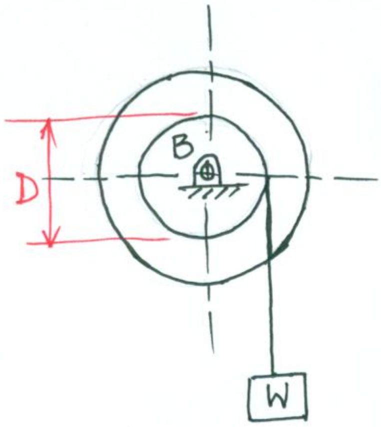
1414/P.418



$W_B = 2576$ lb

$\bar{k}_B = 14$ in.

$D = 32$ in.

$\omega_0 = 20$ rpm

$\omega_f = 40$ rpm

$S_W = 40$ ft ↓

$W = ?$

Friction negligible.

Sol^n

$$\Delta KE = \frac{W}{2g}\left(v_f^2 - v_0^2\right) + \frac{\bar{I}_B}{2}\left(\omega_f^2 - \omega_0^2\right)$$

Here, $\omega_0 = \frac{20 \times 2\pi}{60}$ rad/s $= 2{\cdot}09$ rad/s.

$\omega_f = \frac{40 \times 2\pi}{60}$ rad/s $= 4{\cdot}19$ rad/s.

$v = r\omega$

$v_0 = \frac{16}{12} \times 2{\cdot}09 = 2{\cdot}787$ fps

$v_f = \frac{16}{12} \times 4{\cdot}19 = 5{\cdot}587$ fps

$\bar{I}_B = \bar{k}_B^2 m_B = \left(\frac{14}{12}\right)^2 \times \frac{2576}{32{\cdot}2} = 108{\cdot}89$ slug-ft^2

$$\therefore \Delta KE = \frac{W}{2 \times 32{\cdot}2}\left(5{\cdot}587^2 - 2{\cdot}787^2\right) + \frac{108{\cdot}89}{2}\left(4{\cdot}19^2 - 2{\cdot}09^2\right)$$

$$= 0{\cdot}364\,W + 718{\cdot}02 \text{ ft-lb}$$

$U_{net} = W \cdot S_W = W \times 40 = 40\,W$ ft-lb

Now, according to the principle of work and kinetic energy

$U_{net} = \Delta KE$

$\Rightarrow 40\,W = 0{\cdot}364\,W + 718{\cdot}02$

$\therefore W = \boxed{18{\cdot}12 \text{ lb}}$ Ans.