Electrostatic Potential and Capacitance MCQS TEST - 1

12th Standard

Physics

Electrostatic Potential and Capacitance

Total Mark : 40

Multiple Choice Question

19 × 1 = 19

1) At a particular point, electric field depends upon
(a) Source charge Q only (b) test charge q_o only (c) both Q and q_0 (d) neither Q nor q_o

2) The SI unit of electric field intensity is
(a) N (b) N/C (c) C/m^2 (d) N/m^2

3) Electric field due to a single charge is
(a) asymmetric (b) cylindrically symmetric (c) spherically symmetric (d) None of the above

4) Electric dipole moment is
(a) scalar (b) neither scalar vector (c) a vector directed from -q to +q (d) a vector directed from +q to -q

5) Electric field intensity (E) due to an electric dipole varies with distance (r) of the point from the centre of dipole as:
(a) $E\alpha\frac{1}{r}$ (b) $E\alpha\frac{1}{r^4}$ (c) $E\alpha\frac{1}{r^2}$ (d) $E\alpha\frac{1}{r^3}$

6) At a given distance from the centre of electic dipole, field intensity on axial line is k times the field intensity on equatorial line, where K =
(a) 2 (b) 3 (c) 4 (d) 1

7) Electric field due to an electric dipole is
(a) spherically symmetric (b) cylindrically symmetric (c) asymmetric (d) none of the above

8) When an electric dipole is held at an angle in a uniform electric field, the net force F and torque τ on the dipole are
(a) F = 0, $\tau = 0$ (b) $F \neq 0, \tau \neq 0$ (c) F = 0, $\tau \neq 0$ (d) $F \neq 0, \tau = 0$

9) Potential energy of an electric dipole held at an angle θ in a uniform electric field is zero when $\theta =$
(a) 0^o (b) 90° (c) 180° (d) 360°

10) Force $\vec{F}$ acting on a test charge q_o in a uniform electric field $\vec{E}$ is
(a) $\vec{F} = q_o\vec{E}$ (b) $\vec{F} = \frac{\vec{E}}{q_o}$ (c) $\vec{F} = \frac{\vec{q_o}}{\vec{E}}$ (d) $\vec{F} = q_o^2\vec{E}$

11) Electrostatic potential V at a point, distant r from a charge q varies as
(a) q/r^2 (b) q^2/r (c) q/r (d) q^2/r^2

12) Work done in carrying an electron from A to B lying on an equipotential surface of one volt potential is
(a) 1 eV (b) 10 eV (c) 1 volt (d) Zero

13) The correct relation between electric intensity E and electric potential V is
(a) $E = -\frac{dV}{dr}$ (b) $E = \frac{dV}{dr}$ (c) $V = -\frac{dE}{dr}$ (d) $V = \frac{dE}{dr}$

14) 1 G eV = x eV, where x is
(a) 10^6 (b) 10^3 (c) 10^{12} (d) 10^9

15) The dimensional formula of electric flux is
(a) $[M^1L^2T^{-2}A^{-1}]$ (b) $[M^{-1}L^3T^{-3}A]$ (c) $[M^1L^3T^{-3}A^{-1}]$ (d) $[M^1L^{-3}T^{-3}A^{-1}]$

16) A closed surface in vacuum encloses charges -q and +3q. Another charge -2q lies outside the surface. Total electric flux over the surface is
(a) Zero (b) $\frac{2q}{\epsilon_o}$ (c) $-\frac{3q}{\epsilon_o}$ (d) $\frac{4q}{\epsilon_o}$

17) The number of electric lines of force radiating from a closed surface in vacuum is 1.13×10^{11}. The charge enclosed by the surface is
(a) 1 C (b) $1\mu C$ (c) 0.1 C (d) 0.1μC

18) A charge of 10μC lies at the centre of a square. Work done in carrying a charge of $2\mu C$ from one corner of square to the diagonally opposite corner is
(a) 20 J (b) 5 J (c) zero (d) 20 μ J

19) A uniform electric field of 100 N/C exists in vertically upward direction. The decrease in electric potential as one goes up through a height of 20cm is
(a) 20 V (b) 120 V (c) 5 V (d) Zero

Fill up / 1 Marks

5 × 1 = 5

20) Electric field intensity at any point is the .... experienced by .... placed at that point.

21) Electric intensity is a .... quantity and its units are ....

22) Electric field due to a single charge is ....

23) The electric lines of force are .... as against magnetic lines o force which are ....

24) Net charge on an electric dipole is ....

Assertion and reason

4 × 1 = 4

26) **Assertion (A) :** The whole charge of a conductor cannot be transferred to another isolated conductor.

Reason (R) : The total transfer of charge from one to another is not possible.

Codes:

(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 and R is also false

27) **Assertion (A)** : Electric potential of the earth is zero.

Reason (R) : The electric field due to the earth is zero.

Codes:

(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 and R is also false

28) **Assertion (A) :** Capacity of a parallel plate capacitor increases when distance between the plates is decreased.

Reason (R) : Capacitance of capacitor is inversely proportional to distance between them.

Codes:

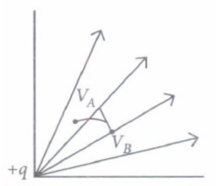
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

4 Mark Questions

3 × 4 = 12

29) Electrostatic potential energy of a system of point charges is defined as the total amount of work done in bringing the different charges to their respective positions from infinitely charge mutual separations. The work is stored in the system of two point charges in the form of electrostatic potential energy U of the system. Electric potential difference between any points A and B in an electric field is the amount of work done in moving a unit positive test charge from A to B along any path agents the electrostatic force

$V_B - V_A = \frac{W_{AB}}{q_0} = \int | \vec{E} \cdot dl$



(i) A test charge is moved from lower potential point to a higher potential point. The potential energy of test charge will

(a) remain the same **(b) increase**
(c) decrease **(d) become zero**

(ii) Which of the following statement is not true?

(a) Electrostatic force is a conservative force.
(b) Potential energy of charge q at a point is the work done per unit charge in bringing a charge from any point to infinity
(c) Spring force and gravitational force are conservative force.
(d) Both (a) and (c).

(iii) Work done in moving a charge from one point to another inside a uniformly charged conducting sphere is

(a) always zero **(b) non-zero** **(c) maybe zero** **(d) none of these**

(iv) The work done in bringing a unit positive charge from infinite distance to a point at distance x from a positive charge Q is W. Then the potential ϕ at that point is

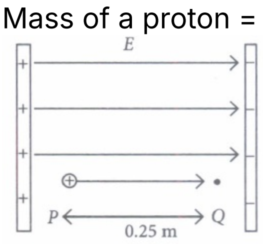
(a) $\frac{WQ}{x}$ **(b) W** (c) $\frac{W}{x}$ **(d) WQ**

(v) If $1\mu C$ charge is shifted from A to B and it is found that work done by an external force is $40\mu J$. In doing so against electrostatics force, the potential difference V_A- V_B is

(a) 40 V **(b) -40 V** **(c) 20 V** **(d) -60 V**

30) Potential difference (ΔV) between two points A and B separated by a distance x, in a uniform electric field E is given by $\Delta V = -Ex$,where x is measured parallel to the field lines. If a charge qo moves from P to Q, the changein potential energy (ΔU) is given as $\Delta U = q_0 \Delta V$. A proton is released from rest in uniform electric field of magnitude $4.0 \times 10^8 \mathrm{Vm}^{-1}$ directed along the positive X-axis. The proton undergoes a displacement of 0.25 m in the direction of E.

Mass of a proton = 1.66×10^{-27} kg and charge of proton = 1.6×10^{-19} C



(i) The change in electric potential of the proton between the points A and B is

(a) -1×10^8 V (b) 1×10^8 V
(c) 6.4×10^{-19} V (d) -6.4×10^{-19} V

(iii) The mutual electrostatic potential energy between two protons which are at a distance of 9 × 10^{-15} m, in ${}_{92}\mathrm{U}^{235}$ nucleus is

(a) 1.56×10^{-14} J (b) 5.5×10^{-14} J
(c) 2.56×10^{-14} J (d) 4.56×10^{-14} J

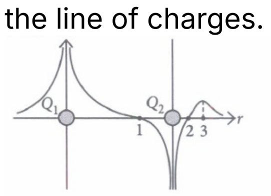
(iv) If a system consists of two charges 4 mC and -3mC with no external field placed at (-5 em, 0, 0) and (5 em, 0, 0) respectively. The amount of work required to separate the two charges infinitely away from each other is

(a) -1.1 J **(b) 2 J**
(c) 2.5 J **(d) 3 J**

(v) As the proton moves from P to Q, then

(a) the potential energy of proton decreases **(b) the potential energy of proton increases**
(c) the proton loses kinetic energy **(d) total energy of the proton increases**

31) The potential at any observation point P of a static electric field is defined as the work done by the external agent (or negative of work done by electrostatic field) in slowly bringing a unit positive point charge from infinity to the observation point. Figure shows the potential variation along the line of charges. Two point charges Q_1 and Q_2 lie along a line at a distance from each other.



(i) At which of the points 1, 2 and 3 is the electric field is zero?

(a) 1 **(b) 2** **(c) 3** **(d) Both (a) and (b)**

(ii) The signs of charges Q_1 and Q_2 respectively are

(a) positive and negative **(b) negative and positive**
(c) positive and positive **(d) negative and negative**

(iii) Which of the two charges Q_1 and Q_2 is greater in magnitude?

(a) Q_2 **(b) Q_1** **(c) Same** **(d) Can't determined**

(iv) Which of the following statement is not true?

(a) Electrostatic force is a conservative force
(b) Potential energy of charge q at a point is the work done per unit charge in bringing a charge from any point to infinity
(c) When two like charges lie infinite distance apart, their potential energy is zero.
(d) Both (a) and (c).

(v) Positive and negative point charges of equal magnitude are kept at $\left(0,0,\frac{a}{2}\right)$ and $\left(0,0,\frac{-a}{2}\right)$ respectively.

The work done by the electric field when another positive point charge is moved from (-a, 0, 0) to (0, a, 0) is

(a) positive
(b) negative
(c) zero
(d) depends on the path connecting the initial and final positions

Multiple Choice Question

19 × 1 = 19

1)
(a) Source charge Q only

2)
(b) N/C

3)
(c) spherically symmetric

4)
(c) a vector directed from -q to +q

5)
(d) $E \alpha \frac{1}{r^3}$

6)
(a) 2

7)
(b) cylindrically symmetric

8)
(c) F = 0, $\tau \neq 0$

9)
(b) 90°

10)
(a) $\vec{F} = q_o \vec{E}$

11)
(c) q/r

12)
(d) Zero

13)

(d) 10^9

15)

(c) $[M^1L^3T^{-3}A^{-1}]$

16)

(b) $\frac{2q}{\epsilon_o}$

17)

(a) 1 C

18)

(c) zero

19)

(a) 20 V

Fill up / 1 Marks

5 × 1 = 5

20)

force; unit positive charge.

21)

vector ; N/C

22)

spherically symmetric

23)

discontinuous, continuous

24)

Zero

Assertion and reason

4 × 1 = 4

25)

(c): If two points P and Q in an electric field are separated by an infinitesimal distance Δx and have a potential difference ΔV between then, $E=\frac{-\Delta V}{\Delta x}$.

Here negative sign implies that $\vec{E}$ has got a direction opposite to the potential gradient i.e. in the direction of $\vec{E}$ the potential decreases i.e. positive charge always move from a higher potential point to a lower potential point.

26)

(d): The whole charge of a conductor can be transferred to another isolated conductor, if it is placed inside the hollow insulated conductor and connected with it.

27)

(c): Earth is a good conductor of very large size. When some small charge is given to earth, its potential does not change. Hence potential of earth is assumed to be zero. It is just like sea level which does not alter materially when water is added to it or removed from it. Thus, the potential of all other bodies are measured with reference to the earth. For this, if the connection of a charged body to the ground by a metallic conductor would cause electrons to flow to that body from ground, the body is at positive potential. Conversely, is also true. In either case the conductor is neutralized and brought to zero potential. In fact the atmosphere does possess significant electric field.

28)

(a): Capacitance of parallel plate capacitor is $C=\frac{\varepsilon_0 A}{d}$ Thus distance decreases and capacitance of capacitor increases.

4 Mark Questions

3 × 4 = 12

29)

(i) (c)

(ii) (b)

(iii) (a): Since, E = 0 inside the conductor and has no tangential component on the surface, no work is done in moving a small test charge within the conductor and on its surface.

(iv) (b): The work done in bringing unit positive charge from infinity to a point which is at a distance x from the positive charge Q is defined as the potential at the given point due to the charge Q. Therefore

$\phi=W$

(v) (b): $W_{\text{ext}}=q_0\Delta V$

$(W_{AB})_{\text{ext}}=q(V_B-V_A)$

$40\mu\text{J}=1\mu\text{C}(V_B-V_A)$

$V_A-V_B=-40\text{ V}$

30)

(iii) (c) : Here, $q_1 = q_2 = 1.6 \times 10^{-19} \mathrm{C}, r = 9 \times 10^{-15}$ m
$U = \frac{9 \times 10^9 \times 1.6 \times 10^{-19} \times 1.6 \times 10^{-19}}{9 \times 10^{-15}} = 2.56 \times 10^{-14}$ J
(iv) (a): Here, $q_1 = 4 \mu \mathrm{C}, q_2 = -3 \mu \mathrm{C}$
r = 10 cm = 0.1 m
Electrostatic potential energy,
$U = \frac{1}{4 \pi \varepsilon_o} \frac{q_1 q_2}{r} = 9 \times 10^9 \times \frac{4 \times 10^{-6} \times (-3) \times 10^{-6}}{0.1} = -1.1$ J
(v) (a) : As proton moves in the direction of the electric field, then its potential energy decreases.

31)

(I) (c) : As $\frac{-dV}{dr} = E_r$ the negative of the slope of V versus r curve represents the component of electric field along r. Slope of curve is zero only at point 3. Therefore, the electric field vector is zero at point 3.
(ii) (a) : Near positive charge, net potential is positive and near a negative charge, net potential is negative. Thus, charge Q_1 is positive and Q_2 is negative.
(iii) (b) : From the figure, it can be seen that net potential due to two charges is positive everywhere in the region left to charge Q_1. Therefore the magnitude of potential due to charge Q_1 is greater than due to Q_2.
(iv) (b)
(v) (c) : It can be seen that potential at the points both A and B are zero. When the charge is moved from A to B, work done by the electric field on the charge will be zero.