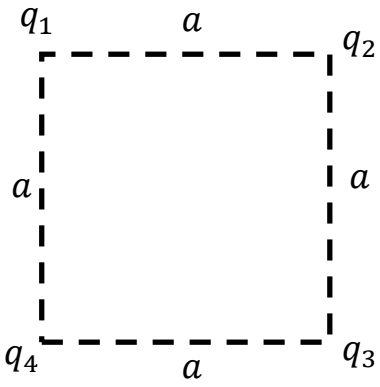
Answer on Question #57176 - Physics - Electromagnetism

Determine the electric potential energy of a group of four identical charges ($q = 5.0 \times 10^{-6}\text{C}$ each) from infinity and place them on the square, one to a corner, of side $a = 0.500$ meter.

Solution:



$$q_1 = q_2 = q_3 = q_4 = q$$

The potential energy of for charges is given by ($\varepsilon_0 = 8.854 \times 10^{-12}\,\frac{\text{F}}{\text{m}}$)

$$U = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r_{12}} + \frac{q_2 q_3}{r_{23}} + \frac{q_3 q_4}{r_{34}} + \frac{q_4 q_1}{r_{41}} + \frac{q_1 q_3}{r_{13}} + \frac{q_4 q_2}{r_{24}}\right) =$$

$$= \frac{q^2}{4\pi\varepsilon_0}\left(\frac{4}{a} + \frac{\sqrt{2}}{a}\right) = \frac{q^2}{4\pi\varepsilon_0 a}\left(4 + \sqrt{2}\right) = \frac{(5.0 \times 10^{-6}\text{C})^2}{4\pi 8.854 \times 10^{-12}\,\frac{\text{F}}{\text{m}} \cdot 0.5\ \text{m}}\left(4 + \sqrt{2}\right) =$$

$$= 2.54\ \text{J}$$

Answer: 2.54 J.