DPP

DAILY PRACTICE PROBLEMS

Class : XIIth

Date :

Solutions

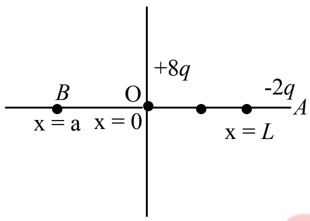
Subject : PHYSICS

DPP No. :10

Topic :- Electric charges and fields

1 **(a)**

Suppose that a point B, where net electric field is zero due to charges $8q$ and $-2q$.



$$\boldsymbol{E}_{BO} = \frac{-1}{4\pi\varepsilon_0} \cdot \frac{8q}{a^2}\hat{\boldsymbol{i}}$$

$$\boldsymbol{E}_{BA} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{+2q}{(a+L)^2}\hat{\boldsymbol{I}}$$

According to condition $\boldsymbol{E}_{BO} + \boldsymbol{E}_{BA} = 0$

$$\therefore \frac{1}{4\pi\varepsilon_0}\frac{8q}{a^2} = \frac{1}{4\pi\varepsilon_0}\frac{2q}{(a+L)^2}$$

$$\Rightarrow \frac{2}{a} = \frac{1}{a+L}$$

$$\Rightarrow 2a + 2L = a$$

$$\therefore \ 2L = -a$$

Thus, at distance $2L$ from origin, net electric field will be zero.

2 **(c)**

Force acting between two current carrying conductors

$$F = \frac{\mu_0 I_1 I_2}{2\pi \ d} l \quad ....(i)$$

Where $d =$ distance between the conductors

l = length of each conductor

Again, $F' = \frac{\mu_0}{2\pi}\frac{(-2I_1)(I_2)}{(3d)}.l$

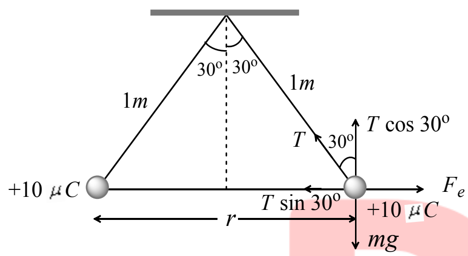
$$= -\frac{\mu_0}{2\pi}\frac{2I_1I_2}{d}.l \text{ ...(ii)}$$

Thus, from Eqs.(i) and ii

$$\frac{F'}{F} = -\frac{2}{3} \Rightarrow F' = -\frac{2}{3}F$$

3 **(b)**

In the following figure, in equilibrium $F_e = T\sin 30^o$, $r = 1m$



$$\Rightarrow 9\times10^9.\frac{Q^2}{r^2} = T\times\frac{1}{2}$$

$$\Rightarrow 9\times10^9.\frac{(10\times10^{-6})^2}{1^2} = T\times\frac{1}{2} \Rightarrow T = 1.8\ N$$

4 **(a)**

Electric field due to a hollow spherical conductor is governed by following equation

$E = 0$, for $r < R$ ...(i)

and $E = \frac{Q}{4\pi\varepsilon_0 r^2}$ for $r \geq R$ ...(ii)

i.e. inside the conductor field will be zero and outside the conductor will vary according to $E \propto \frac{1}{r^2}$

5 **(c)**

$$E = \frac{\sigma}{2\varepsilon} = \frac{\sigma}{2\varepsilon_0 K}$$

8 **(c)**

In uniform electric field dipole experience only torque but no force

9 **(c)**

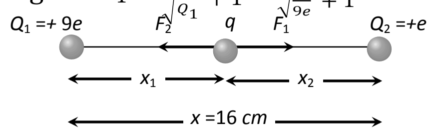
$$K = \frac{t}{t-d'} \Rightarrow 2 = \frac{1}{1-d'} \Rightarrow d' = \frac{1}{2}mm$$

So new distance $= 3 + \frac{1}{2} = 3.5\ mm$

10 **(b)**

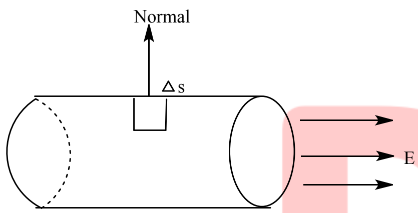
Suppose q is placed at a distance x from $+9e$, then for equilibrium net force on it must be zero *i.e.* $|F_1| = |F_2|$

Which gives $x_1 = \frac{x}{\sqrt{\frac{Q_2}{Q_1}} + 1} = \frac{16}{\sqrt{\frac{e}{9e}} + 1} = 12\ cm$



11 **(a)**

Let us take a small area ΔS on the cylindrical surface.



The normal to this area will be perpendicular to the axis of the cylinder and electric field is parallel to axis of cylinder.

So, flux $\Delta\phi = \mathbf{E}.\Delta\mathbf{S}$

$= E\Delta S \cos 90° = 0$

Summing over the entire surface, the total flux from the surface of cylinder is zero.

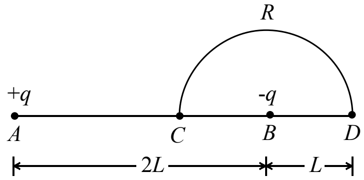
12 **(d)**

Potential at C $V_C = 0$

Potential at D $V_D = \frac{K(-q)}{L} + \frac{Kq}{3L} = -\frac{2Kq}{3\ L}$

$\therefore$ Potential difference $V_D - V_C = -\frac{2Kq}{3\ L}$

$\Rightarrow W = Q.(V_D - V_C) = -\frac{2}{3} \times \frac{1}{4\pi \in_0} . \frac{qQ}{L} = -\frac{qQ}{6\pi \in_0 L}$



13 **(a)**

Energy required to charge the capacitor is $W = U = QV$

$$\Rightarrow U = CV^2 = \frac{\varepsilon_0 A}{d}.V^2 = \frac{\varepsilon_0 Ad}{d^2}V^2 = \varepsilon_0 E^2 Ad$$

$$\left[\because E = \frac{V}{d}\right]$$

14 **(c)**

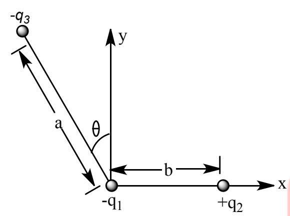
$$U = \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times (200)^2 \times 10^{-6} = 0.04J$$

15 **(c)**

Electric field near the conductor surface is given by $\frac{\sigma}{\varepsilon_0}$ and it is perpendicular to surface

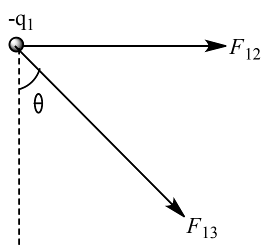
16 **(b)**

Force on $-q_1$



$$\boldsymbol{F} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{b^2}\hat{\boldsymbol{i}} + \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_3}{a^2}[\sin\theta\hat{\mathbf{i}} - \cos\theta\hat{\mathbf{j}}]$$

From above, x' component of force is



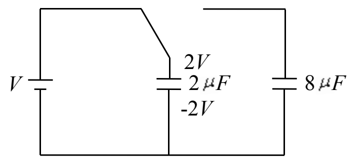
$$F_x = \frac{q_1}{4\pi\varepsilon_0}\left[\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta\right]$$

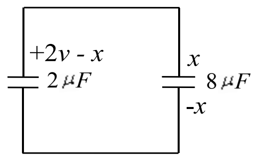
$$F_x \propto \left[\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta\right]$$

17 **(c)**

Top of the stratosphere has an electric field E is nearly equal to $100V/m$

18 **(d)**





$U_i = \frac{1}{2}(2)V^2, V_{common} = \frac{V}{5}$

$U_f = \frac{1}{2}(2+8)\left(\frac{V}{5}\right)^2$

$\frac{U_i - U_f}{U_i} \times 100$

$= \frac{V^2 - \frac{V^2}{5}}{V^2} \times 100$

$\frac{4}{5} \times 100 = 80\ \%$

19 **(b)**

$E = 9 \times 10^9 . \frac{Q}{r^2} = 9 \times 10^9 \times \frac{5 \times 10^{-6}}{(0.8)^2} = 7 \times 10^4 N/C$

20 **(d)**

In case of an electric dipole, $F \propto \frac{1}{r^3}$

$\therefore$ new force $= F/2^3 = F/8.$

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