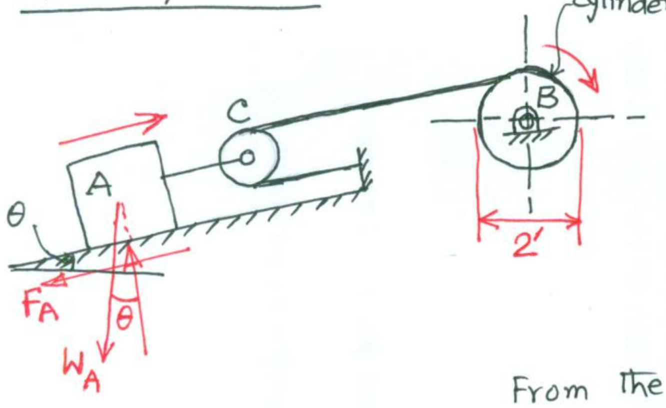
1423/P.419



$W_A = 128.8$ lb $S_A = 20$ ft (up the plane)

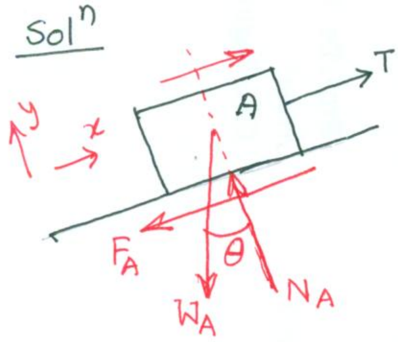
$\theta = 15^\circ$

$f = 0.15$ $W_B = ?$

$\omega_{B0} = 40$ rpm

$\omega_{Bf} = 0$

Sol^n



From the freebody of A, taking $\Sigma F_y = 0$, +y direct^n as +ve

$$N_A - W_A \cos\theta = 0$$

$$\therefore N_A = W_A \cos\theta = 128.8 \times \cos 15^\circ = 124.41 \text{ lb}$$

$$F_A = N_A \times f_A = 124.41 \times 0.15 = 18.66 \text{ lb}$$

For the entire system,

$$U_{net} = -W_A \sin\theta \times S_A - F_A \times S_A$$

$$= -128.8 \sin 15^\circ \times 20 - 18.66 \times 20$$

$$= -1039.92 \text{ lb-ft}$$

$$\Delta KE = \frac{1}{2} m_A \left(v_{Af}^2 - v_{A0}^2\right) + \frac{1}{2} \bar{I}_B \left(\omega_{Bf}^2 - \omega_{B0}^2\right)$$

$$= \frac{1}{2} \times \frac{128.8}{32.2} \times \left(0 - 2.09^2\right) + \frac{1}{2} \times \frac{W_B}{64.4} \times \left(0 - 4.19^2\right)$$

$$= -8.74 - 0.136 W_B$$

[Note: For a cylinder, $\bar{I} = \frac{mr^2}{2}$, Art. 160, P. 230; Art. 167, P. 236]

$$\omega_{B0} = 40 \text{ rpm} = \frac{40}{60} \times 2\pi = 4.19 \text{ rad/s.}$$

$$v_{A0} = \frac{1}{2} r_B \, \omega_{B0} = \frac{1}{2} \times 1 \times 4.19 = 2.09 \text{ fps}$$

$$v_{Af} = \frac{1}{2} r_B \, \omega_{Bf} = \frac{1}{2} \times 1 \times 0 = 0$$

$$\bar{I}_B = \frac{m_B r_B^2}{2} = \frac{W_B \times 1^2}{2 \times 32.2} = \frac{W_B}{64.4} \text{ slug-ft}^2$$

Now, $U_{net} = \Delta KE$

$$\Rightarrow -1039.92 = -8.74 - 0.136 W_B$$

$$\therefore W_B = \boxed{7582.2 \text{ lb}}$$ Ans.