PROB. 13-133

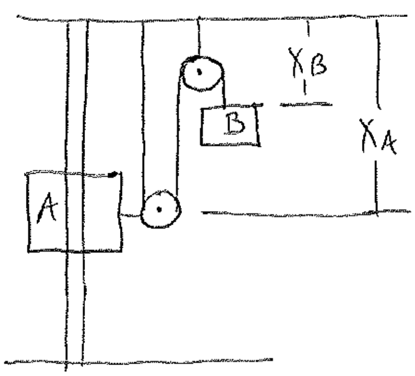
FIND Δt FOR $v_{A,2} = 1\ \frac{m}{s}$, $m_A = 20$ kg, $m_B = 15$ kg

$v_{A,1} = v_{B,1} = 0$

KINEMATICS: $2X_A + X_B = \text{CONSTANT}$

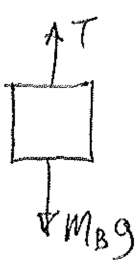
$2v_A + v_B = 0$

$v_B = -2v_A$



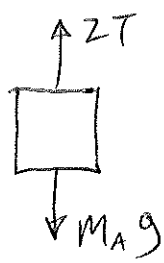
STATIC ANALYSIS:

FBD MASS B:



$T = M_B g$

FBD MASS A:



$2T = M_A g$

$T = M_B g = (15^{kg})(9.81\ \frac{m}{s^2}) = 147.1^N$

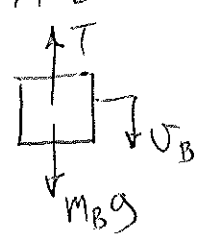
$2T = 294.3^N$

$M_A g = (20^{kg})(9.81\ \frac{m}{s^2}) = 196.2^N$

SINCE $2T > M_A g$, BLOCK A MOVES UP, BLOCK B MOVES DOWN

DEFINE ~~DOWNWA~~ DOWNWARD VELOCITY AS POSITIVE

BLOCK B: $m_B \vec{v}_{B,1} \overset{0}{} + \Sigma \overrightarrow{IMP}_{1-2} = m_B \vec{v}_{B,2}$



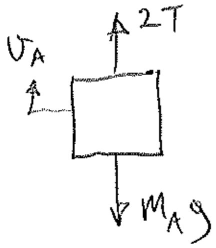
PROB. 13-133 CONT.

$$\Sigma IMP_{1-2} = (m_B g - T)\Delta t$$

$$(m_B g - T)\Delta t = m_B v_{B,2}$$

$$T = m_B g - m_B \cdot \frac{v_{B,2}}{\Delta t} = m_B\left(g - \frac{v_{B,2}}{\Delta t}\right)$$

BLOCK A:



$$m_A \vec{v}_{A,1}^{\,\to 0} + \Sigma \vec{IMP}_{1-2} = m_A \vec{v}_{A,2}$$

$$(2T - m_A g)\Delta t = m_A v_{A,2}$$

$$\left[2m_B\left(g - \frac{v_{B,2}}{\Delta t}\right) - m_A g\right]\Delta t = m_A v_{A,2}$$

$$(2m_B - m_A) g \Delta t = m_A v_{A,2} + 2 m_B v_{B,2}$$

$$v_{B,2} = 2 v_{A,2}$$

$$\Delta t = \frac{(m_A + 4m_B) v_{A,2}}{(2m_B - m_A) g}$$

$$\Delta t = \frac{[(20\,kg) + 4(15\,kg)](1\,\frac{m}{s})}{[2(15\,kg) - (20\,kg)](9.81\,\frac{m}{s^2})} \boxed{= 0.8155\ \frac{m}{s}}$$