37.9. Model: The electron volt is a unit of energy. It is defined as the energy gained by an electron if it accelerates through a potential difference of 1 volt.

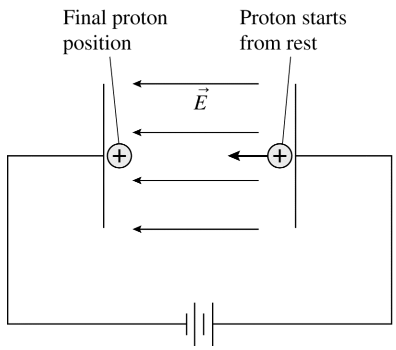
Solve: **(a)** The kinetic energy is

$$K = \tfrac{1}{2}mv^2 = \tfrac{1}{2}\left(9.11\times10^{-31}\ \text{kg}\right)\left(5.0\times10^{6}\ \text{m/s}\right)^2 = 1.139\times10^{-17}\ \text{J}\times\frac{1\ \text{eV}}{1.60\times10^{-19}\ \text{J}} = 71.2\ \text{eV}$$

(b) The potential energy is

$$U = \frac{1}{4\pi\varepsilon_0}\frac{(e)(-e)}{0.10\ \text{nm}} = \frac{-\left(9.0\times10^{9}\ \text{N m}^2/\text{C}^2\right)\left(1.60\times10^{-19}\right)^2}{0.10\times10^{-9}\ \text{m}} = -2.30\times10^{-18}\ \text{J}\times\frac{1\ \text{eV}}{1.60\times10^{-19}\ \text{J}} = -14.4\ \text{eV}$$

(c)



The figure shows a proton accelerating from rest across a parallel plate capacitor with a potential difference of ΔV = 5000 V. The energy conservation equation $K_f + qV_f = K_i + qV_i$ is

$$K_f = K_i + q(V_i - V_f) = 0\ \text{J} + e\Delta V = e(5000\ \text{V}) = 5000\ \text{eV} = 5.0\ \text{keV}$$