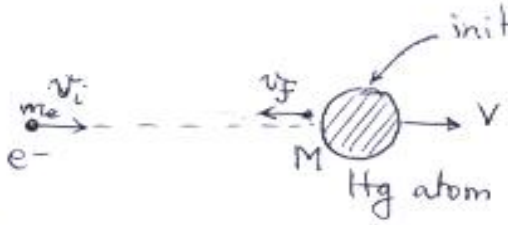
Pb # 38.



For the electron $K_i = 100\ eV$

The collision with the mercury (Hg) atom is elastic

$\Rightarrow$ Conservation of linear momentum and kinetic energy

momentum $\Rightarrow$ $m_e v_i + 0 = -m_e v_f + MV$ ——— (1)

Kinetic energy $\Rightarrow$ $(K_i)_e + 0 = (K_f)_e + K_{Hg}$ ——— (2)

Fraction of initial energy lost by the electron is

$$\frac{\Delta K}{K} = \frac{(K_i)_e - (K_f)_e}{(K_i)_e} = \frac{K_{Hg}}{(K_i)_e} = \frac{\frac{1}{2} M V^2}{\frac{1}{2} m_e v_i^2} = \frac{M}{m_e} \frac{V^2}{v_i^2} \quad -(3)$$

From (1) $\Rightarrow$ $v_i = \frac{M}{m_e} V + v_f$ ——— (4)

From (2) $\Rightarrow$ $v_i^2 = v_f^2 + \frac{M}{m_e} V^2$ ——— (5)

Substitute $\left(\frac{M}{m_e} V + v_f \right)^2 = v_f^2 + \frac{M}{m_e} V^2$

$$\Rightarrow \frac{M}{m_e} V \left(\frac{M}{m_e} V - V - 2 v_f \right) = 0$$

$\Rightarrow$ either $V = 0$

or $\frac{M}{m_e} V - V - 2 v_f = 0 \Rightarrow v_f = \frac{\left(\frac{M}{m_e} - 1 \right) V}{2}$ —(6)