DPP No: 25	PHYSICS
Maximum Time 50 Min	TARGET JEE-MAINS

SYLLABUS : ELECTROSTATICS

1. A uniformly charged sphere of radius 1 cm has potential of 8000 V at surface. The energy density near the surface of sphere will be:

(A) 64×10^5 J/m^3 (B) 8×10^3 J/m^3 (C) 32 J/m^3 (D) 2.83 J/m^3

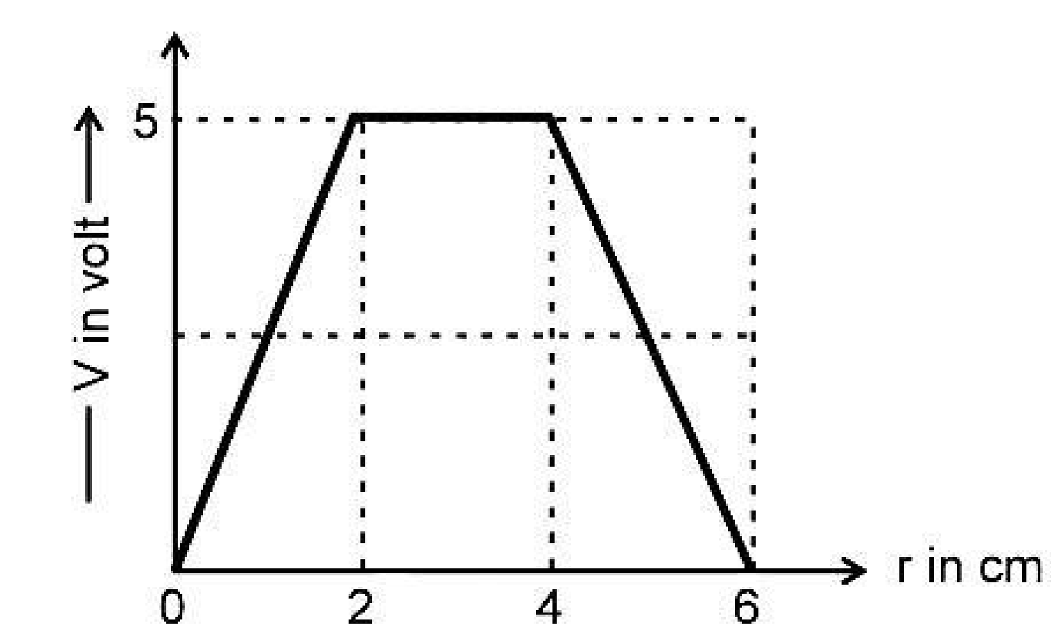
2. If 'n' identical water drops (assumed spherical each) each charged to a potential energy U coalesce to form a single drop, the potential energy of the single drop is(Assume that drops are uniformly charged):

(A) $n^{1/3}$ U (B) $n^{2/3}$ U (C) $n^{4/3}$ U (D) $n^{5/3}$ U

3. In a solid uniformly charged sphere of total charge Q and radius R, if energy stored out side the sphere is U_0 joules then find out self energy of sphere in term of U_0?

(A) $\frac{6U_0}{3}$ Joules (B) $\frac{7U_0}{5}$ Joules (C) $\frac{6U_0}{5}$ Joules (D) $\frac{5U_0}{6}$ Joules

4. The variation of potential with distance r from a fixed point is shown in Figure. The electric field at r = 5 cm, is :



(A) (2.5) V/cm (B) (–2.5) V/cm (C) (–2/5) cm (D) (2/5) V/cm

5. The electric potential V as a function of distance x (in metre) is given by

$V = (5x^2 + 10x - 9)$ volt.

The value of electric field at x = 1 m would be :

(A) – 20 volt/m (B) 6 volt/m (C) 11 volt/m (D) –23 volt/m

6. A uniform electric field having a magnitude E_0 and direction along positive X-axis exists. If the electric potential V is zero at x = 0, then its value at x = +x will be :

(A) $V_x = xE_0$ (B) $V_x = -xE_0$ (C) $V_x = x^2E_0$ (D) $V_x = -x^2 E_0$

7. A non-conducting ring of radius 0.5 m carries a total charge of 1.11×10^{-10} C distributed non-uniformly on its circumference producing an electric field $\vec{E}$ every where in space. The value of the line integral $\int_{\ell=\infty}^{\ell=0} -\vec{E}.d\vec{\ell}$ (ℓ = 0 being centre of the ring) in volts is : (Approximately)

(A) + 2 (B) – 1 (C) – 2 (D) zero

8. If $\vec{E} = 2y\hat{i} + 2x\hat{j}$, then find V (x, y, z)

(A) – 2xy + C (B) – 3xy + C (C) – 5xy + C (D) None of these

9. The dipole moment of a system of charge +q distributed uniformly on an arc of radius R subtending an angle $\pi/2$ at its centre where another charge –q is placed is

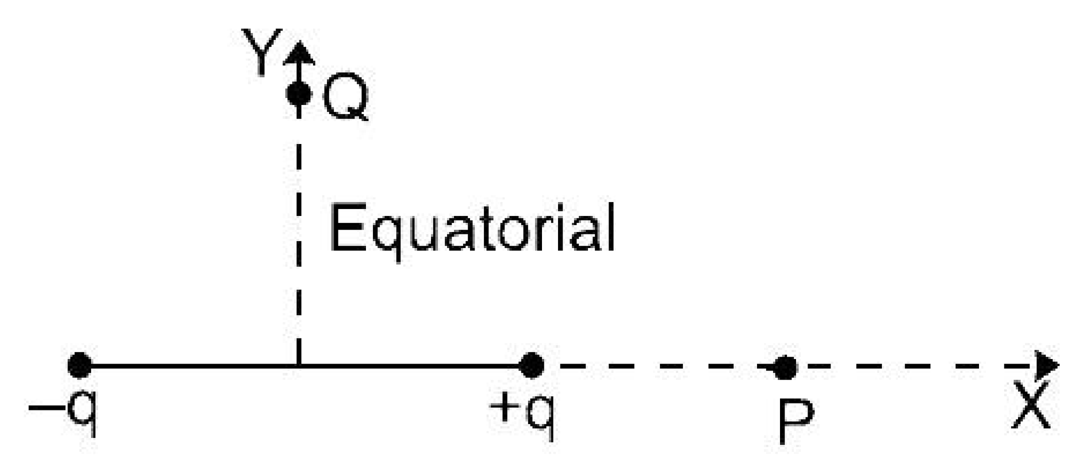
(A) $\frac{2\sqrt{2}qR}{\pi}$ (B) $\frac{\sqrt{2}qR}{\pi}$ (C) $\frac{qR}{\pi}$ (D) $\frac{2qR}{\pi}$

10. Point P lies on the axis of a dipole. If the dipole is rotated by 90° anticlock wise, the electric field vector $\vec{E}$ at P will rotate by :

(A) 90° clockwise (B) 180° clockwise (C) 90° anticlock wise (D) 180° anticlockwise

11. Due to an electric dipole shown in fig.,

the electric field intensity is parallel to dipole axis :



(A) at P only

(B) at Q only

(C) both at P and at Q (D) neither at P nor at Q

12. An electric dipole of dipole moment $\vec{p}$ is placed at the origin along the x-axis. The angle made by electric field with x-axis at a point P, whose position vector makes an angle θ with x-axis, is :(where, $\tan\alpha = \frac{1}{2}\tan\theta$)

(A) α (B) θ (C) $\theta + \alpha$ (D) $\theta + 2\alpha$

13. A dipole of electric dipole moment P is placed in a uniform electric field of strength E. If θ is the angle between positive directions of P and E, then the potential energy of the electric dipole is largest when θ is :

(A) zero (B) $\pi/2$ (C) π (D) $\pi/4$

14. Two opposite and equal charges of magnitude 4×10^{-8} coulomb each when placed 2×10^{-2} cm apart form a dipole. If this dipole is placed in an external electric field of 4×10^{8} N/C, the value of maximum torque and the work required in rotating it through 180° from its initial orientation which is along electric field will be : (Assume rotation of dipole about an axis passing through centre of the dipole):

(A) 64×10^{-4} N-m and 44×10^{-4} J (B) 32×10^{-4} N-m and 32×10^{-4} J

(C) 64×10^{-4} N-m and 32×10^{-4} J (D) 32×10^{-4} N-m and 64×10^{-4} J

15. At a point on the axis (but not inside the dipole and not at infinity) of an electric dipole

(A) The electric field is zero

(B) The electric potential is zero

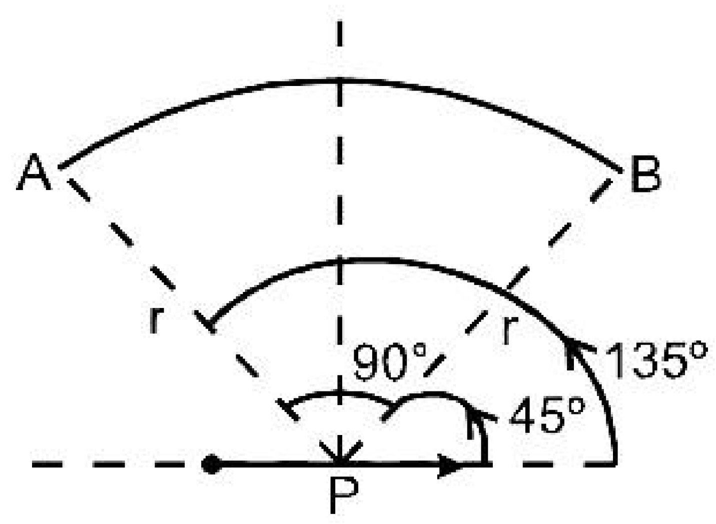
(C) Neither the electric field nor the electric potential is zero

(D) The electric field is directed perpendicular to the axis of the dipole

16. The force between two short electric dipoles separated by a distance r is directly proportional to :

(A) r^2 (B) r^4 (C) r^{-2} (D) r^{-4}

17. A charge 'q' is carried slowly from a point A (r, 135°) to a point B (r, 45°) following a path which is a quadrant of circle of radius 'r'. If the dipole moment is $\vec{P}$, then find out the work done by external agent.

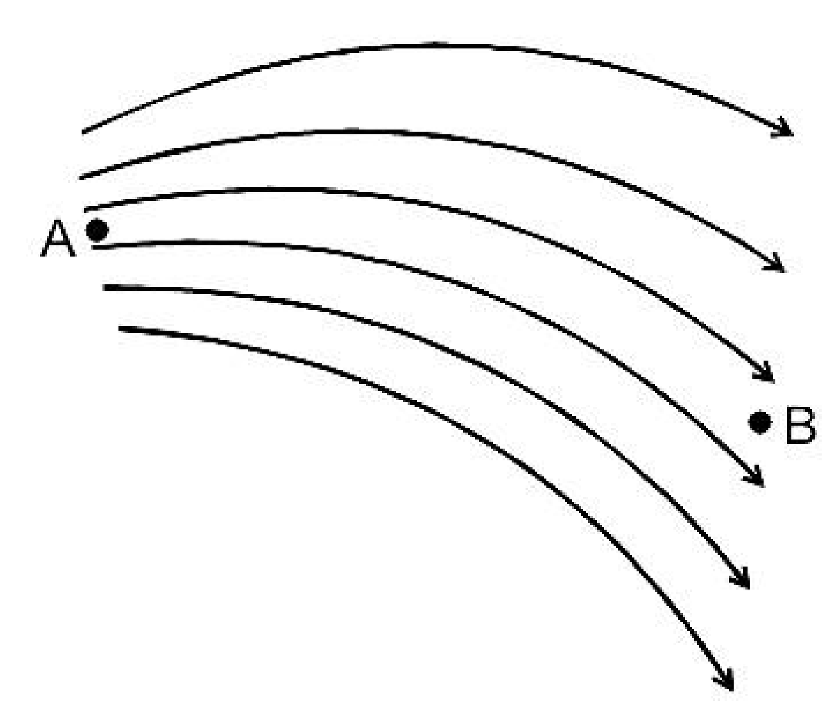


(A) $\frac{\sqrt{2}\,qP}{2\pi\varepsilon_0 r^2}$ (B) $\frac{\sqrt{2}\,qP}{4\pi\varepsilon_0 r^2}$ (C) $\frac{\sqrt{5}\,qP}{4\pi\varepsilon_0 r^2}$ (D) $\frac{\sqrt{2}\,qP}{\pi\varepsilon_0 r^2}$

18. A square of side 'a' is lying in xy plane such that two of its sides are lying on the axis. If an electric field $\vec{E} = E_0 x\hat{k}$ is applied on the square. The flux passing through the square is :–

(A) E_0a^3 (B) $\frac{E_0a^3}{2}$ (C) $\frac{E_0a^3}{3}$ (D) $\frac{E_0a^2}{2}$

19. The figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the distance between A and B is r, then



(A) $E_A < E_B$ (B) $E_A > E_B$

(C) $E_A = \frac{E_B}{r}$ (D) $E_A = \frac{E_B}{r^2}$

20. An electric dipole is placed at the centre of a sphere. Mark the correct options.

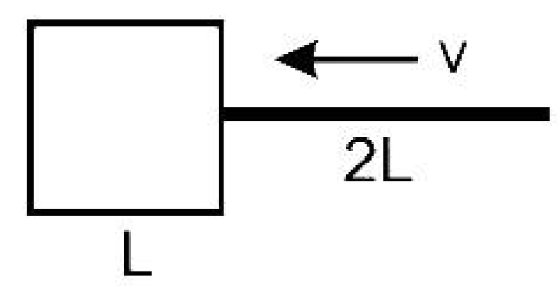
(A) The electric field is zero at every point of the sphere.

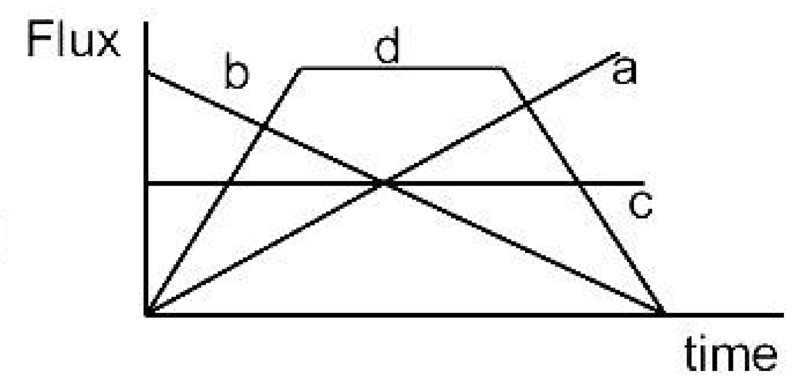
(B) The flux of the electric field through the sphere is non-zero.

(C) The electric field is zero on a circle on the sphere.

(D) The electic field is not zero anywhere on the sphere.

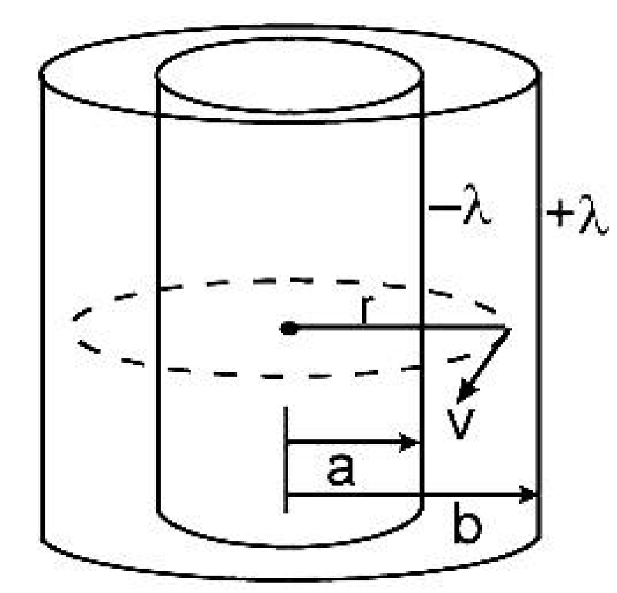
21. Figure (a) shows an imaginary cube of edge length L. A uniformly charged rod of length 2L moves towards left at a small but constant speed v. At t = 0, the left end of the rod just touches the centre of the face of the cube opposite to it. Which of the graphs shown in fig.(b) represents the flux of the electric field through the cube as the rod goes through it ?

(a) 

(b) 

(A) a (B) b (C) c (D) d

22. Figure shows two large cylindrical shells having uniform linear charge densities + λ and – λ. Radius of inner cylinder is 'a' and that of outer cylinder is 'b'. A charged particle of mass m, charge q revolves in a circle of radius r. Then, its speed 'v' is : (Neglect gravity and assume the radii of both the cylinders to be very small in comparison to their length.)



(A) $\sqrt{\frac{\lambda q}{2\pi \epsilon_0 m}}$ (B) $\sqrt{\frac{2\lambda q}{\pi \epsilon_0 m}}$ (C) $\sqrt{\frac{\lambda q}{\pi \epsilon_0 m}}$ (D) $\sqrt{\frac{\lambda q}{4\pi \varepsilon_0 m}}$

23. Find out the electric flux through an area 10 m^2 lying in XY plane due to an electric field $\vec{E} = 2\hat{i} - 10\hat{j} + 5\hat{k}$.

(A) 15 Nm^2/C (B) 25 Nm^2/C (C) 35 Nm^2/C (D) 50 Nm^2/C

24. A neutral spherical metallic object A is placed near a finite metal plate B carrying a positive charge. The electric force on the object will be :

(A) away from the plate B (B) towards the plate B

(C) parallel to the plate B (D) zero

25. Three concentric conducting spherical shells carry charges as follows : + 4Q on the inner shell, - 2 Q on the middle shell and – 5 Q on the outer shell. The charge on the inner surface of the outer shell is:

(A) 0 (B) 4 Q (C) - Q (D) - 2 Q

ANSWER KEY

1.	(D)	**2.**	(D)	**3.**	(C)	**4.**	(A)	**5.**	(A)
6.	(B)	**7.**	(A)	**8.**	(A)	**9.**	(A)	**10.**	(A)
11.	(C)	**12.**	(C)	**13.**	(C)	**14.**	(D)	**15.**	(D)
16.	(D)	**17.**	(B)	**18.**	(B)	**19.**	(B)	**20.**	(D)
21.	(D)	**22.**	(A)	**23.**	(D)	**24.**	(B)	**25.**	(D)