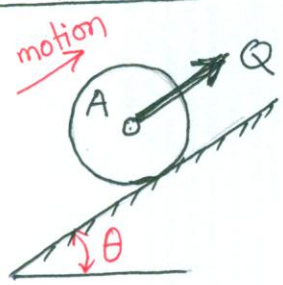
1439/p.421



$W_A = 161$ lb $D_A = 12$ inch

$\theta = 30^\circ$ $Q = 96.5$ lb

(a) $\bar{v}_{Af} = ?$ $\bar{v}_{A0} = 0$ $s_A = 15$ ft

(b) $\alpha_A = ?$

(c) $F = ?$ $fc = ?$

Soln

(a) $U_{net} = (Q - W_A \sin\theta) \times s_A = (96.5 - 161 \sin 30^\circ) \times 15 = 240$ lb-ft

$$\Delta KE = \frac{1}{2} \cdot \frac{W_A}{g} \bar{v}_{Af}^2 + \frac{1}{2} \bar{I}_A \omega_{Af}^2$$

$$= \frac{1}{2} \times \frac{161}{32.2} \times \bar{v}_{Af}^2 + \frac{1}{2} \times 0.625 \times (2\bar{v}_{Af})^2$$

$$= 3.75\, \bar{v}_{Af}^2 \text{ lb-ft.}$$

$\bar{I}_A = \frac{m_A r_A^2}{2} = \frac{1}{2} \times \frac{161}{32.2} \times \left(\frac{6}{12}\right)^2 = 0.625$ slug-ft^2

$\omega_{Af} = \frac{v_{Af}}{r_A} = \frac{v_{Af}}{6/12} = 2v_A$

According to the principles of work and kinetic energy

$U_{net} = \Delta KE \Rightarrow 240 = 3.75\, \bar{v}_{Af}^2$ $\therefore \bar{v}_{Af} =$ **8 fps**

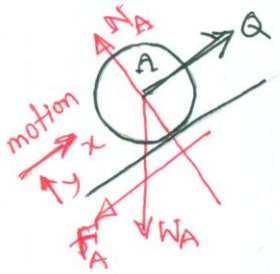
(b) $\omega_{Af} = 2v_{Af} = 2 \times 8 = 16$ rad/s

$\omega_{Af}^2 = 0 + 2\alpha_A \theta_A$ $\theta_A = \frac{s_A}{r_A} = \frac{15}{6/12} = 30$ rad/s.

$\Rightarrow 16^2 = 2 \times \alpha_A \times 30$

$\therefore \alpha_A =$ **4.27 rad/s^2**

(c) $v_{Af}^2 = v_{A0}^2 + 2as_A \Rightarrow 8^2 = 0 + 2 \times a \times 15$ $\therefore a = 2.13$ fps^2



$\Sigma F_x = m_A a$, +ve x direct^n +ve

$\Rightarrow Q - W_A \sin\theta - F_A = \frac{W_A}{g} \cdot a$

$\Rightarrow 96.5 - 161 \sin 30^\circ - F_A = \frac{161}{32.2} \times 2.13$

$\therefore F_A =$ **5.35 lb.**

$\Sigma F_y = 0$ gives, $N_A - W_A \cos\theta = 0$

$\therefore N_A = 161 \cos 30^\circ = 139.43$ lb

$\therefore f = \frac{F_A}{N_A} = \frac{5.35}{139.43} =$ **0.0384**