29.43. **Model:** Mechanical energy is conserved.
Visualize: Please refer to Figure P29.43. Label the 5.0 nC charge with subscript 1, the 3.0 nC with subscript 2, and so on.
Solve: The conservation of energy equation $K_f + U_f = K_i + U_i$ is

$$K_f + 0\text{ J} = 0\text{ J} + U_i \Rightarrow K_f = U_i = U_{12} + U_{13} + U_{14} + U_{23} + U_{24} + U_{34}$$

$$U_{12} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r_{12}} = \frac{\left(9.0\times10^9\text{ N m}^2/\text{C}^2\right)\left(5.0\times10^{-9}\text{ C}\right)\left(3.0\times10^{-9}\text{ C}\right)}{0.035\text{ m}} = 3.857\times10^{-6}\text{ J}$$

$$U_{13} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_3}{r_{13}} = \frac{\left(9.0\times10^9\text{ N m}^2/\text{C}^2\right)\left(5.0\times10^{-9}\text{ C}\right)\left(4.0\times10^{-9}\text{ C}\right)}{\sqrt{(0.035\text{ m})^2 + (0.015\text{ m})^2}} = 4.727\times10^{-6}\text{ J}$$

$$U_{14} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_4}{r_{14}} = \frac{\left(9.0\times10^9\text{ N m}^2/\text{C}^2\right)\left(5.0\times10^{-9}\text{ C}\right)\left(2.0\times10^{-9}\text{ C}\right)}{0.015\text{ m}} = 6.000\times10^{-6}\text{ J}$$

Likewise, $U_{23} = 7.200\times10^{-6}$ J, $U_{24} = 1.418\times10^{-6}$ J, and $U_{34} = 2.057\times10^{-6}$ J. The sum of all the potential energies is 25.3×10^{-6} J, which is the final kinetic energy K_f.