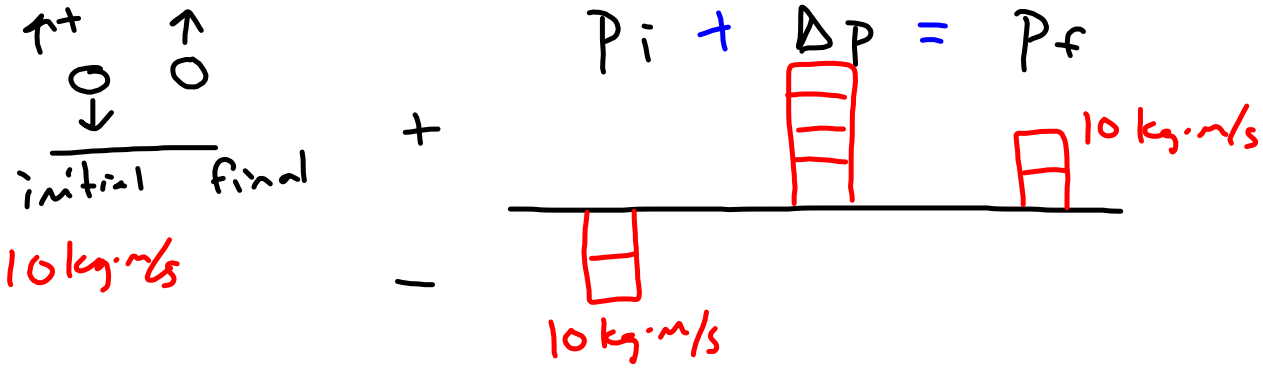
Energy and Momentum

- Perfectly elastic collision → energy AND momentum are conserved
- Perfectly inelastic collision → momentum is conserved, but not energy

Momentum Diagram



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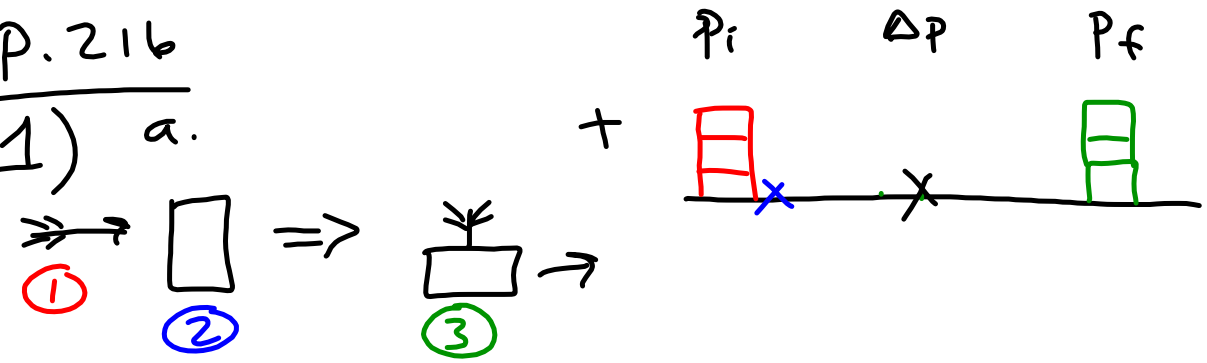
1) a.



$m_1 + m_2$

$$\bar{p}_i = \bar{p}_f$$

$$m_1 \bar{v}_{1i} + m_2 \bar{v}_{2i} = (m_1 + m_2) v_f$$

$$v_f = \frac{m_1 v_{1i}}{m_1 + m_2} = \frac{(0.25\,kg)(12\,m/s)}{0.25\,kg + 6.8\,kg}$$

$$= 0.43\,m/s$$

b. $\Delta K = K_f - K_i$

$$= \frac{1}{2}(m_1 + m_2) v_f^2 - \frac{1}{2} m_1 v_{1i}^2$$

$$= \frac{1}{2}(0.25\,kg + 6.8\,kg)(0.43\,m/s)^2 - \frac{1}{2}(0.25\,kg)(12\,m/s)^2$$

$$= -17.3\,J$$

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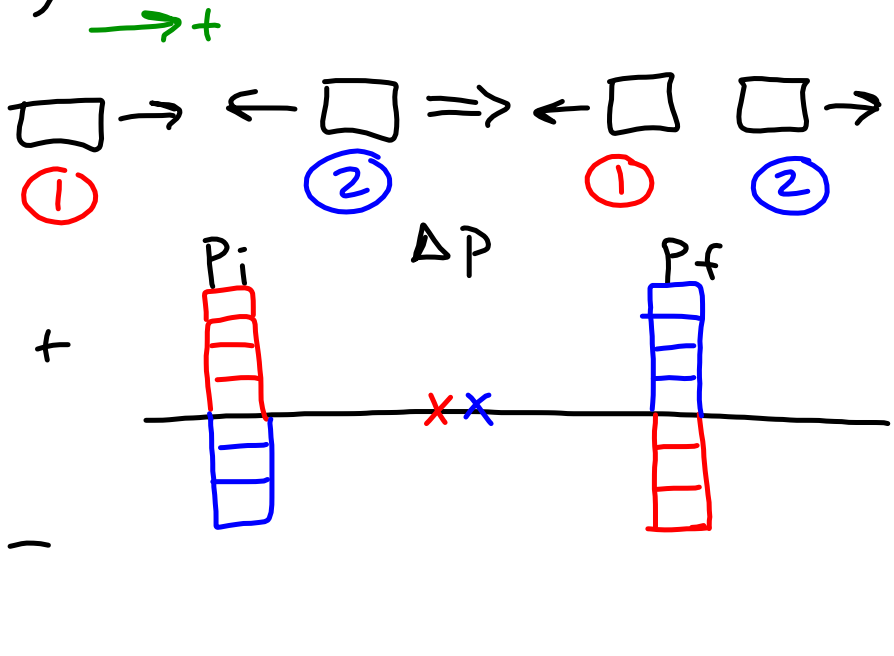
2) a.



$m_1 = 14\ kg$
$v_{1i} = 16\ m/s$
$v_{1f} = -14.4\ m/s$
$m_2 = 16\ kg$
$v_{2i} = -12.5\ m/s$
$v_{2f} = ?$

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$m_2 v_{2f} = m_1\bar{v}_{1i} + m_2\bar{v}_{2i} - m_1\bar{v}_{1f}$$

$$v_{2f} = \frac{1}{m_2}\left[m_1\bar{v}_{1i} + m_2\bar{v}_{2i} - m_1\bar{v}_{1f}\right]$$

$$= \frac{1}{16\ kg}\left[(14\ kg)(16\ m/s) + (16\ kg)(-12.5\ m/s) - (14\ kg)(-14.4\ m/s)\right]$$

$$= 14.1\ m/s$$

Problem-Solving Ideas

1. Draw picture.
2. Draw $p_i / \Delta p / p_f$ chart
3. Write equation.
4. Solve.