Flipping Physics Lecture Notes:

Introductory Conservation of Momentum Explosion Problem Demonstration

Knowns:

$$m_b = 0.066kg;\ m_n = 1.791kg;\ \Delta x_b = x_{bf} - x_{bi} = 0.015m - 0.451m = -0.436m;\ \Delta t_b = 0.11\text{sec}$$

$$v_{bf} = \frac{\Delta x_b}{\Delta t_b} = \frac{-0.436m}{0.11\text{sec}} = -3.9\overline{63}\frac{m}{s}$$

Conservation of momentum:

$$\sum \vec{p}_i = \sum \vec{p}_f \Rightarrow \vec{p}_{bi} + \vec{p}_{ni} = \vec{p}_{bf} + \vec{p}_{nf} \Rightarrow m_b\vec{v}_{bi} + m_n\vec{v}_{ni} = m_b\vec{v}_{bf} + m_n\vec{v}_{nf}$$

Note: The initial velocity of everything is zero, therefore the initial momentum of the system is zero.

$$\Rightarrow 0 = m_b\vec{v}_{bf} + m_n\vec{v}_{nf} \Rightarrow m_n\vec{v}_{nf} = -m_b\vec{v}_{bf} \Rightarrow \vec{v}_{nf} = -\frac{m_b\vec{v}_{bf}}{m_n}$$

$$\Rightarrow \vec{v}_{nf} = -\frac{\left(0.066\right)\left(-3.9\overline{63}\right)}{1.791} = 0.14606\frac{m}{s} \approx 0.15\frac{m}{s}\left(predicted\right)$$

$$\left(observed\right)\vec{v}_{nf} = \frac{\Delta\vec{x}}{\Delta t} = \frac{x_f - x_i}{\Delta t} = \frac{0.416m - 0.400m}{0.11\text{sec}} = 0.1\overline{45}\frac{m}{s}$$

$$E_r = \frac{O - A}{A} \times 100 = \frac{\left(0.1\overline{45}\right) - \left(0.14606\right)}{0.14606} \times 100 = -0.4170 \approx -0.42\%$$