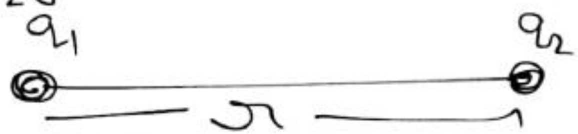
Q - Ex 2 ~~12~~, 22, 26

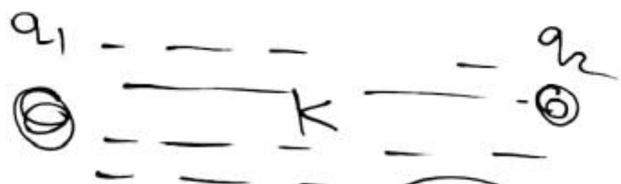
Q22 -:



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

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

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

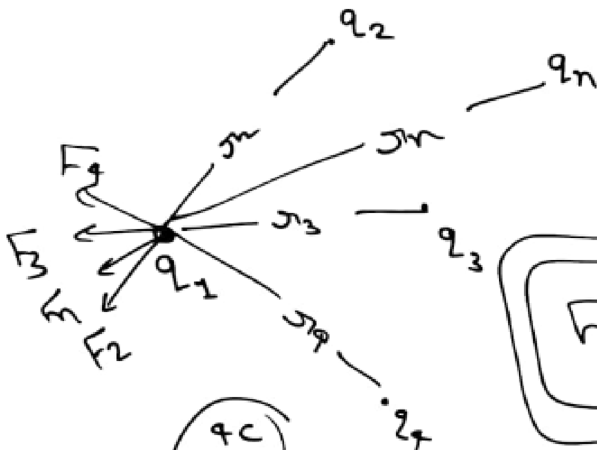


Q-) 26

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

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

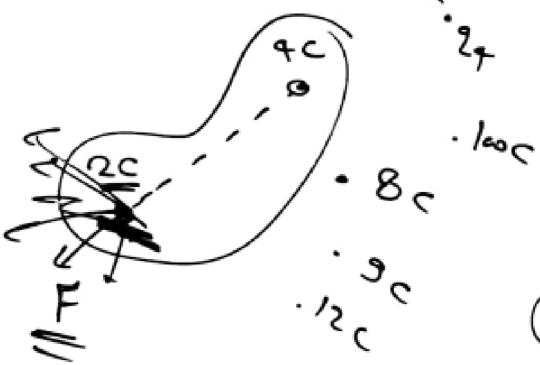
Super position principle

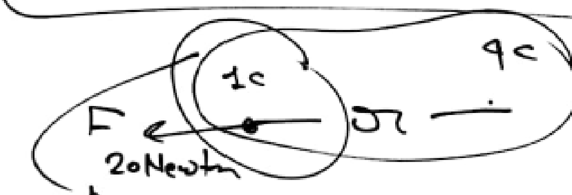


Force on q_1 due to q_2 does not depends on other charges.

Net Force on q_1

$$\vec{F}_{net} = \vec{F_2} + \vec{F_3} + \vec{F_4} + \cdots + \vec{F_n}$$



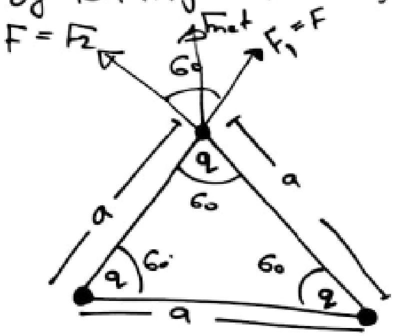


Net Force Badal Jayega और Charge same है।

$$F = \frac{1}{4\pi\varepsilon} \times \frac{1 \times 4}{r^2}$$

Super position principle

ⓐ A equilateral triangle, q charge placed on all corner of triangle & side of triangle is a. find net force on any charge.



$$F_1 = \frac{1}{4\pi\varepsilon_0}\frac{q\times q}{a^2} = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{a^2}$$

$$F_2 = \frac{1}{4\pi\varepsilon_0}\frac{q\times q}{a^2} = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{a^2}$$

$$F_1 = F_2 = F$$

$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

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

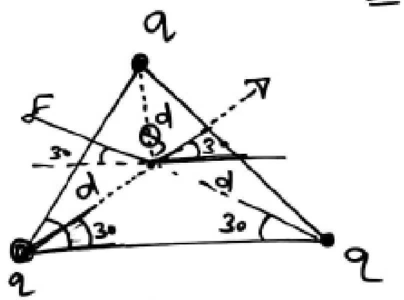
$$= \sqrt{2F^2 + 2F^2\times\frac{1}{2}} = F\sqrt{3}$$

$$= \sqrt{2F^2 + F^2} = \sqrt{3F^2}$$

$$= F\sqrt{3}$$

$$\frac{1}{4\pi\varepsilon_0}\frac{q^2}{a^2}\sqrt{3} = F_{net}$$

Q: Find Net Force on Q Placed at the centre of equilateral triangle.

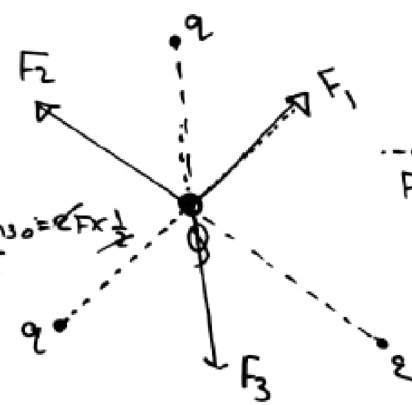


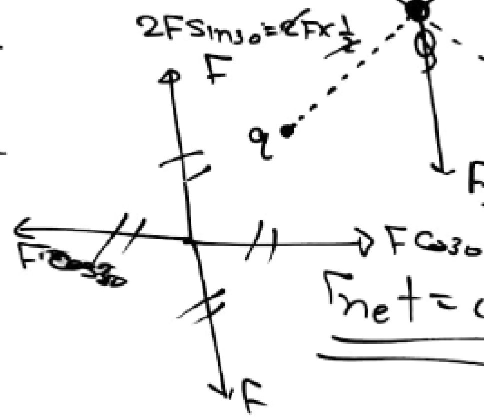
$\Longrightarrow$ Ans = 0

$$F_1 = \frac{1}{4\pi\varepsilon}\frac{qQ}{d^2}$$

$$F_2 = \frac{1}{4\pi\varepsilon}\frac{qQ}{d^2}$$

$$F_3 = F$$



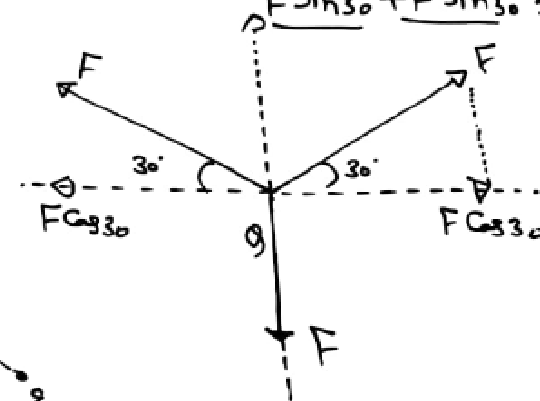


$F_{net} = 0$

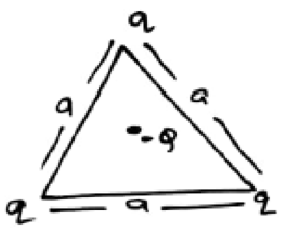
$F\sin 30 + F\sin 30 = 2F\sin 30$

$= 2F \times \frac{1}{2}$

$= F$

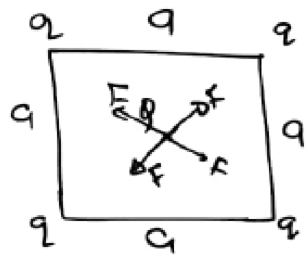


(a)



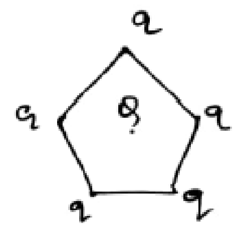
F_{net} on Q = 0

(b)



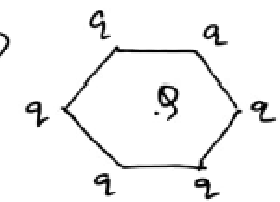
F_{net} on Q = 0

(c)



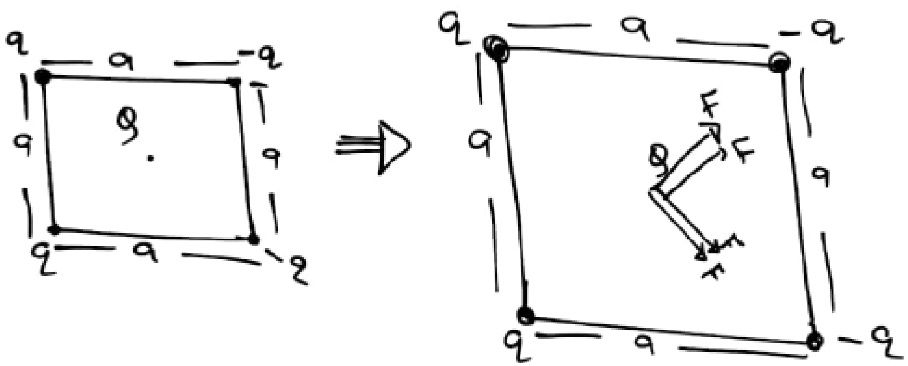
F_{net} on Q = 0

(d)

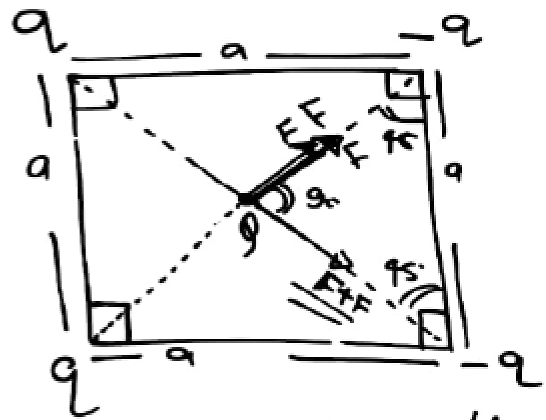


F_{net} on Q = 0

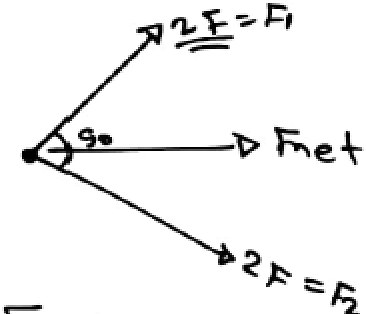
#



⇒ find Net Force on Q



$$F = \frac{1}{4\pi\varepsilon}\frac{Qq}{(a/\sqrt{2})^2} = \frac{1}{4\pi\varepsilon}\frac{Qq}{a^2/2} = \frac{2Qq}{4\pi\varepsilon_0 a^2}$$



$$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

$$= \sqrt{(2F)^2 + (2F)^2 + 2(2F)(2F)\cos 90}$$

$$= \sqrt{4F^2 + 4F^2}$$

$$= 2\sqrt{2}F$$

$$F_{net} = (2\sqrt{2})\frac{2Qq}{4\pi\varepsilon_0 a^2}$$

$$F_{net} = \frac{Qq\sqrt{2}}{\pi\varepsilon_0 a^2}$$

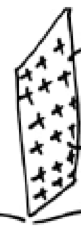
$$\boxed{F_{net} = \frac{Qq\sqrt{2}}{\pi\varepsilon_0 a^2}}$$

Charge density

Linear charge density (λ)

$$\lambda = \frac{q}{l}$$

Surface charge density



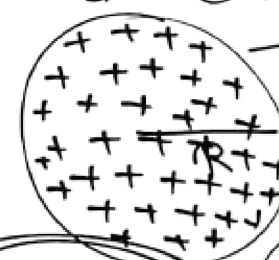
$$\sigma = \frac{q}{A}$$

Sigma

$A \longrightarrow q$

$1 \longrightarrow \frac{q}{A} = \sigma$

Volume Charge density (ρ)



→ Non-Conducting sphere.

$$\rho = \frac{q}{V} = \frac{q}{\frac{4}{3}\pi R^3} = \frac{3q}{4\pi R^3}$$

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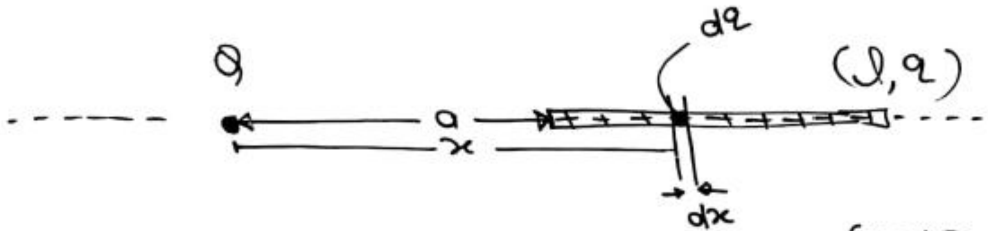
Q1: Find Force on Q due to rod.

⟹ Find Force on rod due to Q.



Coulomb's Law

Applicable for point Charges

$l \longrightarrow q$

$1 \longrightarrow \frac{q}{l}$

$dx = \frac{q}{l} dx$

$dq = \frac{q}{l} dx$

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

$dF = \frac{1}{4\pi\varepsilon_0} \frac{\left(\frac{q}{l}\right) dx\, Q}{x^2}$

$dF = \frac{1}{4\pi\varepsilon_0} \frac{qQ}{l} \left(\frac{dx}{x^2}\right)$

$\int \frac{dx}{x^2} = \int x^{-2} dx = \frac{x^{-2+1}}{-2+1} = \frac{x^{-1}}{-1} = -\frac{1}{x}$

$\int dF = \frac{1}{4\pi\varepsilon} \frac{Qq}{l} \int_a^{a+l} \frac{dx}{x^2}$

$F = \frac{1}{4\pi\varepsilon} \frac{Qq}{l} \left[-\frac{1}{x}\right]_a^{a+l}$

$F = \frac{1qQ}{4\pi\varepsilon_0 l} \left[-\frac{1}{(a+l)} - \left(-\frac{1}{a}\right)\right]$

$F = \frac{1Qq}{4\pi\varepsilon_0 l} \left(\frac{1}{a} - \frac{1}{a+l}\right)$