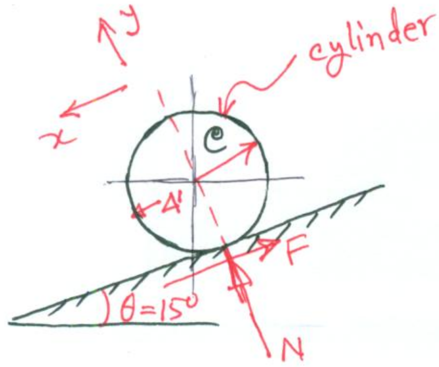
Ex. 281/P. 402



$W_c = 966$ lb , rolling down

$\theta = 15^0$

$v_1 = 0$, $v_2 = ?$

$S_c = 50$ ft

Note: N does no work – no movement in y direction

F does no work – the cylinder is rolling (Art. 280/P. 401)

Sol^n

$$U_{net} = W_c \sin\theta \times S_c = 966 \times \sin 15^\circ \times 50 = 12500'96 \text{ ft-lb}$$

$$\Delta KE = \frac{W_c}{2g}\left(v_2^2 - v_1^2\right) + \frac{\bar{I}_c}{2}\left(\omega_2^2 - \omega_1^2\right)$$

Taking c.g. as the reference point

here, $\omega_1 = \frac{v_1}{r_c} = 0$, $\omega_2 = \frac{v_2}{r_c} = \frac{v_2}{2}$

$$\bar{I}_c = \frac{m_c r_c^2}{2} = \frac{966}{32'2} \times \frac{2^2}{2} = 60 \text{ slug-ft}^2$$

$$\therefore \Delta KE = \frac{966}{2 \times 32'2} \times \left(v_2^2 - 0\right) + \frac{60}{2} \times \left(\frac{v_2^2}{4} - 0\right)$$

$$= 22'5\, v_2^2$$

Using $U_{net} = \Delta KE$

$$12500'96 = 22'5\, v_2^2$$

$$\therefore v_2 = \boxed{23'57 \text{ fps}} \quad \text{Ans.}$$

* In the book, the problem is solved in a different way considering the instantaneous center as the reference point.