(d) -9.60×10^{-17}J

14) Two positive charges of magnitude ‘q’ are placed, at the ends of a side (side 1) of a square of side ‘2a’. Two negative charges of the same magnitude are kept at the other corners. Starting from rest, if a charge Q moves from the middle of side 1 to the centre of square, its kinetic energy at the centre of square is

(a) zero

(b) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1+\frac{1}{\sqrt{5}}\right)$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{2}{\sqrt{5}}\right)$

(d) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{1}{\sqrt{5}}\right)$

15) This question has statement – 1 and statement – 2. Of the four choices given after the statements, choose the one that best describes the two statements.

An insulating solid sphere of radius R has a uniformly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphere and also at a point outside the sphere. The electric potential at infinite is zero.

Statement – 1: When a charge q is taken from the centre to the surface of the sphere its potential energy changes by $\frac{q\rho}{3\varepsilon_0}$.

Statement –2: The electric field at a distance r ($r < R$) from the centre of the sphere is $\frac{\rho r}{3\varepsilon_0}$.

(a) Statement – 1 is true, Statement – 2 is true; Statement – 2 is not the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is false.

(c) Statement – 1 is false, Statement – 2 is true.

(d) Statement – 1 is true, Statement – 2 is true; Statement – 2 is the correct explanation of Statement – 1.

16) This question has statement – 1 and statement – 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1: No work is required to be done to move a test charge between any two points on an equilateral surface.

Statement – 2: Electric lines of force at the equipotential surfaces are mutually perpendicular to each other.

(a) Statement – 1 is true, Statement – 2 is true; Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is true; Statement – 2 is not the correct explanation of Statement – 1.

(c) Statement – 1 is true, Statement – 2 is false.

(d) Statement – 1 is false, Statement – 2 is true.

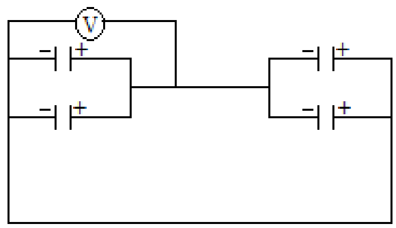
ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	d	c	d	c	a	c	c	b	a
11	12	13	14	15	16				
d	a	c	d	c	c				

Topic 58: Capacitors, Capacitance, Grouping of Capacitors & Energy Stored in a Capacitor

1) A 4μF conductor is charged to 400 volts and then its plates are joined through a resistance of 1kΩ. The heat produced in the resistance is

(a) 0.16 J
(b) 1.28 J
(c) 0.64 J
(d) 0.32 J

2) The four capacitors, each of 25μF are connected as shown in fig. The dc voltmeter reads 200V. The charge on each plate of capacitor is

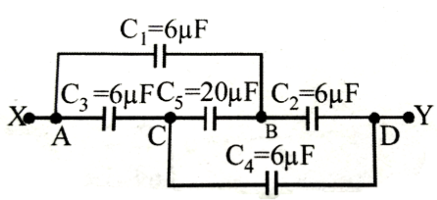


(a) $\pm 2 \times 10^{-3}$C
(b) $\pm 5 \times 10^{-3}$C
(c) $\pm 2 \times 10^{-2}$C
(d) $\pm 5 \times 10^{-2}$C

3) If the potential of a capacitor having capacity 6μF is increase from 10V to 20V, then increase in its energy will be

(a) 4×10^{-4} J
(b) 5×10^{-4} J
(c) 9×10^{-4} J
(d) 12×10^{-6} J

4) What is the effective capacitance between points X and Y?



(a) 24μF
(b) 18μF
(c) 12μF
(d) 6μF

5) A parallel plate condenser with oil between the plates (dielectric constant of oil K = 2) has a capacitance C. If the oil is removed, then capacitance of the capacitor becomes

(a) $\sqrt{2}$C
(b) 2C
(c) $\frac{C}{\sqrt{2}}$
(d) $\frac{C}{2}$

6) A capacitor is charged to store an energy U. The charging battery is disconnected. An identical capacitor is now connected to the first capacitor in parallel. The energy in each of the capacitor is

(a) U/2 (b) 3U/2

(c) U (d) U/4

7) Energy stored in a capacitor is

(a) $\frac{1}{2}$ QV (b) QV

(c) $\frac{1}{QV}$ (d) $\frac{2}{QV}$

8) The capacity of a parallel plate condenser is 10μF when the distance between its plates is 8 cm. If the distance between the plates is reduced to 4cm then the capacity of this parallel plate condenser will be

(a) 5μF (b) 10μF

(c) 20μF (d) 40μF

9) In a parallel capacitor, the distance between the plates is d and potential difference across the plates is V. Energy stored per unit volume between the plates of capacitor is

(a) $\frac{Q^2}{2V^2}$ (b) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$

(c) $\frac{1}{2}\frac{V^2}{\varepsilon_0 d^2}$ (d) $\frac{1}{2}\varepsilon_0\frac{V^2}{d}$

10) A capacitor C_1 is charged to a potential difference V. The charging battery is then removed and the capacitor is connected to an uncharged capacitor C_2. The potential difference across the combination is

(a) $\frac{VC_1}{(C_1+C_2)}$ (b) $V\left(1+\frac{C_2}{C_1}\right)$

(c) $V\left(1+\frac{C_1}{C_2}\right)$ (d) $\frac{VC_2}{(C_1+C_2)}$

11) Three capacitors each of capacity 4μF are to be connected in such a way that the effective capacitance is 6μF. This can be done by

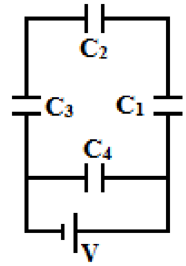
(a) connecting two in parallel and one in series

(b) connecting all of them in series

(c) connecting them in parallel

(d) connecting two in series and one in parallel

12) A network of four capacitors of capacity equal to C_1 = C, C_2 = 2C, C_3 = 3C and C_4 = 4C are conducted to a battery as shown in the figure. The ratio of the charges on C_2 and $C_4$is:



(a) $\frac{4}{7}$

(b) $\frac{3}{22}$

(c) $\frac{7}{4}$

(d) $\frac{22}{3}$

13) A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates

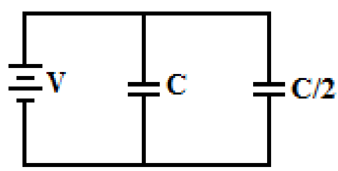
(a) does not change

(b) becomes zero

(c) increases

(d) decreases

14) Two condensers, one of capacity C and other of capacity C/2 are connected to a V- volt battery, as shown.



The work done in charging fully both the condensers is

(a) $\frac{1}{4}$ CV^2

(b) $\frac{3}{4}$ CV^2

(c) $\frac{1}{2}$ CV^2

(d) 2 CV^2

15) Three capacitors each of capacitance C and of breakdown voltage V are joined in series. The capacitance and breakdown voltage of the combination will be

(a) 3C, $\frac{V}{3}$

(b) $\frac{C}{3}$, 3V

(c) 3C, 3V

(d) $\frac{C}{3}$, $\frac{V}{3}$

16) Two parallel metal plates having charges +Q and –Q face each other at a certain distance between them. If the plates are now dipped in kerosene oil tank, the electric field between the plates will

(a) remain same

(b) become zero

(c) increases

(d) decreases

17) A series combination of n_1 capacitors, each of value C_1, is charged by a source of potential difference 4V. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then

(a) $\frac{2C_1}{n_1 n_2}$

(b) $16\frac{n_1}{n_2}C_1$

(c) $2\frac{n_2}{n_1}C_1$

(d) $\frac{16C_1}{n_1 n_2}$

18) A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, the energy stored in the capacitor is:

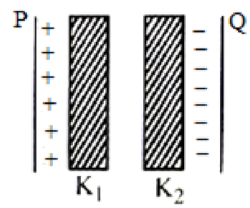
(a) $\frac{1}{2}\ \varepsilon_0 E^2$

(b) $E^2 Ad/\varepsilon_0$

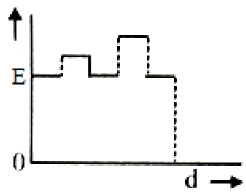
(c) $\frac{1}{2}\ \varepsilon_0 E^2 Ad$

(d) $\varepsilon_0 EAd$

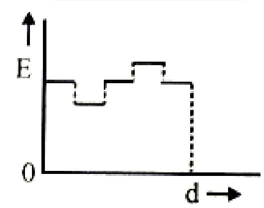
19) Two thin dielectric slabs of dielectric constants K_1 and K_2 ($K_1 < K_2$) are inserted between plates of a parallel plate capacitor, as shown in the figure. The variation of electric field 'E' between the plates with distance 'd' as measured from plate P is correctly shown by:



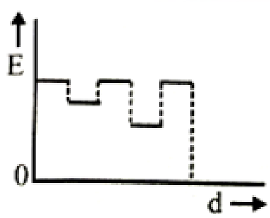
(a)



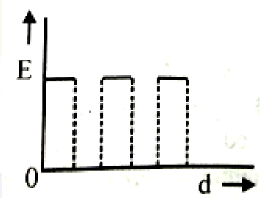
(b)



(c)



(d)



20) A parallel plate air capacitor has capacity 'C' distance of separation between plates is'd' and potential difference 'V' is applied between the plates. Force of attraction between the plates of the parallel plate air capacitor is

(a) $\frac{CV^2}{2d}$

(b) $\frac{CV^2}{d}$

(c) $\frac{C^2V^2}{2d^2}$

(d) $\frac{C^2V^2}{2d}$

21) A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

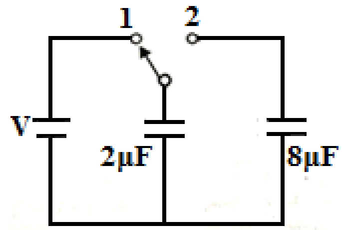
(a) The energy stored in the capacitor decreases K times

(b) The chance in energy stored is $\frac{1}{2}\, CV^2 \left(\frac{1}{K} - 1\right)$

(c) The charge on the capacitor is not conserved

(d) The potential difference between the plates decreases K times.

22)



A capacitor of 2μF is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is:

(a) 0%
(b) 20%
(c) 75%
(d) 80%

23) A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system:

(a) decreases by factor of 2
(b) remains the same
(c) increases by a factor of 2
(d) increases by a factor of 4

24) Capacitance (in F) of a spherical conductor with radius 1 m is

(a) 1.1×10^{-10}
(b) 10^{-6}
(c) 9×10^{-9}
(d) 10^{-3}

25) If there are n capacitors in parallel connected to V volt source, then the energy stored is equal to

(a) CV
(b) $\frac{1}{2}nCV^2$
(c) CV^2
(d) $\frac{1}{2n}CV^2$

26) The work done in placing a charge of 8×10^{-18} coulomb on a condenser of capacity 100 micro – farad is

(a) 16×10^{-32} joule
(b) 3.1×10^{-26} joule
(c) 4×10^{-10} joule
(d) 32×10^{-32} joule

27) A sheet of aluminum foil of negligible thickness is introduced between the plates of a capacitor. The capacitance of the capacitor

(a) decreases
(b) remains unchanged
(c) becomes infinite
(d) increases

28) A fully charged capacitor has a capacitance 'C'. It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity 's' and mass 'm'. If the temperature of the block is raised by 'ΔT', the potential difference 'V' across the capacitance is

(a) $\frac{mC\,\Delta T}{s}$

(b) $\sqrt{\frac{2mC\,\Delta T}{s}}$

(c) $\sqrt{\frac{2ms\,\Delta T}{C}}$

(d) $\frac{ms\,\Delta T}{C}$

29) A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is 'C' then the resultant capacitance is

(a) (n + 1) C

(b) (n – 1) C

(c) nC

(d) C

30) A parallel plate condenser with dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volt. The distance slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

(a) zero

(b) $\frac{1}{2}$ (K – 1) CV^2

(c) $\frac{CV^2(K-1)}{K}$

(d) (K – 1) CV^2

31) A parallel plate capacitor with air between the plates has capacitance of 9pF. The separation between its plates is 'd'. The space between the plates is now filled with two dielectrics. One of the dielectrics has dielectric constant k_1 = 3 and thickness $\frac{d}{3}$ while the other one has dielectric constant k_2 = 6 and thickness $\frac{2d}{3}$. Capacitance of the capacitor is now

(a) 1.8pF

(b) 45pF

(c) 40.5pF

(d) 20.25pF

32) Let C be the capacitance of a capacitor discharging through a resistor R. Suppose t_1 is the time taken for the energy stored in the capacitor to reduce to half its initial value and t_2 is the time taken for the charge to reduce to one – fourth its initial value. Then the ratio t_1/t_2 will be

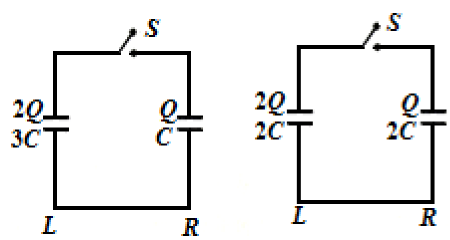
(a) 1

(b) $\frac{1}{2}$

(c) $\frac{1}{4}$

(d) 2

33) Two circuits (a) and (b) have charged capacitors of capacitance C, 2C and 3C with open switches. Charges on each of the capacitor are as shown in the figures. On closing the switches



(a) No charge flows in (a) but charge flows from R to L in (b)

(b) Charges flow from L to R in both (a) and (b)

(c) Charges flow from R to L in (a) and from L to R in (b)

(d) No charge flows in (a) but charge flows from L to R in (b)

34) A series combination of n_1 capacitors, each of capacity C_1 is charged by source of potential difference 4V. When another parallel combination of n_2 capacitors each of capacity C_2 is charged by a source of potential difference V, it has the same total energy stored in it as the first combination has. The value of C_2 in terms of C_1 is then

(a) $16\frac{n_2}{n_1}C_1$ (b) $\frac{2C_1}{n_1 n_2}$

(c) $2\frac{n_2}{n_1}C_1$ (d) $\frac{16C_1}{n_1 n_2}$

35) This question has statement – 1 and statement – 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1: It is not possible to make a sphere of capacity 1 farad using a conducting material.

Statement – 2: It is possible for earth as its radius is 6.4×10^6 m.

(a) Statement – 1 is true, Statement – 2 is true; Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is false, Statement – 2 is true.

(c) Statement – 1 is true, Statement – 2 is true; Statement – 2 is not the correct explanation of Statement – 1.

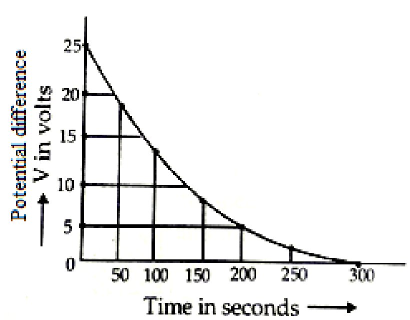
(d) Statement – 1 is true, Statement – 2 is false.

36) The capacitor of an oscillatory circuit is enclosed in a container. When the container is evacuated, the resonance frequency of the circuit is 10kHz. When the container is filled with a gas, the resonance frequency changes by 50Hz. The dielectric constant of the gas is

(a) 1.001 (b) 2.001

(c) 1.01 (d) 3.01

37) The figure shows an experimental plot discharging of a capacitor in an RC circuit. The time constant τ of this circuit lies between:



(a) 150 sec and 200 sec

(b) 0 sec and 50 sec

(c) 50 sec and 100 sec

(d) 100 sec and 150 sec

38) A uniform electric field $\vec{E}$exists between the plates of a charged condenser. A charged particle enters the space between the plates and perpendicular to $\vec{E}$. The path of the particle between the plates is a

(a) straight line

(b) hyperbola

(c) parabola

(d) circle

39) To establish an instantaneous current of 2A through a 1μF capacitor; the potential difference across the capacitor plates should be changed at the rate of:

(a) 2×10^4 V/s

(b) 4×10^6 V/s

(c) 2×10^6 V/s

(d) 4×10^4 V/s

40) A parallel plate capacitor having a separation between the plates d, plate area A and material with dielectric constant K has capacitance C_0. Now one - third of the material is replaced by another material with dielectric constant 2K, so that effectively there are two capacitors one with area $\frac{1}{3}$ A, dielectric constant 2K and another with area $\frac{2}{3}$ A and dielectric constant K. If the capacitance of this new capacitor is C then $\frac{C}{C_0}$ is

(a) 1

(b) $\frac{4}{3}$

(c) $\frac{2}{3}$

(d) $\frac{1}{3}$

41) Three capacitors, each of 3μF, are provided. These cannot be combined to provide the resultant capacitance of:

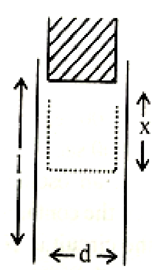
(a) 1μF

(b) 2μF

(c) 4.5μF

(d) 6μF

42) A parallel plate capacitor is made of two plates of length *l*, width w and separated by distance d. A dielectric slab (dielectric constant K) that fits exactly between the plates is held near the edge of the plates. It is pulled into the capacitor by a force F = $-\frac{\partial U}{\partial x}$ where U is the energy of the capacitor when dielectric is inside the capacitor up to distance x (See figure). If the charge on the capacitor is Q then the force on the dielectric when it is near the edge is:



(a) $\frac{Q^2 d}{2\omega l^2 \varepsilon_0} K$

(b) $\frac{Q^2 \omega}{2 d l^2 \varepsilon_0} (K-1)$

(c) $\frac{Q^2 d}{2\omega l^2 \varepsilon_0} (K-1)$

(d) $\frac{Q^2 \omega}{2 d l^2 \varepsilon_0} K$

43) The space between the plates of a parallel plate capacitor is filled with a ‘dielectric’ whose ‘dielectric constant’ varies with distance as per the relation:

$K(x) = K_0 + \lambda x$ (λ = a constant)

The capacitance C, of the capacitor, would be related to its vacuum capacitance C_0 for the relation:

(a) $C = \frac{\lambda d}{\ln(1+K_0\lambda d)} C_0$

(b) $C = \frac{\lambda}{d.\ln(1+K_0\lambda d)} C_0$

(c) $C = \frac{\lambda d}{\ln(1+\lambda d/K_0)} C_0$

(d) $C = \frac{\lambda}{d.\ln(1+K_0/\lambda d)} C_0$

44) The gap between the plates of a parallel plate capacitor of area A and distance between plates d, is filled with dielectric whose permittivity varies linearly from ϵ_1 at one plate to ϵ_2 at the other. The capacitance of capacitor is:

(a) $\epsilon_0 (\epsilon_1 + \epsilon_2) A/d$

(b) $\epsilon_0 (\epsilon_2 + \epsilon_1) A/2d$

(c) $\epsilon_0 A/ [d/n (\epsilon_2/\epsilon_1)]$

(d) $\epsilon_0 (\epsilon_2 - \epsilon_1) A/ [d/n (\epsilon_2 / \epsilon_1)]$

45) A parallel plate capacitor is made of two circular plates separated by a distance 5 mm and with a dielectric of dielectric constant 2.2 between them. When the electric field in the dielectric is 3×10^4 V/m the charge density of the positive plate will be close to:

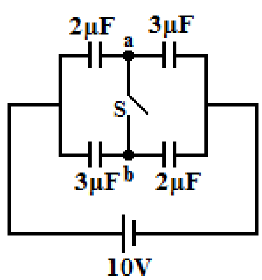
(a) 6×10^{-7} C/m^2

(b) 3×10^{-7} C/m^2

(c) 3×10^4 C/m^2

(d) 6×10^4 C/m^2

46) In figure a system of four capacitors connected across a 10V battery is shown. Charge that will flow from switch S when it is closed is:



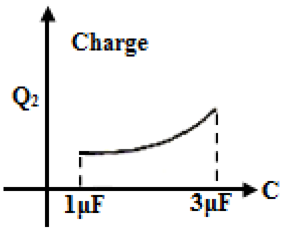
(a) 5μC from b to a

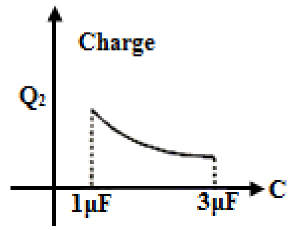
(b) 20μC from a to b

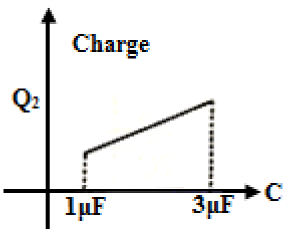
(c) zero

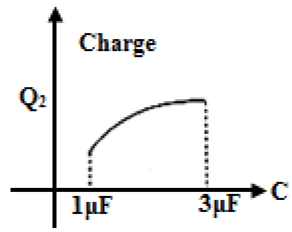
(d) 5μC from a to b

47) In the given circuit, charge Q_2 on the 2μF capacitor changes as C is varied from 1μF to 3μF. Q_2 as a function of ‘C’ is given properly by: (figure are drawn schematically and are not to scale)

(a)


(b)


(c)


(d)


48) Three capacitors each of 4μF are to be connected in such a way that the effective capacitance is 6μF. This can be done by connecting them:

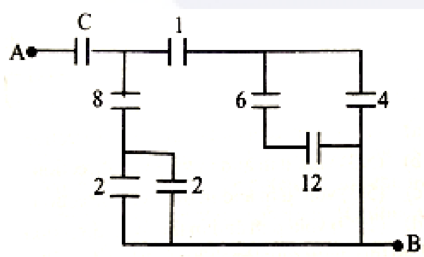
(a) all in series

(b) all in parallel

(c) two in parallel and one in series

(d) two in series and one in parallel

49) Figure shows a network of capacitors where the numbers indicates capacitance in micro Farad. The value of capacitance C if the equivalent capacitance between point A and B is to be 1μF is:



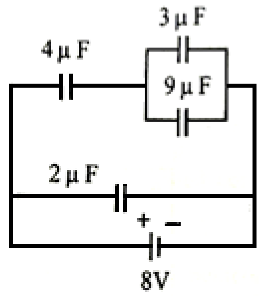
(a) $\frac{32}{23}$μF

(b) $\frac{31}{23}$ μF

(c) $\frac{33}{23}$μF

(d) $\frac{34}{23}$μF

50) A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the 4μF and 9μF capacitors), at a point distance 30m from it, would equal:

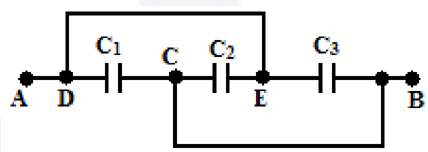


(a) 420 N/C
(b) 480 N/C
(c) 240 N/C
(d) 360 N/C

51) The energy stored in the electric field produced by a metal sphere is 4.5J. If the sphere contains 4μC charge, its radius will be: [Take : $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N – m^2/ C^2]

(a) 20mm
(b) 32mm
(c) 28mm
(d) 16mm

52) A combination of parallel plate capacitors is maintained at a certain potential difference.



When a 3mm thick slab is introduced between all the plates, in order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm.

Find the dielectric constant of the slab.

(a) 3
(b) 4
(c) 5
(d) 6

53) A capacitance of 2μF is required in an electric circuit across a potential difference of 1.0 kV. A large number of 1μF capacitors are available which can withstand a potential difference of not more than 300V. The minimum number of capacitors required this is

(a) 24
(b) 32
(c) 2
(d) 16

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	b	c	d	d	a	a	c	b	a
11	12	13	14	15	16	17	18	19	20
d	b	c	b	b	d	d	c	c	a
21	22	23	24	25	26	27	28	29	30
c	d	a	a	b	d	b	c	b	a
31	32	33	34	35	36	37	38	39	40
c	c	c	d	d	c	d	c	c	b
41	42	43	44	45	46	47	48	49	50
d	c	c	d	a	a	d	d	a	a
51	52	53							
d	c	b							

Topic 59: Electric Current, Drift of Electrons, Ohm's Law, Resistance & Resistivity

1) The masses of the three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance is

(a) 1 : 3 : 5 (b) 5 : 3 : 1

(c) 1 : 25 : 125 (d) 125 : 15 : 1

2) The velocity of charge carries of current (about 1 amp) in a metal under normal conditions is of the order of

(a) a fraction of mm/sec (b) velocity of light

(c) several thousand metres/second (d) a few hundred metres per second

3) If a wire of resistance R is melted and recasted to half of its length, then the new resistance of the wire will be

(a) R/4 (b) R/2

(c) R (d) 2R

4) If a negligibly small current is passed through a wire of length 15m and of resistance 5Ω having uniform cross – section of $6 \times 10^{-7} m^2$, then coefficient of resistivity of material, is

(a) 1×10^{-7}Ω-m (b) 2×10^{-7}Ω-m

(c) 3×10^{-7}Ω-m (d) 4×10^{-7}Ω-m

5) If the resistance of a conductor is 5Ω at 50°C and 7Ω at 100°C, then the mean temperature coefficient of resistance (of the material) is

(a) 0.001/°C (b) 0.004/°C

(c) 0.006/°C (d) 0.008/°C

6) There are three copper wires of length and cross sectional area (L, A), (2L, $\frac{1}{2}$A), ($\frac{1}{2}$ L, 2A). In which case is the resistance minimum?

(a) It is the same in all three cases (b) Wire of cross – sectional area 2A

(c) Wire of cross – sectional area A (d) Wire of cross – sectional area $\frac{1}{2}$ A

7) The resistance of a discharge tube is

(a) zero (b) ohmic

(c) non – ohmic (d) infinity

8) A wire has a resistance of 3.1Ω at 30°C and a resistance 4.5Ω at 100°C. The temperature coefficient of resistance of the wire

(a) $0.0064°C^{-1}$
(b) $0.0034°C^{-1}$
(c) $0.0025°C^{-1}$
(d) $0.0012°C^{-1}$

9) Si and Cu are cooled to a temperature of 300K, then resistivity?

(a) For Si increases and for Cu decreases
(b) For Cu increases and for Si decreases
(c) Decreases for both Si and Cu
(d) Increases for both Si and Cu

10) The resistivity (specific resistance) of a copper wire

(a) increases with increase in its temperature

(b) decreases with increase in its cross – section

(c) increases with increase in its length

(d) increases with increase in its cross – section

11) A 6 volt battery is connected to the terminals of the three meter long wire of uniform thickness and resistance of 100ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be

(a) 1.5 volt
(b) 3 volt
(c) 2 volt
(d) 1 volt

12) The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then

(a) the resistance and the specific resistance, will both remain unchanged

(b) the resistance will be doubled and the specific resistance will be halved

(c) the resistance will be halved and the specific resistance will remain unchanged

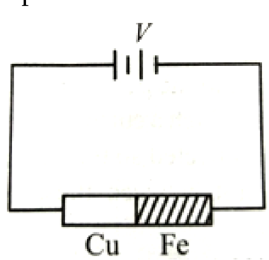
(d) the resistance will be halved and the specific resistance will be doubled

13) A wire of a certain material is stretched slowly by ten per cent. Its new resistance and specific resistance become respectively:

(a) 1.2 times, 1.3 times
(b) 1.21 times, same
(c) both remain the same
(d) 1.1 times, 1.1 times

14) Two rods are joined end to end, as shown. 'Both have a cross – sectional area of $0.01 cm^2$. Each is 1 meter long. One rod is of copper with a resistivity of 1.7×10^{-6} ohm – centimeter, the other is of iron with a resistivity of 10^{-5} ohm – centimeter.

How much voltage is required to produce a current of 1 ampere in the rods?



(a) 0.117 V

(b) 0.00145 V

(c) 0.0145 V

(d) 1.7×10^{-6}V

15) A wire of resistance 4Ω is stretched to twice its original length. The resistance of stretched wire would be

(a) 4Ω

(b) 8Ω

(c) 16Ω

(d) 2Ω

16) Across a metallic conductor of non – uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is:

(a) current

(b) drift velocity

(c) electric field

(d) current density

17) The resistance of a wire 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be:-

(a) $\frac{R}{n}$

(b) n^2R

(c) $\frac{R}{n^2}$

(d) nR

18) The length of a given cylindrical wire is increased by 100%. Due to the consequent decreases in diameter the change in the resistance of the wire will be

(a) 200%

(b) 100%

(c) 50%

(d) 300%

19) An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii are in the ratio of $\frac{4}{3}$ and $\frac{2}{3}$, then the ratio of the current passing through the wires will be

(a) 8/9

(b) 1/3

(c) 3

(d) 2

20) A material 'B' has twice the specific resistance of 'A'. A circular wire made of 'B' has twice the diameter of a wire made of 'A' then for the two wires to have the same resistance, the ratio l_B / l_A of their respective lengths must be

(a) 1

(b) $\frac{1}{2}$

(c) $\frac{1}{4}$

(d) 2

21) The resistance of a wire is 5 ohm at 50°C and 6 ohm at 100°C. The resistance of the wire at 0°C will be

(a) 3 ohm

(b) 2 ohm

(c) 1 ohm
(d) 4 ohm

DIRECTIONS: Question No. 22 and 23 are based on the following paragraph.

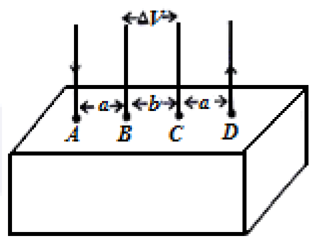
Consider a block of conducting material of resistivity ‘ρ’ shown in the figure. Current ‘I’ enters at ‘A’ and leaves from ‘D’. We apply superposition principle to find voltage ‘ΔV’ developed between ‘B’ and ‘C’. The calculation is done in the following steps:

(i) Take current ‘I’ entering from ‘A’ and assume it to spread over a hemispherical surface in the block.

(ii) Calculate field E(r) at distance ‘r’ from A by using Ohm’s law E = ρj, where j is the current per unit area at ‘r’.

(iii) From the ‘r’ dependence of E(r), obtain the potential V(r) at r.

(iv) Repeat (i),(ii) and (iii) for current ‘I’ leaving ‘D’ and superpose results for ‘A’ and ‘D’.



22) For current entering at A, the electric field at a distance ‘r’ from A is

(a) $\frac{\rho I}{8\pi r^2}$
(b) $\frac{\rho I}{r^2}$

(c) $\frac{\rho I}{2\pi r^2}$
(d) $\frac{\rho I}{4\pi r^2}$

23) ΔV measured between B and C is

(a) $\frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$
(b) $\frac{\rho I}{a} - \frac{\rho I}{(a+b)}$

(c) $\frac{\rho I}{2\pi a} - \frac{\rho I}{2\pi(a+b)}$
(d) $\frac{\rho I}{2\pi(a-b)}$

24) If a wire is stretched to make it 0.1% longer, its resistance will :

(a) increase by 0.2%
(b) decrease by 0.2%

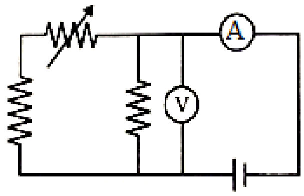
(c) decrease by 0.05%
(d) increase by 0.05%

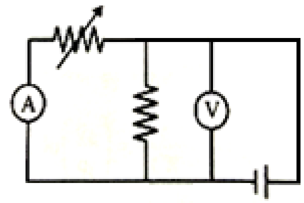
25) The resistance of a wire is R. It is bent at the middle by 180° and both the ends are twisted together to make a shorter wire. The resistance of the new wire is

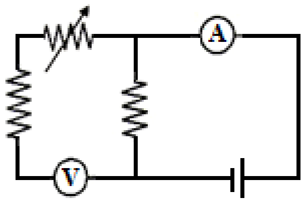
(a) 2R
(b) R/2

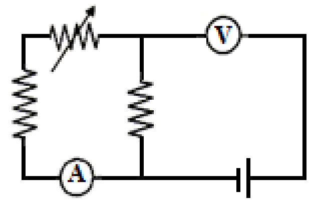
(c) R/4
(d) R/8

26) Correct set up to verify Ohm’s law is:

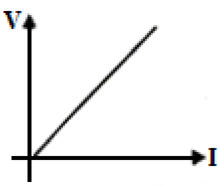
(a) 

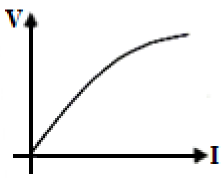
(b) 

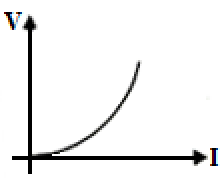
(c) 

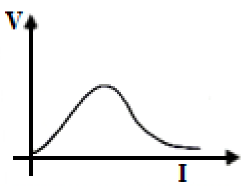
(d) 

27) Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then V – I graph for a wire made of such a material is best given by:

(a) 

(b) 

(c) 

(d) 

28) When 5V potential difference is applied across a wire of length 0.1m, the drift speed of electrons is $2.5\times10^{-4}ms^{-1}$ If the electrons density in the wire is $8 \times 10^{28} m^{-3}$, the resistivity of the material is close to:

(a) $1.6 \times 10^{-6}\ \Omega m$

(b) $1.6 \times 10^{-5}\ \Omega m$

(c) $1.6 \times 10^{-8}\ \Omega m$

(d) $1.6 \times 10^{-7}\ \Omega m$

29) A uniform wire of length l and radius r has a resistance of 100Ω. It is recast into a wire of radius $\frac{r}{2}$. The resistance of new wire will be:

(a) 1600Ω

(b) 400Ω

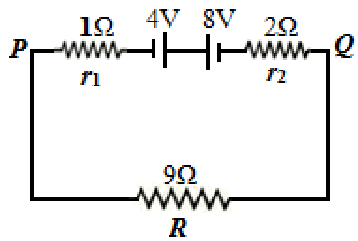
(c) 200Ω

(d) 100Ω

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	a	a	b	a	b	c	a	b	a
11	12	13	14	15	16	17	18	19	20
d	c	b	a	c	a	b	d	b	d
21	22	23	24	25	26	27	28	29	
d	c	a	a	c	a	c	b	a	

Topic 60: Combination of Resistances

1) Two batteries of emf 4V and 8V with internal resistance 1Ω and 2Ω are connected in a circuit with a resistance of 9Ω as shown in figure. The current and potential difference between the points P and Q are



(a) $\frac{1}{3}$ A and 3V

(b) $\frac{1}{6}$ A and 4V

(c) $\frac{1}{9}$ A and 9V

(d) $\frac{1}{12}$ A and 12V

2) n equal resistors are first connected in series and then connected in parallel. What is the ratio of the maximum to the minimum resistance?

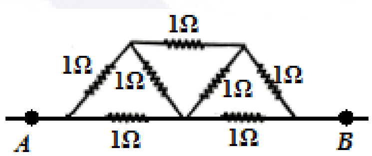
(a) n

(b) $1/n^2$

(c) n^2

(d) 1/n

3) In the network shown in the Figure, each resistance is 1Ω. The effective resistance between A and B is



(a) $\frac{4}{3}$ Ω

(b) $\frac{3}{2}$ Ω

(c) 7Ω

(d) $\frac{8}{7}$ Ω

4) You are given several identical resistances each of value R = 10Ω and each capable of carrying a maximum current of one ampere. It is required to make a suitable combination of these resistances of 5Ω which can carry a current of 4 ampere. The minimum number of resistances of the type R that will be required for this job is

(a) 4

(b) 10

(c) 8

(d) 20

5) Current through 3Ω resistor is

0.8 ampere, then potential drop through 4Ω resistor is

(a) 9.6V (b) 2.6V

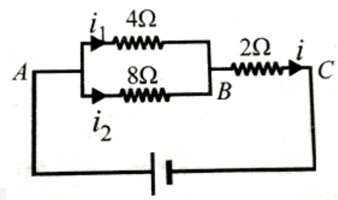
(c) 4.8V (d) 1.2V

6) Three resistances each of 4Ω are connected to form a triangle. The resistance between any two terminals is

(a) 12Ω (b) 2Ω

(c) 6Ω (d) 8/3Ω

7) In the circuit shown in Fig, the current in 4Ω resistance is 1.2A. What is the potential difference between B and C.



(a) 3.6 volt (b) 6.3 volt

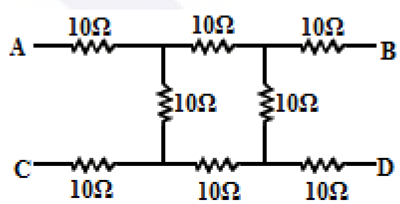
(c) 1.8 volt (d) 2.4 volt

8) Two wires of the same metal have same length, but their cross – sections are in the ratio 3 :1. They are joined in series. The resistance of thicker wire is 10Ω. The total resistance of the combination will be

(a) 10Ω (b) 20Ω

(c) 40Ω (d) 100Ω

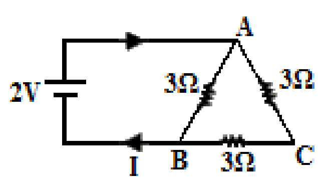
9) What will be the equivalent resistance of circuit shown in figure between two points A and D



(a) 10Ω (b) 20Ω

(c) 30Ω (d) 40Ω

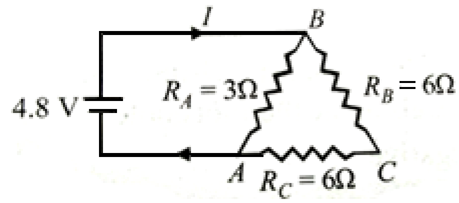
10) The current in the following circuit is



(a) 1A (b) $\frac{2}{3}$ A

(c) $\frac{2}{9}$ A (d) $\frac{1}{8}$ A

11) The current (I) in the given circuit is



(a) 1.6A
(b) 2.0A
(c) 0.32A
(d) 3.2A

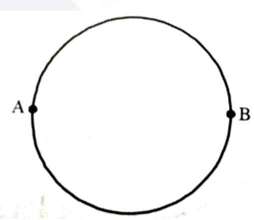
12) Resistances n, each of r ohm, when connected in parallel give an equivalent resistance of R ohm. If these resistances were connected in series, the combination would be a resistance in ohms, equal to

(a) nR
(b) n^2R
(c) R/n^2
(d) R/n

13) When a wire of uniform cross – section a, length *l* and resistance R is bent into a complete circle, resistance between any two of diametrically opposite points will be

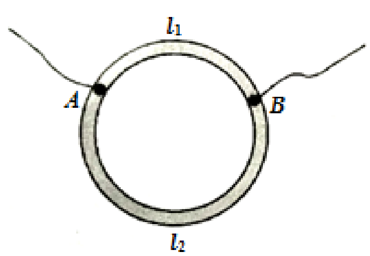
(a) $\frac{R}{4}$
(b) 4R
(c) $\frac{R}{8}$
(d) $\frac{R}{2}$

14) A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10cm. The resistance between its two diametrically opposite points, A and B as shown in figure, is



(a) 3Ω
(b) $6\pi\Omega$
(c) 6Ω
(d) $0.6\pi\Omega$

15) A ring is made of a wire having a resistance $R_0 = 12\Omega$. Find the points A and B as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub – circuit between these points is equal to $\frac{8}{3}\,\Omega$.



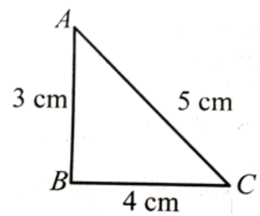
(a) $\frac{l_1}{l_2} = \frac{5}{8}$

(b) $\frac{l_1}{l_2} = \frac{1}{3}$

(c) $\frac{l_1}{l_2} = \frac{3}{8}$

(d) $\frac{l_1}{l_2} = \frac{1}{2}$

16) A 12cm wire is given a shape of a right angled triangle ABC having sides 3cm, 4cm and 5cm as shown in the figure. The resistance between two ends (AB, BC, CA) of the respective sides are measured one by one by a multi – meter. The resistances will be in the ratio of



(a) 3: 4 : 5

(b) 9 : 16 : 25

(c) 27: 32 : 35

(d) 21 : 24 : 25

17) Two metal wires of identical dimension are connected in series. If σ_1 and σ_2 are the conductivities of the metal wires respectively, the effective conductivity of the combination is:

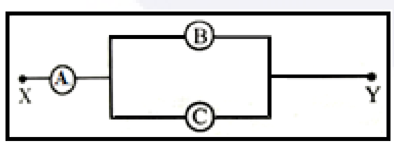
(a) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$

(b) $\frac{\sigma_1+\sigma_2}{\sigma_1\sigma_2}$

(c) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(d) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

18) A, B and C are voltmeters of resistance R, 1.5R and 3R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively. Then



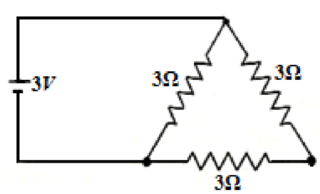
(a) $V_A \neq V_B = V_C$

(b) $V_A = V_B \neq V_C$

(c) $V_A \neq V_B \neq V_C$

(d) $V_A = V_B = V_C$

19) A 3 volt battery with negligible internal resistance is connected in a circuit as shown in the figure. The current I, in the circuit will be



(a) 1A

(b) 1.5A

(c) 2A

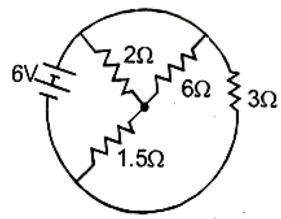
(d) 1/3A

20) The resistance of the series combination of two resistances is S. When they are joined in parallel the total resistance is P. If S = nP then the minimum possible value of n is

(a) 2 (b) 3

(c) 4 (d) 1

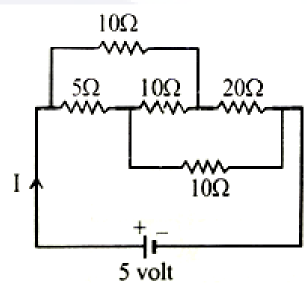
21) The total current supplied to the circuit by the battery is



(a) 4A (b) 2A

(c) 1A (d) 6A

22) The current I drawn from the 5 volt source will be



(a) 0.33 A (b) 0.5 A

(c) 0.67 A (d) 0.17 A

23) Two conductors have the same resistance at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly

(a) $\frac{\alpha_1+\alpha_2}{2}$, $\alpha_1 + \alpha_2$ (b) $\alpha_1 + \alpha_2$, $\frac{\alpha_1+\alpha_2}{2}$

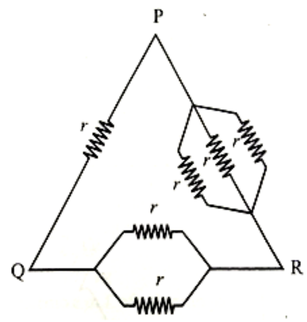
(c) $\alpha_1 + \alpha_2$, $\frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}$ (d) $\frac{\alpha_1+\alpha_2}{2}$, $\frac{\alpha_1+\alpha_2}{2}$

24) A letter 'A' is constructed of a uniform wire with resistance 1.0Ω per cm, The sides of the letter are 20 cm and the cross piece in the middle is 10 cm long. The apex angle is 60. The resistance between the ends of the legs is close to:

(a) 50.0 Ω (b) 10 Ω

(c) 36.7 Ω (d) 26.7 Ω

25) Six equal resistance are connected between points P,Q and R as shown in figure. Then net resistance will be maximum between:



(a) P and R

(b) P and Q

(c) Q and R

(d) Any two points

26)

A 9V battery with internal resistance of 0.5Ω is connected across an infinite network as shown in the figure. All ammeters A_1, A_2, A_3 and voltmeter V are ideal.

Choose the correct answer

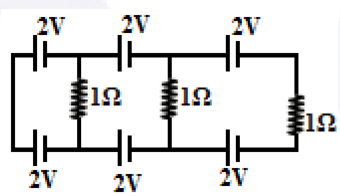
(a) Reading of A_1 is 2A

(b) Reading of A_1 is 18A

(c) Reading of V is 9V

(d) Reading of V is 7V

27)



In the above circuit the current in each resistance is

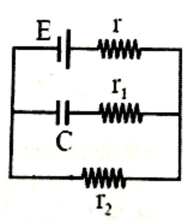
(a) 0.5A

(b) 0A

(c) 1A

(d) 0.25A

28) In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be:



(a) CE $\frac{r_2}{(r+r_2)}$

(b) CE $\frac{r_1}{(r_1+r)}$

(c) CE

(d) CE $\frac{r_1}{(r_2+r)}$

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
a	c	d	c	c	d	a	c	c	a
11	12	13	14	15	16	17	18	19	20
b	b	a	a	d	c	d	d	b	c
21	22	23	24	25	26	27	28		
a	b	d	d	b	a	b	a		

Topic 61: Kirchhoff's Laws, Cells, Thermo emf & Electrolysis

1) Faraday's laws are consequence of conservation of

(a) energy
(b) energy and magnetic field
(c) charge
(d) magnetic field

2) Direct current is passed through a copper sulphate solution using platinum electrodes. The elements liberated at the electrodes are

(a) copper at anode and sulphur at cathode
(b) sulphur at anode and copper at cathode
(c) oxygen at anode and copper at cathode
(d) copper at anode and oxygen at cathode

3) Kirchhoff's first law, i.e., $\sum i = 0$ at a junction, deals with the conservation of

(a) charge
(b) energy
(c) momentum
(d) angular momentum

4) If nearly 10^5 coulombs liberate 1 gm – equivalent of aluminium, then the amount of aluminium (equivalent weight 9), deposited through electrolysis in 20 minutes by a current of 50amp. will be

(a) 0.6gm
(b) 0.09gm
(c) 5.4gm
(d) 10.8gm

5) A car battery has e.m.f 12 volt and internal resistance 5×10^{-2}ohm. If it draws 60 amp current, the terminal voltage of the battery will be

(a) 15 volt
(b) 3 volt
(c) 5 volt
(d) 9 volt

6) In electrolysis, the amount of mass deposited or liberated at an electrode is directly proportional to

(a) square of electric charge
(b) amount of charge
(c) square of current
(d) concentration of electrolyte

7) The potential difference between the terminals of a cell in an open circuit is 2.2V. When a resistor of 5Ω is connected across the terminals of the cell, the potential difference between the terminals of the cell is found to be 1.8V. The internal resistance of the cell is

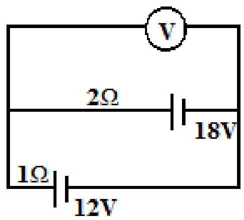
(a) $\frac{7}{12}\,\Omega$
(b) $\frac{10}{9}\,\Omega$
(c) $\frac{9}{10}\,\Omega$
(d) $\frac{12}{7}\,\Omega$

8) A battery is charged at a potential of 15V for 8 hours when the current flowing is 10A. The battery on discharge supplies a current of 5A for 15 hours. The mean terminal voltage during discharge is 14V. The "watt – hour" efficiency of the battery is

(a) 87.5% (b) 82.5%

(c) 80% (d) 90%

9) Two batteries, one of emf 18 volt and internal resistance 2Ω and the other of emf 12 volt and internal resistance 1Ω, are connected as shown. The voltmeter V will record a reading of



(a) 30 volt (b) 18 volt

(c) 15 volt (d) 14 volt

10) Two cells, having the same e.m.f., are connected in series through an external resistance R. Cells have internal resistances r_1 and r_2 ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is

(a) $\frac{r_1+r_2}{2}$ (b) $\frac{r_1-r_2}{2}$

(c) $r_1 + r_2$ (d) $r_1 - r_2$

11) Kirchhoff's first and second laws for electrical circuits are consequences of

(a) conservation of electric charge and energy respectively

(b) conservation of electric charge

(c) conservation of energy and electric charge respectively

(d) conservation of energy

12) In producing chlorine through electrolysis, 100 watt power at 125V is being consumed. How much chlorine per minute is liberated? E.C.E of chlorine is 0.367×10^{-6}kg/coulomb.

(a) 21.3mg (b) 24.3mg

(c) 13.6mg (d) 17.6mg

13) A steady current of 1.5 amp flows through a copper voltameter for 10 minutes. If the electrochemical equivalent of copper is 30×10^{-5}g coulomb^{-1}, the mass of copper deposited on the electrode will be

(a) 0.50g (b) 0.67g

(c) 0.27g (d) 0.40g

14) A cell can be balanced against 110cm and 100 cm of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is

(a) 1.0ohm (b) 0.5ohm

(c) 2.0ohm (d) zero

15) A student measures the terminal potential difference (V) of a cell (of emf E and internal resistance r) as a function of the current (I) flowing through it. The slope and intercept, of the graph between V and I, then, respectively, equal:

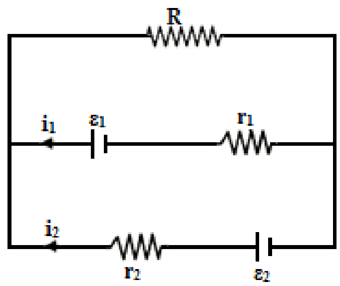
(a) –r and E

(b) r and –E

(c) –E and r

(d) E and –r

16) See the electric circuit shown in the figure.



Which of the following equations is a correct equation for it?

(a) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

(b) $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

(c) $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

(d) $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

17) The thermo e.m.f E in volts of a certain thermocouple is found to vary with temperature difference θ in °C between the two junctions according to the relation

$$E = 30\theta - \frac{\theta^2}{15}$$

The neutral temperature for the thermocouple will be

(a) 30°C

(b) 450°C

(c) 400°C

(d) 225°C

18) Consider the following two statements:

(A) Kirchhoff’s junction law follows from the conservation of charge.

(B) Kirchhoff’s loop law follows from the conservation of energy.

(a) Both (A) and (B) are wrong

(b) (A) is correct (B) is wrong

(c) (A) is wrong and (B) is correct

(d) Both (A) and (B) are correct

19) In producing chlorine by electrolysis 100kW power at 125V is being consumed. How much chlorine per unit per minute is liberated? (E.C.E of chlorine is 0.367×10^{-6}kg/C)

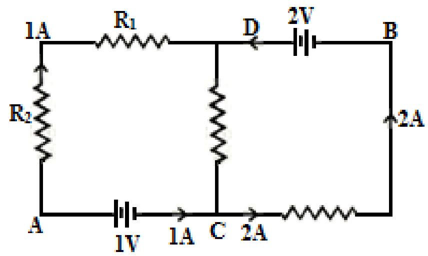
(a) 1.76×10^{-3}kg

(b) 9.67×10^{-3}kg

(c) 17.61×10^{-3}kg

(d) 3.67×10^{-3}kg

20) In the circuit shown in the figure, if potential at point A is taken to be zero, the potential at point A is taken to be zero, the potential at point B is



(a) –1V

(b) +2V

(c) –2V

(d) +1V

21) A thermocouple of negligible resistance produces an e.m.f of 40μV/°C in the linear range of temperature. A galvanometer of resistance 10 ohm whose sensitivity is 1μA/div, is employed with the thermocouple. The smallest value of temperature difference that can be detected by the system will be

(a) 0.5°C

(b) 1°C

(c) 0.1°C

(d) 0.25°C

22) The rate of increase of thermo – e.m.f with temperature at the neutral temperature of a thermocouple

(a) is positive

(b) is zero

(c) depends upon the choice of the two materials of the thermocouple

(d) is negative

23) A current of 2A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5A when connected across 9Ω resistor. The internal resistance of the battery is

(a) 0.5Ω

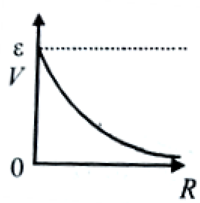
(b) 1/3Ω

(c) 1/4Ω

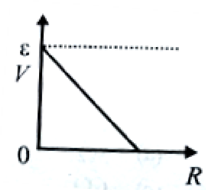
(d) 1 Ω

24) Cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by:

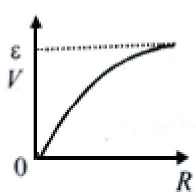
(a)



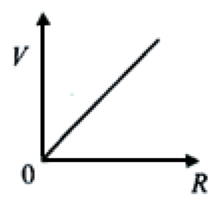
(b)



(c)



(d)



25) The internal resistance of a 2.1V cell which gives a current of 0.2A through a resistance of 10Ω is

(a) 0.5Ω

(b) 0.8Ω

(c) 1.0Ω (d) 0.2Ω

26) The mass of product liberated on anode in an electrochemical cell depends on

(a) $(It)^{1/2}$ (b) It

(c) I/t (d) I^2t

(where t is the time period for which the current is passed).

27) The negative Zn pole of a Daniell cell, sending a constant current through a circuit, decreases in mass 0.13g in 30 minutes. If the electrochemical equivalent of Zn and Cu are 32.5 and 31.5 respectively, the increase in the mass of the positive Cu pole in this time is

(a) 0.180g (b) 0.141g

(c) 0.126g (d) 0.242g

28) The thermo e.m.f of a thermo – couple is 25μV/°C at room temperature. A galvanometer of 40ohm resistance, capable of detecting current as low as 10^{-5}A, is connected with the thermo couple. The smallest temperature difference that can be detected by this system is

(a) 16°C (b) 12°C

(c) 8°C (d) 20°C

29) The electrochemical equivalent of a metal is 3.35×10^{-7} kg per Coulomb. The mass of the metal liberated at the cathode when a 3A current is passed for 2 seconds will be

(a) 6.6×10^{57}kg (b) 9.9×10^{-7}kg

(c) 19.8×10^{-7}kg (d) 1.1×10^{-7}kg

30) The thermo emf of a thermocouple varies with the temperature θ of the hot junction as $E = a\theta + b\theta^2$ in volts where the ratio a/b is 700°C. If the cold junction is kept at 0°C, then the neutral temperature is

(a) 1400°C

(b) 350°C

(c) 700°C

(d) No neutral temperature is possible for this thermocouple

31) An energy source will supply a constant current into the load if its internal resistance is

(a) very large as compared to the load resistance (b) equal to the resistance of the load

(c) non - zero but less than the resistance of the load (d) zero

32) Two voltameters, one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltameters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are Z_1 and Z_2 respectively the charge which flows through the silver voltameter is

(a) $\frac{q}{1+\frac{Z_2}{Z_1}}$ (b) $\frac{q}{1+\frac{Z_1}{Z_2}}$

(c) $q\frac{Z_2}{Z_1}$ (d) $q\frac{Z_1}{Z_2}$

33) Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then

(a) $R = R_2 - R_1$ (b) $R = R_2 \times (R_1 + R_2) / (R_2 - R_1)$

(c) $R = R_1 R_2 / (R_2 - R_1)$ (d) $R = R_1 R_2 / (R_1 - R_2)$

34) A thermocouple is made from two metals, Antimony and Bismuth. If one junction of the couple is kept hot and other is kept cold, then, an electric current will

(a) flow from Antimony to Bismuth at the hot junction

(b) flow from Bismuth to Antimony at the cold junction

(c) now flow through the thermocouple

(d) flow from Antimony to Bismuth at the cold junction

35) The Kirchhoff's first law ($\sum i = 0$) and second law ($\sum iR = \sum E$), where the symbols have their usual meanings, are respectively based on

(a) conservation of charge, conservation of momentum

(b) conservation of energy, conservation of charge

(c) conservation of momentum, conservation of charge

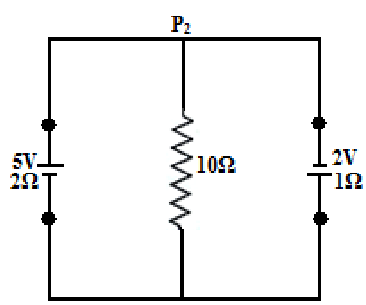
(d) conservation of charge, conservation of energy

36) A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

(a) 1/2 (b) 1

(c) 2 (d) 1/4

37) A 5V battery with internal resistance 2Ω and a 2V battery with internal resistance 1Ω are connected to a 10Ω resistor as shown in figure.

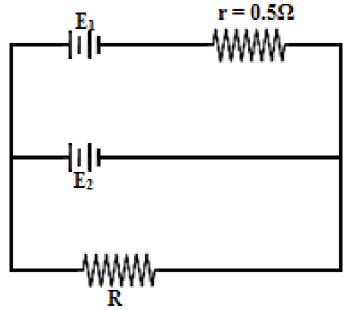


The current in the 10 Ω resistor is

(a) 0.27 AP_2 to P_1 (b) 0.03AP_1 to P_2

(c) 0.03 AP_2 to P_1 (d) 0.27AP_1 to P_2

38) A dc source of emf E_1 = 100V and internal resistance r = 0.5Ω, a storage battery of emf E_2 = 90V and an external resistance R are connected as shown in figure. For what value of R no current will pass through the battery?



(a) 5.5Ω (b) 3.5Ω

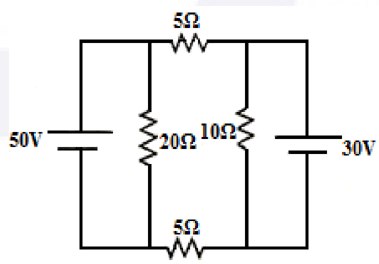
(c) 4.5Ω (d) 2.5Ω

39) A d.c. main supply of e.m.f 220V is connected across a storage battery of e.m.f 200V through a resistance of 1Ω. The battery terminals are connected to an external resistance 'R'. The minimum value of 'R', so that a current passes through the battery to charge it is:

(a) 7Ω (b) 9Ω

(c) 11Ω (d) Zero

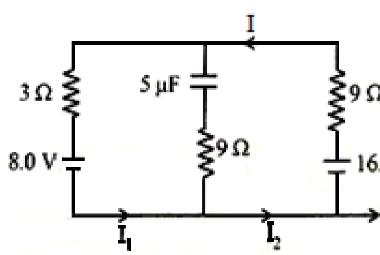
40) In the circuit shown, current (in A) through 50V and 30V batteries are, respectively.



(a) 2.5 and 3 (b) 3.5 and 2

(c) 4.5 and 1 (d) 3 and 2.5

41) The circuit shown here has two batteries of 8.0V and 16.0V and three resistors 3Ω, 9Ω and 9Ω and a capacitor of 5.0μF.

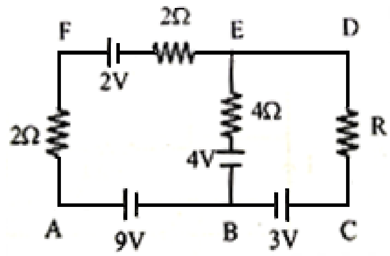


How much is the current I in the circuit is steady state?

(a) 1.6A (b) 0.67A

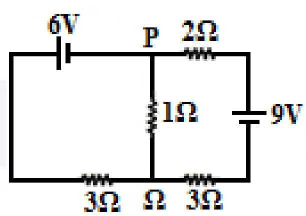
(c) 2.5A (d) 0.25A

42) In the electric network shown, when no current flows through the 4Ω resistor in the arm EB, the potential difference between the points A and D will be:



(a) 6V
(b) 3V
(c) 5V
(d) 4V

43) In the circuit shown, the current in the 1Ω resistor is:



(a) 0.13A, from Q to P
(b) 0.13A, from P to Q
(c) 1.3A, from P to Q
(d) 0A

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	a	c	d	b	b	a	d	d
11	12	13	14	15	16	17	18	19	20
a	d	c	a	a	d	d	d	c	d
21	22	23	24	25	26	27	28	29	30
d	b	b	c	a	b	c	a	c	d
31	32	33	34	35	36	37	38	39	40
d	a	a	d	d	a	c	c	c	a
41	42	43							
b	c	a							

Topic 62: Heating Effects of Current

1) A current of 2A, passing through a conductor produces 80J of heat in 10 seconds. The resistance of the conductor in ohm is

(a) 0.5
(b) 2
(c) 4
(d) 20

2) Forty electric bulbs are connected in series across a 220V supply. After one bulb is fused the remaining 39 are connected again in series across the same supply. The illumination will be

(a) more with 40 bulbs than with 39
(b) more with 39 bulbs than with 40
(c) equal in both the cases
(d) in the ratio $40^2 : 39^2$

3) Two identical batteries each of e.m.f 2V and internal resistance 1Ω are available to produce heat in an external resistance by passing a current through it. The maximum power that can be developed across R using these batteries is

(a) 3.2W
(b) 2.0W
(c) 1.28W
(d) $\frac{8}{9}$ W

4) A 4μF capacitor is charged to 400 volts and then its plates are joined through a resistance of 1kΩ. The heat produced in the resistance is

(a) 0.16J
(b) 1.28J
(c) 0.64J
(d) 0.32J

5) A heating coil is labelled 100W, 220V. The coil is cut in half and the two pieces are joined in parallel to the same source. The energy now liberated per second is

(a) 25J
(b) 50J
(c) 200J
(d) 400J

6) A (100W, 200V) bulb is connected to a 160V power supply. The power consumption would be

(a) 125W
(b) 100W
(c) 80W
(d) 64W

7) A 5°C rise in temperature is observed in a conductor by passing a current. When the current is doubled the rise in temperature will be approximately

(a) 10°C
(b) 16°C
(c) 20°C
(d) 12°C

8) Three equal resistors connected across a source of e.m.f together dissipate 10 watt of power. What will be the power dissipated in watts if the same resistors are connected in parallel across the same source of e.m.f.?

(a) 10

(b) $\frac{10}{3}$

(c) 30

(d) 90

9) Two electric bulbs, one of 220V, 40W and other of 200V, 100W are connected in a domestic circuit. Then

(a) they have equal resistance

(b) the resistance of 40W bulb is more than 100W bulb

(c) the resistance of 100W bulb is more than 40W bulb

(d) they have equal current through them

10) A battery of 10V and internal resistance 0.5Ω is connected across a variable resistance R. The value of R for which the power delivered is maximum is equal to

(a) 0.25Ω

(b) 0.5Ω

(c) 1.0Ω

(d) 2.0Ω

11) If 25W, 220V and 100W, 220V bulbs are connected in series across a 440V line, then

(a) only 25W bulb will fuse

(b) only 100W bulb will fuse

(c) both bulbs will fuse

(d) none of these

12) Fuse wire is a wire of

(a) low resistance and high melting point

(b) high resistance and high melting point

(c) high resistance and low melting point

(d) low resistance and low melting point

13) Two 220 volt, 100 watt bulbs are connected first in series and then in parallel. Each time the combination is connected to a 220 volt a.c. supply line. The power drawn by the combination in each case respectively will be

(a) 50 watt, 200 watt

(b) 50 watt, 100 watt

(c) 100 watt, 50 watt

(d) 200 watt, 150 watt

14) An electric kettle has two heating coils. When one of the coils is connected to an a.c. source, the water in the kettle boils in 10 minutes. When the other coil is used, the water boils in 40 minutes. If both the coils are connected in parallel, the time taken by the same quantity of water to boil will be

(a) 15min

(b) 8min

(c) 4min

(d) 25min

15) In India electricity is supplied for domestic use at 220V. It is supplied at 110V in USA. If the resistance of a 60W bulb for use in India is R, the resistance of a 60W bulb for use in USA will be

(a) R/2

(b) R

(c) 2R

(d) R/4

16) When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 220 volt supply, the power drawn by them will be

(a) 20 watt

(b) 60 watt

(c) 180 watt

(d) 10 watt

17) A 5 – ampere fuse wire can withstand a maximum power 1 watt in the circuit. The resistance of the fuse wire is

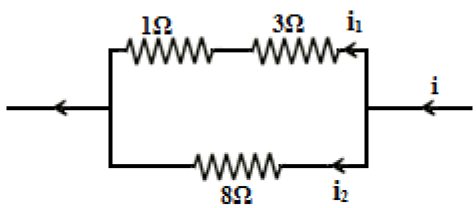
(a) 0.04ohm

(b) 0.2ohm

(c) 5 ohm

(d) 0.4ohm

18) Power dissipated across the 8Ω resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the 3Ω resistor is



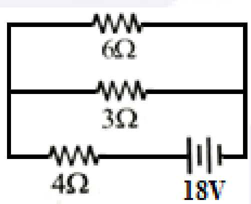
(a) 1.0

(b) 0.5

(c) 3.0

(d) 2.0

19) The total power dissipated in watts in the circuit shown here is



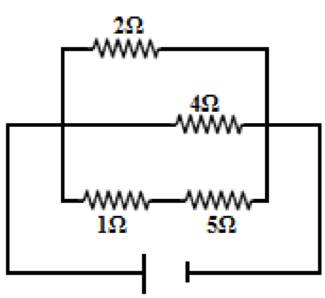
(a) 40

(b) 54

(c) 4

(d) 16

20) A current of 3 amp flows through the 2Ω resistor shown in the circuit. The power dissipated in the 5Ω resistor is:



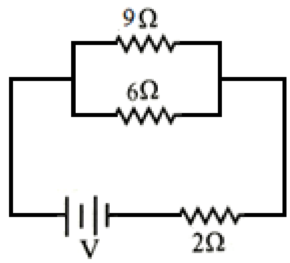
(a) 4 watt

(b) 2 watt

(c) 1 watt

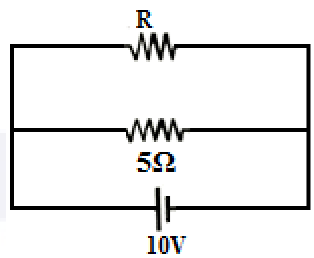
(d) 5 watt

21) If power dissipated in the 9-Ω resistor in the circuit shown in 36 watt, the potential difference across the 2-Ω resistor is



(a) 4 volt
(b) 8 volt
(c) 10 volt
(d) 2 volt

22) The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is:



(a) 20Ω
(b) 15Ω
(c) 10Ω
(d) 30Ω

23) If voltage across a bulb rated 220 Volt – 100 Watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is:

(a) 20%
(b) 2.5%
(c) 5%
(d) 10%

24) Ten identical cells connected in series are needed to heat a wire of length one meter and radius ‘r’ by 10°C in time ‘t’. How many cells will be required to heat the wire of length two meter of the same radius by the same temperature in time ‘t’?

(a) 10
(b) 20
(c) 30
(d) 40

25) Two cities are 150km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5Ω. The power loss in the wires is:

(a) 19.2 W
(b) 19.2kW
(c) 19.2 J
(d) 12.2kW

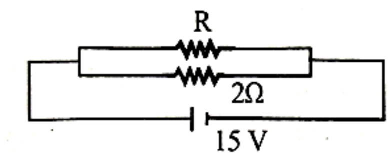
26) The charge flowing through a resistance R varies with time t as $Q = at - bt^2$, where a and b are positive constants. The total heat produced in R is:

(a) $\frac{a^3R}{6b}$
(b) $\frac{a^3R}{3b}$

(c) $\frac{a^3R}{2b}$

(d) $\frac{a^3R}{b}$

27) If in the circuit, power dissipation is 150W, then R is



(a) 2Ω

(b) 6Ω

(c) 5Ω

(d) 4Ω

28) A wire when connected to 220V mains supply has power dissipation P_1. Now the wire is cut into two equal pieces which are connected in parallel to the same supply. Power dissipation in this case is P_2. Then $P_2 : P_1$ is

(a) 1

(b) 4

(c) 2

(d) 3

29) A 220 volt, 1000 watt bulb is connected across a 110 volt mains supply. The power consumed will be

(a) 750 watt

(b) 500 watt

(c) 250 watt

(d) 1000 watt

30) Time taken by a 836W heater to heat one litre of water from 10°C to 40°C is

(a) 150s

(b) 100s

(c) 50s

(d) 200s

31) The thermistors are usually made of

(a) metal oxides with high temperature coefficients of resistivity

(b) metals with high temperature coefficients of resistivity

(c) metal with low temperature coefficient of resistivity

(d) semiconducting materials having low temperature coefficient of resistivity

32) The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100W and 200V lamp when not in use?

(a) 20Ω

(b) 40Ω

(c) 200Ω

(d) 400Ω

33) A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be

(a) four times

(b) doubled

(c) halved

(d) one fourth

34) An electric bulb is rated 220 volt – 100 watt. The power consumed by it when operated on 110 volt will be

(a) 75 watt
(b) 40 watt
(c) 25 watt
(d) 50 watt

35) The resistance of a bulb filament is 100Ω at a temperature of 100°C. If its temperature coefficient of resistance be 0.005 per °C, its resistance will become 200 Ω at a temperature of

(a) 300°C
(b) 400°C
(c) 500°C
(d) 200°C

36) This question has statement – 1 and statement – 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement 1: The possibility of an electric bulb fusing is higher at the time of switching ON.

Statement 2: Resistance of an electric bulb when it is not lit up is much smaller than when it is lit up.

(a) Statement 1 is true, Statement 2 is false.

(b) Statement 1 is false, Statement 2 is true; Statement 2 is not a correct explanation of Statement 1.

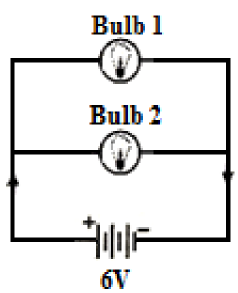
(c)Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation of Statement 1.

(d) Statement 1 is false, Statement 2 is true.

37) Three resistors of 4Ω, 6Ω and 12Ω are connected in parallel and combination is connected in series with a 1.5V battery of 1Ω internal resistance. The rate of Joule heating in the 4Ω resistor is

(a) 0.55 W
(b) 0.33 W
(c) 0.25 W
(d) 0.86 W

38) A 6.0 volt battery is connected to two light bulbs as shown in figure. Light bulb 1 has resistance 3 ohm while light bulb 2 has resistance 6 ohm. Battery has negligible internal resistance. Which bulb will glow brighter?



(a) Bulb 1 will glow more first and then its brightness will become less than bulb 2

(b) Bulb 1

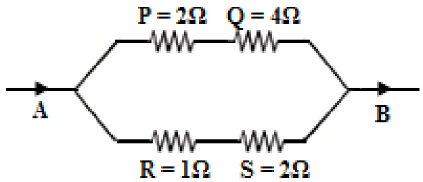
(c) Bulb 2

(d) Both glow equally

39) Two electric bulbs rated 25W – 220V and 100W – 220V are connected in series to a 440V supply. Which of the bulbs will fuse?

(a) Both | (b) 100W
(c) 25W | (d) Neither

40) Which of the four resistance P,Q, R and S generate the greatest amount of heat when a current flows from A to B?

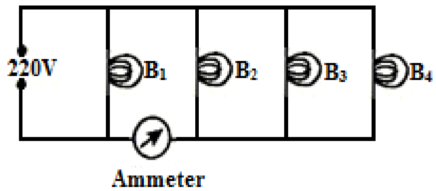


(a) Q | (b) S
(c) P | (d) R

41) The supply voltage to room is 120V. The resistance of the lead wires is 6Ω. A 60W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240W heater is switched on in parallel to the bulb?

(a) zero | (b) 2.9 Volt
(c) 13.3 Volt | (d) 10.04 Volt

42) Four bulbs B_1, B_2, B_3 and B_4 of 100W each are connected to 220 V main as shown in the figure.



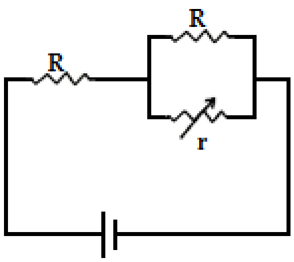
The reading in an ideal ammeter will be:

(a) 0.45 A | (b) 0.90 A
(c) 1.35 A | (d) 1.80 A

43) In a large building, there are 15 bulbs of 40W, 5 bulbs of 100W, 5 fans of 80W and 1 heater of 1 kW. The voltage of electric mains is 220V. The minimum capacity of the main fuse of the building will be:

(a) 8 A | (b) 10 A
(c) 12 A | (d) 14 A

44)



In the circuit shown, the resistance r is a variable resistance. If for r = fR, the heat generation in r is maximum then the value of f is:

(a) $\frac{1}{2}$

(b) 1

(c) $\frac{1}{4}$

(d) $\frac{3}{4}$

45) The resistance of an electrical toaster has a temperature dependence given by $R(T) = R_0[1+ \alpha(T - T_0)]$ in its range of operation. At T_0 = 300K, R = 100Ω and at T = 500 K, R = 120 Ω. The toaster is connected to a voltage source at 200 V and its temperature is raised at a constant rate from 300 to 500 K in 30s. The total wok done in raising the temperature is:

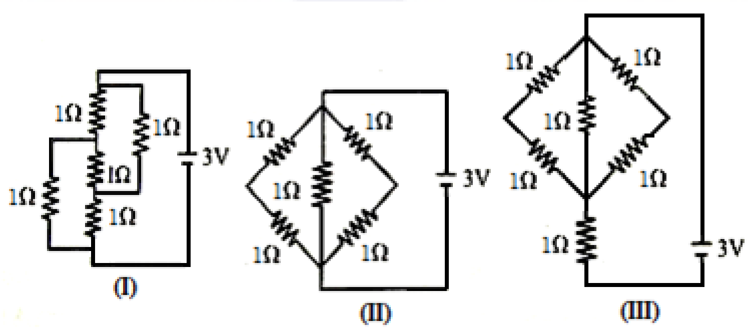
(a) $400 \ln \frac{5}{6}$ J

(b) $200 \ln \frac{2}{3}$ J

(c) None

(d) $400 \ln \frac{1.5}{1.3}$ J

46) The figure shows three circuits I, II and III which are connected to a 3V battery. If the powers dissipated by the configurations I, II and III are P_1, P_2 and P_3 respectively, then



(a) $P_1 > P_2 > P_3$

(b) $P_1 > P_3 > P_2$

(c) $P_2 > P_1 > P_3$

(d) $P_3 > P_2 > P_1$

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
b	b	b	d	b	d	d	c	b	b
11	12	13	14	15	16	17	18	19	20
a	c	a	b	d	a	a	c	b	d
21	22	23	24	25	26	27	28	29	30
c	c	c	b	b	a	b	b	c	a
31	32	33	34	35	36	37	38	39	40
a	b	b	c	b	c	c	b	c	b
41	42	43	44	45	46				
d	c	c	c	c	c				

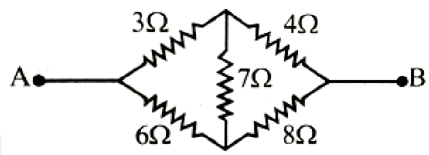
Topic 63: Wheatstone bridge & Different Measuring Instruments

1) In a meter – bridge, the balancing length from the left end when standard resistance of 1Ω is in right gap is found to be 20cm. The value of unknown resistance is

(a) 0.25Ω (b) 0.4Ω

(c) 0.5Ω (d) 4Ω

2) Five resistances have been connected as shown in the figure. The effective resistance between A and B is



(a) $\frac{14}{3}$ Ω (b) $\frac{20}{3}$ Ω

(c) 14Ω (d) 21Ω

3) Potentiometer measures potential more accurately because

(a) it measures potential in the open circuit

(b) it uses sensitive galvanometer for null deflection

(c) it uses high resistance potentiometer wire

(d) it measures potential in the closed circuit

4) If specific resistance of a potentiometer wire is 10^{-7}Ωm, the current flow through it is 0.1A and the cross – sectional area of wire is 10^{-6}m^2 then potential gradient will be

(a) 10^{-2}volt/m (b) 10^{-4}volt/m

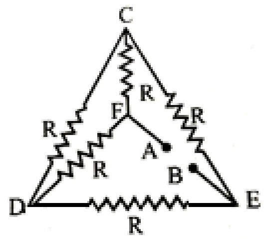
(c) 10^{-6}volt/m (d) 10^{-8}volt/m

5) In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is

(a) 2R (b) $\frac{R}{4}$

(c) $\frac{V}{R}$ (d) R

6) Five equal resistances each of resistance R are connected as shown in the figure. A battery of V volts is connected between A and B. The current flowing in AFCEB will be



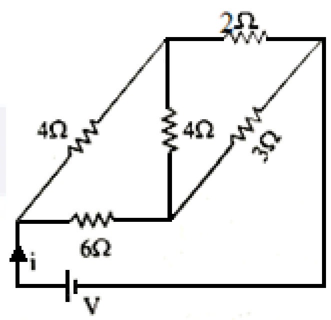
(a) $\frac{2V}{R}$

(b) $\frac{3V}{R}$

(c) $\frac{V}{R}$

(d) $\frac{V}{2R}$

7) For the network shown in the Fig. the value of the current is



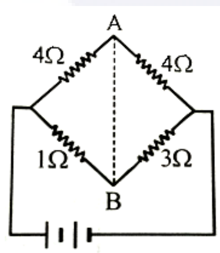
(a) $\frac{9V}{35}$

(b) $\frac{18V}{5}$

(c) $\frac{5V}{9}$

(d) $\frac{5V}{18}$

8) In the circuit shown, if a conducting wire is connected between A and B, the current in this wire will



(a) flow in the direction which will be decided by the value of V

(b) be zero

(c) flow from B to A

(d) flow from A to B

9) Three resistances P, Q, R each of 2Ω and an unknown resistance S from the four arms of a Wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S?

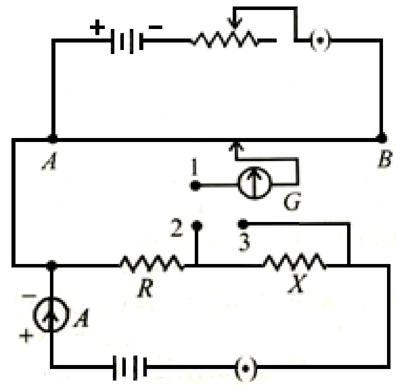
(a) 3Ω

(b) 6Ω

(c) 1Ω

(d) 2Ω

10) A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt/cm and the ammeter, present in the circuit, reads 1.0A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to



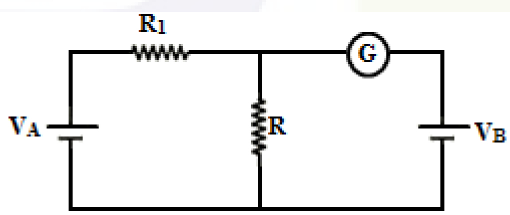
(a) k ($l_2 - l_1$) and k l_2

(b) k l_1 and k ($l_2 - l_1$)

(c) k ($l_2 - l_1$) and k l_1

(d) k l_1 and k l_2

11) In the circuit shown the cells A and B have negligible resistances. For V_A = 12V, R_1 = 500Ω and R = 100Ω the galvanometer (G) shows no deflection. The value of V_B is:



(a) 4V

(b) 2V

(c) 12V

(d) 6V

12) The resistance of the four arms P, Q, R and S in a Wheatstone's bridge are 10ohm, 30ohm, 30ohm and 90ohm, respectively. The e.m.f. and internal resistance of the cell are 7 volt and 5 ohm respectively. If the galvanometer resistance is 50 ohm, the current drawn from the cell will be

(a) 0.2A

(b) 0.1A

(c) 2.0A

(d) 1.0A

13) A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery used across the potentiometer wire, has an emf of 2.0V and a negligible internal resistance. The potentiometer wire itself is 4m long, When the resistance R, connected across the given cell, has values of

(i) infinity

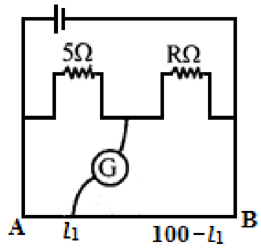
(ii) 9.5Ω

The balancing lengths', on the potentiometer wire are found to be 3m and 2.85m, respectively. The value of internal resistance of the cell is

(a) 0.25Ω (b) 0.95Ω

(c) 0.5Ω (d) 0.75Ω

14) The resistances in the two arms of the meter bridge are 5Ω and RΩ, respectively. When the resistance R is shunted with an equal resistance, the new balance point is at $1.6l_1$. The resistance 'R' is:



(a) 10Ω (b) 15Ω

(c) 20Ω (d) 25Ω

15) A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f. E_0 and a resistance r_1. An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by:

(a) $\frac{E_0 r}{(r+r_1)} \cdot \frac{l}{L}$ (b) $\frac{E_0 l}{L}$

(c) $\frac{LE_0 r}{(r+r_1)l}$ (d) $\frac{LE_0 r}{l r_1}$

16) A potentiometer wire has length 4m and resistance 8Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f 2V, so as to get a potential gradient 1mV per cm on the wire is

(a) 40Ω (b) 44Ω

(c) 48Ω (d) 32Ω

17) A potentiometer wire is 100cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50cm and 10cm from the positive end of the wire in the two cases. The ratio of emf's is:

(a) 5 : 1 (b) 5 : 4

(c) 3 : 4 (d) 3 : 2

18) A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves

(a) Potential gradient

(b) A condition of no current flow through the galvanometer

(c) A combination of cells, galvanometer and resistances

(d) Cells

19) If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a

(a) low resistance in parallel
(b) high resistance in parallel
(c) high resistance in series
(d) low resistance in series

20) An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10A the value of the required shunt is

(a) 0.03Ω
(b) 0.3Ω
(c) 0.9Ω
(d) 0.09Ω

21) The length of a wire of a potentiometer is 100 cm, and the e.m.f of its standard cell is E volt. It is employed to measure the e.m.f. of a battery whose internal resistance is 0.5Ω. If the balance point is obtained at *l* = 30cm from the positive end, the e.m.f. of the battery is

(a) $\frac{30E}{100.5}$
(b) $\frac{30E}{(100-0.5)}$
(c) $\frac{30(E-0.5i)}{100}$
(d) $\frac{30E}{100}$

22) In a meter bridge experiment null point is obtained at 20cm from one end of the wire when resistance X is balanced against another resistance Y. If X < Y, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4X against Y

(a) 40cm
(b) 80cm
(c) 50cm
(d) 70cm

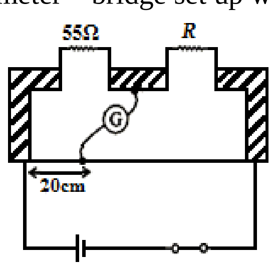
23) In a potentiometer experiment the balancing with a cell is at length 240cm. On shunting the cell with a resistance of 2Ω, the balancing length becomes 120 cm. The internal resistance of the cell is

(a) 0.5Ω
(b) 1Ω
(c) 2Ω
(d) 4Ω

24) In a Wheatstone's bridge, three resistances P, Q and R connected in the three arms and the fourth arm is formed by two resistance S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will be

(a) $\frac{P}{Q} = \frac{2R}{S_1+S_2}$
(b) $\frac{P}{Q} = \frac{R(S_1+S_2)}{S_1S_2}$
(c) $\frac{P}{Q} = \frac{R(S_1+S_2)}{2S_1S_2}$
(d) $\frac{P}{Q} = \frac{R}{S_1+S_2}$

25) Shown in the figure below is a meter – bridge set up with null deflection in the galvanometer.



The value of the unknown resistor R is

(a) 13.75Ω

(b) 220Ω

(c) 110Ω

(d) 55Ω

26) The current in the primary circuit of a potentiometer is 0.2A. The specific resistance and cross section of the potentiometer wire are 4×10^{-7} ohm meter and $8\times 10^{-7} m^2$, respectively. The potential gradient will be equal to

(a) 1 V/m

(b) 0.5 V/m

(c) 0.1 V/m

(d) 0.2 V/m

27) In a metre bridge experiment null point is obtained at 40 cm from one end of the wire when resistance X is balanced against another resistance Y. If $X < Y$, then the new position of the null point from the same end, if one decides to balance a resistance of 3X against Y, will be close to:

(a) 80cm

(b) 75cm

(c) 67cm

(d) 50cm

28) In a sensitive meter bridge apparatus the bridge wire should possess

(a) high resistivity and low temperature coefficient.

(b)low resistivity and high temperature coefficient.

(c) low resistivity and low temperature coefficient.

(d) high resistivity and high temperature coefficient.

29) It is preferable to measure the e.m.f of a cell by potentiometer than by a voltmeter because of the following possible reasons.

(i) In case of potentiometer, no current flows through the cell.

(ii) The length of the potentiometer allows greater precision.

(iii) Measurement by the potentiometer is quicker.

(iv) The sensitivity of the galvanometer, when using a potentiometer is not relevant.

Which of these reasons are correct?

(a) (i), (iii), (iv)

(b) (i), (ii), (iv)

(c) (i), (ii)

(d) (i),(ii), (iii), (iv)

30) In an experiment of potentiometer for measuring the internal resistance of primary cell a balancing length l is obtained on the potentiometer wire when the cell is open circuit. Now the cell is short circuited by a resistance R. If R is to be equal to the internal resistance of the cell the balancing length on the potentiometer wire will be

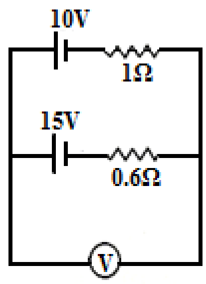
(a) l

(b) $2l$

(c) $l/2$

(d) $l/4$

31) A 10V battery with internal resistance 1Ω and a 15V battery with internal resistance 0.6Ω are connected in parallel to a voltmeter (see figure). The reading in the voltmeter will be close to:



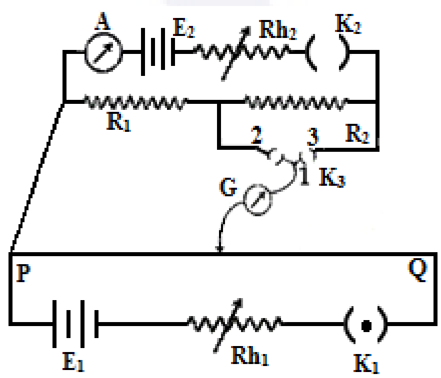
(a) 12.5 V

(b) 24.5 V

(c) 13.1 V

(d) 11.9 V

32) A potentiometer PQ is set up to compare two resistance as shown in figure. The ammeter A in the circuit reads 1.0A when two way key K_3 is open. The balance point is at a length l_1 cm from P when two way key K_3 is plugged in between 2 and 1, while the balance point is at a length l_2 cm from P when key K_3 is plugged in between 3 and 1. The ratio of two resistances $\frac{R_1}{R_2}$, is found to be:



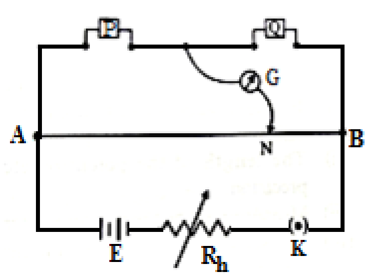
(a) $\frac{l_1}{l_1+l_2}$

(b) $\frac{l_2}{l_2-l_1}$

(c) $\frac{l_1}{l_1-l_2}$

(d) $\frac{l_1}{l_2-l_1}$

33) In a meter bridge experiment resistances are connected as shown in the figure. Initially resistance P = 4Ω and the neutral point N is 60cm from A. Now an unknown resistance R is connected in series to P and the new position of the neutral point is at 80 cm from A. The value of unknown resistance R is:



(a) $\frac{33}{5}\ \Omega$ (b) 6Ω

(c) 7Ω (d) $\frac{20}{3}\ \Omega$

34) Which of the following statements is false ?

(a) A rheostat can be used as a potential divider

(b) Kirchoff's second law represents energy conservation

(c) Wheatstone bridge is the most sensitive when all the four resistances are of the same order of magnitude

(d) In a balanced wheatstone bridge if the cell and the galvanometer are exchanged, the null point is disturbed.

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	a	a	a	d	d	d	c	a	b
11	12	13	14	15	16	17	18	19	20
b	a	c	b	a	d	d	b	c	d
21	22	23	24	25	26	27	28	29	30
d	c	c	b	b	c	c	a	c	c
31	32	33	34						
c	d	d	d						

Topic 64: Motion of Charged Particle in Magnetic Field & Moment

1) A current carrying coil is subjected to a uniform magnetic field. The coil orient so that its plane becomes

(a) inclined at 45° to the magnetic field

(b) inclined at any arbitrary angle to the magnetic field

(c) parallel to the magnetic field

(d) perpendicular to the magnetic field

2) A uniform magnetic field acts at right angles to the direction of motion of electron. As a result, the electron moves in a circular path of radius 2cm. If the speed of electron is doubled, then the radius of the circular path will be

(a) 2.0cm
(b) 0.5cm
(c) 4.0cm
(d) 1.0cm

3) A deuteron of kinetic energy 50keV is describing a circular orbit of radius 0.5 meter in a plane perpendicular to the magnetic field B. The kinetic energy of the proton that describes a circular orbit of radius 0.5 meter in the same plane with the same B is

(a) 25keV
(b) 50keV
(c) 200keV
(d) 100keV

4) A charge moving with velocity v in X – direction is subjected to a field of magnetic induction in negative X – direction. As a result, the charge will

(a) remain unaffected

(b) start moving in a circular path Y – Z plane

(c) retard along X – axis

(d) move along a helical path around X – axis

5) An electron enters a region where magnetic field (B) and electric field (E) are mutually perpendicular, then

(a) it will always move in the direction of B

(b) it will always move in the direction of E

(c) it always possesses circular motion

(d) it can go undeflected also

6) A beam of electrons is moving with constant velocity in a region having simultaneous perpendicular electric and magnetic fields of strength $20Vm^{-1}$ and 0.5T respectively at right angles to the direction of motion of the electrons. Then the velocity of electrons must be

(a) 8 m/s
(b) 20 m/s
(c) 40 m/s
(d) $\frac{1}{40}$ m/s

7) A 10eV electron is circulating in a plane at right angles to a uniform field at magnetic induction 10^{-4} Wb/m^2 (= 1.0 gauss). The orbital radius of the electron is

(a) 12 cm
(b) 16 cm
(c) 11 cm
(d) 18 cm

8) A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will

(a) continue to move due east

(b) move in a circular orbit with its speed unchanged

(c) move in a circular orbit with its speed increased

(d) gets deflected vertically upwards

9) When a proton is accelerated through 1V, then its kinetic energy will be

(a) 1840eV
(b) 13.6eV
(c) 1eV
(d) 0.54eV

10) A proton moving with a velocity 3×10^5 m/s enters a magnetic field of 0.3 tesla at an angle of 30° with the field. The radius of curvature of its path will be (e/m for proton = 10^8 C/kg)

(a) 2 cm
(b) 0.5 cm
(c) 0.02 cm
(d) 1.25 cm

11) A charged particle of charge q and mass m enters perpendicularly in a magnetic field $\vec{B}$. Kinetic energy of the particle is E; then frequency of rotation is

(a) $\frac{qB}{m\pi}$
(b) $\frac{qB}{2\pi m}$
(c) $\frac{qBE}{2\pi m}$
(d) $\frac{qB}{2\pi E}$

12) In a certain region of space electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other and an electron enters in region perpendicular to the direction of $\vec{B}$ and $\vec{E}$ both and moves undeflected, then velocity of electron is

(a) $\frac{|\vec{E}|}{|\vec{B}|}$
(b) $\vec{E} \times \vec{B}$

(c) $\frac{|\vec{B}|}{|\vec{E}|}$

(d) $\vec{E}\,.\,\vec{B}$

13) A charged particle moves through a magnetic field in a direction perpendicular to it. Then the

(a) velocity remains unchanged

(b) speed of the particle remains unchanged

(c) direction of the particle remains unchanged

(d) acceleration remains unchanged

14) An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to

(a) $\sqrt{\frac{B}{v}}$

(b) $\frac{B}{v}$

(c) $\sqrt{\frac{v}{B}}$

(d) $\frac{v}{B}$

15) Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with uniform speed v. The time period of the motion

(a) depends on both R and v

(b) is independent of both R and v

(c) depends on R and not on v

(d) depends on v and not on R

16) A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by

(a) qvR^2

(b) $qvR^2/2$

(c) qvR

(d) qvR/2

17) In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular path of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional to

(a) $1/R^2$

(b) R^2

(c) R

(d) 1/R

18) A beam of electron passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off, and the same magnetic field is maintained, the electron move

(a) in a circular orbit

(b) along a parabolic path

(c) along a straight line

(d) in an elliptical orbit

19) A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction $\vec{B}$. After 3 seconds, the kinetic energy of the particle will be:

(a) 3T

(b) 2T

(c) T (d) 4T

20) Under the influence of a uniform magnetic field, a charged particle moves with constant speed v in a circle of radius R. The time period of rotation of the particle:

(a) depends on R and not on v (b) is independent of both v and R

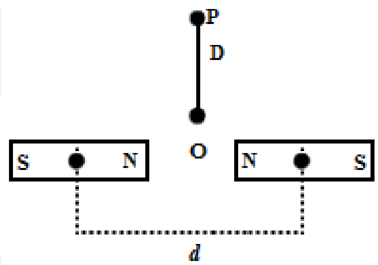
(c) depends on both v and R (d) depends on v and not on R

21) The magnetic force acting on a charged particle of charge $-2\mu C$ in a magnetic field of 2T acting in y direction, when the particle velocity is $(2\hat{i} + 3\hat{j}) \times 10^{6} ms^{-1}$, is

(a) 4N in z direction (b) 8N in y direction

(c) 8N in z direction (d) 8N in $-$z direction

22) Two identical bar magnets are fixed with their centers at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the Figure. The force on the charge Q is



(a) directed perpendicular to the plane of paper (b) zero

(c) directed along OP (d) directed along PO

23) A uniform electric field and uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron

(a) will turn towards right of direction of motion (b) speed will decrease

(c) speed will increase (d) will turn towards left direction of motion

24) A proton carrying 1MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α – particle to describe a circle of same radius in the same field?

(a) 2MeV (b) 1MeV

(c) 0.5MeV (d) 4MeV

25) An α – particle moves in a circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb/m^2. The wavelength associated with the particle will be:

(a) 1Å (b) 0.1Å

(c) 10Å (d) 0.01Å

26) An alternating electric field, of frequency v, is applied across the dees (radius = R) of cyclotron that is being used to accelerate protons (mass = m). The operating magnetic field (B) used in the cyclotron and the kinetic energy (K) of the proton beam, produced by it, are given by:

(a) $B = \dfrac{me}{v}$ and $K = 2m\pi^2v^2R^2$

(b) $B = \dfrac{2\pi mv}{e}$ and $K = m^2\pi vR^2$

(c) $B = \dfrac{2\pi mv}{e}$ and $K = 2m\pi^2v^2R^2$

(d) $B = \dfrac{mv}{e}$ and $K = 2m^2\pi vR^2$

27) A proton and an alpha particle both enter a region of uniform magnetic field B, moving at right angles of field B. If the radius of circular orbits for both the particles is equal and the kinetic energy acquired by proton is 1MeV the energy acquired by the alpha particle will be:

(a) 0.5MeV

(b) 1.5MeV

(c) 1MeV

(d) 4MeV

28) The time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of its

(a) speed

(b) mass

(c) charge

(d) magnetic induction

29) If an electron and a proton having same momenta enter perpendicular to a magnetic field, then

(a) curved path of electron and proton will be same (ignoring the sense of revolution)

(b) they will move undeflected

(c) curved path of electron is more curved than that of the proton

(d) path of proton is more curved.

30) A particle of mass M and charge Q moving with velocity $\vec{v}$ describes a circular path of radius R when subjected to a uniform transverse magnetic field of induction B. The work done by the field when the particle completes one full circle is

(a) $\left(\dfrac{Mv^2}{R}\right)2\pi R$

(b) zero

(c) B Q $2\pi R$

(d) B Qv $2\pi R$

31) A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity then

(a) its velocity will increase

(b) its velocity will decrease

(c) it will turn towards left of direction of motion

(d) it will turn towards right of direction of motion

32) A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is

(a) $\frac{2\pi q^2 B}{m}$

(b) $\frac{2\pi mq}{B}$

(c) $\frac{2\pi m}{qB}$

(d) $\frac{2\pi qB}{m}$

33) In a region, steady and uniform electric and magnetic fields are present. These two fields are parallel to each other. A charged particle is released from rest in this region. The path of the particle will be a

(a) helix

(b) straight line

(c) ellipse

(d) circle

34) A charged particle moves through a magnetic field perpendicular to its direction. Then

(a) kinetic energy changes but the momentum is constant

(b) the momentum changes but the kinetic energy is constant

(c) both momentum and kinetic energy of the particle are not constant

(d) both momentum and kinetic energy of the particle are constant

35) A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

(a) $\vec{v} = \vec{B} \times \vec{E} / E^2$

(b) $\vec{v} = \vec{E} \times \vec{B} / B^2$

(c) $\vec{v} = \vec{B} \times \vec{E} / B^2$

(d) $\vec{v} = \vec{E} \times \vec{B} / E^2$

36) An electric charge +q moves with velocity $\vec{v} = 3\hat{\imath} + 4\hat{\jmath} + \hat{k}$ in an electromagnetic field given by $\vec{E} = 3\hat{\imath} + \hat{\jmath} + 2\hat{k}$ and $\vec{B} = \hat{\imath} + \hat{\jmath} - 3\hat{k}$ The y – component of the force experienced by +q is:

(a) 11q

(b) 5q

(c) 3q

(d) 2q

37) The velocity of certain ions that pass undeflected through crossed electric field E = 7.7k V/m and magnetic field B = 0.14 T is

(a) 18 km/s

(b) 77 km/s

(c) 55 km/s

(d) 1078 km/s

38) The magnetic force acting on charged particle of charge 2μC in magnetic field of 2T acting in y - direction, when the particle velocity is $(2\hat{\imath} + 3\hat{\jmath}) \times 10^6$ ms^{-1} is

(a) 8 N in z – direction

(b) 8 N in y – direction

(c) 4 N in y – direction

(d) 4 N in z – direction

39) A proton and a deuteron are both accelerated through the same potential difference and enter in a magnetic field perpendicular to the direction of the field. If the deuteron follows a path of radius R, assuming the neutron and proton masses are nearly equal, the radius of the proton's path will be

(a) $\sqrt{2}R$

(b) $\frac{R}{\sqrt{2}}$

(c) $\frac{R}{2}$

(d) R

40) This question contains Statement 1 and Statement 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement 1: A charged particle is moving at right angle to a static magnetic field. During the motion the kinetic energy of the charge remains unchanged.

Statement 2: Static magnetic field exert force on a moving charge in the direction perpendicular to the magnetic field.

(a) Statement 1 is false, Statement 2 is true

(b) Statement 1 is true, Statement 2 is true; Statement 2 is not the correct explanation of Statement 1

(c) Statement 1 is true, Statement 2 is false

(d) Statement 1 is true, Statement 2 is true; Statement 2 is the correct explanation of Statement 1

41) Proton, deuteron and alpha particle of same kinetic energy are moving in circular trajectories in a constant magnetic field. The radii of proton, deuteron and alpha particle are respectively r_p, r_d, and r_α. Which one of the following relations is correct?

(a) $r_\alpha = r_p = r_d$

(b) $r_\alpha = r_p < r_d$

(c) $r_\alpha > r_d > r_p$

(d) $r_\alpha = r_d > r_p$

42) A particle of charge 16×10^{-16} C moving with velocity $10 ms^{-1}$ along x – axis enters a region where magnetic field of induction $\vec{B}$ is along the y – axis and an electric field of magnitude 10^4 Vm^{-1} is along the negative z – axis. If the charged particle continues moving along x – axis, the magnitude of $\vec{B}$ is:

(a) 16×10^3 Wbm^{-2}

(b) 2×10^3 Wbm^{-2}

(c) 1×10^3 Wbm^{-2}

(d) 4×10^3 Wbm^{-2}

43) A positive charge ‘q’ of mass ‘m’ is moving along the + x - axis. We wish to apply a uniform magnetic field B for time Δt so that the charge reverses its direction crossing the y – axis at a distance d. Then:

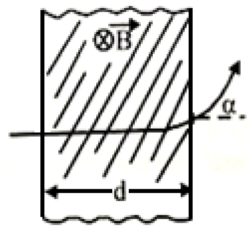
(a) $B = \frac{mv}{qd}$ and $\Delta t = \frac{\pi d}{v}$

(b) $B = \frac{mv}{2qd}$ and $\Delta t = \frac{\pi d}{2v}$

(c) $B = \frac{2mv}{qd}$ and $\Delta t = \frac{\pi d}{2v}$

(d) $B = \frac{2mv}{qd}$ and $\Delta t = \frac{\pi d}{v}$

44) A proton (mass m) accelerated by a potential difference V flies through a uniform transverse magnetic field B. The field occupies a region of space by width ‘d’. If α be the angle of deviation of proton from initial direction of motions (see figure), the value of sin α will be:



(a) $qV\sqrt{\frac{Bd}{2m}}$

(b) $\frac{B}{2}\sqrt{\frac{qd}{mV}}$

(c) $\frac{B}{d}\sqrt{\frac{q}{2mV}}$

(d) $Bd\sqrt{\frac{q}{2mV}}$

45) Consider a thin metallic sheet perpendicular to the plane of the paper moving with speed 'v' in a uniform magnetic field B going into the plane (See figure). If charge densities σ_1 and σ_2 are induced on the left and right surfaces, respectively, of the sheet then (ignore fringe effects):

(a) $\sigma_1 = \frac{-\epsilon_0 vB}{2}$, $\sigma_2 = \frac{\epsilon_0 vB}{2}$

(b) $\sigma_1 = \epsilon_0 vB$, $\sigma_2 = -\epsilon_0 vB$

(c) $\sigma_1 = \frac{\epsilon_0 vB}{2}$, $\sigma_2 = \frac{-\epsilon_0 vB}{2}$

(d) $\sigma_1 = \sigma_2 = \epsilon_0 vB$

46) In a certain region static electric and magnetic fields exist. The magnetic field is given by $\vec{B} = B_0(\hat{i} + 2\hat{j} - 4\hat{k})$ If a test charge moving with a velocity $\vec{v} = v_0(3\hat{i} - \hat{j} + 2\hat{k})$ experiences no force in that region, then the electric field in the region, in SI units is:

(a) $\vec{E} = -v_0 B_0(3\hat{i} - 2\hat{j} - 4\hat{k})$

(b) $\vec{E} = -v_0 B_0(\hat{i} + \hat{j} + 7\hat{k})$

(c) $\vec{E} = v_0 B_0(14\hat{j} + 7\hat{k})$

(d) $\vec{E} = -v_0 B_0(14\hat{j} + 7\hat{k})$

47) A negative test charge is moving near a long straight wire carrying a current. The force acting on the test charge is parallel to the direction of the current. The motion of the charge is:

(a) away from the wire

(b) towards the wire

(c) parallel to the wire along the current

(d) parallel to the wire opposite to the current

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	c	d	a	d	c	c	b	c	b
11	12	13	14	15	16	17	18	19	20
b	a	b	d	b	d	a	a	c	b
21	22	23	24	25	26	27	28	29	30
d	b	b	b	d	c	c	a	a	b
31	32	33	34	35	36	37	38	39	40
b	c	b	b	b	a	c	a	b	d
41	42	43	44	45	46	47			
b	c	c	d	b	d	b			

Topic 65: Magnetic Field, Biot – Savart's Law & Ampere's Circuital Law

1) Tesla is the unit of

(a) magnetic flux (b) magnetic field

(c) magnetic induction (d) magnetic moment

2) Energy in a current carrying conductor coil is stored in the form of

(a) electric field (b) magnetic field

(c) dielectric induction (d) heat

3) The magnetic induction at a point P which is at a distance of 4cm from a long current carrying wire is 10^{-3}T. The field of induction at a distance 12cm from the current will be

(a) 3.33×10^{-4} T (b) 1.11×10^{-4} T

(c) 3×10^{-3} T (d) 9×10^{-3} T

4) The magnetic field at a distance r from a long wire carrying current i is 0.4 tesla. The magnetic field at a distance 2r is

(a) 0.2 tesla (b) 0.8 tesla

(c) 0.1 tesla (d) 1.6 tesla

5) At what distance from a long straight wire carrying a current of 12A will the magnetic field be equal to 3×10^{-5}Wb/m^2?

(a) 8×10^{-2}m (b) 12×10^{-2}m

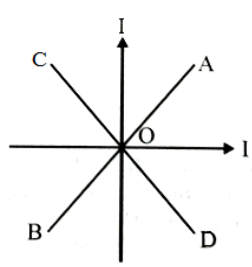
(c) 18×10^{-2}m (d) 24×10^{-2}m

6) A straight wire of diameter 0.5mm carrying a current of 1A is replaced by another wire of 1mm diameter carrying same current. The strength of magnetic field far away is

(a) twice the earlier value (b) same as the earlier value

(c) one – half of the earlier value (d) one – quarter of the earlier value

7) Two equal electric currents are flowing perpendicular to each other as shown in the figure. AB and CD are perpendicular to each other and symmetrically placed with respect to the current flow. Where do we expect the resultant magnetic field be zero?



(a) on AB

(b) on CD

(c) on both AB and CD

(d) on both OD and BO

8) The magnetic field ($d\vec{B}$) due to small element (dl) at a distance ($\vec{r}$) and element carrying current is

(a) $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r}\right)$

(b) $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r^2}\right)$

(c) $d\vec{B} = \frac{\mu_0}{4\pi} i^2 \left(\frac{d\vec{l} \times \vec{r}}{r}\right)$

(d) $d\vec{B} = \frac{\mu_0}{4\pi} i \left(\frac{d\vec{l} \times \vec{r}}{r^3}\right)$

9) A coil of one turn is made of a wire of certain length and then from the same length a coil of two turns is made. If the same current is passed in both the cases, then the ratio of the magnetic inductions at their centers will be

(a) 2 : 1

(b) 1 : 4

(c) 4 : 1

(d) 1 : 2

10) If a long hollow copper pipe carries a current, then magnetic field is produced

(a) inside the pipe only

(b) outside the pipe only

(c) both inside and outside the pipe

(d) no where

11) Magnetic field intensity at the centre of a coil of 50 turns, radius 0.5m and carrying a current of 2 A is

(a) 0.5×10^{-5}T

(b) 1.25×10^{-4}T

(c) 3×10^{-5}T

(d) 4×10^{-5}T

12) Two long parallel wires P and Q are both perpendicular to the plane of the paper with distances 5m between them. If P and Q carry currents of 2.5 amp and 5 amp respectively in the same direction, then the magnetic field at a point half – way between the wire is

(a) $\frac{3\mu_0}{2\pi}$

(b) $\frac{\mu_0}{\pi}$

(c) $\frac{\sqrt{3}\mu_0}{2\pi}$

(d) $\frac{\mu_0}{2\pi}$

13) A wire carries a current. Maintaining the same current it is bent first from a circular plane coil of one turn which produces a magnetic field B at the centre of the coil. The same length is now bent more sharply to give a double loop of smaller radius. The magnetic field at the centre of the double loop, caused by the same current is

(a) 4B

(b) B/4

(c) B/2

(d) 2B

14) A long solenoid carrying a current produces a magnetic field B along its axis. If the current is double and the number of turns per cm is halved, the new value of the magnetic fields is

(a) 4B

(b) B/2

(c) B

(d) 2B

15) Two circular coils 1 and 2 are made from the same wire but the radius of the 1^{st} coil is twice that of the 2^{nd} coil. What potential difference in volts should be applied across them so that the magnetic field at their centers is the same

(a) 4
(b) 6
(c) None
(d) 3

16) A current loop consists of two identical semicircular parts each of radius R, one lying in the x – y plane and the other in x – z plane. If the current in the loop is i., the resultant magnetic field due to the two semicircular parts at their common centre is

(a) $\frac{\mu_0 i}{\sqrt{2}R}$
(b) $\frac{\mu_0 i}{2\sqrt{2}R}$
(c) $\frac{\mu_0 i}{2R}$
(d) $\frac{\mu_0 i}{4R}$

17) A particle having a mass of 10^{-2} kg carries a charge of 5×10^{-8}C. The particle is given an initial horizontal velocity of $10^5 ms^{-1}$ in the presence of electric field $\vec{E}$ and magnetic field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that

(1) $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity.

(2) Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity.

(3) Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity.

(4) $\vec{B}$ should be along the direction of velocity and $\vec{E}$ should be perpendicular to the direction of velocity.

Which one of the following pairs of statements is possible?

(a) (2) and (4)
(b) (1) and (3)
(c) (3) and (4)
(d) (2) and (3)

18) Charge q is uniformly spread on a thin ring of radius R. The ring rotates about its axis with a uniform frequency f Hz. The magnitude of magnetic induction at the centre of the ring is

(a) $\frac{\mu_0 qf}{2R}$
(b) $\frac{\mu_0 q}{2fR}$
(c) $\frac{\mu_0 q}{2\pi fR}$
(d) $\frac{\mu_0 qf}{2\pi R}$

19) Two similar coils of radius R are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and 2I, respectively. The resultant magnetic field induction at the centre will be:

(a) $\frac{\sqrt{5}\mu_0 I}{2R}$
(b) $\frac{3\mu_0 I}{2R}$
(c) $\frac{\mu_0 I}{2R}$
(d) $\frac{\mu_0 I}{R}$

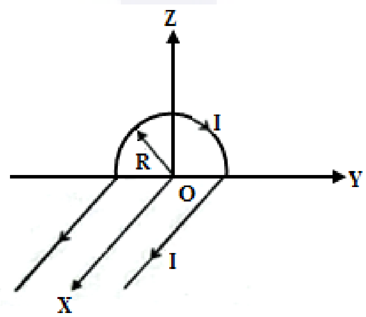
20) When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ towards west. The electric and magnetic fields in the room are respectively

(a) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down
(b) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ up
(c) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down
(d) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up

21) Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point of the two. The wires carry I_1 and I_2 currents respectively. Point 'P' is lying at distance 'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be:

(a) $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$
(b) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$
(c) $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$
(d) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

22) A wire carrying current I has the shape as shown in adjoining figure. Linear parts of the wire are very long and parallel to X – axis while semicircular portion of radius R is lying in Y – Z plane. Magnetic field at point O is:



(a) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}(\mu\hat{i} \times 2\hat{k})$
(b) $\vec{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} + 2\hat{k})$
(c) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} - 2\hat{k})$
(d) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} + 2\hat{k})$

23) An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude:

(a) Zero
(b) $\frac{\mu_0 n^2 e}{r}$
(c) $\frac{\mu_0 ne}{2r}$
(d) $\frac{\mu_0 ne}{2\pi r}$

24) A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross – section. The ratio of the magnetic fields B and B', at radial distances $\frac{a}{2}$ and 2a respectively, from the axis of the wire is:

(a) $\frac{1}{4}$
(b) $\frac{1}{2}$
(c) 1
(d) 4

25) If in a circular coil A of radius R, current I is flowing and in another coil B of radius 2R a current 2I is flowing, then the ratio of the magnetic fields B_A and B_B produced by them will be

(a) 1
(b) 2
(c) 1/2
(d) 4

26) The magnetic field due to a current carrying circular loop of radius 3cm at a point on the axis at a distance of 4cm from the centre is 54μT. What will be its value at the centre of loop?

(a) 125μT
(b) 150μT
(c) 250μT
(d) 75μT

27) A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil B. It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be

(a) 2nB
(b) n^2B
(c) nB
(d) $2n^2B$

28) A current i ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is

(a) $\frac{\mu_0}{4\pi}.\frac{2i}{r}$ tesla
(b) zero
(c) infinite
(d) $\frac{2i}{r}$ tesla

29) Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3 ampere and 4 ampere are the currents flowing in each coil respectively. The magnetic induction in Weber/m^2 at the centre of the coils will be ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A.m)

(a) 10^{-5}
(b) 12×10^{-5}
(c) 7×10^{-5}
(d) 5×10^{-5}

30) A long solenoid has 200 turns per cm and carries a current i. The magnetic field at its centre is 6.28×10^{-2} Weber/m^2. Another long solenoid has 100 turns per cm and it carries a current $\frac{i}{3}$. The value of the magnetic field at its centre is

(a) 1.05×10^{-2} Weber/m^2
(b) 1.05×10^{-5} Weber/m^2
(c) 1.05×10^{-3} Weber/m^2
(d) 1.05×10^{-4} Weber/m^2

31) Two identical conducting wires AOB and COD are placed at right angles to each other. The wire AOB carries an electric current I_1 and COD carries a current I_2. The magnetic field on a point lying at a distance d from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by

(a) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)$

(b) $\frac{\mu_0}{2\pi}\left(\frac{I_1+I_2}{d}\right)^{\frac{1}{2}}$

(c) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{\frac{1}{2}}$

(d) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$

32) A current I flows along the length of an infinitely long, straight, thin walled pipe. Then

(a) the magnetic field at all points inside the pipe is the same, but not zero

(b) the magnetic field is zero only on the axis of the pipe

(c) the magnetic field is different at different points inside the pipe

(d) the magnetic field at any point inside the pipe is zero

33) A long straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross section. The ratio of the magnetic field at a/2 and 2a is

(a) 1/2

(b) 1/4

(c) 4

(d) 1

34) A horizontal overhead powerline is at height of 4m from the ground and carries a current of 100A from east to west. The magnitude field directly below it on the ground is ($\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$)

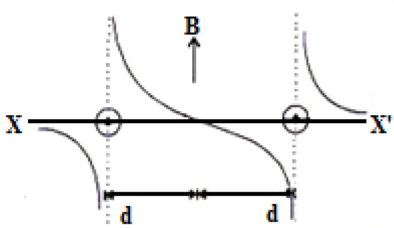
(a) 2.5×10^{-7}T southward

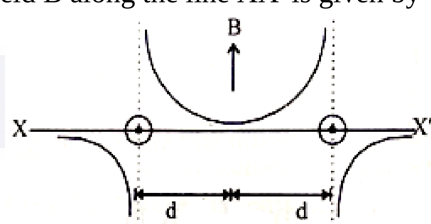
(b) 5×10^{-6}T northward

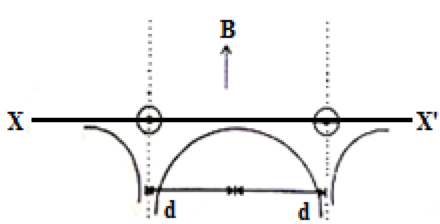
(c) 5×10^{-6}T southward

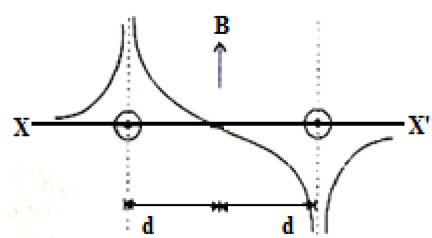
(d) 2.5×10^{-7}T northward

35) Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX' is given by

(a)


(b)


(c)


(d)


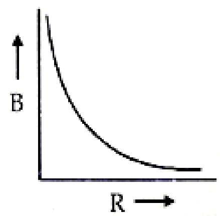
36) A current I flows in an infinitely long wire with cross section in the form of a semi - circular ring of radius R. The magnitude of the magnetic induction along its axis is:

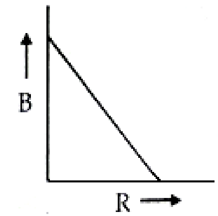
(a) $\frac{\mu_0 I}{2\pi^2 R}$

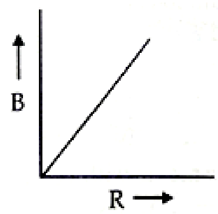
(b) $\frac{\mu_0 I}{2\pi R}$

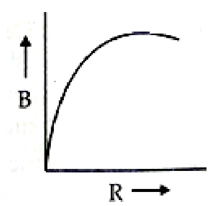
(c) $\frac{\mu_0 I}{4\pi R}$ (d) $\frac{\mu_0 I}{\pi^2 R}$

37) A charge Q is uniformly disturbed over the surface of non conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing through its centre with an angular velocity ω. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure:

(a)


(b)


(c)


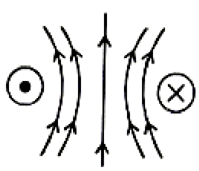
(d)


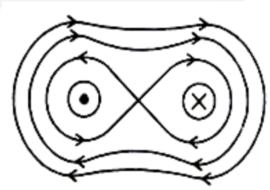
38) An electric current is flowing through a circular coil of radius R. The ratio of the magnetic field at the centre of the coil and that a distance $2\sqrt{2}$ R from the centre of the coil and on its axis is:

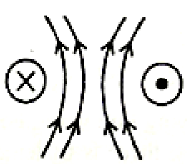
(a) $2\sqrt{2}$ (b) 27

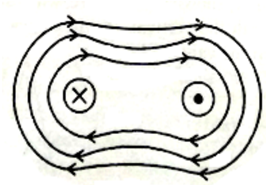
(c) 36 (d) 8

39) Choose the correct sketch of the magnetic field lines of a circular current loop shown by the dot ⊙ and the cross ⊗.

(a)


(b)


(c)


(d)


40) A current i is flowing in a straight conductor of length L. The magnetic induction at a point on its axis at a distance $\frac{L}{4}$ from its centre will be:

(a) Zero (b) $\frac{\mu_0 i}{2\pi L}$

(c) $\frac{\mu_0 i}{\sqrt{2}L}$

(d) $\frac{4\mu_0 i}{\sqrt{5}\pi L}$

41) A parallel plate capacitor of area $60cm^2$ and separation 3mm is charged initially to 90μC. If the medium between the plate gets slightly conducting and the plate loses the charge initially at the rate of 2.5×10^{-8}C/s, then what is the magnetic field between the plates?

(a) 2.5×10^{-8}T

(b) 2.0×10^{-7}T

(c) 1.63×10^{-11}T

(d) Zero

42) Consider two thin identical conducting wires covered with very thin insulating material. One of the wires is bent into a loop and produces magnetic field B_1, at its centre when a current I passes through it. The ratio $B_1 : B_2$ is:

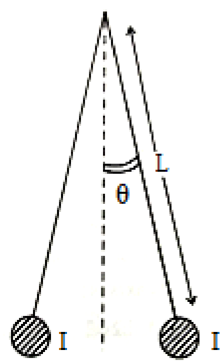
(a) 1 : 1

(b) 1 : 3

(c) 1 : 9

(d) 9 : 1

43) Two long current carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle 'θ' with the vertical. If wires have mass λ per unit length then the value of I is:



(a) $2\sqrt{\frac{\pi g L}{\mu_0}\tan\theta}$

(b) $\sqrt{\frac{\pi\lambda g L}{\mu_0}\tan\theta}$

(c) $\sin\theta\sqrt{\frac{\pi\lambda g L}{\mu_0 \cos\theta}}$

(d) $2\sin\theta\sqrt{\frac{\pi\lambda g L}{\mu_0 \cos\theta}}$

44) Two identical wires A and B, each of length '*l*', carry the same current I. Write A is bent into a circle of radius R and wire B is bent to form a square of side 'a'. If B_A and B_B are the values of magnetic field at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is:

(a) $\frac{\pi^2}{16}$

(b) $\frac{\pi^2}{8\sqrt{2}}$

(c) $\frac{\pi^2}{8}$

(d) $\frac{\pi^2}{16\sqrt{2}}$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	b	a	a	a	b	a	d	b	b
11	12	13	14	15	16	17	18	19	20
b	d	a	c	c	b	d	a	a	a
21	22	23	24	25	26	27	28	29	30
d	b	c	c	a	c	b	b	d	a
31	32	33	34	35	36	37	38	39	40
c	d	d	c	a	d	a	b	a	a
41	42	43	44						
d	b	d	b						

Topic 66: Force & Torque on a Current Carrying Conductor

1) A straight wire of length 0.5 meter and carrying a current of 1.2 ampere is placed in uniform magnetic field of induction 2 tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is

(a) 2.4 N (b) 1.2 N

(c) 3.0 N (d) 2.0 N

2) A coil carrying electric current is placed in uniform magnetic field, then

(a) torque is formed (b) e.m.f is induced

(c) both (a) and (b) are correct (d) none of the above

3) Two long parallel wires are at a distance of 1meter. Both of them carry one ampere of current. The force of attraction per unit length between the two wires is

(a) 2×10^{-7}N/m (b) 2×10^{-8}N/m

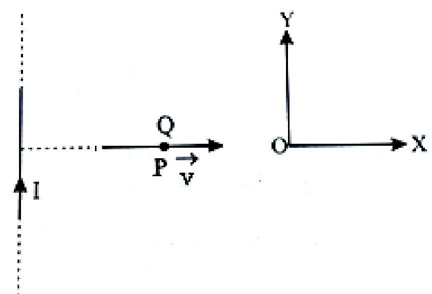
(c) 5×10^{-8}N/m (d) 10^{-7}N/m

4) A particle having charge q moves with a velocity $\vec{v}$ through a region in which both an electric field $\vec{E}$ and a magnetic field $\vec{B}$ are present. The force on the particle is

(a) $q\vec{E} + q(\vec{B} \times \vec{v})$ (b) $q\vec{E} \cdot (\vec{B} \times \vec{v})$

(c) $q\vec{v} + q(\vec{E} \times \vec{B})$ (d) $q\vec{E} + q(\vec{v} \times \vec{B})$

5) A very long straight wire carries a current I. At the instant when a charge +Q at a point P has velocity $\vec{v}$, as shown, the force on the charge is



(a) along OY (b) opposite to OY

(c) along OX (d) opposite to OX

6) When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non – zero. This implies that

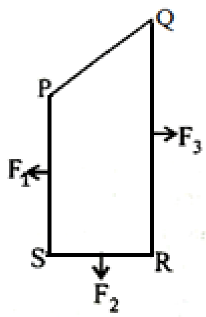
(a) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°

(b) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

(c) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

(d) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°

7)



A closed loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segments PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is

(a) $F_3 - F_1 - F_2$

(b) $\sqrt{(F_3 - F_1)^2 + F_2^2}$

(c) $\sqrt{(F_3 - F_1)^2 - F_2^2}$

(d) $F_3 - F_1 + F_2$

8) A closely wound solenoid of 2000 turns and area of cross – section $1.5 \times 10^{-4} m^2$ carries a current of 2.0A. It suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be:

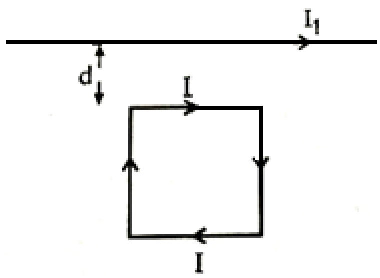
(a) 3×10^{-2} N – m

(b) 3×10^{-3} N – m

(c) 1.5×10^{-3} N – m

(d) 1.5×10^{-2} N – m

9) A square loop, carrying a steady current I, is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance d from the conductor as shown in figure. The loop will experience



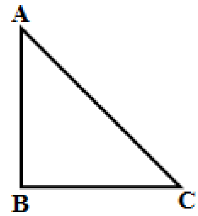
(a) a net repulsive force away from the conductor

(b) a net torque acting upward perpendicular to the horizontal plane

(c) a net torque acting downward normal to the horizontal plane

(d) a net attractive force towards the conductor

10) A current carrying loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is F, what is the force on the arm AC?



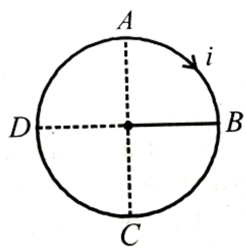
(a) $-\sqrt{2}\,\vec{F}$

(b) $-\vec{F}$

(c) $\vec{F}$

(d) $\sqrt{2}\,\vec{F}$

11) A circular coil ABCD carrying a current *i* is placed in a uniform magnetic field. If the magnetic force on the segment AB is $\vec{F}$, the force on the remaining segment BCDA is



(a) $\vec{F}$

(b) $-\vec{F}$

(c) $3\vec{F}$

(d) $-3\vec{F}$

12) A long straight wire carries a certain current and produces a magnetic field of $2 \times 10^{-4} \frac{\text{weber}}{\text{m}^2}$ at a perpendicular distance of 5 cm from the wire. An electron situated at 5 cm from the wire. An electron situated at 5 cm from the wire moves with a velocity 10^7m/s towards the wire along perpendicular to it. The force experienced by the electron will be

(charge on electron = 1.6×10^{-19}C)

(a) Zero

(b) 3.2N

(c) 3.2×10^{-16}N

(d) 1.6×10^{-16}N

13) A current loop in a magnetic field

(a) can be in equilibrium in one orientations

(b) can be in equilibrium in two orientations, both the equilibrium states are unstable

(c) can be in equilibrium in two orientations, one stable while other is unstable

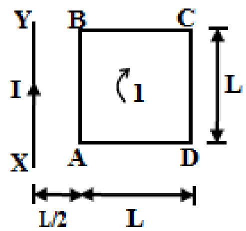
(d) experiences a torque whether the field is uniform or non – uniform in all orientations

14) A rectangular coil of length 0.12m and width 0.1m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 weber/m^2. The coil carries a current of 2A. If the plane of the coil is inclined at an angle of 30° with the direction of the field, the torque required to keep the coil in stable equilibrium will be:

(a) 0.20Nm (b) 0.24Nm

(c) 0.12Nm (d) 0.15Nm

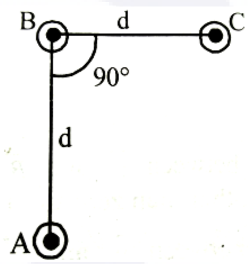
15) A square loop ABCD carrying a current i, is placed near and coplanar with a long straight conductor XY carrying a current I, the net force on the loop will be:



(a) $\frac{2\mu_0 Ii}{3\pi}$ (b) $\frac{\mu_0 Ii}{2\pi}$

(c) $\frac{2\mu_0 IiL}{3\pi}$ (d) $\frac{\mu_0 IiL}{2\pi}$

16) An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current 'I along the same direction is shown in fig. Magnitude of force per unit length on the middle wire 'B' is given by



(a) $\frac{2\mu_0 i^2}{\pi d}$ (b) $\frac{\sqrt{2}\mu_0 i^2}{\pi d}$

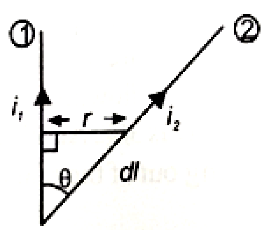
(c) $\frac{\mu_0 i^2}{\sqrt{2}\pi d}$ (d) $\frac{\mu_0 i^2}{2\pi d}$

17) A 250 turn rectangular coil of length 2.1cm and width 1.25cm carries a current of 85μA and subjected to magnetic field of strength 0.85T. Work done for rotating the coil by 180° against the torque is

(a) 4.55μJ (b) 2.3μJ

(c) 1.15μJ (d) 9.1μJ

18) Wires 1 and 2 carrying currents i_1 and i_2 respectively are inclined at an angle θ to each other. What is the force on a small element dl of wire 2 at a distance of r from wire 1 (as shown in figure) due to the magnetic field of wire 1?



(a) $\frac{\mu_0}{2\pi r} i_1 i_2$ dl tan θ

(b) $\frac{\mu_0}{2\pi r} i_1 i_2$ dl sin θ

(c) $\frac{\mu_0}{2\pi r} i_1 i_2$ dl cos θ

(d) $\frac{\mu_0}{4\pi r} i_1 i_2$ dl sin θ

19) If a current is passed through a spring then the spring will

(a) expand

(b) compress

(c) remains same

(d) none of these

20) Two long conductors, separated by a distance d carry current I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of the force between them is

(a) $-\frac{2F}{3}$

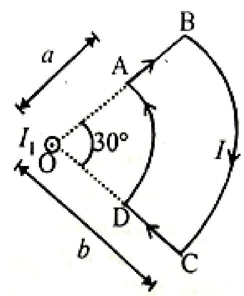
(b) $\frac{F}{3}$

(c) $-2F$

(d) $-\frac{F}{3}$

Directions: Question number 21 and 22 are based on the following paragraph.

A current loop ABCD is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the loop are joined by two straight wires AB and CD. A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I_1 flowing out of the plane of the paper is kept at the origin.



21) Due to the presence of the current I_1 at the origin:

(a) The forces on AD and BC is zero.

(b) The magnitude of the net force on the loop is given by $\frac{I_1 I}{4\pi}$ μ_0 [2(b – a) + π/3 (a + b)].

(c) The magnitude of the net force on the loop is given by $\frac{\mu_0 I I_1}{24ab}$ (b – a).

(d) The forces on AB and DC is zero.

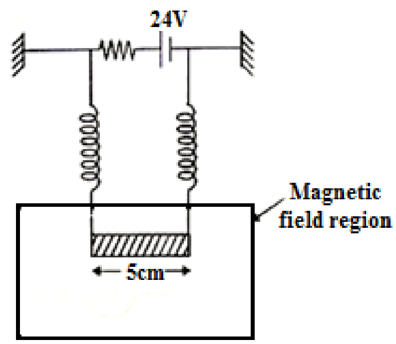
22) The magnitude of the magnetic field (B) due to the loop ABCD at the origin (O) is:

(a) $\frac{\mu_0 I(b-a)}{24ab}$

(b) $\frac{\mu_0 I}{4\pi}\left[\frac{(b-a)}{ab}\right]$

(c) $\frac{\mu_0 I}{4\pi}$ [2(b – a) + π/3 (a + b)] (d) zero

23) The circuit in figure consist of wire at the top and bottom and identical springs as the left and right sides. The wire at the bottom has a mass of 10g and is 5cm long. The wire is hanging as shown in the figure. The springs stretch 0.5cm under the weight of the wire and the circuit has a total resistance of 12Ω. When the lower wire is subjected to a static magnetic field, the springs, stretch an additional 0.3cm. The magnetic field is



(a) 0.6T and directed out of page (b) 1.2T and directed into the plane of page

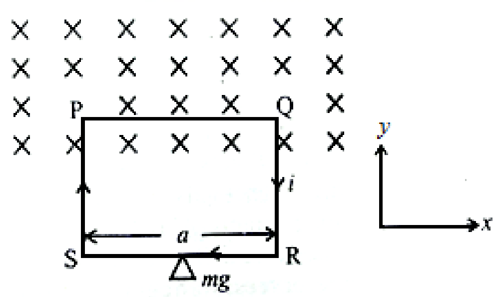
(c) 0.6T and directed into the plane of page (d) 1.2T and directed out of page

24) Currents of a 10 ampere and 2 ampere are passed through two parallel thin wires A and B respectively in opposite directions. Wire A is infinitely long and the length of the wire B is 2m. The force acting on the conductor B, which is situated at 10cm distance from A will be

(a) 8×10^{-5}N (b) 5×10^{-5}N

(c) $8\pi \times 10^{-7}$N (d) $4\pi \times 10^{-7}$N

25) A rectangular loop of wire, supporting a mass m, hangs with one end in a uniform magnetic field $\vec{B}$ pointing out of the plane of the paper. A clockwise current is set up such that $i > mg/Ba$, where a is the width of the loop. Then:



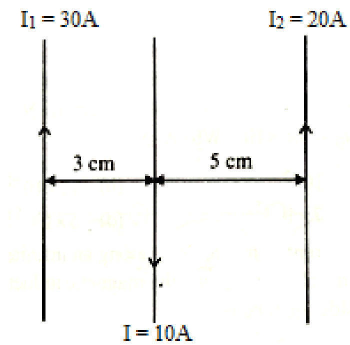
(a) The weight rises due to a vertical force caused by the magnetic field and work is done on the system.

(b) The weight do not rise due to a vertical force caused by the magnetic field and work is done on the system.

(c) The weight rises due to a vertical force caused by the magnetic field but no work is done on the system.

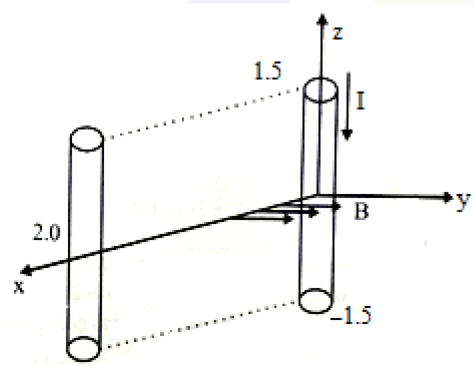
(d) The weight rises due to a vertical force caused by the magnetic field and work is extracted from the magnetic field.

26) Three straight parallel current carrying conductors are shown in the figure. The force experienced by the middle conductor of length 25cm is:



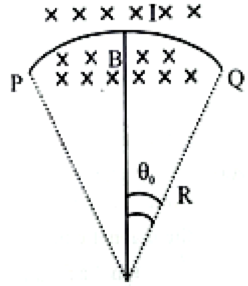
(a) 3×10^{-4}N toward right
(b) 6×10^{-4}N toward right
(c) 9×10^{-4}N toward right
(d) Zero

27) A conductor lies along the z – axis at $-1.5 \leq z < 1.5$m and carries a fixed current of 10.0A in $-\hat{a}_z$ direction (see figure). For a field $\vec{B} = 3.0 \times 10^{-4} e^{-0.2x}\, \hat{a}_y$ T, find the power required to move the conductor at constant speed to x = 2.0m, y = 0m in 5×10^{-3}s. Assume parallel motion along the x – axis.



(a) 1.57W
(b) 2.97W
(c) 14.85W
(d) 29.7W

28) A wire carrying current I is tied between points P and Q and is in the shape of a circular arc of radius R due to a uniform magnetic field B (perpendicular to the plane of the paper, shown by xxx) in the vicinity of the wire. If the wire subtends an angle $2\theta_0$ at the centre of the circle (of which it forms an arc) then the tension in the wire is:



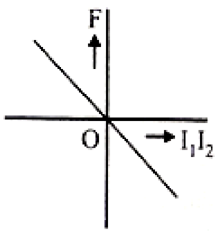
(a) $\frac{IBR}{2\sin\theta_0}$

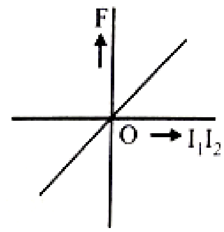
(b) $\frac{IBR\theta_0}{\sin\theta_0}$

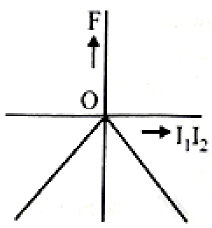
(c) IBR

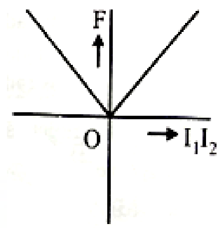
(d) $\frac{IBR}{\sin\theta_0}$

29) Two long straight parallel wires, carrying (adjustable) current I_1 and I_2, are kept at a distance d apart. If the force 'F' between the two wires is taken as 'positive' when the wires repel each other and 'negative' when the wires attract each other, the graph showing the dependence of 'F' on the product I_1I_2, would be:

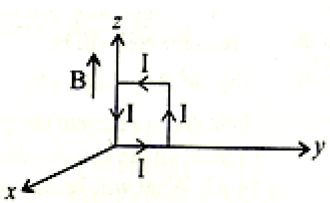
(a)


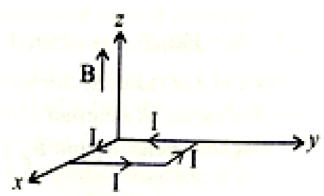
(b)


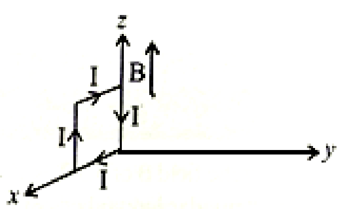
(c)


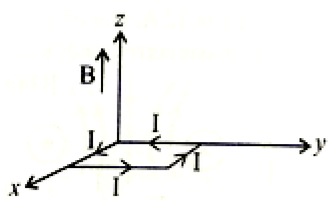
(d)


30) A rectangular loop of sides 10cm and 5cm carrying a current 1 of 12A is placed in different orientations as shown in the figures below:

(A)


(B)


(C)


(D)


If there is a uniform magnetic field of 0.3T in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium?

(a) (B) and (D), respectively

(b) (B) and (C), respectively

(c) (A) and (B), respectively

(d) (A) and (C), respectively

31) Two coaxial solenoids of different radius carry current I in the same direction. $\vec{F}_1$ be the magnetic force on the inner solenoid due to outer one and $\vec{F}_2$ be the magnetic force on the outer solenoid due to the inner one. Then:

(a) $\vec{F}_1$ is radially inwards and $\vec{F}_2 = 0$

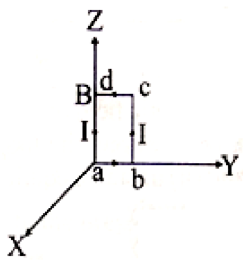
(b) $\vec{F}_1$ is radially outwards and $\vec{F}_2 = 0$

(c) $\vec{F}_1 = \vec{F}_2 = 0$

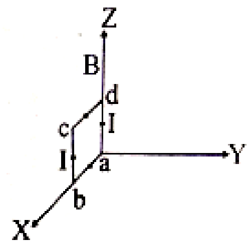
(d) $\vec{F}_1$ is radially inwards and $\vec{F}_2$ is radially outwards

32) A uniform magnetic field B of 0.3T is along the positive Z – direction. A rectangular loop (abcd) of sides 10cm × 5cm carries a current 1 of 12A. Out of the following different orientations which one corresponds to stable equilibrium?

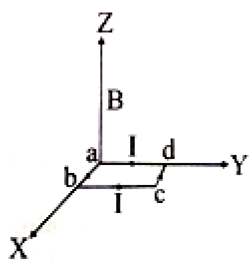
(a)



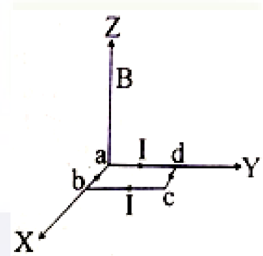
(b)



(c)



(d)



ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	a	a	d	a	b	b	d	d	b
11	12	13	14	15	16	17	18	19	20
b	c	c	a	a	c	d	c	b	a
21	22	23	24	25	26	27	28	29	30
d	a	a	a	c	a	b	c	a	a
31	32								
c	c								

Topic 67: Galvanometer and Its Conversion into Ammeter & Voltmeter

1) To convert a galvanometer into an ammeter, one needs to connect a

(a) low resistance in parallel
(b) high resistance in parallel
(c) low resistance in series
(d) high resistance in series

2) A galvanometer of resistance 20Ω gives full scale deflection with a current of 0.004A. To convert it into an ammeter of range 1A, the required shunt resistance should be

(a) 0.38 Ω
(b) 0.21 Ω
(c) 0.08 Ω
(d) 0.05 Ω

3) A galvanometer having a resistance of 8 ohms is shunted by a wire of resistance 2 ohms. If the total current is 1 amp, the part of it passing through the shunt will be

(a) 0.25amp
(b) 0.8amp
(c) 0.2amp
(d) 0.5amp

4) A galvanometer of 50ohm resistance has 25 divisions. A current of 4×10^{-4}ampere gives a deflection of one per division. To convert this galvanometer into a voltmeter having a range of 25 volts, it should be connected with a resistance of

(a) 2450Ω in series
(b) 2500Ω in series
(c) 245Ω in series
(d) 2550Ω in series

5) A galvanometer acting as a voltmeter will have

(a) a low resistance in series with its coil
(b) a high resistance in parallel with its coil
(c) a high resistance in series with its coil
(d) a low resistance in parallel with its coil

6) The resistance of an ammeter is 13Ω and its scale is graduated for a current upto 100 amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 amperes by this meter. The value of shunt – resistance is

(a) 2 Ω
(b) 0.2Ω
(c) 2kΩ
(d) 20Ω

7) A galvanometer of resistance 50Ω is connected to battery of 3V along with a resistance of 2950Ω is series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be

(a) 5050Ω
(b) 5550Ω

(c) 6050Ω (d) 4450Ω

8) A galvanometer having a coil resistance of 60Ω shows full scale deflection when a current of 1.0amp passes through it. It can be converted into an ammeter to read currents upto 5.0 amp by

(a) putting in series a resistance of 15Ω

(b) putting in series a resistance of 240Ω

(c) putting in parallel a resistance of 15Ω

(d) putting in parallel a resistance of 240Ω

9) A galvanometer has a coil of resistance 100ohm and gives a full – scale deflection for 30mA current. It is to work as a voltmeter of 30 volt range, the resistance required to be added will be

(a) 900Ω (b) 1800Ω

(c) 500Ω (d) 1000Ω

10) A galvanometer of resistance, G is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is

(a) $\frac{S^2}{(S+G)}$ (b) $\frac{SG}{(S+G)}$

(c) $\frac{G^2}{(S+G)}$ (d) $\frac{G}{(S+G)}$

11) A milli voltmeter of 25 milli volt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be:

(a) 0.001 (b) 0.01

(c) 1 (d) 0.05

12) In an ammeter 0.2% of main current passes through the galvanometer. If resistance of galvanometer is G the resistance of ammeter will be:

(a) $\frac{1}{499}$ G (b) $\frac{499}{500}$ G

(c) $\frac{1}{500}$ G (d) $\frac{500}{499}$ G

13) A circuit contains an ammeter, a battery of 30V and a resistance 40.8Ω all connected in series. If the ammeter has a coil of resistance 480Ω and a shunt of 20Ω, the reading in the ammeter will be:

(a) 0.25A (b) 2A

(c) 1A (d) 0.5A

14) A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 – divisions per milliampere and voltage sensitivity is 2 divisions per milli volt. In order that each division reads 1volt, the resistance in ohms needed to be connected in series with the coil will be-

(a) 10^5 (b) 10^3

(c) 9995 (d) 99995

15) In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be-

(a) 100Ω (b) 200Ω

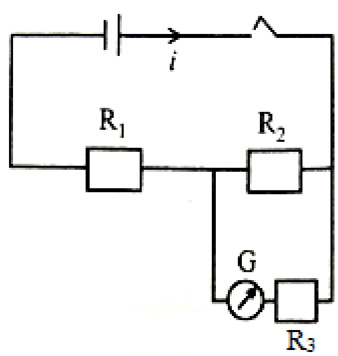
(c) 1000Ω (d) 500Ω

16) A shunt of resistance 1Ω is connected across a galvanometer of 120Ω resistance. A current of 5.5 ampere gives full scale deflection in the galvanometer. The current that will give full scale deflection in the absence of the shunt is nearly:

(a) 5.5 ampere (b) 0.5 ampere

(c) 0.004 ampere (d) 0.045 ampere

17) To find the resistance of a galvanometer by the half deflection method the following circuit is used with resistances R_1 = 9970W, R_2 = 30W and R_3 = 0. The deflection in the galvanometer is d. With R_3 = 107W the deflection changed to $\frac{d}{2}$. The galvanometer resistance is approximately:



(a) 107Ω (b) 137Ω

(c) 107/2Ω (d) 77Ω

18) This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement 1: Higher the range, greater is the resistance of ammeter.

Statement 2: To increase the range of ammeter, additional shunt needs to be used across it.

(a) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

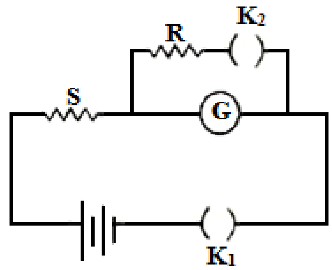
(b)Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

(c) Statement 1 is true, Statement 2 is false.

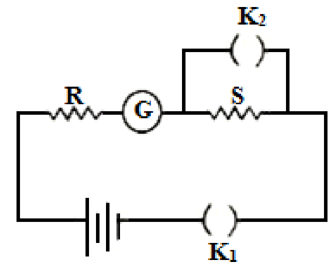
(d) Statement 1 is false, Statement 2 is true.

19) In the circuit diagram (A, B, C and D) shown below, R is a high resistance and S is a resistance of the order of galvanometer resistance G. The correct circuit, corresponding to the half deflection method for finding the resistance and figure of merit of the galvanometer, is the circuit labelled as:

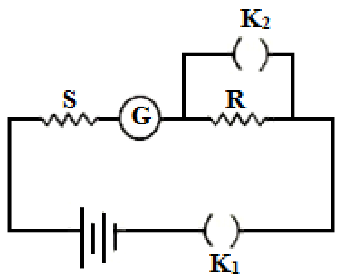
(A)



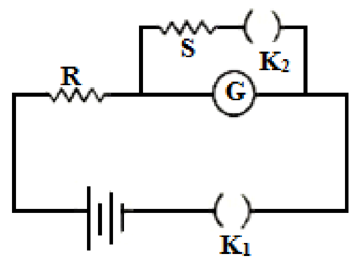
(B)



(C)



(D)



(a) Circuit A with $G = \frac{RS}{(R-S)}$

(b) Circuit B with G = S

(c) Circuit C with G = S

(d) Circuit D with $G = \frac{RS}{(R-S)}$

20) The AC voltage across a resistance can be measured using a:

(a) hot wire galvanometer

(b) moving coil galvanometer

(c) potential coil galvanometer

(d) moving magnet galvanometer

21) To know the resistance G of a galvanometer by half deflection method, a battery of emf V_E and resistance R is used to deflect the galvanometer by angle θ. If a shunt of resistance S is needed to get half deflection then G, R and S related by the equation:

(a) S (R + G) = RG

(b) 2S (R + G) = RG

(c) 2G = S

(d) 2S = G

22) A 50Ω resistance is connected to a battery of 5V. A galvanometer of resistance 100Ω is to be used as an ammeter to measure current through the resistance, for this a resistance r_s is connected to the galvanometer. Which of the following connections should be employed if the measured current is within 1% of the current without the ammeter in the circuit?

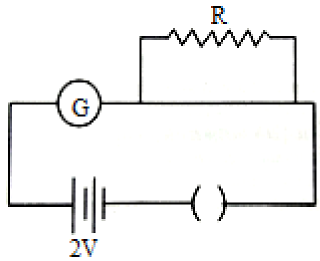
(a) r_s = 0.5Ω in series with the galvanometer

(b) r_s = 1Ω in series with galvanometer

(c) r_s = 1Ω in parallel with galvanometer

(d) r_s = 0.5Ω in parallel with the galvanometer

23) A galvanometer has a 50 divisions scale. Battery has no internal resistance. It is found that there is deflection of 40 divisions when R = 2400Ω. Deflection becomes 20 divisions when resistance taken from resistance box is 4900Ω. Then we can conclude:



(a) Current sensitivity of galvanometer is 20μA/division.

(b) Resistance of galvanometer is 200Ω.

(c) Resistance required on R.B. for a deflection of 10 divisions is 9800Ω.

(d) Incomplete Question

24) A galvanometer having a coil resistance of 100Ω gives a full scale deflection, when a current of 1mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10A, is:

(a) 0.1Ω

(b) 3Ω

(c) 0.01Ω

(d) 2Ω

25) When a current of 5mA is passed through galvanometer having a coil of resistance 15Ω, it shows full scale deflection. The value of the resistance to be put in series with the galvanometer to convert it into voltmeter of range 0 – 10V is

(a) $2.535 \times 10^3 \Omega$

(b) $4.005 \times 10^3 \Omega$

(c) $1.985 \times 10^3 \Omega$

(d) $2.045 \times 10^3 \Omega$

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
a	c	b	a	c	a	d	c	a	c
11	12	13	14	15	16	17	18	19	20
a	c	d	c	a	d	d	d	d	b
21	22	23	24	25					
a	d	d	c	c					

Topic 68: Magnetism, Gauss's Law, Magnetic Moment & Properties of Magnet

1) The work done in turning a magnet of magnetic moment M by an angle of 90° from the meridian, is n times the corresponding work done to turn it through an angle of 60°. The value of n is given by

(a) 2
(b) 1
(c) 0.5
(d) 0.25

2) A bar magnet, of magnetic moment $\vec{M}$, is placed in a magnetic field of induction $\vec{B}$. The torque exerted on it is

(a) $\vec{M}.\vec{B}$
(b) $-\vec{M}.\vec{B}$
(c) $\vec{M} \times \vec{B}$
(d) $\vec{B} \times \vec{M}$

3) Current i is flowing in a coil of area A and number of turns N, then magnetic moment of the coil, M is

(a) NiA
(b) $\frac{Ni}{A}$
(c) $\frac{Ni}{\sqrt{A}}$
(d) N^2Ai

4) A coil in the shape of an equilateral triangle of side *l* is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in the plane of the coil. If due to a current i in the triangle a torque τ acts on it, the side *l* of the triangle is

(a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B.i}\right)^{\frac{1}{2}}$
(b) $2\left(\frac{\tau}{\sqrt{3}B.i}\right)^{\frac{1}{2}}$
(d) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B.i}\right)$
(d) $\frac{1}{\sqrt{3}}\frac{\tau}{B.i}$

5) A bar magnet having a magnetic moment of $2 \times 10^4 JT^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}T$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is

(a) 12 J
(b) 6 J
(c) 2 J
(d) 0.6 J

6) A short bar magnet of magnetic moment $0.4JT^{-1}$ is placed in a uniform magnetic field of 0.16T. The magnet is in stable equilibrium when the potential energy is

(a) −0.064J
(b) zero
(c) −0.082J
(d) 0.064J

7) A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}$ J of work to turn it through 60°. The torque needed to maintain the needle in this position will be:

(a) $2\sqrt{3}$ J

(b) 3 J

(c) $\sqrt{3}$ J

(d) $\frac{3}{2}$ J

8) A bar magnet of magnetic moment M is placed at right angles to a magnetic induction B. If a force F is experienced by each pole of magnet, the length of the magnet will be

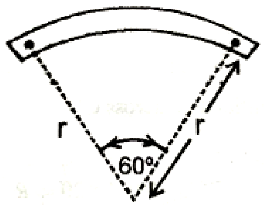
(a) F/MB

(b) MB/F

(c) BF/M

(d) MF/B

9) A bar magnet of length '*l*' and magnetic dipole moment 'M' is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be



(a) $\frac{3}{\pi}$ M

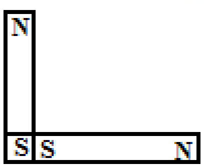
(b) $\frac{2}{\pi}$ M

(c) $\frac{M}{2}$

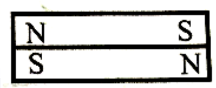
(d) M

10) Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment?

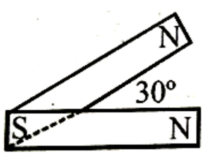
A.



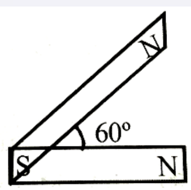
B.



C.



D.



(a) A

(b) B

(c) C

(d) D

11) The magnetic lines of force inside a bar magnet

(a) are from north – pole to south – pole of the magnet

(b) do not exist

(c) depend upon the area of cross section of the bar magnet

(d) are from south – pole to north – pole of the Magnet

12) A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque needed to maintain the needle in this position will be

(a) $\sqrt{3}$ W

(b) W

(c) $\frac{\sqrt{3}}{2}$ W

(d) 2 W

13) The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2s. The magnet is cut along its length into three equal parts and these parts are then placed on each other with their like poles together. The time period of this combination will be

(a) $2\sqrt{3}$ s

(b) $\frac{2}{3}$ s

(c) 2s

(d) $\frac{2}{\sqrt{3}}$ s

14) A magnetic needle is kept in a non – uniform magnetic field. It experiences

(a) neither a force nor a torque

(b) a torque but not a force

(c) a force but not a torque

(d) a force and a torque

15) A thin circular disc of radius R is uniformly charged with density $\sigma > 0$ per unit area. The disc rotates about its axis with a uniform angular speed ω. The magnetic moment of the disc is

(a) $\pi R^4 \sigma\omega$

(b) $\frac{\pi R^4}{2} \sigma\omega$

(c) $\frac{\pi R^4}{4} \sigma\omega$

(d) $2\pi R^4 \sigma\omega$

16) A bar magnet of length 6cm has a magnetic moment of $4 JT^{-1}$. Find the strength of magnetic field at a distance of 200cm from the center of the magnet along its equatorial line.

(a) 4×10^{-8} tesla

(b) 3.5×10^{-8} tesla

(c) 5×10^{-8} tesla

(d) 3×10^{-8} tesla

17) A 25cm long solenoid has radius 2cm and 500 total number of turns. It carries a current of 15A. If it is equivalent to a magnet of the same size and magnetization $\vec{M}$ (magnetic moment/volume), then $|\vec{M}|$ is:

(a) $30000\pi Am^{-1}$

(b) $3\pi Am^{-1}$

(c) $30000 Am^{-1}$

(d) $300 Am^{-1}$

18) A magnetic dipole is acted upon by two magnetic fields which are inclined to each other at an angle of 75°. One of the fields has a magnitude of 15mT. The dipole attains stable equilibrium at an angle of 30° with this field. The magnitude of the other field (in mT) is close to:

(a) 1

(b) 11

(c) 36

(d) 1060

19) A magnetic dipole in a constant magnetic field has:

(a) maximum potential energy when the torque is maximum.

(b) zero potential energy when the torque is minimum.

(c) zero potential energy when the torque is maximum.

(d) minimum potential energy when the torque is maximum.

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	a	b	b	a	b	b	a	c
11	12	13	14	15	16	17	18	19	
d	a	b	d	c	c	c	b	c	

Topic 69: The Earth’s Magnetism, Magnetic Materials and their Properties

1) A diamagnetic material in a magnetic field moves

(a) perpendicular to the field

(b) from stronger to the weaker parts of the field

(c) from weaker to the stronger parts of the field

(d) in none of the above directions

2) According to Curie’s law, the magnetic susceptibility of a substance at an absolute temperature T is proportional to

(a) T^2
(b) $1/T$
(c) T
(d) $1/T^2$

3) If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by μ_d, μ_p and μ_f respectively, then

(a) $\mu_d = 0$ and $\mu_p \neq 0$
(b) $\mu_d \neq 0$ and $\mu_p = 0$
(c) $\mu_p = 0$ and $\mu_f \neq 0$
(d) $\mu_d \neq 0$ and $\mu_f \neq 0$

4) Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show

(a) anti ferromagnetism
(b) no magnetic property
(c) diamagnetism
(d) paramagnetism

5) Curie temperature is the temperature above which

(a) ferromagnetic material becomes paramagnetic material

(b) paramagnetic material becomes diamagnetic material

(c) paramagnetic material becomes ferromagnetic material

(d) ferromagnetic material becomes diamagnetic material

6) If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is:

(a) repelled by the north pole and attracted by the south pole

(b) attracted by north pole and repelled by the south pole

(c) attracted by both the poles

(d) repelled by both the poles

7) The magnetic moment of a diamagnetic atom is

(a) equal to zero
(b) much greater than one
(c) 1
(d) between zero and one

8) Electromagnets are made of soft iron because soft iron has

(a) low retentivity and high coercive force

(b) high retentivity and high coercive force

(c) low retentivity and low coercive force

(d) high retentivity and low coercive force

9) There are four light – weight – rod samples A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted

(i) A is feebly repelled
(ii) B is feebly attracted
(iii) C is strongly attracted
(iv) D remains unaffected

Which one of the following is true?

(a) B is of a paramagnetic material
(b) C is of a diamagnetic material
(c) D is of a ferromagnetic material
(d) A is of a non – magnetic material

10) The magnetic susceptibility is negative for:

(a) diamagnetic material only
(b) paramagnetic material only
(c) ferromagnetic material only
(d) paramagnetic and ferromagnetic materials

11) If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by:-

(a) $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$
(b) $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$
(c) $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$
(d) $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

12) Curie temperature is the temperature above which

(a) a ferromagnetic material becomes paramagnetic

(b) a paramagnetic material becomes diamagnetic

(c) a ferromagnetic material becomes diamagnetic

(d) a paramagnetic material becomes ferromagnetic

13) A thin rectangular magnet suspended freely has a period of oscillation equal to T. Now it is broken into two equal halves (each having half of the original length) and one piece is made to oscillate freely in the same field. If its period of oscillation is T', the ratio $\frac{T'}{T}$ is

(a) $\frac{1}{2\sqrt{2}}$
(b) $\frac{1}{2}$
(c) 2
(d) $\frac{1}{4}$

14) The materials suitable for making electromagnets should have

(a) high retentivity and low coercivity

(b) low retentivity and low coercivity

(c) high retentivity and high coercivity

(d) low retentivity and high coercivity

15) Needles N_1, N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet when brought close to them will

(a) attract N_1 and N_2 strongly but repel N_3

(b) attract N_1 strongly, N_2 weakly and repel N_3 weakly

(c) attract N_1 strongly, but repel N_2 and N_3weakly

(d) attract all three of them

16) Relative permittivity and permeability of a material ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material?

(a)$\varepsilon_r = 0.5$, $\mu_r = 1.5$

(b) $\varepsilon_r = 1.5$, $\mu_r = 0.5$

(c) $\varepsilon_r = 0.5$, $\mu_r = 0.5$

(d) $\varepsilon_r = 1.5$, $\mu_r = 1.5$

17) The earth's magnetic field lines resemble that of a dipole at the centre of the earth. If the magnetic moment of this dipole is close to $8 \times 10^{22} Am^2$, the value of earth's magnetic field near the equator is close to (radius of the earth = 6.4×10^6m)

(a) 0.6 Gauss

(b) 1.2Gauss

(c) 1.8Gauss

(d) 0.32Gauss

18) The short bar magnets of length 1cm each have magnetic moments $1.20 Am^2$ and $1.00 Am^2$ respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0cm. The value of the resultant horizontal magnetic induction at the mid – point O of the joining their centers is close to (Horizontal component of earth's magnetic induction is $3.6 \times 10.5 Wb/m^2$)

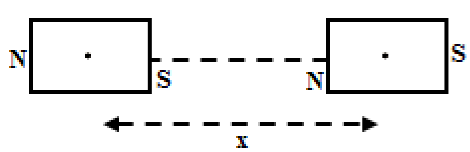
(a) $3.6 \times 10.5 Wb/m^2$

(b) $2.56 \times 10.4 Wb/m^2$

(c) $3.50 \times 10.4 Wb/m^2$

(d) $5.80 \times 10.4 Wb/m^2$

19) The mid points of two small magnetic dipoles of length d in end – on positions, are separated by a distance x, (x >> d). The force between them is proportional to x^{-n} where n is:



(a) 1

(b) 2

(c) 3

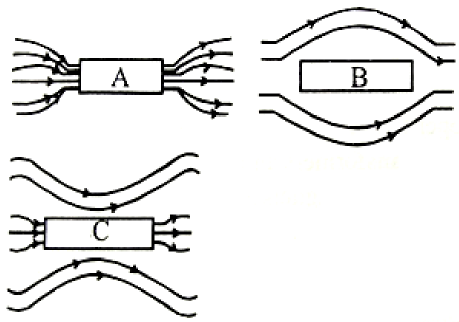
(d) 4

20) The magnetic field of earth at the equator is approximately 4×10^{-5}T. The radius of earth is 6.4×10^6m. Then the dipole of moment of the earth will be nearly of the order of:

(a) $10^{23}Am^2$ (b) $10^{20}Am^2$

(c) $10^{16}Am^2$ (d) $10^{10}Am^2$

21) Three identical bars A, B and C are made of different magnetic materials. When kept in a uniform magnetic field, the field lines around them look as follows:



Make the correspondence of these bars with their material being diamagnetic (D), ferromagnetic (F) and paramagnetic (P):

(a) A ↔ D, B ↔ P, C ↔ F (b) A ↔ F, B ↔ D, C ↔ P

(c) A ↔ P, B ↔ F, C ↔ D (d) A ↔ F, B ↔ P, C ↔ D

22) An example of a perfect diamagnet is a superconductor. This implies that when a superconductor is put in a magnetic field of intensity B, the magnetic field B_S inside the superconductor will be such that:

(a) $B_S = -B$ (b) $B_S = 0$

(c) $B_S = B$ (d) $B_S < B$ but $B_S \neq 0$

23) The coercivity of a small magnet where the ferromagnet gets demagnetized is $3 \times 10^3 Am^{-1}$. The current required to be passed in a solenoid of length 10cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is:

(a) 30mA (b) 60mA

(c) 3A (d) 6A

24) A short bar magnet is placed in the magnetic meridian of the earth with north pole pointing north. Neutral points are found at a distance of 30cm from the magnet on the East – West line, drawn through the middle point of the magnet. The magnetic moment of the magnet in Am^2 is close to: (Given $\frac{\mu_0}{4\pi} = 10^{-7}$ in SI units and B_H = Horizontal component of earth's magnetic field = 3.6×10^{-5}tesla)

(a) 14.6 (b) 19.4

(c) 9.7 (d) 4.9

25) A fighter plane of length 20m, wing span (distance from tip of one wing to the tip of the other wing) of 15m and height 5m is lying towards east over Delhi. Its speed is $240ms^{-1}$. The earth's magnetic field over Delhi is $5\times 10^{-5}T$ with the declination angle ~0° and dip of θ such that $\sin\theta = \frac{2}{3}$. If the voltage developed is V_B between the lower and upper side of the plane and V_W between the tips of the wings then V_B and V_W are close to:

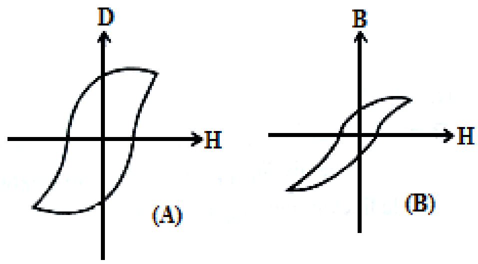
(a) V_B = 40mV; V_W = 135mV with left side of pilot at higher voltage

(b) V_B = 45mV; V_W = 120mV with right side of pilot at higher voltage

(c) V_B = 40mV; V_W = 135mV with right side of pilot at higher voltage

(d) V_B = 45mV; V_W = 120mV with left side of pilot at higher voltage

26) Hysteresis loops for two magnetic materials A and B are given below:



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use:

(a) A for transformers and B for electric generators.

(b) B for electromagnets and A for transformers.

(c) A for electric generators and transformers.

(d) A for electromagnets and B for electric generators.

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	b	a	d	a	d	a	d	a	a
11	12	13	14	15	16	17	18	19	20
d	a	b	b	b	b	a	b	d	a
21	22	23	24	25	26				
b	b	c	c	d	b				

Topic 70: Magnetic Equipments

1) A bar magnet is oscillating in the earth's magnetic field with a period T. What happens to its period of motion, if its mass is quadrupled

(a) motion remains simple harmonic with new period = T/2

(b) motion remains simple harmonic with new period = 2T

(c) motion remains simple harmonic with new period = 4T

(d) motion remains simple harmonic and the period stays nearly constant

2) For protecting a sensitive equipment from the external electric arc, it should be

(a) wrapped with insulation around it when a current is passing through it

(b) placed inside an iron can

(c) surrounded with fine copper sheet

(d) placed inside an aluminum can

3) Two magnets of magnetic moments M and 2M are placed in a vibration magnetometer, with the identical poles in the same direction. The time period of vibration is T_1. If the magnets are placed with opposite poles together and vibrate with time period T_2, then

(a) T_2 is infinite

(b) $T_2 = T_1$

(c) $T_2 > T_1$

(d) $T_2 < T_1$

4) A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

(a) 1s

(b) 2s

(c) 3s

(d) 4s

5) A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It:

(a) will become rigid showing no movement

(b) will stay in any position

(c) will stay in north – south direction only

(d) will stay in east – west direction only

6) A magnetic needle of magnetic moment $6.7 \times 10^{-2} Am^2$ and moment of inertia $7.5 \times 10^{-6} kgm^2$ is performing simple harmonic oscillations in a magnetic field of 0.01T. Time taken for 10 complete oscillations is:

(a) 6.98s

(b) 8.76s

(c) 6.65s

(d) 8.89s

ANSWER KEY					
1	2	3	4	5	6
b	b	c	d	b	c

Topic 71: Magnetic Flux, Faraday's & Lenz's Law

1) In the circuit of Fig, the bulb will become suddenly bright if

(a) contact is made or broken
(b) contact is made
(c) contact is broken
(d) won't become bright at all

2) A magnetic field of 2×10^{-2}T acts at right angles to a coil of area $100cm^2$, with 50 turns. The average e.m.f induced in the coil is 0.1V, when it is removed from the field in t sec. The value of t is

(a) 10 s
(b) 0.1 s
(c) 0.01 s
(d) 1 s

3) The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by

(a) $Q = R \cdot \frac{\Delta\phi}{\Delta t}$
(b) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$
(c) $Q = \frac{\Delta\phi}{R}$
(d) $Q = \frac{\Delta\phi}{\Delta t}$

4) As a result of change in the magnetic flux linked to the closed loop shown in the Fig,

an e.m.f V volt is induced in the loop. The work done (joules) in taking a charge Q coulomb once along the loop is

(a) QV
(b) 2QV
(c) QV/2
(d) Zero

5) A circular disc of radius 0.2 meter is placed in a uniform magnetic field of induction $\frac{1}{\pi}$ (Wb/m^2) in such a way that its axis makes an angle of 60° with $\vec{B}$. The magnetic flux linked with the disc is:

(a) 0.02Wb
(b) 0.06Wb
(c) 0.08Wb
(d) 0.01Wb

6) A conducting circular loop is placed in a uniform magnetic field of 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2mm/s. The induced emf in the loop when the radius is 2cm

(a) 4.8πμV

(b) 0.8πμV

(c) 1.6πμV

(d) 3.2πμV

7) A rectangular, a square, a circular and an elliptical loop, all in the (x – y) plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{V} = v\hat{i}$. The magnetic field is directed along the negative z axis direction. The induced emf during the passage of these loops, out of the field region, will not remain constant for

(a) the circular and the elliptical loops

(b) only the elliptical loop

(c) any of the four loops

(d) the rectangular, circular and elliptical loops

8) A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop.

The radius of the loop is made to shrink at a constant rate of $1 mms^{-1}$. The induced e.m.f when the radius is 2cm, is

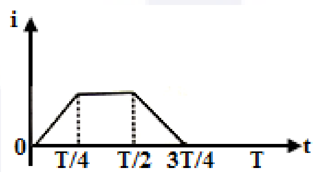
(a) 2πμV

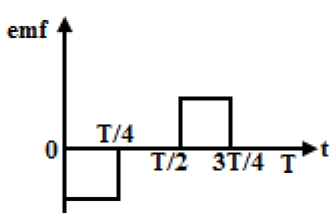
(b) πμV

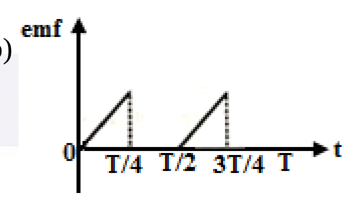
(c) $\frac{\pi}{2}$ μV

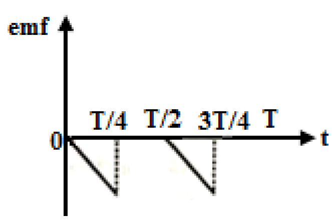
(d) 2μV

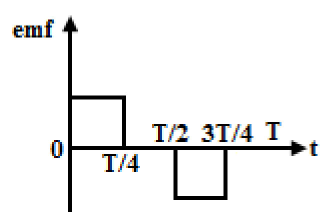
9) The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be



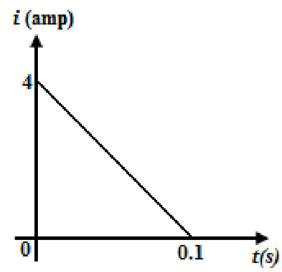
(a)


(b)


(c)


(d)


10) In a coil of resistance 10Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is:



(a) 8
(b) 2
(c) 6
(d) 4

11) A coil of resistance 400Ω is placed in a magnetic field. If the magnetic flux ϕ (wb) linked with the coil varies with time t (sec) as $\phi = 50t^2 + 4$. The current in the coil at t = 2 sec is:

(a) 0.5A
(b) 0.1A
(c) 2A
(d) 1A

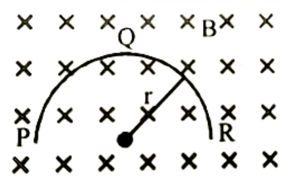
12) A current of 2.5A flows through a coil of inductance 5H. The magnetic flux linked with the coil is

(a) 2Wb
(b) 0.5Wb
(c) 12.5Wb
(d) Zero

13) A wire loop is rotated in a magnetic field. The frequency of change of direction of the induced e.m.f is

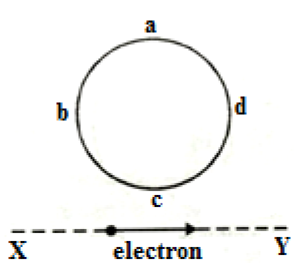
(a) twice per revolution
(b) four times per revolution
(c) six times per revolution
(d) once per revolution

14) A thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B, as shown in figure. The potential difference developed across the ring when its speed is v, is:



(a) Zero
(b) $Bv\pi r^2/2$ and P is at higher potential
(c) πrBv and R is at higher potential
(d) 2rBv and R is at higher potential

15) An electron moves on a straight line path XY as shown. The abcd is a coil adjacent to the path of electron. What will be the direction of current if any, induced in the coil?



(a) adcb

(b) The current will reverse its direction as the electron goes past the coil

(c) No current induced

(d) abcd

16) A long solenoid of diameter 0.1m has 2×10^4 turns per meter. At the center of the solenoid, a coil of 100 turns and radius 0.01m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4A in 0.05s. If the resistance of the coil is $10\pi^2\ \Omega$. The total charge flowing through the coil during this time is:-

(a) 16μC (b) 32μC

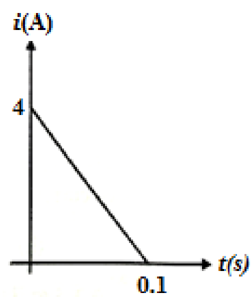
(c) 16πμC (d) 32πμC

17) The flux linked with a coil at any instant 't' is given by $\phi = 10t^2 - 50t + 250$. The induced emf at t = 3s is

(a) –190V (b) –10V

(c) 10V (d) 190V

18) Magnetic flux through a coil of resistance 10Ω is changed by Δϕ in 0.1s. The resulting current in the coil varies with time as shown in the figure. The |Δϕ| is equal to (in weber)



(a) 6 (b) 4

(c) 2 (d) 8

19) A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; It is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to:

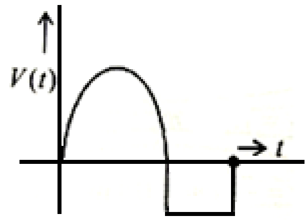
(a) development of air current when the plate is placed

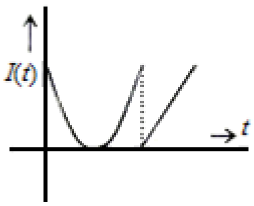
(b) induction of electrical charge on the plate

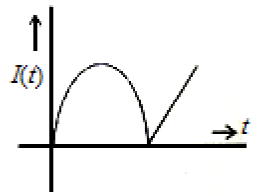
(c) shielding of magnetic lines of force as aluminium is a paramagnetic material.

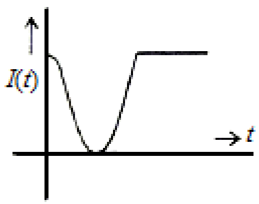
(d) electromagnetic induction in the aluminium plate giving rise to electromagnetic damping.

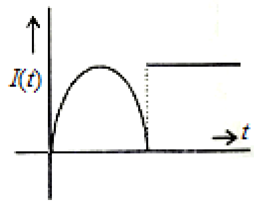
20) Two coils, X and Y, are kept in close vicinity of each other. When a varying current, I(t), flows through coil X, the induced emf (V(t)) in coil Y, varies in the manner shown here. The variation of I(t), with time, can then be represented by the graph labelled as graph:



(A) 

(B) 

(C) 

(D) 

(a) A
(b) C
(c) B
(d) D

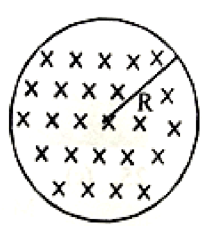
21) A circular loop of radius 0.3cm lies parallel to a much bigger circular loop of radius 20cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centers is 15cm. If a current of 2.0A flows through the smaller loop, then the flux linked with bigger loop is

(a) 9.1×10^{-11}weber
(b) 6×10^{-11}weber
(c) 3.3×10^{-11}weber
(d) 6.6×10^{-9}weber

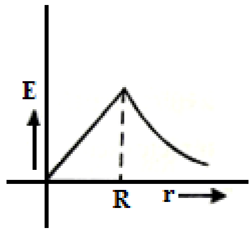
22) A coil of circular cross – section having 1000 turns and $4cm^2$ face area is placed with its parallel to a magnetic field which decreases by 10^{-2}Wb m^{-2} in 0.01s. The e.m.f. induced in the coil is:

(a) 400mV
(b) 200mV
(c) 4mV
(d) 0.4mV

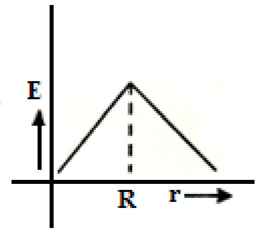
23) Figure shows a circular area of radius R where a uniform magnetic field $\vec{B}$ is going into the plane of paper and increasing in magnitude at a constant rate. In that case which of the following graphs, drawn schematically, correctly shows the variation of the induced electric field E(r)?



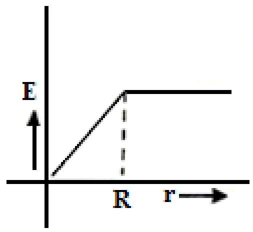
(a)



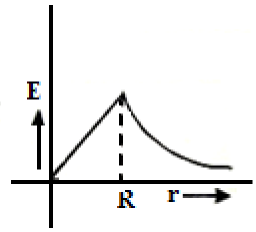
(b)



(c)



(d)



24) When the current in a coil changes from 5A to 2A in 0.1s, average voltage of 50V is produced. The self – inductance, of the coil is:

(a) 6H

(b) 0.67H

(c) 3H

(d) 1.67H

25) A conducting metal circular – wire – loop of radius r is placed perpendicular to a magnetic field which varies with time as $B = B_0 e^{-t/\tau}$, where B_0 and τ are constants, at time t = 0. If the resistance of the loop is R then the heat generated in the loop after a long time ($t \rightarrow \infty$) is;

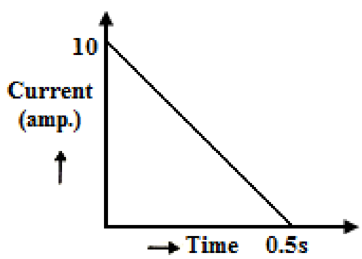
(a) $\frac{\pi^2 r^4 B_0^4}{2\tau R}$

(b) $\frac{\pi^2 r^4 B_0^2}{2\tau R}$

(c) $\frac{\pi^2 r^4 B_0^2 R}{\tau}$

(d) $\frac{\pi^2 r^4 B_0^2}{\tau R}$

26) In a coil of resistance 100Ω, a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is



(a) 250Wb

(b) 275Wb

(c) 200Wb

(d) 225Wb

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	b	c	a	a	d	a	b	a	b
11	12	13	14	15	16	17	18	19	20
a	c	a	d	b	b	b	c	d	a
21	22	23	24	25	26				
a	a	a	d	b	a				

Topic 72: Motional and Static EMI & Applications of EMI

1) The current in self inductance L = 40mH is to be increased uniformly from 1amp to 11amp in 4milliseconds. The e.m.f induced in the inductor during the process is

(a) 100 volt
(b) 0.4 volt
(c) 4.0 volt
(d) 440 volt

2) The total charge induced in a conducting loop when it is moved in a magnetic field depends on

(a) the rate of change of magnetic flux
(b) initial magnetic flux only
(c) the total change in magnetic flux
(d) final magnetic flux only

3) An inductor may store energy in

(a) its electric field
(b) its coil
(c) its magnetic field
(d) both in electric and magnetic fields

4) If the number of turns per unit length of a coil of solenoid is doubled, the self – inductance of the solenoid will

(a) remain unchanged
(b) be halved
(c) be doubled
(d) become four times

5) A 100 millihenry coil carries a current of 1A. Energy stored in its magnetic field is

(a) 0.5J
(b) 1A
(c) 0.05J
(d) 0.1J

6) The total charge induced in a conducting loop when it is moved in a magnetic field depend on

(a) the rate of change of magnetic flux
(b) initial magnetic flux only
(c) the total change in magnetic flux
(d) final magnetic flux only

7) A rectangular coil of 20 turns and area of cross – section 25sq. cm has a resistance of 100Ω. If a magnetic field which is perpendicular to the plane of coil changes at a rate of 1000tesla per second, the current in the coil is

(a) 1A
(b) 50A
(c) 0.5A
(d) 5A

8) If N is the number of turns in a coil, the value of self inductance varies as

(a) N^0
(b) N
(c) N^2
(d) N^{-2}

9) What is the self – inductance of a coil which produces 5V when the current changes from 3 ampere to 2 ampere in one millisecond?

(a) 5000 henry
(b) 5 milli – henry
(c) 50 henry
(d) 5 henry

10) A varying current in a coil changes from 10A to zero in 0.5sec. If the average e.m.f induced in the coil is 220V, the self – inductance of the coil is

(a) 5 H
(b) 6 H
(c) 11 H
(d) 12 H

11) A conductor of length 0.4m is moving with a speed of 7m/s perpendicular to a magnetic field of intensity 0.9 Wb/m^2. The induced e.m.f. across the conductor is

(a) 1.26V
(b) 2.52V
(c) 5.04V
(d) 25.2V

12) Two coils have a mutual inductance 0.005 H. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where I_0 = 10A and $\omega = 100\pi$ radian/sec. The maximum value of e.m.f. in the second coil is

(a) 2π
(b) 5π
(c) π
(d) 4π

13) In an inductor of self – inductance L = 2mH, current changes with time according to relation $i = t^2e^{-t}$. At what time emf is zero?

(a) 4s
(b) 3s
(c) 2s
(d) 1s

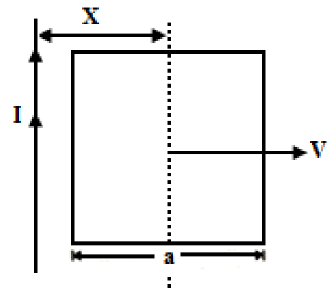
14) Two coils of self – inductances 2mH and 8mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is

(a) 6mH
(b) 4mH
(c) 16mH
(d) 10mH

15) A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4×10^{-3}Wb. The self – inductance of the solenoid is

(a) 2.5 henry
(b) 2.0 henry
(c) 1.0 henry
(d) 40 henry

16) A conducting square frame of side ‘a’ and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity ‘V’. The emf induced in the frame will be proportional to



(a) $\frac{1}{(2x-a)^2}$

(b) $\frac{1}{(2x+a)^2}$

(c) $\frac{1}{(2x-a)(2x+a)}$

(d) $\frac{1}{x^2}$

17) A long solenoid has 1000 turns. When a current of 4A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3}Wb. The self inductance of the solenoid is:

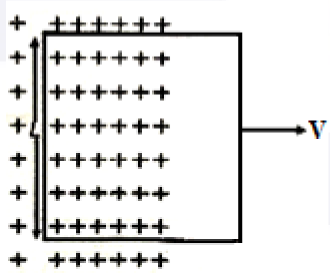
(a) 4H

(b) 3H

(c) 2H

(d) 1H

18) A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced emf is



(a) zero

(b) RvB

(c) vBL/R

(d) vBL

19) When the current changes from +2A to −2A in 0.05 second, an e.m.f. of 8V is induced in a coil. The coefficient of self – induction of the coil is

(a) 0.2H

(b) 0.4H

(c) 0.8H

(d) 0.1H

20) Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

(a) the rates at which currents are changing in the two coils

(b) relative position and orientation of the two coils

(c) the materials of the wires of the coils

(d) the currents in the two coils

21) A coil having n turns and resistance RΩ is connected with a galvanometer of resistance 4RΩ. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

(a) $-\frac{(W_2-W_1)}{Rnt}$

(b) $-\frac{n(W_2-W_1)}{5Rt}$

(c) $-\frac{(W_2-W_1)}{5Rnt}$

(d) $-\frac{n(W_2-W_1)}{Rt}$

22) A metal conductor of length 1m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.2×10^{-4}T, then the e.m.f. developed between the two ends of the conductor is

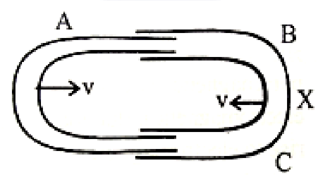
(a) 5mV

(b) 50μV

(c) 5μV

(d) 50mV

23) One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v, then the emf induced in the circuit in terms of B, *l* and v where *l* is the width of each tube, will be



(a) $-Blv$

(b) Blv

(c) $2Blv$

(d) zero

24) Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross – sectional area A = 10cm^2 and length = 20cm. If one of the solenoid has 300 turns and the other 400 turns, their mutual inductance is ($\mu_0 = 4\pi\times 10^{-7}$TmA^{-1})

(a) $2.4\pi\times 10^{-5}$H

(b) $4.8\pi\times 10^{-4}$H

(c) $4.8\pi\times 10^{-5}$H

(d) $2.4\pi\times 10^{-4}$H

25) A rectangular loop has a sliding connector PQ of length *l* and resistance RΩ and it is moving with a speed v as shown. The set – up is placed in a uniform magnetic field going into the plane of the paper. The three currents I_1, I_2 and I are

(a) $I_1 = -I_2 = \frac{Blv}{6R}$, $I = \frac{2Blv}{6R}$

(b) $I_1 = I_2 = \frac{Blv}{3R}$, $I = \frac{2Blv}{3R}$

(c) $I_1 = I_2 = I = \frac{Blv}{R}$

(d) $I_1 = I_2 = \frac{Blv}{6R}, I = \frac{Blv}{3R}$

26) A horizontal straight wire 20m long extending from east to west falling with a speed of 5.0m/s, at right angles to the horizontal component of the earth's magnetic field 0.30×10^{-4} Wb/m^2. The instantaneous value of the e.m.f. induced in the wire will be

(a) 3mV

(b) 4.5mV

(c) 1.5mV

(d) 6.0mV

27) A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5}NA^{-1}m^{-1} due north and horizontal. The boat carries a vertical aerial 2m long. If the speed of the boat is 1.50ms^{-1}, the magnitude of the induced emf in the wire of aerial is:

(a) 0.75mV

(b) 0.50mV

(c) 0.15mV

(d) 1mV

28) This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement 1: Self inductance of a long solenoid of length L, total number of turns N and radius r is less than $\frac{\pi\mu_0 N^2 r^2}{L}$.

Statement 2: The magnetic induction in the solenoid in Statement 1 carrying I is $\frac{\mu_0 NI}{L}$ in the middle of the solenoid but becomes less as we move towards its ends.

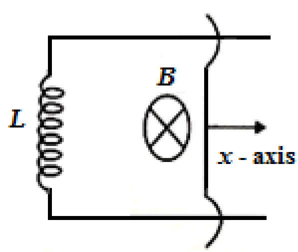
(a) Statement 1 is true, Statement 2 is false

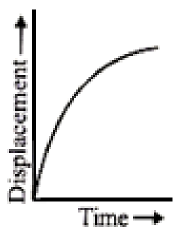
(b)Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

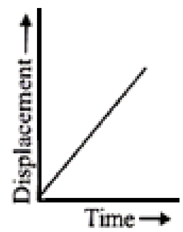
(c) Statement 1 is false, Statement 2 is true.

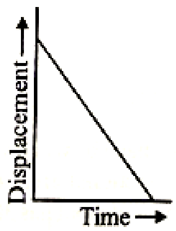
(d) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

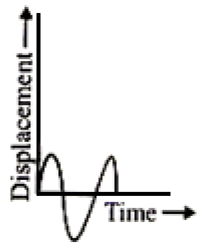
29) A coil of self inductance L is connected at one end of two rails as shown in figure. A connector of length *l*, mass *m* can slide freely over the two parallel rails. The entire set up is placed in a magnetic field of induction B going into the page. At an instant t = 0 an initial velocity v_0 is imparted to it and as a result of that it starts moving along x – axis. The displacement of the connector is represented by the figure.



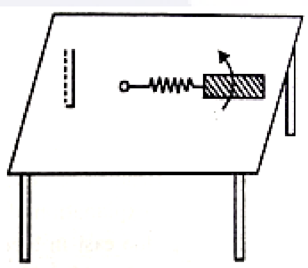
(a) 

(b) 

(c) 

(d) 

30) A metallic rod of length '*l*' is tied to a string of length 2*l* and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is



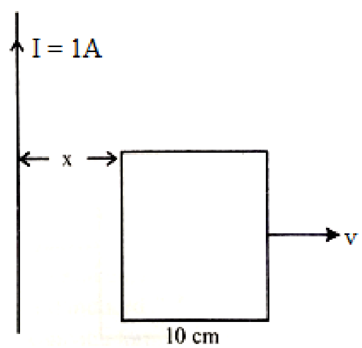
(a) $\frac{2B\omega l^2}{2}$

(b) $\frac{3B\omega l^2}{2}$

(c) $\frac{4B\omega l^2}{2}$

(d) $\frac{5B\omega l^2}{2}$

31) A square frame of side 10cm and a long straight wire carrying current 1A are in the plate of the paper. Starting from close to the wire, the frame moves towards the right with a constant speed of $10ms^{-1}$ (see figure).



The e.m.f. induced at the time the left arm of the frame is at x = 10cm from the wire is:

(a) 2μV

(b) 1μV

(c) 0.75μV (d) 0.5μV

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	c	d	c	c	c	c	b	c
11	12	13	14	15	16	17	18	19	20
b	b	c	b	c	c	d	d	d	b
21	22	23	24	25	26	27	28	29	30
b	b	c	d	b	a	c	b	d	d
31									
b									

Topic 73: Alternating Current, Voltage & Power

1) In a region of uniform magnetic induction $B = 10^{-2}$ tesla, a circular coil of radius 30cm and resistance π^2 ohm is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil. If the coil rotates at 200 rpm the amplitude of the alternating current induced in the coil is

(a) $4\pi^2$mA (b) 30mA

(c) 6mA (d) 200mA

2) In an a.c circuit, the r.m.s value of current, i_{rms} is related to the peak current, i_0 by the relation

(a) $I_{rms} = \sqrt{2}\, I_0$ (b) $I_{rms} = \pi\, I_0$

(c) $I_{rms} = \frac{1}{\pi} I_0$ (d) $I_{rms} = \frac{1}{\sqrt{2}} I_0$

3) In an A.C. circuit with voltage V and current I the power dissipated is

(a) dependent on the phase between V and I (b) $\frac{1}{\sqrt{2}}$ VI

(c) $\frac{1}{2}$ VI (d) VI

4) In an a.c. circuit the e.m.f (e) and the current (i) at any instant are given respectively by

$e = E_0 \sin \omega t$

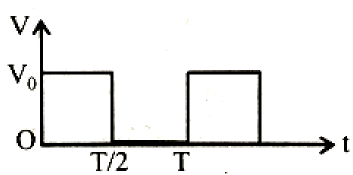
$i = I_0 \sin (\omega t - \phi)$

The average power in the circuit over one cycle of a.c. is

(a) $\frac{E_0 I_0}{2}$ (b) $\frac{E_0 I_0}{2} \sin \phi$

(c) $\frac{E_0 I_0}{2} \cos \phi$ (d) $E_0 I_0$

5) The r.m.s value of potential difference V shown in the figure is



(a) V_0 (b) $V_0/\sqrt{2}$

(c) $V_0/2$ (d) $V_0/\sqrt{3}$

6) In an ac circuit an alternating voltage $e = 200\sqrt{2} \sin 100t$ volts is connected to a capacitor of capacity 1μF. The r.m.s value of the current in the circuit is

(a) 10mA (b) 100mA

(c) 200mA (d) 20mA

7) The instantaneous values of alternating current and voltages in a circuit are given as

i = $\frac{1}{\sqrt{2}}$ sin (100πt) amper

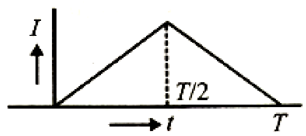
e = $\frac{1}{\sqrt{2}}$ sin (100πt + π/3) Volt

The average power in Watts consumed in the circuit is:

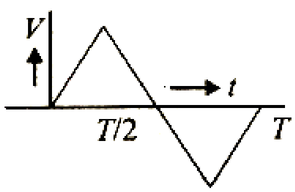
(a) $\frac{1}{4}$ (b) $\frac{\sqrt{3}}{4}$

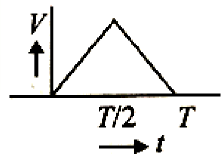
(c) $\frac{1}{2}$ (d) $\frac{1}{8}$

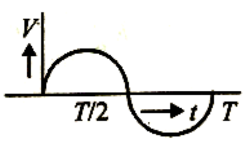
8) The current (I) in the inductance is varying with time according to the plot shown in figure.

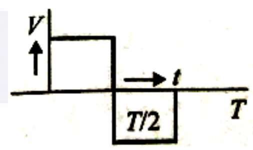


Which one of the following is the correct variation with time in the coil?

(a)


(b)


(c)


(d)


9) A small signal voltage V(t) = V_0 sin ωt is applied across an ideal capacitor C:

(a) Current I(t), lags voltage V(t) by 90°.

(b) Over a full cycle the capacitor C does not consume any energy from the voltage source.

(c) Current I(t) is in phase with voltage V(t).

(d) Current I(t) leads voltage V(t) by 180°.

10) Alternating current can not be measured by D.C. ammeter because

(a) Average value of current for complete cycle is zero

(b) A.C. Changes direction

(c) A.C. can not pass through D.C. Ammeter

(d) D.C. Ammeter will get damaged

11) In a uniform magnetic field of induction B a wire in the form of a semicircle of radius r rotates about the diameter of the circle with an angular frequency ω. The axis of rotation is perpendicular to the field. If the total resistance of the circuit is R, the mean power generated per period of rotation is

(a) $\frac{(B\pi r\omega)^2}{2R}$

(b) $\frac{(B\pi r^2\omega)^2}{8R}$

(c) $\frac{B\pi r^2\omega}{2R}$

(d) $\frac{(B\pi r\omega^2)^2}{8R}$

12) In an a.c. circuit the voltage applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$. The power consumption in the circuit is given by

(a) $P = \sqrt{2}\, E_0 I_0$

(b) $P = \frac{E_0 I_0}{\sqrt{2}}$

(c) P = zero

(d) $P = \frac{E_0 I_0}{2}$

13) A sinusoidal voltage V(t) = 100 sin (500t) is applied across a pure inductance of L = 0.02H. The current through the coil is:

(a) 10 cos (500t)

(b) −10 cos (500t)

(c) 10 sin (500t)

(d) −10 sin (500t)

14) A small circular loop of wire of radius a is located at the centre of a much larger circular wire loop of radius b. The two loops are in the same plane. The outer loop of radius b carries an alternating current $I = I_0 \cos(\omega t)$. The emf induced in the smaller inner loop is nearly:

(a) $\frac{\pi\mu_0 I_0}{2}\frac{a^2}{b}\,\omega \sin(\omega t)$

(b) $\frac{\pi\mu_0 I_0}{2}\frac{a^2}{b}\,\omega \cos(\omega t)$

(c) $\pi\mu_0 I_0 \frac{a^2}{b}\,\omega \sin(\omega t)$

(d) $\frac{\pi\mu_0 I_0 b^2}{a}\,\omega \cos(\omega t)$

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
c	d	a	c	b	d	d	d	b	a
11	12	13	14						
b	c	b	a						

Topic 74: A.C. Circuit, LCR Circuit, Quality & Power Factor

1) The time constant of C – R circuit is

(a) 1/CR
(b) C/R
(c) CR
(d) R/C

2) An LCR series circuit is connected to a source of alternating current. At resonance, the applied voltage and the current flowing through the circuit will have a phase difference of

(a) π
(b) $\frac{\pi}{2}$
(c) $\frac{\pi}{4}$
(d) 0

3) In an experiment, 200 V A.C. is applied at the ends of an LCR circuit. The circuit consists of an inductive reactance (X_L) = 50Ω, capacitive reactance (X_C) = 50Ω and ohmic resistance (R) = 10Ω. The impedance of the circuit is

(a) 10Ω
(b) 20Ω
(c) 30Ω
(d) 40Ω

4) An inductance L having a resistance R is connected to an alternating source of angular frequency ω. The quality factor Q of the inductance is

(a) $\frac{R}{\omega L}$
(b) $\left(\frac{\omega L}{R}\right)^2$
(c) $\left(\frac{R}{\omega L}\right)^{1/2}$
(d) $\frac{\omega L}{R}$

5) A capacitor has capacity C and reactance X. If capacitance and frequency become double, then reactance will be

(a) 4X
(b) X/2
(c) X/4
(d) 2X

6) In a series resonant circuit, having L, C and R as its elements, the resonant current is i. The power dissipated in the circuit at resonance is

(a) $\frac{i^2 R}{\left(\omega L - \frac{1}{\omega C}\right)}$
(b) zero
(c) $i^2 \omega L$
(d) $i^2 R$

where ω is the angular resonance frequency.

7) A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is

(a) 20 seconds
(b) 5 seconds
(c) 1/5 seconds
(d) 40 seconds

8) In a circuit, L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is

(a) $\frac{1}{\pi f\,(2\pi f L - R)}$
(b) $\frac{1}{2\pi f\,(2\pi f L - R)}$
(c) $\frac{1}{\pi f\,(2\pi f L + R)}$
(d) $\frac{1}{2\pi f\,(2\pi f L + R)}$

9) A coil of inductive reactance 31Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitative reactance 25Ω. The combination is connected to an a.c. source of 110 volt. The power factor of the circuit is

(a) 0.64
(b) 0.80
(c) 0.33
(d) 0.56

10) What is the value of inductance L for which the current is maximum in a series LCR circuit with C = 10μF and ω = 1000s^{-1}?

(a) 1mH
(b) cannot be calculated unless R is known
(c) 10mH
(d) 100mH

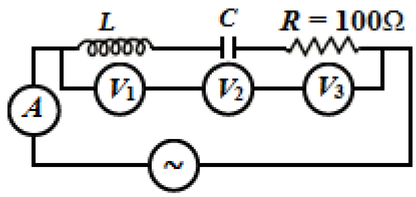
11) Power dissipated in an LCR series circuit connected to an a.c. source of emf ε is

(a) $\frac{\varepsilon^2\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}{R}$
(b) $\frac{\varepsilon^2\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}{R}$
(c) $\frac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}$
(d) $\frac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$

12) A condenser of capacity C is charged to a potential difference of V_1.The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to V_2 is

(a) $\left(\frac{C(V_1^2 - V_2^2)}{L}\right)^{1/2}$
(b) $\left(\frac{C\,(V_1 - V_2)^2}{L}\right)^{1/2}$
(c) $\frac{C(V_1^2 - V_2^2)}{L}$
(d) $\frac{C\,(V_1 - V_2)}{L}$

13) In the given circuit the reading of voltmeter V_1 and V_2 are 300 volts each. The reading of the voltmeter V_3 and ammeter A are respectively



(a) 150V, 2.2A

(b) 220V, 2.2A

(c) 220V, 2.0A

(d) 100V, 2.0A

14) A coil has resistance 30 ohm and inductive reactance 20ohm at 50Hz frequency. If an ac source, of 200 volt, 100Hz, is connected across the coil, the current in the coil will be

(a) 4.0A

(b) 8.0A

(c) $\frac{20}{\sqrt{13}}$ A

(d) 2.0A

15) An ac voltage is applied to a resistance R and an inductor L in series. If R and the inductive reactance are both equal to 3Ω, the phase difference between the applied voltage and the current in the circuit is

(a) $\pi/6$

(b) $\pi/4$

(c) $\pi/2$

(d) zero

16) In an electrical circuit R, L, C and an a.c. voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is

(a) $1/2$

(b) $1/\sqrt{2}$

(c) 1

(d) $\sqrt{3}/2$

17) A coil of self – inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when

(a) number of turns in the coil is reduced

(b) a capacitance of reactance $X_C = X_L$ is included in the same circuit

(c) an iron rod is inserted in the coil

(d) frequency of the AC source is decreased

18) A series R – C circuit is connected to an alternating voltage source. Consider two situations:

(A) When capacitor is air filled.

(B) When capacitor is mica filled.

Current through resistor is i and voltage across capacitor is V then:

(a) $V_a > V_b$

(b) $i_a > i_b$

(c) $V_a = V_b$

(d) $V_a < V_b$

19) A resistance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be

(a) $P\sqrt{\frac{R}{Z}}$

(b) $P\left(\frac{R}{Z}\right)$

(c) P

(d) $P\left(\frac{R}{Z}\right)^2$

20) An inductor 20mH, a capacitor 50μF and a resistor 40Ω are connected in series across a source of emf V = 10 sin 340 t. The power loss in A.C. circuit is:

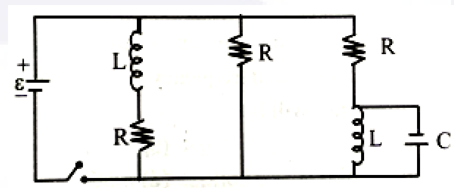
(a) 0.51 W

(b) 0.67 W

(c) 0.76 W

(d) 0.89 W

21) Figure shows a circuit that contains three identical resistors with resistance R = 9.0Ω each, two identical inductors with inductance L = 2.0mH each, and an ideal battery with emf ε = 18 V. The current 'i' through the battery just after the switch closed is



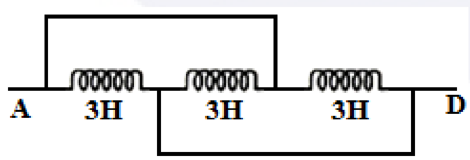
(a) 0.2A

(b) 2A

(c) 0

(d) 2mA

22) The inductance between A and D is



(a) 3.66H

(b) 9H

(c) 0.66H

(d) 1H

23) The power factor of an AC circuit having resistance (R) and inductance (L) connected in series and an angular velocity ω is

(a) R/ωL

(b) $R/(R^2 + \omega^2L^2)^{1/2}$

(c) ωL/R

(d) $R/(R^2-\omega^2L^2)^{1/2}$

24) In a LCR circuit capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to

(a) L/2

(b) 2L

(c) 4L

(d) L/4

25) In a LCR series a.c. circuit, the voltage across each of the components, L, C and R is 50V. The voltage across the LC combination will be

(a) 100V
(b) $50\sqrt{2}$V
(c) 50V
(d) 0V (zero)

26) The self inductance of the motor of an electric fan is 10H. In order to impart maximum power at 50Hz, it should be connected to a capacitance of

(a) 8μF
(b) 4μF
(c) 2μF
(d) 1μF

27) A coil of inductance 300mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in

(a) 0.1s
(b) 0.05s
(c) 0.3s
(d) 0.15s

28) A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be

(a) 0.4
(b) 0.8
(c) 0.125
(d) 1.25

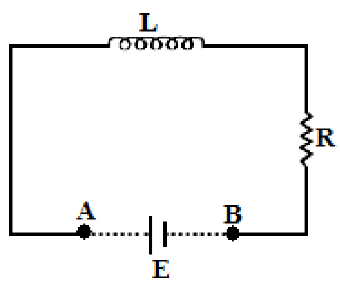
29) The phase difference between the alternating current and emf is $\frac{\pi}{2}$. Which of the following cannot be the constituent of the circuit?

(a) R, L
(b) C alone
(c) L alone
(d) L, C

30) In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is

(a) N.A.B.R.ω
(b) N.A.B
(c) N.A.B.R.
(d) N.A.B.ω

31) An inductor (L = 100mH), a resistor (R = 100Ω) and a battery (E = 100V) are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the points A and B. The current in the circuit 1ms after the short circuit is



(a) 1/eA
(b) eA

(c) 0.1A

(d) 1A

32) In a series resonant LCR circuit, the voltage across R is 100 volts and R = 1kΩ with C = 2μF. The resonant frequency ω is 200rad/s. At resonance the voltage across L is

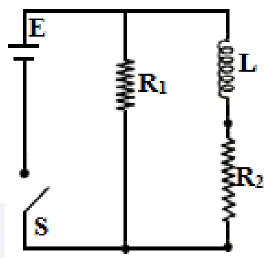
(a) 2.5×10^{-2}V

(b) 40V

(c) 250V

(d) 4×10^{-3}V

33) An inductor of inductance L = 400mH and resistors of resistance $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at t = 0. The potential drop across L as a function of time is



(a) $\frac{12}{t} e^{-3t}$V

(b) $6\,(1 - e^{-t/0.2})$V

(c) $12e^{-5t}$V

(d) $6e^{-5t}$V

34) In a series LCR circuit R = 200Ω and the voltage and the frequency of the main supply is 200V and 50Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30°. On taking out the inductor from the circuit the current leads the voltage by 30°. The power dissipated in the LCR circuit is

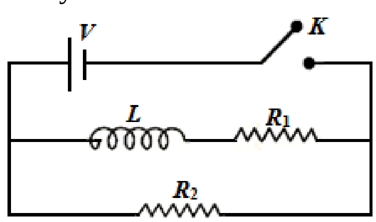
(a) 305W

(b) 210W

(c) Zero

(d) 242W

35) In the circuit shown below, the key K is closed at t = 0. The current through the battery is



(a) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at t = 0 and $\frac{V}{R_2}$ at t = ∞

(b) $\frac{V}{R_2}$ at t = 0 and $\frac{V(R_1+R_2)}{R_1R_2}$ at t = ∞

(c) $\frac{V}{R_2}$ at t = 0 and $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at t = ∞

(d) $\frac{V(R_1+R_2)}{R_1R_2}$ at t = 0 and $\frac{V}{R_2}$ at t = ∞

36) Combination of two identical capacitors, *a* resistor R and *adc* voltage source of voltage 6V is used in an experiment on a (C – R) circuit. It is found that for a parallel combination of the capacitor the time in which the voltage of the fully charged combination reduces to half its original voltage is 10 second. For

series combination the time for needed for reducing the voltage of the fully charged series combination by half is

(a) 10 second (b) 5 second

(c) 2.5 second (d) 20 second

37) A resistor 'R' and 2μF capacitor in series is connected through a switch to 200V direct supply. Across the capacitor is a neon bulb that lights up at 120V. Calculate the value of R to make the bulb light up 5s after the switch has been closed. ($\log_{10} 2.5 = 0.4$)

(a) $1.7 \times 10^5 \Omega$ (b) $2.7 \times 10^6 \Omega$

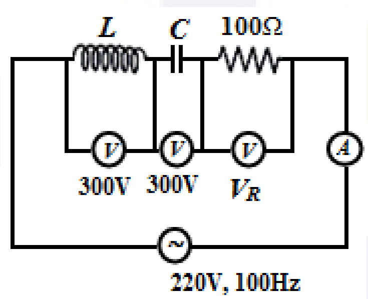
(c) $3.3 \times 10^7 \Omega$ (d) $1.3 \times 10^4 \Omega$

38) A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic fields is:

(a) $\frac{\pi}{4}\sqrt{LC}$ (b) $2\pi\sqrt{LC}$

(c) $\sqrt{LC}$ (d) $\pi\sqrt{LC}$

39) In an LCR circuit shown in the following figure, what will be the readings of the voltmeter across the resistor and ammeter if an a.c. source of 220V and 100Hz is connected to it as shown?



(a) 800V, 8A (b) 110V, 1.1A

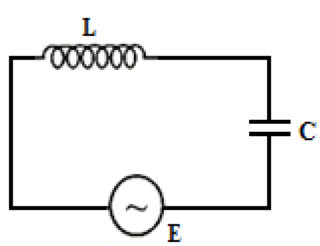
(c) 300V, 3A (d) 220V, 2.2A

40) A resistance R and a capacitance C are connected in series to a battery of negligible internal resistance through a key. The key is closed at t = 0. If after t sec the voltage across the capacitance was seven times the voltage across R, the value of t is

(a) 3 RC *ln*2 (b) 2 RC *ln*2

(c) 2 RC *ln*7 (d) 3 RC *ln*7

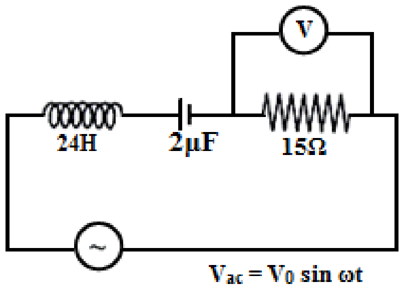
41) In the circuit shown here, the voltage across E and C are respectively 300V and 400V. The voltage E of the ac source is:



(a) 400 Volt (b) 500 Volt

(c) 100 Volt (d) 700 Volt

42) An LCR circuit as shown in the figure is connected to a voltage source V_{ac} whose frequency can be varied.



The frequency, at which the voltage across the resistor is maximum, is:

(a) 902Hz (b) 143Hz

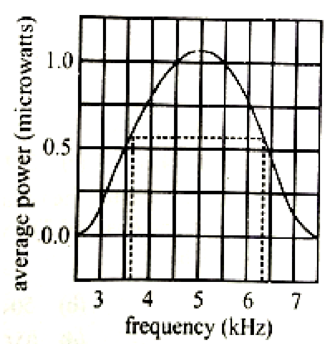
(c) 23Hz (d) 345Hz

43) In a series L – C – R circuit, C = 10^{-11} Farad, L = 10^{-5} Henry and R = 100 Ohm, when a constant D.C. voltage E is applied to the circuit, the capacitor acquires a charge 10^{-9}C. The D.C. source is replaced by a sinusoidal voltage source in which the peak voltage E_0 is equal to the constant D.C. voltage E. At resonance the peak value of the charge acquired by the capacitor will be:

(a) 10^{-15}C (b) 10^{-6}C

(c) 10^{-10}C (d) 10^{-8}C

44) The plot given below is of the average power delivered to an LRC circuit versus frequency. The quality factor of the circuit is:



(a) 5.0 (b) 2.0

(c) 2.5 (d) 0.4

45) When resonance is produced in a series LCR circuit, then which of the following is not correct?

(a) Current in the circuit is in phase with the applied voltage.

(b) Inductive and capacitive reactances are equal.

(c) If R is reduced, the voltage across capacitor will increase.

(d) Impedance of the circuit is maximum.

46) A series LR circuit is connected to an ac source of frequency ω and the inductive reactance is equal to 2R. A capacitance of capacitive reactance equal to R is added in series with L and R. The ratio of the new power factor to the old one is:

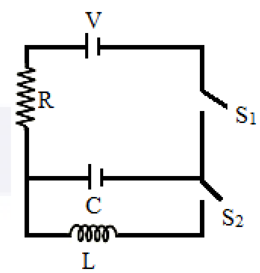
(a) $\sqrt{\frac{2}{3}}$

(b) $\sqrt{\frac{2}{5}}$

(c) $\sqrt{\frac{3}{2}}$

(d) $\sqrt{\frac{5}{2}}$

47) In an LCR circuit as shown below both switches are open initially. Now switch S_1 is closed, S_2 kept open. (q is charge on the capacitor and $\tau = RC$ is Capacitive time constant). Which of the following statement is correct?



(a) Work done by the battery is half of the energy dissipated in the resistor

(b) At, $t = \tau$, $q = CV/2$

(c) At, $t = 2\tau$, $q = CV(1 - e^{-2})$

(d) At, $t = 2\tau$, $q = CV(1 - e^{-1})$

48) When the rms voltages V_L, V_C and V_R are measured respectively across the inductor L, the capacitor C and the resistor R in a series LCR circuit connected to an AC source, it is found that the ratio $V_L : V_C : V_R = 1 : 2 : 3$. If the rms voltage of the AC sources is 100V, the V_R is close to:

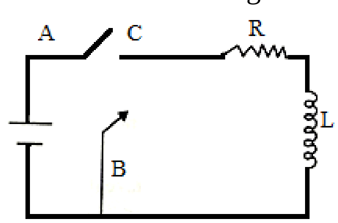
(a) 50V

(b) 70V

(c) 90V

(d) 100V

49) In the circuit shown here, the point 'C' is kept connected to point 'A' till the current flowing through the circuit becomes constant. Afterward, suddenly, point 'C' is disconnected from point 'A' and connected to point 'B' at time t = 0. Ratio of the voltage across resistance and the inductor at t = L/R will be equal to:



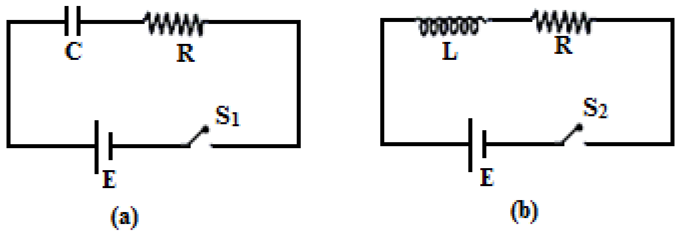
(a) $\frac{e}{1-e}$

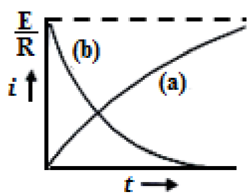
(b) 1

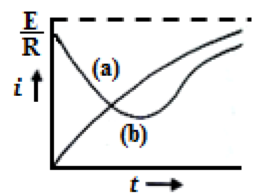
(c) –1

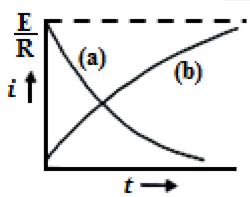
(d) $\frac{1-e}{e}$

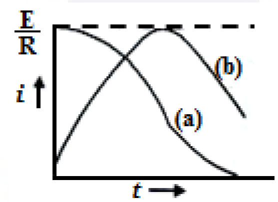
50) In the circuits (a) and (b) switches S_1 and S_2 are closed at t = 0 and are kept closed for a long time. The variation of current in the two circuits for $t \geq 0$ are roughly shown by figure (figures are schematic and not drawn to scale):



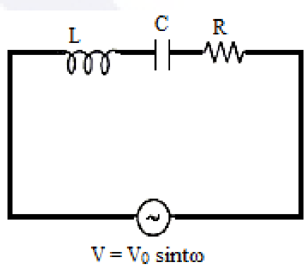
(a) 

(b) 

(c) 

(d) 

51) For the LCR circuit, shown here, the current is observed to lead the applied voltage. An additional capacitor C', when joined with the capacitor C present in the circuit, makes the power factor of the circuit unity. The capacitor C', must have been connected in:



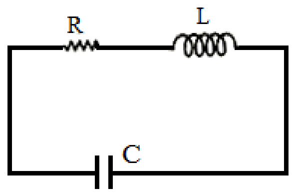
(a) series with C and has a magnitude $\frac{C}{(\omega^2 LC - 1)}$

(b) series with C and has a magnitude $\frac{1-\omega^2 LC}{\omega^2 L}$

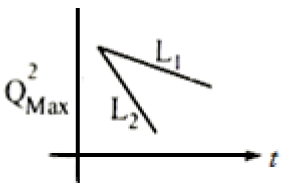
(c) parallel with C and has a magnitude $\frac{1-\omega^2 LC}{\omega^2 L}$

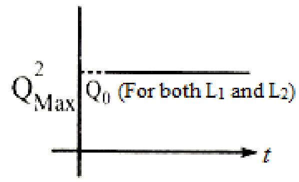
(d) parallel with C and has a magnitude $\frac{C}{(\omega^2 LC - 1)}$

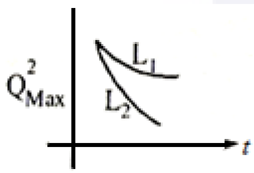
52) An LCR circuit is equivalent to a damped pendulum. In an LCR circuit the capacitor is charged to Q_0 and then connected to the L and R as shown below:

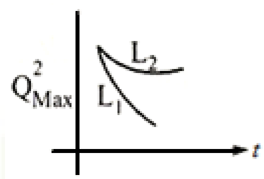


If a student plot graphs of the square of maximum charge (Q_{Max}^2) on the capacitor with time(t) for two different values L_1 and L_2 ($L_1 > L_2$) of L then which of the following represents this graph correctly? (*plots are schematic and not draw to scale*)

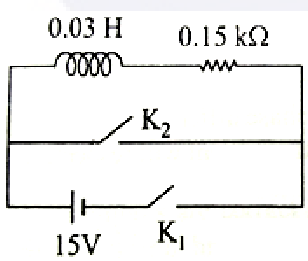
(a)


(b)


(c)


(d)


53) An inductor (L = 0.03H) and a resistor (R = 0.15kΩ) are connected in series to a battery of 15V emf in a circuit shown below. The key K_1 has been kept closed for a long time. Then at t = 0, K_1 is opened and key K_2 is closed simultaneously. At t = 1ms, the current in the circuit will be: ($e^5 \cong 150$)



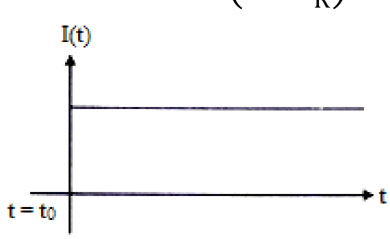
(a) 6.7mA

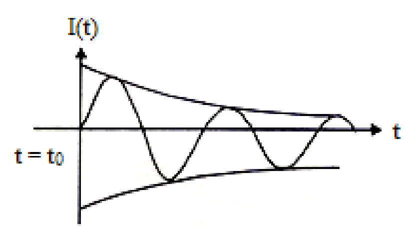
(b) 0.67mA

(c) 100mA

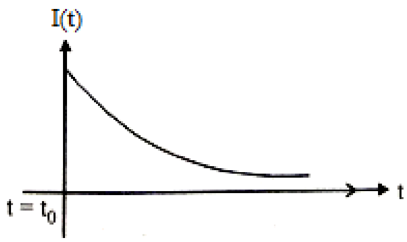
(d) 67mA

54) A series LR circuit is connected to a voltage source with $V(t) = V_0 \sin \omega t$. After very large time, current I(t) behaves as $\left(t_0 \gg \frac{L}{R}\right)$:

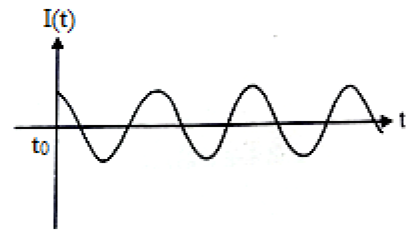
(a)


(b)


(c)



(d)



55) An arc lamp requires a direct current of 10A at 80V to function. If it is connected to a 220V (rms), 50Hz AC supply, the series inductor needed for it to work is close to:

(a) 0.044H

(b) 0.065H

(c) 80H

(d) 0.08H

56) A sinusoidal voltage of peak value 283V and angular frequency 320/s is applied to a series LCR circuit. Given that R = 5Ω, L = 25mH and C = 1000μF. The total impedance, and phase difference between the voltage across the source and the current will respectively be:

(a) 10Ω and $\tan^{-1}\left(\frac{5}{3}\right)$

(b) 7Ω and 45°

(c) 10Ω and $\tan^{-1}\left(\frac{8}{3}\right)$

(d) 7Ω and $\tan^{-1}\left(\frac{5}{3}\right)$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	d	a	d	c	d	b	d	b	d
11	12	13	14	15	16	17	18	19	20
d	a	b	a	b	c	c	a	d	a
21	22	23	24	25	26	27	28	29	30
b	d	b	a	d	d	a	b	a	d
31	32	33	34	35	36	37	38	39	40
a	c	c	d	b	c	b	a	d	a
41	42	43	44	45	46	47	48	49	50
c	c	d	b	d	d	c	c	c	c
51	52	53	54	55	56				
c	c	b	d	b	b				

Topic 75: Transformers & LC Oscillations

1) Eddy currents are produced when

(a) a metal is kept in varying magnetic field

(b) a metal is kept in steady magnetic field

(c) a circular coil is placed in a magnetic field

(d) through a circular coil, current is passed

2) The primary winding of a transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an A.C. supply of 20V, 50Hz. The secondary will have an output of

(a) 2V, 5Hz
(b) 200V, 500Hz
(c) 2V, 50Hz
(d) 200V, 50Hz

3) A step – up transformer operates on a 230 V line and supplies a load of 2 ampere. The ratio of the primary and secondary windings is 1 : 25. The current in the primary is

(a) 25 A
(b) 50 A
(c) 15 A
(d) 12.5 A

4) A transistor – oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4C, the frequency will be

(a) 8f
(b) $f/2\sqrt{2}$
(c) $f/2$
(d) $f/4$

5) The core of a transformer is laminated because

(a) the weight of the transformer may be reduced

(b) rusting of the core may be prevented

(c) ratio of voltage in primary and secondary may be increased

(d) energy losses due to eddy currents may be minimized

6) A transformer is used to light a 100W and 110V lamp from a 220V mains. If the main current is 0.5 amp, the efficiency of the transformer is approximately

(a) 50%
(b) 90%
(c) 10%
(d) 30%

7) The primary and secondary coil of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in webers, t is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is

(a) 120 volts
(b) 220 volts

(c) 30 volts

(d) 90 volts

8) A 220 volts input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

(a) 3.6 ampere

(b) 2.8ampere

(c) 2.5ampere

(d) 5.0ampere

9) The primary of a transformer when connected to a dc battery of 10 volt draws a current of 1mA. The numbers of turns of the primary and secondary windings are 50 and 100 respectively. The voltage in the secondary and the current drawn by the circuit in the secondary are respectively

(a) 20V and 0.5mA

(b) 20V and 2.0mA

(c) 10V and 0.5mA

(d) Zero and therefore no current

10) A transformer having efficiency of 90% is working on 200 V and 3kW power supply. If the current in the secondary coil is 6A, the voltage across the secondary coil and the current in the primary coil respectively are:

(a) 300V, 15A

(b) 450V, 15A

(c) 450V, 13.5A

(d) 600V, 15A

11) In a transformer, number of turns in the primary coil are 140 and that in the secondary coil are 280. If current in primary coil is 4A, then that in the secondary coil is

(a) 4A

(b) 2A

(c) 6A

(d) 10A

12) The core of any transformer is laminated so as to

(a) reduce the energy loss due to eddy currents

(b) make it light weight

(c) make it robust and strong

(d) increase the secondary voltage

13) In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

(a) $\frac{Q}{2}$

(b) $\frac{Q}{\sqrt{3}}$

(c) $\frac{Q}{\sqrt{2}}$

(d) Q

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	d	b	b	d	b	a	d	d	b
11	12	13							
b	a	c							

Topic 76: Electromagnetic Waves, Conduction & Displacement Current

1) The frequency of electromagnetic wave, which is best suited to observe a particle of radius 3×10^{-4}cm is of the order of

(a) 10^{15}

(b) 10^{14}

(c) 10^{13}

(d) 10^{12}

2) The oscillating electric and magnetic field vectors of electromagnetic wave are oriented along

(a) the same direction and in phase

(b) the same direction but have a phase difference of 90°

(c) mutually perpendicular directions and are in phase

(d) mutually perpendicular directions but has a phase difference of 90°

3) If ε_0 and μ_0 are the electric permittivity and magnetic permeability in vacuum, ε and μ are corresponding quantities in medium, then refractive index of the medium is

(a) $\sqrt{\frac{\varepsilon}{\varepsilon_0}}$

(b) $\sqrt{\frac{\varepsilon_0\mu}{\varepsilon\mu_0}}$

(c) $\sqrt{\frac{\varepsilon_0\mu_0}{\varepsilon\mu}}$

(d) $\sqrt{\frac{\varepsilon\mu}{\varepsilon_0\mu_0}}$

4) The electromagnetic radiations are caused by

(a) a stationary charge

(b) uniformly moving charges

(c) accelerated charges

(d) all of above

5) If $\vec{E}$ and $\vec{B}$represent electric and magnetic field vectors of the electromagnetic waves, then the direction of propagation of the waves will be along

(a) $\vec{B} \times \vec{E}$

(b) $\vec{E}$

(c) $\vec{B}$

(d) $\vec{E} \times \vec{B}$

6) The electric and magnetic field of an electromagnetic wave are

(a) in opposite phase and perpendicular to each other

(b) in opposite phase and parallel to each other

(c) in phase and perpendicular to each other

(d) in phase and parallel to each other

7) The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by

(a) $\sqrt{\frac{\epsilon_0}{\mu_0}}$ (b) $\sqrt{\mu_0 \epsilon_0}$

(c) $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$ (d) $\sqrt{\frac{\mu_0}{\epsilon_0}}$

8) The electric part of an electromagnetic wave in a medium is represented by $E_X = 0$; $E_Y = 2.5 \frac{N}{C} \cos \left[\left(2\pi \times 10^6 \frac{rad}{m}\right) t - \left(\pi \times 10^{-2} \frac{rad}{s}\right) x\right]$; $E_Z = 0$. The wave is:

(a) moving along x – direction with frequency 10^6 Hz and wave length 100m.

(b) moving along x – direction with frequency 10^6 Hz and wave length 200m.

(c) moving along $-$x direction with frequency 10^6 Hz and wave length 200m.

(d) moving along y – direction with frequency $2\pi \times 10^6$ Hz and wave length 200m.

9) Which of the following statement is false for the properties of electromagnetic waves?

(a) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.

(b) The energy in electromagnetic wave is divided equally between electric and magnetic vectors.

(c) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave.

(d) These wave do not require any material medium for propagation.

10) The electric and the magnetic field associated with an E.M. wave, propagating along the +z – axis, can be represented by

(a) $[\vec{E} = E_0\hat{i}, \vec{B} = B_0\hat{j}]$ (b) $[\vec{E} = E_0\hat{k}, \vec{B} = B_0\hat{i}]$

(c) $[\vec{E} = E_0\hat{j}, \vec{B} = B_0\hat{i}]$ (d) $[\vec{E} = E_0\hat{j}, \vec{B} = B_0\hat{k}]$

11) The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to:

(a) the speed of light in vacuum

(b) reciprocal of speed of light in vacuum

(c) the ratio of magnetic permeability to the electric susceptibility of vacuum

(d) unity

12) The electric field associated with an e.m. wave in vacuum is given by $[\vec{E} = \hat{i}\ 40 \cos (kz - 6 \times 10^8 t)$, where E, z and t are in volt/m, meter and seconds respectively. The value of wave vector k is:

(a) $2m^{-1}$ (b) $0.5m^{-1}$

(c) $6m^{-1}$ (d) $3m^{-1}$

13) An electromagnetic wave of frequency v = 3.0MHz passes from vacuum into a dielectric medium with relative permittivity $\varepsilon = 4.0$. Then

(a) wavelength is doubled and frequency is unchanged

(b) wavelength is doubled and frequency becomes half

(c) wavelength is halved and frequency remain unchanged

(d) wavelength and frequency both remain unchanged

14) Light with an energy flux of $25 \times 10^4 Wm^{-2}$ falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm^2, the average force exerted on the surface is:

(a) 1.25×10^{-6}N

(b) 2.50×10^{-6}N

(c) 1.20×10^{-6}N

(d) 3.0×10^{-6}N

15) A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light)

(a) $\frac{2E}{C}$

(b) $\frac{2E}{C^2}$

(c) $\frac{E}{C^2}$

(d) $\frac{E}{C}$

16) Out of the following options which one can be used to produce a propagating electromagnetic wave?

(a) A charge moving at constant velocity

(b) A stationary charge

(c) A chargeless particle

(d) An accelerating charge

17) In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6V/m. The peak value of the magnetic field is:-

(a) 2.83×10^{-8}T

(b) 0.70×10^{-8}T

(c) 4.23×10^{-8}T

(d) 1.41×10^{-8}T

18) Electromagnetic waves are transverse in nature is evident by

(a) polarization

(b) interference

(c) reflection

(d) diffraction

19) An electromagnetic wave of frequency v = 3.0MHz passes from vacuum into a dielectric medium with permittivity $\epsilon = 4.0$. Then

(a) wave length is halved and frequency remains unchanged

(b) wave length is doubled and frequency becomes half

(c) wave length is doubled and frequency remains unchanged

(d) wave length and frequency both remains unchanged.

20) An electromagnetic wave with frequency ω and wavelength λ travels in the +y direction. Its magnetic field is along +x – axis. The vector equation for the associated electric field (of amplitude E_0) is

(a) $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right) \hat{x}$

(b) $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right) \hat{x}$

(c) $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right) \hat{z}$

(d) $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right) \hat{z}$

21) An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

(a) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

(b) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

(c) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

(d) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

22) Select the correct statement from the following:

(a) Electromagnetic waves cannot travel in vacuum.

(b)Electromagnetic waves are longitudinal waves.

(c) Electromagnetic waves are produced by charges moving with uniform velocity.

(d) Electromagnetic waves carry both energy and momentum as they propagate through space.

23) A plane electromagnetic wave in a non – magnetic dielectric medium is given by $\vec{E} = \vec{E}_0 (4 \times 10^{-7}x - 50t)$ with distance being in meter and time in seconds. The dielectric constant of the medium is:

(a) 2.4

(b) 5.8

(c) 8.2

(d) 4.8

24) The magnetic field in a travelling electromagnetic wave has a peak value of 20nT. The peak value of electric field strength is:

(a) 3V/m

(b) 6V/m

(c) 9V/m

(d) 12V/m

25) An electromagnetic wave of frequency 1×10^{14} hertz is propagating along z – axis. The amplitude of electric field is 4V/m. If $\varepsilon_0 = 8.8 \times 10^{-12} C^2/N - m^2$, then average energy density of electric field will be:

(a) $35.2 \times 10^{-10} J/m^3$

(b) $35.2 \times 10^{-11} J/m^3$

(c) $35.2 \times 10^{-12} J/m^3$

(d) $35.2 \times 10^{-13} J/m^3$

26) A lamp emits monochromatic green light uniformly in all directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes 100W of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 5m from the lamp will be nearly:

(a) 1.34V/m

(b) 2.68V/m

(c) 4.02V/m

(d) 5.36V/m

27) During the propagation of electromagnetic waves in a medium:

(a) Electric energy density is double of the magnetic energy density.

(b) Electric energy density is half of the magnetic energy density.

(c) Electric energy density is equal to the magnetic energy density.

(d) Both electric and magnetic energy densities are zero.

28) An electromagnetic wave travelling in the x – direction has frequency of 2×10^{14}Hz and electric field amplitude of $27Vm^{-1}$. From the options given below, which one describes the magnetic field for this wave?

(a) $\vec{B}$ (x, t) = $(3 \times 10^{-8}T)\ \hat{j}$

$\sin [2\pi (1.5 \times 10^{-8}x - 2 \times 10^{14}t)]$

(b) $\vec{B}$ (x, t) = $(9 \times 10^{-8}T)\ \hat{\imath}$

$\sin [2\pi (1.5 \times 10^{-8}x - 2 \times 10^{14}t)]$

(c) $\vec{B}$ (x, t) = $(9 \times 10^{-8}T)\ \hat{j}$

$\sin [1.5 \times 10^{-6}x - 2 \times 10^{14}t]$

(d) $\vec{B}$ (x, t) = $(9 \times 10^{-8}T)\ \hat{k}$

$\sin [2\pi (1.5 \times 10^{-6}x - 2 \times 10^{14}t)]$

29) For plane electromagnetic waves propagating in the z – direction, which one of the following combination gives the correct possible direction for $\vec{E}$ and $\vec{B}$ field respectively?

(a) $(2\hat{\imath} + 3\hat{j})$ and $(\hat{\imath} + 2\hat{j})$

(b) $(-2\hat{\imath}-3\hat{j})$ and $(3\hat{\imath}- 2\hat{j})$

(c) $(3\hat{\imath} + 4\hat{j})$ and $(4\hat{\imath}- 3\hat{j})$

(d) $(\hat{\imath} + 2\hat{j})$ and $(2\hat{\imath}-\hat{j})$

30) Consider an electromagnetic wave propagating in vacuum. Choose the correct statement:

(a) For an electromagnetic wave propagating in +y direction the electric field is $\vec{E} = \frac{1}{\sqrt{2}} E_{yz}$ (x, t) $\hat{z}$ and the magnetic field is $\vec{B} = \frac{1}{\sqrt{2}} B_{yz}$ (x, t) $\hat{y}$

(b) For an electromagnetic wave propagating in +y direction the electric field is $\vec{E} = \frac{1}{\sqrt{2}} E_{yz}$ (x, t) $\hat{y}$ and the magnetic field is $\vec{B} = \frac{1}{\sqrt{2}} B_{yz}$ (x, t) $\hat{z}$

(c) For an electromagnetic wave propagating in +x direction the electric field is $\vec{E} = \frac{1}{\sqrt{2}} E_{yz}$ (y, z, t) $(\hat{y}+\hat{z})$ and the magnetic field is $\vec{B} = \frac{1}{\sqrt{2}} B_{yz}$ (y, z, t) $(\hat{y} + \hat{z})$

(d) For an electromagnetic waves propagating in the +x direction, electric field is $\vec{E} = \frac{1}{\sqrt{2}} E_{yz}$ (x, t) $(\hat{y}-\hat{z})$ and the magnetic field is $\vec{B} = \frac{1}{\sqrt{2}} B_{yz}$ (x, t) $(\hat{y} + \hat{z})$

31) Magnetic field in a plane electromagnetic wave is given by $\vec{B} = B_0 \sin (kx + \omega t)\ \hat{j}T$

Expression for corresponding electric field will be:

Where c is speed of light.

(a) $\vec{E} = B_0 c \sin(kx + \omega t)\,\hat{k}$ V/m

(b) $\vec{E} = \frac{B_0}{c} \sin(kx + \omega t)\,\hat{k}$ V/m

(c) $\vec{E} = -B_0 c \sin(kx + \omega t)\,\hat{k}$ V/m

(d) $\vec{E} = B_0 c \sin(kx - \omega t)\,\hat{k}$ V/m

32) The electric field component of a monochromatic radiation is given by

$\vec{E} = 2E_0\,\hat{\imath} \cos kz \cos \omega t$

Its magnetic field $\vec{B}$ is then given by:

(a) $\frac{2E_0}{c}\hat{j} \sin kz \cos \omega t$

(b) $-\frac{2E_0}{c}\hat{j} \sin kz \sin \omega t$

(c) $\frac{2E_0}{c}\hat{j} \sin kz \sin \omega t$

(d) $\frac{2E_0}{c}\hat{j} \cos kz \cos \omega t$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	c	d	c	d	c	c	b	c	a
11	12	13	14	15	16	17	18	19	20
b	a	c	b	a	d	a	a	a	c
21	22	23	24	25	26	27	28	29	30
b	d	b	b	c	b	c	d	b	d
31	32								
a	c								

Topic 77: Electromagnetic Spectrum

1) Which of the following, is the longest wave?

(a) X – rays
(b) γ – rays
(c) microwaves
(d) radio waves

2) Pick out the longest wavelength from the following types of radiation.

(a) blue light
(b) gamma rays
(c) X – rays
(d) red light

3) The structure of solids is investigated by using

(a) cosmic rays
(b) X – rays
(c) γ – rays
(d) infra – red radiations

4) Which one of the following electromagnetic radiations has the smallest wavelength?

(a) Ultraviolet waves
(b) X – rays
(c) γ – rays
(d) microwaves

5) The frequencies of X – rays, γ – rays and ultraviolet rays are respectively a, b and c. Then

(a) $a < b, b < c$
(b) $a < b, b > c$
(c) $a > b, b > c$
(d) $a > b, b < c$

6) Which of the following is positively charged?

(a) α – particles
(b) β – particles
(c) γ – rays
(d) X – rays

7) Green – house effect is the heating up of earth's atmosphere due to

(a) green plants
(b) infra – red rays
(c) X – rays
(d) ultraviolet rays

8) Which of the following electromagnetic radiations has the least wavelength?

(a) gamma rays
(b) infra – red
(c) ultraviolet
(d) X – rays

9) We consider the radiation emitted by the human body. Which of the following statements is true?

(a) the radiation emitted lies in the ultraviolet region and hence is not visible.

(b) the radiation emitted lies in the infra – red region.

(c) the radiation is emitted only during the day.

(d) the radiation is emitted during the summers and absorbed during the winters.

10) Which one of the following rays is not electromagnetic wave?

(a) heat rays
(b) X – rays
(c) γ – rays
(d) β – rays

11) If λ_v, λ_x and λ_m represents the wavelengths of visible light, X – rays and microwaves respectively, then

(a) $\lambda_m > \lambda_x > \lambda_v$
(b) $\lambda_m > \lambda_v > \lambda_x$
(c) $\lambda_v > \lambda_x > \lambda_m$
(d) $\lambda_v > \lambda_m > \lambda_x$

12) The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is

(a) microwave, infrared, ultraviolet, gamma rays

(b) gamma rays, ultraviolet, infrared, microwaves

(c) microwaves, gamma rays, infrared, ultraviolet

(d) infrared, microwave, ultraviolet, gamma rays

13) The condition under which a microwave oven heats up a food item containing water molecules most efficiently is

(a) the frequency of the microwaves has no relation with natural frequency of water molecules.

(b) microwaves are heat waves, so always produce heating.

(c) infra – red waves produce heating in a microwave oven.

(d) the frequency of the microwaves must match the resonant frequency of the water molecules.

14) The energy of the em waves is of the oder of 15keV. To which part of the spectrum does it belong?

(a) Infra – red rays
(b) Ultraviolet rays
(c) γ – rays
(d) X – rays

15) The frequency of X – rays; γ – rays and ultraviolet rays are respectively a, b and c then

(a) $a < b$; $b > c$
(b) $a > b$; $b > c$
(c) $a < b < c$
(d) $a = b = c$

16) Photons of an electromagnetic radiation has an energy 11keV each. To which region of electromagnetic spectrum does it belong?

(a) X – ray region
(b) Ultra violet region
(c) Infrared region
(d) Visible region

17) Match List I (Wavelength range of electromagnetic spectrum) with List II (Method of production of these waves) and select correct option from the options given below the lists.

List I		List II	
(1)	700 nm to 1mm	(i)	Vibration of atoms and molecules.
(2)	1nm to 400 nm	(ii)	Inner sell electrons in atoms moving from one energy level to a lower level.
(3)	$< 10^{-3}$nm	(iii)	Radioactive decay of the nucleus.
(4)	1mm to 0.1m	(iv)	Magnetron valve.

(a) (1) – (iv), (2) – (iii), (3) – (ii), (4) – (i)

(b) (1) – (iii), (2) – (iv), (3) – (i), (4) – (ii)

(c) (1) – (ii), (2) – (iii), (3) – (iv), (4) – (i)

(d) (1) – (i), (2) – (ii), (3) – (iii), (4) – (iv)

18) Match the List – I (Phenomenon associated with electromagnetic radiation) with List – II (Part of electromagnetic spectrum) and select the correct code from the choices given below this lists:

List I		List II	
I	Double of sodium	(A)	Visible radiation
II	Wavelength corresponding to temperature associated with the isotropic radiation filling all space	(B)	Microwave
III	Wavelength emitted by atomic hydrogen in interstellar space	(C)	Short radio wave
IV	Wavelength of radiation arising from two close energy levels in hydrogen	(D)	X – rays

(a) (I) – (A), (II) – (B), (III) – (B), (IV) – (C)

(b) (I) – (A), (II) – (B), (III) – (C), (IV) – (C)

(c) (I) – (D), (II) – (C), (III) – (A), (IV) – (B)

(d) (I) – (B), (II) – (A), (III) – (D), (IV) – (A)

19) If microwaves, X rays, infrared, gamma rays, ultra – violet, radio waves and visible parts of the electromagnetic spectrum are denoted by M, X, I, G, U, R and V then which of the following is the arrangement in ascending order of wavelength?

(a) R, M, I, V, U, X and G

(b) M, R,V, X, U, G and I

(c) G, X, U, V, I, M and R

(d) I, M, R, U, V, X and G

20) Match List – I (Electromagnetic wave type) with List – II (Its association/ application) and select the correct option from the choices given below the lists:

	List 1		List 2
1.	Infrared waves	(i)	To treat muscular strain
2.	Radio waves	(ii)	For broadcasting
3.	X – rays	(iii)	To detect fracture of bones
4.	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere

	1	2	3	4
(a)	(iv)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(iii)	(ii)	(i)	(iv)
(d)	(i)	(ii)	(iii)	(iv)

21) Microwave oven acts on the principle of:

(a) giving rotational energy to water molecules

(b) giving translational energy to water molecules

(c) giving vibrational energy to water molecules

(d) transferring electrons from lower to higher energy levels in water molecule

22) Arrange the following electromagnetic radiations per quantum in the order of increasing energy

A: Blue light

B: Yellow light

C: X – ray

D: Radiowave

(a) C, A, B, D

(b) B, A, D, C

(c) D, B, A, C

(d) A, B, D, C

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	d	b	c	b	a	b	a	b	d
11	12	13	14	15	16	17	18	19	20
b	a	d	d	a	a	d	d	c	d
21	22								
c	c								

Topic 78: Plane Mirror, Spherical Mirror & Reflection of Light

1) Ray optics is valid, when characteristics dimensions are

(a) of the same order as the wavelength of light

(b) much smaller than the wavelength of light

(c) of the order of one millimeter

(d) much larger than the wavelength of light

2) If two mirrors are kept inclined at 60° to each other and a body is placed at the middle, then total number of images formed is

(a) six
(b) five
(c) four
(d) three

3) A person is six feet tall. How tall must a vertical mirror be if he is able to see his entire length?

(a) 3ft
(b) 4.5ft
(c) 7.5ft
(d) 6ft

4) A rod of length 10cm lies along the principal axis of a concave mirror of focal length 10cm in such a way that its end closer to the pole is 20cm away from the mirror. The length of the image is:

(a) 10cm
(b) 15cm
(c) 2.5cm
(d) 5cm

5) Two plane mirrors are inclined at 70°. A ray incident on one mirror at angle θ after reflection falls on second mirror and is reflected from there parallel to first mirror. The value of θ is

(a) 50°
(b) 45°
(c) 30°
(d) 55°

6) Match the corresponding entries of column – 1 with column – 2 (Where m is the magnification produced by the mirror):

	Column – 1	Column – 2
(P)	$m = -2$	(A) Convex mirror
(Q)	$m = -\frac{1}{2}$	(B) Concave mirror
(R)	$m = +2$	(C) Real image
(S)	$m = +\frac{1}{2}$	(D) Virtual image

(a) P → B and C, Q → B and C, R → B and D, S → A and D.

(b) P → A and C, Q → A and D, R → A and B, S → C and D.

(c) P → A and D, Q → B and C, R → B and D, S → B and C.

(d) P → C and D, Q → B and D, R → B and C, S → A and D.

7) A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source I. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by

(a) $\frac{y}{x}$
(b) $\frac{x}{2y}$
(c) $\frac{x}{y}$
(d) $\frac{y}{2x}$

8) If two plane mirrors are kept at 60° to each other, then the number of images formed by them is

(a) 5
(b) 6
(c) 7
(d) 8

9) To get three images of a single object, one should have two plane mirrors at an angle of

(a) 60°
(b) 90°
(c) 120°
(d) 30°

10) A car is fitted with a convex side – view mirror of focal length 20cm. A second car 2.8m behind the first car is overtaking the first car at a relative speed of 15m/s. The speed of the image of the second car as seen in the mirror of the first one is:

(a) $\frac{1}{15}$ m/s
(b) 10m/s
(c) 15m/s
(d) $\frac{1}{10}$ m/s

11) You are asked to design a shaving mirror assuming that a person keeps it 10cm from his face and views the magnified image of the face at the closest comfortable distance of 25cm. The radius of curvature of the mirror would then be:

(a) 60cm
(b) – 24cm
(c) – 60 cm
(d) 24cm

ANSWER KEY										
1	2	3	4	5	6	7	8	9	10	11
d	b	a	d	a	a	d	a	b	a	c

Topic 79: Refraction of Light at Plane Surface & Total Internal Reflection

1) Green light of wavelength 5460 Å is incident on an air – glass interface. If the refractive index of glass is 1.5, the wavelength of light in glass would be ($c = 3 \times 10^8 ms^{-1}$)

(a) 3640 Å
(b) 5460 Å
(c) 4861 Å
(d) none of the above

2) A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5, the wavelength of refracted light will be

(a) dependent on intensity of refracted light
(b) same
(c) smaller
(d) larger

3) Time taken by sunlight to pass through a window of thickness 4mm whose refractive index is $\frac{3}{2}$ is

(a) 2×10^{-4} sec
(b) 2×10^{8} sec
(c) 2×10^{-11} sec
(d) 2×10^{11} sec

4) A point source of light is placed 4m below the surface of water of refractive index $\frac{5}{3}$. The minimum diameter of a disc, which should be place over the source, on the surface of water to cut off all light coming out of water is

(a) ∞
(b) 6m
(c) 4m
(d) 3m

5) One face of a rectangular glass 6cm thick is silvered. An object held 8cm in front of the first face forms and image 12cm behind the silvered face. The refractive index of the glass is

(a) 0.4
(b) 0.8
(c) 1.2
(d) 1.6

6) Light travels through a glass plate of thickness t and refractive index μ. If c is the speed of light in vacuum, the time taken by light to travel this thickness of glass is

(a) μtc
(b) $\frac{tc}{\mu}$
(c) $\frac{t}{\mu c}$
(d) $\frac{\mu t}{c}$

7) An electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air enters in a glass slab of refractive index (μ). The frequency, wavelength and velocity of light in the glass slab will be respectively

(a) n, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

(b) n, 2λ and $\frac{v}{\mu}$

(c) $\frac{n}{\mu}$, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

(d) $\frac{2\pi}{\mu}$, $\frac{\lambda}{\mu}$ and v

8) Light enters at an angle of incidence in a transparent rod of refractive index n. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence?

(a) $n > \sqrt{2}$

(b) n = 1

(c) n = 1.1

(d) n = 1.3

9) Wavelength of light of frequency 100Hz

(a) 2×10^6m

(b) 3×10^6m

(c) 4×10^6m

(d) 5×10^6m

10) An air bubble in a glass slab (μ = 1.5) is 5cm deep when viewed from one face and 2cm deep when viewed from the opposite face. The thickness of the slab is

(a) 7.5cm

(b) 10.5cm

(c) 7cm

(d) 10cm

11) The reddish appearance of the sun at sunrise and sunset is due to

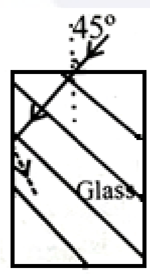
(a) the colour of the sky

(b) the scattering of the sky

(c) the polarization of light

(d) the colour of the sun

12) A light ray falls on a rectangular glass slab as shown. The index of refraction of the glass, if total internal reflection is to occur at the vertical face, is



(a) $\sqrt{3/2}$

(b) $\frac{(\sqrt{3}+1)}{2}$

(c) $\frac{(\sqrt{2}+1)}{2}$

(d) $\sqrt{5}/2$

13) A beam of light composed of red and green rays is incident obliquely at a point on the face of rectangular glass slab. When coming out on the opposite parallel face, the red and green rays emerge from

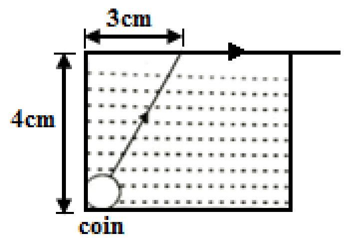
(a) one point propagating in the same direction

(b) two points propagating in two different non – parallel directions

(c) two points propagating in two different directions

(d) one point propagating in two different directions

14) A small coin is resting on the bottom of a beaker filled with liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface. How fast is the light travelling in the liquid?



(a) 2.4×10^8m/s

(b) 3.0×10^8m/s

(c) 1.2×10^8m/s

(d) 1.8×10^8m/s

15) The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 Å. The refractive index of material will be

(a) 1.50

(b) 3.00

(c)1.33

(d) 1.40

16) A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of μ the ray can undergo total internal reflection?

(a) $\mu = 1.33$

(b) $\mu = 1.40$

(c) $\mu = 1.50$

(d) $\mu = 1.25$

17) Which of the following is not due to total internal reflection?

(a) Working of optical fibre

(b) Difference between apparent and real depth of pond

(c) Mirage on hot summer days

(d) Brilliance of diamond

18) Which of the following is used in optical fibres?

(a) total internal reflection

(b) scattering

(c) diffraction

(d) refraction

19) Consider telecommunication through optical fibres. Which of the following statements is not true?

(a) Optical fibres can be graded refractive index

(b) Optical fibres are subjected to electromagnetic interference from outside

(c) Optical fibres have extremely low transmission loss

(d) Optical fibres may have homogeneous core with a suitable cladding

20) A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and the fish is 12cm below the surface, the radius of this circle in cm is

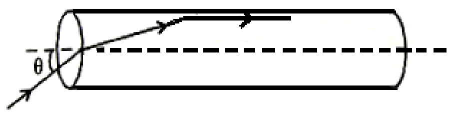
(a) $\frac{36}{\sqrt{7}}$

(b) $36\sqrt{7}$

(c) $4\sqrt{5}$

(d) $36\sqrt{5}$

21) A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid – point of one end of the rod as shown in the figure.



The incident angle θ for which the light ray grazes along the wall of the rod is:

(a) $\sin^{-1}(\sqrt{3}/2)$

(b) $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

(c) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

(d) $\sin^{-1}(1/2)$

22) A beaker contains water up to a height h_1 and kerosene of height h_2 above water so that the total height of (water + kerosene) is $(h_1 + h_2)$. Refractive index of water is μ_1 and that of kerosene is μ_2. The apparent shift in the position of the bottom of the beaker when viewed from above is

(a) $\left(1+\frac{1}{\mu_1}\right)h_1 - \left(1+\frac{1}{\mu_2}\right)h_2$

(b) $\left(1-\frac{1}{\mu_1}\right)h_1 + \left(1-\frac{1}{\mu_2}\right)h_2$

(c) $\left(1+\frac{1}{\mu_1}\right)h_2 - \left(1+\frac{1}{\mu_2}\right)h_1$

(d) $\left(1-\frac{1}{\mu_1}\right)h_2 + \left(1-\frac{1}{\mu_2}\right)h_1$

23) Let have x –z plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with $z < 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\vec{A} = 6\sqrt{3}\hat{\imath} + 8\sqrt{3}\hat{\jmath} - 10\hat{k}$ is incident on the plane of separation. The angle of refraction in medium 2 is:

(a) 45°

(b) 60°

(c) 75°

(d) 30°

24) Light is incident from a medium into air at two possible angles of incidence (A) 20° and (B) 40°. In the medium light travels 3.0cm in 0.2ns. The ray will:

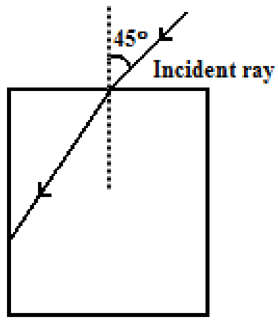
(a) suffer total internal reflection in both cases (A) and (B)

(b) suffer total internal reflection in case (B) only

(c) have partial reflection and partial transmission in case (B)

(d) have 100% transmission in case (A)

25) A light ray falls on a square glass slab as shown in the diagram. The index of refraction of the glass, if total internal reflection is to occur at the vertical face, is equal to:



(a) $\frac{(\sqrt{2}+1)}{2}$

(b) $\sqrt{\frac{5}{2}}$

(c) $\frac{3}{2}$

(d) $\sqrt{\frac{3}{2}}$

26) A printed page is pressed by a glass of water. The refractive index of the glass and water is 1.5 and 1.33, respectively. If the thickness of the bottom of glass is 1cm and depth of water is 5cm, how much the page will appear to be shifted if viewed from the top?

(a) 1.033cm

(b) 3.581cm

(c) 1.3533cm

(d) 1.90cm

27) A diver looking up through the water sees the outside world contained in a circular horizon. The refractive index of water is $\frac{4}{3}$, and the diver's eyes are 15cm below the surface of water. Then the radius of the circle is:

(a) $15 \times 3 \times \sqrt{5}$ cm

(b) $15 \times 3\sqrt{7}$ cm

(c) $\frac{15 \times \sqrt{7}}{3}$ cm

(d) $\frac{15 \times 3}{\sqrt{7}}$ cm

28) Let the refractive index of a denser medium with respect to a rarer medium be n_{12} and its critical angle be θ_C. At an angle of incidence A when light is travelling from denser medium to rarer medium, a part of the light is reflected and the rest is refracted and the angle between reflected and refracted rays is 90°. Angle A is given by:

(a) $\frac{1}{\cos^{-1} \sin \theta_C}$

(b) $\frac{1}{\tan^{-1} \sin \theta_C}$

(c) $\cos^{-1}(\sin \theta_C)$

(d) $\tan^{-1}(\sin \theta_C)$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	c	b	c	d	a	a	b	b
11	12	13	14	15	16	17	18	19	20
b	a	c	d	b	c	b	a	b	a
21	22	23	24	25	26	27	28		
c	b	a	b	d	c	d	d		

Topic 80: Refraction at Curved Surface, Lenses & Power of Lens

1) Focal length of a convex lens of refractive index 1.5 is 2cm. Focal length of the lens when immersed in a liquid of refractive index of 1.25 will be

(a) 10cm
(b) 2.5cm
(c) 5cm
(d) 7.5cm

2) Focal length of a convex lens will be maximum for

(a) blue light
(b) yellow light
(c) green light
(d) red light

3) A lens is placed between a source of light and a wall. It forms images of area A_1 and A_2 on the wall for its two different positions. The area of the source of light is

(a) $\sqrt{A_1A_2}$
(b) $\frac{A_1+A_2}{2}$
(c) $\frac{A_1-A_2}{2}$
(d) $\frac{1}{A_1}+\frac{1}{A_2}$

4) An achromatic combination of lenses is formed by joining

(a) 2 convex lenses
(b) 2 concave lenses
(c) 1 convex and 1 concave lens
(d) 1 convex and 1 plane mirror

5) If f_V and f_R are focal lengths of a convex lens for violet and red light respectively and F_V and F_R are focal lengths of concave lens for violet and red light respectively, then we have

(a) $f_V < f_R$ and $F_V > F_R$
(b) $f_V < f_R$ and $F_V < F_R$
(c) $f_V > f_R$ and $F_V > F_R$
(d) $f_V > f_R$ and $F_V < F_R$

6) A convex lens of focal length 80cm and a concave lens of focal length 50cm are combined together. What will be their resulting power?

(a) +6.5 D
(b) – 6.5 D
(c) + 7.5 D
(d) – 0.75 D

7) The focal length of converging lens is measured for violet, green and red colours. It is respectively f_v, f_g, f_r,. We will get

(a) $f_v = f_g$
(b) $f_g > f_r$
(c) $f_v < f_r$
(d) $f_v > f_r$

8) A luminous object is placed at a distance of 30cm from the convex lens of focal length 20cm. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10cm be placed in order to have an upright image of the object coincident with it?

(a) 12cm
(b) 30cm
(c) 50cm
(d) 60cm

9) A plano – convex lens is made of material of refractive index 1.6. The radius of curvature of the curved surface is 60cm. The focal length of the lens is

(a) 50cm
(b) 100cm
(c) 200cm
(d) 400cm

10) The radius of curvature of a thin plano – convex lens is 10cm (of curved surface) and the refractive index is 1.5. If the plane surface is silvered, then it behaves like concave mirror of focal length

(a) 10cm
(b) 15cm
(c) 20cm
(d) 5cm

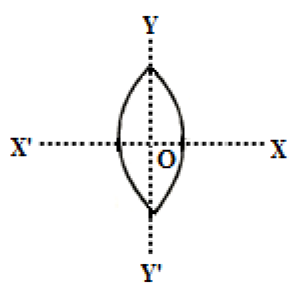
11) A body is located on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens. The lens is placed at a distance 'd' ahead of second wall, then the required focal length will be

(a) only $\frac{d}{4}$
(b) only $\frac{d}{2}$
(c) more than $\frac{d}{4}$ but less than $\frac{d}{2}$
(d) less than $\frac{d}{4}$

12) A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will

(a) remain unchanged
(b) become zero
(c) become infinite
(d) become small, but non - zero

13) An equiconvex lens is cut into two halves along (i) XOX' and (ii) YOY' as shown in the figure. Let f, f', f'' be the focal lengths of the complete lens, of each half in case (i), and of each half in case (ii), respectively.



Choose the correct statement from the following

(a) $f' = 2f$, $f'' = 2f$
(b) $f' = f$, $f'' = 2f$
(c) $f' = 2f$, $f'' = f$
(d) $f' = f$, $f'' = f$

14) A convex lens and a concave lens, each having same focal length of 25cm, are put in contact to form a combination of lenses. The power in diopters of the combination is

(a) 50

(b) infinite

(c) zero

(d) 25

15) A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10cm. The diameter of the Sun is 1.39×10^{9}m and its mean distance from the earth is 1.5×10^{11}m.What is the diameter of the Sun's image on the paper?

(a) 9.2×10^{-4}m

(b) 6.5×10^{-4}m

(c) 6.5×10^{-5}m

(d) 1.24×10^{-4}m

16) Two thin lenses of focal lengths f_1 and f_2 are in contact and coaxial. The power of the combination is:

(a) $\sqrt{\frac{f_1}{f_2}}$

(b) $\sqrt{\frac{f_2}{f_1}}$

(c) $\frac{f_1+f_2}{2}$

(d) $\frac{f_1+f_2}{f_1 f_2}$

17) A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively:

(a) f and $\frac{I}{4}$

(b) $\frac{3f}{4}$ and $\frac{I}{2}$

(c) f and $\frac{3I}{4}$

(d) $\frac{f}{2}$ and $\frac{I}{2}$

18) A converging beam of rays is incident on a diverging lens. Having passed through the lens the rays intersect at a point 15cm from the lens on the opposite side. If the lens is removed the point where the rays meet will move 5cm closer to the lens. The focal length of the lens is

(a) – 10cm

(b) 20cm

(c) – 30cm

(d) 5cm

19) A biconvex lens has a radius of curvature of magnitude 20cm. Which one of the following options best describe the image formed of an object of height 2cm placed 30cm from the lens?

(a) Virtual, upright, height = 1cm

(b) Virtual, upright, height = 0.5cm

(c) Real, inverted, height = 4cm

(d) Real, inverted, height = 1cm

20) A concave mirror of focal length 'f_1' is placed at a distance of 'd' from a convex lens of focal length 'f_2'. A beam of light coming from infinity and falling on this convex lens – concave mirror combination returns to infinity.

(a) $f_1 + f_2$

(b) $-f_1 + f_2$

(c) $2f_1 + f_2$

(d) $-2f_1 + f_2$

21) When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index.

(a) equal to that of glass
(b) less than one
(c) greater than that of glass
(d) less than that of glass

22) A plano convex lens fits exactly into a plano concave lens. Their plane surfaces are parallel to each other. If lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then the focal length of the combination is

(a) $\frac{R}{2(\mu_1-\mu_2)}$
(b) $\frac{R}{(\mu_1-\mu_2)}$
(c) $\frac{2R}{(\mu_2-\mu_1)}$
(d) $\frac{R}{2(\mu_1+\mu_2)}$

23) Two identical thin plano – convex glass lenses (refractive index 1.5) each having radius of curvature of 20cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is

(a) – 25cm
(b) – 50cm
(c) 50cm
(d) – 20cm

24) A plano convex lens of refractive index 1.5 and radius of curvature 30cm. Is silvered at the curved surface. Now this lens has been used to form the image of an object. At what distance from this lens an object be placed in order to have a real image of size of the object

(a) 60cm
(b) 30cm
(c) 20cm
(d) 80cm

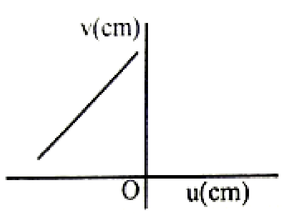
25) A thin glass (refractive index 1.5) lens has optical power of – 5D in air. Its optical power in a liquid medium with refractive index 1.6 will be

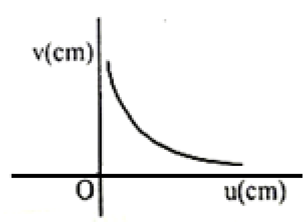
(a) – 1D
(b) 1D
(c) – 25D
(d) 25D

26) Two lenses of power – 15D and +5D are in contact with each other. The focal length of the combination is

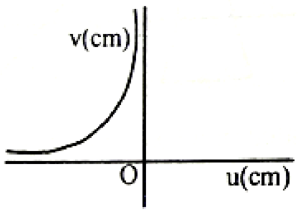
(a) +10cm
(b) – 20cm
(c) – 10cm
(d) +20cm

27) A student measures the focal length of a convex lens by putting an object pin at a distance ‘u’ from the lens and measuring the distance ‘v’ of the image pin. The graph between ‘u’ and ‘v’ plotted by the student should look like

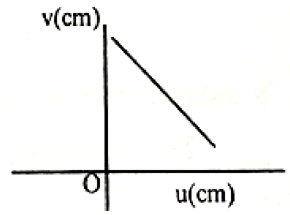
(a)


(b)


(c)



(d)



28) In an optics experiment, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and the image distance v, from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 45° with the x – axis meets the experimental curve at P. The coordinates of P will be

(a) $\left(\frac{f}{2}, \frac{f}{2}\right)$

(b) (f, f)

(c) $(4f, 4f)$

(d) $(2f, 2f)$

29) When monochromatic red light is used instead of blue light in a convex lens, its focal length will

(a) increase

(b) decrease

(c) remain same

(d) does not depend on colour of light

30) An object at 2.4m in front of a lens forms a sharp image on a film 12cm behind the lens. A glass plate 1cm thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object shifted to be in sharp focus of film?

(a) 7.2m

(b) 2.4m

(c) 3.2m

(d) 5.6m

31) The image of an illuminated square is obtained on a screen with the help of a converging lens. The distance of the square from the lens is 40cm. The area of the image is 9 times that of the square. The focal length of the lens is:

(a) 36cm

(b) 27cm

(c) 60cm

(d) 30cm

32) Diameter of a plano – convex lens is 6cm and thickness at the centre is 3mm. If speed of light in material of lens is 2×10^8 m/s, the focal length of the lens is

(a) 15cm

(b) 20cm

(c) 30cm

(d) 10cm

33) An object is located in a fixed position in front of a screen. Sharp image is obtained on the screen for two positions of a thin lens separated by 10cm. The size of the image in two situations are in the ratio 3:3. What is the distance between the screen and the object?

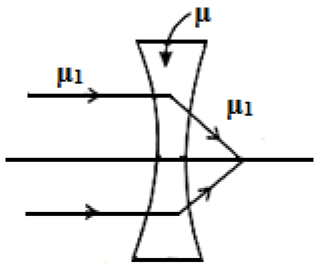
(a) 124.5cm

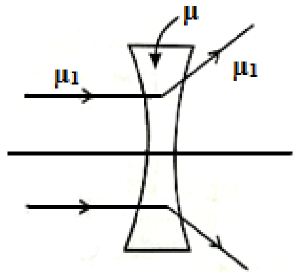
(b) 144.5cm

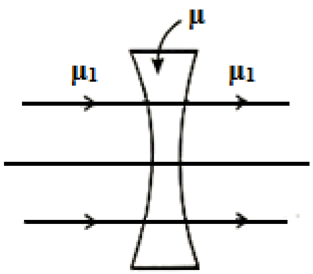
(c) 65.0cm

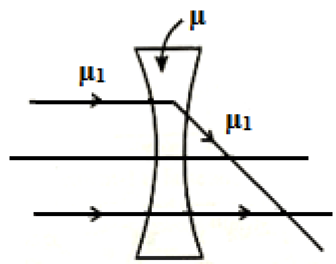
(d) 99.0cm

34) The refractive index of the material of a concave lens is μ. It is immersed in a medium of refractive index μ_1. A parallel beam of light is incident on the lens. The path of the emergent rays when $\mu_1 > \mu$ is:

(a)


(b)


(c)


(d)


35) A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length f. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal lengths f_1 and f_2 respectively. The correct relation between the focal lengths is:

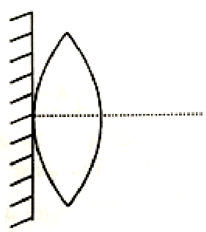
(a) $f_1 = f_2 < f$

(b) $f_1 > f$ and f_2 becomes negative

(c) $f_2 > f$ and f_1 becomes negative

(d) f_1 and f_2 both becomes negative

36) A thin convex lens of focal length ‘f’ is put on a plane mirror as shown in the figure. When an object is kept at a distance ‘a’ from the lens – mirror combination, its image is formed at a distance $\frac{a}{3}$ in front of the combination. The value of ‘a’ is:



(a) 3f

(b) $\frac{3}{2}$ f

(c) f

(d) 2f

37) To find the focal length of a convex mirror, a student records the following data:

Object Pin	Convex lens	Convex Mirror	Image Pin
22.2cm	32.2cm	45.8cm	71.2cm

The focal length of the convex lens is f_1 and that of mirror is f_2. Then taking index correction to be negligibly small, f_1 and f_2 are close to:

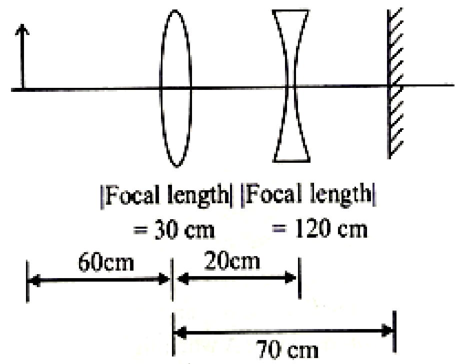
(a) $f_1 = 7.8cm$ $f_2 = 12.7cm$

(b) $f_1 = 12.7cm$ $f_2 = 7.8cm$

(c) $f_1 = 15.6cm$ $f_2 = 25.4cm$

(d) $f_1 = 7.8cm$ $f_2 = 25.4cm$

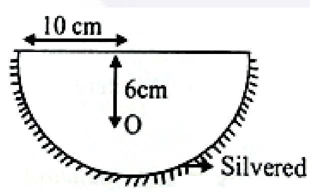
38) A convex lens, of focal length 30cm, a concave lens of focal length 120cm, and a plane mirror are arranged as shown. For an object kept at a distance of 60cm from the convex lens, the final image, formed by the combination, is a real image, at a distance of:



(a) 60cm from the convex lens (b) 60cm from the concave lens

(c) 70cm from the convex lens (d) 70cm from the concave lens

39) A hemispherical glass body of radius 10cm and refractive index 1.5 is silvered on its curved surface. A small air bubble is 6cm below the flat surface inside it along the axis. The position of the image of the air bubble made by the mirror is seen:



(a) 14cm below flat surface (b) 20cm below flat surface

(c) 16cm below flat surface (d) 30cm below flat surface

40) In an experiment a convex lens of focal length 15cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5cm from it. It is found that an object and its image coincide, if the object is placed at a distance of 20cm from the lens. The focal length of the convex mirror is:

(a) 27.5cm (b) 20.0cm

(c) 25.0cm (d) 30.5cm

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	d	a	c	a	d	c	c	b	a
11	12	13	14	15	16	17	18	19	20
b	c	b	c	a	d	c	c	c	c
21	22	23	24	25	26	27	28	29	30
a	b	b	c	b	c	c	d	a	d
31	32	33	34	35	36	37	38	39	40
d	c	d	a	b	d	a	a	b	a

Topic 81: Prism & Dispersion of Light

1) Angle of deviation (δ) by a prism (refractive index = μ and supposing the angle of prism A to be small) can be given by

(a) $\delta = (\mu - 1)\,A$

(b) $\delta = (\mu + 1)\,A$

(c) $\delta = \dfrac{\sin\frac{A+\delta}{2}}{\sin\frac{A}{2}}$

(d) $\delta = \dfrac{\mu-1}{\mu+1}\,A$

2) The refractive index of the material of the prism is $\sqrt{3}$; then the angle of minimum deviation of the prism is

(a) 30°

(b) 45°

(c) 60°

(d) 75°

3) The refractive index of the material of a prism is $\sqrt{2}$ and its refracting angle is 30°.One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light enters the prism from the mirror surface if its angle of incidence of the prism is

(a) 30°

(b) 45°

(c) 60°

(d) 0°

4) A thin prism of angle 15° made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index $\mu_2 = 1.75$. The combination of the prism produces dispersion without deviation. The angle of second prism should be

(a) 7°

(b) 10°

(c) 12°

(d) 5°

5) For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index:

(a) lies between $\sqrt{2}$ and 1

(b) lies between 2 and $\sqrt{2}$

(c) is less than 1

(d) is greater than 2

6) A ray of light is incident at an angle of incidence, i, on one face of prism of angle A (assumed to be small) and emerges normally from the opposite face. If the refractive index of the prism is μ, the angle of incidence i, is nearly equal to:

(a) μA

(b) $\dfrac{\mu A}{2}$

(c) $\dfrac{A}{\mu}$

(d) $\dfrac{A}{2\mu}$

7) Rainbow is formed due to combination of

(a) dispersion and total internal reflection

(b) refraction and absorption

(c) dispersion and focusing

(d) refraction and scattering

8) The angle of a prism is ‘A’. One of its refracting surfaces is silvered. Light rays falling at an angle of incidence 2A on the first surface returns back through the same path after suffering reflection at the silvered surface. The refractive index μ, of the prism is:

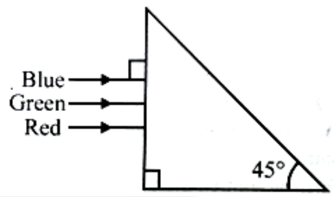
(a) 2 sin A

(b) 2 cos A

(c) $\frac{1}{2}$ cos A

(d) tan A

9) A beam of light consisting of red, green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red, green and blue wavelengths is 1.39, 1.44 and 1.47, respectively.



The prism will:

(a) separate all the three colours from one another

(b) not separate the three colours at all

(c) separate the red colour part from the green and blue colours

(d) separate the blue colour part from the red and green colours

10) The refracting angle of a prism is ‘A’, and refractive index of the material of the prism is cot (A/2). The angle of minimum deviation is:

(a) 180°− 2A

(b) 90°− A

(c) 180°+ 2A

(d) 180°− 3A

11) The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are:

(a) 45°, $\frac{1}{\sqrt{2}}$

(b) 30°, $\sqrt{2}$

(c) 45°, $\sqrt{2}$

(d) 30°, $\frac{1}{\sqrt{2}}$

12) A thin prism having refracting angle 10° is made of glass of refractive index 1.42. The prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be

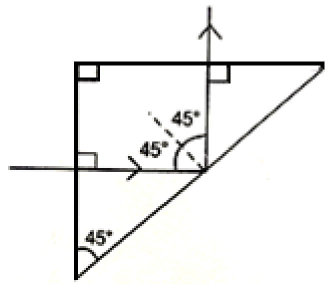
(a) 6°

(b) 8°

(c) 10°

(d) 4°

13) A light ray is incident perpendicularly to one face of 90° prism and is totally internally reflected at the glass – air interface. If the angle of reflection is 45°, we conclude that the refractive index n



(a) $n > \frac{1}{\sqrt{2}}$

(b) $n > \sqrt{2}$

(c) $n < \frac{1}{\sqrt{2}}$

(d) $n < \sqrt{2}$

14) The refractive index of a glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass. Then,

(a) $D_1 < D_2$

(b) $D_1 = D_2$

(c) D_1 can be less than or greater than D_2 depending upon the angle of prism

(d) $D_1 > D_2$

15) Which of the following processes play a part in the formation of a rainbow?

(i) Refraction

(ii) Total internal reflection

(iii) Dispersion

(iv) Interference

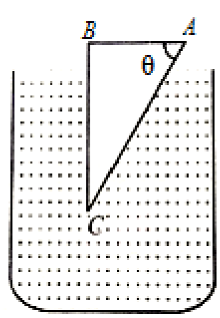
(a) (i), (ii) and (iii)

(b) (i) and (ii)

(c) (i), (ii) and (iv)

(d) (iii) and (iv)

16) A glass prism of refractive index 1.5 is immersed in water (refractive index $\frac{4}{3}$) as shown in figure. A light beam incident normally on the face AB is totally reflected to reach the face BC, if



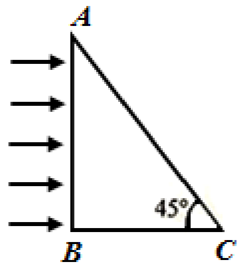
(a) $\sin\theta > \frac{5}{9}$

(b) $\sin\theta > \frac{2}{3}$

(c) $\sin\theta > \frac{8}{9}$

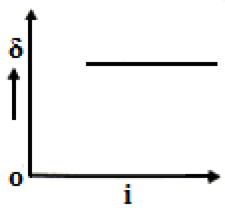
(d) $\sin\theta > \frac{1}{3}$

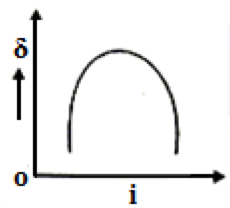
17) A beam of light consisting of red, green and blue colours is incident on a right angled prism on face AB. The refractive indices of the material for the above red, green and blue colours are 1.39, 1.44 and 1.47 respectively. A person looking on surface AC of the prism will see

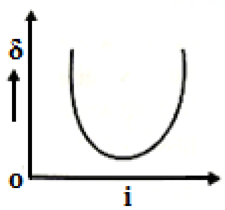


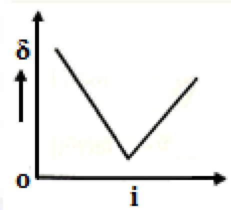
(a) no light
(b) green and blue colours
(c) red and green colours
(d) red colour only

18) The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by

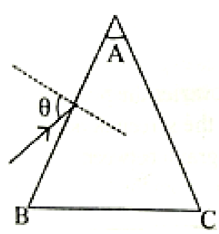
(a)


(b)


(c)


(d)


19) Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ, on the face AB would get transmitted through the face AC of the prism provided:



(a) $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$
(b) $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$
(c) $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$
(d) $\theta < \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

20) In an experiment for determination of refractive index of glass of a prism by i – δ, plot it was found that a ray incident at angle 35°, suffers a deviation of 40° and that it emerges at angle 79°. In that case which of the following is closest to the maximum possible value of the refractive index?

(a) 1.7 (b) 1.8

(c) 1.5 (d) 1.6

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	b	b	b	a	a	b	c	a
11	12	13	14	15	16	17	18	19	20
b	a	b	a	a	c	d	c	c	c

Topic 82: Optical Instruments

1) The hypermetropia is a

(a) short – sight defect

(b) long – sight defect

(c) bad vision due to old age

(d) none of these

2) An astronomical telescope has a length of 44cm and tenfold magnification. The focal length of the objective lens is

(a) 4 cm

(b) 40 cm

(c) 44 cm

(d) 440 cm

3) A telescope has an objective lens of 10cm diameter and is situated at a distance of one kilometer from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000Ȧ, is of the order of

(a) 5cm

(b) 0.5m

(c) 5m

(d) 5mm

4) A microscope is focused on a mark on a piece of paper and then a slab of glass of thickness 3cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?

(a) 4.5cm downward

(b) 1cm downward

(c) 2cm upward

(d) 1cm upward

5) The magnifying power of a telescope is 9. When it is adjusted for parallel rays the distance between the objective and eyepiece is 20cm. The focal length of lenses are:

(a) 10cm, 10cm

(b) 15cm, 5cm

(c) 18cm, 2cm

(d) 11cm, 9cm

6) For a normal eye, the cornea of eye provides a converging power of 40D and the least converging power of the eye lens behind the cornea is 20D. Using this information, the distance between the retina and the eye lens of the eye can be estimated to be

(a) 2.5cm

(b) 1.67cm

(c) 1.5cm

(d) 5cm

7) If the focal length of objective lens is increased then magnifying power of:

(a) microscope will increase but that of telescope decrease

(b) microscope and telescope both will increase

(c) microscope and telescope both will decrease

(d) microscope will decrease but that of telescope increase

8) In an astronomical telescope in normal adjustment a straight black line of length L is drawn on inside part of objective lens. The eyepiece forms a real image of this line. The length of this image is *l*. The magnification of the telescope is:

(a) $\frac{L}{I} - 1$

(b) $\frac{L+I}{L-I}$

(c) $\frac{L}{I}$

(d) $\frac{L}{I} + 1$

9) A astronomical telescope has objective and eyepiece of focal lengths 40cm and 4cm respectively. To view an object 200cm away from the objective, the lenses must be separated by a distance:

(a) 37.3cm

(b) 46.0cm

(c) 50.0cm

(d) 54.0cm

10) An astronomical telescope has a large aperture to

(a) reduce spherical aberration

(b) have high resolution

(c) increase span of observation

(d) have low dispersion

11) The image formed by an objective of a compound microscope is

(a) virtual and diminished

(b) real and diminished

(c) real and enlarged

(d) virtual and enlarged

12) An experiment is performed to find the refractive index of glass using a travelling microscope. In this experiment distances are measured by

(a) a vernier scale provided on the microscope

(b) a standard laboratory scale

(c) a meter scale provided on the microscope

(d) a screw gauge provided on the microscope

13) We wish to make a microscope with the help of two positive lenses both with a focal length of 20mm each and object is positioned 25mm from the objective lens. How far apart the lenses should be so that the final image is formed at infinity?

(a) 20mm

(b) 100mm

(c) 120mm

(d) 80mm

14) A telescope of aperture 3×10^{-2} m diameter is focused on a window at 80m distance fitted with a wire mesh of spacing 2×10^{-3} m. Given $\lambda = 5.5 \times 10^{-7}$m, which of the following is true for observing the mesh through the telescope?

(a) Yes, it is possible with the same aperture size

(b) Possible also with an aperture half the present diameter

(c) No, it is not possible

(d) Given data is not sufficient

15) The focal length of the objective and the eyepiece of a telescope are 50cm and 5cm respectively. If the telescope is focused for distinct vision on a scale distant 2m from its objective, then its magnifying power will be:

(a) – 4
(b) – 8
(c) +8
(d) – 2

16) This question contains Statement -1 and Statement - 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement – 1: Very large size telescopes are reflecting telescopes instead of refracting telescopes.

Statement – 2: It is easier to provide mechanical support to large size mirrors than large size lenses

(a) Statement – 1 is true and Statement – 2 is false

(b) Statement – 1 is false and Statement – 2 is true

(c) Statement – 1 is and Statement – 2 are true and Statement – 2 is correct explanation for Statement – 1.

(d) Statement – 1 is and Statement – 2 are true and Statement – 2 is not the correct explanation for Statement – 1.

17) The focal lengths of objective lens and eye lens of a Galilean telescope are respectively 30cm and 3.0cm, telescope produces virtual, erect image of an object situated far away from it at least distance of distinct vision from the eye lens. In this condition, the magnifying power of the Galilean telescope should be:

(a) +11.2
(b) – 11.2
(c) – 8.8
(d) +8.8

18) In a compound microscope, the focal length of objective lens is 1.2cm and focal length of eye piece is 3.0cm. When object kept at 1.25cm in front of objective, final image is formed at infinity. Magnifying power of the compound microscope should be:

(a) 200
(b) 100
(c) 400
(d) 150

19) A telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5cm. If a 50m tall tower at a distance of 1km is observed through this telescope in normal setting, the angle formed by the image of the tower is θ, then θ is close to:

(a) 30°
(b) 15°
(c) 60°
(d) 1°

20) To determine refractive index of glass slab using a travelling microscope, minimum number of readings required are:

(a) Two
(b) Four
(c) Three
(d) Five

21) An observer looks at a distant tree of height 10m with a telescope of magnifying power of 20. To the observer the tree appears:

(a) 20 times taller

(b) 20 times nearer

(c) 10 times taller

(d) 10 times nearer

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	b	d	d	c	b	d	c	d	b
11	12	13	14	15	16	17	18	19	20
c	a	c	a	d	c	d	a	c	c
21									
b									

Topic 83: Wavefront, Interference of Light, Coherent & Incoherent Sources

1) Which one of the following phenomena is not explained by Huygens construction of wavefront?

(a) Refraction

(b) Reflection

(c) Diffraction

(d) Origin of spectra

2) Interference is possible in

(a) light waves only

(b) sound waves only

(c) both light and sound waves

(d) neither light nor sound waves

3) Ratio of intensities of two waves are given by 4 : 1. Then the ratio of the amplitudes of the two waves is:

(a) 2 : 1

(b) 1 : 2

(c) 4 : 1

(d) 1 : 4

4) Interference was observed in interference chamber where air was present, now the chamber is evacuated, and if the same light is used, a careful observer will see

(a) no interference

(b) interference with brighter bands

(c) interference with dark bands

(d) interference fringe with larger width

5) Colours appear on a thin soap film and on soap bubbles due to the phenomenon of

(a) refraction

(b) dispersion

(c) interference

(d) diffraction

6) The periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is:

(a) $I_1 + I_2$

(b) $\left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

(c) $\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

(d) $2\,(I_1 + I_2)$

Directions: Questions number 7 – 10 are based on the following paragraph.

An initially parallel cylindrical beam travels in a medium of refractive index $\mu(I) = \mu_0 + \mu_2 I$, where μ_0 and μ_2 are positive constants and I is the intensity of the light beam. The intensity of the beam is decreasing with increasing radius.

7) To demonstrate the phenomenon of interference, we require two sources which emit radiation

(a) of nearly the same frequency

(b) of the same frequency

(c) of different wavelengths

(d) of the same frequency and having a definite phase relationship

8) The speed of light in the medium is

(a) minimum on the axis of the beam

(b) the same everywhere in the beam

(c) directly proportional to the intensity *I*

(d) maximum on the axis of the beam

9) The initial shape of the wave front of the beam is

(a) convex

(b) concave

(c) convex near the axis and concave near the periphery

(d) planar

10) As the beam enters the medium, it will

(a) diverge

(b) converge

(c) diverge near the axis and converge near the periphery

(d) travel as a cylindrical beam

11) This question has a paragraph followed by two statements, Statement – 1 and Statement – 2. Of the given four alternatives after the statements, choose the one that describes the statements.

A thin air film is formed by putting the convex surface of a plane – convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate) surface of the film.

Statement – 1: When light reflects from the air – glass plate interface, the reflected wave suffers a phase change of π.

Statement – 2: The centre of the interference pattern is dark.

(a) Statement – 1 is true, Statement – 2 is true, Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is true, Statement – 2 is not the correct explanation of Statement 1.

(c) Statement – 1 is false, Statement – 2 is true.

(d) Statement – 1 is true, Statement – 2 is false.

12) Two coherent plane light waves of equal amplitude makes a small angle α ($<< 1$) with each other. They fall almost normally on a screen. If λ is the wavelength of light waves, the fringe width Δx of interference patterns of the two sets of waves on the screen is

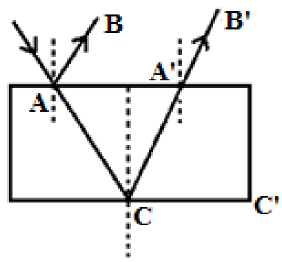
(a) $\frac{2\lambda}{\alpha}$

(b) $\frac{\lambda}{\alpha}$

(c) $\frac{\lambda}{(2\alpha)}$

(d) $\frac{\lambda}{\sqrt{\alpha}}$

13) A ray of light of intensity I is incident on a parallel glass slab at point A as shown in diagram. It undergoes partial reflection. At each reflection, 25% of incident energy is reflected. The rays AB and A'B' undergo interference. The ratio of I_{max} and I_{min} is:



(a) 49 : 1
(b) 7 : 1
(c) 4 : 1
(d) 8 : 1

14) n identical waves each of intensity I_0 interfere with each other. The ratio of maximum intensities if the interference is (i) coherent and (ii) incoherent is:

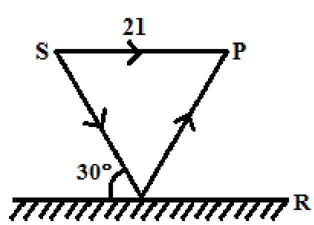
(a) n^2
(b) $\frac{1}{n}$
(c) $\frac{1}{n^2}$
(d) n

15) Two monochromatic light beams of intensity 16 and 9 units are interfering. The ratio of intensities of bright and dark parts of the resultant pattern is:

(a) $\frac{16}{9}$
(b) $\frac{4}{3}$
(c) $\frac{7}{1}$
(d) $\frac{49}{1}$

16) Interference pattern is observed at 'P' due to superimposition of two rays coming out from a source 'S' as shown in the figure. The value of 'I' for which maxima is obtained at 'P' is:

(R is perfect reflecting surface)



(a) $1 = \frac{2n\lambda}{\sqrt{3}-1}$
(b) $1 = \frac{(2n-1)\lambda}{2(\sqrt{3}-1)}$
(c) $1 = \frac{(2n-1)\lambda\sqrt{3}}{4(2-\sqrt{3})}$
(d) $1 = \frac{(2n-1)\lambda}{\sqrt{3}-1}$

17) On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam:

(a) bends downwards

(b) bends upwards

(c) becomes narrower

(d) goes horizontally without any deflection

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	c	a	d	c	d	d	a	d	b
11	12	13	14	15	16	17			
b	c	a	d	d	c	b			

Topic 84: Young's Double Slit Experiment

1) In Young's double slit experiment, the fringe width is found to be 0.4mm. If the whole apparatus is immersed in water of refractive index $\frac{4}{3}$, without distributing the geometrical arrangement, the new fringe width will be

(a) 0.30mm
(b) 0.40mm
(c) 0.53mm
(d) 450 microns

2) The Young's double slit experiment is performed with blue and with green light of wavelengths 4360Å and 5460Å respectively. If x is the distance of 4th maxima from the central one, then

(a) x (blue) = x (green)
(b) x (blue) > x (green)
(c) x (blue) < x (green)
(d) $\frac{x\text{ (blue)}}{x\text{ (green)}} = \frac{5460}{4360}$

3) In Young's experiment, two coherent sources are placed 0.90mm apart and fringe are observed one meter away. If it produces second dark fringe at a distance of 1mm from central fringe, the wavelength of monochromatic light used would be

(a) 60×10^{-4}cm
(b) 10×10^{-4}cm
(c) 10×10^{-5}cm
(d) 6×10^{-5}cm

4) If yellow light emitted by sodium lamp in Young's double slit experiment is replaced by a monochromatic blue light of the same intensity

(a) fringe width will decrease
(b) fringe width will increase
(c) fringe width will remain unchanged
(d) fringe will become less intense

5) In Young's double slit experiment carried out with light of wavelength (λ) = 5000Å, the distance between the slits is 0.2mm and the screen is at 200cm from the slits. The central maximum is at x = 0. The third maximum (taking the central maximum as zeroth maximum) will be at x equal to

(a) 1.67cm
(b) 1.5cm
(c) 0.5cm
(d) 5.0cm

6) In Young's double slit experiment the distance between the slits and the screen is doubled. The separation between the slits is reduced to half. As a result the fringe width

(a) is doubled
(b) is halved
(c) becomes four times
(d) remains unchanged

7) In Young's double slit experiment, the slits are 2mm apart and are illuminated by photons of two wavelengths λ_1 = 12000Å and λ_2 = 10000Å. At what minimum distance from the common central bright fringe on the screen 2m from the slit will a bright fringe one interference pattern coincide with a bright fringe from the other?

(a) 6mm
(b) 4mm
(c) 3mm
(d) 8mm

8) In the Young's double slit experiment, theintensity of light at a point on the screen where the path difference is λ is K, (λ being the wave length of light used). The intensity at a point where the path difference is $\lambda/4$, will be:

(a) K
(b) K/4
(c) K/2
(d) Zero

9) Two slits in Young's experiment have widths in the ratio 1 : 25. The ratio of intensity at the maxima and minima in the interference pattern, $\frac{I_{max}}{I_{min}}$ is:

(a) $\frac{121}{49}$
(b) $\frac{49}{121}$
(c) $\frac{4}{9}$
(d) $\frac{9}{4}$

10) In a double slit experiment, the two slits are 1mm apart and the screen is placed 1m away. A monochromatic light wavelength 500nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern?

(a) 0.1mm
(b) 0.5mm
(c) 0.02mm
(d) 0.2mm

11) The intensity at the maximum in a Young's double slit experiment is I_0. Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance $D = 10d$?

(a) I_0
(b) $\frac{I_0}{4}$
(c) $\frac{3}{4} I_0$
(d) $\frac{I_0}{2}$

12) Young's double slit experiment is first performed in air and then in a medium other than air. It is found that 8^{th} bright fringe in the medium lies where 5^{th} dark fringe lies in air. The refractive index of the medium is nearly

(a) 1.59
(b) 1.69
(c) 1.78
(d) 1.25

13) The maximum number of possible interference maxima for slit – separation equal to twice the wavelength in Young's double – slit experiment is

(a) three
(b) five
(c) infinite
(d) zero

14) A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is

(a) circle
(b) hyperbola
(c) parabola
(d) straight line

15) In a Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ being the wavelength of light used) is I. If I_0 denotes the maximum intensity, $\frac{I}{I_0}$ is equal to

(a) $\frac{3}{4}$
(b) $\frac{1}{\sqrt{2}}$
(c) $\frac{\sqrt{3}}{2}$
(d) $\frac{1}{2}$

16) A mixture of light, consisting of wavelength 590nm and an unknown wavelength, illuminates Young's double slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe of the unknown light. From this data, the wavelength of the unknown light is:

(a) 885.0nm
(b) 442.5nm
(c) 776.8nm
(d) 393.4nm

17) In a Young's double slit experiment, the two slits act as coherent sources of wave of equal amplitude A and wavelength λ. In another experiment with the same arrangement the two slits are made to act as incoherent sources of waves of same amplitude and wavelength. If the intensity at the middle point of the screen in the first case is I_1 and in the second case is I_2, then the ratio $\frac{I_1}{I_2}$ is

(a) 2
(b) 1
(c) 0.5
(d) 4

18) At two points P and Q on screen in Young's double slit experiment, waves from slits S_1 and S_2 have a path difference of 0 and $\frac{\lambda}{4}$, respectively. The ratio of intensities at P and Q will be:

(a) 2 : 1
(b) $\sqrt{2}$: 1
(c) 4 : 1
(d) 3 : 2

19) In a Young's double slit experiment with light of wavelength λ, fringe pattern on the screen has fringe width β. When two thin transparent glass (refractive index μ) plates of thickness t_1 and t_2 ($t_1 > t_2$) are placed in the path of the two beams respectively, the fringe pattern with shift by a distance

(a) $\frac{\beta(\mu-1)}{\lambda}\left(\frac{t_1}{t_2}\right)$
(b) $\frac{\mu\beta}{\lambda}\frac{t_1}{t_2}$
(c) $\frac{\beta(\mu-1)}{\lambda}(t_1 - t_2)$
(d) $(\mu - 1)\frac{\lambda}{\beta}(t_1 + t_2)$

20) The maximum number of possible interference maxima for slit separation equal to 1.8λ, where λ is the wavelength of light used, in a Young's double slit experiment is

(a) zero
(b) 3
(c) infinite
(d) 5

21) In Young's double slit interference experiment, the slit widths are in the ratio 1 : 25. Then the ratio of intensity at the maxima and minima in the interference pattern is

(a) 3 : 2
(b) 1 : 25
(c) 9 : 4
(d) 1 : 5

22) In Young's double slit experiment, one of the slit is wider than other, so that amplitude of the light from one slit is double of that other slit. If I_m be the maximum intensity, the resultant intensity I when they interfere at phase difference ϕ is given by:

(a) $\frac{I_m}{9}(4 + 5\cos\phi)$
(b) $\frac{I_m}{3}\left(1 + 2\cos^2\frac{\phi}{2}\right)$
(c) $\frac{I_m}{5}\left(1 + 4\cos^2\frac{\phi}{2}\right)$
(d) $\frac{I_m}{9}\left(1 + 8\cos^2\frac{\phi}{2}\right)$

23) This question has Statement – 1 and Statement – 2. Of the given after the statements, choose the one that best describes the two statements.

Statement – 1: In Young's double slit experiment, the number of fringes observed in the field of view is small with longer wavelength of light and is large with shorter wavelength of light.

Statement – 2: In the double slit experiment the fringe width depends directly on the wavelength of light.

(a) Statement – 1 is true, Statement – 2 is true, Statement – 2 is correct explanation of Statement – 1.

(b) Statement – 1 is false and the Statement – 2 is true.

(c) Statement – 1 is true, Statement – 2 is true, Statement – 2 is not correct explanation of Statement – 1.

(d) Statement – 1 is true and the Statement – 2 is false.

24) A thin glass plate of thickness is $\frac{2500}{3}\lambda$ (λ is wavelength of light used) and refractive index μ =1.5 is inserted between one of the slits and the screen in Young's double slit experiment. At a point on the screen equidistant from the slits, the ratio of the intensities before and after the introduction of the glass plate is:

(a) 2 : 1
(b) 1 : 4
(c) 4 : 1
(d) 4 : 3

25) The source that illuminates the double – slit in 'double – slit interference experiment' emits two distinct monochromatic waves of wavelength 500nm and 600nm, each of them producing its own pattern on the screen. At the central point of the pattern when path difference is zero, maxima of both the patterns coincide and the resulting interference pattern is most distinct at the region of zero path difference. But as one moves out of this central region, the two fringe systems are gradually out of step such that maximum due to on wavelength coincides with the minimum due to the other and the combined fringe system becomes completely indistinct. This may happen when path difference in nm is:

(a) 2000

(b) 3000

(c) 1000

(d) 1500

26) Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be

(a) points

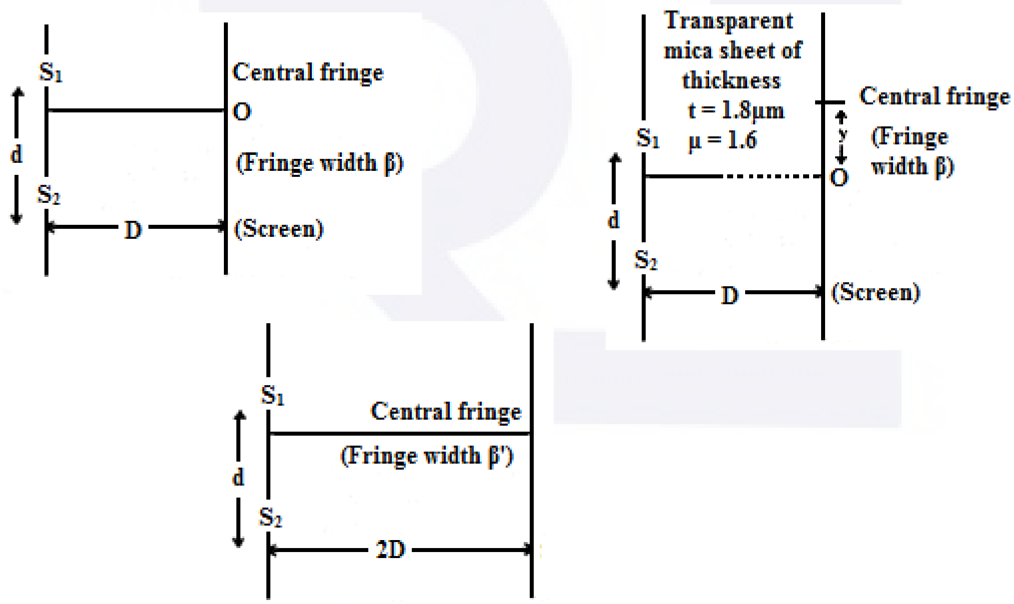
(b) straight lines

(c) semi – circles

(d) concentric circles

27) Using monochromatic light of wavelength λ, an experimentalist sets up the Young's double slit experiment in three ways as shown.

If she observes that $y = \beta'$, the wavelength of light used



(a) 520nm

(b) 540nm

(c) 560nm

(d) 580nm

28) In a Young's double slit experiment, the distance between the two identical slits is 6.1 times larger than the slit width. Then the number of intensity maxima observed within the central maximum of the single slit diffraction pattern is:

(a) 3

(b) 6

(c) 12

(d) 24

29) In a Young's double slit experiment with light of wavelength λ the separation of slits is d and distance of screen is D such that D >> d >> λ. If the fringe width is β, the distance from point of maximum intensity to the point where intensity falls to half of maximum intensity on either side is:

(a) $\frac{\beta}{6}$

(b) $\frac{\beta}{3}$

(c) $\frac{\beta}{4}$

(d) $\frac{\beta}{2}$

30) A single slit of width *b* is illuminated by a coherent monochromatic light of wavelength λ. If the second and fourth minima in the diffraction pattern at a distance 1m from the slit are at 3cm and 6cm respectively from the central maximum, what is the width of the central maximum? (i.e. distance between first minimum on either side of the central maximum)

(a) 1.5cm

(b) 3.0cm

(c) 4.5cm

(d) 6.0cm

31) In a Young's double slit experiment, slits are separated by 0.5mm, and the screen is placed 150cm away. A beam of light consisting of two wavelengths, 650nm and 520nm, is used to obtain interference fringes on the screen. The least distance from the common central maximum to the point where the bright fringes due to both the wavelengths coincide is:

(a) 9.75mm

(b) 15.6mm

(c) 1.56mm

(d) 7.8mm

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	d	a	b	c	a	c	d	d
11	12	13	14	15	16	17	18	19	20
d	c	b	d	a	b	a	a	c	b
21	22	23	24	25	26	27	28	29	30
c	d	c	c	d	d	b	c	c	b
31									
d									

Topic 85: Diffraction, Polarization of Light & Resolving Power

1) Which of the following phenomenon is not common to sound and light waves?

(a) Interference
(b) Diffraction
(c) Coherence
(d) Polarisation

2) A parallel beam of monochromatic light of wavelength 5000Å is incident normally on a single narrow slit of width 0.001mm. The light is focused by a convex lens on a screen placed in focal plane. The first minimum will be formed for the angle of diffraction equal to

(a) 0°
(b) 15°
(c) 30°
(d) 50°

3) In a Fresnel biprism experiment, the two positions of lens give separation between the slits as 16cm and 9cm respectively. What is the actual distance of separation?

(a) 12.5cm
(b) 12cm
(c) 13cm
(d) 14cm

4) A paper, with two marks having separation d, is held normal to the line of sight of an observer at a distance of 50m. The diameter of the eye – lens of the observer is 2mm. Which of the following is the least value of d, so that the marks can be seen as separate? The mean wavelength of visible light may be taken as 5000Å.

(a) 1.25m
(b) 12.5cm
(c) 1.25cm
(d) 2.5mm

5) The angular resolution of a 10cm diameter telescope at a wavelength of 5000Å is of the order of

(a) 10^{6}rad
(b) 10^{-2}rad
(c) 10^{-4}rad
(d) 10^{-6}rad

6) A parallel beam of light of wavelength λ is incident normally on a narrow slit. A diffraction pattern is formed on a screen placed perpendicular to the direction of the incident beam. At second minimum of the diffraction pattern, the phase difference between the rays coming from the two edges of slit is

(a) πλ
(b) 2π
(c) 3π
(d) 4π

7) A parallel beam of fast moving electrons is incident normally on a narrow slit. A fluorescent screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statements is correct?

(a) The angular width of the central maximum of the diffraction pattern will increase.

(b) The angular width of the central maximum will decrease.

(c) The angular width of the central maximum will be unaffected.

(d) Diffraction pattern is not observed on the screen in case of electrons.

8) A beam of light of λ = 600nm from a distant source falls on a single slit 1mm wide and the resulting diffraction pattern is observed on a screen 2m away. The distance between first dark fringes on either side of the central bright fringe is:

(a) 1.2cm
(b) 1.2mm
(c) 2.4cm
(d) 2.4mm

9) At the first minimum adjacent to the central maximum of a single – slit diffraction pattern, the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the midpoint of the slit is:

(a) $\frac{\pi}{2}$ radian
(b) π radian
(c) $\frac{\pi}{8}$ radian
(d) $\frac{\pi}{4}$ radian

10) For a parallel beam of monochromatic light of wavelength 'λ', diffraction is produced by a single slit whose width 'a' is of the wavelength of the light. If 'D' is the distance of the screen from the slit, the width of the central maxima will be:

(a) $\frac{D\lambda}{a}$
(b) $\frac{Da}{\lambda}$
(c) $\frac{2Da}{\lambda}$
(d) $\frac{2D\lambda}{a}$

11) In a diffraction pattern due to a single slit of width 'a', the first minimum is observed at an angle 30° when light of wavelength 5000Å is incident on the slit. The first secondary maximum is observed at an angle of:

(a) $\sin^{-1}\left(\frac{1}{4}\right)$
(b) $\sin^{-1}\left(\frac{2}{3}\right)$
(c) $\sin^{-1}\left(\frac{1}{2}\right)$
(d) $\sin^{-1}\left(\frac{3}{4}\right)$

12) The ratio of resolving powers of an optical microscope for two wavelengths λ_1 = 4000Å and λ_2 = 6000Å is

(a) 9 : 4
(b) 3 : 2
(c) 16 : 81
(d) 8 : 27

13) Two Polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1. The intensity of transmitted light through P_2 is

(a) $\frac{I_0}{4}$

(b) $\frac{I_0}{8}$

(c) $\frac{I_0}{16}$

(d) $\frac{I_0}{2}$

14) Wavelength of light used in an optical instrument are λ_1 = 4000Å and λ_2 = 5000Å, then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is

(a) 16 : 25

(b) 9 : 1

(c) 4 : 5

(d) 5 : 4

15) The angle of incidence at which reflected light is totally polarized for reflection from air to glass (refractive index n), is

(a) $\tan^{-1}(1/n)$

(b) $\sin^{-1}(1/n)$

(c) $\sin^{-1}(n)$

(d) $\tan^{-1}(n)$

16) Two point white dots are 1mm apart on a black paper. They are viewed by eye of pupil diameter 3mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye? [Take wavelength of light = 500nm]

(a) 1m

(b) 5m

(c) 3m

(d) 6m

17) When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is

(a) $\frac{1}{4} I_0$

(b) $\frac{1}{2} I_0$

(c) I_0

(d) zero

18) If I_0 is the intensity of the principle maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled?

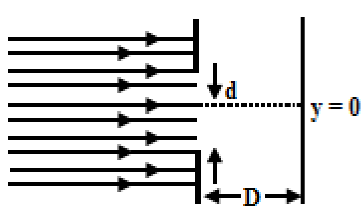
(a) $4I_0$

(b) $2I_0$

(c) $\frac{I_0}{2}$

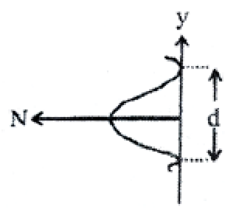
(d) I_0

19) In an experiment electrons are made to pass through a narrow slit of width 'd' comparable to their de Broglie wavelength. They are detected on a screen at a distance 'D' from the slit (see figure)

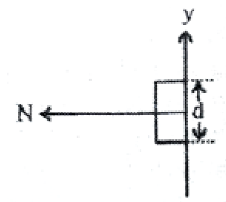


Which of the following graphs can be expected to represent the number of electrons 'N' detected as a function of the detector position 'y' (y = 0 corresponds to the middle of the slit)

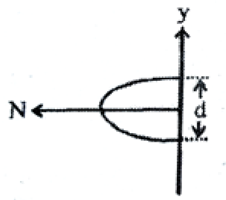
(a)



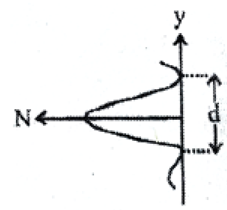
(b)



(c)



(d)



20) **Statement – 1:** On viewing the clear blue portion of the sky through a Calcite Crystal, the intensity of transmitted light varies as the crystal is rotated.

Statement – 2: The light coming from the sky is polarized due to scattering of sun light by particles in the atmosphere. The scattering is largest for blue light.

(a) Statement – 1 is true, Statement – 2 is false.

(b) Statement – 1 is true, Statement – 2 is true, Statement – 2 is the correct explanation of Statement – 1.

(c) Statement – 1 is true, Statement – 2 is true, Statement – 2 is not the correct explanation of Statement – 1.

(d) Statement – 1 is false, Statement – 2 is true.

21) Two polaroids have their polarizing directions parallel so that the intensity of a transmitted light is maximum. The angle through which either polaroid must be turned if the intensity is to drop by one – half is

(a) 135°

(b) 90°

(c) 120°

(d) 180°

22) The first diffraction minimum due to the single slit diffraction is seen at $\theta = 30°$ for a light of wavelength 5000Å falling perpendicularly on the slit. The width of the slit is

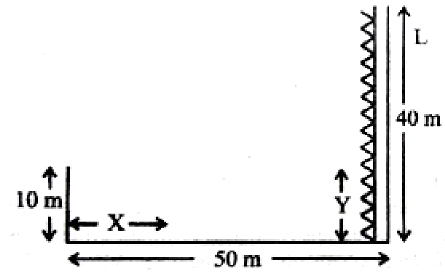
(a) 2.5×10^{-5}cm

(b) 1.25×10^{-5}cm

(c) 10×10^{-5}cm

(d) 5×10^{-5}cm

23) A person lives in a high – rise building on the bank of a river 50m wide. Across the river is a well lit tower of height 40m. When the person, who is at a height of 10m, looks through a polarizer at an appropriate angle at light of the tower reflecting from the river surface, he notes that intensity of light coming from distance X from his building is the least and this corresponds to the light coming from light bulbs at height 'Y' on the tower. The values of X and Y are respectively close to (refractive index of water $\simeq \frac{4}{3}$)



(a) 25m, 10m
(b) 13m, 27m
(c) 22m, 13m
(d) 17m, 20m

24) This question has Statement – 1 and Statement – 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement – 1: Out of radio waves and microwaves, the radio waves undergo more diffraction.

Statement – 2: Radio waves have greater frequency compared to microwaves.

(a) Statement – 1 is true, Statement – 2 is true and Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is false, Statement – 2 is true.

(c) Statement – 1 is true, Statement – 2 is false.

(d) Statement – 1 is true, Statement – 2 is true but Statement – 2 is not the correct explanation of Statement – 1.

25) A beam of unpolarized light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of the emergent light is

(a) I_0
(b) $I_0/2$
(c) $I_0/4$
(d) $I_0/8$

26) In an experiment of single slit diffraction pattern, first minimum for red light coincides with first maximum of some other wavelength. If wavelength of red light is 6600Å, then wavelength of first maximum will be:

(a) 3300Å
(b) 4400Å
(c) 5500Å
(d) 6600Å

27) A ray of light is incident from a denser to a rarer medium. The critical angle for total internal reflection is θ_{iC} and Brewster's angle of incidence is θ_{iB} , such that $\sin \theta_{iC} / \sin \theta_{iB} = \eta = 1.28$. The relative refractive index of the two media is:

(a) 0.2
(b) 0.4
(c) 0.8
(d) 0.9

28) The diameter of the objective lens of microscope makes an angle β at the focus of the microscope. Further, the medium between the object and the lens is an oil of refractive index n. Then the resolving power of the microscope

(a) increases with decreasing value of n

(b) increases with decreasing value of β

(c) increases with increasing value of n sin 2β

(d) increases with increasing value of $\frac{1}{n\sin 2\beta}$

29) Two beams, A and B, of plane polarized light with mutually perpendicular planes of polarization are seen through a polaroid. From the position when the beam A has maximum intensity (and beam B has zero intensity), a rotation of polaroid through 30° makes the two beams appear equally bright. If the initial intensities of the two beams are I_A and I_B respectively, then $\frac{I_A}{I_B}$ equals:

(a) 3

(b) $\frac{3}{2}$

(c) 1

(d) $\frac{1}{3}$

30) Unpolarized light of intensity I_0 is incident on surface of a block of glass at Brewster's angle. In that case, which one of the following statements is true?

(a) reflected light is completely polarized with intensity less than $\frac{I_0}{2}$

(b) transmitted light is completely polarized with intensity less than $\frac{I_0}{2}$

(c) transmitted light is partially polarized with intensity $\frac{I_0}{2}$

(d) reflected light is partially polarized with intensity $\frac{I_0}{2}$

31) Assuming human pupil to have a radius of 0.25cm and a comfortable viewing distance of 25cm, the minimum separation between two objects that human eye can resolve at 500nm wavelength is:

(a) 100μm

(b) 300μm

(c)1μm

(d) 30μm

32) In Young's double slit experiment, the distance between slits and the screen is 1.0m and monochromatic light of 600nm is being used. A person standing near the slits is looking at the fringe pattern. When the separation between the slits is varied, the interference pattern disappears for a particular distance d_0 between the slits. If the angular resolution of the eye is $\frac{1°}{60}$, the value of d_0 is close to:

(a) 1mm

(b) 3mm

(c) 2mm

(d) 4mm

33) Two stars are 10 light years away from the earth. They are seen through a telescope of objective diameter 30cm. The wavelength of light is 600nm. To see the stars just resolved by the telescope, the minimum distance between them should be (1 light year = 9.46×10^{15}m) of the order of:

(a) 10^8km
(b) 10^{10}km
(c) 10^{11}km
(d) 10^6km

34) The box of a pin hole camera, of length L, has a hole of radius a. It is assumed that when the hole is illuminated by a parallel beam of light of wavelength λ the spread of the spot (obtained on the opposite wall of the camera) is the sum of its geometrical spread and the spread due to diffraction. The spot would then its minimum size (say b_{min}) when:

(a) $a = \sqrt{\lambda L}$ and $b_{min} = \sqrt{4\lambda L}$
(b) $a = \frac{\lambda^2}{L}$ and $b_{min} = \sqrt{4\lambda L}$
(c) $a = \frac{\lambda^2}{L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$
(d) $a = \sqrt{\lambda L}$ and $b_{min} = \left(\frac{2\lambda^2}{L}\right)$

35) A single slit of width 0.1mm is illuminated by a parallel beam of light of wavelength 6000Å and diffraction bands are observed on a screen 0.5m from the slit. The distance of the third dark band from the central bright band is:

(a) 3mm
(b) 9mm
(c) 4.5mm
(d) 1.5mm

36) An observer is moving with half the speed of light towards a stationary microwave source emitting waves at frequency 10GHz. What is the frequency of the microwave measured by the observer? (speed of light = $3 \times 10^8 ms^{-1}$)

(a) 17.3GHz
(b) 15.3GHz
(c) 10.1GHz
(d) 12.1GHz

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
d	c	b	b	d	d	b	d	b	d
11	12	13	14	15	16	17	18	19	20
d	b	b	d	d	b	b	a	d	b
21	22	23	24	25	26	27	28	29	30
a	c	b	c	c	b	c	c	d	a
31	32	33	34	35	36				
d	c	a	a	b	a				

Topic 86: Matter Waves, Cathode & Positive Rays

1) An ionization chamber with parallel conducting plates as anode and cathode has 5×10^7 electrons and the same number of singly charged positive ions per cm^3. The electrons are moving towards the anode with velocity 0.4 m/s. The current density from anode to cathode is $4\mu A/m^2$. The velocity of positive ions moving towards cathode is

(a) 0.4 m/s
(b) 1.6 m/s
(c) zero
(d) 0.1 m/s

2) Gases begin to conduct electricity at low pressure because

(a) at low pressures gases turn of plasma

(b) colliding electrons can acquire higher kinetic energy due to increased mean free path leading to ionization of atoms

(c) atoms break up into electrons and protons

(d) the electrons in atoms can move freely at low pressures

3) The wavelength associated with an electron accelerated through a potential difference of 100 V, is of the order of

(a) 1000 $\dot{A}$
(b) 100 $\dot{A}$
(c) 10.5 $\dot{A}$
(d) 1.2 $\dot{A}$

4) Which one of the following statements is not true for cathode rays?

(a) Cathode rays produce heat when incident on metals

(b) Cathode rays travel in a straight line

(c) Cathode rays do not deflect in electric field

(d) Cathode rays produce fluorescence when they fall on certain materials

5) Which of the following moving particles (moving with same velocity) has largest wavelength of matter waves?

(a) Electron
(b) α – particle
(c) Proton
(d) Neutron

6) In a discharge tube ionization of enclosed gas is produced due to collisions between

(a) negative electrons and neutral atoms/ molecules

(b) photons and neutral atoms/ molecules

(c) neutral gas atoms/ molecules

(d) positive ions and neutral atoms/ molecules

7) A particle of mass 1mg has the same wavelength as an electron moving with a velocity of 3×10^{6} ms^{-1} The velocity of the particle is:

(a) 2.7×10^{-18} ms^{-1}

(b) 9×10^{-2} ms^{-1}

(c) 3×10^{-31} ms^{-1}

(d) 2.7×10^{-21} ms^{-1}

(mass of electron = 9.1×10^{-31} kg)

8) In the phenomenon of electric discharge through gases at low pressure, the coloured glow in the tube appears as a result of:

(a) excitation of electrons in the atoms

(b) collision between the atoms of the gas

(c) collisions between the charged particles emitted from the cathode and the atoms of the gas

(d) collision between different electrons of the atoms of the gas

9) In the Davisson and Germer experiment, the velocity of electrons emitted from the electron gun can be increased by

(a) increasing potential difference between the anode and filament

(b) increasing the filament current

(c) decreasing the filament current

(d) decreasing the potential difference between the anode and filament

10) Electrons used in an electron microscope are accelerated by a voltage of 25kV. If the voltage is increased to 100kV then the de – Broglie wavelength associated with the electrons would

(a) increase by 2 times

(b) decrease by 2 times

(c) decrease by 4 times

(d) increase by 4 times

11) If the momentum of electron is changed by P, then the de Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be:

(a) 200 P

(b) 400 P

(c) $\frac{P}{200}$

(d) 100 P

12) The de – Broglie wavelength of neutron in thermal equilibrium at temperature T is

(a) $\frac{30.8}{\sqrt{T}}\dot{A}$

(b) $\frac{3.08}{\sqrt{T}}\dot{A}$

(c) $\frac{0.308}{\sqrt{T}}\dot{A}$

(d) $\frac{0.0308}{\sqrt{T}}\dot{A}$

13) The wavelength λ_e of an electron and λ_p of a photon are of same energy E are related by

(a) $\lambda_p \propto \lambda_e$

(b) $\lambda_p \propto \sqrt{\lambda_e}$

(c) $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

(d) $\lambda_p \propto \lambda_e^2$

14) If the kinetic energy of the particle is increased to 16 times its previous value, the percentage change in the de – Broglie wavelength of the particle is:

(a) 25

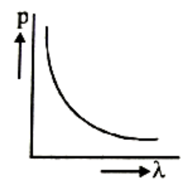
(b) 75

(c) 60

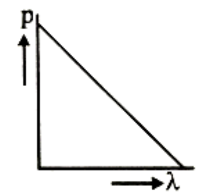
(d) 50

15) Which of the following figures represents the variation of particle momentum and the associated de – Broglie wavelength?

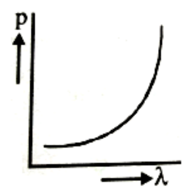
(a)



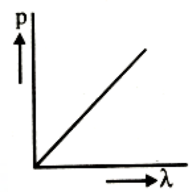
(b)



(c)



(d)



16) An electron of mass m and a photon have same energy E. The ratio of de – Broglie wavelengths associated with them is:

(a) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(b) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(c) $c\ (2mE)^{\frac{1}{2}}$

(d) $\frac{1}{xc}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

17) The de – Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is :-

(a) $\frac{h}{\sqrt{3mkT}}$

(b) $\frac{2h}{\sqrt{3mkT}}$

(c) $\frac{2h}{\sqrt{mkT}}$

(d) $\frac{h}{\sqrt{mkT}}$

18) Formation of covalent bonds in compounds exhibits

(a) wave nature of electron

(b) particle nature of electron

(c) both wave and particle nature of electron

(d) none of these

19) If the kinetic energy of a free electron doubles, it's de – Broglie wavelength changes by the factor

(a) 2

(b) $\frac{1}{2}$

(c) $\sqrt{2}$

(d) $\frac{1}{\sqrt{2}}$

20) Electrons are accelerated through a potential difference V and protons are accelerated through a potential difference 4V. The de – Broglie wavelengths are λ_e and λ_p for electrons and protons respectively. The ratio of $\frac{\lambda_e}{\lambda_p}$ is given by: (given m_e is mass of electron and m_p is mass of proton).

(a) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$

(b) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m_p}}$

(c) $\frac{\lambda_e}{\lambda_p} = \frac{1}{2}\sqrt{\frac{m_e}{m_p}}$

(d) $\frac{\lambda_e}{\lambda_p} = 2\sqrt{\frac{m_p}{m_e}}$

21) For which of the following particles will it be most difficult to experimentally verify the de – Broglie relationship?

(a) an electron

(b) a proton

(c) an α – particle

(d) a dust particle

22) de – Broglie wavelength of an electron accelerated by a voltage of 50V is closed to ($|e| = 1.6 \times 10^{-19}$C, $m_e = 9.1 \times 10^{-31}$kg, $h = 6.6 \times 10^{-34}$Js):

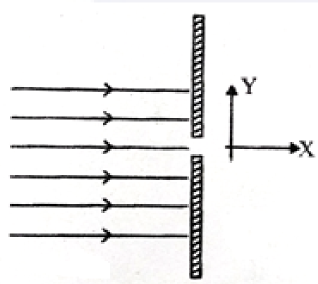
(a) 2.4Å

(b) 0.5Å

(c) 1.7Å

(d) 1.2Å

23) A parallel beam of electrons travelling in x – direction falls on a slit of width d (see figure). If after passing the slit, an electron acquires momentum p_y in the y – direction then for a majority of electrons passing through the slit (h is Planck's constant):



(a) $|P_y|d > h$

(b) $|P_y|d < h$

(c) $|P_y|d \simeq h$

(d) $|P_y|d >> h$

24) A particle A of mass m and initial velocity v collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de – Broglie wavelengths λ_A and λ_B after the collision is

(a) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$

(b) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

(c) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$

(d) $\frac{\lambda_A}{\lambda_B} = 2$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	b	d	c	a	a	d	a	a	b
11	12	13	14	15	16	17	18	19	20
a	a	d	b	a	a	a	a	d	d
21	22	23	24						
d	c	a	d						

Topic 87: Electron Emission, Photon Photoelectric Effect & X – ray

1) The threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 5000Å. Its work function is

(a) 4×10^{-19}J
(b) 1J
(c) 2×10^{-19}J
(d) 3×10^{-19}J

2) The energy of a photon of wavelength λ is

(a) hc λ
(b) $\frac{hc}{\lambda}$
(c) $\frac{\lambda}{hc}$
(d) $\frac{\lambda h}{c}$

3) Ultraviolet radiations of 6.2eV falls on an aluminium surface. K.E. of fastest electron emitted is (work function = 4.2eV)

(a) 3.2×10^{-21}J
(b) 3.2×10^{-19}J
(c) 7×10^{-22}J
(d) 9×10^{-32}J

4) The momentum of a photon of an electromagnetic radiation is 3.3×10^{-29}kgms^{-1}. What is the frequency of the associated waves? [h = 6.6×10^{-34}Js; c = 3×10^{8}ms^{-1}]

(a) 1.5×10^{13}Hz
(b) 7.5×10^{12}Hz
(c) 6.0×10^{3}Hz
(d) 3.0×10^{3}Hz

5) A radio transmitter operates at a frequency 880 kHz and a power of 10kW. The number of photons emitted per second is

(a) 1.72×10^{31}
(b) 1.327×10^{25}
(c) 1.327×10^{37}
(d) 1.327×10^{45}

6) Energy levels A, B, C of a certain atom correspond to increasing values of energy i.e., $E_A < E_B < E_C$. If λ_1, λ_2, λ_3 are the wavelengths of radiation corresponding to the transitions C to B, B to A and C to A respectively, which of the following relation is correct?

(a) $\lambda_3 = \lambda_1 + \lambda_2$
(b) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$
(c) $\lambda_1 + \lambda_2 + \lambda_3 = 0$
(d) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

7) Photoelectric work function of a metal is 1eV. Light of wavelength λ = 3000Å falls on it. The photo electrons come out with velocity

(a) 10metres/sec
(b) 10^2metres/sec
(c) 10^4metres/sec
(d) 10^6metres/sec

8) The wavelength of a 1keV photon is 1.24×10^{-9}m. What is the frequency of 1MeV photon?

(a) 1.24×10^{15}

(b) 2.4×10^{20}

(c) 1.24×10^{18}

(d) $2 \times 4 \times 10^{23}$

9) The cathode of a photoelectric cell is changed such that work function changes from $W_1$to W_2 ($W_2 > W_1$). If the current before and after changes are I_1 and I_2, all other conditions remaining unchanged, then (assuming $h\nu > W_2$)

(a) $I_1 = I_2$

(b) $I_1 < I_2$

(c) $I_1 > I_2$

(d) $I_1 < I_2 < 2I_1$

10) Momentum of a photon of wavelength λ is

(a) $\frac{h}{\lambda}$

(b) zero

(c) $\frac{h\lambda}{c^2}$

(d) $\frac{h\lambda}{c}$

11) Number of ejected photoelectron increases with increase

(a) in intensity of light

(b) in wavelength of light

(c) in frequency of light

(d) never

12) When light of wavelength 300nm (nanometer) falls on a photoelectric emitter, photoelectrons are liberated. For another emitter, however, light of 600nm wavelength is sufficient for creating photoemission. What is the ratio of the work functions of the two emitters?

(a) 1 : 2

(b) 2 : 1

(c) 4 : 1

(d) 1 : 4

13) Doubly ionized helium atoms and hydrogen ions are accelerated from rest through the same potential drop. The ratio of the final velocities of the helium and the hydrogen ion is

(a) 1/2

(b) 2

(c) $1/\sqrt{2}$

(d) $\sqrt{2}$

14) In photoelectric effect the work function of a metal is 3.5eV. The emitted electrons can be stopped by applying a potential of – 1.2V. Then

(a) the energy of the incident photon is 4.7eV

(b) the energy of the incident photon is 2.3eV

(c) if higher frequency photon be used, the photoelectric current will rise

(d) when the energy of photon is 3.5eV, the photoelectric current will be maximum

15) Kinetic energy of an electron, which is accelerated in a potential difference of 100V is

(a) 1.6×10^{-17}J

(b) 1.6×10^{-19}J

(c) 1.6×10^{-21}J

(d) 1.6×10^{-25}J

16) If the threshold wavelength for a certain metal is 2000Å, then the work – function of the metal is

(a) 6.2J
(b) 6.2eV
(c) 6.2MeV
(d) 6.2keV

17) The nature of ions knocked out from hot surfaces is

(a) Protons
(b) Neutrons
(c) Electrons
(d) Nuclei

18) An electron of mass m and charge e is accelerated from rest through a potential difference of V volt in vacuum. Its final speed will be

(a) $\frac{eV}{2m}$
(b) $\frac{eV}{m}$
(c) $\sqrt{\frac{2eV}{m}}$
(d) $\sqrt{\frac{eV}{2m}}$

19) The X – rays cannot be diffracted by means of an ordinary grating because of

(a) high speed
(b) short wavelength
(c) large wavelength
(d) none of these

20) Which of the following statement is correct?

(a) Photocurrent increases with intensity of light

(b) Photocurrent is proportional to the applied voltage

(c) Current in photocell increases with increasing frequency

(d) Stopping potential increases with increase of incident light

21) Light of wavelength 5000Å falls on a sensitive plate with photo – electric work function of 1.9eV. The kinetic energy of the photo – electrons emitted will be

(a) 0.58eV
(b) 2.48eV
(c) 1.24eV
(d) 1.16eV

22) The 21cm radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperfine interaction in atomic hydrogen. The energy of the emitted wave is nearly

(a) 10^{-17}J
(b) 1 J
(c) 7×10^{-8}J
(d) 10^{-24}J

23) In a photo – emissive cell, with exciting wavelength λ, the fastest electron has speed v. If the existing wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be

(a) $(3/4)^{1/2}$.v
(b) $(4/3)^{1/2}$.v
(c) less than $(4/3)^{1/2}$.v
(d) greater than $(4/3)^{1/2}$.v

24) The photoelectric work function for a metal surface is 4.125eV. The cut off wavelength for this surface is

(a) 4125 Å
(b) 3000Å
(c) 6000Å
(d) 2062.5Å

25) As the intensity of incident light increases

(a) photoelectric current increases

(b) K.E. of emitted photoelectrons increases

(c) photoelectric current decreases

(d) K.E. of emitted photoelectrons decreases

26) Einstein work on the photoelectric effect provided support for the equation

(a) E = hv
(b) $E = mc^2$
(c) $E = -\frac{Rhc}{n^2}$
(d) K.E. = $\frac{1}{2}mv^2$

27) When ultraviolet radiation is incident on a surface, no photoelectrons are emitted. If a second beam causes photoelectrons to be ejected, it may consists of

(a) infra – red waves
(b) X – rays
(c) visible light rays
(d) radio waves

28) A photoelectric cell is illuminated by a point source of light 1m away. When the source is shifted to 2m then

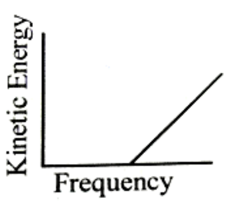
(a) number of electrons emitted is a quarter of the initial number

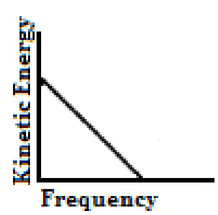
(b) each emitted electron carries one quarter of the initial energy

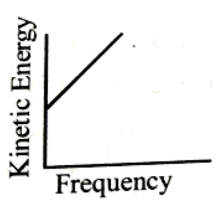
(c) number of electrons emitted is half the initial number

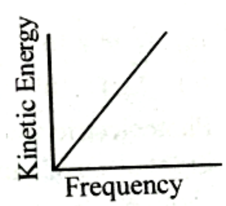
(d) each emitted electron carries half the initial energy

29) According to Einstein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

(a) 

(b) 

(c) 

(d) 

30) The work functions for metals A, B and C are respectively 1.92eV, 2.0eV and 5eV. According to Einstein's equation, the metals which will emit photoelectrons for a radiation of wavelength 4100Ȧ is/are

(a) none
(b) A only
(c) A and B only
(d) all three metals

31) A photosensitive metallic surface has work function, hv_0. If photons of energy $2hv_0$ fall on this surface, the electrons come out with a maximum velocity of 4×10^6m/s. When the photon energy is increased to $5\ hv_0$, then maximum velocity of photoelectrons will be

(a) 2×10^7m/s
(b) 2×10^6m/s
(c) 8×10^6m/s
(d) 8×10^5m/s

32) The momentum of a photon of energy 1MeV in kg m/s, will be

(a) 7×10^{-24}
(b) 10^{-22}
(c) 5×10^{-22}
(d) 0.33×10^6

33) A photo – cell employs photoelectric effect to convert

(a) change in the intensity of illumination into a change in photoelectric current
(b) change in the intensity of illumination into a change in the work function of the photocathode
(c) change in the frequency of light into a change in the electric current
(d) change in the frequency of light into a change in electric voltage

34) When photons of energy hv fall on an aluminium plate (of work function E_0), photoelectrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be

(a) 2K
(b) K
(c) K + hv
(d) $K + E_0$

35) A 5 watt source emits monochromatic light of wavelength 5000Ȧ. When placed 0.5m away, it liberates photoelectrons from a photosensitive metallic surface. When the source is moved to a distance of 1.0m, the number of photoelectrons liberated will be reduced by a factor of

(a) 8
(b) 16
(c) 2
(d) 4

36) Monochromatic light of frequency 6.0×10^{14}Hz is produced by a laser. The power emitted is 2×10^{-3} ω. The number of photons emitted, on the average, by the sources per second is

(a) 5×10^{16}
(b) 5×10^{17}
(c) 5×10^{14}
(d) 5×10^{15}

37) The work function of a surface of a photosensitive material is 6.2eV. The wavelength of incident radiation for which the stopping potential is 5V lies in the:

(a) Ultraviolet region
(b) Visible region

(c) Infrared region

(d) X – ray region

38) Monochromatic light of wavelength 667nm is produced by a helium neon laser. The power emitted is 9mW. The number of photons arriving per sec on the average at a target irradiated by this beam is:

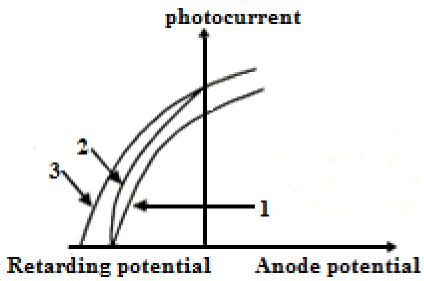
(a) 3×10^{16}

(b) 9×10^{15}

(c) 3×10^{19}

(d) 9×10^{17}

39) The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement?



(a) Curves (1) and (2) represent incident radiations of same frequency but of different intensities.

(b) Curves (2) and (3) represent incident radiations of different frequencies and different intensities.

(c) Curves (2) and (3) represent incident radiations of same frequency having same intensity.

(d) Curves (1) and (2) represent incident radiations of different frequencies and different intensities.

40) The number of photo electrons emitted for light of a frequency v (higher than the threshold frequency v_0) is proportional to:

(a) Threshold frequency (v_0)

(b) Intensity of light

(c) Frequency of light (v)

(d) $v - v_0$

41) The potential difference that must be applied to stop the fastest photoelectrons emitted by a nickel surface, having work function 5.01eV, when ultraviolet light of 200nm falls on it, must be:

(a) 2.4 V

(b) – 1.2V

(c) – 2.4V

(d) 1.2V

42) A source S_1 is producing, 10^{15} photons per second of wavelength 5000Å. Another source S_2 is producing 1.02×10^{15} photons per second of wavelength 5100Å Then, (power of S_2) (power of S_1) is equal to:

(a) 1.00

(b) 1.02

(c) 1.04

(d) 0.98

43) The threshold frequency for a photosensitive metal is 3.3×10^{14}Hz. If light of frequency 8.2×10^{14}Hz is incident on this metal, the cut off voltage for the photoelectric emission is nearly

(a) 2V

(b) 3V

(c) 5V (d) 1V

44) In photoelectric emission process from a metal of work function 1.8eV, the kinetic energy of most energetic electrons is 0.5eV. The corresponding stopping potential is

(a) 1.8V (b) 1.2V

(c) 0.5V (d) 2.3V

45) Light of two different frequencies whose photons have energies 1eV and 2.5eV respectively illuminate a metallic surface whose work function is 0.5eV successively. Ratio of maximum speeds of emitted electrons will be

(a) 1 : 4 (b) 1 : 2

(c) 1 : 1 (d) 1 : 5

46) The momentum of a photon of energy hv will be

(a) hv/c (b) c/hv

(c) hv (d) hv/c^2

47) Photoelectric emission occurs only when the incident light has more than a certain minimum

(a) power (b) wavelength

(c) intensity (d) frequency

48) Two radiations of photons energies 1eV and 2.5eV, successively illuminated a photosensitive metallic surface of work function 0.5eV. The ratio of the maximum speeds of the emitted electrons is:

(a) 1 : 4 (b) 1 : 2

(c) 1 : 1 (d) 1 : 5

49) Monochromatic radiation emitted when electron on hydrogen atom jumps from first excited to the ground state irradiates a photosensitive material. The stopping potential is measured to be 3.57V. The threshold frequency of the material is:

(a) 4×10^{15}Hz (b) 5×10^{15}Hz

(c) 1.6×10^{15}Hz (d) 2.5×10^{15}Hz

50) A 200W sodium street lamp emits yellow light of wavelength 0.6μm. Assuming it to be 25% efficient in converting electrical energy to light, the number of photons of yellow light it emits per second is

(a) 1.5×10^{20} (b) 6×10^{18}

(c) 62×10^{20} (d) 3×10^{19}

51) A source of light is placed at a distance of 50cm from a photocell and the stopping potential is found to be V_0. If the distance between the light source and photocell is made 25cm, the new stopping potential will be

(a) $2V_0$ (b) $V_0/2$

(c) V_0 (d) $4V_0$

52) For photoelectric emission from certain metal the cut – off frequency is v. If radiation of frequency 2v impinges on the metal plate, the maximum possible velocity of the emitted electron will be (m is the electron mass)

(a) $\sqrt{hv/m}$

(b) $\sqrt{2hv/m}$

(c) $2\sqrt{hv/m}$

(d) $\sqrt{hv/(2m)}$

53) When the energy of the incident radiation is increased by 20%, the kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5eV to 0.8eV. The work function of the metal is:

(a) 0.65eV

(b) 1.0eV

(c) 1.3eV

(d) 1.5eV

54) A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is:

(h = Planck's constant, c = speed of light)

(a) $\frac{hc}{\lambda}$

(b) $\frac{2hc}{\lambda}$

(c) $\frac{hc}{3\lambda}$

(d) $\frac{hc}{2\lambda}$

55) Light of wavelength 500nm is incident on a metal with work function 2.28eV. The wavelength of the emitted electron is:

(a) $< 2.8 \times 10^{-9}$m

(b) $\geq 2.8 \times 10^{-9}$m

(c) $\leq 2.8 \times 10^{-12}$m

(d) $< 2.8 \times 10^{-10}$m

56) A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photo – electric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photo – electric effect is

(a) 4λ

(b) $\frac{\lambda}{4}$

(c) $\frac{\lambda}{6}$

(d) 6 λ

57) When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is:

(a) 4λ

(b) 5λ

(c) $\frac{5}{2}\lambda$

(d) 3λ

58) The photoelectric threshold wavelength of silver is 3250×10^{-10}m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10}m is (Given h = 4.14×10^{-10} eVs and c = 3×10^{8}ms^{-1})

(a) $\approx 0.6 \times 10^{6}$ms^{-1}

(b) $\approx 61 \times 10^{3}$ms^{-1}

(c) $\approx 0.3 \times 10^{6}$ms^{-1}

(d) $\approx 6 \times 10^{5}$ms^{-1}

59) Sodium and copper have work functions 2.3eV and 4.5eV respectively. Then the ratio of the wavelengths is nearest to

(a) 1 : 2

(b) 4 : 1

(c) 2 : 1

(d) 1 : 4

60) Two identical photocathodes receive light of frequencies f_1 and f_2. If the velocities of the photo electrons (of mass m) coming out are respectively v_1 and v_2 then

(a) $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$

(b) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{1/2}$

(c) $v_1^2 + v_2^2 = \frac{2h}{m}(f_1 + f_2)$

(d) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}$

61) The work function of a substance is 4.0eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately

(a) 310nm

(b) 400nm

(c) 540nm

(d) 220nm

62) According to Einstein's photoelectric equation, the plot of the kinetic energy of the emitted photo electrons from a metal Versus the frequency, of the incident radiation gives a straight line whose slope

(a) depends both on the intensity of the radiation and the metal used

(b) depends on the intensity of the radiation

(c) depends on the nature of the metal used

(d) is the same for the all metals and independent of the intensity of the radiation

63) A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

(a) Ec

(b) $2E/c$

(c) E/c

(d) E/c^2

64) A photocell is illuminated by a small bright source placed 1m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photocathode would

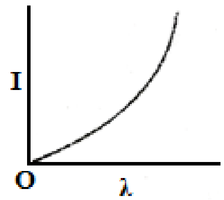
(a) increase by a factor of 4

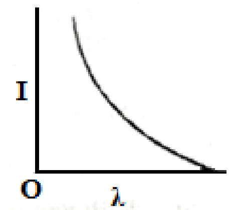
(b) decrease by a factor of 4

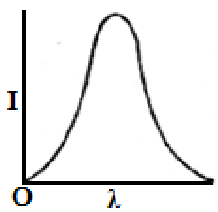
(c) increase by a factor of 2

(d) decrease by a factor of 2

65) The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows

(a)


(b)


(c)


(d)


66) The time taken by a photoelectron to come out after the photon strikes is approximately

(a)10^{-4}s

(b) 10^{-10}s

(c) 10^{-16}s

(d) 10^{-1}s

67) The threshold frequency for a metallic surface corresponds to an energy of 6.2eV and the stopping potential for a radiation incident on this surface is 5V. The incident radiation lies in

(a) ultra – violet region

(b) infra – red region

(c) visible region

(d) X – ray region

68) Photon of frequency ν has a momentum associated with it. If c is the velocity of light, the momentum is

(a) hν/c

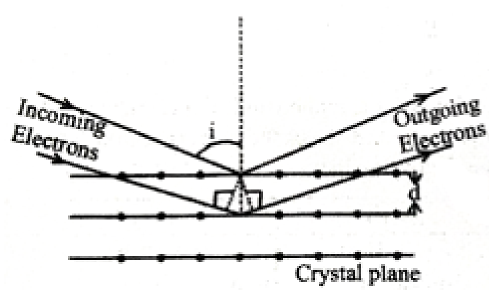
(b) ν/c

(c) hνc

(d) $h\nu/c^2$

Directions: Question No. 69 and 70 are based on the following paragraph.

Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained b requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see figure).



69) If a strong diffraction peak is observed when electrons are incident at an angle 'i' from the normal to the crystal planes with distance 'd' between them (see figure), de Broglie wavelength λ_{dB} of electrons can be calculated by the relationship (n is an integer)

(a) $d \sin i = n\lambda_{dB}$ (b) $2d \cos i = n\lambda_{dB}$

(c) $2d \sin i = n\lambda_{dB}$ (d) $d \cos i = n\lambda_{dB}$

70) Electrons accelerated by potential V are diffracted from a crystal. If d = 1Å and i = 30°, V should be about ($h = 6.6 \times 10^{-34}$Js, $m_e = 9.1 \times 10^{-31}$kg, $e = 1.6 \times 10^{-19}$C)

(a) 2000V (b) 50V

(c) 500V (d) 1000V

71) The surface of a metal is illuminated with the light of 400nm. The kinetic energy of the ejected photoelectrons was found to be 1.68eV. The work function of the metal is:

(hc = 1240eV.nm)

(a) 1.41eV (b) 1.51eV

(c) 1.68eV (d) 3.09eV

72) **Statement – 1:** When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is K_{max}. When the ultraviolet light is replaced by X – rays, both V_0 and K_{max} increase.

Statement – 2: Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light.

(a) Statement – 1 is true, Statement – 2 is true, Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is true, Statement – 2 is **not** the correct explanation of Statement – 1.

(c) Statement – 1 is false, Statement – 2 is true.

(d) Statement – 1 is true, Statement – 2 is false.

73) This question has Statement – 1 and Statement – 2. Of the four choices given after the statements, choose the one that describes the two statements.

Statement – 1: A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are K_{max} and V_0 respectively. If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.

Statement – 2: The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.

(a) Statement – 1 is true, Statement – 2 is true, Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is true, Statement – 2 is true, Statement – 2 is not the correct explanation of Statement 1.

(c) Statement – 1 is false, Statement – 2 is true.

(d) Statement – 1 is true, Statement – 2 is false.

74) This question has Statement – 1 and Statement – 2. Of the four choices given after the statements, choose the one that describes the two statements.

Statement – 1: A metallic surface is irradiated by a monochromatic light of frequency $\upsilon > \upsilon_0$ (the threshold frequency). If the incident frequency is now doubled, the photocurrent and the maximum kinetic energy are also doubled.

Statement – 2: The maximum kinetic energy of photoelectrons emitted from a surface is linearly dependent on the frequency of the incident light. The photocurrent depends only on the intensity of the incident light.

(a) Statement – 1 is true, Statement – 2 is true, Statement – 2 is the correct explanation of Statement – 1.

(b) Statement – 1 is false, Statement – 2 is true.

(c) Statement – 1 is true, Statement – 2 is false.

(d) Statement – 1 is true, Statement – 2 is true, Statement – 2 is not the correct explanation of Statement 1.

75) Photoelectrons are ejected from a metal when light of frequency υ falls on it. Pick out the wrong statement from the following.

(a) No electrons are emitted if υ is less than W/h, where W is the work function of the metal.

(b) The ejection of the photoelectrons is instantaneous.

(c) The maximum energy of the photoelectrons is $h\upsilon$.

(d) The maximum energy of the photoelectrons is independent of the intensity of the light.

76) The equation has statement 1 and statement 2. Of the four choices given after the statements, choose the one that describes the two statements.

Statement 1: Davisson – Germer experiment established the wave nature of electrons.

Statement 2: If electrons have wave nature, they can interfere and show diffraction.

(a) Statement 1 is false, Statement 2 is true.

(b) Statement 1 is true, Statement 2 is false.

(c) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

(d) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

77) A copper ball of radius 1cm and work function 4.47eV is irradiated with ultraviolet radiation of wavelength 2500Å. The effect of irradiation results in the emission of electrons from the ball. Further the ball will acquire charge and due to this there will be a finite value of the potential on the ball. The charge acquired by the ball is:

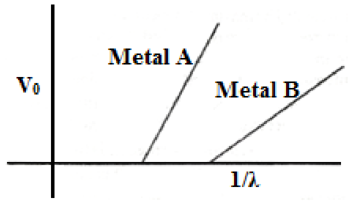
(a) 5.5×10^{-13}C

(b) 7.5×10^{-13}C

(d) 4.5×10^{-12}C

(d) 2.5×10^{-11}C

78) In an experiment on photoelectric effect, a student plots stopping potential V_0 against reciprocal of the wavelength λ of the incident light for two different metals A and B. These are shown in the figure.



Looking at the graphs, you can most approximately say that:

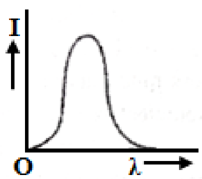
(a) Work function of metal B is greater than that of metal A.

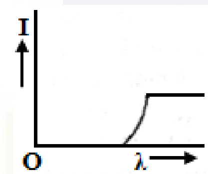
(b) For light of certain wavelength falling on both metal, maximum kinetic energy of electrons emitted from A will be greater than those emitted from B.

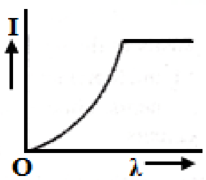
(c) Work function of metal A is greater than that of metal B

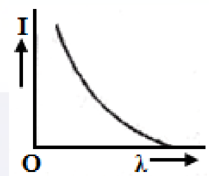
(d) Students data is not correct.

79) The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plane current I of the photocell varies as follows:

(a) 

(b) 

(c) 

(d) 

80) A photon of wavelength λ is scattered from an electron, which was at rest. The wavelength shift $\Delta\lambda$ is three times of λ and the angle of scattering θ is 60°. The angle at which the electron recoiled is ϕ. The value of tan ϕ is: (electron speed is much smaller than the speed of light)

(a) 0.16 | (b) 0.22

(c) 0.25 | (d) 0.28

81) A beam of light has two wavelengths of 4972Å and 6216Å with a total intensity of 3.6×10^{-3} Wm^{-2} equally distributed among the two wavelengths. The beam falls normally on an area of $1 cm^2$ of a clean metallic surface of work function 2.3eV. Assume that there is no loss of light by reflection and that each capable photon ejects one electron. The number of photoelectrons liberated in 2s is approximately:

(a) 6×10^{11} | (b) 9×10^{11}

(c) 11×10^{11} | (d) 15×10^{11}

82) Match **List – I** (Fundamental Experiment) with **List – II** (its conclusion) and select the correct option from the choices given below the list:

List – I	**List – II**
A. Franck – Hertz Experiment	(i) Particle nature of light
B. Photo – electric experiment	(ii) Discrete energy levels of atom
C. Davison – Germer experiment	(iii) Wave nature of electron
	(iv) Structure of atom

(a) (A) – (ii); (B) – (i); (C) – (iii)

(b) (A) – (iv); (B) – (iii); (C) – (ii)

(c) (A) – (i); (B) – (iv); (C) – (iii)

(d) (A) – (ii); (B) – (iv); (C) – (iii)

83) When photons of wavelength λ_1 are incident on an isolated sphere, the corresponding stopping potential is found to be V. When photons of wavelength λ_2 are used, the corresponding stopping potential was thrice that of the above value. If light of wavelength λ_3 is used then find the stopping potential for this case:

(a) $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{\lambda_2}-\frac{1}{\lambda_1}\right]$

(b) $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{2\lambda_2}-\frac{1}{\lambda_1}\right]$

(c) $\frac{hc}{e}\left[\frac{1}{\lambda_3}-\frac{1}{\lambda_2}-\frac{1}{\lambda_1}\right]$

(d) None

84) A photoelectric surface is illuminated successively by monochromatic light of wavelengths λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface is:

(a) $\frac{hc}{2\lambda}$

(b) $\frac{hc}{\lambda}$

(c) $\frac{hc}{3\lambda}$

(d) $\frac{3hc}{\lambda}$

85) Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be:

(a) $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

(b) $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

(c) $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

(d) $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

86) The maximum velocity of the photoelectrons emitted from the surface is v when light of frequency n falls on a metal surface. If the incident frequency is increased to 3n, the maximum velocity of the ejected photoelectrons will be:

(a) less than $\sqrt{3}$v

(b) v

(c) more than $\sqrt{3}$v

(d) equal to $\sqrt{3}$v

87) A Laser light of wavelength 660nm is used to weld Retina detachment. If a Laser pulse of width 60ms and power 0.5kW is used the approximate number of photons in the pulse are: [Take Planck's constant h = 6.62×10^{-34}Js]

(a) 10^{20}

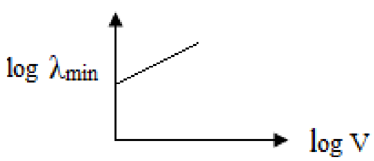
(b) 10^{18}

(c) 10^{22}

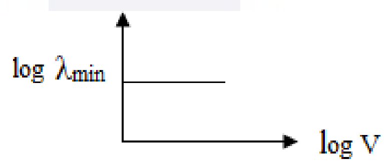
(d) 10^{19}

88) An electron beam is accelerated by a potential difference V to hit a metallic target to produce X – rays. It produces continues as well as characteristic X – rays. If λ_{min} is the smallest possible wavelength of X – ray in the spectrum, the variation of log λ_{min} with log V is correctly represented in:

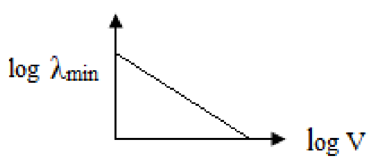
(a)



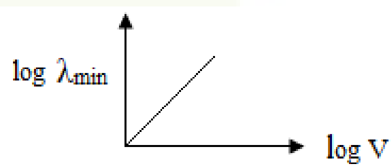
(b)



(c)



(d)



ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	b	b	a	a	b	d	b	a	a
11	12	13	14	15	16	17	18	19	20
a	b	d	a	a	b	c	c	b	a
21	22	23	24	25	26	27	28	29	30
a	d	d	b	a	a	b	a	a	c
31	32	33	34	35	36	37	38	39	40
c	c	a	c	d	d	a	a	a	b
41	42	43	44	45	46	47	48	49	50
d	a	a	c	b	a	d	b	c	a
51	52	53	54	55	56	57	58	59	60
c	b	b	d	b	a	d	a,d	c	a
61	62	63	64	65	66	67	68	69	70
a	d	b	a	b	b	a	a	b	b
71	72	73	74	75	76	77	78	79	80
a	d	c	b	c	c	a	d	d	b
81	82	83	84	85	86	87	88		
b	a	d	a	c	c	a	c		

Topic 88: Atomic Structure, Rutherford’s Nuclear Model of Atom

1) What is the radius of iodine atom (At. no. 53, mass no. 126)

(a) 2.5×10^{-11}m

(b) 2.5×10^{-9}m

(c) 7×10^{-9}m

(d) 7×10^{-6}m

2) In Rutherford’s scattering experiment, what will be the correct angle for α – scattering for an impact parameter, b = 0?

(a) 90°

(b) 270°

(c) 0°

(d) 180°

3) Who indirectly determine the mass of the electron by the measuring the charge of the electron?

(a) Millikan

(b) Rutherford

(c) Einstein

(d) Thomson

4) J.J. Thomson’s experiment demonstrated that

(a) the e/m ratio of the cathode – ray particles changes when a different gas is placed in the discharge tube

(b) cathode rays are streams of negatively charged ions

(c) all the mass of an atom is essentially in the nucleus

(d) the e/m of electrons is much greater than the e/m of protons

5) In a Rutherford scattering experiment when a projectile of charge Z_1 and mass M_1 approaches a target nucleus of charge Z_2 and mass M_2, the distance of closest approach is r_0. The energy of the projectile is

(a) directly proportional to Z_1Z_2

(b) inversely proportional to Z_1

(c) directly proportional to mass M_1

(d) directly proportional to $M_1 \times M_2$

6) An alpha nucleus of energy $\frac{1}{2}$ mv^2 bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

(a) $\frac{1}{\mathrm{Ze}}$

(b) v^2

(c) $\frac{1}{m}$

(d) $\frac{1}{v^4}$

7) When an α – particle of mass ‘m’ moving with velocity ‘v’ bombards on a heavy nucleus of charge ‘Ze’, its distance of closest approach from the nucleus depends on m as:

(a) $\frac{1}{m}$

(b) $\frac{1}{\sqrt{m}}$

(c) $\frac{1}{m^2}$

(d) m

8) An α – particle of energy 5MeV is scattered through 180° by a fixed uranium nucleus. The distance of closest approach is of the order of

(a) 10^{-12}cm

(b) 10^{-10}cm

(c)10^{-14}cm

(d) 10^{-15}cm

9) An alpha nucleus of energy $\frac{1}{2}mv^2$ bombards of a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

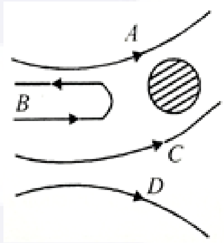
(a) v^2

(b) $\frac{1}{m}$

(c) $\frac{1}{v^2}$

(d) $\frac{1}{Ze}$

10) In the Rutherford experiment, α – particles are scattered from a nucleus as shown. Out of the four paths, which path is not possible?



(a) D

(b) B

(c) C

(d) A

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	d	d	b	a	c	a	a	b	c

Topic 89: Bohr Model &the Spectra of the Hydrogen Atom

1) The ionization energy of hydrogen atom is 13.6eV, the ionization energy of helium atom would be

(a) 13.6eV
(b) 27.2eV
(c) 6.8eV
(d) 54.4eV

2) To explain his theory, Bohr used

(a) conservation of linear momentum
(b) conservation of angular momentum
(c) conservation of quantum momentum
(d) conservation of energy

3) The ground state energy of H – atom 13.6eV. The energy needed to ionize H – atom from its second excited state.

(a) 1.51eV
(b) 3.4eV
(c) 13.6eV
(d) 12.1eV

4) The ionization energy of hydrogen atom is 13.6eV. Following Bohr's theory, the energy corresponding to a transition between 3rd and 4th orbit is

(a) 3.40eV
(b) 1.51eV
(c) 0.85eV
(d) 0.66eV

5) In terms of Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by

(a) $4a_0$
(b) $8a_0$
(c) $\sqrt{2}a_0$
(d) $2a_0$

6) Which source is associated with a line emission spectrum?

(a) Electric fire
(b) Neon street sign
(c) Red traffic light
(d) Sun

7) The radius of hydrogen atom in its ground state is 5.3×10^{-11}m. After collision with an electron it is found to have a radius of 21.2×10^{-11}m. What is the principal quantum number n of the final state of the atom

(a) n = 4
(b) n = 2
(c) n = 16
(d) n = 3

8) When a hydrogen atom is raised from the ground state to an excited state,

(a) P.E decreases and K.E. increases
(b) P.E increases and K.E. decreases
(c) both K.E. and P.E decrease
(d) absorption spectrum

9) The spectrum obtained from a sodium vapour lamp is an example of

(a) band spectrum

(b) continuous spectrum

(c) emission spectrum

(d) absorption spectrum

10) When hydrogen atom is in its first excited level, its radius is

(a) four times its ground state radius

(b) twice

(c) same

(d) half

11) In the Bohr model of a hydrogen atom, the centripetal force is furnished by the coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, m is the mass, e is the charge on the electron and ε_0 is the vacuum permittivity, the speed of the electron is

(a) 0

(b) $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$

(c) $\frac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$

(d) $\frac{\sqrt{4\pi\varepsilon_0 a_0 m}}{e}$

12) Which of the following transitions in a hydrogen atom emits the photon of highest frequency?

(a) n = 2 to n = 1

(b) n = 2 to n = 6

(c) n = 6 to n = 2

(d) n = 1 to n = 2

13) When an electron jumps from the fourth orbit to the second orbit, one gets the

(a) second line of Lyman series

(b) second line of Paschen series

(c) second line of Balmer series

(d) first line of Pfund series

14) The energy of hydrogen atom in nth orbit is E_n, then the energy in nth orbit of single ionized helium atom will be

(a) $4E_n$

(b) $E_n/4$

(c) $2E_n$

(d) $E_n/2$

15) An electron charges its position from orbit n = 2 to the orbit n = 4 of an atom. The wavelength of the emitted radiations is (R = Rydberg’s constant)

(a) $\frac{16}{R}$

(b) $\frac{16}{3R}$

(c) $\frac{16}{5R}$

(d) $\frac{16}{7R}$

16) In which of the following systems will the radius of the first orbit (n = 1) be minimum?

(a) Hydrogen atom

(b) Doubly ionized lithium

(c) Singly ionized helium

(d) Deuterium atom

17) Energy E of a hydrogen atom with principal quantum number n is given by $E = -13.6/n^2$eV. The energy of photon ejected when the electron jumps from n = 3 state to n = 2 state of hydrogen is approximately

(a) 1.9eV (b) 1.5eV

(c) 0.85eV (d) 3.4eV

18) The Bohr model of atoms

(a) predicts the same emission spectra for all types of atoms

(b) assumes that the angular momentum of electrons is quantised

(c) uses Einstein's photoelectric equation

(d) predicts continuous emission spectra for atoms

19) The total energy of an electron in the first excited state of hydrogen atom is about −3.4eV. Its kinetic energy in this state is

(a) 3.4eV (b) 6.8eV

(c) −3.4eV (d) −6.8eV

20) Ionization potential of hydrogen atom is 13.6eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be

(a) three (b) Four

(c) One (d) Two

21) The total energy of electron in the ground state of hydrogen atom is – 13.6eV. The kinetic energy of an electron in the first excited state is

(a) 6.8eV (b) 13.6eV

(c) 1.7eV (d) 3.4eV

22) The ground state energy of hydrogen atom is 13.6eV. When its electron is in the first excited state, its excitation energy is

(a) 3.4eV (b) 6.8eV

(c) 10.2eV (d) 0

23) The ionization energy of the electron in the hydrogen atom in its ground state is 13.6eV. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiations corresponds to the transition between

(a) n = 3 to n = 1 states (b) n = 2 to n = 1 states

(c) n = 4 to n = 3 states (d) n = 3 to n = 2 states

24) The energy of a hydrogen atom in the ground state is – 13.6eV. The energy of a He^+ ion in the first excited state will be

(a) – 13.6eV (b) – 27.2eV

(c) – 54.4eV (d) – 6.8eV

25) Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model?

(a) 1.9eV
(b) 11.1eV
(c) 13.6eV
(d) 0.65eV

26) An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted illuminates a photosensitive material having work function 2.75eV. If the stopping potential of the photoelectron is 10V, the value of n is

(a) 3
(b) 4
(c) 5
(d) 2

27) The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen like ion. The atomic number Z of hydrogen like ion is

(a) 3
(b) 4
(c) 1
(d) 2

28) The transition from the state n = 3 to n = 1in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from:

(a) $2 \rightarrow 1$
(b) $3 \rightarrow 2$
(c) $4 \rightarrow 2$
(d) $4 \rightarrow 3$

29) An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity that the atom acquired as a result of photon emission will be:

(a) $\frac{24hR}{25m}$
(b) $\frac{25hR}{24m}$
(c) $\frac{25m}{24hR}$
(d) $\frac{24m}{25hR}$

30) Electron in hydrogen atom first jumps from third excited state to second excited state and then from second excited to the first excited state. The ratio of the wavelength $\lambda_1 : \lambda_2$ emitted in the two cases is

(a) 7/5
(b) 27/20
(c) 27/5
(d) 20/7

31) An electron in hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n_1 and n_2 are principal quantum numbers of the two states. Assuming Bohr's model to be valid the time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are

(a) $n_1 = 4$ and $n_2 = 2$
(b) $n_1 = 6$ and $n_2 = 2$
(c) $n_1 = 8$ and $n_2 = 1$
(d) $n_1 = 8$ and $n_2 = 2$

32) Hydrogen atom in ground state is excited by a monochromatic radiation of $\lambda = 975\text{Å}$. Number of spectral lines in the resulting spectrum emitted will be

(a) 3
(b) 2

(c) 6 (d) 10

33) In the spectrum of hydrogen, the ratio of the longest wavelength in the Lyman series to the longest wavelength in the Balmer series is

(a) $\frac{9}{4}$ (b) $\frac{27}{5}$

(c) $\frac{5}{27}$ (d) $\frac{4}{9}$

34) Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy ε. If final velocities of particles be v_1 and v_2 then we must have

(a) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$

(b) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

(c) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$

(d) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

35) Consider 3^{rd} orbit of He^+ (Helium), using non – relativistic approach, the speed of electron in this orbit will be [given K = 9×10^9 constant, Z = 2 and h (Planck's Constant) = 6.6×10^{-34}Js]

(a) 1.46×10^6m/s (b) 0.73×10^6m/s

(c) 3.0×10^8m/s (d) 2.92×10^6m/s

36) Given the value of Rydberg constant is $10^7 m^{-1}$, the wave number of the last line of the Balmer series in hydrogen spectrum will be:

(a) $0.025 \times 10^4 m^{-1}$ (b) $0.5 \times 10^7 m^{-1}$

(c) $0.25 \times 10^7 m^{-1}$ (d) $2.5 \times 10^7 m^{-1}$

37) The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is:-

(a) 1 (b) 4

(c) 0.5 (d) 2

38) If 13.6eV energy is required to ionize the hydrogen atom, then the energy required to remove an electron from n = 2 is

(a) 10.2eV (b) 0eV

(c) 3.4eV (d) 6.8eV

39) The wavelengths involved in the spectrum of deuterium (^2_1D) are slightly different from that of hydrogen spectrum, because

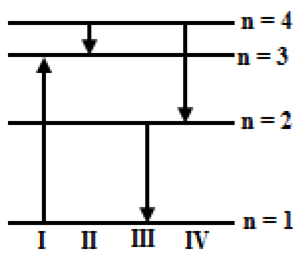
(a) the size of the two nuclei are different

(b) the nuclear forces are different in the two cases

(c) the masses of the two nuclei are different

(d) the attraction between the electron and the nuclei is different in the two cases

40) The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?



(a) IV
(b) III
(c) II
(d) I

41) Which of the following transitions in hydrogen atoms emit photons of highest frequency?

(a) n = 1 to n = 2
(b) n = 2 to n = 6
(c) n = 6 to n = 2
(d) n = 2 to n = 1

42) Suppose an electron is attracted towards the origin by a force $\frac{k}{r}$ where 'k' is a constant and 'r' is the distance of the electron from the origin. By applying Bohr model to this system, the radius of the n^{th} orbital of the electron is found to be 'r_n' and the kinetic energy of the electron to be 'T_n'. Then which of the following is true?

(a) $T_n \propto \frac{1}{n^2}$, $r_n \propto n^2$
(b) T_n is independent of n, $r_n \propto n$
(c) $T_n \propto \frac{1}{n}$, $r_n \propto n$
(d) $T_n \propto \frac{1}{n^3}$, $r_n \propto n^2$

43) The transition from the state n = 4 to n = 3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from:

(a) $3 \rightarrow 2$
(b) $4 \rightarrow 2$
(c) $5 \rightarrow 4$
(d) $2 \rightarrow 1$

44) Energy required for the electron excitation in Li^{++} from the first to the third Bohr orbit is:

(a) 36.3eV
(b) 108.8eV
(c) 122.4eV
(d) 12.1eV

45) The electron of a hydrogen atom makes a transition from the $(n+1)^{th}$ orbit to the n^{th} orbit. For large n the wavelength of the emitted radiation is proportional to

(a) n
(b) n^3

(c) n^4

(d) n^2

46) A hypothetical atom has only three energy levels. The ground level has energy, $E_1 = -8eV$. The two excited states have energies, $E_2 = -6eV$ and $E_3 = -2eV$. Then which of the following wavelengths will not be present in the emission spectrum of this atom?

(a) 207nm

(b) 465nm

(c) 310nm

(d) 620nm

47) A doubly ionized Li atom is excited from its ground state (n = 1) to n = 3 state. The wavelengths of the spectral lines are given by λ_{32}, λ_{31} and λ_{21}. The ratio $\lambda_{32}/\lambda_{31}$ and $\lambda_{21}/\lambda_{31}$ are, respectively

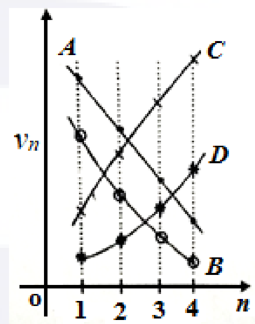
(a) 8.1, 0.67

(b) 8.1, 1.2

(c) 6.4, 1.2

(d) 6.4, 0.67

48) Which of the plots shown in the figure represents speed (v_n) of the electron in a hydrogen atom as a function of the principal quantum number (n)?



(a) B

(b) D

(c) C

(d) A

49) A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by (n is an integer)

(a) $\frac{(m_1+m_2)^2n^2h^2}{2m_1^2m_2^2r^2}$

(b) $\frac{n^2h^2}{2(m_1+m_2)r^2}$

(c) $\frac{2n^2h^2}{(m_1+m_2)r^2}$

(d) $\frac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$

50) Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be:

(a) 2

(b) 3

(c) 5

(d) 6

51) In the Bohr model an electron moves in a circular orbit around the proton. Considering the orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in n^{th} excited state, is:

(a) $\left(\frac{e}{2m}\frac{n^2h}{2\pi}\right)$

(b) $\left(\frac{e}{m}\right)\frac{nh}{2\pi}$

(c) $\left(\frac{e}{2m}\right)\frac{nh}{2\pi}$

(d) $\left(\frac{e}{m}\right)\frac{n^2h}{2\pi}$

52) Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de – Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the n^{th} orbital will therefore be proportional to:

(a) n^2

(b) n

(c) $n^{1/2}$

(d) $n^{1/4}$

53) In the Bohr's model of hydrogen – like atom the force between the nucleus and the electron is modified as $F = \frac{e^2}{4\pi\varepsilon_0}\left(\frac{1}{r^2}+\frac{\beta}{r^3}\right)$, where β is a constant. For this atom, the radius of the n^{th} orbit in terms of the Bohr radius $\left(a_0 = \frac{\varepsilon_0 h^2}{m\pi e^2}\right)$is:

(a) $r_n = a_0 n - \beta$

(b) $r_n = a_0 n^2 + \beta$

(c) $r_n = a_0 n^2 - \beta$

(d) $r_n = a_0 n + \beta$

54) A 12.5eV electron beam is used to bombard gaseous hydrogen at room temperature. It will emit:

(a) 2 lines in the Lyman series and 1 line in the Balmer series

(b) 3 lines in the Lyman series

(c) 1 lines in the Lyman series and 2 lines in the Balmer series

(d) 3 lines in the Balmer series

55) In a hydrogen like atom electron make transition from an energy level with quantum number n to another with quantum number (n – 1). If n >> 1, the frequency of radiation emitted is proportional to:

(a) $\frac{1}{n}$

(b) $\frac{1}{n^2}$

(c) $\frac{1}{n^{3/2}}$

(d) $\frac{1}{n^3}$

56) The binding energy of the electron in a hydrogen atom is 13.6eV, the energy required to remove the electron from the first excited state of Li^{++} is:

(a) 122.4eV

(b) 30.6eV

(c) 13.6eV

(d) 3.4eV

57) Match List – I (Experiment performed) with List –II (Phenomena discovered/associated) and select the correct option from the options given below the lists:

List I		List II	
(1)	Davisson and Germer experiment	(i)	Waves nature of electrons
(2)	Millikan's oil drop experiment	(ii)	Charge of an electron
(3)	Rutherford experiment	(iii)	Quantisation of energy levels
(4)	Franck – Hertz experiment	(iv)	Existence of nucleus

(a) (1) – (i), (2) – (ii), (3) – (iii), (4) – (iv)

(b) (1) – (i), (2) – (ii), (3) – (iv), (4) – (iii)

(c) (1) – (iii), (2) – (iv), (3) – (i), (4) – (ii)

(d) (1) – (iv), (2) – (iii), (3) – (ii), (4) – (i)

58) Hydrogen ($_1H^1$), Deuterium ($_1H^2$), singly ionized Helium $(_2H^4)^+$ and doubly ionized lithium $(_3Li^6)^{++}$ all have one electron around the nucleus. Consider an electron transition from n = 2 to n = 1. If the wavelengths of emitted radiation are λ_1, λ_2, λ_3 and λ_4 respectively then approximately which one of the following is correct?

(a) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

(b) $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

(c) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

(d) $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

59) The radiation corresponding to 3 → 2 transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of 3×10^{-4}T. If the radius of the largest circular path followed by these electrons is 10.0mm, the work function of the metal is close to:

(a) 1.8eV

(b) 1.1eV

(c) 0.8eV

(d) 1.6eV

60) If one were to apply Bohr model to a particle of mass 'm' and charge 'q' moving in a plane under the influence of a magnetic field 'B', the energy of the charged particle in the nth level will be:

(a) $n\left(\frac{hqB}{2\pi m}\right)$

(b) $n\left(\frac{hqB}{8\pi m}\right)$

(c) $n\left(\frac{hqB}{4\pi m}\right)$

(d) $n\left(\frac{hqB}{\pi m}\right)$

61) The de – Broglie wavelength associated with the electron in the n = 4 level is:

(a) $\frac{1}{4}$ th of the de – Broglie wavelength of the electron in the ground state.

(b) four times the de – Broglie wavelength of the electron in the ground state.

(c) two times the de – Broglie wavelength of the electron in the ground state.

(d) half of the de – Broglie wavelength of the electron in the ground state.

62) As an electron makes a transition from an excited state to the ground state of a hydrogen – like atom/ion:

(a) kinetic energy decreases, potential energy increases but total energy remains same

(b) kinetic energy and total energy decrease but potential energy increases

(c) its kinetic energy increases but potential energy and total energy decrease

(d) kinetic energy, potential energy and total energy decrease

63) A hydrogen atom makes a transition from n = 2 to n = 1 and emits a photon. This photon strikes a doubly ionized lithium atom (z = 3) in excited state and completely removes the orbiting electron. The least quantum number for the excited state of the ion for the process is:

(a) 2
(b) 4
(c) 5
(d) 3

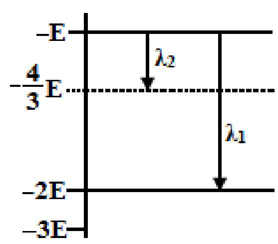
64) According to Bohr's theory, the time averaged magnetic field at the centre (i.e. nucleus) of a hydrogen atom due to the motion of electrons in the n^{th} orbit is proportional to: (n = principal quantum number)

(a) n^{-4}
(b) n^{-5}
(c) n^{-3}
(d) n^{-2}

65) The acceleration of an electron in the first orbit of the hydrogen atom (z = 1) is:

(a) $\frac{h^2}{\pi^2 m^2 r^3}$
(b) $\frac{h^2}{8\pi^2 m^2 r^3}$
(c) $\frac{h^2}{4\pi^2 m^2 r^3}$
(d) $\frac{h^2}{4\pi m^2 r^3}$

66) Some energy levels of a molecule are shown in the figure. The ratio of the wavelength $r = \lambda_1/\lambda_2$, is given by



(a) $r = \frac{3}{4}$
(b) $r = \frac{1}{3}$
(c) $r = \frac{4}{3}$
(d) $r = \frac{2}{3}$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	b	a	d	a	b	b	b	c	a
11	12	13	14	15	16	17	18	19	20
c	a	c	a	b	b	a	b	a	a
21	22	23	24	25	26	27	28	29	30
d	c	c	a	b	b	d	d	a	c
31	32	33	34	35	36	37	38	39	40
a	c	c	b	a	c	b	c	c	b
41	42	43	44	45	46	47	48	49	50
d	b	c	b	b	b	c	a	d	d
51	52	53	54	55	56	57	58	59	60
c	c	c	a	d	b	b	c	b	c
61	62	63	64	65	66				
b	c	b	d	c	b				

Topic 90: Composition and Size of the Nucleus

1) The ratio of the radii of the nuclei $_{13}Al^{27}$ and $_{52}Te^{125}$ is approximately

(a) 6 : 10

(b) 13 : 52

(c) 40 : 177

(d) 14 : 73

2) The nuclei $_{6}C^{13}$ and $_{7}N^{14}$ can be described as

(a) isotones

(b) isobars

(c) isotopes of carbon

(d) isotopes of nitrogen

3) In the nucleus of $_{11}Na^{23}$, the number of protons, neutrons and electrons are

(a) 11, 12, 0

(b) 23, 12, 11

(c) 12, 11, 0

(d) 23, 11, 12

4) The constituents of atomic nuclei are believed to be

(a) neutrons and protons

(b) protons only

(c) electrons and protons

(d) electrons, protons and neutrons

5) The mass density of a nucleus varies with mass number A as

(a) A^2

(b) A

(c) constant

(d) 1/A

6) The nucleus which has radius one – third of the radius of Cs^{189} is

(a) ${}^{4}_{2}He$

(b) ${}^{7}_{3}Li$

(c) ${}^{141}_{56}Ba$

(d) ${}^{235}_{92}U$

7) The mass number of He is 4 and that for sulphur is 32. The radius of sulphur nuclei is larger than that of helium by

(a) $\sqrt{8}$

(b) 4

(c) 2

(d) 8

8) The mass number of a nucleus is equal to the number of

(a) protons it contains

(b) nucleons it contains

(c) neutrons it contains

(d) electron it contains

9) A nucleus ruptures into two nuclear parts, which have their velocity ratio equal to 2 : 1. What will be the ratio of their nuclear size (nuclear radius)?

(a) $2^{1/3} : 1$

(b) $1 : 2^{1/3}$

(c) $3^{1/2} : 1$

(d) $1 : 3^{1/2}$

10) The stable nucleus that has a radius half that of Fe^{56} is

(a) Li^{7} (b) Na^{21}

(c) S^{16} (d) Ca^{40}

11) Atomic weight of Boron is 10.81 and it has two isotopes ${}_5B^{10}$ and ${}_5B^{11}$. Then the ratio ${}_5B^{10}$: ${}_5B^{11}$ in nature would be

(a) 19 : 81 (b) 10 : 11

(c) 15 : 16 (d) 81 : 19

12) M_n and M_p represents mass of neutron and proton respectively. If an element having atomic mass M has N – neutron and Z – proton, then the correct relation will be

(a) $M < [NM_n + ZM_p]$ (b) $M > [NM_n + ZM_p]$

(c) $M = [NM_n + ZM_p]$ (d) $M = N[M_n + M_p]$

13) The volume occupied by an atom is greater than the volume of the nucleus by a factor of about

(a) 10^{15} (b) 10^{1}

(c) 10^{5} (d) 10^{10}

14) The mass number of a nucleus is

(a) sometimes less than and sometimes more than its atomic number

(b) always less than its atomic number

(c) always more than its atomic number

(d) sometimes equal to its atomic number

15) A nucleus represented by the symbol ${}^{A}_{Z}X$ has

(a) A protons and (Z – A) neutrons (b) Z neutrons and (A – Z) protons

(c) Z protons and (A – Z) neutrons (d) Z protons and A neutrons

16) The nuclei of which one of the following pairs of nuclei are isotones?

(a) ${}_{34}Se^{74}$, ${}_{31}Ga^{71}$ (b) ${}_{38}Sr^{84}$, ${}_{38}Sr^{86}$

(c) ${}_{42}Mo^{92}$, ${}_{40}Zr^{92}$ (d) ${}_{20}Ca^{40}$, ${}_{16}S^{32}$

17) The radius of germanium (Ge) nuclide is measured to be twice the radius of ${}^{9}_{4}Be$. The number of nucleons in Ge are

(a) 74 (b) 75

(c) 72 (d) 73

18) If the nucleus ${}^{27}_{13}Al$ has nuclear radius of about 3.6fm, then ${}^{125}_{32}Te$ would have its radius approximately as

(a) 9.6fm (b) 12.0fm

(c) 4.8fm
(d) 6.0fm

19) Two nuclei have their mass number in the ratio of 1 : 3. The ratio of their nuclear densities would be

(a) 1 : 3
(b) 3 : 1
(c) $(3)^{1/3}$: 1
(d) 1 : 1

20) If the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is:

(a) 2.4
(b) 1.2
(c) 4.8
(d) 3.6

21) If radius of the $^{27}_{12}Al$ nucleus is taken to be R_{Al}, then the radius of $^{125}_{53}Te$ nucleus is nearly:

(a) $\frac{5}{3} R_{Al}$
(b) $\frac{3}{5} R_{Al}$
(c) $\left(\frac{13}{53}\right)^{1/3} R_{Al}$
(d) $\left(\frac{53}{13}\right)^{1/3} R_{Al}$

22) If radius of the $^{27}_{13}Al$ nucleus is estimated to be 3.6 fermi then the radius of $^{125}_{52}Te$ nucleus be nearly

(a) 8 fermi
(b) 6 fermi
(c) 5 fermi
(d) 4 fermi

23) Which of the following are the constituents of the nucleus?

(a) Electrons and protons
(b) Neutrons and protons
(c) Electrons and neutrons
(d) Neutrons and positrons

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	a	a	a	c	b	c	b	b	a
11	12	13	14	15	16	17	18	19	20
a	a	a	d	c	a	c	d	d	c
21	22	23							
a	b	b							

Topic 91: Mass – Energy & Nuclear Reactions

1) The average binding energy of a nucleon inside an atomic nucleus is about

(a) 8MeV
(b) 8eV
(c) 8 J
(d) 8 ergs

2) Which of the following statements is true for nuclear forces?

(a) they obey the inverse square law of distance

(b) they obey the inverse third power law of distance

(c) they are short range forces

(d) they are equal in strength to electromagnetic forces

3) If the nuclear force between two protons, two neutrons and between proton and neutron is denoted by F_{pp}, F_{nn} and F_{pn} respectively, then

(a) $F_{pp} \approx F_{nn} \approx F_{pn}$
(b) $F_{pp} \neq F_{nn}$ and $F_{pp} = F_{nn}$
(c) $F_{pp} = F_{nn} = F_{pn}$
(d) $F_{pp} \neq F_{nn} \neq F_{pn}$

4) An electron with (rest mass m_0) moves with a speed of 0.8c. Its mass when it moves with this speed is

(a) m_0
(b) $\frac{m_0}{6}$
(c) $\frac{5m_0}{3}$
(d) $\frac{3m_0}{5}$

5) The energy equivalent of one atomic mass unit is

(a) 1.6×10^{-19}J
(b) 6.02×10^{23}J
(c) 931MeV
(d) 9.31MeV

6) Solar energy is due to

(a) fusion reaction
(b) fission reaction
(c) combustion reaction
(d) chemical reaction

7) Energy released in the fission of a single $^{235}_{92}U$ nucleus is 200MeV. The fission rate of a $^{235}_{92}U$ filled reactor operating at a power level of 5W is

(a) $1.56 \times 10^{-10} s^{-1}$
(b) $1.56 \times 10^{11} s^{-1}$
(c) $1.56 \times 10^{-16} s^{-1}$
(d) $1.56 \times 10^{-17} s^{-1}$

8) Heavy water is used as a moderator in a nuclear reactor. The function of the moderator is

(a) to control energy realized in the reactor

(b) to absorb neutrons and stop chain reaction

(c) to cool the reactor

(d) to slow down the neutrons to thermal energies

9) If the binding energy per nucleon in $_3Li^7$ and $_2He^4$ nuclei are respectively 5.60MeV and 7.06MeV, then the energy of proton in the in the reaction $_3Li^7 + p \rightarrow 2\ _2He^4$ is

(a) 19.6MeV
(b) 2.4MeV
(c) 8.4MeV
(d) 17.3MeV

10) Which of the following is used as a moderator in nuclear reactors?

(a) Plutonium
(b) Cadmium
(c) Heavy water
(d) Uranium

11) In the fission reaction

$^{236}_{92}U \rightarrow {}^{117}X + {}^{117}Y + n + n$

the binding energy per nucleon of X and Y is 8.5MeV whereas of ^{236}U is 7.6MeV. The total energy liberated will be about

(a) 2000MeV
(b) 200MeV
(c) 2MeV
(d) 200keV

12) Complete the equation for the following fission process: $_{92}U^{235} + {}_0n^1 \rightarrow {}_{38}Sr^{90} + \ldots.$

(a) $_{54}X^{143} + 3\ _0n^1$
(b) $_{54}X^{145} + 3\ _0n^1$
(c) $_{57}X^{142} + 3\ _0n^1$
(d) $_{54}X^{142} + {}_0n^1$

13) The explosion of the atomic bomb takes place due to

(a) nuclear fission
(b) nuclear fusion
(c) scattering
(d) thermionic emission

14) In nuclear reactions, we have the conservation of

(a) mass only
(b) energy only
(c) momentum only
(d) mass, energy and momentum

15) It is possible to understand nuclear fission on the basis of the

(a) liquid drop model of the nucleus
(b) meson theory of the nuclear forces
(c) proton – proton cycle
(d) independent particle model of the nucleus

16) For a nuclear fusion process, the suitable nuclei are

(a) any nuclei

(b) heavy nuclei

(c) light nuclei

(d) nuclei lying in the middle of the periodic table

17) The mass of proton is 1.0073u and that of neutron is 1.0087u (u = atomic mass unit). The binding energy of ${}^{4}_{2}He$ is

(a) 0.061u
(b) 0.0305j
(c) 0.0305erg
(d) 28.4MeV

18) Solar energy is mainly caused due to

(a) gravitational contraction

(b) burning of hydrogen in the oxygen

(c) fission of uranium present in the Sun

(d) fusion of protons during synthesis of heavier elements

19) M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N neutrons. The mass M (N, Z) of the nucleus is given by (c is the velocity of light)

(a) $M(N, Z) = NM_n + ZM_p + B/c^2$
(b) $M(N, Z) = NM_n + ZM_p - Bc^2$
(c) $M(N, Z) = NM_n + ZM_p + Bc^2$
(d) $M(N, Z) = NM_n + ZM_p - B/c^2$

20) If in nuclear fusion process the masses of the fusing nuclei be m_1 and m_2 and the mass of the resultant nucleus be m_3, then

(a) $m_3 > (m_1 + m_2)$
(b) $m_3 = m_1 + m_2$
(c) $m_3 = |m_1 - m_2|$
(d) $m_3 < (m_1 + m_2)$

21) Fission of nuclei is possible because the binding energy per nucleon in them

(a) increases with mass number at low mass numbers.

(b) decreases with mass number at low mass numbers.

(c) increases with mass number at high mass numbers.

(d) decreases with mass number at high mass numbers.

22) In any fission process, the ratio $\frac{\text{mass of fission products}}{\text{mass of parent nucleus}}$ is

(a) equal to 1
(b) greater than 1
(c) less than 1
(d) depends on the mass of the parent nucleus

23) In the reaction, ${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$, if the binding energies of ${}^{2}_{1}H$, ${}^{3}_{1}H$ and ${}^{4}_{2}He$ are respectively, a, b and c (in MeV), then the energy (in MeV) released in this reaction is

(a) a + b + c
(b) a + b – c
(c) c – a – b
(d) c + a – b

24) The binding energy of deuteron is 2.2MeV and that of ${}^{4}_{2}He$ is 28MeV. If two deuterons are fused to form one ${}^{4}_{2}He$, then the energy released is

(a) 23.6MeV
(b) 19.2MeV
(c) 30.2MeV
(d) 25.8MeV

25) A nucleus ${}^{A}_{Z}X$ has mass represented by M(A, Z). If M_p and M_n denote the mass of proton and neutron respectively and B.E. the binding energy in MeV, then

(a) B.E. = $[ZM_p + (A – Z) M_p – M(A, Z)]c^2$
(b) B.E. = $[ZM_p + ZM_n – M(A, Z)]c^2$
(c) B.E. = $M(A, Z) – ZM_p – (A – Z)M_n$
(d) B.E. = $[M(A, Z) – ZM_p – (A – Z)M_n]c^2$

26) If M (A; Z), M_p and M_n denote the masses of the nucleus ${}^{A}_{Z}X$, proton and neutron respectively in units of u ($1u = 931.5MeV/c^2$) and BE represents its bonding energy in MeV, then

(a) $M(A, Z) = ZM_p + (A – Z)M_n – BE/c^2$
(b) $M(A, Z) = ZM_p + (A – Z)M_n + BE$
(c) $M(A, Z) = ZM_p + (A – Z)M_n – BE$
(d) $M(A, Z) = ZM_p + (A – Z)M_n + BE/c^2$

27) The binding energy per nucleon in deuterium and helium nuclei are 1.1MeV and 7.0MeV, respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is:

(a) 30.2MeV
(b) 23.6MeV
(c) 2.2MeV
(d) 28.0MeV

28) The mass of a ${}^{7}_{3}Li$ nucleus is 0.042u less than the sum of the masses of all its nucleons. The binding energy per nucleon of ${}^{7}_{3}Li$ nucleus is nearly

(a) 46MeV
(b) 5.6MeV
(c) 3.9MeV
(d) 23MeV

29) Fusion reaction takes place at high temperature because

(a) nuclei break up at high temperature

(b) atoms get ionized at high temperature

(c) kinetic energy is high enough to overcome the coulomb repulsion between nuclei

(d) molecules break up at high temperature

30) A nucleus of mass M emits a photon of frequency v and the nucleus recoils. The recoil energy will be

(a) $Mc^2 – hv$
(b) $h^2v^2/2Mc^2$
(c) zero
(d) hv

31) The power obtained in a reactor using U^{235} disintegration is 1000kW. The mass decay of U^{235} per hour is

(a) 10 microgram
(b) 20 microgram
(c) 40microgram
(d) 1microgram

32) How does the binding energy per nucleon vary with the increase in the number of nucleons?

(a) Increases continuously with mass number

(b) Decreases continuously with mass number

(c) First decreases and then increases with increase in mass number

(d) First increases and then decreases with increase in mass number

33) A certain mass of Hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 a.m.u. The energy liberated per a.m.u. is (Given: 1 a.m.u = 931MeV)

(a) 26.7MeV
(b) 6.675MeV
(c) 13.35MeV
(d) 2.67MeV

34) The Binding energy per nucleon of ${}_{3}^{7}\mathrm{Li}$ and ${}_{2}^{4}\mathrm{He}$ nuclei are 5.60MeV and 7.06MeV, respectively.

In the nuclear reaction ${}_{3}^{7}\mathrm{Li} + {}_{1}^{1}\mathrm{H} \rightarrow {}_{2}^{4}\mathrm{He} + \mathrm{Q}$, the value of energy Q released is:

(a) 19.6MeV
(b) −2.4MeV
(c) 8.4MeV
(d) 17.3MeV

35) A nucleus of uranium decays at rest into nuclei of thorium and helium. Then:

(a) the helium nucleus has less momentum than the thorium nucleus.

(b) the helium nucleus has more momentum than the thorium nucleus.

(c) the helium nucleus has less kinetic energy than the thorium nucleus.

(d) the helium nucleus has more kinetic energy than the thorium nucleus.

36) In the nuclear fusion reaction

${}_{1}^{2}\mathrm{H} + {}_{1}^{3}\mathrm{H} \rightarrow {}_{2}^{4}\mathrm{He} + \mathrm{n}$

Given that the repulsive potential energy between the two nuclei is $\sim 7.7 \times 10^{-14}$J, the temperature at which the gases must be initiate the reaction is nearly

[Boltzmann’s Constant $k = 1.38 \times 10^{-23}$J/K]

(a) 10^{7}K
(b) 10^{5}K
(c) 10^{3}K
(d) 10^{9}K

37) When a U^{238} nucleus originally at rest, decays by emitting an alpha particle having a speed ‘u’, the recoil speed of the residual nucleus is

(a) $\frac{4u}{238}$
(b) $-\frac{4u}{234}$
(c) $\frac{4u}{234}$
(d) $-\frac{4u}{238}$

38) The binding energy per nucleon of deuteron $({}_{1}^{2}\mathrm{H})$ and helium nucleus $({}_{2}^{4}\mathrm{He})$ is 1.1MeV and 7MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is

(a) 23.6MeV
(b) 26.9MeV

(c) 13.9MeV

(d) 19.2MeV

39) A nucleus disintegrated into two nuclear parts which have their velocities in the ratio of 2 : 1. The ratio of their nuclear sizes will be

(a) $3^{1/2} : 1$

(b) $1 : 2^{1/3}$

(c) $2^{1/3} : 1$

(d) $1 : 3^{1/2}$

40) A nuclear transformation is denoted by X(n, α) ${}^{7}_{3}\mathrm{Li}$. Which of the following is the nucleus of element X?

(a) ${}^{10}_{5}\mathrm{B}$

(b) ${}^{12}\mathrm{C}_{6}$

(c) ${}^{11}_{4}\mathrm{Be}$

(d) ${}^{9}_{5}\mathrm{B}$

41) If the binding energy per nucleon in ${}^{7}_{3}\mathrm{Li}$ and ${}^{4}_{2}\mathrm{He}$ nuclei are 5.60MeV 7.06MeV respectively, then in the reaction

$$p + {}^{7}_{3}\mathrm{Li} \rightarrow 2\,{}^{4}_{2}\mathrm{He}$$

energy of proton must be

(a) 28.24MeV

(b) 17.28MeV

(c) 1.46MeV

(d) 39.2MeV

42) When ${}_{3}\mathrm{Li}^{7}$ nuclei are bombarded by protons, and the resultant nuclei are ${}_{4}\mathrm{Be}^{8}$, the emitted particles will be

(a) alpha particles

(b) beta particles

(c) gamma particles

(d) neutrons

43) If M_O is the mass of an oxygen isotope ${}_{8}\mathrm{O}^{17}$, M_P and M_N are the masses of a proton and a neutron respectively, the nuclear binding energy of the isotope is

(a) $(M_O - 17M_N)c^2$

(b) $(M_O - 8M_P)c^2$

(c) $(M_O - 8M_P - 9M_N)c^2$

(d) $M_O c^2$

44) This question contains Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement 1: Energy is released when heavy nuclei undergo fission or light nuclei undergo fusion and

Statement 2: For heavy nuclei, binding energy per nucleon increases with increasing Z while for light nuclei it decreases with increasing Z.

(a) Statement 1 is false, Statement 2 is true.

(b)Statement 1 is true, Statement 2 is true, Statement 2 is a correct explanation of Statement 1.

(c) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.

(d) Statement 1 is true, Statement 2 is false.

DIRECTIONS: Questions number 45 – 46 are based on the following paragraph.

A nucleus of mass M + Δm is at rest and decays into two daughter nuclei of equal mass $\frac{M}{2}$ each. Speed of light is c.

45) The speed of daughter nuclei is

(a) $c\,\frac{\Delta m}{M+\Delta m}$

(b) $c\sqrt{\frac{2\Delta m}{M}}$

(c) $c\sqrt{\frac{\Delta m}{M}}$

(d) $c\sqrt{\frac{\Delta m}{M+\Delta m}}$

46) The binding energy per nucleon for the parent nucleus is E_1 and that for the daughter nuclei is E_2. Then

(a) $E_2 = 2E_1$

(b) $E_1 > E_2$

(c) $E_2 > E_1$

(d) $E_1 = 2E_2$

47) After absorbing a slowly moving neutron of mass m_N (momentum ≈ 0) a nucleus of mass M breaks into two nuclei of masses m_1 and $5m_1$ ($6m_1 = M + m_N$) respectively. If the de Broglie wavelength of the nucleus with mass m_1 is λ, the de Broglie wavelength of the nucleus will be

(a) 5λ

(b) λ/5

(c) λ

(d) 25λ

48) Ionisation energy of Li (Lithium) atom in ground state is 5.4eV. Binding energy of an electron in Li^+ ion in ground state is 75.6eV. Energy required to remove all three electrons of Lithium (Li) atom is

(a) 81.0eV

(b) 135.4eV

(c) 203.4eV

(d) 156.6eV

49) Assume that a neutron breaks into a proton and an electron. The energy released during this process is: (mass of neutron = 1.6725×10^{-27}kg, mass of proton = 1.6725×10^{-27}kg, mass of electron = 9×10^{-31} kg).

(a) 0.51MeV

(b) 7.10MeV

(c) 6.30MeV

(d) 5.4MeV

50) When Uranium is bombarded with neutrons, it undergoes fission. The fission reaction can be written as: ${}_{92}U^{235} + {}_{0}n^{1} \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3x + Q$ (energy)

Where three particles named x are produced and energy Q is released. What is the name of the particle x?

(a) electron

(b) α – particle

(c) neutron

(d) neutrino

51) Two deuterons undergo nuclear fusion to form a Helium nucleus. Energy released in this process is: (given binding energy per nucleon for deuteron = 1.1MeV and for helium = 7.0MeV)

(a) 30.2MeV

(b) 32.4MeV

(c) 23.6MeV

(d) 25.8MeV

52) Imagine that a reactor converts all given mass into energy and that it operates at a power level of 10^9watt. The mass of the fuel consumed per hour in the reactor will be: (velocity of light, c is 3×10^8m/s)

(a) 0.96gm

(b) 0.8gm

(c) 4×10^{-2}gm

(d) 6.6×10^{-5}gm

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
a	c	d	c	c	a	b	d	d	c
11	12	13	14	15	16	17	18	19	20
b	a	a	d	a	c	d	d	d	d
21	22	23	24	25	26	27	28	29	30
d	c	c	a	a	a	b	b	c	b
31	32	33	34	35	36	37	38	39	40
c	d	b	d	d	d	c	a	b	a
41	42	43	44	45	46	47	48	49	50
b	c	c	d	b	c	c	d	a	c
51	52								
c	c								

Topic 92: Radioactivity

1) The nucleus $^{115}_{48}\mathrm{Cd}$, after two successive β – decay will give

(a) $^{115}_{46}$ Pa

(b) $^{114}_{49}$ In

(c) $^{113}_{50}$ Sn

(d) $^{115}_{50}$ Sn

2) A radioactive sample with a half life of 1month has the label: 'Activity = 2 micro curies on 1– 8– 1991. What should be its activity two months earlier?

(a) 1.0 micro curie

(b) 0.5 micro curie

(c) 4 micro curie

(d) 8 micro curie

3) Curie is a unit of

(a) energy of gamma – rays

(b) half – life

(c) radioactivity

(d) intensity of gamma – rays

4) An element A decays into element C by a two step process

$A \rightarrow B + {}_2He^4$

$B \rightarrow C + 2e^-$

Then

(a) A and C are isotopes

(b) A and C are isobars

(c) A and B are isotopes

(d) A and B are isobars

5) A radioactive element has half life period 800 years. After 6400 years what amount will remain?

(a) $\frac{1}{2}$

(b) $\frac{1}{16}$

(c) $\frac{1}{8}$

(d) $\frac{1}{256}$

6) The nucleus ${}_6C^{12}$ absorbs an energetic neutron and emits a beta particle (β).The resulting nucleus is

(a) ${}_7N^{14}$

(b) ${}_7N^{13}$

(c) ${}_5B^{13}$

(d) ${}_6C^{13}$

7) The half life of radium is 1600 years. The fraction of a sample of radium that would remain after 6400 years

(a) 1/4

(b) 1/2

(c) 1/8

(d) 1/16

8) The mass of α – particle is

(a) less than the sum of masses of two protons and two neutrons

(b) equal to mass of four protons

(c) equal to mass of four neutrons

(d) equal to sum of masses of two protons and two neutrons

9) In a given reaction

${}_{Z}X^{A} \rightarrow {}_{Z+1}Y^{A} \rightarrow {}_{Z-1}K^{A-4} \rightarrow {}_{Z-1}K^{A-4}$

Radioactive radiations are emitted in the sequence of

(a) α, β, γ
(b) γ, α, β
(c) β, α, γ
(d) γ, β, α

10) The count rate of a Geiger Muller counter for the radiation of a radioactive material of half – life 30 minutes decreases to 5 sec^{-1} after 2 hours. The initial count rate was

(a) 20 sec^{-1}
(b) 25 sec^{-1}
(c) 80 sec^{-1}
(d) 625 sec^{-1}

11) What is the respective number of α and β – particles emitted in the following radioactive decay ${}^{200}X_{90} \rightarrow {}^{168}Y_{80}$?

(a) 6 and 8
(b) 6 and 6
(c) 8 and 8
(d) 8 and 6

12) The most penetrating radiation of the following is

(a) gamma – rays
(b) alpha particles
(c) beta –rays
(d) X – rays

13) A free neutron decays into a proton, an electron and

(a) a beta particle
(b) an alpha particle
(c) an anti – neutron
(d) a neutrino

14) The activity of a radioactive sample is measured as 9750 counts per minute at t = 0 and as 975 counts per minute at t = 5 minutes. The decay constant is approximately

(a) 0.922 per minute
(b) 0.691 per minute
(c) 0.461 per minute
(d) 0.230 per minute

15) Half – lives of two radioactive substances A and B are respectively 20 minutes and 40 minutes. Initially, the sample of A and B have equal number of nuclei. After 80 minutes the ratio of remaining numbers of A and B nuclei is

(a) 1 : 16
(b) 4 : 1
(c) 1 : 4
(d) 1 : 1

16) After 1α and 2β – emissions

(a) mass number reduces by 4
(b) mass number reduces by 5

(c) mass number reduces by 6

(d) mass number increases by 4

17) Alpha – particles are

(a) protons

(b) positron

(c) neutrally charged

(d) ionized helium atoms

18) Atomic hydrogen has life period of

(a) one minute

(b) one day

(c) a fraction of a second

(d) one hour

19) The decay constant (λ) and the half – life (T) of a radioactive isotope are related as

(a) $\lambda = \frac{\log_e 2}{T}$

(b) $\lambda = \frac{1}{\log_e 2.T}$

(c) $\lambda = \frac{T}{\log_e 2}$

(d) $\lambda = \frac{2}{T}$

20) A deuteron strikes $_8O^{16}$ nucleus with subsequent emission of an alpha particle. Identify the nucleus so produced

(a) $_3Li^7$

(b) $_5B^{10}$

(c) $_7N^{13}$

(d) $_7N^{14}$

21) A sample has 4×10^{16} radioactive nuclei of half life 10 days. The number of atoms decaying in 30 days is

(a) 3.9×10^{16}

(b) 5×10^{15}

(c) 10^{16}

(d) 3.5×10^{16}

22) A sample of radioactive element has a mass of 10gm at an instant t = 0. The approximate mass of this element in the sample after two mean lives is

(a) 6.30gm

(b) 1.35gm

(c) 2.50gm

(d) 3.70gm

23) A nuclear reaction is given by

$_ZX^A \rightarrow {}_{Z+1}Y^A + {}_{-1}e^0 + \bar{\nu}$, represents

(a) fission

(b) β – decay

(c) γ – decay

(d) fusion

24) The half life of radium is about 1600 years. Of 100g of radium exciting now, 25g will remain unchanged after

(a) 3200 years

(b) 4800 years

(c) 6400 years

(d) 2400 years

25) In a radioactive material the activity at time t_1 is R_1 and at a later t_2, it is R_2. If the decay constant of the material is λ, then

(a) $R_1 = R_2e^{\lambda(t_1-t_2)}$

(b) $R_1 = R_2e^{(t_2/t_1)}$

(c) $R_1 = R_2$

(d) $R_1 = R_2e^{-\lambda(t_1-t_2)}$

26) In a radioactive decay process, the negatively charge emitted β – particles are

(a) the electrons produced as a result of the decay of neutrons inside the nucleus

(b) the electrons produced as a result of collisions between atoms

(c) the electrons orbiting around the nucleus

(d) the electrons present inside the nucleus

27) Two radioactive substances A and B have decay constants 5λ and λ respectively. At t = 0 they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $(1/e)^2$ after a time interval.

(a) 4λ

(b) 2λ

(c) 1/2λ

(d) 1/4λ

28) Two radioactive materials X_1 and X_2 have decay constant 5λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be $\frac{1}{e}$ after a time

(a) λ

(b) $\frac{1}{2}\lambda$

(c) $\frac{1}{4\lambda}$

(d) $\frac{e}{\lambda}$

29) In the nuclear decay given below:

${}^{A}_{Z}X \rightarrow {}_{Z+1}{}^{A}Y \rightarrow {}^{A-4}_{Z-1}B^{*} \rightarrow {}^{A-4}_{Z-1}B$,

The particles emitted in the sequence are

(a) γ, β, α

(b) β, γ, α

(c) α, β, γ

(d) β, α, γ

30) The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an

(a) isomer of parent

(b) isotone of parent

(c) isotope of parent

(d) isobar of parent

31) The decay constant of a radio isotope is λ. If A_1 and A_2 are its activities at times t_1 and t_2 respectively, the number of nuclei which have decayed during the time $(t_1 - t_2)$:

(a) $\lambda (A_1 - A_2)$

(b) $A_1t_1 - A_2t_2$

(c) $A_1 - A_2$

(d) $(A_1 - A_2)/\lambda$

32) The activity of a radioactive sample is measured as N_0 counts per minute at t = 0 and N_0/e counts per minute at t = 5 minutes. The time (in minutes) at which the activity reduces to half its value is

(a) $\log_e 2/5$

(b) $\frac{5}{\log_e 2}$

(c) $5 \log_{10} 2$

(d) $5 \log_e 2$

33) Two radioactive nuclei P and Q, in a given sample decay into a stable nucleolus R. At time t = 0, number of P species are $4N_0$ and that of Q are N_0. Half – life of P (for conversion to R) is 1 minute where as that of Q is 2 minutes. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal, the number of nuclei of R present in the sample would be

(a) $3N_0$

(b) $\frac{9N_0}{2}$

(c) $\frac{5N_0}{2}$

(d) $2N_0$

34) A nucleus ${}^{m}_{n}X$ emits one α – particle and two β – particles. The resulting nucleus is

(a) ${}^{m-6}_{n-4}Z$

(b) ${}^{m-6}_{n}Z$

(c) ${}^{m-4}_{n}X$

(d) ${}^{m-4}_{n-2}Y$

35) The half life of a radioactive isotope 'X' is 50 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio of 1 :15 in a sample of a given rock. The age of the rock was estimated to be

(a) 150 years

(b) 200 years

(c) 250 years

(d) 100 years

36) The half life of a radioactive nucleus is 50 days. The time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and the time t_1 when $\frac{1}{3}$ of it had decayed is:

(a) 30 days

(b) 50 days

(c) 60 days

(d) 15 days

37) A mixture consists of two radioactive materials A_1 and A_2 with half lives of 20s and 10s respectively. Initially the mixture has 40g of A_1 and 160g of A_2. The amount of the two in the mixture will become equal after:

(a) 60s

(b) 80s

(c) 20s

(d) 40s

38) α – particles, β – particles and γ – rays are all having same energy. Their penetrating power in a given medium in increasing order will be

(a) β, γ, α

(b) γ, α, β

(c) α, β, γ

(d) β, α, γ

39) The half life of a radioactive isotope ‘X’ is 20 years. It decays to another element ‘Y’ which is stable. The two elements ‘X’ and ‘Y’ were found to be in the ratio of 1 : 7 in a sample of the given rock. The age of the rock is estimated to be

(a) 60 years
(b) 80 years
(c) 100 years
(d) 40 years

40) A radio isotope ‘X’ with a half life 1.4×10^9 years decays to ‘Y’ which is stable. A sample of the rock from a cave was found to contain ‘X’ and ‘Y’ in the ratio 1 : 7. The age of the rock is:

(a) 1.96×10^9 years
(b) 3.92×10^9 years
(c) 4.20×10^9 years
(d) 8.40×10^9 years

41) Radioactive material ‘A’ has decay constant ‘8λ’ and material ‘B’ has decay constant ‘λ’. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material ‘B’ to that ‘A’ will be $\frac{1}{e}$?

(a) $\frac{1}{7\lambda}$
(b) $\frac{1}{8\lambda}$
(c) $\frac{1}{9\lambda}$
(d) $\frac{1}{\lambda}$

42) If N_0 is the original mass of the substance of half – life period $t_{1/2}$ = 5 years, then the amount of substance left after 15 years is

(a) $N_0/8$
(b) $N_0/16$
(c) $N_0/2$
(d) $N_0/4$

43) At a specific instant emission of radioactive compound is deflected in a magnetic field. The compound can emit

(i) electrons
(ii) protons
(iii) He^{2+}
(iv) neutrons

The emission at instant can be

(a) i, ii, iii
(b) i, ii, iii, iv
(c) iv
(d) ii, iii

44) A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 minutes, the rate is 1250 disintegrations per minute. Then, the decay constant (per minute) is

(a) 0.4 ln 2
(b) 0.2 ln 2
(c) 0.1 ln 2
(d) 0.8 ln 2

45) A nucleus with Z = 92 emits the following in a sequence:

$\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \beta^+, \alpha$

Then Z of the resulting nucleus is

(a) 76

(b) 78

(c) 82

(d) 74

46) Which of the following **cannot** be emitted by radioactive substances during their decay?

(a) Protons

(b) Neutrinoes

(c) Helium nuclei

(d) Electrons

47) The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to $\frac{I}{8}$. The thickness of lead which will reduce the intensity to $\frac{I}{2}$ will be

(a) 9mm

(b) 6mm

(c) 12mm

(d) 18mm

48) Starting with a sample of pure ^{66}Cu, $\frac{7}{8}$ of it decays into Zn in 15 minutes. The corresponding half life is

(a) 15 minutes

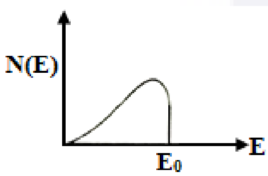
(b) 10 minutes

(c) $7\frac{1}{2}$ minutes

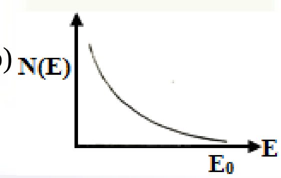
(d) 5 minutes

49) The energy spectrum of β – particles [number N(E) as a function of β – energy E] emitted from a radioactive source is

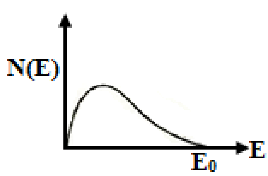
(a)



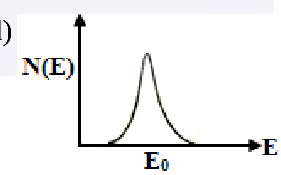
(b)



(c)



(d)



50) The half life period of a radio - active element X is same as the mean life time of another radio – active element Y. Initially they have the same number of atoms. Then

(a) X and Y decay at same rate always

(b) X will decay faster than Y

(c) Y will decay faster than X

(d) X and Y have same decay rate initially

51) A radioactive nucleus (initial mass number A and atomic number Z emits 3α – particles and 2 positrons. The ratio of number of neutrons to that of protons in the final nucleus will be

(a) $\frac{A-Z-8}{Z-4}$

(b) $\frac{A-Z-4}{Z-8}$

(c) $\frac{A-Z-12}{Z-4}$

(d) $\frac{A-Z-4}{Z-2}$

52) **Statement -1:** A nucleus having energy E_1 decays by β^- emission to daughter nucleus having energy E_2, but the β^- rays are emitted with a continuous energy spectrum having end point energy $E_1 - E_2$.

Statement – 2: To conserve energy and momentum in β^- decay at least three particles must take part in the transformation.

(a) Statement – 1 is correct but Statement – 2 is not correct.

(b) Statement – 1 and Statement – 2 both are correct and statement – 2 is the correct explanation of statement – 1.

(c) Statement – 1 and Statement – 2 is correct and statement – 2 is not the correct explanation of statement – 1.

(d) Statement – 1 is incorrect, Statement – 2 is correct.

53) The half life of a radioactive substance is 20 minutes. The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it had decayed and time t_1 when $\frac{1}{3}$ of it had decayed is:

(a) 14 min (b) 20 min

(c) 28 min (d) 7 min

54) A sample originally contained 10^{20} radioactive atoms, which emit α – particles. The ratio of α – particles emitted in the third year to that emitted during the second year is 0.3. How many α – particles were emitted in the first year?

(a) 3×10^{18} (b) 3×10^{19}

(c) 5×10^{18} (d) 7×10^{19}

55) Which of the following Statement is correct?

(a) The rate of radioactive decay cannot be controlled but that of nuclear fission can be controlled.

(b) Nuclear forces are short range, attractive and charge dependent.

(c) Nuclei of atoms having same number of neutrons are known as isobars.

(d) Wavelength of matter waves is given by de – Broglie formula but that of photons is not given by the same formula

56) The decay constants of a radioactive substance for α and β emission are λ_α and λ_β respectively. If the substance emits α and β simultaneously, then the average half life of the material will be

(a) $\frac{2T_\alpha T_\beta}{T_\alpha + T_\beta}$ (b) $T_\alpha + T_\beta$

(c) $\frac{T_\alpha T_\beta}{T_\alpha + T_\beta}$ (d) $\frac{1}{2}\left(T_\alpha + T_\beta\right)$

57) The counting rate observed from a radioactive source at t = 0 was 1600 counts s^{-1}, and t = 8s, it was 100 counts s^{-1}. The counting rate observed as counts s^{-1} at t = 6 s will be

(a) 250 (b) 400

(c) 300 (d) 200

58) The half – life of a radioactive element A is the same as the mean – life of another radioactive element B. Initially both substances have the same number of atoms, then:

(a) A and B decay at the same rate always.

(b) A and B decay at the same rate initially.

(c) A will decay at a faster rate than B.

(d) B will decay at a faster rate than A.

59) A radioactive nuclei with decay constant 0.5/s is being produced at a constant rate of 100 nuclei/s. If at t = 0 there were no nuclei, the time when there are 50 nuclei is:

(a) 1s (b) $2ln\left(\frac{4}{3}\right)$s

(c) ln 2s (d) $ln\left(\frac{4}{3}\right)$s

60) A piece of bone of an animal from a ruin is found to have ^{14}C activity of 12 disintegrations per minute per gm of its carbon content. The ^{14}C activity of a living animal is 16 disintegrations per minute per gm. How long ago nearly did the animal die? (Given half life of ^{14}C is $t_{1/2}$ = 5760 years)

(a) 1672 years (b) 2391 years

(c) 3291 years (d) 4453 years

61) A piece of wood from a recently cut tree shows 20 decays per minute. A wooden piece of same size placed in a museum (obtained from a tree cut many years back) shows 2 decays per minute. If half life of C^{14} is 5730 years, then age of the wooden piece placed in the museum is approximately:

(a) 10439 years (b) 13094 years

(c) 19039 years (d) 39049 years

62) Let N_β be the number of β particles emitted by 1 gram of Na^{24} radioactive nuclei (half life = 15 hrs) in 7.5 hours, N_β is close to (Avogadro number = 6.023×10^{23}/g. mole):

(a) 6.2×10^{21} (b) 7.5×10^{21}

(c) 1.25×10^{22} (d) 1.75×10^{22}

63) Half – lives of two radioactive elements A and B are 20 minutes and 40 minutes, respectively. Initially, the samples have equal number of nuclei. After 80 minutes, the ratio of decayed number of A and B nuclei will be:

(a) 1 : 4 (b) 5 : 4

(c) 1 : 16 (d) 4 : 1

64) A radioactive nucleus A with a half life T, decays into a nucleus B. At t = 0, there is no nucleus B. At sometime t, the ratio of the number of B to that of A is 0.3. Then, t is given by

(a) $t = T \log(1.3)$

(b) $t = \dfrac{T}{\log(1.3)}$

(c) $t = T\dfrac{\log 2}{\log 1.3}$

(d) $t = \dfrac{\log 1.3}{\log 2}$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	d	c	a	d	b	d	a	c	c
11	12	13	14	15	16	17	18	19	20
d	a	c	c	c	a	d	c	a	d
21	22	23	24	25	26	27	28	29	30
d	b	b	a	d	a	c	c	d	c
31	32	33	34	35	36	37	38	39	40
d	d	b	c	b	b	d	c	a	c
41	42	43	44	45	46	47	48	49	50
a	a	a	a	b	a	c	d	c	c
51	52	53	54	55	56	57	58	59	60
b	b	b	b	a	c	d	d	b	b
61	62	63	64						
c	b	b	d						

Topic 93: Solids, Semiconductors and P – N Junction Diode

1) At absolute zero, Si acts as

(a) non – metal
(b) metal
(c) insulator
(d) none of these

2) p – n junction is said to be forward biased, when

(a) the positive pole of the battery is joined to the p – semiconductor and negative pole to the n – semiconductor

(b) the positive pole of the battery is joined to the n – semiconductor and p– semiconductor joined to negative pole of the battery

(c) the positive pole of the battery is connected to n – semiconductor and p– semiconductor is connected to the positive pole of the battery

(d) a mechanical force is applied in the forward direction

3) When n – type semiconductor is heated

(a) number of electrons increases while that of holes decreases

(b) number of holes increases while that of electrons decreases

(c) number of electrons and holes remain same

(d) number of electrons and holes increases equally.

4) The depletion layer in the p – n junction region is caused by

(a) drift of holes
(b) diffusion of charge carries
(c) migration of impurity ions
(d) drift of electrons

5) For an electronic valve, the plate current I and plate voltage V in the space charge limited region are related as

(a) I is proportional to $V^{3/2}$
(b) I is proportional to $V^{2/3}$
(c) I is proportional to V
(d) I is proportional to V^2

6) Which one of the following is the weakest kind of bonding in solids

(a) ionic
(b) metallic
(c) Vander Waal’s
(d) covalent

7) Diamond is very hard because

(a) it is a covalent solid
(b) it has large cohesive energy
(c) high melting point
(d) insoluble in all solvents

8) A piece of copper and other of germanium are cooled from the room temperature to 80K, then

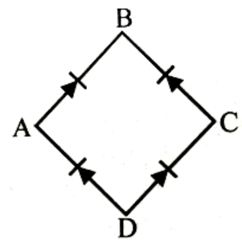
(a) resistance of each will increase

(b) resistance of copper will decrease

(c) resistance of copper will increase while that of germanium will decrease

(d) resistance of copper will decrease while that of germanium will increase

9) In the diagram, the input is across the terminals A and C and the output is across B and D. Then the output is



(a) zero

(b) same as the input

(c) full wave rectifier

(d) half wave rectifier

10) When a p – n junction diode is reverse biased the flow of current across the junction is mainly due to

(a) diffusion of charges

(b) drift of charges

(c) depends on the nature of material

(d) both drift and diffusion of charges

11) Which of the following, when added as an impurity, into the silicon, produces n –type semiconductor?

(a) Phosphorus

(b) Aluminium

(c) Magnesium

(d) Both b and c

12) When arsenic is added as an impurity to silicon, the resulting material is

(a) n – type semiconductor

(b) p – type semiconductor

(c) n – type conductor

(d) insulator

13) To obtain a p – type germanium semiconductor, it must be doped with

(a) arsenic

(b) antimony

(c) indium

(d) phosphorus

14) The cause of the potential barrier in a p – n diode is

(a) depletion of positive charges near the junction

(b) concentration of positive charges near the junction

(c) depletion of negative charges near the junction

(d) concentration of positive and negative charges near the junction

15) A semi – conducting device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be

(a) a p – n junction | (b) an intrinsic semi – conductor

(c) a p – type semi – conductor | (d) an n – type semi – conductor

16) In a junction diode, the holes are due to

(a) protons | (b) extra electrons

(c) neutrons | (d) missing electrons

17) Which of the following when added acts as an impurity into silicon produced n –type semi – conductor?

(a) P | (b) A*l*

(c) B | (d) Mg

18) A depletion layer consists of

(a) electrons | (b) protons

(c) mobile ions | (d) immobile ions

19) In forward bias, the width of potential barrier in a p – n junction diode

(a) increases | (b) decreases

(c) remains constant | (d) first ‘1’ then ‘2’

20) An alternating current can be converted into direct current by a

(a) transformer | (b) dynamo

(c) motor | (d) rectifier

21) The intrinsic semiconductor becomes an insulator at

(a) 0°C | (b) 0 K

(c) 300 K | (d) –100°C

22) In a p – n junction

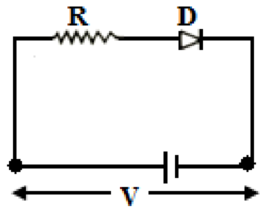
(a) The potential of the p and n –sides becomes higher alternatively

(b) The p – side is at higher electrical potential than the n side

(c) The n – side is at higher electrical potential than the p side

(d) Both the p and n – sides are at the same potential

23) A d.c. battery of V volt is connected to a series combination of a resistor R and an ideal diode D as shown in the figure below. The potential difference across R will be



(a) 2V when diode is forward biased

(b) Zero when diode is forward biased

(c) V when diode is reverse biased

(d) V when diode is forward biased

24) Reverse bias applied to a junction diode

(a) increases the minority carrier current

(b) lowers the potential barrier

(c) raises the potential barrier

(d) increases the majority carrier current

25) Barrier potential of a p – n junction diode does not depend on

(a) doping density

(b) diode design

(c) temperature

(d) forward bias

26) If a full wave rectifier circuit is operating from 50Hz mains, the fundamental frequency in the ripple will be

(a) 100Hz

(b) 25Hz

(c) 50Hz

(d) 70.7Hz

27) In a p – n junction photocell, the value of the photo – electromotive force produced by monochromatic light is proportional to

(a) the voltage applied at the p – n junction

(b) the barrier voltage at the p – n junction

(c) the intensity of the light falling on the cell

(d) the frequency of the light falling on the cell

28) The peak voltage in the output of a half – wave diode rectifier fed with a sinusoidal signal without filter is 10V. The d.c. component of the output voltage is

(a) $20/\pi V$

(b) $10/\sqrt{2}V$

(c) $10/\pi V$

(d) 10V

29) In semiconductors, at room temperature

(a) the conduction band is completely empty

(b) the valence band is partially empty and the conduction band is partially filled

(c) the valence band is completely filled and the conduction band is partially filled

(d) the valence band is completely filled

30) Zener diode is used for

(a) amplification

(b) rectification

(c) stabilisation

(d) producing oscillations in an oscillator

31) Application of a forward bias to a p – n junction

(a) widens the depletion zone

(b) increases the potential difference across the depletion zone

(c) increases the number of donors on the n side

(d) increases the electric field in the depletion zone

32) Carbon, Silicon and germanium atoms have four valence electrons each. Their valence and conduction bands separately by energy band gaps represented by $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$ respectively. Which one of the following relationships is true in their case?

(a) $(E_g)_{Si} > (E_g)_{Ge} < (E_g)_C$

(b) $(E_g)_C < (E_g)_{Si}$

(c) $(E_g)_C = (E_g)_{Si}$

(d) $(E_g)_C < (E_g)_{Ge}$

33) Choose the only **false** statement from the following

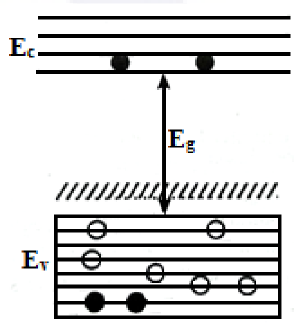
(a) In conductors, the valence and conducting bands may overlap

(b) Substances with energy gap of the order of 10eV are insulators

(c) The resistivity of a semiconductor increases with increase in temperature

(d) The conductivity of a semiconductor increases with increase in temperature

34) In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is



(a) an insulator

(b) a metal

(c) an n – type semiconductor

(d) a p – type semiconductor

35) For a cubic crystal structure which one of the following relations indicating the cell characteristics is correct?

(a) a ≠ b ≠ c and α = β = γ = 90°

(b) a = b = c and α ≠ β ≠ γ = 90°

(c) a = b = c and α = β = γ = 90°

(d) a ≠ b ≠ c and α ≠ β and γ≠ 90°

36) A p – n photodiode is made of a material with a band gap of 2.0eV. The minimum frequency of the radiation that can be absorbed by the material is nearly

(a) 10×10^{14}Hz
(b) 5×10^{14}Hz
(c) 1×10^{14}Hz
(d) 20×10^{14}Hz

37) Sodium has body centred packing. Distance between two nearest atoms is 3.7Å. The lattice parameter is

(a) 4.3Å
(b) 3.0Å
(c) 8.6Å
(d) 6.8Å

38) A p – n photodiode is fabricated from a semiconductor with a band gap of 2.5eV. It can detect a signal of wavelength

(a) 4000nm
(b) 6000nm
(c) 4000Å
(d) 6000Å

39) Which one of the following bonds produces a solid that reflects light in the visible region and whose electrical conductivity decreases with temperature and has high melting point?

(a) metallic bonding
(b) van der Waal's bonding
(c) ionic bonding
(d) covalent bonding

40) Which one of the following statement is FALSE?

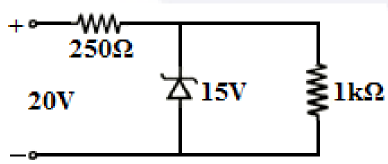
(a) Pure Si doped with trivalent impurities gives a p – type semiconductor

(b) Majority carries in a n – type semiconductors are holes

(c) Minority carries in a p –type semiconductor are electrons

(d) The resistance of intrinsic semiconductor decreases with increase of temperature

41) A zener diode, having breakdown voltage equal to 15V, is used in a voltage regulator circuit shown in figure. The current through the diode is



(a) 10mA
(b) 15mA
(c) 20mA
(d) 5mA

42) Pure Si at 500K has equal number of electron (n_e) and hole (n_h) concentrations of $1.5 \times 10^{16}m^{-3}$. Doping by indium increases n_h to $4.5 \times 10^{22}m^{-3}$. The doped semiconductor is of

(a) n – type with electron concentration $n_e = 5 \times 10^{22}m^{-3}$

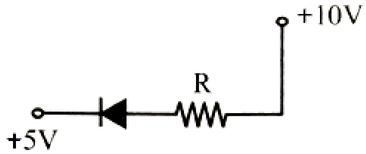
(b) p – type with electron concentration $n_e = 2.5 \times 10^{10}m^{-3}$

(c) n – type with electron concentration $n_e = 2.5 \times 10^{23}m^{-3}$

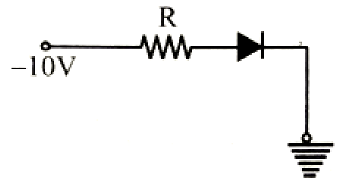
(d) p – type with electron concentration $n_e = 5 \times 10^{9}m^{-3}$

43) In the following figure, the diodes which are forward biased, are

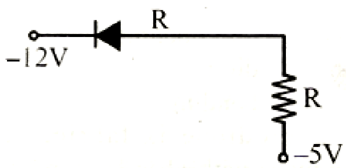
(A)



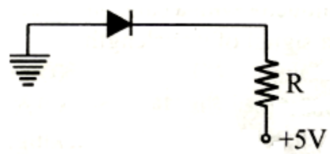
(B)



(C)



(D)



(a) (C) only

(b) (C) and (A)

(c) (B) and (D)

(d) (A), (B) and (D)

44) If a small amount of antimony is added to germanium crystal

(a) it becomes a p – type semiconductor

(b) the antimony becomes an acceptor atom

(c) there will be more free electrons than holes in the semiconductor

(d) its resistance is increased

45) In forward biasing of the p – n junction

(a) the positive terminal of the battery is connected to p – side and the depletion region becomes thick

(b) the positive terminal of the battery is connected to n – side and the depletion region becomes thin

(c) the positive terminal of the battery is connected to n – side and the depletion region becomes thick

(d) the positive terminal of the battery is connected to p – side and the depletion region becomes thin

46) C and Si both have same lattice structure, having 4 bonding electrons in each. However, C is insulator whereas Si is intrinsic semiconductor. This is because:

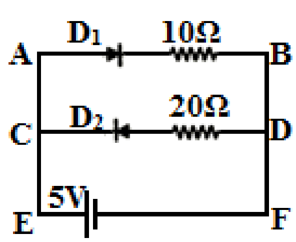
(a) In case of C the valence band is not completely filled at absolute zero temperature.

(b) In case of C the conduction band is partly filled even at absolute zero temperature.

(c) The four bonding electrons in the case of C lie in the second orbit, whereas in the case of Si they lie in the third.

(d) The four bonding electrons in the case of C lie in the third orbit, whereas in the case of Si they lie in the fourth orbit.

47) Two ideal diodes are connected to a battery as shown in the circuit. The current supplied by the battery is:



(a) 0.75A

(b) zero

(c) 0.25A

(d) 0.5A

48) In an unbiased p – n junction, holes diffuse from the p – region to n – region because of

(a) the potential difference across the p – n junction

(b) the attraction of free electrons of n –region

(c) the higher hole concentration in p – region than that in n – region

(d) the higher concentration of electrons in the n – region than that in the p – region

49) In a n – type semiconductor, which of the following statement is true?

(a) Electrons are minority carriers and pentavalent atoms are dopants.

(b) Holes are minority carriers and pentavalent atoms are dopants.

(c) Holes are majority carriers and trivalent atoms are dopants.

(d) Electrons are majority carriers and trivalent atoms are dopants.

50) The barrier potential of a p – n junction depends on:

(A) type of semi conductor material

(B) amount of doping

(C) temperature

Which one of the following is correct?

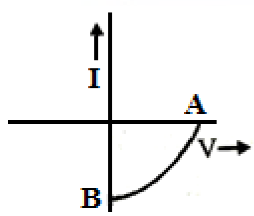
(a) (A) and (B) only

(b) (B) only

(c) (B) and (C) only

(d) (A), (B) and (C)

51) The given graph represents V – I characteristic for a semiconductor device.



Which of the following statement is **correct?**

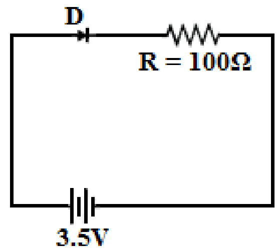
(a) It is V – I characteristic for solar cell where, point A represents open circuit voltage and point B short circuit current.

(b) It is for a solar cell A and B represents open circuit voltage and current, respectively.

(c) It is for a photodiode and points A and B represents open circuit voltage and current, respectively.

(d) It is for a LED and points A and B represents open circuit voltage and short circuit current, respectively.

52) In the given figure, a diode D is connected to an external resistance R = 100Ω and an e.m.f of 3.5V. If the barrier potential developed across the diode is 0.5V, the current in the circuit will be:



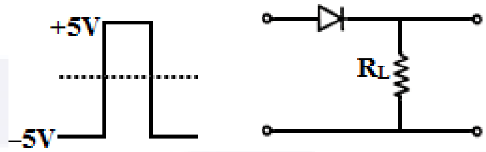
(a) 40mA

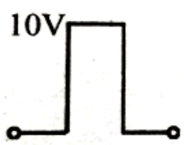
(b) 20mA

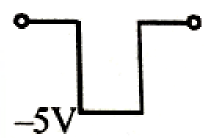
(c) 35mA

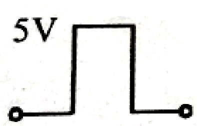
(d) 30mA

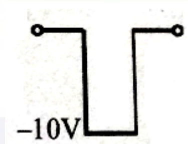
53) If in a p – n junction, a square input signal of 10V is applied as shown, then the output across R_L will be



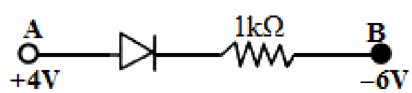
(a) 

(b) 

(c) 

(d) 

54) Consider the junction diode as ideal. The value of current flowing through AB is:



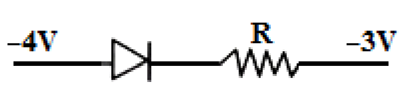
(a) 0A

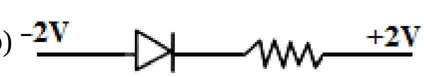
(b) 10^{-2}A

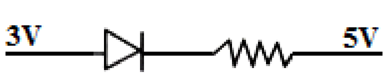
(c) 10^{-1}A

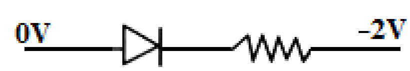
(d) 10^{-3}A

55) Which of the following represents forward bias diode?

(a) 

(b) 

(c) 

(d) 

56) The energy band gap is maximum in

(a) metals

(b) superconductors

(c) insulators (d) semiconductors

57) By increasing the temperature, the specific resistance of a conductor and a semiconductor

(a) increases for both (b) decreases for both

(c) increases, decreases (d) decreases, increases

58) At absolute zero, Si acts as

(a) non – metal (b) metal

(c) insulator (d) none of these

59) In the middle of the depletion layer of a reverse – biased p – n junction, the

(a) electric field is zero (b) potential is maximum

(c) electric field is maximum (d) potential is zero

60) The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the

(a) crystal structure

(b) variation of the number of charge carries with temperature

(c) type of bonding

(d) variation of scattering mechanism with temperature

61) A strip of copper and another of germanium are cooled from room temperature to 80K. The resistance of

(a) each of these decreases

(b) copper strip increases and that of germanium decreases

(c) copper strip decreases and that of germanium increases

(d) each of these increases

62) When p – n junction diode is forward biased then

(a) both the depletion region and barrier height are reduced

(b) the depletion region is widened and barrier height is reduced

(c) the depletion region is reduced and barrier height is increased

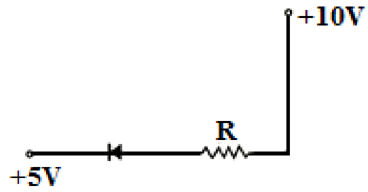
(d) Both the depletion region and barrier height are increased

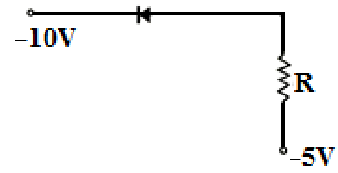
63) The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480nm is incident on it. The band gap in (eV) for the semiconductor is

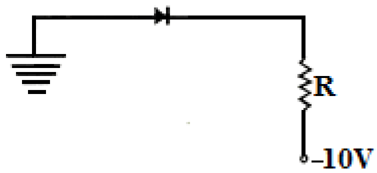
(a) 2.5eV (b) 1.1eV

(c) 0.7eV (d) 0.5eV

64) In the following, which one of the diodes reverse biased?

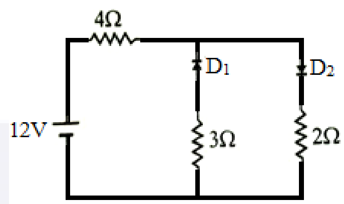
(a) 

(b) 

(c) 

(d)

65) The circuit has two oppositively connected ideal diodes in parallel. What is the current flowing in the circuit?



(a) 1.71A

(b) 2.00A

(c) 2.31A

(d) 1.33A

66) If the ratio of the concentration of electrons to that of holes in a semiconductor is $\frac{7}{5}$ and the ratio of currents is $\frac{7}{4}$, then what is the ratio of their drift velocities?

(a) $\frac{5}{8}$

(b) $\frac{4}{5}$

(c) $\frac{5}{4}$

(d) $\frac{4}{7}$

67) A solid which is not transparent to visible light and whose conductivity increases with temperature is formed by

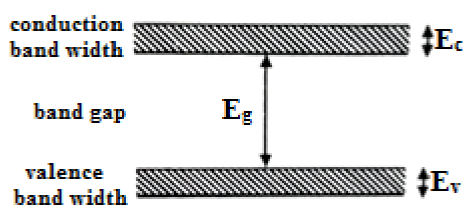
(a) Ionic bonding

(b) Covalent bonding

(c) Vander Waals bonding

(d) Metallic bonding

68) If the lattice constant of this semiconductor is decreased then which of the following is correct?



(a) All E_c , E_g , E_v increase

(b) E_c and E_v increase, but E_g decreases

(c) E_c and E_v decrease, but E_g increases

(d) All E_c , E_g , E_v decrease

69) Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statement is most appropriate?

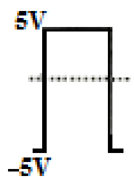
(a) The number of free electrons for conduction is significant only in Si and Ge but small in C.

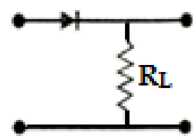
(b) The number of free conduction electrons is significant in C but small in Si and Ge.

(c) The number of free conduction electrons is negligibly small in all the three.

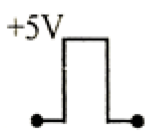
(d) The number of free electrons for conduction is significant in all the three.

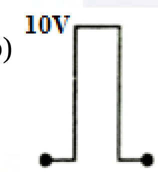
70) If in p – n junction diode, a square input signal of 10V is applied as shown

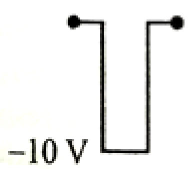


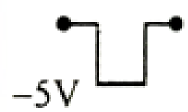


Then the output signal across R_L will be

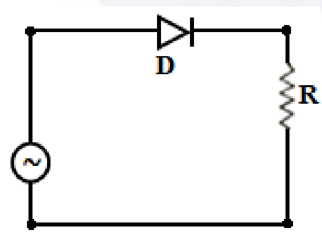
(a) 

(b) 

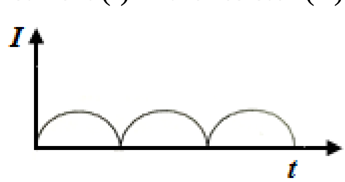
(c) 

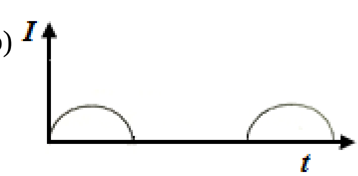
(d) 

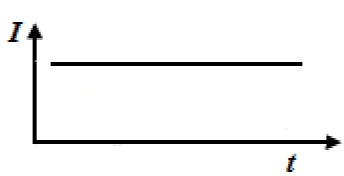
71) A p – n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit.

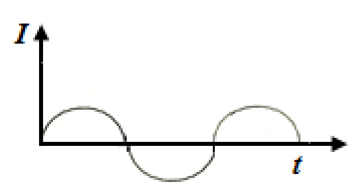


The current (I) in the resistor (R) can be shown by:

(a) 

(b) 

(c) 

(d) 

72) This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement 1:A pure semiconductor has negative temperature coefficient of resistance.

Statement 2: On raising the temperature, more charge carries are released into the conduction band.

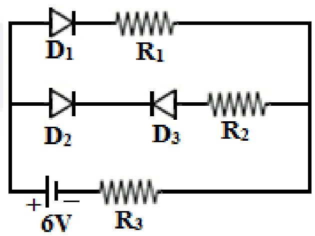
(a) Statement 1 is false, Statement 2 is true.

(b)Statement 1 is true, Statement 2 is false.

(c) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.

(d) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

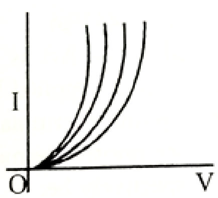
73) Figure shows a circuit in which three identical diodes are used. Each diode has forward resistance of 20Ω and infinite backward resistance. Resistors $R_1 = R_2 = R_3 = 50\Omega$. Battery voltage is 6V. The current through R_3 is:

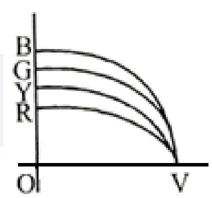


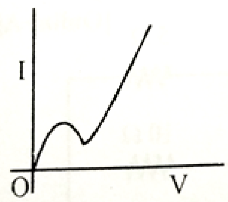
(a) 50mA (b) 100mA

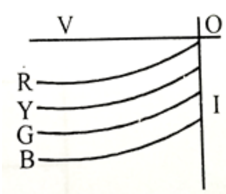
(c) 60mA (d) 25mA

74) The I –V characteristic of an LED is **(2013)**

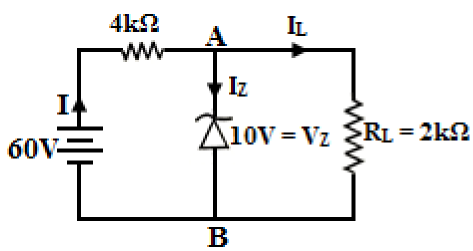
(a)


(b)


(c)


(d)


75) A Zener diode is connected to a battery and a load as show below:



The currents, I, I_Z, and I_L are respectively.

(a) 15mA, 5mA, 10mA

(b) 15mA, 7.5mA, 7.5mA

(c) 12.5mA, 5mA, 7.5mA

(d) 12.5mA, 7.5mA, 5mA

76) For LED's to emit light in visible region of electromagnetic light, it should have energy band gap in the range of:

(a) 0.1eV to 0.4eV

(b) 0.5eV to 0.8eV

(c) 0.9eV to 1.6eV

(d) 1.7eV to 3.0eV

77) The forward biased diode connection is:

(a) 

(b) 

(c) 

(d) 

78) In an unbiased n – p junction electrons diffuse from n – region to p – region because:

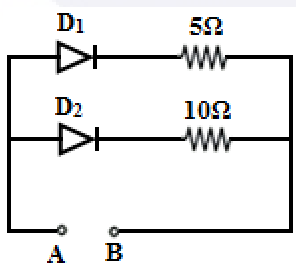
(a) holes in p – region attract them

(b) electrons travel across the junction due to potential difference

(c) only electrons move from n to p region and not the vice – versa

(d) electron concentration in n – region is more compared to that in p – region

79) A 2V battery is connected across AB as shown in the figure. The value of the current supplied by the battery when in one case battery's positive terminal is connected to A and in other case when positive terminal of battery is connected to B will respectively be:



(a) 0.4A and 0.2A

(b) 0.2A and 0.4A

(c) 0.1A and 0.2A

(c) 0.2A and 0.1A

80) A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1m from the diode is:

(a) 5.48V/m

(b) 7.75V/m

(c) 1.73V/m

(d) 2.45V/m

81) An experiment is performed to determine the 1 – V characteristics of a Zener diode, which has a protective resistance of R = 100Ω, and a maximum power of dissipation rating of 1W. The minimum voltage range of the DC source in the circuit is:

(a) 0 – 5V
(b) 0 – 24V
(c) 0 – 12V
(d) 0 – 8V

82) The temperature dependence of resistances of Cu and undoped Si in the temperature range 300 – 400K, is best described by:

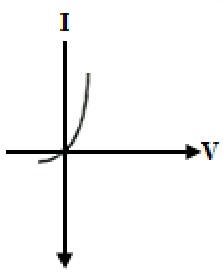
(a) Linear increase for Cu, exponential decrease of Si.

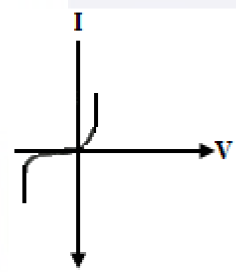
(b) Linear decrease for Cu, linear decrease for Si.

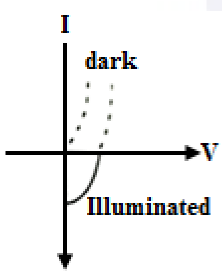
(c) Linear increase for Cu, linear increase for Si.

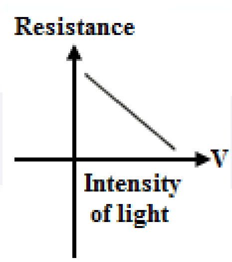
(d) Linear increase for Cu, exponential increase for Si.

83) Identify the semiconductor devices whose characteristics are given below, in the order (i), (ii), (iii), (iv):

(i)


(ii)


(iii)


(iv)


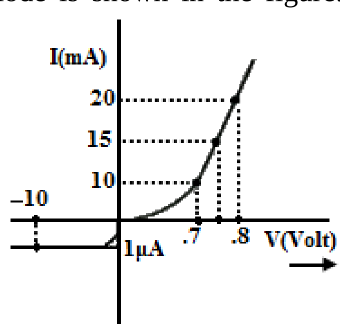
(a) Solar cell, Light dependent resistance, Zener diode, simple diode

(b) Zener diode, Solar cell, simple diode, Light dependent resistance

(c) Simple diode, Zener diode, Solar cell, Light dependent resistance

(d) Zener diode, Simple diode, Light dependent resistance, Solar cell

84) The V – I characteristic of a diode is shown in the figure. The ratio of forward to reverse bias resistance is:



(a) 10 (b) 10^{-6}

(c) 10^{6} (d) 100

85) What is the conductivity of a semiconductor sample during electron concentration of $5 \times 10^{18} m^{-3}$, hole concentration of $5 \times 10^{19} m^{-3}$, electrons mobility of $2.0 m^2V^{-1}s^{-1}$ and hole mobility of $0.01 m^2V^{-1}s^{-1}$? (Take charge of electron as 1.6×10^{-19}C)

(a) 1.68 $(\Omega - m)^{-1}$ (b) 1.83 $(\Omega - m)^{-1}$

(c) 0.59$(\Omega - m)^{-1}$ (d) 1.20 $(\Omega - m)^{-1}$

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
c	a	d	b	a	c	b	d	c	b
11	12	13	14	15	16	17	18	19	20
a	a	c	d	a	d	a	d	b	d
21	22	23	24	25	26	27	28	29	30
a	b	b	c	b	a	c	c	c	c
31	32	33	34	35	36	37	38	39	40
c	a	c	d	c	b	a	c	a	b
41	42	43	44	45	46	47	48	49	50
d	d	b	c	d	c	d	c	b	d
51	52	53	54	55	56	57	58	59	60
a	d	c	b	d	c	c	c	c	b
61	62	63	64	65	66	67	68	69	70
c	a	d	d	b	a	b	c	a	a
71	72	73	74	75	76	77	78	79	80
b	d	a	a	d	d	a	d	a	d
81	82	83	84	85					
c	a	c	b	a					

Topic 94: Junction Transistor

1) Radiowaves of constant amplitude can be generated with

(a) FET (b) filter

(c) rectifier (d) oscillator

2) In a common base amplifier the phase difference between the input signal voltage and the output voltage is

(a) 0 (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{2}$ (d) π

3) To use a transistor as an amplifier

(a) the emitter base junction is forward biased and the base collector junction is reverse biased

(b) no bias voltage is required

(c) both junctions are forward biased

(d) both junctions are reverse biased

4) For amplification by a triode, the signal to be amplified is given to

(a) the cathode (b) the grid

(c) the glass – envelope (d) the anode

5) The part of the transistor which is heavily doped to produce large number of majority carries is

(a) emitter

(b) base

(c) collector

(d) any of the above depending upon the nature of transistor

6) An oscillator is nothing but an amplifier with

(a) positive feedback (b) negative feedback

(c) large gain (d) no feedback

7) When an n – p – n transistor is used as an amplifier then

(a) the electrons flow from emitter to collector

(b) the holes flow from emitter to collector

(c) the electrons flow from collector to emitter

(d) the electrons flow from battery to emitter

8) The current gain for a transistor working as common – base amplifier is 0.96. If the emitter current is 7.2mA, then the base current is

(a) 0.29mA
(b) 0.35mA
(c) 0.39mA
(d) 0.43mA

9) The transfer ratio β of a transistor is 50. The input resistance of the transistor when used in the common emitter configuration is 1kΩ. The peak value of the collector A.C. current for an A.C. input voltage of 0.01V peak is

(a) 100μA
(b) 0.01mA
(c) 0.25mA
(d) 500μA

10) In the study of transistor as amplifier, if $\alpha = \frac{I_C}{I_E}$ and $\beta = \frac{I_C}{I_B}$, where, I_C, I_B and I_E are the collector, base and emitter currents, then

(a) $\beta = \frac{(1+\alpha)}{\alpha}$
(b) $\beta = \frac{(1-\alpha)}{\alpha}$
(c) $\beta = \frac{\alpha}{(1-\alpha)}$
(d) $\beta = \frac{\alpha}{(1+\alpha)}$

11) For a common emitter circuit if $\frac{I_C}{I_E} = 0.98$ then current gain for common emitter circuit will be

(a) 49
(b) 98
(c) 4.9
(d) 25.5

12) In the case of a common emitter transistor amplifier, the ratio of the collector current to the emitter current I_c / I_e is 0.96. The current gain of the amplifier is

(a) 6
(b) 48
(c) 24
(d) 12

13) An n – p – n transistor conducts when

(a) both collector and emitter are negative with respect to the base

(b) both collector and emitter are positive with respect to the base

(c) collector is positive and emitter is negative with respect to the base

(d) collector is positive and emitter is at same potential as the base

14) A transistor is operated in common emitter configuration at constant collector voltage V_c = 1.5V such that a change in the base current from 100μA to 150μA produces a change in the collector current from 5mA to 10mA. The current gain (β) is

(a) 75
(b) 100
(c) 50
(d) 67

15) The voltage gain of an amplifier with 9% negative feedback is 10. The voltage gain without feedback will be

(a) 90 (b) 10

(c) 1.25 (d) 100

16) A transistor is operated in common – emitter configuration at V_c = 2V such that a change in the base current from 100μA to 200μA produces a change in the collector current from 5mA to 10mA. The current gain is

(a) 100 (b) 150

(c) 50 (d) 75

17) For transistor action:

(1) Base, emitter and collector regions should have similar size and doping concentrations.

(2) The base region must be very thin and lightly doped.

(3) The emitter – base junction is forward biased and base – collector junction is reverse based.

(4) Both the emitter – base junction as well as the base – collector junction are forward biased.

(a) (3), (4) (b) (4), (1)

(c) (1), (2) (d) (2), (3)

18) A common emitter amplifier has a voltage gain of 50, an input impedance of 100Ω and an output impedance of 200Ω. The power gain of the amplifier is

(a) 500 (b) 1000

(c) 1250 (d) 50

19) A transistor is operated in common emitter configuration at V_c = 2V such that a change in the base current from 100μA to 300μA produces a change in the collector current from 10mA to 20mA. The current gain is

(a) 50 (b) 75

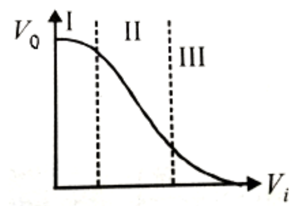
(c) 100 (d) 25

20) The input resistance of a silicon transistor is 100W. Base current is changed by 40μA which results in a change in collector current by 2mA. This transistor is used as a common emitter amplifier with a load resistance of 4KΩ. The voltage gain of the amplifier is:

(a) 2000 (b) 3000

(c) 4000 (d) 1000

21) Transfer characteristics [output voltage (V_0) vs input voltage (V_1)] for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used:



(a) in region III
(b) both in region (I) and (III)
(c) in region II
(d) in region (I)

22) In a CE transistor amplifier, the audio signal voltage across the collector resistance of 2kΩ is 2V. If the base resistance is 1kΩ and the current amplification of the transistor is 100, the input signal voltage is:

(a) 0.1V
(b) 1.0V
(c) 1mV
(d) 10mV

23) One way in which the operation of a n – p – n transistor differs from that of a p – n – p

(a) the emitter junction is reversed biased in n – p – n

(b) the emitter junction injects minority carries into the base region of the p – n – p

(c) the emitter injects holes into the base of the p – n – p and electrons into the base region of n – p – n

(d) the emitter injects holes into the base of n – p – n

24) In a common emitter (CE) amplifier having a voltage gain G, the transistor used as transconductance 0.03mho and current gain 25. If the above transistor is replaced with another one with transconductance 0.02mho and current gain 20, the voltage gain will be

(a) 1.5G
(b) $\frac{1}{3}$ G
(c) $\frac{5}{4}$ G
(d) $\frac{2}{3}$ G

25) The input signal given to a CE amplifier having a voltage gain of 150 is $V_1 = 2\cos\left(15t + \frac{\pi}{3}\right)$. The corresponding output signal will be:

(a) $75\cos\left(15t + \frac{2\pi}{3}\right)$
(b) $2\cos\left(15t + \frac{5\pi}{6}\right)$
(c) $300\cos\left(15t + \frac{4\pi}{3}\right)$
(d) $300\cos\left(15t + \frac{\pi}{3}\right)$

26) A npn transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800Ω is connected in the collector circuit and the voltage drop across it is 0.8V. If the current amplification factor is 0.96 and the input resistance of the circuit is 192Ω, the voltage gain and the power gain of the amplifier will respectively be:

(a) 4, 3.84
(b) 3.69, 3.84
(c) 4, 4
(d) 4, 3.69

27) In a common emitter transistor amplifier the audio signal voltage across the collector is 3V. The resistance of collector is 3kΩ. If current gain is 100 and the base resistance is 2kΩ, the voltage and power gain of the amplifier is

(a) 15 and 200
(b) 150 and 15000
(c) 20 and 2000
(d) 200 and 1000

28) The part of a transistor which is most heavily doped to produce large number of majority carriers is

(a) emitter
(b) base
(c) collector
(d) can be any of the above three.

29) For a transistor amplifier in common emitter configuration for load impedance of 1kΩ (h_{fe} = 50 and h_{oe} = 25) the current gain is

(a) −24.8
(b) −15.7
(c) −5.2
(d) −48.78

30) When npn transistor is used as an amplifier

(a) electrons move from collector to base
(b) holes moves from emitter to base
(c) electrons move from base to collector
(d) holes moves from base to emitter

31) In a common base amplifier, the phase difference between the input signal voltage and output voltage is

(a) π
(b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$
(d) 0

32) In a common base mode of a transistor, the collector current is 5.488mA for an emitter current of 5.60mA. The value of the base current amplification factor (β) will be

(a) 49
(b) 50
(c) 51
(d) 48

33) A working transistor with its three legs marked P, Q and R is tested using a multimeter. No conduction is found between P and Q. By connecting the common (negative) terminal of the multimeter to R and the other (positive) terminal to P or Q, some resistance is seen on the multimeter. Which of the following is true for the transistor?

(a) It is an npn transistor with R as base
(b) It is a pnp transistor with R as base
(c) It is a pnp transistor with R as emitter
(d) It is an npn transistor with R as collector

34) An n – p – n transistor has three leads A, B and C. Connecting B and C by moist fingers, A to the positive lead of an ammeter, and C to the negative lead of the ammeter, one finds large deflection. Then A, B and C refer respectively to:

(a) Emitter, base and collector

(b) Base, emitter and collector

(c) Base, collector and emitter

(d) Collector, emitter and base

35) An unknown transistor needs to be identified as a npn or pnp type. A multimeter, with +ve and –ve terminals, is used to measure resistance between different terminals of transistor. If terminal 2 is the base of the transistor then which of the following is correct for a pnp transistor?

(a) +ve terminal 2, –ve terminal 3, resistance low

(b) +ve terminal 2, –ve terminal 1, resistance high

(c) +ve terminal 1, –ve terminal 2, resistance high

(d) +ve terminal 3, –ve terminal 2, resistance high

36) The ratio (R) of output resistance r_0, and the input resistance r_i in measurements of input and output characteristics of a transistor is typically in the range:

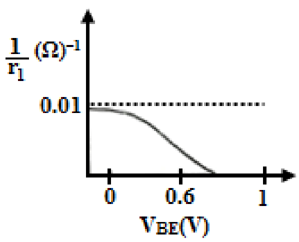
(a) $R \sim 10^2 - 10^3$

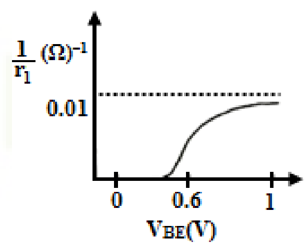
(b) $R \sim 1 - 10$

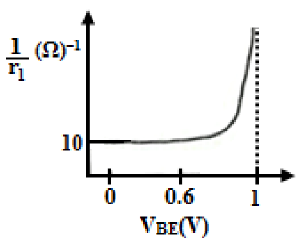
(c) $R \sim 0.1 - 1.0$

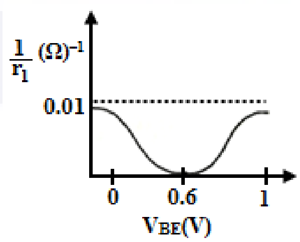
(d) $R \sim 0.1 - 0.01$

37) A realistic graph depicting the variation of the reciprocal of input resistance in an input characteristics measurement in a common transistor configuration is:

(a)


(b)


(c)


(d)


38) For a common emitter configuration, if α and β have their usual meanings, the incorrect relationship between α and β is:

(a) $\alpha = \dfrac{\beta}{1+\beta}$

(b) $\alpha = \dfrac{\beta^2}{1+\beta^2}$

(c) $\dfrac{1}{\alpha} = \dfrac{1}{\beta} + 1$

(d) None of these

39) In a common emitter amplifier circuit using an n –p – n transistor, the phase difference between the input and the output voltages will be:

(a) 135°

(b) 180°

(c) 45°

(d) 90°

40) The current gain of a common emitter amplifier is 69. If the emitter currents is 7.0mA, collector current is:

(a) 9.6mA

(b) 6.9mA

(c) 0.69mA

(d) 69mA

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
d	a	a	b	a	a	a	a	d	c
11	12	13	14	15	16	17	18	19	20
a	c	c	b	d	c	d	c	a	a
21	22	23	24	25	26	27	28	29	30
b	d	c	d	c	a	b	a	d	d
31	32	33	34	35	36	37	38	39	40
d	a	b	c	c	c	c	b	b	b

Topic 95: Digital Electronics and Logic Gates

1) The following truth table corresponds to the logic gate

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

(a) NAND
(b) OR
(c) AND
(d) XOR

2) The following truth table belongs to which of the following four gates?

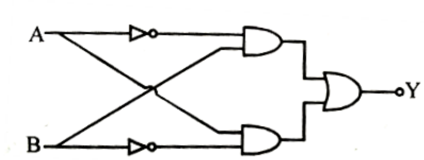
A	B	Y
1	1	0
1	0	0
0	1	0
0	0	1

(a) NOR
(b) XOR
(c) NAND
(d) OR

3) Which of the following gates will have an output of 1?

(a) D
(b) A
(c) B
(d) C

4) The following circuit represents



(a) OR gate
(b) XOR gate
(c) AND gate
(d) NAND gate

5) A gate has the following truth table

P	**Q**	**R**
1	1	1
1	0	0
0	1	0
0	0	0

The gate is

(a) AND
(b) NOR
(c) OR
(d) NAND

6) Which gate is represented by the following truth table?

A	**B**	**X**
0	0	1
1	0	1
0	1	1
1	1	0

(a) XOR
(b) NOT
(c) NAND
(d) AND

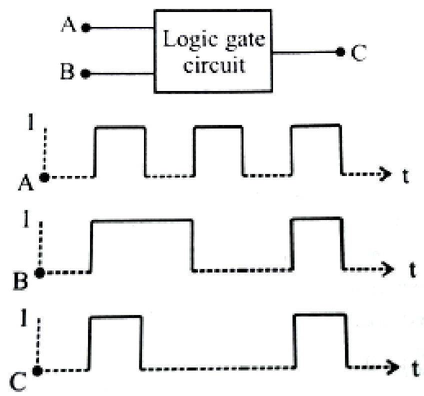
7) Following diagram performs the logic function of

(a) XOR gate
(b) AND gate
(c) NAND gate
(d) OR gate

8) The output of OR gate is 1

(a) if either input is zero
(b) if both inputs are zero
(c) if either or both input are 1
(d) only if both inputs are 1

9) The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below



The logic circuit gate is

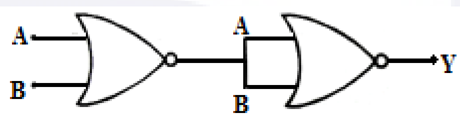
(a) NAND gate

(b) NOR gate

(c) OR gate

(d) AND gate

10) In the following circuit, the output Y for all possible inputs A and B is expressed by the truth table



(a)

A	B	Y
0	1	1
0	1	1
1	0	1
1	1	0

(b)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

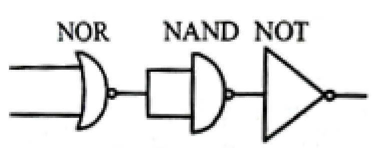
(c)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(d)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

11) The circuit



is equivalent to

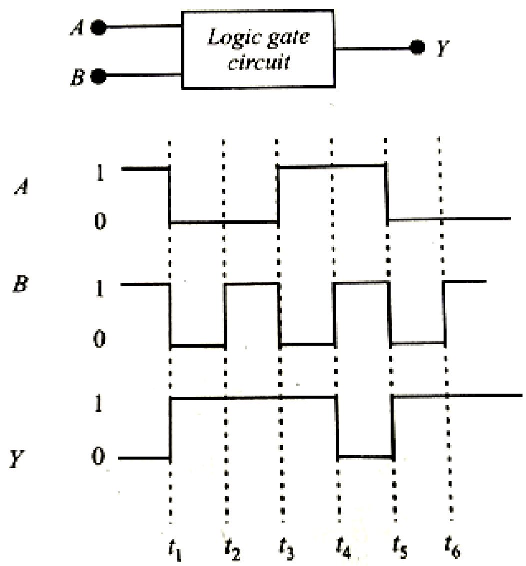
(a) AND gate

(b) NAND gate

(c) NOR gate

(d) OR gate

12) The following Figure shows a logic gate circuit with two inputs A and B and the output Y. The voltage waveforms of A, B and Y are given:



The logic gate is:

(a) NAND gate (b) NOR gate

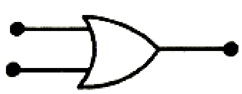
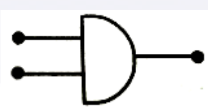
(c) OR gate (d) AND gate

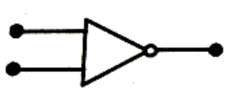
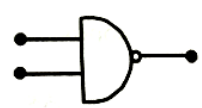
13) The device that can act as a complete electronic circuit is

(a) junction diode (b) integrated circuit

(c) junction transistor (d) zener diode

14) Symbolic representation of four logic gate are shown as

(i)  (ii) 

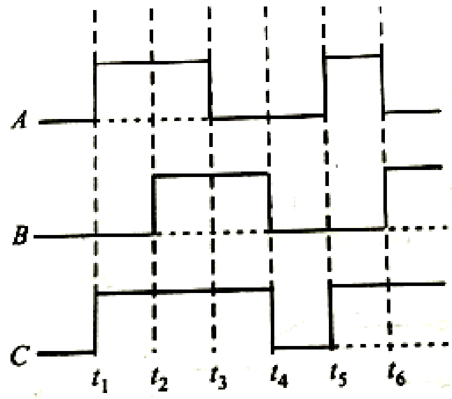
(iii)  (iv) 

Pick out which ones are for AND, NAND and NOT gates, respectively

(a) (ii), (iii) and (iv) (b) (iii), (ii) and (i)

(c) (iii), (iii) and (iv) (d) (ii), (iv) and (iii)

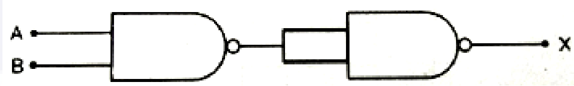
15) The figure shows a logic circuit with two inputs A and B and the output C. The voltage wave forms across A, B and C are as given. The logic circuit gate is:



(a) OR gate (b) NOR gate

(c) AND gate (d) NAND gate

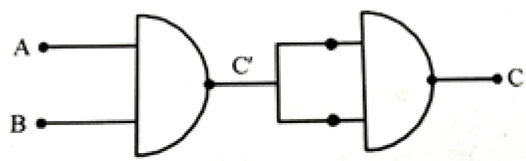
16) The output (X) of the logic circuit shown in figure will be



(a) $X = \overline{A.B}$ (b) $X = A.B$

(c) $X = \overline{A+B}$ (d) $X = \overline{\overline{A}} + \overline{\overline{B}}$

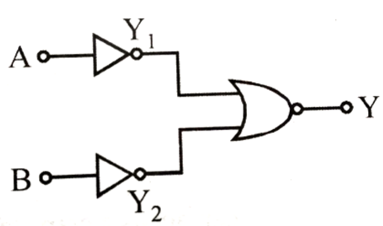
17) The output from a NAND gate is divided into two in parallel and fed to another NAND gate. The resulting gate is a



(a) NOT gate (b) AND gate

(c) NOR gate (d) OR gate

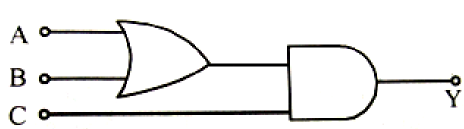
18) Which logic gate is represented by the following combination of logic gate?



(a) NAND (b) AND

(c) NOR (d) OR

19) To get output 1 for the following circuit, the correct choice for the input is



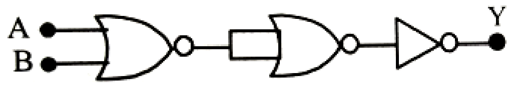
(a) A = 0, B = 1, C = 0

(b) A = 1, B = 0, C = 0

(c) A = 1, B = 1, C = 0

(d) A = 1, B = 0, C = 1

20) The given electrical network is equivalent to:



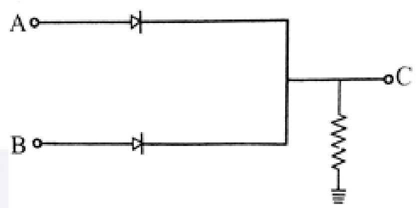
(a) OR gate

(b) NOR gate

(c) NOT gate

(d) AND gate

21) In the circuit below, A and B represent two inputs and C represents the output.



The circuit represents

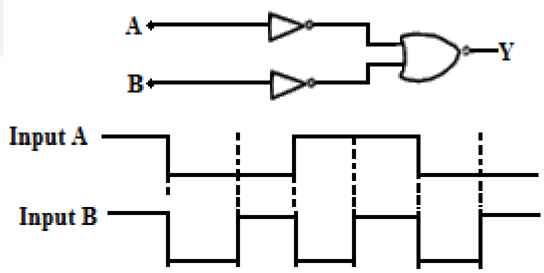
(a) NOR gate

(b) AND gate

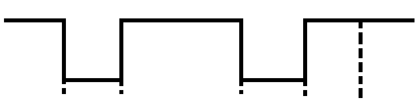
(c) NAND gate

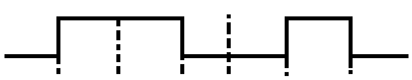
(d) OR gate

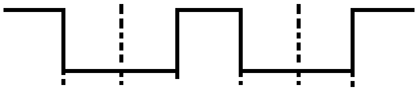
22) The logic circuit shown below has the input waveforms 'A' and 'B' as shown. Pick out the correct output waveform.

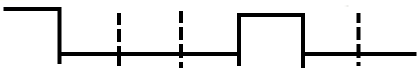


Output is

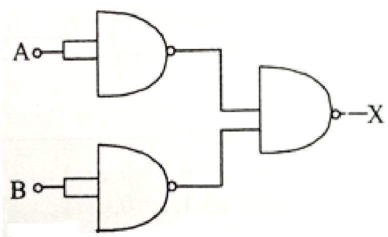
(a) 

(b) 

(c) 

(d) 

23) The combination of gates shown below yields

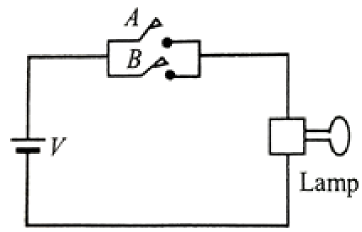


(a) OR gate
(b) NOT gate
(c) XOR gate
(d) NAND gate

24) The output of an OR gate is connected to both the inputs of a NAND gate. The combination will serve as a:

(a) NOT gate
(b) NOR gate
(c) AND gate
(d) OR gate

25) Which logic gate with inputs A and B performs the same operation as that performed by the following circuit?

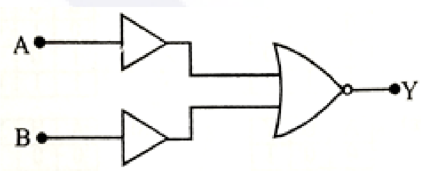


(a) NAND gate
(b) OR gate
(c) NOR gate
(d) AND gate

26) Which one of the following is the Boolean expression for NOR gate?

(a) Y = $\overline{A + B}$
(b) Y = $\overline{A. B}$
(c) Y = A. B
(d) Y = $\overline{A}$

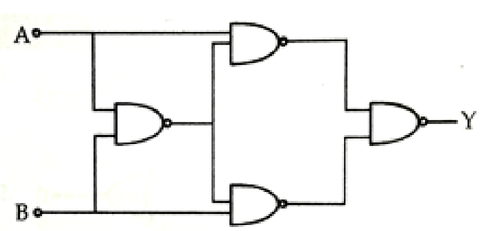
27) The figure shows a combination of two NOT gates and a NOR gate.



The combination is equivalent to a

(a) NAND gate
(b) NOR gate
(c) AND gate
(d) OR gate

28) Truth table for system of four NAND gates as shown in figure is:



(a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(b)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	1

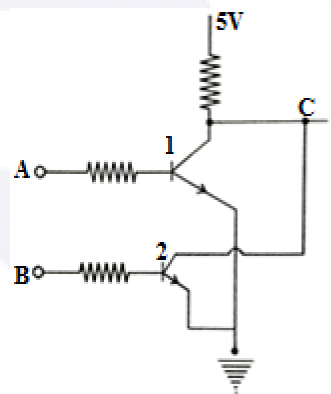
(c)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(d)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

29) Consider two npn transistor as shown in figure. If 0 Volts corresponds to false and 5 Volts correspond to true then the output at C corresponds to:



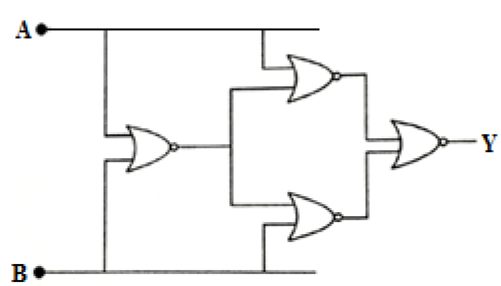
(a) A NAND B

(b) A OR B

(c) A AND B

(d) A NOR B

30) A system of four gates is set up as shown. The 'truth table' corresponding to this system is:



(a)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(b)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

(c)

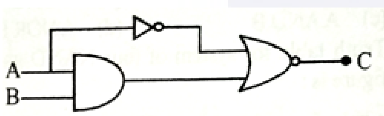
A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

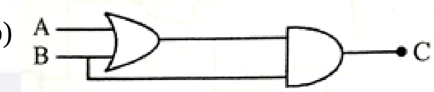
(d)

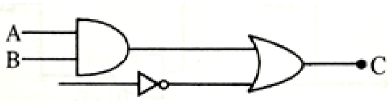
A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

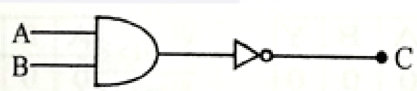
31) Which of the following circuits correctly represents the following truth table?

A	B	C
0	0	0
0	1	0
1	0	1
1	1	0

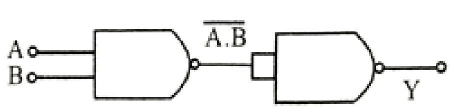
(a) 

(b) 

(c) 

(d) 

32) Identify the gate and match A, B, Y in brackets to check.



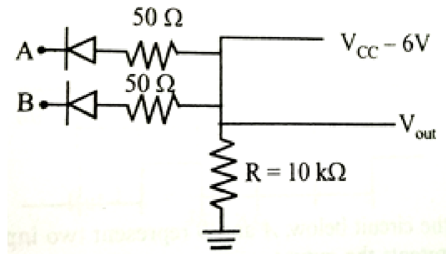
(a) AND (A = 1, B = 1, Y = 1)

(b) OR (A = 1, B = 1, Y = 0)

(c) NOT (A = 1, B = 1, Y = 1)

(d) XOR (A = 0, B = 0, Y = 0)

33)



Given: A and B are input terminals.

Logic 1 = > 5V

Logic 0 = < 1V

Which logic gate operation, the above circuit does?

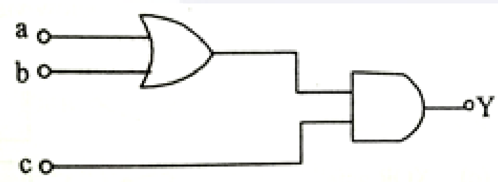
(a) AND Gate
(b) OR Gate
(c) XOR Gate
(d) NOR Gate

34) The truth table given in fig. represents:

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

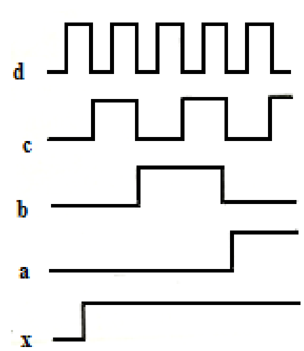
(a) OR – Gate
(b) NAND – Gate
(c) AND – Gate
(d) NOR – Gate

35) To get an output of 1 from the circuit shown in figure the input must be:



(a) a = 0, b = 0, c = 1
(b) a = 1, b = 0, c = 0
(c) a = 1, b = 0, c = 1
(d) a = 0, b = 1, c = 0

36) If a, b, c, d are inputs to a gate and x is its output, then, as per the following time graph, the gate is:



(a) OR
(b) NAND
(c) NOT
(d) AND

ANSWER KEY									
1	2	3	4	5	6	7	8	9	10
b	a	d	b	a	c	b	c	d	c
11	12	13	14	15	16	17	18	19	20
c	a	b	d	a	b	b	b	d	b
21	22	23	24	25	26	27	28	29	30
d	d	a	b	b	a	c	a	a	a
31	32	33	34	35	36				
a	a	a	a	c	a				