

Electric Potential Energy of Three Point Charges



#1 Place q_1 , then q_2 , then q_3 , and add all changes in potential energy:

$$U = 0 + k \frac{q_1 q_2}{r_{12}} + k \left(\frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right) = k \left(\frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right).$$

#2 Symmetric expression of potential energy U in terms of the potentials V_i experienced by point charges q_i :

$$U = \frac{1}{2} \sum_{i=1}^3 q_i V_i = k \left(\frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right),$$

where

$$V_1 = k \left(\frac{q_2}{r_{12}} + \frac{q_3}{r_{13}} \right),$$

$$V_2 = k \left(\frac{q_1}{r_{12}} + \frac{q_3}{r_{23}} \right),$$

$$V_3 = k \left(\frac{q_1}{r_{13}} + \frac{q_2}{r_{23}} \right).$$

