LAKSHYA (JEE)

Electric Charges and Field

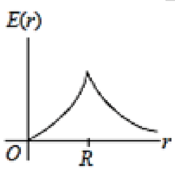
DPP-09

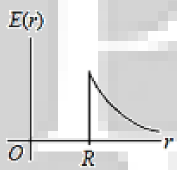
1. A charge Q is placed at the corner of a cube. The electric flux through all the six faces of the cube is:

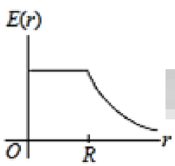
(a) $\frac{Q}{3\epsilon_0}$ (b) $\frac{Q}{24\epsilon_0}$

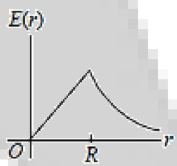
(c) $\frac{Q}{8\epsilon_0}$ (d) $\frac{Q}{\epsilon_0}$

2. A thin spherical shell of radius *R* has charge *Q* spread uniformly over its surface. Which of the following graphs most closely represents the electric field *E*(*r*)produced by the shell in the range $0 \le r < \alpha$, where *r* is the distance from the centre of the shell?

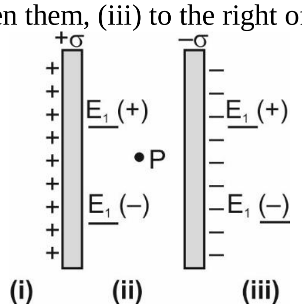
(a) 

(b) 

(c) 

(d) 

3. Two infinite parallel planes carry equal but opposite uniform charge densities $+\sigma$ and $-\sigma$ in the side figure. Find the field in each of the three regions: (i) to the left both, (ii) in between them, (iii) to the right of both.



4. A uniform linear charge density of 4.0 n C/m is distributed along the entire *x*-axis.
Consider a spherical (radius = 5.0 cm) surface centred on the origin. Determine the electric flux through this surface

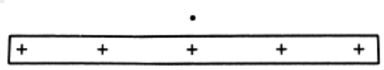
(a) 68 N.m^2 / C (b) 62 N. m^2 / C
(c) 45 N. m^2/ C (d) 79 N. m^2 / C
(e) 23 N. m^2 / C

5. A charge of 4×10^{-8} C is distributed uniformly on the surface of a sphere of radius 1cm. It is covered by a concentric, hollow conducting sphere of radius 5 cm.

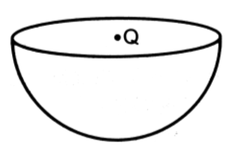
(a) Find the electric field at a point 2 cm away from the centre.

(b) A charge of 6×10^{-8} C is placed on the hollow sphere. Find the surface charge density on the outer surface of the hollow sphere.

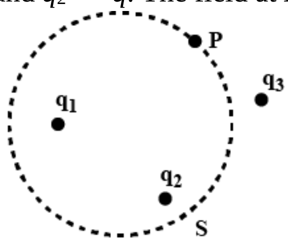
6. A particle of mass 5×10^{-6} g is kept over a large horizontal sheet of charge of density 4.0×10^{-6} C/m^2 (figure). What charge should be given to this particle so that if released, it does not fall down? How many electrons are to be removed to give this charge? How much mass is decreased due to the removal of these electrons?



7. A charge *q* is situated at the centre of an imaginary hemispherical surface, as shown in Fig. Using Gauss's Theorem and symmetry considerations, determine the electric flux due to this charge through the hemispherical surface.

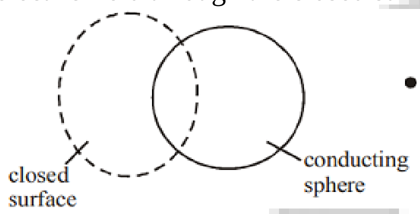


8. A Gaussian Surface S encloses two charges $q_1 = q$ and $q_2 = -q$. The field at P is :



(a) $\vec{E}_1 + \vec{E}_2$ (b) $\vec{E}_1 + \vec{E}_2 + \vec{E}_3$
(c) $\vec{E}_3$ (d) $\vec{E}_1 + \vec{E}_2 - \vec{E}_3$

9. Figure shows a closed surface which intersects a conducting sphere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface



(a) Will remain zero
(b) Will become positive
(c) Will become negative
(d) Will become undefined

10. A flat, square with sides of length L is described by the equations

$$x = L, 0 \le y \le L, 0 \le z \le L$$

The electric flux through the square due to positive point charge q located at the origin ($x = 0, y = 0, z = 0$) is:

(a) $\dfrac{q}{4\epsilon_0}$

(b) $\dfrac{q}{6\epsilon_0}$

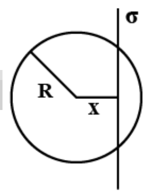
(c) $\dfrac{q}{24\epsilon_0}$

(d) $\dfrac{q}{48\epsilon_0}$

11. As per Gauss law.
Which of the following is true about this $\int \vec{E} \cdot ds = \dfrac{q_{\text{int}}}{\epsilon_0}$

(a) This is valid for symmetrical surface only
(b) E is the electric field to the charge inside the surface
(c) Electric flux on the closed surface due to outside charge is always zero
(d) none of the above

12. An infinite uniformly charged sheet with surface charge density σ cuts through a spherical Gaussian surface of radius R at a distance x from its center as shown in the figure. the electric flux ϕ, through the Gaussian surface is



(a) $\dfrac{\pi R^2 \sigma}{\epsilon_0}$ (b) $\dfrac{2\pi(R^2 - x^2)\sigma}{\epsilon_0}$

(c) $\dfrac{\pi(R - x)^2 \sigma}{\epsilon_0}$ (d) $\dfrac{\pi(R^2 - x^2)\sigma}{\epsilon_0}$

13. Consider a sphere of radius r having charge qC distributed uniformly over the sphere. This sphere is now covered with a hollow conducting sphere of radius $R > r$.

(a) Find the electric field at point P away from the centre O of the sphere such that $r < OP < R$.
(b) Find the surface charge density on the outer surface of the hollow sphere if charge q'C is placed on the hollow sphere.

ANSWERS

1. (c)

2. (c)

3. (i) and (iii) = Zero; (ii) = $\frac{\sigma}{\epsilon_0}$

4. (c)

5. (a) 9×10^5 N/C, (b) 10×10^8 C

6. $q = 2.21 \times 10^{-13}$ C, No. of $e^- = 1.4 \times 10^6$, decreased mass = 1.3×10^{-24} kg

7. $\frac{q}{2\epsilon_0}$

8. (b)

9. (c)

10. (c)

11. (c)

12. (d)

13. (a) $E = \frac{q}{4\pi\epsilon_0 r^2}$; (b) $q_{\text{outer}} = (q' + q)$ C

Note - If you have any query/issue

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