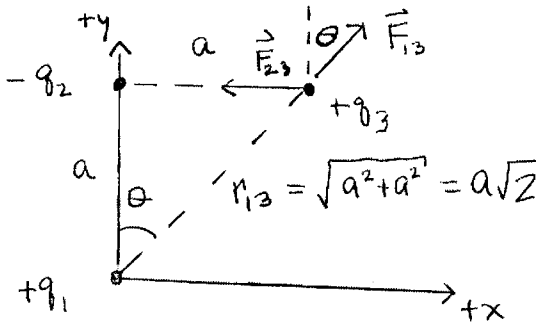
| Due to mass (no polarity) | Due to charge (+ or –) |
|---|---|

3. Electrical Forces obey Newton's 3rd Law

With $F_{12}$ = force by $q_1$ on $q_2$,


By Newton's 3rd Law, $F_{12} = F_{21}$

4. EXAMPLE: Consider three charges $+q_1$, $-q_2$ and $+q_3$ located at the origin, at $(0,a)$ and $(a,a)$ respectively. Given that $q_1 = 5.00\mu C, q_2 = 2.00\mu C$ and $q_3 = 5.00\mu C$ and $a = 0.100$ m, find the magnitude and direction (with respect to the $+x$ axis) of $\vec{F}_3$, the resultant force on $+q_3$.




$$\vec{F}_3 = \underbrace{\vec{F}_{13}}_{\text{force of } +q_1 \text{ on } +q_3} + \vec{F}_{23} = F_{13}\sin\theta\,\hat{i} + F_{13}\cos\theta\,\hat{j} - F_{23}\,\hat{i}$$

**Equation 1:** $\vec{F}_3 = (F_{13}\sin\theta - F_{23})\hat{i} + F_{13}\cos\theta\,\hat{j}$

How to get $2a^2$ for $r_{13}^2$?

**Equation 2:** $F_{13} = k_e q_3 q_1 / r_{13}^2 = k_e q_3 q_1 / 2a^2 = \dfrac{8.99\times10^9\left(5\times10^{-6}\right)\left(5\times10^{-6}\right)}{2(0.1)^2} = 11.2N$