

Potential Energy of Many Charges



What is the total energy required to bring in three identical charges, from infinitely far away to the points on an equilateral triangle shown.

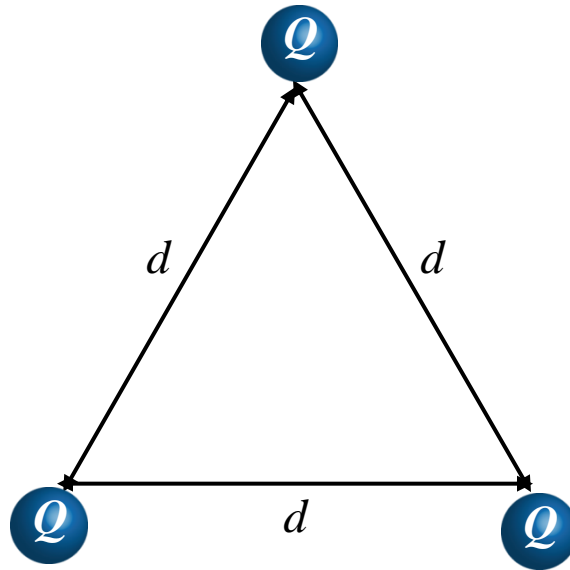
A) 0

B) $\Delta U = \frac{Q^2}{4\pi\epsilon_0} \frac{1}{d}$

C) $\Delta U = 2 \frac{Q^2}{4\pi\epsilon_0} \frac{1}{d}$

D) $\Delta U = 3 \frac{Q^2}{4\pi\epsilon_0} \frac{1}{d}$

E) $\Delta U = 6 \frac{Q^2}{4\pi\epsilon_0} \frac{1}{d}$



$$W = \sum W_i = -\frac{3}{4\pi\epsilon_0} \frac{Q^2}{d}$$

$$\Delta U = +\frac{3}{4\pi\epsilon_0} \frac{Q^2}{d}$$

Work by E to bring in first charge: $W_1 = 0$

Work by E to bring in second charge: $W_2 = -\frac{1}{4\pi\epsilon_0} \frac{Q^2}{d}$

Work by E to bring in third charge: $W_3 = -\frac{1}{4\pi\epsilon_0} \frac{Q^2}{d} - \frac{1}{4\pi\epsilon_0} \frac{Q^2}{d} = -\frac{2}{4\pi\epsilon_0} \frac{Q^2}{d}$