DPP - Daily Practice Problems

Chapter-wise Sheets

Date : ______ **Start Time :** ______ **End Time :** ______

PHYSICS

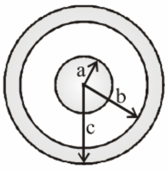
CP15

SYLLABUS : Electric Charges and Fields

Max. Marks : 120 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. A solid conducting sphere of radius a has a net positive charge 2Q. A conducting spherical shell of inner radius b and outer radius c is concentric with the solid sphere and has a net charge –Q. The surface charge density on the inner and outer surfaces of the spherical shell will be respectively



(a) $-\dfrac{2Q}{4\pi b^2}, \dfrac{Q}{4\pi c^2}$ (b) $-\dfrac{Q}{4\pi b^2}, \dfrac{Q}{4\pi c^2}$

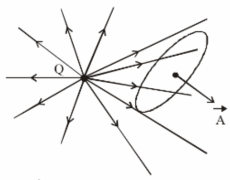
(c) $0, \dfrac{Q}{4\pi c^2}$ (d) $\dfrac{Q}{4\pi c^2}, 0$

2. 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 $\dfrac{\sigma}{2\in_0}$. With respect to the field at the centre, the electric field along the axis at a distance R from the centre of the disc reduces by

(a) 70.7% (b) 29.3%

(c) 9.7% (d) 14.6%

3. In the figure, the net electric flux through the area A is $\phi = \vec{E} \cdot \vec{A}$ when the system is in air. On immersing the system in water the net electric flux through the area



(a) becomes zero (b) remains same

(c) increases (d) decreases

4. An electric dipole is placed in a uniform electric field. The dipole will experience

(a) a force that will displace it in the direction of the field

(b) a force that will displace it in a direction opposite to the field.

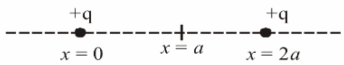
(c) a torque which will rotate it without displacement

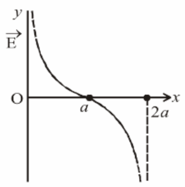
(d) a torque which will rotate it and a force that will displace it

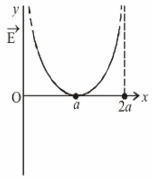
RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

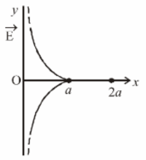
Space for Rough Work

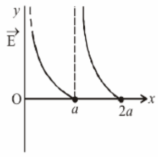
5. Figure shows two charges of equal magnitude separated by a distance 2a. As we move away from the charge situated at x = 0 to the charge situated at x = 2a, which of the following graphs shows the correct behaviour of electric field ?



(a) 

(b) 

(c) 

(d) 

6. An uniform electric field E exists along positive x-axis. The work done in moving a charge 0.5 C through a distance 2 m along a direction making an angle 60° with x-axis is 10 J. Then the magnitude of electric field is

(a) $5\,Vm^{-1}$ (b) $2\,Vm^{-1}$ (c) $\sqrt{5}\ Vm^{-1}$ (d) $20\,Vm^{-1}$

7. An electric dipole is placed along the x-axis at the origin O. A point P is at a distance of 20 cm from this origin such that OP makes an angle π/3 with the x-axis. If the electric field at P makes an angle θ with the x-axis, the value of θ would be

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{3}+\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(c) $\frac{2\pi}{3}$ (d) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

8. A spherically symmetric charge distribution is characterised by a charge density having the following variations:

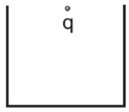
$$\rho(r)=\rho_o\left(1-\frac{r}{R}\right) \text{ for } r<R \quad \rho(r)=0 \text{ for } r\ge R$$

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

(a) $\frac{\rho_o}{4\varepsilon_o}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$ (b) $\frac{\rho_o}{\varepsilon_o}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

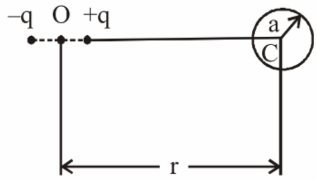
(c) $\frac{\rho_o}{3\varepsilon_o}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$ (d) $\frac{\rho_o}{12\varepsilon_o}\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

9. A charge q is placed at the centre of the open end of a cylindrical vessel. The flux of the electric field through the surface of the vessel is



(a) zero (b) q/ε_o (c) $q/2\varepsilon_o$ (d) $2q/\varepsilon_o$

10. A short electric dipole of dipole moment $\vec{p}$ is placed at a distance r from the centre of a solid metallic sphere of radius a (<< r) as shown in the figure. The electric field intensity at the centre of sphere C due to induced charge on the sphere is



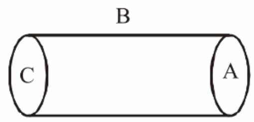
(a) zero (b) $\frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3}$ along CO

(c) $\frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3}$ along OC (d) $\frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$ along CO

11. 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) $\frac{\lambda^2}{2\pi\varepsilon_0 a}$

12. 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) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$

13. 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}

14. A solid sphere of radius R has a charge Q distributed in its volume with a charge density $\rho = \kappa r^a$, where κ and a are constants and r is the distance from its centre.

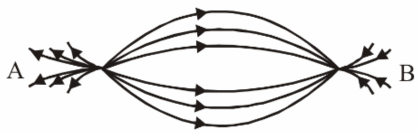
If the electric field at $r=\frac{R}{2}$ is $\frac{1}{8}$ times that at $r = R$, find the value of a

(a) 2 (b) 3 (c) 5 (d) 6

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ

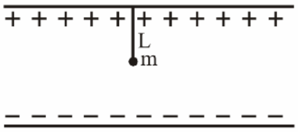
Space for Rough Work

15. The spatial distribution of electric field due to charges (A, B) is shown in figure. Which one of the following statements is correct ?



(a) A is +ve and B –ve, |A| > |B|
(b) A is –ve and B +ve, |A| = |B|
(c) Both are +ve but A > B
(d) Both are –ve but A > B

16. A small sphere carrying a charge 'q' is hanging in between two parallel plates by a string of length L. Time period of pendulum is T_0. When parallel plates are charged, the time period changes to T. The ratio T/T_0 is equal to



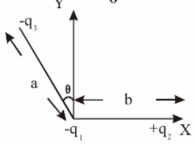
(a) $\left(\dfrac{g+\dfrac{qE}{m}}{g}\right)^{1/2}$ (b) $\left(\dfrac{g}{g+\dfrac{qE}{m}}\right)^{3/2}$

(c) $\left(\dfrac{g}{g+\dfrac{qE}{m}}\right)^{1/2}$ (d) None of these

17. In a medium of dielectric constant K, the electric field is $\vec{E}$. If $\in_0$ is permittivity of the free space, the electric displacement vector is

(a) $\dfrac{K\vec{E}}{\in_0}$ (b) $\dfrac{\vec{E}}{K\in_0}$ (c) $\dfrac{\in_0\vec{E}}{K}$ (d) $K\in_0\vec{E}$

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



(a) $\dfrac{q_2}{b^2}-\dfrac{q_3}{a^2}\cos\theta$ (b) $\dfrac{q_2}{b^2}+\dfrac{q_3}{a^2}\sin\theta$

(c) $\dfrac{q_2}{b^2}+\dfrac{q_3}{a^2}\cos\theta$ (d) $\dfrac{q_2}{b^2}-\dfrac{q_3}{a^2}\sin\theta$

19. An oil drop of radius r and density ρ is held stationary in a uniform vertically upwards electric field 'E'. If ρ_0 (< ρ) is the density of air and e is quanta of charge, then the drop has–

(a) $\dfrac{4\pi r^3(\rho-\rho_0)g}{3eE}$ excess electrons

(b) $\dfrac{4\pi r^2(\rho-\rho_0)g}{eE}$ excess electrons

(c) deficiency of $\dfrac{4\pi r^3(\rho-\rho_0)g}{3eE}$ electrons

(d) deficiency of $\dfrac{4\pi r^2(\rho-\rho_0)g}{eE}$ electrons

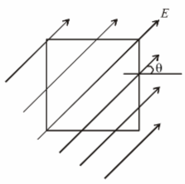
20. A surface has the area vector $\vec{A}=\left(2\hat{i}+3\hat{j}\right)m^2$. The flux of an electric field through it if the field is $\vec{E}=4\hat{i}\dfrac{V}{m}$:

(a) 8V-m (b) 12V-m (c) 20V-m (d) zero

21. Two small similar metal spheres A and B having charges 4q and – 4q, when placed at a certain distance apart, exert an electric force F on each other. When another identical uncharged sphere C, first touched with A then with B and then removed to infinity, the force of interaction between A and B for the same separation will be

(a) F/2 (b) F/8 (c) F/16 (d) F/32

22. 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 the 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

23. Two point dipoles of dipole 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 dipoles is :

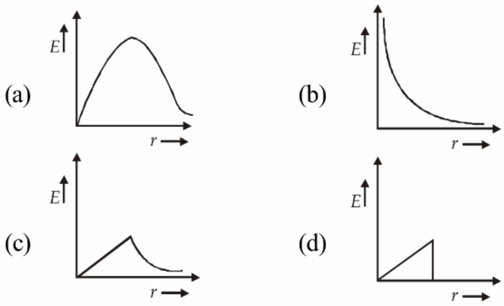
(a) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{4p_1p_2}{x^4}$ (b) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{3p_1p_2}{x^3}$

(c) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{6p_1p_2}{x^4}$ (d) $\dfrac{1}{4\pi\varepsilon_0}\dfrac{8p_1p_2}{x^4}$

RESPONSE GRID					
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	

Space for Rough Work

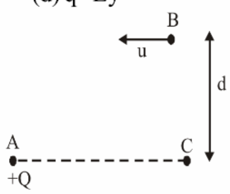
24. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be:



25. 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) $qE^2 y$ (c) qEy (d) $q^2 Ey$

26. A positive charge +Q is fixed at a point A. Another positively charged particle of mass m and charge +q is projected from a point B with velocity u as shown in the figure. The point B is at the large distance from A and at distance d from the line AC. The initial velocity is parallel to the line AC. The point C is at very large distance from A. The minimum distance (in meter) of +q from +Q during the motion is $d(1+\sqrt{A})$. Find the value of A. [Take $Qq = 4\pi\varepsilon_0 mu^2 d$ and $d = (\sqrt{2}-1)$ meter.]

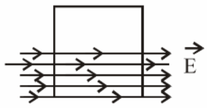


(a) 3 (b) 2 (c) 4 (d) 5

27. Which of the following is a wrong statement?

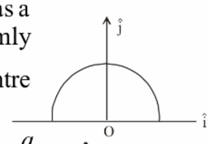
(a) The charge of an isolated system is conserved
(b) It is not possible to create or destroy charged particles
(c) It is possible to create or destroy charged particles
(d) It is not possible to create or destroy net charge

28. A square surface of side L metres is in the 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) $EL^2/(2\varepsilon_0)$

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



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

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

30. 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) $\dfrac{4\pi\varepsilon_0 Fd^2}{e^2}$ (b) $\sqrt{\dfrac{4\pi\varepsilon_0 Fe^2}{d^2}}$

(c) $\sqrt{\dfrac{4\pi\varepsilon_0 Fd^2}{e^2}}$ (d) $\dfrac{4\pi\varepsilon_0 Fd^2}{q^2}$

RESPONSE GRID	
	24. ⓐⓑⓒⓓ 25. ⓐⓑⓒⓓ 26. ⓐⓑⓒⓓ 27. ⓐⓑⓒⓓ 28. ⓐⓑⓒⓓ
	29. ⓐⓑⓒⓓ 30. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP15 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work