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CLASS 12 PHYSICS · NCERT CHAPTER 2 · IMU CET PRACTICE

Electrostatic Potential and Capacitance

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Questions: 45 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 potential is
(A) volt (B) farad
(C) newton per coulomb (D) coulomb
- 2 The electric potential at distance r from a point charge q is
(A) kqr (B) kq^2/r
(C) kq/r^2 (D) kq/r
- 3 The potential at a point 0.3 m from a charge of 3 nC is
(A) 900 V (B) 30 V
(C) 90 V (D) 9 V
- 4 The work done in moving a charge of 2 C between two points with potential difference 10 V is
(A) 0.2 J (B) 12 J
(C) 20 J (D) 5 J
- 5 The relation between electric field and potential is
(A) $E = dV/dr$ (B) $E = -dV/dr$
(C) $E = V/r^2$ (D) $E = -V/r$
- 6 Equipotential surfaces are always
(A) parallel to electric field lines (B) random with respect to field lines
(C) at 45° to field lines (D) perpendicular to electric field lines
- 7 The work done in moving a charge on an equipotential surface is
(A) zero (B) negative
(C) infinite (D) positive
- 8 The equipotential surfaces of a point charge are
(A) cylinders (B) ellipsoids
(C) concentric spheres (D) planes
- 9 The potential at a point on the equatorial line of a dipole is
(A) kp/r^2 (B) $2kp/r^2$
(C) kp/r^3 (D) zero



- 10 The potential due to a short dipole on its axis at distance r is
(A) kp/r^2 (B) zero
(C) kp/r^3 (D) $2kp/r^3$
- 11 The electric potential energy of two charges q_1 and q_2 separated by r is
(A) kq_1q_2/r^2 (B) kq_1q_2r
(C) $-kq_1q_2/r^2$ (D) kq_1q_2/r
- 12 The potential energy of a dipole in a uniform field E at angle θ is
(A) pE (B) $-pE \cos \theta$
(C) $-pE \sin \theta$ (D) $pE \sin \theta$
- 13 1 electron volt equals
(A) $1.6 \times 10^{-19} \text{ C}$ (B) $9.1 \times 10^{-31} \text{ J}$
(C) $1.6 \times 10^{-19} \text{ J}$ (D) 1 J
- 14 Inside a charged conducting sphere of radius R carrying charge Q , the potential is
(A) zero (B) kQ/r
(C) varies as r^2 (D) kQ/R (constant)
- 15 The capacitance of a parallel plate capacitor is
(A) $\epsilon_0 d/A$ (B) ϵ_0/Ad
(C) Ad/ϵ_0 (D) $\epsilon_0 A/d$
- 16 The SI unit of capacitance is
(A) farad (B) henry
(C) ohm (D) tesla
- 17 If the separation between the plates of a parallel plate capacitor is doubled, its capacitance becomes
(A) four times (B) double
(C) unchanged (D) half
- 18 A dielectric of constant K completely fills the space between the plates. The capacitance becomes
(A) $1/K$ times (B) unchanged
(C) K times (D) K^2 times
- 19 Capacitance of an isolated sphere of radius R is
(A) $2\pi\epsilon_0 R$ (B) $4\pi\epsilon_0 R^2$
(C) $4\pi\epsilon_0 R$ (D) $R/4\pi\epsilon_0$
- 20 The capacitance of the Earth ($R = 6.4 \times 10^6 \text{ m}$) is about
(A) $711 \mu\text{F}$ (B) 711 F
(C) 1 F (D) 7.1 pF
- 21 Two capacitors of $3 \mu\text{F}$ and $6 \mu\text{F}$ are connected in series. The equivalent capacitance is
(A) $18 \mu\text{F}$ (B) $2 \mu\text{F}$
(C) $4.5 \mu\text{F}$ (D) $9 \mu\text{F}$



- 22** Two capacitors of $3\ \mu\text{F}$ and $6\ \mu\text{F}$ are connected in parallel. The equivalent capacitance is
(A) $3\ \mu\text{F}$ (B) $9\ \mu\text{F}$
(C) $18\ \mu\text{F}$ (D) $2\ \mu\text{F}$
- 23** In a series combination of capacitors, which quantity is the same for each capacitor?
(A) Charge (B) Energy
(C) Capacitance (D) Potential difference
- 24** The energy stored in a capacitor is
(A) $\frac{1}{2}CV^2$ (B) $\frac{1}{2}CV$
(C) $Q^2C/2$ (D) CV^2
- 25** A $10\ \mu\text{F}$ capacitor is charged to $100\ \text{V}$. The energy stored is
(A) $5\ \text{J}$ (B) $0.05\ \text{J}$
(C) $0.5\ \text{J}$ (D) $0.005\ \text{J}$
- 26** The energy density in an electric field E (in vacuum) is
(A) $\frac{1}{2}\epsilon_0 E^2$ (B) $E^2/2\epsilon_0$
(C) $\epsilon_0 E^2$ (D) $\frac{1}{2}\epsilon_0 E$
- 27** A capacitor is charged by a battery and then disconnected. A dielectric slab of constant K is inserted. The charge on it
(A) becomes $1/K$ times (B) remains the same
(C) becomes zero (D) becomes K times
- 28** A capacitor charged and disconnected from battery has a dielectric (K) inserted. The energy stored
(A) becomes K^2 times (B) remains same
(C) becomes $1/K$ times (D) becomes K times
- 29** A capacitor remains connected to a battery while a dielectric of constant K is inserted. The charge on it
(A) becomes zero (B) becomes K times
(C) remains the same (D) becomes $1/K$ times
- 30** Three capacitors of $2\ \mu\text{F}$ each are connected in series. The equivalent capacitance is
(A) $3\ \mu\text{F}$ (B) $2/3\ \mu\text{F}$
(C) $1\ \mu\text{F}$ (D) $6\ \mu\text{F}$
- 31** Two capacitors $2\ \mu\text{F}$ and $4\ \mu\text{F}$ in series are connected across $12\ \text{V}$. The charge on each is
(A) $16\ \mu\text{C}$ (B) $8\ \mu\text{C}$
(C) $24\ \mu\text{C}$ (D) $48\ \mu\text{C}$
- 32** In the previous question, the potential difference across the $2\ \mu\text{F}$ capacitor is
(A) $6\ \text{V}$ (B) $4\ \text{V}$
(C) $8\ \text{V}$ (D) $12\ \text{V}$

- 33** The electric field inside a parallel plate capacitor with surface charge density σ (vacuum) is
(A) σ/ϵ_0 (B) $\sigma/2\epsilon_0$
(C) $2\sigma/\epsilon_0$ (D) zero
- 34** A dielectric material when placed in an electric field
(A) increases the field inside it
(B) becomes magnetised
(C) gets polarised, reducing the net field inside it
(D) conducts current
- 35** The dielectric constant of a metal (conductor) is effectively
(A) zero (B) negative
(C) one (D) infinite
- 36** Two charged spheres of radii 1 cm and 2 cm are connected by a thin wire. The ratio of their surface charge densities (small : large) is
(A) 4 : 1 (B) 2 : 1
(C) 1 : 2 (D) 1 : 1
- 37** The potential at the centre of a square of side a with charges $+q$ at all four corners is
(A) $4\sqrt{2} kq/a$ (B) $4kq/a$
(C) zero (D) $2\sqrt{2} kq/a$
- 38** A charge of $5 \mu\text{C}$ moves from a point at 200 V to one at 50 V. The work done by the electric field is
(A) $1.25 \times 10^{-3} \text{ J}$ (B) $-7.5 \times 10^{-4} \text{ J}$
(C) $2.5 \times 10^{-4} \text{ J}$ (D) $7.5 \times 10^{-4} \text{ J}$
- 39** The potential in a region is $V = 6x - 8y$ (SI). The magnitude of the electric field is
(A) 48 V/m (B) 10 V/m
(C) 14 V/m (D) 2 V/m
- 40** Van de Graaff generator is used to
(A) measure current (B) store magnetic energy
(C) produce alternating current (D) build up high voltages
- 41** An electron is accelerated from rest through a potential difference of 100 V. Its kinetic energy is
(A) $1.6 \times 10^{-19} \text{ J}$ (B) 1 eV
(C) 100 eV (D) 10^4 eV
- 42** When two capacitors C_1 (charged to V_1) and C_2 (charged to V_2) are connected in parallel (like plates together), the common potential is
(A) $V_1V_2/(V_1 + V_2)$ (B) $(C_1V_1 + C_2V_2)/(C_1 + C_2)$
(C) $(C_1 + C_2)/(V_1 + V_2)$ (D) $(V_1 + V_2)/2$



- 43** When charge is shared between two capacitors, the total energy
(A) decreases (some is lost as heat/radiation)
(B) increases
(C) becomes zero
(D) remains constant
-
- 44** A parallel plate capacitor has plate area 0.01 m^2 and separation 1 mm in air. Its capacitance is ($\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$)
(A) 0.885 pF
(B) 885 pF
(C) 8.85 pF
(D) 88.5 pF
-
- 45** The electric field in a region is zero. The potential in that region is
(A) increasing linearly
(B) decreasing
(C) constant
(D) zero necessarily
-

Answer Key

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

Hints & Solutions

- (A)** $V = W/q \rightarrow J/C = \text{volt}.$
- (D)** $V = q/(4\pi\epsilon_0 r).$
- (C)** $V = 9 \times 10^9 \times 3 \times 10^{-9}/0.3 = 90 \text{ V}.$
- (C)** $W = q\Delta V = 2 \times 10 = 20 \text{ J}.$
- (B)** The field is the negative potential gradient.
- (D)** No work is done moving along an equipotential, so E has no component along it.
- (A)** $W = q\Delta V = 0.$
- (C)** $V = kq/r$ is the same on spheres centred at the charge.
- (D)** Contributions from $+q$ and $-q$ are equal and opposite.
- (A)** $V = kp \cos \theta/r^2$, with $\theta = 0 \rightarrow kp/r^2.$
- (D)** $U = q_1 q_2 / (4\pi\epsilon_0 r).$
- (B)** $U = -p \cdot E = -pE \cos \theta.$
- (C)** $1 \text{ eV} = \text{energy gained by an electron through } 1 \text{ V} = 1.6 \times 10^{-19} \text{ J}.$
- (D)** $E = 0$ inside, so V is constant and equals the surface value.
- (D)** $C = \epsilon_0 A/d.$
- (A)** $C = Q/V \rightarrow \text{coulomb/volt} = \text{farad}.$
- (D)** $C \propto 1/d.$
- (C)** $C = K\epsilon_0 A/d.$
- (C)** $V = kQ/R \rightarrow C = Q/V = 4\pi\epsilon_0 R.$
- (A)** $C = R/k = 6.4 \times 10^6 / (9 \times 10^9) \approx 7.1 \times 10^{-4} \text{ F} = 711 \mu\text{F}.$
- (B)** $C = 3 \times 6 / (3 + 6) = 2 \mu\text{F}.$
- (B)** $C = C_1 + C_2 = 9 \mu\text{F}.$
- (A)** The same charge flows onto each capacitor in series.

24. (A) $U = \frac{1}{2}CV^2 = \frac{Q^2}{2C} = \frac{1}{2}QV$.
25. (B) $U = \frac{1}{2} \times 10 \times 10^{-6} \times 10^4 = 0.05 \text{ J}$.
26. (A) $u = \frac{1}{2}\epsilon_0 E^2$.
27. (B) Isolated capacitor: Q is constant; C becomes KC , V becomes V/K .
28. (C) $U = Q^2/2C$; Q fixed, $C \rightarrow KC \rightarrow U/K$.
29. (B) V fixed by battery; $C \rightarrow KC \rightarrow Q = KCV$.
30. (B) $1/C = 3/2 \rightarrow C = 2/3 \mu\text{F}$.
31. (A) $C_{\text{eq}} = 8/6 = 4/3 \mu\text{F}$; $Q = (4/3) \times 12 = 16 \mu\text{C}$.
32. (C) $V = Q/C = 16/2 = 8 \text{ V}$.
33. (A) Fields from both plates add between them: $\sigma/2\epsilon_0 + \sigma/2\epsilon_0 = \sigma/\epsilon_0$.
34. (C) Induced dipoles create an opposing field, so $E_{\text{inside}} = E_0/K$.
35. (D) A conductor reduces the field inside to zero, equivalent to $K \rightarrow \infty$.
36. (B) Equal potentials $\rightarrow Q \propto R$; $\sigma = Q/4\pi R^2 \propto 1/R \rightarrow 2 : 1$.
37. (A) Each corner is at $a/\sqrt{2}$ from centre: $V = 4 \times kq/(a/\sqrt{2}) = 4\sqrt{2} kq/a$.
38. (D) $W_{\text{field}} = q(V_A - V_B) = 5 \times 10^{-6} \times 150 = 7.5 \times 10^{-4} \text{ J}$.
39. (B) $E = -\nabla V = (-6, 8) \rightarrow |E| = 10 \text{ V/m}$.
40. (D) It accumulates charge on a large conducting shell, reaching millions of volts.
41. (C) $K = eV = 100 \text{ eV} = 1.6 \times 10^{-17} \text{ J}$.
42. (B) Charge is conserved: total charge / total capacitance.
43. (A) Loss = $C_1 C_2 (V_1 - V_2)^2 / (2(C_1 + C_2)) \geq 0$.
44. (D) $C = 8.85 \times 10^{-12} \times 0.01/10^{-3} = 8.85 \times 10^{-11} \text{ F} = 88.5 \text{ pF}$.
45. (C) $E = -dV/dr = 0 \rightarrow V$ is constant (not necessarily zero).

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