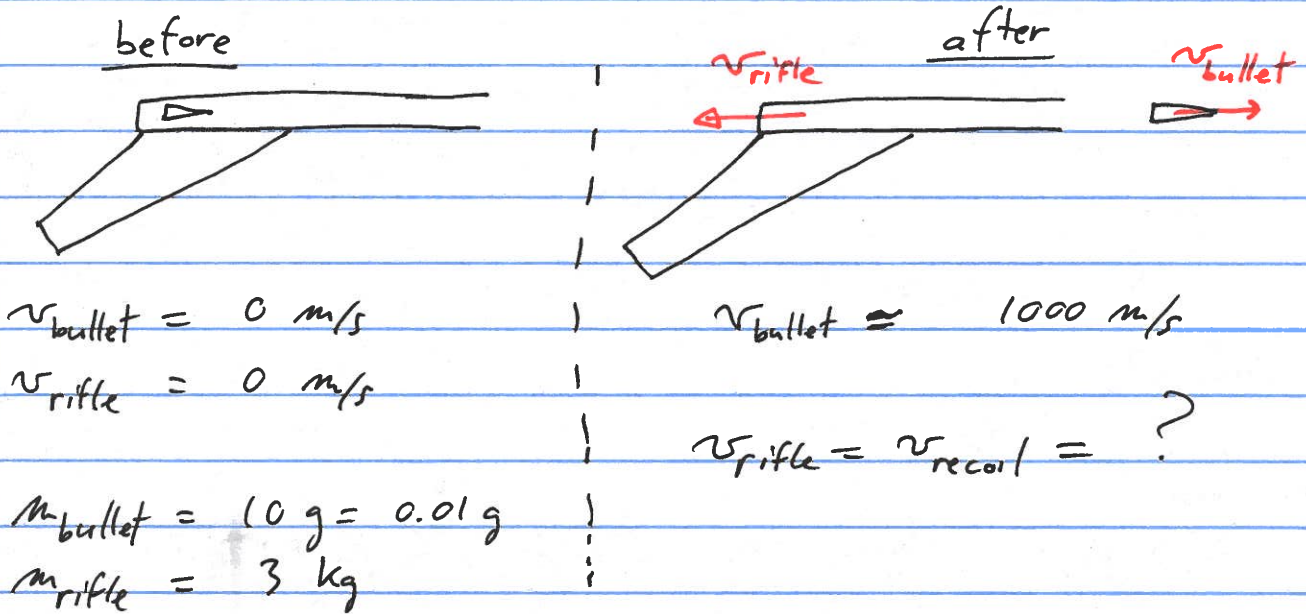


Monday, August 31, 2020

Example: Momentum Conservation: rifle recoil



Initial Momentum: $p = mv$

$$\begin{array}{l}
 P_{\text{bullet},i} = (0.01)(0) = 0 \text{ kg}\cdot\text{m/s} \\
 P_{\text{rifle},i} = (3)(0) = 0 \text{ kg}\cdot\text{m/s}
 \end{array}
 \left| \Rightarrow \begin{array}{l}
 P_{\text{total},i} = P_{\text{bullet},i} + P_{\text{rifle},i} \\
 = 0
 \end{array}
 \right.$$

Final Momentum: $P_{\text{total},f} = P_{\text{total},i} = 0$ by conservation of momentum

$$P_{\text{bullet},f} = (0.01)(1000) = 10 \text{ kg}\cdot\text{m/s}$$

$$P_{\text{rifle},f} = ? , \text{ but } \underbrace{P_{\text{bullet},f} + P_{\text{rifle},f}}_{P_{\text{total},f}} = 0 \Rightarrow P_{\text{rifle},f} = -P_{\text{bullet},f}$$

$$\Leftrightarrow \overset{3 \text{ kg}}{m_{\text{rifle}}} \cdot v_{\text{rifle},f} = -10 \text{ kg}\cdot\text{m/s} \Leftrightarrow v_{\text{rifle},f} = -\frac{10}{3} = -3.33 \text{ m/s} = v_{\text{recoil}}$$