HW5

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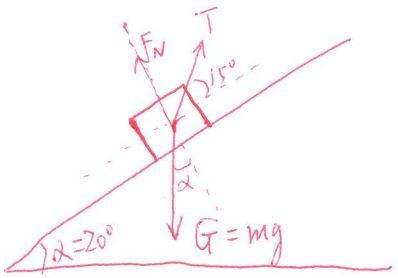

$T\cos 15° - G\sin 20° = F_{//}$

$T\sin 15° + F_N = G\cos 20°$

(a) $T=150N$, $F_{//} = 150\times\cos 15° - 50\times 9.8\times\sin 20° = 144.89 - 167.59 = -22.7N$

$\therefore a_{//} = \frac{F_{//}}{m} = -0.454\ m/s^2$.

(b) $T=200N$, $F_{//} = 200\times\cos 15° - 50\times 9.8\times\sin 20° = 25.595$

$\therefore a_{//} = \frac{F_{//}}{m} = 0.5119\ m/s^2$

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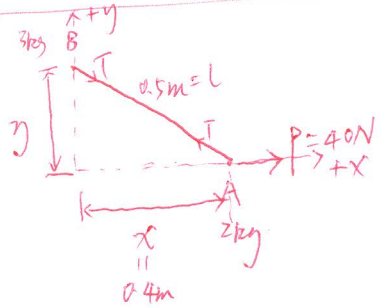

$y = \sqrt{0.5^2 - 0.4^2} = 0.3m$

$l^2 = x^2 + y^2$

$\dot{x} = 0.9m/s$

$\frac{dl^2}{dt} = 0 = 2x\dot{x} + 2y\dot{y}$

$-2x\dot{x} = 2y\dot{y}$ $\quad \dot{y} = \frac{x\dot{x}}{-y} = \frac{0.4\times 0.9}{-0.3}\ m/s = -1.2\ m/s$

$x\dot{x} = -y\dot{y} \Rightarrow x\ddot{x} + \dot{x}^2 = -(y\ddot{y} + \dot{y}^2) \Rightarrow 0.4\ddot{x} + 0.9^2 = -(0.3\ddot{y} + 1.2^2)$ ①

A: $P - T\cos\theta = m_A\ddot{x} \rightarrow 40 - 0.8T = 2\ddot{x} \rightarrow T = \frac{2\ddot{x} - 40}{-0.8}$

B: $-T\sin\theta = m_B\ddot{y} \rightarrow T = \frac{3\ddot{y}}{-0.6}$

$\Rightarrow \frac{2\ddot{x} - 40}{-0.8} = \frac{3\ddot{y}}{-0.6}$

$\therefore \ddot{x} = 2\ddot{y} + 20$. ②

Combine ①, ②, solve it, get $\ddot{y} = -9.32\ m/s^2$. $\Rightarrow T = \frac{2\ddot{x} - 40}{-0.8} = 46.6N$.

$\ddot{x} = 1.36\ m/s^2$

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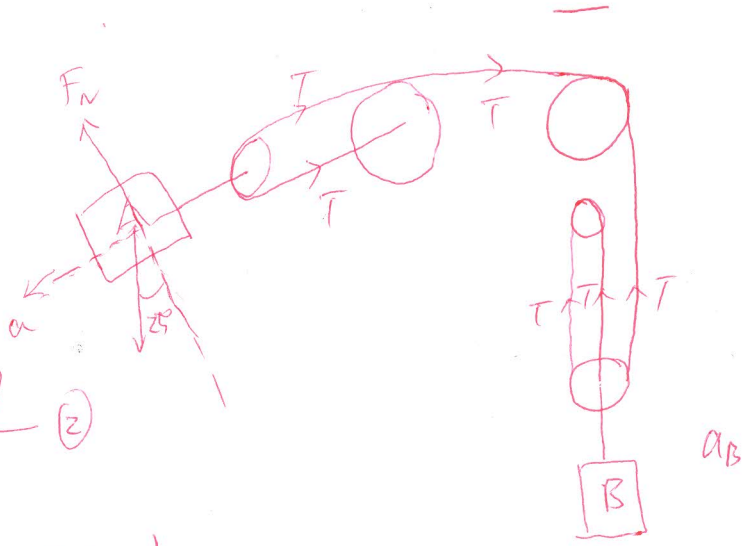
$2a = 3a_B$ $\quad a_B = \frac{2}{3}a$ ①



$mg\sin 25° - 2T = ma$

$3T - W_B = m_B a_B = \frac{W_B}{g} a_B$

$W_B\left(1 + \frac{a_B}{g}\right) = 3T = \frac{3(mg\sin 25° - ma)}{2}$ ②

① ② $\Rightarrow$ $W_B\left(1 + \frac{1}{g}\frac{2a}{3}\right) = \frac{3}{2}(mg\sin 25° - ma)$

$\therefore W_B = \dfrac{\frac{3}{2}(mg\sin 25° - ma)}{1 + \frac{2a}{3g}}$

$a = 5\,ft/s^2$ downwards along slope

$\therefore W_B = \dfrac{\frac{3}{2}(g \times \sin 25° - 5\,ft/s^2) \times 100lb}{1 + \frac{2 \times 5\,ft/s^2}{3g}} = 161.36N$ $\quad \therefore m_B = 16.465kg$ or $36.2991b$.

$a' = 5\,ft/s^2$ upwards along slope.

$a_B = \frac{2}{3}a'$ $\quad 2T - mg\sin 25° = ma'$ $\quad W_B - 3T = \frac{W_B}{g}a_B$ $\quad W_B\left(1 - \frac{a_B}{g}\right) = 3T = 3 \times \frac{1}{2}(ma' + mg\sin 25°)$

$W_B = \frac{3}{2}m(a' + g\sin 25°) / \left(1 - \frac{1}{g}\frac{2}{3}a'\right) = \dfrac{\frac{3}{2} \times 100lb(g \times \sin 25° + 5\,ft/s^2)}{1 - \frac{1}{g}\frac{2}{3} \times 5\,ft/s^2} = 430.08N$

$\therefore m_B = 43.89kg$ or $96.761b$