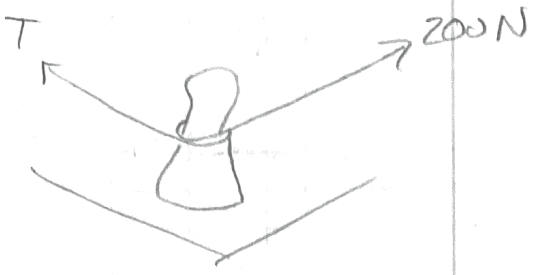
Lesson 42

6.85 | Given: $P = 200\,N$, $n = 1.25$, $\mu_s = 0.30$

Find: T

Rel: $T_2 = T_1 e^{\mu\beta}$



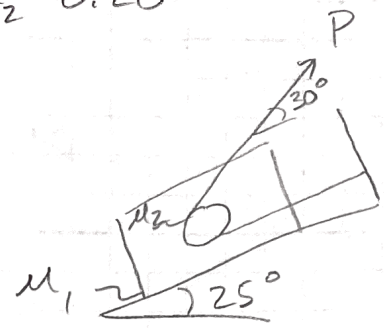
$\beta = 2\pi n = 2\pi(1.25) = 2.5\pi$

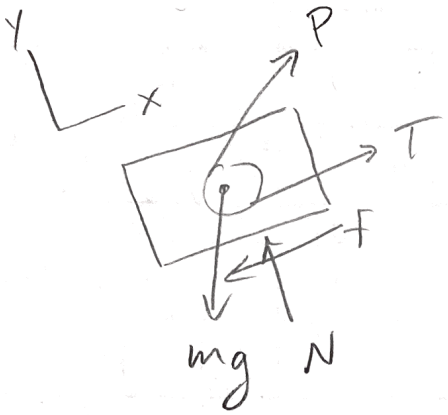
$T_2 = 200\,N\, e^{(0.3)(2.5\pi)} = \boxed{2110\,N}$

6.88 | Given: $m = 40\text{ kg}$, $\mu_1 = 0.40$, $\mu_2 = 0.20$

Find: P to move up ramp

Rel: $T_2 = T_1 e^{\mu\beta}$, $f = \mu N$





$P > T$ for upward motion

$\beta = 180° - 30° = 150°$

$mg = (40\text{ kg})(9.81\frac{\text{m}}{\text{s}^2}) = 392.4\text{ N}$

(1) $\Sigma F_x = 0 = T - f + P\cos 30 - 392.4\sin 25$

(2) $\Sigma F_y = 0 = N + P\sin 30 - 392.4\cos 25$

$f = \mu_1 N = 0.40N$

$P = T_e^{\mu\beta} = T_e^{(0.20)(150)\left(\frac{\pi}{180}\right)} = T_e^{\left(\frac{\pi}{6}\right)}$

(2) $N = 392.4\cos 25 - T_e^{\left(\frac{\pi}{6}\right)}\sin 30 = 355.6 - 0.844T$

(1) $0 = T - 0.40(355.6 - 0.844T) + T_e^{\left(\frac{\pi}{6}\right)}\cos 30 - 392.4\sin 25$

$0 = T - 142.24 + 0.3376T + 1.4619T - 165.8$

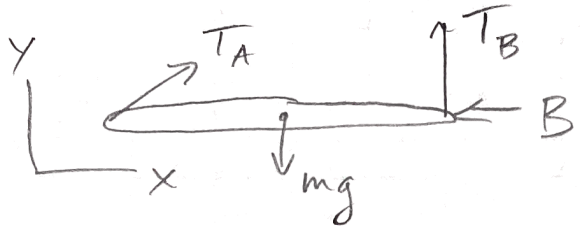
$T = \frac{308.1\text{ N}}{2.7995} = 110\text{ N}$

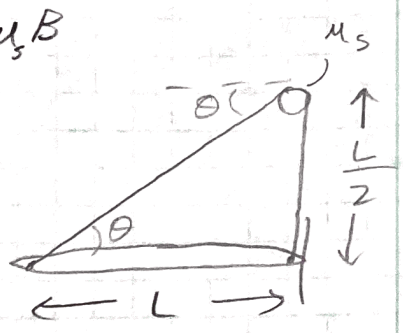
$P = (110\text{ N})e^{\frac{\pi}{6}} = \boxed{185.7\text{ N}}$

6.94 / Given: Diagram

Find: μ_s

Rel: $\Sigma F = 0$, $\Sigma M = 0$, $T_2 = T_1 e^{\mu_s B}$





$$\tan\theta = \frac{\frac{L}{2}}{L} = \frac{1}{2}$$

$$\theta = 26.6^\circ$$

$$B = \theta + 90^\circ = 116.6^\circ$$

$$B = 116.6^\circ\left(\frac{\pi\ \text{rad}}{180^\circ}\right) = 2.035$$

(1) $\Sigma F_x = 0 = T_A \cos 26.6 - B$

(2) $\Sigma F_y = 0 = T_A \sin 26.6 - mg + T_B$

(3) $\Sigma M_A = 0 = T_B L - mg\left(\frac{L}{2}\right)$

(3) $T_B = \dfrac{mg\left(\frac{L}{2}\right)}{L} = \dfrac{mg}{2}$

(2) $0 = T_A \sin 26.6 - mg + \dfrac{mg}{2}$

$$T_A = \frac{mg}{2\sin 26.6}$$

$$T_A = T_B e^{\mu_s B}$$

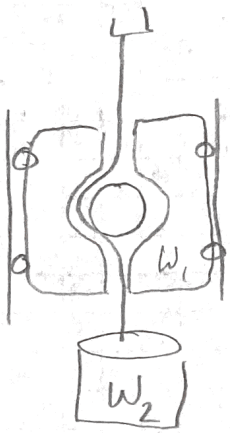
$$\ln\left(\frac{mg}{2\sin 26.6} = \frac{mg}{2} e^{\mu_s (2.035)}\right)$$

$$\mu_s = \frac{0.8035}{2.035} = \boxed{0.395}$$

6.99 | Given: W_1, $\mu_s = 0.35$

Find: $\frac{W_2}{W_1}$

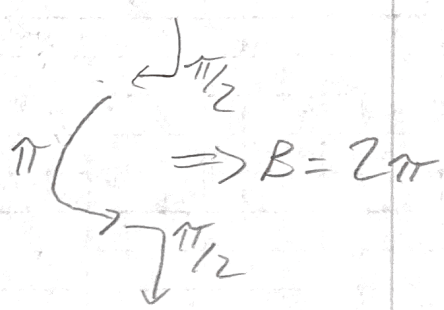
Rel: $\Sigma F = 0$, $\Sigma M = 0$, $T_2 = T_1 e^{\mu B}$



$\Sigma F_y = 0 = T - W_1 - W_2$

$T = W_2 e^{\mu B}$

$T = W_2 e^{(0.35)(2\pi)}$



$\Rightarrow B = 2\pi$

$0 = W_2 e^{0.7\pi} - W_1 - W_2$

$W_1 = W_2 (e^{0.7\pi} - 1)$

$\frac{W_2}{W_1} = \frac{1}{(e^{0.7\pi} - 1)} = \boxed{0.1247}$