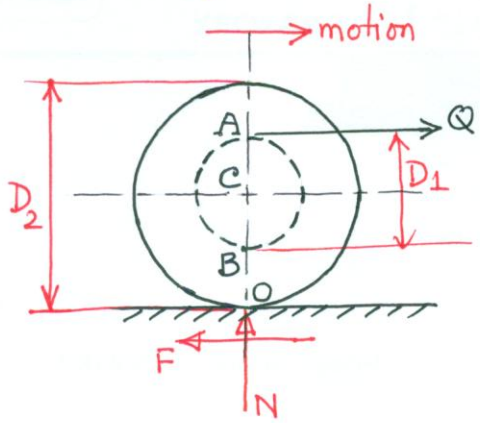
1445/pp. 421 – 422

(Without using energy principles)



Grooved cylinder, rolling

$W = 322$ lb

$S_c = 54$ ft

$D_1 = 18$ in. $= 1'5$ ft

$D_2 = 36$ in. $= 3'0$ ft

$\bar{I} = 10$ slug-ft^2

$\bar{v}_0 = 0$

$\bar{v}_f = 45$ fps

$Q = ?$

Sol^n

$$\bar{v}_f^2 = \bar{v}_0^2 + 2\bar{a}S_c$$

$$\Rightarrow 45^2 = 0 + 2 \times a \times 54$$

$$\therefore a = 18.75 \text{ fps}^2$$

We know, for angular motion, $M = I\alpha$

Considering instantaneous center O as reference point

$$M_0 = I_0 \alpha \quad \text{—— (1)}$$

Now, $M_0 = Q(r_2 + r_1) = Q(1.5 + 0.75) = 2.25Q$

$$I_0 = \bar{I} + m r_2^2 = 10 + \frac{322}{32.2} \times 1.5^2 = 32.5 \text{ slug-ft}^2$$

$$\alpha = \frac{a}{r_2} = \frac{18.75}{1.5} = 12.5 \text{ rad/s}^2$$

$\therefore$ From eq^n (1)

$$2.25Q = 32.5 \times 12.5$$

$$\therefore Q = \boxed{180.6 \text{ lb}}$$