37.12. **Model:** The electron volt is a unit of energy and is defined as the kinetic energy gained by an electron or proton if it accelerates through a potential difference of 1 volt.

Solve: **(a)** Converting electron volts to joules,

$$6 \text{ MeV} = 6\times10^{6} \text{ eV} \times \frac{1.6\times10^{-19} \text{ J}}{1 \text{ eV}} = 9.6\times10^{-13} \text{ J}$$

Using the definition of kinetic energy $K = \frac{1}{2}mv^2$,

$$v = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2\left(9.6\times10^{-13} \text{ J}\right)}{1.67\times10^{-27} \text{ kg}}} = 3.39\times10^{7} \text{ m/s}$$

(b) Likewise, the speed of the helium atom is

$$v = \sqrt{\frac{2(20 \text{ MeV})}{4\left(1.67\times10^{-27} \text{ kg}\right)}} = \sqrt{\frac{2\left(3.20\times10^{-12} \text{ J}\right)}{4\left(1.67\times10^{-27} \text{ kg}\right)}} = 3.10\times10^{7} \text{ m/s}$$

(c) The mass of the particle is

$$m = \frac{2K}{v^2} = \frac{2(1.14 \text{ keV})}{\left(2.0\times10^{7} \text{ m/s}\right)^2} = \frac{2\left(1.82\times10^{-16} \text{ J}\right)}{\left(2.0\times10^{7} \text{ m/s}\right)^2} = 9.12\times10^{-31} \text{ kg}$$

The particle is an electron.