CLASS XII – PHYSICS (042)
PRACTICE PAPER – CHAPTER 1: ELECTRIC CHARGES AND FIELDS

Academic Session 2026–27

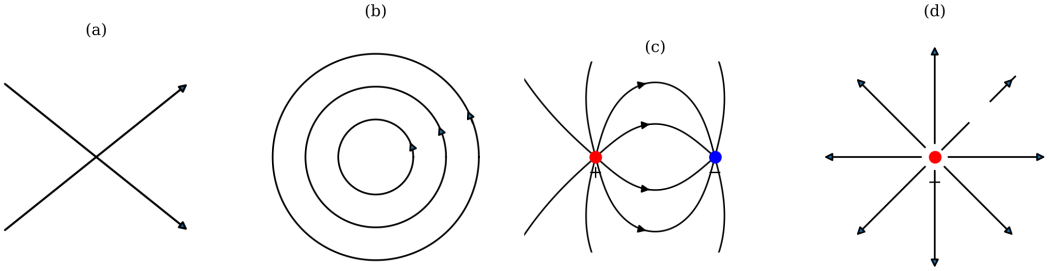
Maximum Marks : 35 **Time Allowed : 1 hour 15 minutes**

General Instructions

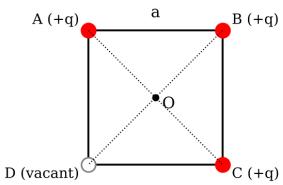
(1) There are 18 questions in all. All questions are compulsory.
(2) The question paper has five sections: Section A, B, C, D and E.
(3) Section A (Q.1–9) has seven MCQs and two Assertion–Reasoning questions of 1 mark each. Section B (Q.10–13) has four questions of 2 marks each. Section C (Q.14–16) has three questions of 3 marks each. Section D (Q.17) is one case study based question of 4 marks. Section E (Q.18) is one long answer question of 5 marks.
(4) There is no overall choice. An internal choice is provided in Q.12 (Section B), Q.15 (Section C), Q.17 part (iv) (Section D) and Q.18 (Section E). Attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.
(6) You may use the following values of physical constants wherever necessary: $e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg, $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}, $1/(4\pi\varepsilon_0) = 9 \times 10^9$ N m^2 C^{-2}, $g = 10$ m s^{-2}

SECTION A (9 × 1 = 9)

1. Which one of the following sketches of electrostatic field lines is physically possible? **1**

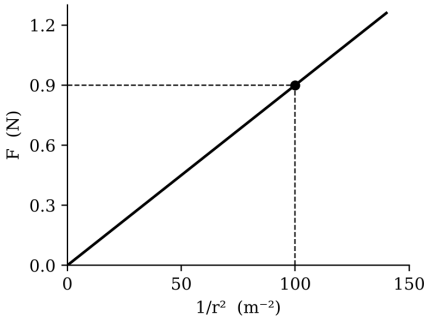


2. Three equal charges +q are fixed at the corners A, B and C of a square ABCD of side a, while the corner D is vacant, as shown. The electric field at the centre O of the square is **1**



(a) zero
(b) $2kq/a^2$, directed towards D
(c) kq/a^2, directed towards D
(d) $2kq/a^2$, directed towards B

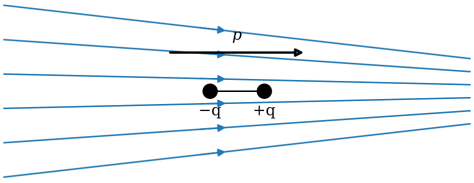
3. The graph shows how the electrostatic force F between two identical point charges (in vacuum) varies with $1/r^2$, where r is their separation. The magnitude of each charge is **1**



(a) 0.1 μC
(b) 0.9 μC
(c) 10 μC
(d) 1 μC

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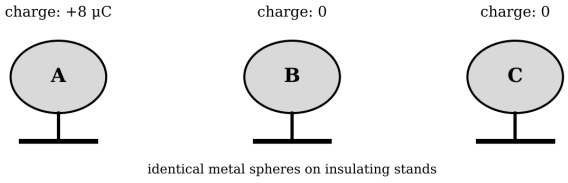
4. An electric dipole is placed in a non-uniform electric field with its dipole moment **p** parallel to the field, as shown. The net force on the dipole is **1**



(a) towards the right
(b) towards the left
(c) zero
(d) perpendicular to the field, upwards

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5. Three identical metal spheres A, B and C are mounted on insulating stands. A carries +8 μC; B and C are uncharged. Sphere C is first touched to A and removed, and then touched to B and removed. The final charges on A and B are respectively **1**



(a) +4 μC, +4 μC
(b) +2 μC, +2 μC
(c) +4 μC, +2 μC
(d) +8 μC, +2 μC

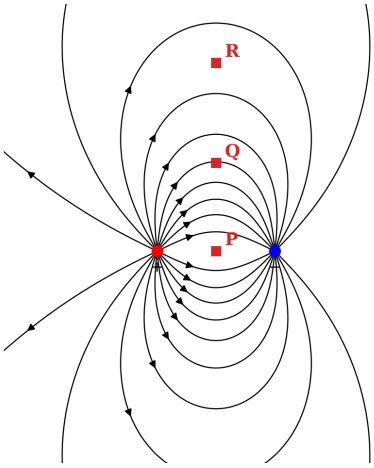
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6. The table gives the outward electric flux through the six faces of a closed rectangular box. The net charge enclosed in the box is **1**

Face	Top	Bottom	Left	Right	Front	Back
Outward flux (N m² C⁻¹)	+12	−3	+6	−2	+4	−7

(a) zero
(b) 8.854×10^{-11} C
(c) 8.854×10^{-12} C
(d) 1.13×10^{11} C

7. The figure shows the field lines of an electric dipole. P is the midpoint of the line joining the two charges; Q and R are two points on the perpendicular bisector of that line, with R farther from the dipole than Q. The magnitudes of the electric field at these points are related as **1**



(a) $E_P < E_Q < E_R$
(b) $E_Q > E_P > E_R$
(c) $E_P = E_Q = E_R$
(d) $E_P > E_Q > E_R$

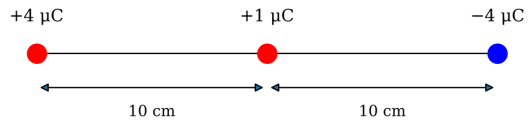
For Questions 8 and 9, a statement of Assertion (A) is followed by a statement of Reason (R). Select the correct answer from the options below.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

8. **Assertion (A):** A charged glass rod attracts small bits of neutral paper. **1**
Reason (R): The non-uniform field of the rod induces a dipole moment in each bit of paper, and a net force then acts on the induced dipole.

9. **Assertion (A):** If the net electric flux through a closed surface is zero, the electric field must be zero at every point of that surface. **1**
Reason (R): The flux through a closed surface depends only on the net charge enclosed by it.

SECTION B (4 × 2 = 8)

10. Three point charges are fixed on a straight line as shown. Find the magnitude and direction of the net electrostatic force on the +1 μC charge. **2**



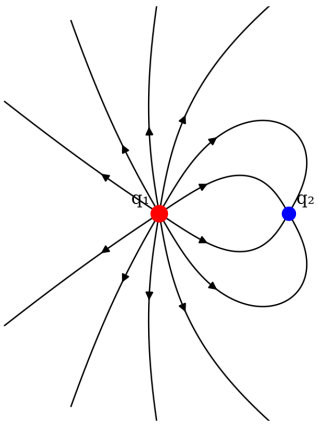
11. A tiny oil drop of mass 4.8×10^{-15} kg remains suspended in air in a uniform electric field of 3×10^{4} N C^{-1} directed vertically downward. Find the sign of the charge on the drop and the number of excess electrons or protons it carries. **2**

12. **(A)** An electric dipole consists of charges +3 μC and −3 μC separated by 4 mm. Calculate its dipole moment. What is the maximum torque it can experience in a uniform electric field of 5×10^{3} N C^{-1}? **2**

OR

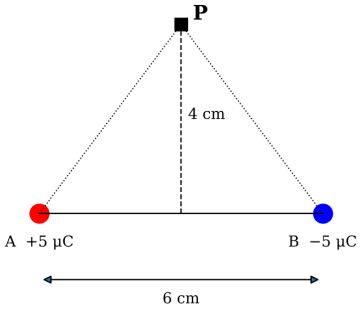
(B) A hollow hemispherical bowl of radius R is placed in a uniform electric field E with its circular rim perpendicular to the field. Using Gauss's law, find the magnitude of the electric flux through the curved surface of the bowl.

13. The figure shows the electric field lines due to two point charges q_1 and q_2. (i) Write the sign of each charge and find the ratio $|q_1| : |q_2|$. (ii) State, with reason, the sign of the net charge of the system. **2**



SECTION C (3 × 3 = 9)

14. Two point charges +5 μC and −5 μC are fixed 6 cm apart, as shown. Find the magnitude and direction of the net electric field at the point P, which lies on the perpendicular bisector of the line AB at a distance of 4 cm from its midpoint. **3**



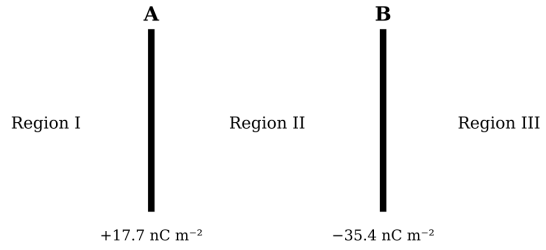
15. **(A)** Derive an expression for the electric field at a point on the axis of an electric dipole. Hence show that, at the same large distance, the axial field is twice the equatorial field. **3**

OR

(B) Derive an expression for the torque on an electric dipole placed in a uniform electric field. State the direction of the net force on the dipole if the field is non-uniform and **p** is parallel to it.

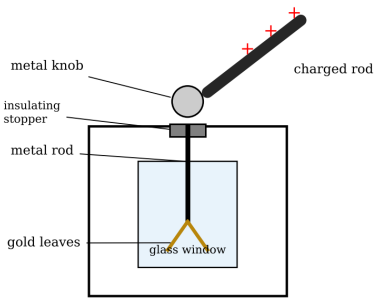
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16. Two large parallel plane sheets A and B carry uniform surface charge densities $+17.7\ \text{nC m}^{-2}$ and $-35.4\ \text{nC m}^{-2}$ respectively, as shown. Find the magnitude and direction of the net electric field in regions I, II and III. **3**



SECTION D (1 × 4 = 4)

17. **Case Study.** A gold-leaf electroscope is a simple device to detect charge. It has a vertical metal rod, insulated from a metal box, with a metal knob on top and two thin gold leaves attached to its lower end. When a charged object touches the knob, charge flows on to the leaves and they diverge, as shown. Answer the following: **4**



(i) The leaves diverge because they

(a) acquire charges of the same sign and repel each other (b) acquire charges of opposite sign and attract each other (c) become heavier (d) are attracted by the rod

(ii) The extent of divergence of the leaves is an indicator of

(a) the sign of the charge (b) the amount of charge (c) the mass of the leaves (d) the temperature of the rod

(iii) The leaves acquire a total charge of $+4.8 \times 10^{-9}$ C. This means the electroscope has

(a) gained 3×10^{10} electrons (b) lost 3×10^{10} electrons (c) lost 3×10^{9} electrons (d) gained 3×10^{9} protons

(iv) A student holds a metal rod in her hand and rubs it with wool, but the rod shows no signs of charging. This is because

(a) metals cannot be charged (b) the charge leaks to the ground through her body (c) metals have no free electrons (d) rubbing does not transfer charge

OR

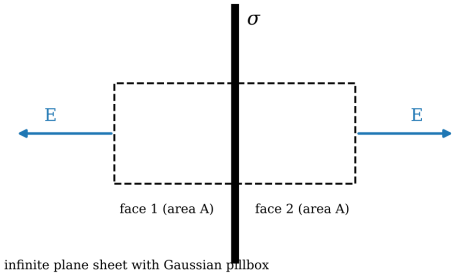
(iv) When the knob of the charged electroscope is touched with a metal wire connected to the ground, the leaves collapse because

(a) charge is destroyed (b) charge flows to the earth through the conductor (c) the leaves become heavier (d) the box absorbs the charge

SECTION E (1 × 5 = 5)

18. **(A)** State Gauss's law. Using the Gaussian pillbox shown in the figure, derive an expression for the electric field due to a thin infinite plane sheet of uniform surface charge density σ. (3) **5**

A large sheet carries a surface charge density of +17.7 nC m^{-2}. Find the electric field near it and the magnitude of the acceleration of an electron released near the sheet. State the direction of the acceleration. (2)

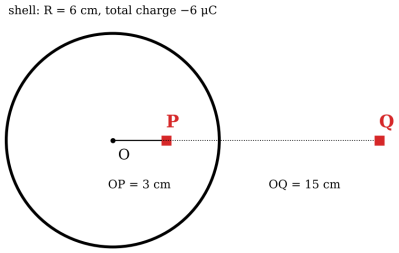


infinite plane sheet with Gaussian pillbox

OR

(B) State Gauss's law. Derive an expression for the electric field due to a uniformly charged thin spherical shell at a point (i) outside and (ii) inside the shell. (3)

The figure shows a thin spherical shell of radius 6 cm carrying a total charge of −6 μC. Find the magnitude and direction of the electric field at the points P and Q. (2)



— End of Question Paper —