PROB. 14-31

$m_1 = 15\ kg$, $m_2 = 20\ kg$, $m_3 = 25\ kg$

$v_{3,0} = 0$, $v_{1,0} = 3\ \frac{m}{s}$, $v_{2,0} = 2\ \frac{m}{s}$

a) FIND ENERGY LOST AS FIRST SUITCASE IS THROWN

INITIAL KINETIC ENERGY:

$$T_1 = \frac{1}{2} m_1 v_{1,0}^2 = \frac{1}{2}(15\ kg)\left(3\ \frac{m}{s}\right)^2 = (67.5\ \frac{kg \cdot m^2}{s^2})\left(\frac{N \cdot s^2}{kg \cdot m}\right)\left(\frac{J}{N \cdot m}\right)$$

$$T_1 = 67.5\ J$$

CONSERVE LINEAR MOMENTUM:

$$m\vec{v} = \sum m_i \vec{v}_i$$

$$(m_1 + m_3) v_3 = m_1 v_{1,0}$$

$$v_3 = \left(\frac{m_1}{m_1 + m_3}\right) v_{1,0} = \left(\frac{15}{15+25}\right)(3) = 1.125\ \frac{m}{s}$$

FINAL KINETIC ENERGY:

$$T_2 = \frac{1}{2}(m_1 + m_2) v_3^2 = \frac{1}{2}(15+25)(1.125)^2 = 25.31\ J$$

$$T_1 - T_2 = (67.5 - 25.31) = \boxed{42.19\ J}$$

b) FIND ENERGY LOST AS SECOND SUITCASE IS THROWN

$$T_1 = \frac{1}{2}(m_1 + m_3) v_3^2 + \frac{1}{2} m_2 v_{2,0}^2$$

$$T_1 = (25.31\ J) + \frac{1}{2}(20\ kg)\left(2\ \frac{m}{s}\right)^2 = 65.31\ J$$

PROB. 14-31 CONT.

CONSERVE LINEAR MOMENTUM:

$$m\bar{v} = \sum m_i \bar{v}_i$$

$$(m_1 + m_2 + m_3)\bar{v} = (m_1 + m_2)v_3 + m_2 v_{2,0}$$

$$\bar{v} = \frac{(m_1 + m_3)v_3 + m_2 v_{2,0}}{(m_1 + m_2 + m_3)}$$

$$\bar{v} = \frac{(15+25)(1.125) + (20)(2)}{(15+20+25)} = 1.417 \ \frac{m}{s}$$

$$T_2 = \frac{1}{2}(m_1 + m_2 + m_3)\bar{v}^2$$

$$T_2 = \frac{1}{2}(15+20+25)(1.417)^2 = 60.21 \ J$$

$$T_1 - T_2 = (65.31 - 60.21) = \boxed{5.102 \ J}$$