DCAM classes

Dynamic Classes for Academic Mastery

Objective Questions

(For Complete Chapter)

Multiple Choice Questions (MCQs)

1. The electric potential V at any point (x, y, z) is given by $V = 3x^2$, where x is in metres and V in volts. The electric field at the point (1, 0, 2) is **CBSE 2021 (Term-I)**

(a) 6 V/m along $-X$-axis
(b) 6 V/m along $+X$-axis
(c) 1.5 V/m along $-X$-axis
(d) 1.5 V/m along $+X$-axis

2. A + 3.0 nC charge Q is initially at a distance of $r_1 = 10$ cm from a + 5.0 nC charge q fixed at the origin. The charge Q is moved away from q to a new position at $r_2 = 15$ cm. In this process the work done by the field is **CBSE 2021 (Term-I)**

(a) 1.29×10^{-5} J
(b) 3.6×10^{5} J
(c) -4.5×10^{-7} J
(d) 4.5×10^{-7} J

3. Two charges $14\,\mu C$ and $-4\,\mu C$ are placed at $(-12\text{ cm}, 0, 0)$ and $(12\text{ cm}, 0, 0)$ in an external electric field $E = \left(\frac{B}{r^2}\right)$, where $B = 1.2 \times 10^6\ \text{N/cm}^2$ and r is in metres.
The electrostatic potential energy of the configuration is **CBSE 2021 (Term-I)**

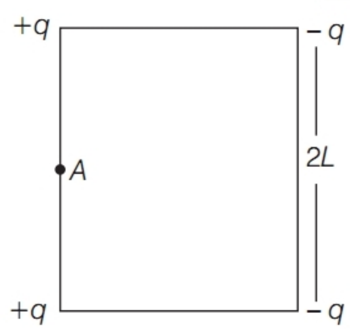
(a) 97.9 J (b) 102.1 J
(c) 2.1 J (d) – 97.9 J

4. Equipotentials at a large distance from a collection of charges whose total sum is not zero are **CBSE 2021 (Term-I)**

(a) spheres
(b) planes
(c) ellipsoids
(d) paraboloids

5. Four charges $-q, -q, +q$ and $+q$ are placed at the corners of a square of side $2\ L$ is shown in figure. The electric potential at point A mid-way between the two charges $+q$ and $+q$ is

CBSE 2021 (Term-I)



(a) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1 - \frac{1}{\sqrt{5}}\right)$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1 + \frac{1}{\sqrt{5}}\right)$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{q}{2L}\left(1 - \frac{1}{\sqrt{5}}\right)$

(d) zero

6. A variable capacitor is connected to a 200 V battery. If its capacitance is changed from $2\ \mu F$ to $X\ \mu F$, then the decrease in energy of the capacitor is 2×10^{-2}J. The value of X is **CBSE 2021 (Term-I)**

(a) $1\,\mu F$ (b) $2\,\mu F$
(c) $3\,\mu F$ (d) $4\,\mu F$

7. A hollow metal sphere of radius 10 cm is charged such that the potential on its surface becomes 80 V. The potential at the centre of the sphere is

(a) 80 V (b) 800 V (c) 8 V (d) zero

8. Which of the following is not true?

(a) For a point charge the electrostatic potential varies as $1/r$
(b) For a dipole the potential depends on the position vector and dipole moment vector
(c) The electric dipole potential varies as $1/r$ at large distance
(d) For a point charge the electrostatic field varies as $1/r^2$

9. The potential of an electric dipole vary with distance r as

(a) $\frac{1}{r}$ (b) $\frac{1}{r^3}$
(c) $\frac{1}{r^4}$ (d) $\frac{1}{r^2}$

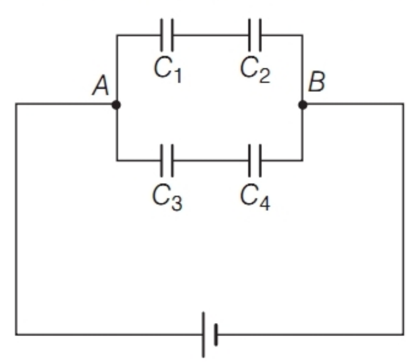
10. What is not true for equipotential surfaces for uniform electric field?

(a) Equipotential surface is flat
(b) Two equipotential surfaces can cross each other
(c) Electric lines are perpendicular to equipotential surface
(d) Work done is zero

11. The capacity of an isolated conducting sphere of radius R is proportional to

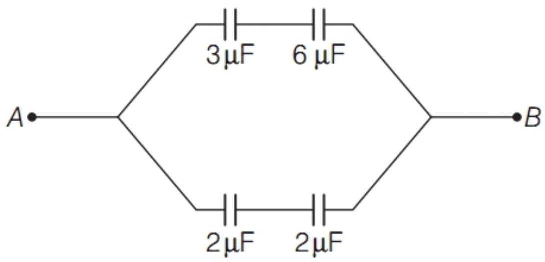
(a) R^2 (b) $\frac{1}{R^2}$ (c) $\frac{1}{R}$ (d) R

12. Effective capacitance between A and B in the figure shown below is
$(C_1 = C_2 = 20\,\mu F, C_3 = C_4 = 10\,\mu F)$



(a) $10\,\mu F$ (b) $15\,\mu F$
(c) $20\,\mu F$ (d) $25\,\mu F$

13. The equivalent capacitance between points A and B in the given figure, is



(a) $\frac{36}{13\ \mu F}$ (b) $2\ \mu F$

(c) $1\ \mu F$ (d) $3\ \mu F$

14. A capacitor of capacitance C has charge Q and stored energy is W. If the charge is increased to $2Q$, the stored energy will be

(a) $\frac{W}{4}$ (b) $\frac{W}{2}$ (c) $2W$ (d) $4W$

Assertion-Reason Questions

Directions (Q. Nos. 15-20) *In the following questions, two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below*

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both Assertion and Reason are incorrect.

15. **Assertion** Conductor having equal positive charge and volume, must also have same potential.

Reason Potential depends only an charge and volume of conductor.

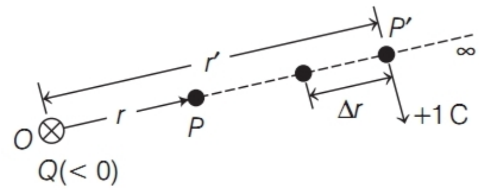
16. **Assertion** When two positive point charges move away from each other, then their electrostatic potential energy decreases.

Reason Change in potential energy between two points is equal to the work done by electrostatic forces.

17. **Assertion** Five charges $+q$ each are placed at five vertices of a regular pentagon. A sixth charge $-Q$ is placed at the centre of pentagon, then net electrostatic force on $-Q$ is zero.

Reason Net electrostatic potential at the centre is zero.

18. **Assertion** Work done by the electrostatic force in bringing the unit positive charge from infinity to the point P is positive.



Reason For $Q < 0$, the force on unit positive charge is attractive, so that the electrostatic force and the displacement (from infinity to P) are in the same direction.

19. **Assertion** In the absence of an external electric field, the dipole moment per unit volume of a polar dielectric is zero.

Reason The dipoles of a polar dielectric are randomly oriented.

20. **Assertion** A capacitor can be given only a limited quantity of charge.

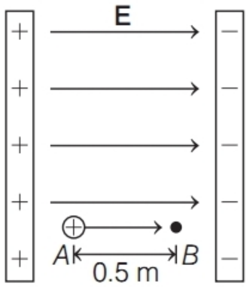
Reason Charge stored by a capacitor depends on the shape and size of the plates of capacitor and the surrounding medium.

Case Based Questions

Directions (Q.Nos. 21-22) *These questions are case study based questions. Attempt any 4 sub-parts from each question. Each question carries 1 mark.*

21. **Proton in an Electric Field**

Potential difference (ΔV) between two points A and B separated by a distance x, in a uniform electric field $\mathbf{E}$ is given by $\Delta V = -Ex$, where x is measured parallel to the field lines. If a charge q_0 moves from A to B, the change in potential energy (ΔU) is given as $\Delta U = q_0 \Delta V$. A proton is released from rest in uniform electric field of magnitude 4.0×10^4 Vm^{-1} directed along the positive X-axis. The proton undergoes a displacement of 0.50 m in the direction of E.



Mass of a proton $= 1.66\times 10^{-27}$ kg

and charge on a proton $= 1.6\times 10^{-19}$ C.

(i) As the proton moves from B to A, 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

(ii) The change in electric potential of the proton between the points A and B is
- (a) 2.0×10^4 V
- (b) -2.0×10^4 V
- (c) 6.4×10^{-19} V
- (d) -6.4×10^{-19} V

(iii) The change in electric potential energy of the proton for displacement from A to B is
- (a) -6.4×10^{-19} J
- (b) 3.2×10^{-19} J
- (c) -3.2×10^{-15} J
- (d) 6.4×10^{-15} J

(iv) The velocity (v_B) of the proton after it has moved 0.50 m starting from rest is
- (a) 1.6×10^8 ms^{-1}
- (b) 1.96×10^6 ms^{-1}
- (c) 1.96×10^4 ms^{-1}
- (d) 1.6×10^6 ms^{-1}

(v) If in place of charged plates, two similar point charges of 2 μC have kept in air at 1m distance from each other, then potential energy is
- (a) 1 J
- (b) 4 eV
- (c) 3.6×10^{-2}J
- (d) zero

22. Electrostatic Potential Energy

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 large mutual separations. By definition, work done in carrying charge from ∞ to any point,

$$W = \text{Potential} \times \text{Charge}$$

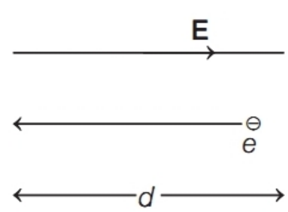
This work is stored in the system of two point charges in the form of electrostatic potential energy U of the system.

(i) Work done in moving a charge particle from one point to another point inside on the charged surface of sphere is
- (a) always zero
- (b) positive
- (c) negative
- (d) None of these

(ii) A positively charged particle is released from rest in an uniform electric field. The electric potential energy of the charge
- (a) remains a constant because the electric field is uniform
- (b) increases because the charge moves along the electric field
- (c) decreases because the charge moves along the electric field
- (d) decreases because the charge moves opposite to the electric field

(iii) Three charges are placed at the vertex of an equilateral triangle of side l as shown in figure. For what value of Q, the electrostatic potential energy of the system is zero?
- (a) $-q$
- (b) $q/2$
- (c) $-2q$
- (d) $-q/2$

(iv) In the figure, electron moves a distance d in a uniform electric field E as shown in the figure. The work done on the electron by electric field is



(a) negative
(b) positive
(c) zero
(d) None of the above

(v) A charge of $2\mu C$ is place near another charged particle which produces an electric potential of 5 V at the location of $2\mu C$ charge particle. Work done to move the $2\mu C$ charge at infinity will be

(a) 10^{-6} J
(b) zero
(c) 10^{-5} J
(d) 2.5×10^{-6} J