JEE MOCK TEST

CH 1, 2 **FM – 100** **TIME – 1 HR**

1. Consider a sphere of radius Rwhich carries a uniform charge density ρ. If a sphere of radius $\frac{R}{2}$is carved out of it, as shown, the ratio

$$| \vec{E}_A |/| \vec{E}_B |$$

of magnitude of electric field $\vec{E}_A$and $\vec{E}_B$, respectively, at points A and B due to the remaining portion is:

$\frac{18}{34}$ $\frac{18}{54}$ $\frac{21}{34}$ $\frac{17}{54}$

2. A charged particle (mass $m$and charge q) moves along X-axis with velocity v_0. When it passes through the origin, it enters a region having uniform electric field $\vec{E} = E\hat{j}$, which extends up to $x = d$. Equation of path of electron in the region $x > d$is:

Options:

$$y = \frac{qEd}{mv_0^2}(x - d)$$

$$y = \frac{qEd}{mv_0^2}x$$

$$y = \frac{qEd}{mv_0^2}\left(\frac{d}{2} - x\right)$$

$$y = \frac{qEd}{mv_0^2}x$$

3. A particle of charge $q$and mass $m$is subjected to an electric field

$$E = E_0(1 - ax^2)$$

in the X-direction, where $a$and $E_0$are constants. Initially, the particle was at rest at $x = 0$. The kinetic energy of the particle becomes zero when the distance of the particle from the origin is:

Options: $\sqrt{\frac{3}{a}}$ $\sqrt{\frac{2}{a}}$ $\sqrt{\frac{1}{a}}$ a

4. Charges $Q_1$and $Q_2$are at points A and B of a right-angle triangle OAB (see figure). The resultant electric field at point O is perpendicular to the hypotenuse, then $Q_1/Q_2$is proportional to:

Options: $\frac{x_1^3}{x_2^3}$ $\frac{x_2^2}{x_1^2}$ $\frac{x_1}{x_2}$ $\frac{x_2}{x_1}$

5. A cube of side 'a' has point charges $+Q$located at each of its vertices except at the origin where the charge is $-Q$. The electric field at the centre of the cube is:

Options:

$$\frac{Q}{3\sqrt{3}\pi\varepsilon_0 a^2}(\hat{\imath}+\hat{\jmath}+\hat{k})$$

$$\frac{Q}{3\sqrt{3}\pi\varepsilon_0 a^2}(\hat{\imath}+\hat{\jmath}+\hat{k})$$

$$\frac{2Q}{3\sqrt{3}\pi\varepsilon_0 a^2}(\hat{\imath}+\hat{\jmath}+\hat{k})$$

$$\frac{-2Q}{3\sqrt{3}\pi\varepsilon_0 a^2}(\hat{\imath}+\hat{\jmath}+\hat{k})$$

6. Consider the force Fon a charge $q$due to a uniformly charged spherical shell of radius Rcarrying charge Qdistributed uniformly over it. Which one of the following statements is true for F, if $q$is placed at a distance $r$from the centre of the shell?

Options:

$F=\frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$for all r

$\frac{1}{4\pi\varepsilon_0}\frac{Qq}{R^2}>F>0$for $r<R$

$F=\frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$for $r>R$

$F=\frac{1}{4\pi\varepsilon_0}\frac{Qq}{R^2}$for $r<R$

7. Three identical charged balls each of charge 2 C are suspended from a common point $P$by silk threads of 2 meach (as shown in the figure). They form an equilateral triangle of side 1 m.

The ratio of net force on a charged ball to the force between any two charged balls will be:

Options:

$1:1$

$1:4$

$\sqrt{3}:2$

$\sqrt{3}:1$

8. Two point charges Qeach are placed at a distance $d$apart. A third point charge $q$is placed at a distance $x$from the mid-point on the perpendicular bisector.

The value of $x$at which charge $q$will experience the maximum Coulomb force is:

Options:

$$x = d$$

$$x = \frac{d}{2}$$

$$x = \frac{d}{\sqrt{2}}$$

$$x = \frac{d}{2\sqrt{2}}$$

9. Two identical charged particles each having a mass 10 gand charge 2.0×10^{-7} Care placed on a horizontal table with a separation Lbetween them such that they stay in limited equilibrium. If the coefficient of friction between each particle and the table is 0.25, find the value of L. Use $g = 10\,\text{m s}^{-2}$.

   Options:

   12 cm

   10 cm

   8 cm

   5 cm

10. For a uniformly charged ring of radius R, the electric field on its axis has the largest magnitude at a distance $h$from its centre.

    The value of $h$is:

    Options:

    $$\frac{R}{\sqrt{2}}$$

    $$\frac{R}{\sqrt{5}}$$

    $$R$$

    $$R\sqrt{2}$$

11. Four point charges $-q, +q, +q$and $-q$are placed on the y-axis at $y = -2d, y = -d, y = +d$and $y = +2d$, respectively.

    The magnitude of the electric field Eat a point on the x-axis at $x = D$, with $D \gg d$, will behave as:

    Options:

    $$E \propto \frac{1}{D^3}$$

    $$E \propto \frac{1}{D}$$

$$E \propto \frac{1}{D^4}$$

$$E \propto \frac{1}{D^2}$$

12. Let a total charge $2Q$ be distributed in a sphere of radius R, with the charge density given by

$$\rho(r) = kr$$

where r is the distance from the centre.

Two charges A and B, of charge $-Q$ each, are placed on diametrically opposite points, at equal distance a from the centre. If A and B do not experience any force, then:

Options:

$$a = \frac{3R}{2^{1/4}}$$

$$a = \frac{R}{\sqrt{3}}$$

$$a = 2^{-1/4}R$$

$$a = 8^{-1/4}R$$

13. A parallel plate capacitor has plate area $40\ \text{cm}^2$ and plate separation 2 mm. The space between the plates is filled with a dielectric medium of thickness 1 mm and dielectric constant 5. The new capacitance of the system

(a) $24\varepsilon_0\ F$

(b) $\frac{3}{10}\varepsilon_0\ F$

(c) $\frac{10}{3}\varepsilon_0\ F$

(d) $10\varepsilon_0\ F$

14. Two isolated metallic solid spheres of radii R and $2R$ are charged such that both have same charge density σ. The spheres are then connected by a thin conducting wire. If the new charge density of the bigger sphere is σ', the ratio

$$\frac{\sigma'}{\sigma}$$

is:

(a) $\frac{9}{4}$

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

(c) $\frac{5}{3}$

(d) $\frac{5}{6}$

15. Sixty four conducting drops each of radius 0.02 mand each carrying a charge of $5\,\mu C$are combined to form a bigger drop. The ratio of surface density of bigger drop to the smaller drop will

(a) $1:4$

(b) $4:1$

(c) $1:8$

(d) $8:1$

16. The electric field in a region is given by

$$\vec{E} = (Ax + B)\,\hat{\imath},$$

where $E$is in $NC^{-1}$and $x$is in metres. The values of constants are $A = 20$ SI unitand $B = 10$ SI unit. If the potential at $x = 1$is $V_1$and at $x = -5$is V_2, then $V_1 - V_2$is:

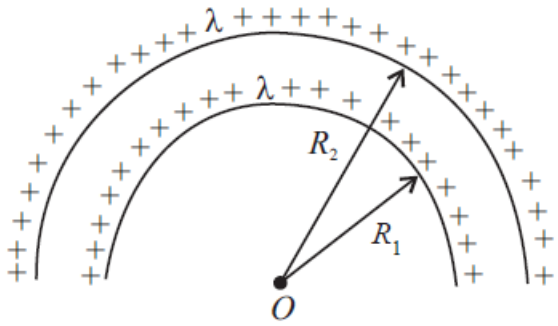
(a) $180\,V$

(b) $-520\,V$

(c) $320\,V$

(d) $-48\,V$

17. The electric potential at the centre of two concentric half rings of radii $R_1$and R_2, having same linear charge density $\lambda$is:



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

(b) $\frac{\lambda}{\varepsilon}$

(c) $\frac{\lambda}{4\varepsilon_0}$

(d) $\frac{\lambda}{\varepsilon_0}$

18. Electric potential at a point 'P' due to a point charge of $5 \times 10^{-9}\, C$is $50\, V$. The distance of 'P' from the point charge is:

(Assume, $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\, Nm^2C^{-2}$)

(a) $3\, cm$

(b) $9\, cm$

(c) $90\, cm$

(d) $0.9\, cm$

19. A parallel-plate capacitor of capacitance $40\, \mu F$is connected to a $100\, V$power supply. Now the space between the plates is completely filled with a dielectric material of dielectric constant $K = 2$. The extra charge and the change in electrostatic energy stored in the capacitor are respectively:

(a) $8\, mC,\ 2.0\, J$

(b) $4\, mC,\ 0.2\, J$

(c) $2\, mC,\ 0.2\, J$

(d) $2\, mC,\ 0.4\, J$

20. The electric field in a region is given by

$$\vec{E} = \left(\frac{3}{5}E_0\hat{\imath} + \frac{4}{5}E_0\hat{\jmath}\right) \text{ N C}^{-1}$$

The ratio of flux of the reported field through the rectangular surface of area $0.2\, \text{m}^2$(parallel to yz-plane) to that of the surface of area $0.3\, \text{m}^2$(parallel to xz-plane) is $a:b$, where $a:b =$_____.

21. The electric field in a region is given by

$$\vec{E} = \frac{2}{5}E_0\hat{\imath} + \frac{3}{5}E_0\hat{\jmath}, \text{with } E_0 = 4.0 \times 10^3 \text{ N C}^{-1}$$

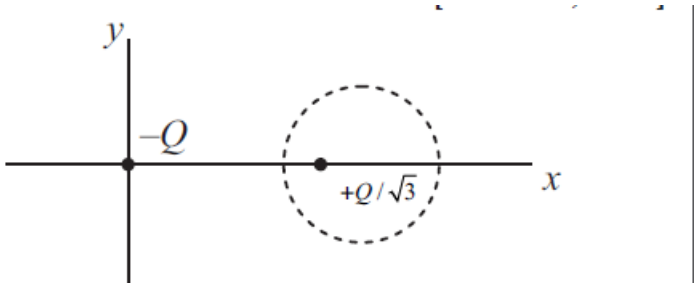
The flux of this field through a rectangular surface of area $0.4\,\text{m}^2$ parallel to the yz-plane is _____ N m^2C^{-1}.

22. The volume charge density of a sphere of radius $6\,\text{m}$ is $2\,\mu\text{C cm}^{-3}$.

The number of lines of force per unit surface area coming out from the surface of the sphere is _____ $\times 10^{10}$ N C^{-1}.

(Given: Permittivity of vacuum $\varepsilon_0 = 8.85 \times 10^{-12}\,\text{C}^2\text{N}^{-1}\text{m}^{-2}$)

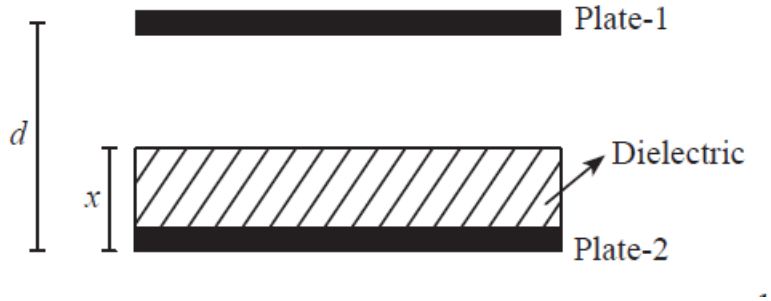
23. Two-point charges $-Q$ and $+\frac{Q}{\sqrt{3}}$ are placed in the xy-plane at the origin $(0, 0)$ and a point $(2, 0)$ respectively, as shown in the figure. This results in an equipotential circle of radius R and potential $V = 0$ in the xy-plane with its center at $(b, 0)$. All lengths are measured in meters.



(a) The value of R is _____ meter.

24. A parallel plate capacitor with plate area A and plate separation d is filled with a dielectric material of dielectric constant $K = 4$. The thickness of the dielectric material is x, where $x < d$.

Let C_1 and C_2 be the capacitance of the system for $x = \frac{1}{3}d$ and $x = \frac{2d}{3}$, respectively. If $C_1 = 2\,\mu F$, the value of C_2 is _____ μF.



25. A composite parallel plate capacitor is made up of two different dielectric materials with different thickness (t_1 and t_2)as shown in figure. The two different dielectric materials are separated by a conducting foil F. The voltage of the conducting foil is _____ V.

Given:

$$\varepsilon_{r1} = 3, t_1 = 0.5 \text{ mm}$$
$$\varepsilon_{r2} = 4, t_2 = 1 \text{ mm}$$

Applied voltage $= 100\,V$