

Electric Forces

PH 112

$$F \propto r^2$$

$$F \propto \frac{q_1 q_2}{r^2} \quad F = k \frac{q_1 q_2}{r^2}$$

$$k = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$$

$$m_e = 9.1095 \times 10^{-31} \text{ kg}$$

$$e = -1.6 \times 10^{-19} \text{ C} \quad q = Ne$$

$$m_p = 1.67261 \times 10^{-27}$$

$$p = 1.6021917 \times 10^{-19} \text{ C}$$

$$\vec{F}_{el} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} \hat{r}$$

$$m_n = 1.67492 \times 10^{-27}$$

$$n = 0$$

Example #1

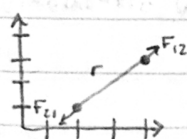
$$q_1 = 2 \mu\text{C} = 2 \times 10^{-6} \text{ C}$$

$$q_2 = 3 \mu\text{C} = 3 \times 10^{-6} \text{ C}$$

$$r_1 = (2, 1) \text{ cm} \times 10^{-2} \text{ m}$$

$$r_2 = (4, 3) \text{ cm} \times 10^{-2} \text{ m}$$

$$\vec{F}_{12} = ?$$



$$r = \sqrt{2^2 + 2^2} = 2\sqrt{2} \times 10^{-2} \text{ m}$$

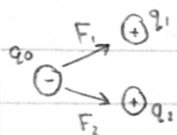
$$F_{12} = 9 \times 10^9 \frac{q_1 q_2}{r^2} \hat{r} = 9 \times 10^9 \frac{2 \times 10^{-6} (3 \times 10^{-6})}{(2\sqrt{2} \times 10^{-2})^2} = \boxed{67.5 \text{ N}}$$

$$\theta = 45^\circ$$

$$F_x = F \cos \theta = 67.5 \cos 45 = \boxed{47.7 \text{ N}}$$

$$F_x = ?, F_y = ?$$

$$F_y = F \sin \theta = 67.5 \sin 45 = \boxed{47.7 \text{ N}}$$



$$F_{el} = F_1 + F_2 \quad |F_{el}| = \sqrt{F_x^2 + F_y^2}$$

$$\uparrow F_{1x} + F_{2x}$$

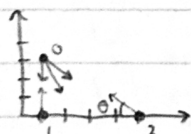
Example #2

$$q_0 = -1 \mu\text{C} \times 10^{-6} \text{ C}$$

$$q_1 = 3 \mu\text{C} \times 10^{-6} \text{ C}$$

$$q_2 = 4 \mu\text{C} \times 10^{-6} \text{ C}$$

$$F_{q_0} = ?$$



$$r_1 = 3 \times 10^{-2} \text{ m}$$

$$r_2 = 5 \times 10^{-2} \text{ m}$$

$$F_{q_0} = 9 \times 10^9 \left(\frac{-10^{-6} (3 \times 10^{-6})}{(3 \times 10^{-2})^2} + \frac{-10^{-6} (4 \times 10^{-6})}{(5 \times 10^{-2})^2} \right) =$$

$$F_{0x} = 11.5 \text{ N}$$

$$F_{0y} = -38.6 \text{ N}$$

$$|F_{q_0}| = \boxed{40.3 \text{ N}}$$