

$$\vec{r}_p = x_p \hat{x} + y_p \hat{y} + z_p \hat{z}$$

$$\vec{r}_i = x_i \hat{x} + y_i \hat{y} + z_i \hat{z}$$

$$\vec{r}_{ip} = \vec{r}_p - \vec{r}_i$$

$$\hat{r}_{ip} = \frac{\vec{r}_{ip}}{|\vec{r}_{ip}|} \quad |\vec{r}_{ip}| = \sqrt{r_{ip,x}^2 + r_{ip,y}^2 + r_{ip,z}^2}$$

$$\vec{F}_p = \sum_{\substack{i=1 \\ i \neq p}}^n k \frac{q_i q_p}{r_{ip}^2} \hat{r}_{ip}$$

$$\vec{F}_p = \int_{\text{all } q} k \frac{q_p dq_i}{r_{ip}^2} \hat{r}_{ip}$$

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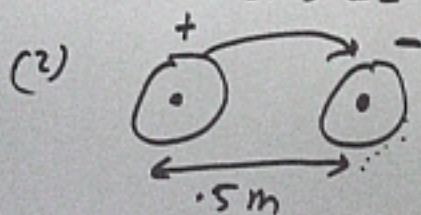
$$\vec{F}_p = \frac{1}{4\pi\epsilon_0} \int_{\text{all } q_i} \frac{dq_i}{r_{ip}^2} \hat{r}_{ip}$$

(1)

$$Q = q_1 + Ne^-$$

$$= 8 \times 10^{-6} + 6 \times 10^{13} (-1.6 \times 10^{-19})$$

$$= -1.6 \times 10^{-6} \text{ C} = -1.6 \mu\text{C}$$



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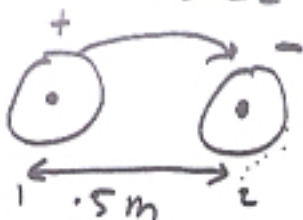
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$$= -1.6 \times 10^{-6} \text{ C} = -1.6 \mu\text{C}$$

(2)



$$Q_1 = N(e^+) = +4.8 \mu\text{C}$$

$$Q_2 = N(e^-) = -4.8 \mu\text{C}$$

$$|\vec{F}| = k \frac{Q_1 Q_2}{r_{12}^2}$$

$$= \frac{8.99 \times 10^9 \cdot \mu \cdot \mu \cdot (3 \times 10^{-5})^2}{(0.5)^2}$$

$$= 0.8 \text{ N}$$

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$$(3) \quad |\vec{F}| = \left| k \frac{q_1 q_2}{r_{12}^2} \right| = 3.4 \text{ N}$$

$$q_2 = \frac{3.4 \text{ N} (r_{12}^2)}{k q_1}$$

$$= \frac{3.4 (.26)^2}{8990 (3.5)} = 7.3 \mu\text{C}$$

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$L = 0.15 \text{ m}$
 $q_1, q_2, q_3 = (-9, 0, 3) \mu\text{C}$
 $\vec{r}_{ip} = \vec{r}_p - \vec{r}_i$ $\vec{F}_p = k q_p \sum_{i=2}^3 \frac{q_i}{r_{ip}^2} \hat{r}_{ip}$
 $\vec{r}_1 = 0\hat{x} + 0.15\hat{y}$ $\vec{r}_{21}, \vec{r}_{31}$
 $\vec{r}_2 = 0.15\hat{x} + 0\hat{y}$
 $\vec{r}_3 = 0\hat{x} + 0\hat{y}$ $.15\hat{x} + 0\hat{y}$
 $\vec{r}_{21} = \vec{r}_1 - \vec{r}_2 = -0.15\hat{x} + 0.15\hat{y}$
 $\vec{r}_{31} = \vec{r}_1 - \vec{r}_3 = 0\hat{x} + 0.15\hat{y}$

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$$\vec{r}_3 = 0\hat{x} + 0\hat{y} \quad \leftarrow \quad .15\hat{x} + 0\hat{y}$$

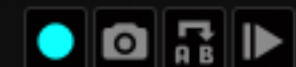
$$\vec{F}_1 = Rg_1 \left[\frac{\vec{r}_{21}}{r_{21}^{3/2}} + \frac{\vec{r}_{31}}{r_{31}^{3/2}} \right]$$

$$= Rg_1 \left[\frac{-.15\hat{x} + .15\hat{y}}{(.15^2 + .15^2)^{3/2}} (g_2) \right]$$

$$+ \frac{0\hat{x} + .15\hat{y}}{(\cancel{.15^2} + 0^2)^{3/2}} (g_3)$$

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$$\vec{r}_3 = 0\hat{x} + 0\hat{y} \quad .15\hat{x} + 0\hat{y}$$

$$\vec{r}_{21} = \vec{r}_1 - \vec{r}_2 = \frac{-1.5\hat{x} + 1.5\hat{y}}{-0.15\hat{x} + 0.15\hat{y}}$$

$$\vec{F}_1 = kq_1 \left[\frac{\vec{r}_{21}}{r_{21}^{3/2}} + \frac{\vec{r}_{31}}{r_{31}^{3/2}} \right]$$

$$= kq_1 \left[\frac{-0.15\hat{x} + 0.15\hat{y}}{(.15^2 + .15^2)^{3/2}} (q_2) + \frac{0\hat{x} + 0.15\hat{y}}{(0^2 + .15^2)^{3/2}} (q_3) \right]$$

← 18

-9

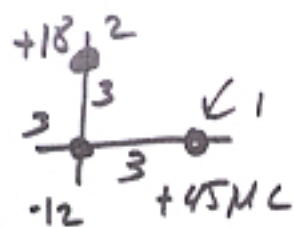
-9(8996)

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$$E_1 = k q_1 \sum_{i=2}^3 \frac{q_i}{r_{ip}^2} \hat{r}_{ip}$$

$$\vec{r}_1, \vec{r}_2, \vec{r}_3$$

$$\vec{r}_{12}, \vec{r}_{13}$$

$$k q_1 \left[\frac{q_2}{r_{12}^2} \hat{r}_{12} + \frac{q_3}{r_{13}^2} \hat{r}_{13} \right]$$

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