Advanced Test on: **Vector** Duration: **40 min.**

Single option correct type

1) A charge q is placed at the origin of co-ordinate system. Find the force on it due to a triangular plate of surface charge density σ and vertices at (a, 0, 0), (0, a, 0) and (0, 0, a).

(A) $\frac{q\sigma}{6\varepsilon_0}$ (B) $\frac{q\sigma}{2\varepsilon_0}$ (C) $\frac{q\sigma}{4\varepsilon_0}$ (D) $\frac{q\sigma}{8\varepsilon_0}$

2) A long cylinder has radius R and charge is distributed symmetrically in its volume such that electric filed at distacne r(r < R) from the axis is E. What is charge density at distance r (r < R)?

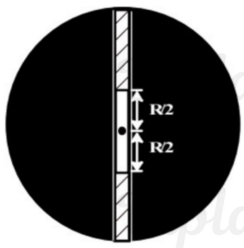
(A) $\rho=\frac{1}{\epsilon_0}\left[\frac{dE}{dr}\right]$ (B) $\rho=\epsilon_0\left[\frac{dE}{dr}\right]$ (C) $\rho=\frac{1}{\epsilon_0}\left[\frac{dE}{dr}+Er\right]$ (D) $\rho=\epsilon_0\left[\frac{dE}{dr}+\frac{E}{r}\right]$

3) Two hemispherical shells of same radius R and surface charge density σ are placed as shown. Find the electric field at point P, just left of the shell A as shown. The point P lies on the line joining the centres of the hemispheres.

(A) $\frac{\sigma}{\varepsilon_0}$ (B) $\frac{\sigma}{2\varepsilon_0}$ (C) $\frac{\sigma}{4\varepsilon_0}$ (D) $\frac{2\sigma}{\varepsilon_0}$

Multi Options correct type:

4) A uniformly charged sphere of radius R has a tunnel of small radius along the diameter of the sphere. Inside the tunnel a non conductor rod just fits. The rod of mass m has two portions, shaded portion has uniform linear charge density λ and unshaded part has uniform linear charge density -2λ as shown in fig. The syst is placed in space and the rod is slightly displaced from its equilibrium position. Choose the correct option(s):



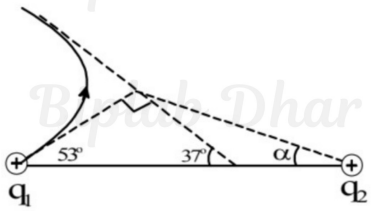
(A) if charge density of the sphere is $+\rho$, the equilibrium of the rod along its length is stable.

(B) if charge density of the sphere is $-\rho$, the equilibrium of the rod along its length is stable.

(C) Time period of oscillation of the rod for stable equilibrium is $2\pi\sqrt{\frac{3m\varepsilon_0}{2\rho R\lambda}}$

(D) Time period of oscillation of the rod for stable equilibrium is $2\pi\sqrt{\frac{3m\varepsilon_0}{\rho R\lambda}}$

5) Shown in the figure is one of the field lines produced due to two charges q_1 and q_2. Take $q_1 = q$. Choose the correct option(s)



(A) Charge $q_2 = 5\,q$ (B) charge $q_2 = 7q$

(C) $\alpha = \tan^{-1}\frac{\sqrt{24}}{5}$ (D) $\alpha = \cos^{-1}\frac{4}{5}$

6) The electric field due to a charge distribution is given by $\vec{E} = E_0\frac{(x-2)\hat{i}+(y-2)j}{(x-2)^2+(y-2)^2}$

(A) The electric flux due to this field through the curved surface of a right circular cone of radius $6\sqrt{2}$ with centre at origin and apex at (0, 0, 6) is $8E_0\pi$

(B) The electric flux due to this field through a sphere of radius $6\sqrt{2}$ with centre at origin is $16E_0\pi$

(C) The electric flux due to this field through a triangle whose corners are at (2, 0, 0); (0, 2, 0) and (2, 2, 2) is $E_0\pi$

(D) The electric flux due to this field through a square whose corners are at (4, 0, 0); (0, 0, 4); (4, 0, 4) and (0, 0, 0) is $E_0\pi$

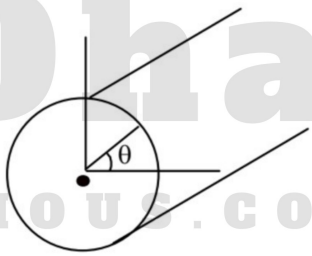
7) Long hollow non conducting cylinder of radius R has surface charge density $\sigma = \sigma_0 \sin\theta$. Choose the correct option(s):

(A) Electric field inside the cylinder is uniform

(B) Electric field inside the cylinder is non-uniform

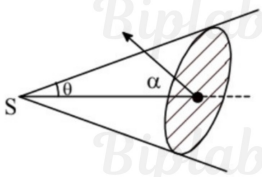
(C) Electric field at the axis of the cylinder is $\frac{\sigma}{2\varepsilon_0}$

(D) Electric field at the axis of the cylinder is $\frac{\sigma}{\varepsilon_0}$

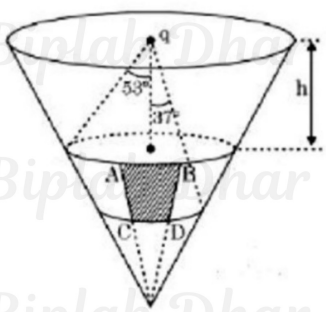


Comprehension Type:

8) A source of electron emits electron at a rate of N electrons per second. The current through the flat surface as shown in figure $\left(\theta = 60° \,\&\, \alpha = 45°\right)$ is $\frac{Ne}{2\sqrt{x}}$. Find x



9) A point charge q is kept at the centre of circular plane surface of cone. A shaded section ABCDA shown at the slant surface of cone. If electric flux through the shaded section is $\frac{n}{m}\times\frac{q}{80\,\pi\varepsilon_0}$ where n an m minimum possible integer, find (n + m). [length AB = h/2]



10) Due to manufacturing defect a solid non conducting sphere with uniform volume charge density ρ has got two spherical cavity of radius R/8 and a hemispherical dent of radius 3R/4. Taken center of the sphere as origin, the cavities have their centres at $\left(\frac{3\sqrt{19}R}{40}, \frac{27R}{40}, 0\right)$ and $\left(-\frac{3\sqrt{19}R}{40}, \frac{27R}{40}, 0\right)$. Hemisphere has centre at origin and thickness R/30 as shown. If the electric field due to this charge configuration at origin is $\frac{\rho R}{80n\varepsilon_0}$. Find n