

3.2 Potential Due to Point charges

2 point charges q_2 & q_3 at x_2 & x_3 are fixed.

1. W_1 to move a charge q_1 from $\infty \rightarrow x_1$

$$V_{x_1} = \frac{1}{4\pi\epsilon_0} \frac{q_2}{x_1 - x_2} + \frac{1}{4\pi\epsilon_0} \frac{q_3}{x_1 - x_3}$$

$$= \frac{1}{4\pi\epsilon_0} \left(\frac{q_2}{r_{12}} + \frac{q_3}{r_{13}} \right)$$

$$W_1 = q_1 V(r) = \frac{q_1}{4\pi\epsilon_0} \left(\frac{q_2}{r_{12}} + \frac{q_3}{r_{13}} \right)$$

The absolute value is important here. Should be $|x_1 - x_2|$ and $|x_1 - x_3|$. Work through the derivation of this formula to see where it comes from.

2. Now q_1 & q_3 are fixed at x_1 & x_3 , Work to bring q_2 from infinity to x_2 is:

Following Similar Steps:

$$W_2 = q_2 V_{x_2} = q_2 \frac{1}{4\pi\epsilon_0} \left(\frac{q_1}{r_{21}} + \frac{q_3}{r_{23}} \right) \quad * \text{where } r_{21} = x_2 - x_1 \text{ \& } r_{23} = x_2 - x_3$$

3. Now q_1 & q_2 are fixed at x_1 & x_2 , Work to bring q_3 from infinity to x_3 is:

$$W_3 = q_3 V_{x_3} = q_3 \frac{1}{4\pi\epsilon_0} \left(\frac{q_1}{r_{31}} + \frac{q_2}{r_{32}} \right) \quad * \text{where } r_{31} = x_3 - x_1 \text{ \& } r_{32} = x_3 - x_2$$