Narayan Gurukul Academy

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CBSE · Physics · Class 12 **Chapter 1 · Electric Charges and Fields**

A · Electric Charge and Its Properties

1. State any three basic properties of electric charge.

2. A glass rod rubbed with silk becomes positively charged while the silk becomes equally negatively charged. Explain the process and show that it is consistent with the law of conservation of charge.

3. How many electrons together make up one coulomb of charge?

4. A metal body acquires a net charge of $+4.8 \times 10^{-19}\ \text{C}$. How many electrons were removed from it?

5. A body carries 2.5×10^{13} excess electrons. Find its net charge in μC.

6. “Repulsion is a sure test of electrification but attraction is not.” Explain with proper reasoning.

B · Coulomb's Law and Superposition

7. State Coulomb's law in electrostatics. Write its scalar form and give the SI units of all quantities involved.

8. Two point charges $+3\ \mu\text{C}$ and $+4\ \mu\text{C}$ are placed 20 cm apart in air. Find the electrostatic force between them.

9. A charge of $5\ \mu\text{C}$ placed in air exerts a force of $0.225\ \text{N}$ on another charge placed 10 cm away. Find the magnitude of the second charge.

10. The force between two point charges is $0.16\ \text{N}$ in air. When a slab of dielectric completely fills the space between them the force becomes $0.02\ \text{N}$. Find the dielectric constant of the slab.

11. A total charge Q is to be divided into two parts so that the electrostatic force between them, at a fixed separation, is maximum. Find the required division.

12. State the principle of superposition of electrostatic forces.

C · Electric Field

13. Define electric field intensity at a point. Give its SI unit and the expression for the field due to a point charge.

14. Calculate the electric field at a distance of 30 cm from a point charge of $+2\ \mu\text{C}$ kept in air.

15. A charge of $-3\ \mu\text{C}$ placed at a point experiences a force of $6 \times 10^{-3}\ \text{N}$ directed towards the north. Find the magnitude and direction of the electric field at that point.

16. An electron ($m_e = 9.1 \times 10^{-31}\ \text{kg}$) is placed in a uniform electric field of $5 \times 10^{4}\ \text{N/C}$. Find the magnitude of its acceleration.

17. Why must a test charge be taken as negligibly small?

D · Charge Distributions and Field Lines

18. Define linear, surface and volume charge densities and write their SI units.

19. Derive an expression for the electric field on the axis of a uniformly charged ring of radius R at a distance x from its centre. Hence show that the field at the centre is zero.

20. Write the expression for the electric field at a distance r from an infinitely long uniformly charged wire of linear charge density λ.

21. An infinite wire carries a linear charge density of $2.5 \times 10^{-7}\ \text{C/m}$. Find the electric field at a distance of 2.5 cm from the wire.

22. State any two important properties of electric field lines. Why can two electric field lines never intersect?

23. If 6 field lines originate from a charge Q_1 and 18 field lines terminate on a charge Q_2, find (a) the signs of Q_1 and Q_2 and (b) the ratio of their magnitudes.

E · Electric Flux and Gauss's Law

24. Define electric flux. Write its SI unit and the expression $\Phi_E = E\,A\cos\theta$ with symbols explained.

25. A plane surface of area $2\ \text{m}^2$ is placed in a uniform electric field of $500\ \text{N/C}$. Find the flux when the plane is (a) perpendicular to the field, (b) parallel to the field, and (c) oriented so that the normal to the plane makes 60° with the field.

26. State Gauss's law. Show that the net flux of a point charge Q through a spherical Gaussian surface is Q/ε_0, independent of the radius r of the sphere.

27. A closed surface encloses point charges $+2\ \mu\text{C}$, $-6\ \mu\text{C}$ and $+3\ \mu\text{C}$. Calculate the net electric flux through the surface.

28. Using Gauss's law, derive the electric field of an infinite non-conducting plane sheet of surface charge density σ. Also state the field just outside an infinite conducting sheet.

Answer Key — Assignment 1

3. 6.25×10^{18} electrons

4. 3 electrons withdrawn

5. $-4\,\mu\text{C}$

8. $2.7\,\text{N}$, repulsive

9. $5 \times 10^{-8}\,\text{C} = 0.05\,\mu\text{C}$

10. $K = 8$

11. Divided as $Q/2$ and $Q/2$

14. $2 \times 10^{5}\,\text{N/C}$, away from the charge

15. $2 \times 10^{3}\,\text{N/C}$, directed south

16. $\approx 8.8 \times 10^{15}\,\text{m/s}^2$

21. $\approx 1.8 \times 10^{5}\,\text{N/C}$

23. Q_1 positive, Q_2 negative; $|Q_1|/|Q_2| = 1/3$

25. (a) $1000\,\text{N}\,m^2/C$ (b) 0 (c) $500\,\text{N}\,m^2/C$

27. Net flux $= -1/\varepsilon_0$ times 10^{-6} i.e. $\approx -1.13 \times 10^{5}\,\text{N}\,m^2/C$