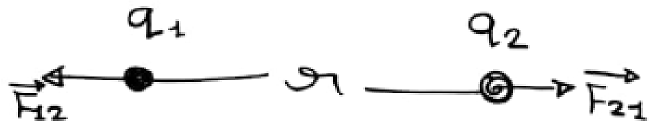
↳



(i) ↳ $|\vec{F}_{12}| = |\vec{F}_{21}| = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$

(ii) ↳ Net Force on q_1 charge is $\frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$.

(iii) ↳ Net Force on q_2 charge is $\frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$

(iv) ↳ *** $\vec{F}_{12} = -\vec{F}_{21}$

(v) ↳ *** Net Force on System of (q_1 & q_2) is zero.

⟹ If F_{net} on System = 0 $\vec{P}_i = \vec{P}_f$

↳ Conservation of moment

- $\vec{F}_{12} = -\vec{F}_{21} \Rightarrow$ Action-reaction pair
- Central force.
  - Force always act on line joining of charge.
- Electro-static force is conservative in nature.

Force b/w charges in medium :-

$$F_{net} = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{r^2}$$

ε = Permitivity of medium

$$\varepsilon = \varepsilon_r \varepsilon_0$$

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0}$$

ε_r = relative permitivity.

ε = permitivity of medium.

ε_0 = permitivity of free space.

$$\varepsilon_r \geq 1$$

$\varepsilon_r = K$ [dielectric of medium]

⇒ For water $\varepsilon_r = 81$

$K = 81$.

ε_r – metal $= \infty$

#,

2 c ●——— 2m ———● 4 c

Air $\varepsilon_r = 1$

Force in air

$$F_{air} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$= \frac{9\times10^9 \times 2 \times 4}{2^2} = 18\times10^9$$

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0}$$

$$\varepsilon = \varepsilon_r \varepsilon_0$$

2 c ●——— 2m ———● 4 c

medium

$\varepsilon_r = 2$

F_{medium}

$$F_{medium} = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{r^2}$$

$$= \frac{1}{4\pi\varepsilon_0\varepsilon_r}\frac{q_1 q_2}{r^2}$$

$$F_{med} = \frac{1}{4\pi\varepsilon_0} \times \frac{1}{\varepsilon_r} \times \frac{q_1 q_2}{r^2} = \frac{F_{air}}{\varepsilon_r}$$

$$F_{med} = \frac{18\times10^9}{2} = 8\times10^9$$

$$F_{med} = \frac{F_{air}}{\varepsilon_r}$$ → Condition r, q_1 ; q_2 does not change

ABLES KOTA

q_1 ——— r ——— q_2

air $\quad \varepsilon_r = 1$

$$F = \frac{1}{4\pi\varepsilon_r\varepsilon_0}\frac{q_1 q_2}{r^2} \Rightarrow \text{air}$$

$$F_{air} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

Q

q_1 — r — q_2

$F = 81N$

air

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2} = 81$$

water

q_1 ——— r ——— q_2

$K = \varepsilon_r = 81$

$$F_{med} = \frac{F_{air}}{81}$$

$$F_{med} = \frac{81}{81} = 1N$$

q_1 ——— r ——— q_2

medium $\quad \varepsilon = \varepsilon_0\varepsilon_r$

$\therefore \varepsilon_r = K$

$$F_{med} = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{r^2}$$

$$= \frac{1}{4\pi\varepsilon_0\varepsilon_r}\frac{q_1 q_2}{r^2}$$

$$F_{med} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2} \times \frac{1}{\varepsilon_r}$$

$$F_{med} = F_{air} \times \frac{1}{\varepsilon_r} = \frac{F_{air}}{\varepsilon_r} = \frac{F_{air}}{K}$$

⇒ Q-: Force b/w two charges q_1 & q_2 placed at distance d is F. Find Force b/w them if they placed in a medium whose relative permitivity is K. $(\varepsilon_r = K)$

(a) $\frac{F}{K}$

(b) $\frac{F}{\sqrt{K}}$

(c) KF

(d) N.O.T

q_1 ● — d — ● q_2

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{d^2}$$

$$F_{med} = \frac{F}{K}$$

medium

q_1 ● — d — ● q_2

$$\varepsilon = \varepsilon_0 \varepsilon_r$$

$$F_{med} = \frac{1}{4\pi\varepsilon}\frac{q_1 q_2}{d^2}$$

$$F_{med} = \frac{1}{4\pi\varepsilon_0\varepsilon_r}\frac{q_1 q_2}{d^2}$$

$$F_{med} = \left(\frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{d^2}\right) \times \frac{1}{\varepsilon_r}$$

$$F_{med} = \frac{F_{air}}{\varepsilon_r} = \frac{F_{air}}{K}$$

Q1) two charge particle 8 C & 9 C placed at distance 3 m. first placed in air & then placed in medium [relative permittivity of medium is 72]. find ratio of Force in air to Force in medium $\left[\frac{F_{air}}{F_{medium}} = ?\right]$

→ 8C ——— 3 m ——— 9C

Air $F = \frac{1}{4\pi\varepsilon_0} \frac{8 \times 9}{3^2}$

$= 9 \times 10^9 \times 8 = 72 \times 10^9$ N

medium 8C ——— 3 m ——— 9C

$F_{med} = \frac{1}{4\pi\varepsilon_0 \varepsilon_r} \frac{q_1 q_2}{r^2}$

$F_{med} = \frac{1}{4\pi\varepsilon} \frac{q_1 q_2}{r^2}$

$F_{med} = \frac{1}{4\pi\varepsilon_0 \varepsilon_r} \times \frac{8 \times 9}{3^2}$

$= \frac{9 \times 10^9 \times 8 \times 9}{72 \times 9}$

$F_{med} = 10^9$

$\frac{F_{air}}{F_{med}} = \frac{72 \times 10^9}{10^9} = 72$

$\varepsilon_r = 81$ water

$F_{air} = \frac{1}{4\pi\varepsilon} \frac{q_1 q_2}{r^2}$

$F_{med} = \frac{1}{4\pi\varepsilon_0 \varepsilon_r} \frac{q_1 q_2}{r^2}$

$\frac{F_{air}}{F_{med}} = \varepsilon_r = 72$

72 : 1

Q) Force b/w two identical spheres charged with same charge is F. If 50% charge of one sphere is transferred to second sphere. then New Force b/w them is

(a) $\frac{3}{8}F$

(b) $\frac{3}{4}F$

(c) $\frac{3}{2}F$

(d) N.O.T.

q —— d —— q

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2}$$

$$q \times \frac{50}{100} = \frac{q}{2}$$

$q - \frac{q}{2}$ → $q/2$ → $q + \frac{q}{2}$

$q/2$ —— d —— $3q/2$

$$F' = \frac{1}{4\pi\varepsilon_0}\frac{\left(\frac{q}{2}\right)\left(\frac{3q}{2}\right)}{d^2}$$

$$F' = \frac{1}{4\pi\varepsilon_0} \times \frac{3q^2}{4d^2}$$

$$F' = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2} \times \frac{3}{4}$$

$$F' = \frac{3F}{4}$$

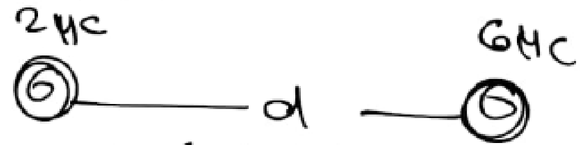
Q-: Two point charges of $+2\mu C$ & $+6\mu C$ repel each other with a Force 12N. If each is given an additional charge of $-4\mu C$, then Force will become.

(a) 12N (attraction)

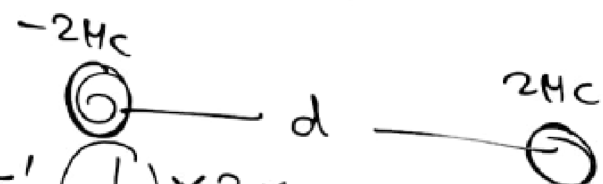
(b) 60N (attraction)

✓ (c) 4N (attraction)

(d) 4N (repulsive.)



$$12N = \frac{1}{4\pi\varepsilon_0}\frac{(2)\times(6)}{d^2} = \frac{1}{4\pi\varepsilon_0}\times\frac{1}{d^2} = \frac{12}{12} = 1$$



$$F' = \frac{1}{4\pi\varepsilon_0}\times\frac{2\times2}{d^2}$$

$$F' = 1\times4 = \underline{4N} \text{ (Attraction)}$$

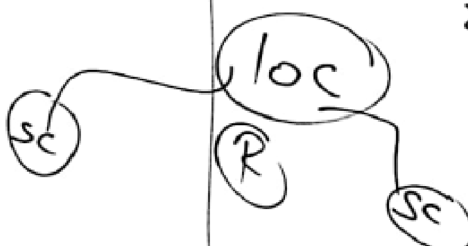
Q) A charge Q is divided in two parts Q_1 & Q_2 & these charges are placed at a distance R. There will be maximum repulsion b/w them when.

(a) $Q_1 = Q - q$, $Q_2 = q$

(b) $Q_1 = \frac{2Q}{3}$, $Q_2 = \frac{Q}{3}$

(c) $Q_1 = \frac{3Q}{4}$, $Q_2 = \frac{Q}{4}$

~~(d)~~ $Q_1 = Q_2 = \frac{Q}{2}$



board Exam-I

$Q \rightarrow q = \frac{Q}{2}$

$Q \rightarrow (Q - q) = \frac{Q}{2}$

$F = \frac{1}{4\pi\varepsilon_0} \frac{q(Q-q)}{R^2}$

$F = \frac{1}{4\pi\varepsilon_0} \frac{(qQ - q^2)}{R^2}$

$\frac{dF}{dq} = \frac{1}{4\pi\varepsilon_0 R^2}(Q - 2q)$

$\boxed{\frac{dF}{dq} = 0}$

$\frac{1}{4\pi\varepsilon_0 R^2}(Q - 2q) = 0 \Rightarrow Q - 2q = 0$

$Q = 2q$

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