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CLASS 12 PHYSICS · NCERT CHAPTER 1 · IMU CET PRACTICE

Electric Charges and Fields

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Questions: 47 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The SI unit of electric charge is
(A) ampere (B) volt
(C) coulomb (D) farad
- 2 The charge on an electron is
(A) $+1.6 \times 10^{-19}$ C (B) -1.6×10^{-19} C
(C) -9.1×10^{-31} C (D) -1.6×10^{-17} C
- 3 The number of electrons in 1 C of charge is
(A) 6.25×10^{18} (B) 6.25×10^{19}
(C) 1.6×10^{19} (D) 1.6×10^{-19}
- 4 Quantisation of charge means
(A) charge is additive
(B) charge exists only as integral multiples of e
(C) charge can be created
(D) charge is conserved
- 5 A glass rod rubbed with silk acquires positive charge because
(A) electrons are transferred from silk to glass
(B) protons are created in glass
(C) electrons are transferred from glass to silk
(D) protons are transferred from silk to glass
- 6 Two point charges repel each other with force F. If the distance between them is halved, the force becomes
(A) 2F (B) 4F
(C) F/4 (D) F/2
- 7 The value of $1/(4\pi\epsilon_0)$ in SI is
(A) 9×10^{-9} N m² C⁻² (B) 9×10^9 N m² C⁻²
(C) 8.85×10^{-12} N m² C⁻² (D) 1.6×10^{-19} N m² C⁻²



- 8 Two charges of $2\ \mu\text{C}$ and $3\ \mu\text{C}$ are 30 cm apart in air. The force between them is
(A) 0.6 N (B) 6 N
(C) 0.2 N (D) 0.06 N
- 9 The force between two charges in air is F . When placed in a medium of dielectric constant 4 at the same separation, the force becomes
(A) $F/4$ (B) $F/16$
(C) $4F$ (D) F
- 10 The unit of electric field intensity is
(A) N C (B) C/N
(C) N/C (D) J/C
- 11 The electric field due to a point charge varies with distance as
(A) $1/r^2$ (B) r
(C) $1/r$ (D) $1/r^3$
- 12 Electric field lines
(A) start from negative charges (B) never intersect each other
(C) form closed loops (D) can intersect
- 13 The electric field inside a charged hollow conducting sphere is
(A) zero (B) kq/R^2
(C) maximum (D) kq/R
- 14 An electric dipole consists of
(A) two equal like charges
(B) two unequal like charges
(C) a single charge
(D) two equal and opposite charges separated by a small distance
- 15 The SI unit of electric dipole moment is
(A) C/m (B) C m
(C) N m (D) C m^2
- 16 The direction of the dipole moment is
(A) along the field always (B) perpendicular to the dipole axis
(C) from negative to positive charge (D) from positive to negative charge
- 17 The electric field at a point on the axial line of a short dipole at distance r is
(A) $2kp/r^2$ (B) $2kp/r^3$
(C) kp/r^3 (D) kp/r^2
- 18 The electric field on the equatorial line of a short dipole at distance r is
(A) kp/r^2 , along p (B) $2kp/r^3$, along p
(C) kp/r^3 , opposite to p (D) zero

- 19 The ratio of electric fields on the axial and equatorial lines of a short dipole at the same distance is
(A) 2 : 1 (B) 1 : 2
(C) 1 : 1 (D) 4 : 1
- 20 The torque on a dipole of moment p in a uniform field E at angle θ is
(A) $pE \sin \theta$ (B) $pE \cos \theta$
(C) pE (D) zero always
- 21 A dipole placed in a uniform electric field experiences
(A) both force and torque (B) torque but no net force
(C) net force but no torque (D) neither force nor torque
- 22 A dipole is in stable equilibrium in a uniform field when the angle between p and E is
(A) 180° (B) 45°
(C) 90° (D) 0°
- 23 Gauss's law states that the total electric flux through a closed surface is
(A) zero always (B) $q_{\text{enclosed}}/\epsilon_0$
(C) $q_{\text{enclosed}} \times \epsilon_0$ (D) $q_{\text{enclosed}}/4\pi\epsilon_0$
- 24 The electric flux through a closed surface enclosing an electric dipole is
(A) zero (B) infinite
(C) q/ϵ_0 (D) $2q/\epsilon_0$
- 25 A charge q is placed at the centre of a cube. The flux through one face is
(A) q/ϵ_0 (B) $6q/\epsilon_0$
(C) $q/4\epsilon_0$ (D) $q/6\epsilon_0$
- 26 A charge q is placed at a corner of a cube. The flux through the whole cube is
(A) q/ϵ_0 (B) $q/6\epsilon_0$
(C) $q/8\epsilon_0$ (D) $q/24\epsilon_0$
- 27 The electric field due to an infinitely long straight line charge of linear density λ at distance r is
(A) $\lambda/(2\epsilon_0)$ (B) $\lambda r/(2\pi\epsilon_0)$
(C) $\lambda/(2\pi\epsilon_0 r)$ (D) $\lambda/(4\pi\epsilon_0 r^2)$
- 28 The electric field due to an infinite plane sheet of charge density σ is
(A) $\sigma/4\epsilon_0$ (B) σ/ϵ_0
(C) $2\sigma/\epsilon_0$ (D) $\sigma/2\epsilon_0$
- 29 The electric field just outside a charged conductor with surface charge density σ is
(A) σ/ϵ_0 (B) $\sigma/2\epsilon_0$
(C) $2\sigma/\epsilon_0$ (D) zero



- 30 The electric field outside a uniformly charged spherical shell at distance r from its centre is
(A) kQ/R^2
(B) kQr/R^3
(C) zero
(D) kQ/r^2 , as if all charge were at the centre
- 31 The electric field inside a uniformly charged solid (non-conducting) sphere at distance r from the centre is
(A) zero
(B) kQr/R^3
(C) kQ/R
(D) kQ/r^2
- 32 The electric flux through a surface of area A in a uniform field E making angle θ with the area vector is
(A) $EA \sin \theta$
(B) EA
(C) $EA \cos \theta$
(D) E/A
- 33 The SI unit of electric flux is
(A) $N \, m \, C^{-1}$
(B) $N \, C^{-1} \, m^{-2}$
(C) $N \, m^2 \, C^{-1}$
(D) $C \, m^{-2}$
- 34 Two charges $+q$ and $+4q$ are placed 3 m apart. The point on the line joining them where the field is zero is at
(A) 1.5 m from $+q$
(B) 0.5 m from $+q$
(C) 2 m from $+q$
(D) 1 m from $+q$
- 35 Three charges each $+q$ are placed at the vertices of an equilateral triangle. The electric field at the centroid is
(A) zero
(B) $3kq/r^2$
(C) $\sqrt{3} \, kq/r^2$
(D) kq/r^2
- 36 A charge of $2 \, \mu C$ is placed in a uniform electric field of $10^4 \, N/C$. The force on it is
(A) 0.2 N
(B) $2 \times 10^{-4} \, N$
(C) 2 N
(D) 0.02 N
- 37 An electron and a proton are placed in the same uniform electric field. The ratio of their accelerations (electron : proton) is about
(A) 1 : 1836
(B) $1836^2 : 1$
(C) 1836 : 1
(D) 1 : 1
- 38 Which property of charge states that the total charge of an isolated system remains constant?
(A) Conservation of charge
(B) Quantisation of charge
(C) Additivity of charge
(D) Invariance of charge
- 39 A dipole of moment $4 \times 10^{-9} \, C \, m$ is placed at 30° to a field of $5 \times 10^4 \, N/C$. The torque on it is
(A) $1.73 \times 10^{-4} \, N \, m$
(B) $5 \times 10^{-5} \, N \, m$
(C) $1 \times 10^{-4} \, N \, m$
(D) $2 \times 10^{-4} \, N \, m$



- 40 A charged body attracts a neutral piece of paper because of
(A) induction (polarisation) of charges in the paper
(B) transfer of charges to the paper
(C) magnetic force
(D) gravitational force
-
- 41 The electric field lines of a positive point charge are
(A) parallel straight lines
(B) concentric circles
(C) radially inward
(D) radially outward
-
- 42 A metal sphere is charged. The charge resides
(A) uniformly throughout the volume
(B) on the outer surface
(C) on the inner surface only
(D) at the centre
-
- 43 Electrostatic shielding is based on the fact that
(A) charges reside inside a conductor
(B) field is maximum inside a conductor
(C) insulators conduct
(D) the field inside a conducting cavity is zero
-
- 44 Two identical metal spheres carry charges $+12\ \mu\text{C}$ and $-4\ \mu\text{C}$. They are touched and separated. The charge on each is
(A) $+8\ \mu\text{C}$
(B) $+4\ \mu\text{C}$
(C) $+6\ \mu\text{C}$
(D) $-4\ \mu\text{C}$
-
- 45 In the previous question, if the spheres are placed at the same separation as before, the ratio of new to old force magnitude is
(A) 2 : 3
(B) 1 : 1
(C) 3 : 1
(D) 1 : 3
-
- 46 The work done in rotating a dipole from $\theta = 0^\circ$ to 180° in a uniform field E is
(A) zero
(B) $-2pE$
(C) pE
(D) $2pE$
-
- 47 Coulomb's force is
(A) a non-central force
(B) independent of medium
(C) a central force
(D) always attractive
-

Answer Key

1	2	3	4	5	6	7	8	9	10
C	B	A	B	C	B	B	A	A	C
11	12	13	14	15	16	17	18	19	20
A	B	A	D	B	C	B	C	A	A
21	22	23	24	25	26	27	28	29	30
B	D	B	A	D	C	C	D	A	D
31	32	33	34	35	36	37	38	39	40
B	C	C	D	A	D	C	A	C	A
41	42	43	44	45	46	47			
D	B	D	B	D	D	C			

Hints & Solutions

- (C) Charge is measured in coulomb (C) = ampere × second.
- (B) $e = 1.6 \times 10^{-19}$ C; the electron carries $-e$.
- (A) $n = q/e = 1/(1.6 \times 10^{-19}) = 6.25 \times 10^{18}$.
- (B) $q = ne$, $n = 0, \pm 1, \pm 2, \dots$
- (C) Only electrons transfer in rubbing; glass loses electrons and becomes positive.
- (B) Coulomb's law: $F \propto 1/r^2 \rightarrow 4F$.
- (B) $k = 1/(4\pi\epsilon_0) \approx 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$.
- (A) $F = 9 \times 10^9 \times 2 \times 10^{-6} \times 3 \times 10^{-6}/0.09 = 0.6 \text{ N}$.
- (A) $F_{\text{medium}} = F/K$.
- (C) $E = F/q \rightarrow \text{N/C}$ (equivalently V/m).
- (A) $E = kq/r^2$.
- (B) Two field directions at one point are impossible, so lines never cross. They start on + and end on – charges.
- (A) For a conductor in electrostatic equilibrium, the field inside is zero.
- (D) A dipole is $\pm q$ separated by $2a$; dipole moment $p = q(2a)$.
- (B) $p = q \times 2a \rightarrow \text{C m}$.
- (C) By convention p points from $-q$ to $+q$.
- (B) $E_{\text{axial}} = 2kp/r^3$ for $r \gg a$.
- (C) $E_{\text{eq}} = kp/r^3$ directed opposite to the dipole moment.
- (A) $2kp/r^3 : kp/r^3 = 2 : 1$.
- (A) $\tau = p \times E$, magnitude $pE \sin \theta$.
- (B) Equal and opposite forces on $\pm q$ cancel, but form a couple (torque) unless $p \parallel E$.
- (D) At $\theta = 0^\circ$, torque is zero and potential energy $-pE$ is minimum.



23. (B) $\oint E \cdot dA = q_{\text{enc}}/\epsilon_0$.
24. (A) Net enclosed charge is $+q - q = 0$.
25. (D) By symmetry, total flux q/ϵ_0 is equally shared among 6 faces.
26. (C) Eight such cubes would enclose the charge fully, so one cube gets $q/8\epsilon_0$.
27. (C) Gaussian cylinder: $E(2\pi r l) = \lambda l/\epsilon_0 \rightarrow E = \lambda/(2\pi\epsilon_0 r)$.
28. (D) Gaussian pillbox: $2EA = \sigma A/\epsilon_0 \rightarrow E = \sigma/2\epsilon_0$, independent of distance.
29. (A) Field inside is zero, so only one face of the pillbox contributes: $E = \sigma/\epsilon_0$.
30. (D) By Gauss's law, the shell behaves like a point charge for $r > R$.
31. (B) Enclosed charge $Q(r^3/R^3) \rightarrow E = kQr/R^3 \propto r$.
32. (C) $\Phi = E \cdot A = EA \cos \theta$.
33. (C) $\Phi = EA \rightarrow (N/C)(m^2)$.
34. (D) $kq/x^2 = k(4q)/(3-x)^2 \rightarrow (3-x) = 2x \rightarrow x = 1 \text{ m}$.
35. (A) Three equal fields at 120° to each other cancel by symmetry.
36. (D) $F = qE = 2 \times 10^{-6} \times 10^4 = 0.02 \text{ N}$.
37. (C) Same force eE ; $a = F/m \rightarrow a \propto 1/m$. $m_p/m_e \approx 1836$.
38. (A) Charge can neither be created nor destroyed in an isolated system.
39. (C) $\tau = pE \sin 30^\circ = 4 \times 10^{-9} \times 5 \times 10^4 \times 0.5 = 1 \times 10^{-4} \text{ N m}$.
40. (A) The charged body induces opposite charge on the near side; the nearer charge is attracted more strongly.
41. (D) Field lines start from positive charges and point away radially.
42. (B) In electrostatic equilibrium, excess charge on a conductor resides on its outer surface.
43. (D) A closed conducting shell shields its interior from external electric fields.
44. (B) Total = $+8 \mu\text{C}$ shared equally $\rightarrow +4 \mu\text{C}$ each.
45. (D) Old $\propto 12 \times 4 = 48$ (attractive); new $\propto 4 \times 4 = 16$ (repulsive). Ratio $16/48 = 1/3$.
46. (D) $W = pE(\cos 0^\circ - \cos 180^\circ) = 2pE$.
47. (C) It acts along the line joining the two charges.

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