

83. The potential energy of the two-charge system is

$$\begin{aligned}U &= \frac{1}{4\pi\epsilon_0} \left[\frac{q_1 q_2}{\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}} \right] \\&= \frac{\left(8.99 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2} \right) (3.0 \times 10^{-6} \text{ C})(-4.0 \times 10^{-6} \text{ C})}{\sqrt{(3.5 + 2.0)^2 + (0.50 - 1.5)^2} \text{ cm}} \\&= -1.9 \text{ J} .\end{aligned}$$

Thus, -1.9 J of work is needed.