88. (Second problem of **Cluster**)

(a) We argue by symmetry that of the total potential energy in the initial configuration, a third converts into the kinetic energy of each of the particles. And, because the total potential energy consists of three equal contributions

$$U = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d}$$

then any of the particle's final kinetic energy is equal to this U. Therefore, using k for$1/4\pi\varepsilon_0$, we obtain

$$v = \sqrt{\frac{2U}{m}} = |q|\sqrt{\frac{2k}{m\,d}} \quad .$$

(b) In this case, two of the U contributions to the total potential energy are converted into a single kinetic term:

$$v = \sqrt{\frac{2(2U)}{m}} = 2|q|\sqrt{\frac{k}{m\,d}} \quad .$$

(c) Now it is clear that the one remaining U contribution is converted into a particle's kinetic energy:

$$v = \sqrt{\frac{2U}{m}} = |q|\sqrt{\frac{2k}{m\,d}} \quad .$$

(d) This leaves no potential energy to convert into kinetic for the last particle that is released. It maintains zero speed.