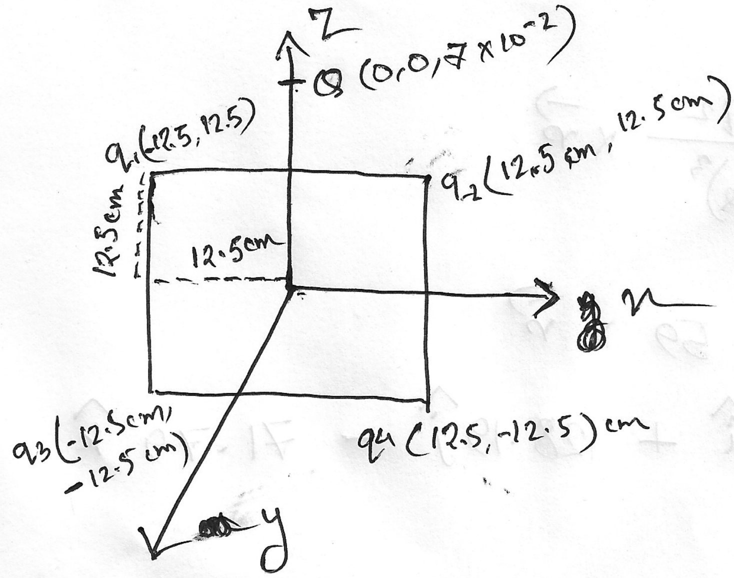
1

Ans. to Q No - 1

a)



Now, $\vec{r}_{q_1Q} = \vec{r}_Q - \vec{r}_{q_1} = (7\times10^{-2}\hat{k}) - (-12.5\times10^{-2}\hat{i} + 12.5\times10^{-2}\hat{j})$

$= 12.5\times10^{-2}\hat{i} - 12.5\times10^{-2}\hat{j} + 7\times10^{-2}\hat{k}$

$\therefore \vec{F}_{q_1Q} = \dfrac{kQq_1}{(r_{q_1Q})^3} \times \vec{r}$

$= \dfrac{8.987\times10^9 \times -28\times10^{-6} \times 28\times10^{-6}}{6.87\times10^{-3}} \times (12.5\times10^{-2}\hat{i} - 12.5\times10^{-2}\hat{j} + 7\times10^{-2}\hat{k})$

$= -1025.59 \times \vec{r}$

$= -128.19\hat{i} + 128.19\hat{j} - 71.79\hat{k}$

Now, $\vec{r}_{q_2Q} = -12.5 \times 10^{-2}\hat{i} - 12.5 \times 10^{-2}\hat{j} + 7 \times 10^{-2}\hat{k}$

$$\therefore \vec{F}_{q_2Q} = \frac{kQq_2}{(r_{q_2Q})^3} \times \vec{r}$$

$$= -1025.59 \times \vec{r}$$

$$= 128.19\,\hat{i} + 128.19\,\hat{j} - 71.79\,\hat{k}$$

similarly,

$$\vec{F}_{q_3Q} = (-1025.59) \times \left(12.5 \times 10^{-2}\hat{i} + 12.5 \times 10^{-2}\hat{j} + 7 \times 10^{-2}\hat{k}\right)$$

$$= -128.19\hat{i} - 128.19\hat{j} - 71.79\hat{k}$$

similarly,

$$\vec{F}_{q_4Q} = (-1025.59) \cancel{\times(-128.19\hat{i} + 128.19\hat{j} +}$$

$$\times \left(-12.5 \times 10^{-2}\hat{i} + 12.5 \times 10^{-2}\hat{j} + 7 \times 10^{-2}\hat{k}\right)$$

$$= 128.19\hat{i} - 128.19\hat{j} - 71.79\hat{k}$$

$$\therefore \vec{F}_{net} = \vec{F}_{q_1Q} + \vec{F}_{q_2Q} + \vec{F}_{q_3Q} + \vec{F}_{q_4Q}$$

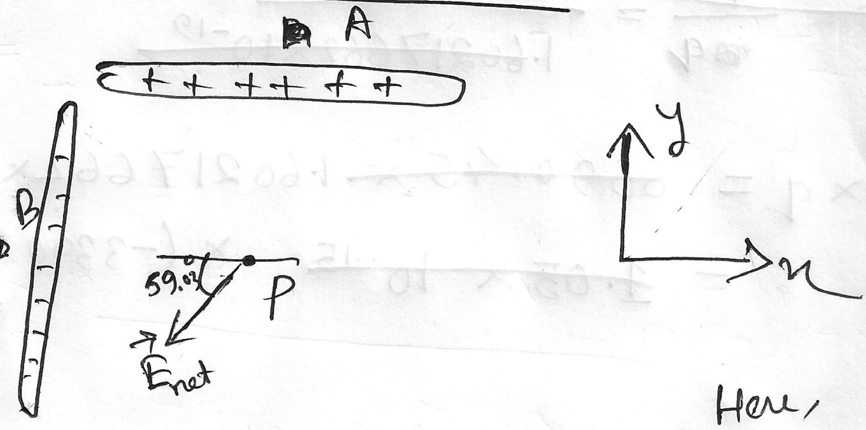
$$= 0\hat{i} + 0\hat{j} - 287.16\hat{k}$$

b) We know,

$$F = m \times a \quad \therefore a = \frac{287.16}{m_e} = 3.15 \times 10^{32}$$

Ans to Q.No - 2

a)



Here,

$r_1 = 3\ m$

$r_2 = 5\ m$

Now, $$\vec{E}_{AP} = \frac{2kq_1}{r_1\sqrt{4r_1^2 + L_1^2}}(-\hat{j})$$

$$= -5651.27\hat{j}$$

$$\vec{E}_{BP} = \frac{2kq_2}{r_2\sqrt{4r_2^2 + L_2^2}}(-\hat{i})$$

$$= -3390.76\hat{i}$$

$$\therefore \vec{E} = -3390.76\,\hat{i} - 5651.27\,\hat{j}$$

$$\therefore |\vec{E}| = 6590.45 \text{ N/C}$$

and, $$\theta = \tan^{-1}\left(\frac{-5651.27}{-3390.76}\right) = 59.03^\circ$$

b) We know,

$$\cancel{F = \frac{E}{q} = \frac{6590.45}{1.60217662\times10^{-19}}}$$

$$F = \vec{E}\times q = \cancel{6590.45\times}\, 1.60217662\times10^{-19}$$

$$= \cancel{1.05\times10^{-15}} \times (-3390.76\,\hat{i} - 5651.27\,\hat{j})$$

$$= -5.43\times10^{-16}\,\hat{i} - 9.05\times10^{-16}\,\hat{j}$$

$$\therefore |\vec{F}| = 1.05\times10^{-15}$$

$$\therefore \theta = \tan^{-1}\left(\frac{-9.05\times10^{-16}}{-5.43\times10^{-16}}\right) = 59.03^\circ$$

Ans to Q. No 4

a) Here, $\vec{E}_{AP} = \frac{V}{y} = \frac{9}{5\times10^{-2}} = 180$

and, $E_{BP} = \frac{V}{y} = \frac{4}{5\times10^{-2}} = 80$

$\therefore E_{net} = 180 + 80 = 260$

b) Force at point $p = E \times q$

$= 4.16 \times 10^{-17}$

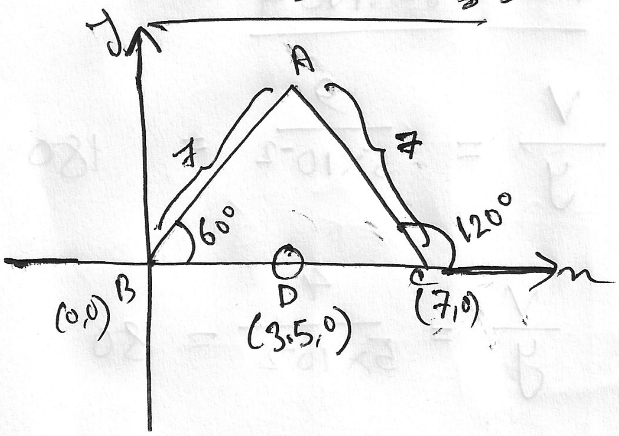
c) Instantaneous accelaration $= \frac{F}{m}$

$= \frac{4.16 \times 10^{-17}}{9.109 \times 10^{-31}}$

$= 4.56 \times 10^{13}$

Ans to Q No-5

a)



$$\vec{F}_{BA} = \frac{kQQ}{7^2} \times \left(\cos(60°)\hat{i} + \sin 60° \hat{j}\right)$$

$$= 1650673469 \left(0.5\,\hat{i} + \frac{\sqrt{3}}{2}\hat{j}\right)$$

$$= 825336734.5\,\hat{i} + 1429525158\,\hat{j}$$

$$\therefore \vec{F}_{CA} = \frac{kQQ}{7^2}\left(\cos 120°\,\hat{i} + \sin 120°\,\hat{j}\right)$$

$$= -825336734.5\,\hat{i} + 1429525158\,\hat{j}$$

Now, $\vec{F}_{\text{net on A}} = \vec{F}_{BA} + \vec{F}_{CA} + \vec{F}_{DA} = 0$

$$\Rightarrow 2859050315\,\hat{j} + \vec{F}_{DA} = 0$$

$$\Rightarrow 2859050315\,\hat{j} + \frac{2.69 \times 10^{10} \times q}{(6.06)^2}\hat{j} = 0$$

$$\Rightarrow q = -3.90\,C$$

b) Net force on charge B

$$\vec{F}_{AB} = -\vec{F}_{BA} = -825336734.5\,\hat{i} - 1429525158\,\hat{j}$$

$$\vec{F}_{DB} = +8583502041\,\hat{i}$$

$$\vec{F}_{CB} = -1650673469\,\hat{i}$$

$$\therefore \vec{F}_{net} = 6107491838\,\hat{i} - 1429525158\,\hat{j}$$

$$\therefore |\vec{F}| = \cancel{67}\ 6272559184$$