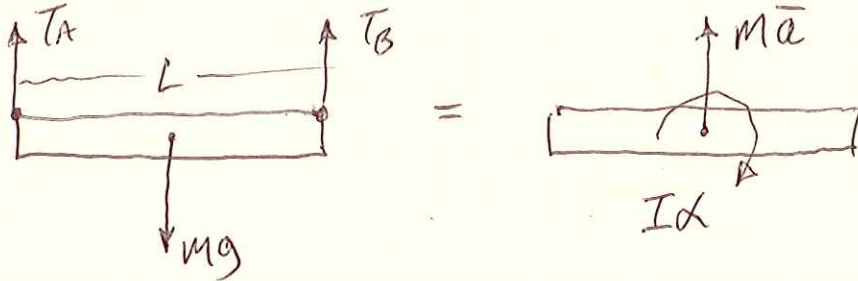


PROB. 16-57

$L = 15^{\text{ft}}$, $W = 500^{\text{LB}}$, $a_A = 20 \frac{\text{ft}}{\text{s}^2}$, $a_B = 2 \frac{\text{ft}}{\text{s}^2}$

FIND T_A , T_B



$$\sum F_y = may: T_A + T_B - mg = m\bar{a}, \quad \bar{a} = \frac{1}{m}(T_A + T_B) - g$$

$$\bar{a} = \left(\frac{g}{W}\right)(T_A + T_B) - g$$

$$\sum \vec{M}_G = \sum (\vec{M}_G)_{\text{EFF}} \quad +\curvearrowright: -\left(\frac{L}{2}\right)T_A + \left(\frac{L}{2}\right)T_B = -I\alpha$$

$$\alpha = \left(\frac{L}{2I}\right)(T_A - T_B)$$

$$I = \frac{1}{12}ML^2 = \frac{1}{12}\left(\frac{W}{g}\right)L^2 \quad \text{SLENDER ROD}$$

$$\alpha = \frac{L}{2\left[\frac{1}{12}\left(\frac{W}{g}\right)L^2\right]} \cdot (T_A - T_B) = \left(\frac{6g}{WL}\right)(T_A - T_B)$$

$$a_A = \bar{a} + \left(\frac{L}{2}\right)\alpha = \left(\frac{g}{W}\right)(T_A + T_B) - g + \left(\frac{L}{2}\right)\left(\frac{6g}{WL}\right)(T_A - T_B)$$

$$a_A = \left(\frac{g}{W}\right)(T_A + T_B) - g + \left(\frac{3g}{W}\right)(T_A - T_B)$$

$$a_A = \left(\frac{g}{W}\right)T_A + \left(\frac{g}{W}\right)T_B - g + \left(\frac{3g}{W}\right)T_A - \left(\frac{3g}{W}\right)T_B$$

$$a_A = \left(\frac{4g}{W}\right)T_A - \left(\frac{2g}{W}\right)T_B - g$$

$$T_B = \left(\frac{W}{2g}\right)\left[-a_A - g + \left(\frac{4g}{W}\right)T_A\right]$$

PROB. 16-57 CONT.

$$T_B = -\left(\frac{W}{2}\right)\left(\frac{a_A}{g} + 1\right) + 2T_A$$

$$a_B = \bar{a} - \left(\frac{L}{2}\right)\alpha = \left(\frac{g}{W}\right)(T_A + T_B) - g - \left(\frac{3g}{W}\right)(T_A - T_B)$$

$$a_B = \left(\frac{g}{W}\right)T_A + \left(\frac{g}{W}\right)T_B - g - \left(\frac{3g}{W}\right)T_A + \left(\frac{3g}{W}\right)T_B$$

$$a_B = \left(\frac{4g}{W}\right)T_B - \left(\frac{2g}{W}\right)T_A - g$$

$$T_A = \left(\frac{W}{2g}\right)\left[-a_B - g + \left(\frac{4g}{W}\right)T_B\right]$$

$$T_A = -\left(\frac{W}{2}\right)\left(\frac{a_B}{g} + 1\right) + 2T_B$$

$$T_B = -\left(\frac{W}{2}\right)\left(\frac{a_A}{g} + 1\right) + 2\left[-\left(\frac{W}{2}\right)\left(\frac{a_B}{g} + 1\right) + 2T_B\right]$$

$$3T_B = \left(\frac{W}{2}\right)\left(\frac{a_A}{g} + 1\right) + 2\left(\frac{W}{2}\right)\left(\frac{a_B}{g} + 1\right)$$

$$T_B = \frac{1}{3}\left(\frac{W}{2}\right)\left[\left(\frac{a_A}{g} + 1\right) + 2\left(\frac{a_B}{g} + 1\right)\right]$$

$$T_B = \left(\frac{W}{6}\right)\left[\left(\frac{a_A}{g}\right) + 2\left(\frac{a_B}{g}\right) + 3\right] = \left(\frac{W}{6}\right)\left[\frac{1}{g}(a_A + 2a_B) + 3\right]$$

$$T_B = \frac{(500 \text{ LB})}{6} \left\{ \frac{1}{(32.2 \frac{\text{ft}}{\text{s}^2})} \cdot \left[(20 \frac{\text{ft}}{\text{s}^2}) + 2(2 \frac{\text{ft}}{\text{s}^2}) \right] + 3 \right\} = 312.1 \text{ LB}$$

$$T_A = -\frac{(500 \text{ LB})}{2} \cdot \left[\frac{(2 \frac{\text{ft}}{\text{s}^2})}{(32.2 \frac{\text{ft}}{\text{s}^2})} + 1 \right] + 2(312.1 \text{ LB})$$

$$T_A = 358.7 \text{ LB}$$