DPP
DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. :6

Topic :- Electric charges and fields

1 **(c)**

$$\frac{1}{C}=\frac{1}{2}+\frac{1}{2}+\frac{1}{2}\Rightarrow C=\frac{2}{3}F$$

2 **(a)**

By using $\frac{1}{2}m\left(v_1^2-v_1^2\right)=QV$

$$\Rightarrow\frac{1}{2}\times10^{-3}\left[v_1^2-(0.2)^2\right]=10^{-8}(600-0)$$

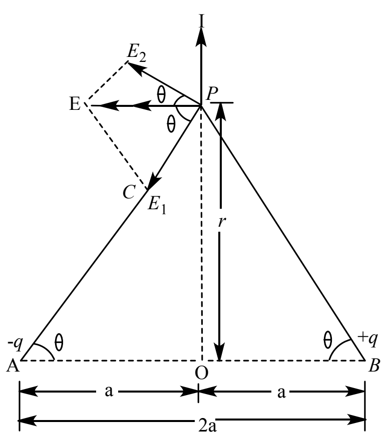
$$\Rightarrow v_1=22.8\ cm/s$$

3 **(d)**

Potential energy of dipole in electric field $U=-PE\cos\theta$; where θ is the angle between electric field and dipole

4 **(a)**

Consider an electric dipole consisting of two point charges –q and +q separated by a small distance $AB=2a$ with centre at O,



As shown in figure, on equatorial line, the resultant electric field $\boldsymbol{E}$ of $\boldsymbol{E}_1$ and $\boldsymbol{E}_2$ is parallel to the axis of the dipole but opposite to the direction of the dipole moment **p** as it is directed from negative charge to positive charge.

5 **(d)**

Number of electric transferred, $n = \frac{q}{e}$

Mass transferred $= m_e \times n = m_e \times \left(\frac{q}{e}\right)$

$= 9.1 \times 10^{-31} \times \left(\frac{2 \times 10^{-7}}{1.6 \times 10^{-19}}\right)$

11.38×10^{-19} kg

6 **(c)**

Electric force $qE = ma \Rightarrow a = \frac{qE}{m}$

$\therefore a = \frac{1.6 \times 10^{-19} \times 1 \times 10^{3}}{9 \times 10^{-31}} = \frac{1.6}{9} \times 10^{15}$

$u = 5 \times 10^{6}$ and $v = 0$

$\therefore$ From $v^2 = u^2 - 2as \Rightarrow s = \frac{u^2}{2a}$

$\therefore$ Distance $s = \frac{(5 \times 10^{6})^2 \times 9}{2 \times 1.6 \times 10^{15}} = 7\ cm.$ (approx)

7 **(c)**

Capacitance of a parallel plate capacitor with air is $C = \frac{\varepsilon_0 A}{d}$

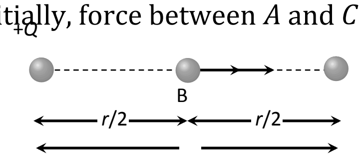
Capacitance of a same parallel plate capacitor with the introduction of a dielectric medium is $C' = \frac{K\varepsilon_0 A}{d}$ where K is the dielectric constant of a medium

$\Rightarrow \frac{C'}{C} = K$ or $\frac{15}{3} = 5$ or $K = \frac{\varepsilon}{\varepsilon_0}$

$\Rightarrow \varepsilon = K\varepsilon_0 = 5 \times 8.854 \times 10^{-12} = 0.4427 \times 10^{-10} C^2 N^{-1} m^{-2}$

8 **(c)**

Initially, force between A and C $F = K\frac{Q^2}{r^2}$



When a similar sphere B having charge $+Q$ is kept at the mid point of the line joining A and C, then Net force on B is $F_{net} = F_A + F_C = k\frac{Q^2}{(r/2)^2} + \frac{kQ^2}{(r/2)^2} = 8\frac{kQ^2}{r^2} = 8F$

9 **(d)**

If charge acquired by the smaller sphere is Q then it's

potential $120 = \frac{kQ}{2}$ ...(i)

Whole charge comes to outer sphere

Also potential of the outer sphere

$V = \frac{kQ}{6}$ ...(ii)

From equation (i) and (ii) $V = 40\ volt$

10 **(d)**

$C = \frac{\varepsilon_0 A}{d}$ and $C' = \frac{\varepsilon_0 A}{\left(d - \frac{d}{2} + \frac{(d/2)}{\infty}\right)} = \frac{2\varepsilon_0 A}{d}$

$\Rightarrow C' = 2C$

11 **(d)**

$$C_{air} = \frac{C_{medium}}{K} = \frac{C}{2}$$

12 **(a)**

From Gauss' theorem,

$$E \propto \frac{q}{r^2} \qquad (q = \text{charge enclosed})$$

$$\frac{E_2}{E_1} = \frac{q_2}{q_1} = \frac{r_1^2}{r_2^2}$$

$$8 = \frac{\int_0^R (4\pi r^2) k r^a dr}{\int_0^{R/2} (4\pi r^2) k r^a dr} \times \frac{\left(\frac{R}{2}\right)^2}{(R)^2}$$

Solving this equation we get, $a = 2$

14 **(d)**

There are 10 electrons and 10 protons in a neutral water molecule.

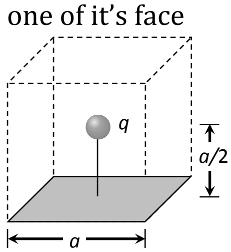
So it's dipole moment is $p = q(2l) = 10\ e\ (2l)$

Hence length of the dipole *i.e.* distance between centres of positive and negative charges is

$$2l = \frac{p}{10e} = \frac{6.4 \times 10^{-30}}{10 \times 1.6 \times 10^{-19}} = 4 \times 10^{-12} m = 4\ pm$$

15 **(d)**

An imaginary cube can be made by considering charge q at the centre and given square is one of it's face



So flux from given square ($i.e.$ one face) $\phi = \frac{q}{6\varepsilon_0}$

16 **(c)**

Let d be the distance between the plates and k be the dielectric constant. Without disconnecting the battery, V is the same

$E_0 = \frac{\sigma}{\varepsilon_0}; V_0 = E_0 d; C_0 = \frac{Q}{V_0} = \frac{\varepsilon_0 A}{d}$

With dielectric,

V remains the same, capacitance increases, U which is energy stored $\left(\frac{1}{2}CV^2\right)$ increases;

$Q = CV$, charge increases

17 **(a)**

The potential difference across the parallel plate capacitor is $10V - (-10V) = 20V$

Capacitance $= \frac{Q}{V} = \frac{40}{20} = 2F$

18 **(c)**

Common potential $V = \frac{6 \times 20 + 3 \times 0}{(6+3)} = \frac{120}{9} Volt$

So, charge on 3 μF capacitor

$Q_2 = 3 \times 10^{-6} \times \frac{120}{9} = 40\mu C$

19 **(d)**

The surface of the conductor is an equipotential surface since there is free flow of electrons within the conductor. Thus potential at Q is the same as that at P. That is $V_P = V_Q = V$. The electric field E at a point on the equipotential surface of the conductor is inversely proportional to the square of the radius of curvature r at that point. That is $E \propto r^{-2}$

Since point Q has a larger radius of curvature than that at point P, the electric field at Q is less than that at P. That is $E_Q < E_P = E$

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