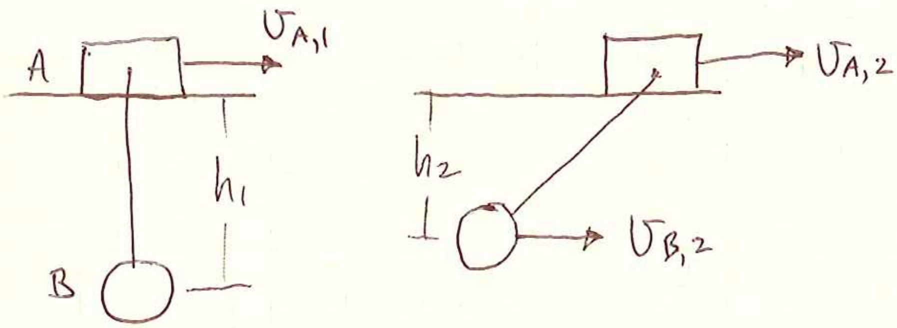
PROB. 14-37



a) FIND v_B AS B REACHES ITS MAXIMUM ELEVATION

AT MAX ELEVATION, $(v_{A/B})_2 = 0$

$$(v_A)_2 = (v_B)_2 + (v_{A/B})_2 \Rightarrow (v_A)_2 = (v_B)_2$$

IMPULSE/MOMENTUM:

$$\sum m_i(\vec{v}_i)_1 + \sum \overrightarrow{IMP}_{1-2} = \sum m_i(\vec{v}_i)_2$$

ALL EXTERNAL IMPULSES ARE IN THE Y-DIRECTION:

$W_A \cdot \Delta t$, $W_B \cdot \Delta t$, $R_A \cdot \Delta t$

X-DIRECTION:

$$m_A v_{A1} = m_A v_{A2} + m_B v_{B2} = (m_A + m_B) v_{B2}$$

$$\boxed{v_{B2} = \frac{m_A v_{A1}}{m_A + m_B} \longrightarrow}$$

b) FIND MAX DISTANCE h THROUGH WHICH B WILL RISE

PROB. 14-37 CONT.

CONSERVATION OF ENERGY:

$$T_1 + V_1 = T_2 + V_2$$

KINETIC ENERGY:

$$T_1 = \frac{1}{2} m_A v_{A1}^2$$

$$T_2 = \frac{1}{2} m_A \cancel{m_A} v_{A2}^2 + \frac{1}{2} m_B v_{B2}^2 = \frac{1}{2}(m_A + m_B) v_{B2}^2$$

$$T_2 = \frac{1}{2}(m_A + m_B)\left[\frac{m_A v_{A1}}{m_A + m_B}\right]^2 = \frac{1}{2}\frac{m_A^2 v_{A1}^2}{(m_A + m_B)}$$

POTENTIAL ENERGY:

$$V_{A,1} = V_{A,2} \ , \ V_{B,1} = m_B g h_1 \ , \ V_{B,2} = m_B g h_2$$

$$\frac{1}{2} m_A v_{A1}^2 + m_B g h_1 = \frac{1}{2} \cdot \frac{m_A^2 v_{A1}^2}{(m_A + m_B)} + m_B g h_2$$

$$m_B g (h_2 - h_1) = \frac{1}{2} m_A v_{A1}^2 - \frac{1}{2} \frac{m_A^2 v_{A1}^2}{(m_A + m_B)}$$

$$(h_2 - h_1) = \frac{v_{A1}^2}{2 m_B g} \cdot \left[m_A - \frac{m_A^2}{(m_A + m_B)}\right]$$

$$= \frac{v_{A1}^2}{2 m_B g}\left[\frac{m_A^2 + m_A m_B - m_A^2}{(m_A + m_B)}\right]$$

$$\boxed{(h_2 - h_1) = \frac{v_{A1}^2}{2g}\left(\frac{m_A}{m_A + m_B}\right)}$$