DPP
DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 8

Topic :- ELECTROSTATIC POTENTIAL AND CAPACITANCE

1 **(c)**

Here $V = \frac{q}{4\pi\varepsilon_0 . r} - \frac{q}{4\pi\varepsilon_0 (3r)} = \frac{1}{4\pi\varepsilon_0} . \frac{2q}{3r}$ and

$E = \frac{1}{4\pi\varepsilon_0} . \frac{q}{(3r)^2} = \frac{1}{4\pi\varepsilon_0} . \frac{q}{9r^2}$

On simplification, we get $\frac{E}{V} = \frac{1}{6r}$ or $E = \frac{V}{6r}$

2 **(c)**

If C is capacity of each condenser, then charge on each capacitor $= 10$ C

$(\because V = 10V)$

When connected in series, potential difference between free plates $= \frac{\text{total charge}}{\text{total capacity}}$

$= \frac{10\ C}{C/6} = 60$ V

4 **(a)**

Net flux leaving the surface

$\phi = 4 \times 10^5 - 5 \times 10^5 = -10^5$ MKS units

$\therefore$ charges must be negative

$q = \phi\varepsilon_0 = -10^5 \times 8.86 \times 10^{-12}$

$= -8.86 \times 10^{-7}$ C

5 **(d)**

Net work done = final PE − initial PE

$= \frac{Qq}{4\pi\varepsilon_0 l} - \frac{Qq}{4\pi\varepsilon_0 l} =$ Zero.

6 **(d)**

PE $= \frac{q_1 q_2}{4\pi\varepsilon_0 r} = \frac{9 \times 10^9 (2 \times 10^{-6})^2}{1} = 0.036$ J

7 **(b)**

Since electrical potential at any point of circle of radius R due to charge Q_2 at its centre is same $V = \frac{Q_2}{4\pi\varepsilon_0 R}$, hence work done in carrying a charge Q_1 round the circle is zero.

8 **(b)**

Co-ordinates of the point are (x, y)

$\therefore$ Distance of point from origin,

$r=\sqrt{x^2+y^2}$, $V=-kxy$

$E_x=-\frac{dV}{dx}=-\frac{d}{dx}(-kxy)=ky$

$E_y=-\frac{dV}{dy}=(-kxy)=kx$

$\therefore\ E=\sqrt{E_x^2+E_y^2}=k\sqrt{y^2+x^2}=kr$

$\therefore\ E\propto r$

9 **(a)**

Required work done,

$W=QV$

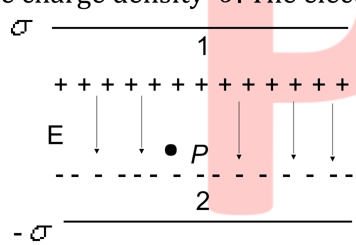
$=(2e)\times 25$

$=50e=50\times 1.6\times 10^{-19}$

$=8\times 10^{-18}\mathrm{J}$

10 **(c)**

The situation is shown in the figure. Plate 1 has surface charge density σ and plate 2 has surface charge density$-\sigma$. The electric fields



at point P due to two charged plates add up, giving

$$E=\frac{\sigma}{2\varepsilon_0}+\frac{\sigma}{2\varepsilon_0}=\frac{\sigma}{\varepsilon_0}$$

Given , $\sigma=26.4\times 10^{-12}\mathrm{Cm^{-2}}$

$\varepsilon_0=8.85\times 10^{-12}\mathrm{C^2N^{-1}m^{-2}}$

Hence , $E=\frac{26.4\times 10^{-12}}{8.85\times 10^{-12}}\approx 3\mathrm{NC^{-1}}$

Note the direction of electric field is from the positive to the negative plate.

11 **(c)**

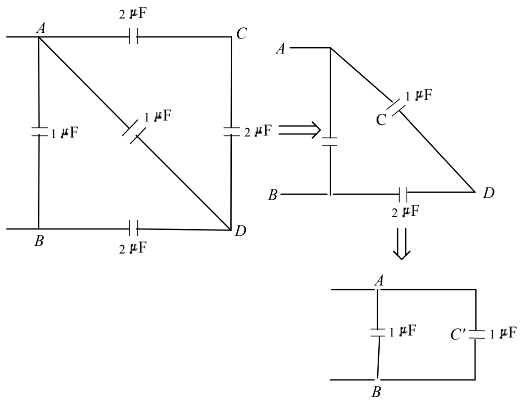
$U=\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r}$

$\therefore U=\frac{9\times 10^9\times(1.6\times 10^{-19})(-1.6\times 10^{-19})}{10^{-10}}$

$=-9\times 10^9\times 1.6\times 10^{-19}\times 10^{10}\mathrm{eV}$

$= -14.4\text{eV}$

12 **(d)**



The capacitors 2 μF and 2 μF of arm ACD are in series. So, their equivalent capacitance is 1 μF which is in parallel with capacitor of 1 μF of arm AD.

So, equivalent capacitance now is 2 μF.

This capacitance is now in series with 2 μF capacitance of arm BD which equivalents to 1 μF is in parallel with 1 μF capacitance of arm AB.

So, final effective capacitance=2 μF.

13 **(b)**

$$\therefore \frac{1}{C_s} = \frac{1}{2} + \frac{1}{1} = \frac{3}{2}$$

$$C_s = \frac{2}{3}\text{F}$$

$$Q = C_s V = \frac{2}{3} \times 12 = 8\text{C}$$

$$V_1 = \frac{Q}{C_1} = \frac{8}{2} = 4\text{V}$$

14 **(a)**

$q_1 = 10 \times 50 = 500\ \mu\text{C}, C_1 = 10\ \mu\text{F}, C_2 = ?, q_2 = 0$

As $\quad V = \frac{q_1 + q_2}{C_1 + C_2}$

$$\therefore\ C_1 + C_2 = \frac{q_1 + q_2}{V} = \frac{500 + 0}{20} = 25\mu\text{F}$$

$C_2 = 25 - C_1 = 25 - 10 = 15\ \mu\text{F}$

15 **(d)**

The capacitance of parallel plate air capacitor

$C = \frac{\varepsilon_0 A}{d}$ ...(i)

where A is the area of each plate and d is the distance between the plates. In a medium of dielectric constant K and with given condition

$C' = \frac{K\varepsilon_0 A'}{d'}$

Given, $\quad A' = A, d' = 2d, C' = 2C$

$\therefore\ 2C = \frac{K\varepsilon_0 A}{2d}$ ...(ii)

Equating Eqs. (i) and (ii), we get

$K = 4$

16 **(c)**

For charge q placed at the centre of circle, the circular path is an equipotential surface and hence works done along all paths AB or AC or AD or AE is zero.

17 **(c)**

The potential due to charge q at a distance r is given by

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

Since, potential is a scalar quantity, it can be added to find the sum due to individual charges.

$$\sum V = V_A + V_B + V_C$$

$$V_A = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2q}{x}$$

$$V_B = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{x}$$

$$V_C = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{x}$$

$$\therefore \ V = \frac{1}{4\pi\varepsilon_0}\left(\frac{2q}{x} - \frac{q}{x} - \frac{q}{x}\right) = 0$$

Electric field is a vector quantity, hence component along OD is taken

$$E = \frac{1}{4\pi\varepsilon_0}\left(\frac{2q}{x^2} + \frac{2q}{x^2}\cos\theta\right) \neq 0$$

18 **(c)**

Total electric flux, $\phi_1 = \phi = \frac{1}{\varepsilon_0}$(charge enclosed) and *ie*, charge of given body is body is constant.

19 **(b)**

$$\frac{E_A}{E_B} = \frac{\frac{1}{2}\ m v_A^2}{\frac{1}{2}\ m v_B^2} = \frac{W_A}{W_B} = \frac{(q)V}{(4q)V}$$

$$\frac{v_A}{v_B} = \frac{1}{2}$$

20 **(c)**

$$\phi_E = \frac{\sum q}{\varepsilon_0} = \frac{(+5-5)\times 10^{-6}}{\varepsilon_0} = \text{ zero}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	C	D	A	D	D	B	B	A	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	D	B	A	D	C	C	C	B	C