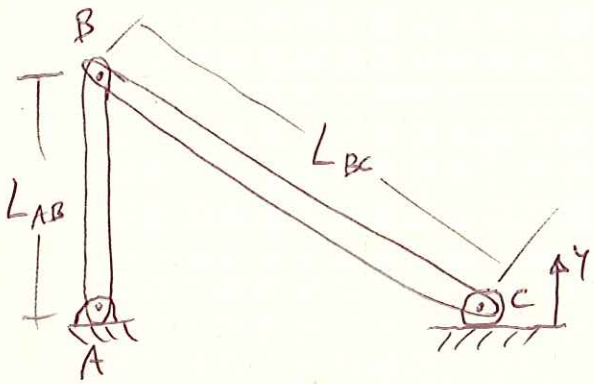
PROB. 17-43

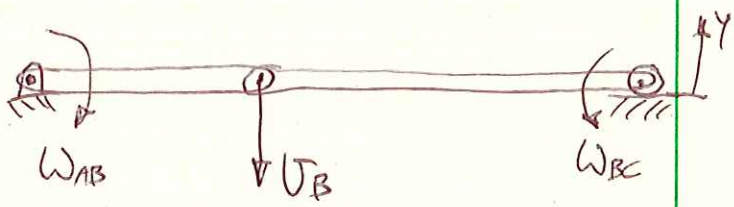
$W_{AB} = 2.4^{LB}$, $W_{BC} = 4^{LB}$, $L_{AB} = 1.5^{ft}$, $L_{BC} = 2.5^{ft}$,

FIND v_B AFTER $\theta_{AB} = 90°$

POSITION 1



POSITION 2



CONSERVATION OF ENERGY: $T_1 + V_1 = T_2 + V_2$

$T_1 = 0$, $V_1 = (V_g)_1 = W_{AB} h_{AB} + W_{BC} h_{BC} = W_{AB}\left(\frac{1}{2} L_{AB}\right) + W_{BC}\left(\frac{1}{2} L_{AB}\right)$

$V_1 = \frac{1}{2} L_{AB} (W_{AB} + W_{BC})$

$T_2 = \frac{1}{2} m \bar{v}^2 + \frac{1}{2} \bar{I} \omega^2$

FOR AB: $\bar{v} = r\omega = \frac{1}{2} L_{AB} \omega_{AB}$, $\bar{I} = \frac{1}{12} M L_{AB}^2 = \frac{1}{12} \cdot \frac{W_{AB}}{g} \cdot L_{AB}^2$

FOR BC: $\bar{v} = \frac{1}{2} v_B = \frac{1}{2} L_{AB} \omega_{AB}$, $\bar{I} = \frac{1}{12} \cdot \frac{W_{BC}}{g} \cdot L_{BC}^2$

$v_B = r\omega_{BC} = L_{BC} \omega_{BC}$

$v_B = r\omega_{AB} = L_{AB} \omega_{AB}$

$\omega_{BC} = \left(\frac{L_{AB}}{L_{BC}}\right) \omega_{AB}$

$T_2 = \frac{1}{2} \cdot \frac{W_{AB}}{g} \cdot \left(\frac{1}{2} L_{AB} \omega_{AB}\right)^2 + \frac{1}{2}\left(\frac{1}{12} \cdot \frac{W_{AB}}{g} \cdot L_{AB}^2\right) \omega_{AB}^2$

$+ \frac{1}{2} \cdot \frac{W_{BC}}{g} \cdot \left(\frac{1}{2} L_{AB} \omega_{AB}\right)^2 + \frac{1}{2}\left(\frac{1}{12} \cdot \frac{W_{BC}}{g} \cdot L_{BC}^2\right)\left[\left(\frac{L_{AB}}{L_{BC}}\right) \omega_{AB}\right]^2$

$$T_2 = \frac{\omega_{AB}^2}{2g}\left[\frac{1}{4}W_{AB}L_{AB}^2 + \frac{1}{12}W_{AB}L_{AB}^2 + \frac{1}{4}W_{BC}L_{AB}^2 + \frac{1}{12}W_{BC}L_{AB}^2\right]$$

$$T_2 = \frac{L_{AB}^2\omega_{AB}^2}{2g}\left(\frac{1}{3}W_{AB} + \frac{1}{3}W_{BC}\right) = \frac{L_{AB}^2\omega_{AB}^2}{6g}\cdot(W_{AB} + W_{BC})$$

$$V_2 = (V_g)_2 = 0$$

$$0 + \frac{1}{2}L_{AB}(W_{AB} + W_{BC}) = \frac{L_{AB}^2\omega_{AB}^2}{6g}\cdot(W_{AB} + W_{BC}) + 0$$

$$\omega_{AB} = \sqrt{\frac{3g}{L_{AB}}}$$

$$v_B = r\omega_{AB} = L_{AB}\cdot\sqrt{\frac{3g}{L_{AB}}} = \sqrt{3gL_{AB}}$$

$$v_B = \sqrt{3\left(32.2\ \frac{ft}{s^2}\right)(1.5\ ft)} = 12.04\ \frac{ft}{s}\ \downarrow$$