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PRACTICE PAPER (SOLUTION)

CLASS XII PHYSICS **TOPIS : Electric potential and Capacitance**

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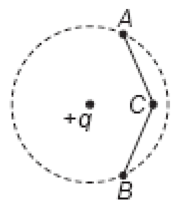
1 What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole? 1

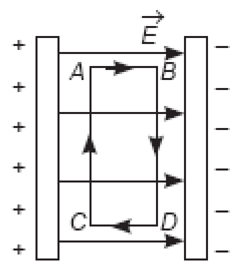
ANS: Zero.

2 If a point charge $+q$ is taken first from A to C and then from C to B of a circle drawn with another point charge $+q$ at centre, then along which path more work will be done? 1



ANS: Since both the points A and B are equidistant from the electric charge $+q$. $\because$ $V_A = V_B$ $\therefore$ Work done $W_{A\to C} = q\,(V_C - V_A) = q(V_C - V_B) = W_{B\to C} = -W_{C\to B}$

3 A uniform electric field E exists between two charged plates as shown in figure. What would be the work done in moving a charge q along the closed rectangular path $ABCDA$? 1



ANS: Work done in moving a charge q along a closed rectangular path $ABCD$ is calculated as $W = W_{AB} + W_{BC} + W_{CD} + W_{DA}$ $W = qE + 0 - qE + 0 = 0$ [$\because$ $AB = CD$]

4 What is the geometrical shape of equipotential surfaces due to a single isolated charge? 1

ANS: The geometrical shape is spherical.

5 Why is there no work done in moving a charge from one point to another on an equipotential surface? 1

ANS: Potential difference between any two points of an equipotential surface is zero. So no work is done in moving a charge from one point to another.

6 Can two equipotential surfaces intersect each other? Justify your answer. 1

ANS: Two equipotential surfaces cannot intersect. The direction of electric field is always perpendicular to the equipotential surface. If they intersect, there will be two directions of the electric field at the point of intersection which is not possible.

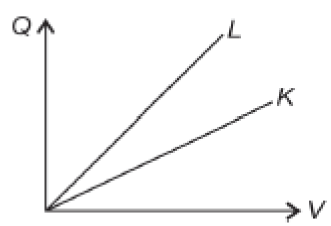
7 In the expression $W = pE$ (cos θ_0 – cos θ_1), why is θ_0 is taken as $\pi/2$ for obtaining expression for the potential energy of electric dipole? 1

ANS: When the dipole axis is perpendicular to the electric field, i.e. $\theta_0 = \pi/2$, the work done against the external electric field $\vec{E}$ in bringing the charges $+q$ and $-q$ is equal and opposite, and cancel out, i.e. $q[V(r_1) - V(r_2)] = 0$. Therefore, initial potential energy is zero.

8 A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. What is the potential at the centre of the sphere? 1

ANS: 10 V, as the potential inside the hollow metal sphere is same everywhere.

9 The following graph shows the variation of charge Q, with voltage V, for two capacitors K and L. In which capacitor is more electrostatic energy stored? 1



ANS: In capacitor L, more electrostatic energy is stored.

10 A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points on the square. 1

ANS: Zero, as the two points are at same potential.

11 Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately.
(a) spheres (b) planes 1
(c) paraboloids (d) ellipsoids

ANS: (a) The collection of charges at great distance is considered as a single point charge. The equipotential surfaces due to a point charge are spherical.

12 If a unit positive charge is taken from one point to another over an equipotential surface, then
(a) work is done on the charge.
(b) work is done by the charge. 1
(c) work done is constant.
(d) no work is done.

ANS: (d) On the equipotential surface, electric field is normal to the charged surface (where potential exists) so that no work will be done.

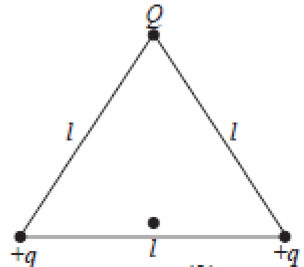
13 A conductor with a positive charge
(a) is always at +ve potential.
(b) is always at zero potential. 1
(c) is always at negative potential.
(d) may be at +ve, zero or –ve potential.

ANS: (d) May be at positive, zero or negative potential, it is according to the way one defines the zero potential.

14 A parallel plate condenser is connected with the terminals of a battery. The distance between the plates is 6mm. If a glass plate (dielectric constant K = 9) of 4.5 mm is introduced between them, then the capacity will become 1
(a) 2 times. (b) the same.
(c) 3 times. (d) 4 times.

ANS: (c) Since $C \propto \frac{1}{d} \Rightarrow \frac{C_{\text{medium}}}{C_{\text{air}}} = \frac{d}{d - t + \frac{t}{K}}$

15 Three charges Q, +q and +q are placed at the vertices of an equilateral triangle of side l as shown in the figure. If the net electrostatic 1



(a) $-q$ (b) $+q$

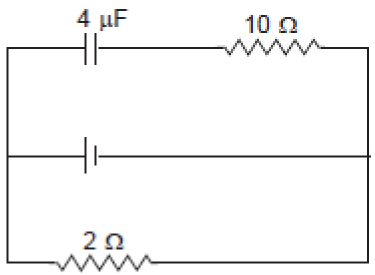
(c) zero (d) $-\frac{q}{2}$

energy of the system is zero, then Q is equal to

ANS: (d) Using, $U = \frac{kQq}{l} + \frac{kq^2}{l} + \frac{kqQ}{l} = 0$

$\therefore\ Q = \frac{-q}{2}$

16 A capacitor of 4 μF is connected as shown in the circuit. The internal resistance of the battery is 0.5 Ω. The amount of charge on the capacitor plates will be 1



(a) 0 (b) 4 μC (c) 16 μC (d) 8 μC

ANS: (d) Using, $I = \frac{V}{R + r}$, $V = IR$, $q = CV$

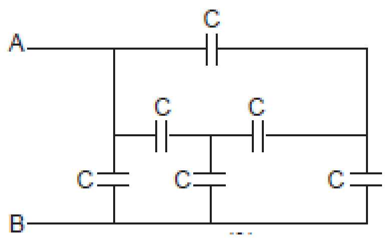
17 If E is the electric field intensity of an electrostatic field, then the electrostatic energy density is proportional to

(a) E (b) E^2 1

(c) $1/E^2$ (d) E^3

ANS: (b) Electrostatic energy density $\frac{dU}{dV} = \frac{1}{2}K\varepsilon_0 E^2$

18 Find the equivalent capacitance of the system across the terminals A and B. All the capacitors have equal capacitances. 1



(a) 2 C (b) 4 C
(c) 3 C (d) 5 C

ANS: (a) By wheatstone Bridge law

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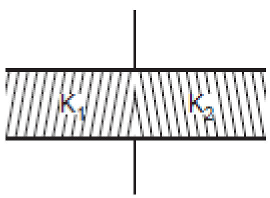
The capacitors of capacitance 4 F, 6 F and 12 F are connected first in series and then in parallel. What is the ratio of equivalent capacitance in the two cases? 1
(a) 2 : 3 (b) 11 : 1
(c) 1 : 11 (d) 1 : 3

ANS: (c) $C_s = 2$ F, $C_p = 22$ F, $\frac{C_s}{C_p} = 1 : 11$

20 A parallel plate capacitor with air as medium between the plates has a capacitance of 10 μF. The area of capacitor is divided into two equal halves and filled with two media having dielectric constant $k_1 = 2$ and $k_2 = 4$ as shown in the figure. The capacitance of the system will 1



now be (a) 10 μF (b) 20 μF
(c) 30 μF (d) 40 μF

ANS: (c) Using $C_R = C_1 + C_2 = \frac{k_1\varepsilon_0 A_1}{d} + \frac{k_2\varepsilon_0 A_2}{d}$

N.B.-This sheet is prepared from home.