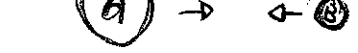
Homework 8 SOLUTIONS

8.43 a) $V_{cm} = \frac{m_A V_{1A} + m_B V_{1B}}{M_{tot}} = \frac{30 \cdot 0.2 - 10 \cdot 0.4}{40} = 0.05 \text{ m/s}$ (5 cm/s)



In cm frame $V'_{1A} = V_{1A} - V_{cm} = 15 \text{ cm/s}$. $V'_{1B} = -45 \text{ cm/s}$.

Then $V'_{2A} = -15 \text{ cm/s}$. $V'_{2B} = +45 \text{ cm/s}$.

In cm frame
$V'_{2A} = -V'_{1A}$
$V'_{2B} = -V'_{1B}$

So $V_{2A} = V'_{2A} + V_{cm} = -10 \text{ cm/s}$. $V_{2B} = 50 \text{ cm/s}$.

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b) $\Delta p_A = p_{2A} - p_{1A} = m_A \cdot (V_{2A} - V_{1A}) = 30 g \cdot \left(-10 \frac{cm}{s} - 20 \frac{cm}{s}\right) = -900 \frac{g\,cm}{s}$.

$\Delta p_B = p_{2B} - p_{1B} = m_B (V_{2B} - V_{1B}) = 10 g \cdot \left(50 \frac{cm}{s} - -40 \frac{cm}{s}\right) = +900 \frac{g\,cm}{s}$.

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c) $\Delta K_A = K_{2A} - K_{1A} = \frac{1}{2} m_A (V_{2A}^2 - V_{1A}^2) = 15 g \cdot (100 - 400) \frac{cm^2}{s^2} = -4500 \frac{g\,cm^2}{s^2}$.

$\Delta K_B = K_{2B} - K_{2A} = \frac{1}{2} m_B (V_{2B}^2 - V_{1B}^2) = 5 g \cdot (2500 - 1600) = +4500 \frac{g\,cm^2}{s^2}$.

8.89 (1) $K = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2$ $\quad \vec{V}_A = \vec{V}_A - \vec{V}_{cm}$ $\quad \vec{V}_B = \vec{V}_B - \vec{V}_{cm}$

$K = \frac{1}{2} m_A (\vec{V}_A' + \vec{V}_{cm}) + \frac{1}{2} m_B (\vec{V}_B' + \vec{V}_{cm})$

$= \frac{1}{2} m_A V_A'^2 + \frac{1}{2} m_B V_B'^2 + \underbrace{\frac{1}{2} m_A V_{cm}^2 + \frac{1}{2} m_B V_{cm}^2}_{\frac{1}{2} M V_{cm}^2} + \underbrace{m_A \vec{V}_A' \vec{V}_{cm} + m_B \vec{V}_B' \vec{V}_{cm}}_{0}$

$K = \frac{1}{2} M V_{cm}^2 + \frac{1}{2} m_A V_A'^2 + \frac{1}{2} m_B V_B'^2$

(2) $K_{min} = \frac{1}{2} M V_{cm}^2$

$m_A + m_B = M$

$m_A \vec{V}_A' + m_B \vec{V}_B' = m_A (\vec{V}_A - \vec{V}_{cm}) + m_B (\vec{V}_B - \vec{V}_{cm})$

$= m_A \vec{V}_A + m_B \vec{V}_B - (m_A \vec{V}_{cm} + m_B \vec{V}_{cm})$

$= M \vec{V}_{cm} - M \vec{V}_{cm}$

$= 0$.