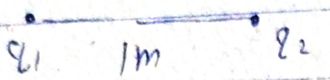
net electrostatic force depends on medium.

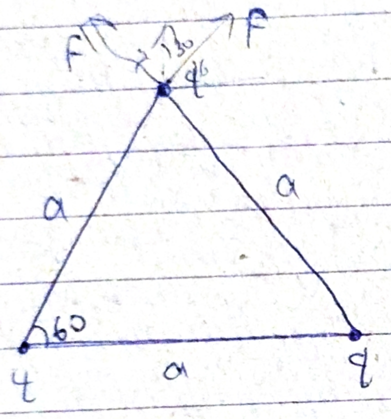
JEE



find minimum possible force b/w them?

$$f_{min} = k e^2$$

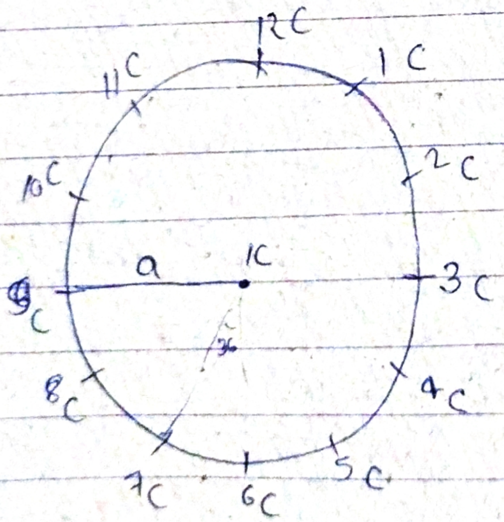
ex

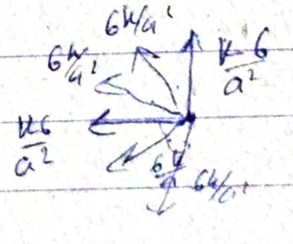


$$F_{net} = \sqrt{F^2 + F^2 + 2F^2 \cos 60}$$

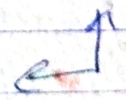
$$= \sqrt{3}\, \frac{k q^2}{a^2}$$

ex.

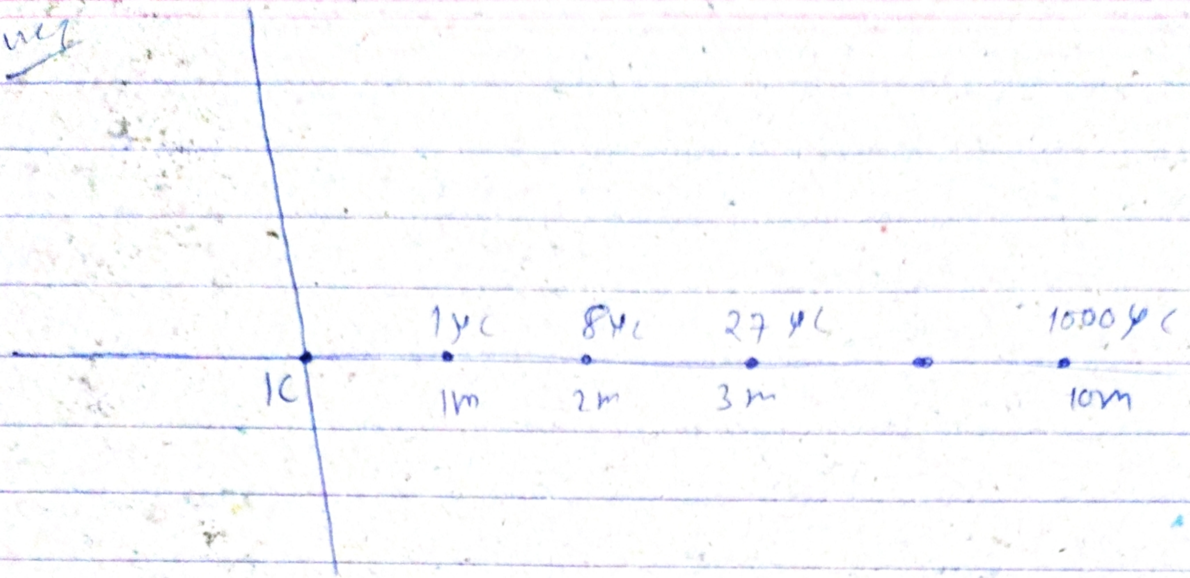




$$\frac{6k}{a^2} + 2\cos 36\, \frac{6k}{a^2} + 2\cos 72\, \frac{6k}{a}$$



Que

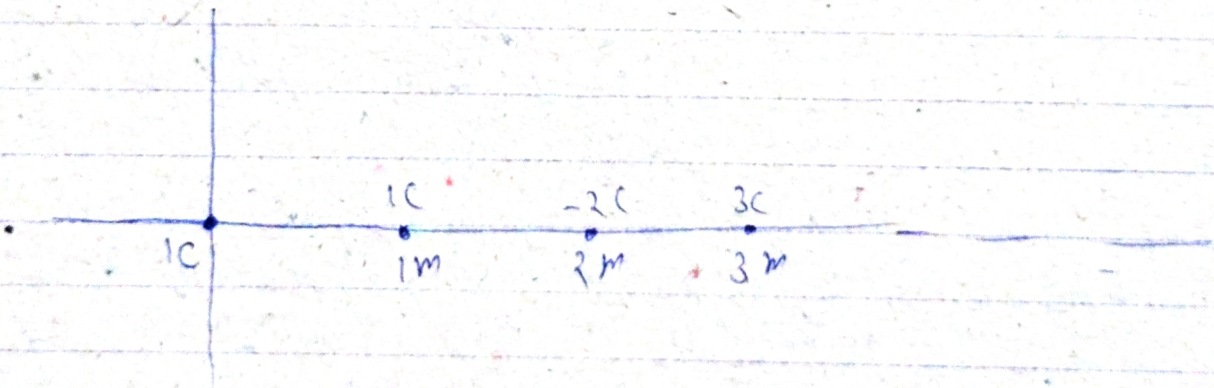


$$k\frac{1}{1} + k\frac{8}{2^2} + k\frac{27}{3^2} + \cdots + k\frac{1000}{10^2}$$

$$= k(1 + 2 + 3 + \cdots + 10)$$

$$= k(55)$$

Que



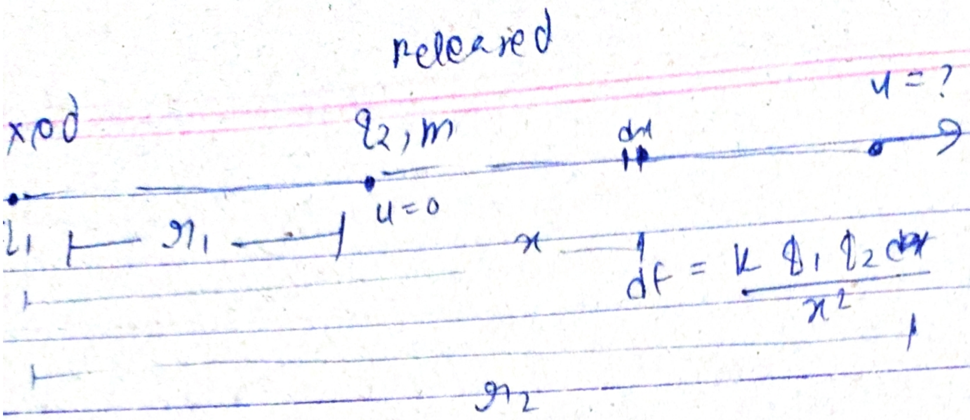
$$k\frac{1}{1} - k\frac{2}{2^2} + k\frac{3}{3^2} - k\frac{4}{4^2}$$

$$k\left(\frac{1}{1} - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} \cdots\right)$$

$$= \boxed{k \ln(1+1)}$$

$$= k \ln 2$$

$$\boxed{\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4}}$$



$$df = \frac{k\, q_1 q_2\, dx}{x^2} \Rightarrow da = \frac{k\, q_1 q_2\, dx}{m x^2}$$

$$F = \frac{k\, q_1 q_2}{r_1^2}$$

$$a = \frac{k\, q_1 q_2}{m r_1^2}$$

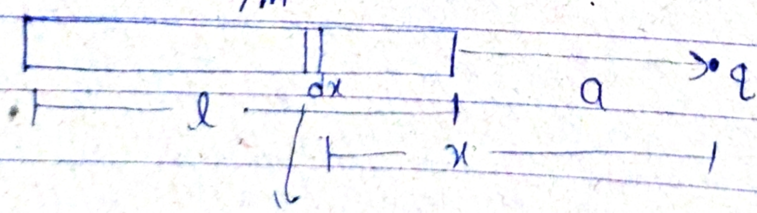
$$\int_0^u u \frac{du}{dx} = \frac{k\, q_1 q_2}{m} \int_{r_1}^{r_2} \frac{dx}{x^2}$$

$$\frac{u^2}{2} = \frac{k\, q_1 q_2}{m} \left[\frac{1}{x} \right]_{r_2}^{r_1}$$

$$\frac{u^2}{2} = \frac{k\, q_1 q_2}{m} \left[\frac{1}{r_1} - \frac{1}{r_2} \right]$$

ind out force on charge due to rod =)

$\lambda\, C/m$

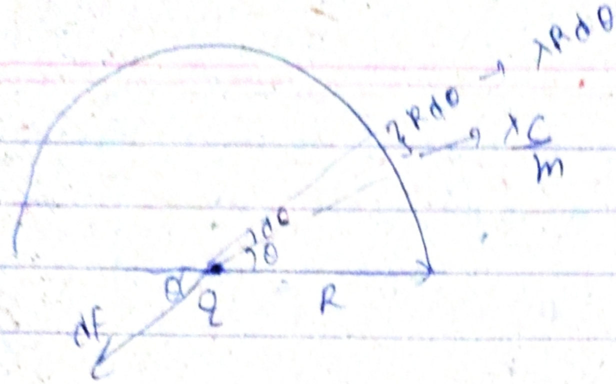


$$dq = \lambda\, dx$$

$$df = \frac{k\, q\, \lambda\, dx}{x^2}$$

$$F = k q \lambda \int_a^{a+l} \frac{dx}{x^2} = \frac{k\, q l \lambda}{a(a+l)}$$

$$\left[\frac{1}{x} \right]_{a+l}^{a} = \left[\frac{1}{a} - \frac{1}{a+l} \right] k q \lambda$$



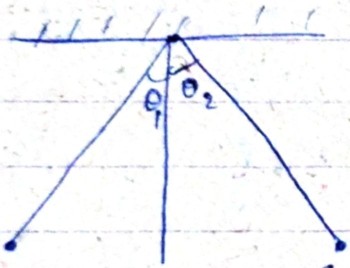
$$dF = \int_0^{\pi/2} \frac{2kq\lambda R\, d\theta \sin\theta}{R^2}$$

$$\int dF = \cancel{\frac{kq\lambda \int d\theta}{R}}$$

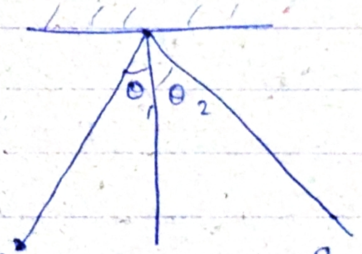
$$= \cancel{\frac{kq\lambda\pi}{R}}$$

$$F = \frac{2kq\lambda}{R}\left[-\cos\theta\right]_0^{\pi/2}$$

$$= \frac{2k\lambda q}{R}$$

① 

$m_1 > m_2$

② 

$q_1 > q_2$

A a. $\theta_1 > \theta_2$

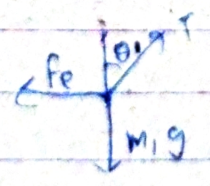
b. $\cancel{\theta_2 < \theta}$ $\theta_1 < \theta_2$

c. $\theta_1 = \theta_2$

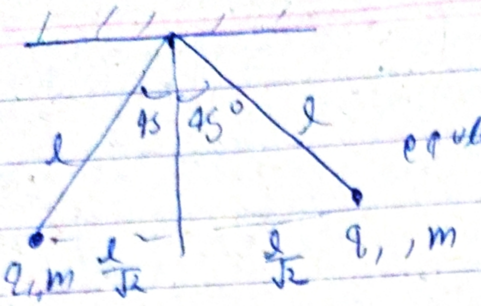
d.

Ans. 1 - b

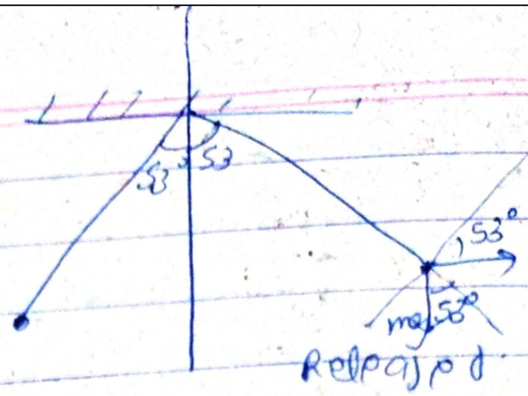
Ans 2 - c



Q1

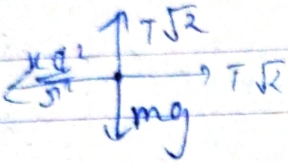


equilibrium



Released

Find acc. at this instant in terms of g only.



$$mg = T\sqrt{2}$$

$$\frac{kq^2}{l^2} = 2mg$$

$$\frac{kq^2}{(8l/5)^2} = \frac{25\,kq^2}{64\,l^2}$$

$$= \frac{25\,mg}{32}$$

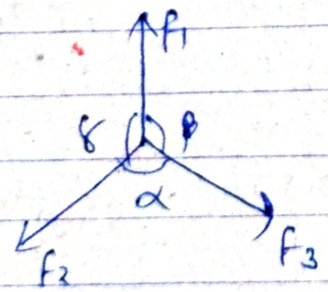
$$a_t = \frac{mg\sin 53 - F_e\cos 53}{m}$$

$$\frac{4g}{5} - \frac{25g}{32} \times \frac{3}{5}$$

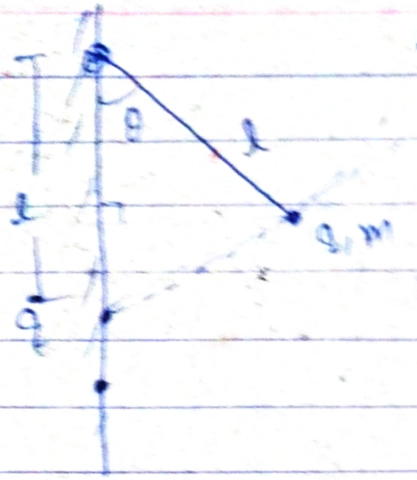
$$=$$

Lami's theorem:

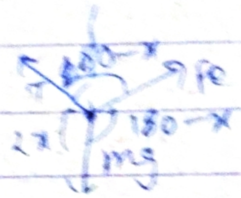
$$\vec{F_1} + \vec{F_2} + \vec{F_3} = 0$$



$$\frac{F_1}{\sin\alpha} = \frac{F_2}{\sin\beta} = \frac{F_3}{\sin\gamma} = \text{constant}$$

Q. 

At equilibrium find T in string in terms of m and g only



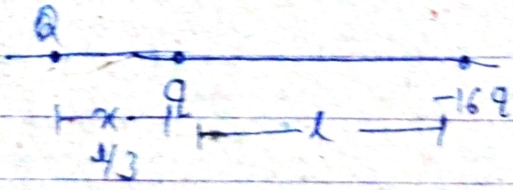
$$\frac{T}{\sin(180-x)} = \frac{mg}{\sin(180-x)}$$

$$T = mg$$

stable equilibrium

unstable equilibrium

Qn

ex 

Find out the magnitude, nature and position of third charge such that all the three charges are in equilibrium.

$$\frac{kq}{x^2} = \frac{k\,16q}{(x+l)^2}$$

$$\frac{1}{x} = \frac{4}{x+l} \Rightarrow x+l = 4x$$

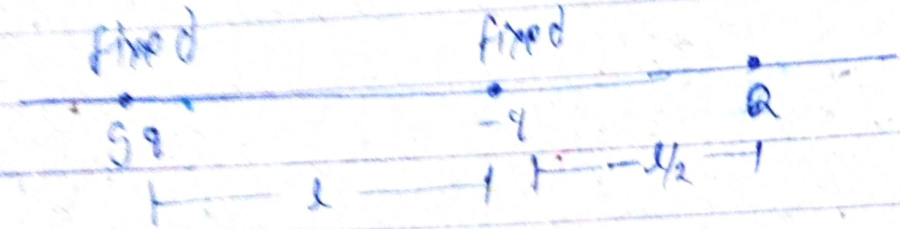
$$l = 3x$$

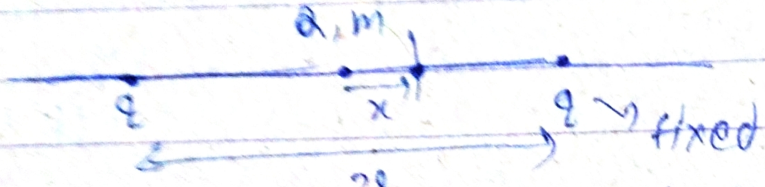
$$\boxed{x = \frac{l}{3}}$$

$$\frac{9kQq}{l^2} = \frac{16kQq}{l^2}$$

$$9Q = 16q \qquad Q = -\frac{16q}{9}$$

छोटे वाले charge के पास आएगा।





$l >> x$

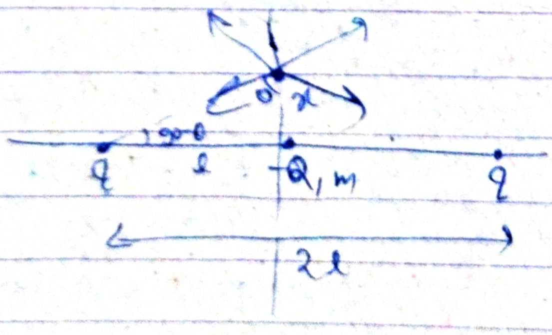
$$F_{net} = \frac{kQq}{(l+x)^2} - \frac{kQq}{(l-x)^2}$$

$$= \frac{kQq\left((l-x)^2-(l+x)^2\right)}{(l^2-x^2)^2}$$

$$= \frac{-kqQ\,4lx}{(l^2-x^2)^2} = -\left(\frac{4kqQ}{l^3}\right)x$$

$$T = 2\pi\sqrt{\frac{ml^3}{4kQq}}$$

Q



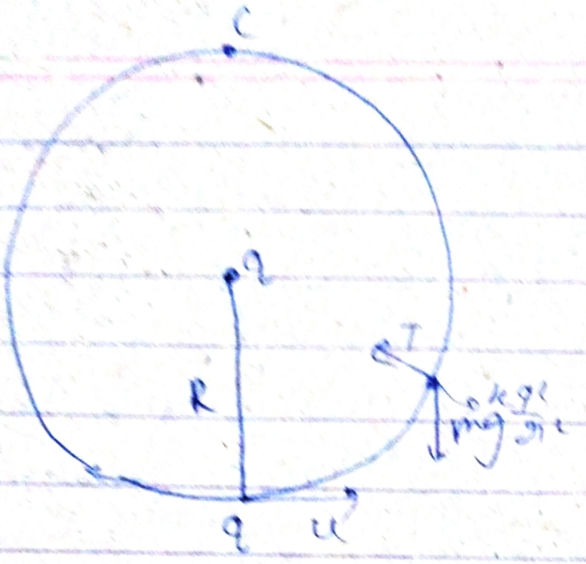
$$T = 2\pi\sqrt{\frac{ml^3}{2kQq}}$$

$x << l$

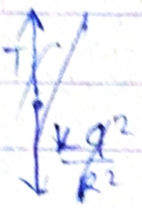
$2F\cos\theta$

$$2F\frac{x}{\sqrt{x^2+l^2}} = \frac{-2kQqx}{(x^2+l^2)^{3/2}} = \left(\frac{-2kQq}{l^3}\right)x$$

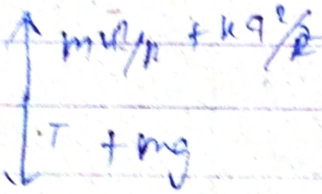
k



what is min. valu of u such that particle will complet verticle circular motion.



$T_c \geq 0$



$$T + mg = \frac{mu^2}{R} + \frac{kq^2}{R^2}$$

$$T = \frac{mu^2}{R} + \frac{kq^2}{R^2} - mg \geq 0$$

$$\cancel{W.D_T}^{0} + \cancel{WD_{electo}}^{0} + WD_{gravity} = K_f - K_i$$

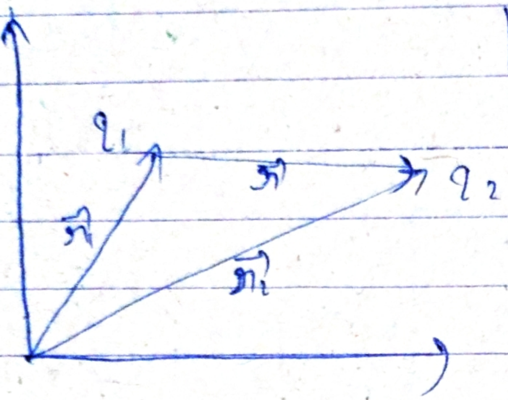
$$-2mgR = \frac{1}{2}mu^2 - \frac{1}{2}mu^2$$

$$mu^2 = mu^2 - 4mgR$$

$$T_c = \frac{mu^2}{R} - 5mg + \frac{kq^2}{R^2} > 0$$

$$u > \sqrt{5gR - \frac{kq^2}{Rm}}$$

vectar farm of caloumb's law →



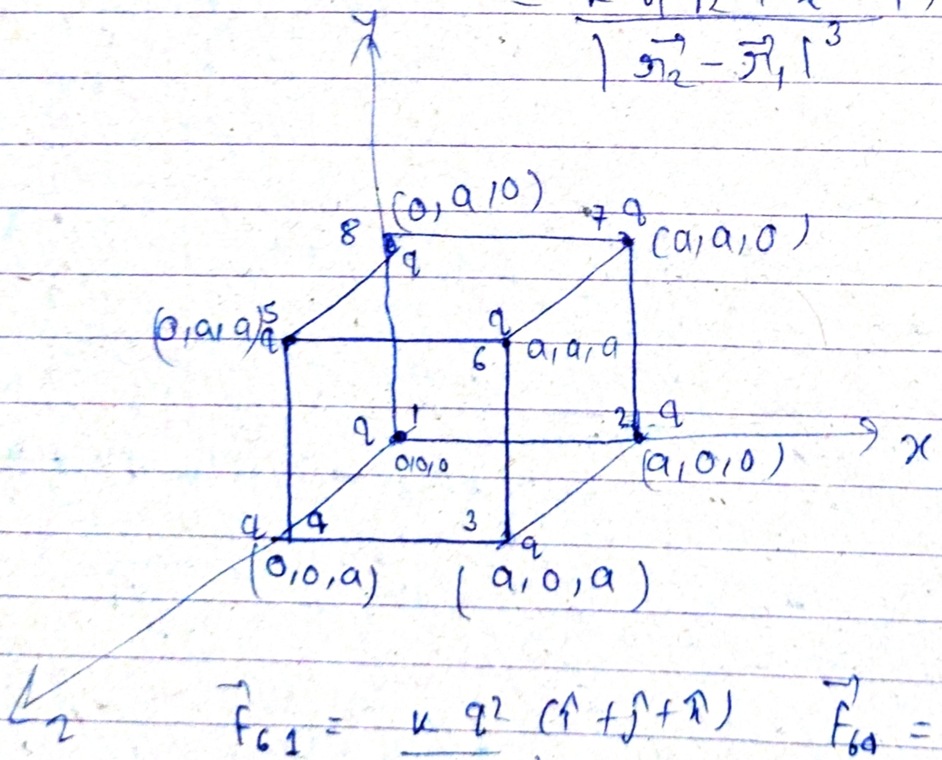
$$|\vec{F}_{21}| = \frac{k q_1 q_2}{|\vec{r}|^2}$$

$$\vec{F}_{21} = \frac{k q_1 q_2 \hat{r}}{|\vec{r}|^2}$$

$$\vec{r} = \vec{r}_2 - \vec{r}_1$$

$$\boxed{\vec{F}_{21} = \frac{k q_1 q_2 \vec{r}}{|\vec{r}|^3}}$$

$$= \frac{k q_1 q_2 (\vec{r}_2 - \vec{r}_1)}{|\vec{r}_2 - \vec{r}_1|^3}$$

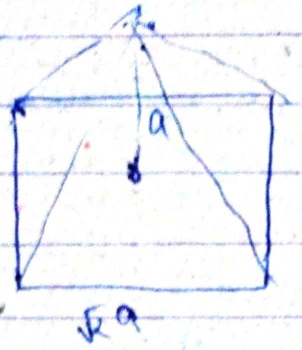


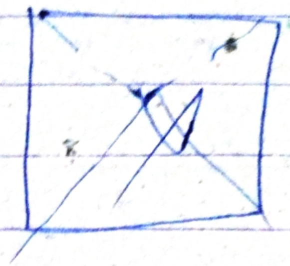
$$\vec{F}_{61} = \frac{k q^2 (\hat{i} + \hat{j} + \hat{k})}{a (\sqrt{3})^3} \qquad \vec{F}_{64} = \frac{k q^2 \hat{i} + \hat{j}}{(\sqrt{2})^3}$$

$$\vec{F}_{62} = \frac{k q^2 (\hat{j} + \hat{k})}{(\sqrt{2})^3} \qquad F_{65} = \frac{k q^2 \hat{i}}{(1)^3}$$

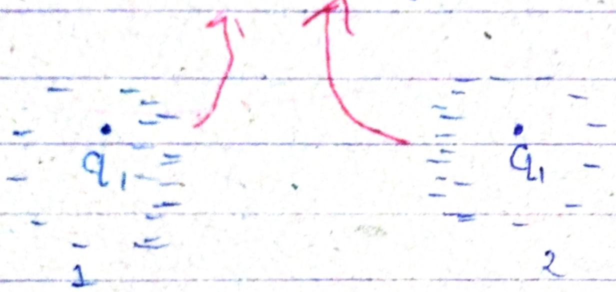
$$\vec{F}_{63} = \frac{k q^2 \; \hat{j}}{1^3} \qquad F_{67} = \frac{k q^2 \hat{k}}{1^3}$$

$$F_{68} = \frac{k q^2 \; \hat{i} + \hat{k}}{(\sqrt{2})^3}$$





Induced charges



force on 1 due to 2 only $= \frac{1}{4\pi\varepsilon_0} \frac{q_1^2}{r^2}$

force on 1 due to charge induced $= \vec{F}_{induced}$

$$= \frac{1}{4\pi\varepsilon_0} \frac{q^2}{r^2} - \frac{1}{4\pi\varepsilon_0 \varepsilon_r} \frac{q^2}{r^2}$$

$$F_{net} = |\vec{F}_{12}| - |\vec{F}_{induced}|$$

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

ε_r → Relative permittivity of medium

$\varepsilon_0 \varepsilon_r$ = Absolute permittivity