

## Physics 1214, Homework #1: solutions

Answers to multiple choice questions: M1: (1) E, (2) 0; M2: E.

P1:  $F = 810 \text{ N}$

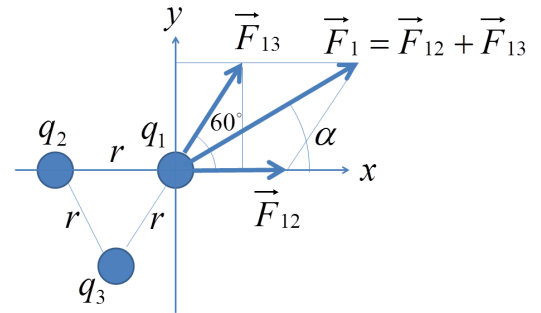
P2: For each charge,

$$F_x = k \frac{q_1 q_2}{r^2} + k \frac{q_1 q_3}{r^2} \cos 60^\circ = k \frac{q_1 q_2}{r^2} + k \frac{q_1 q_3}{r^2} (1/2)$$

$$F_y = k \frac{q_1 q_3}{r^2} \sin 60^\circ = k \frac{q_1 q_3}{r^2} (\sqrt{3}/2)$$

$$F = \sqrt{F_x^2 + F_y^2} = \frac{k}{r^2} \sqrt{(q_1 q_2)^2 + (q_1 q_2)(q_1 q_3) + (q_1 q_3)^2}$$

$$\alpha = \arctan \frac{F_y}{F_x} = \arctan \frac{q_1 q_3 (\sqrt{3}/2)}{q_1 q_2 + q_1 q_3 (1/2)}$$



Charge 1  $\mu\text{C}$ :  $F_1 = 392 \text{ N}$ ,  $\alpha = 36.6^\circ$  (w.r.t.  $1 \mu\text{C} - 2 \mu\text{C}$  line)

Charge 2  $\mu\text{C}$ :  $F_1 = 649 \text{ N}$ ,  $\alpha = 46.1^\circ$  (w.r.t.  $2 \mu\text{C} - 1 \mu\text{C}$  line)

Charge 3  $\mu\text{C}$ :  $F_1 = 714 \text{ N}$ ,  $\alpha = 40.9^\circ$  (w.r.t.  $3 \mu\text{C} - 1 \mu\text{C}$  line)

$$\text{P3: } k \frac{q_1}{r_1^2} = k \frac{q_2}{r_2^2} \quad q_2 = q_1 \left( \frac{r_2}{r_1} \right)^2 = 2 \mu\text{C} \left( \frac{9 \text{ cm}}{3 \text{ cm}} \right)^2 = 18 \mu\text{C}$$

$$\text{P4: } k \frac{q_1 q}{x^2} = k \frac{q_2 q}{(r-x)^2} \quad \frac{r-x}{x} = \sqrt{\frac{q_2}{q_1}} = \sqrt{\frac{4 \mu\text{C}}{1 \mu\text{C}}} = 2 \quad x = \frac{r}{3} = \frac{10 \text{ cm}}{3} = 3.3 \text{ cm}$$