Topic 3: 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

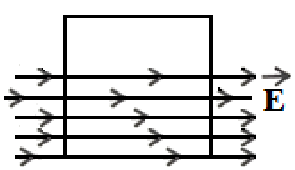
3) A charge QμC is placed at the centre of a cube, the flux coming out from any surface will be

(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

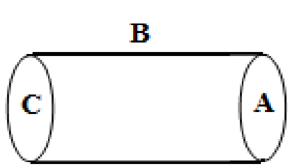
(a) $\frac{q}{6(4\pi\varepsilon_0)}$
(b) $\frac{2\pi q}{6(4\pi\varepsilon_0)}$
(c) $\frac{4\pi q}{6(4\pi\varepsilon_0)}$
(d) $\frac{\pi q}{6(4\pi\varepsilon_0)}$

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

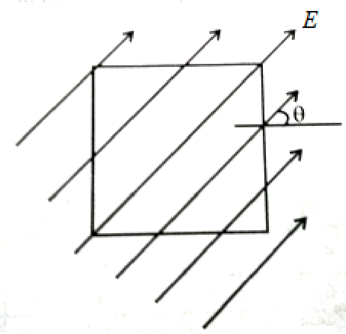
6) A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of voltmeter associated with the curved surface B, the flux linked with the plane surface A in units of voltmeter will be



(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) $\frac{q}{8\varepsilon_0}$

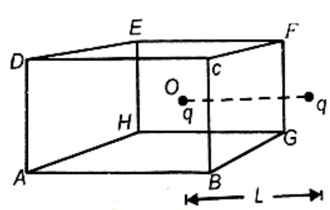
(c) $\frac{q}{\varepsilon_0}$ (d) $\frac{q}{2\varepsilon_0}$

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

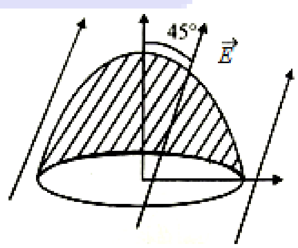
(a) a translational force only in the direction of the field

(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:

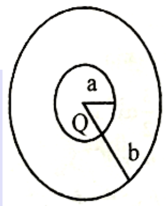
(a) 0.125 Nm^2/C

(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:



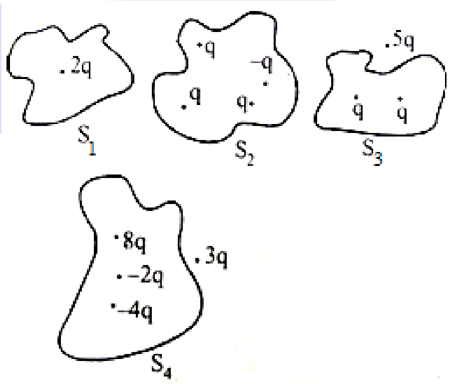
(a) $\frac{2Q}{\pi(a^2 - b^2)}$

(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 $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{i}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3E_1}\hat{j}$ 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	

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