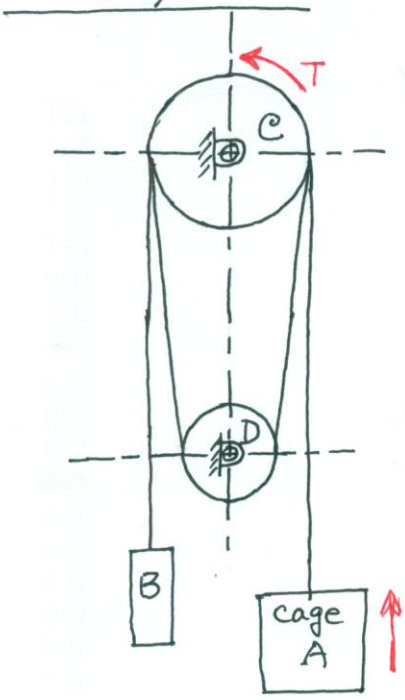
1426/P.420



$W_A = 6000$ lb
$W_B = 5000$ lb
$D_C = D_D = 30'' = 2.5$ ft
$\bar{I}_C = \bar{I}_D = 5$ slug-ft^2
$v_{Ao} = 0$, $v_{Af} = 10$ fps

$S_A = 10$ ft ↑
$S_B = 10$ ft ↓
Torque, $T = ?$
$\Delta PE = ?$

Soln

$$\theta_C = \frac{S_A}{r_C} = \frac{10}{2.5/2} = 8 \text{ rad}$$

$$\omega_C = \frac{v_{Af}}{r_C} = \frac{10}{2.5/2} = 8 \text{ rad/s}$$

$$\omega_D = \omega_C = 8 \text{ rad/s}$$

$$v_{Bf} = v_{Af} = 10 \text{ fps}$$

$$U_{net} = -W_A \times S_A + W_B \times S_B + T \times \theta_C$$

$$= -6000 \times 10 + 5000 \times 10 + T \times 8$$

$$= -10000 + 8T$$

$$\Delta KE = \frac{1}{2} \cdot \frac{W_A}{g} v_{Af}^2 + \frac{1}{2} \cdot \frac{W_B}{g} v_{Bf}^2 + \frac{1}{2} \bar{I}_C \omega_C^2 + \frac{1}{2} \bar{I}_D \omega_D^2$$

$$= \frac{1}{2} \times \frac{6000}{32.2} \times 10^2 + \frac{1}{2} \times \frac{5000}{32.2} \times 10^2 + \frac{1}{2} \times 5 \times 8^2 + \frac{1}{2} \times 5 \times 8^2$$

$$= 9316.77 + 7763.98 + 320$$

$$= 17400.75 \text{ lb-ft}$$

According to principles of work and kinetic energy

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

$$\Rightarrow -10000 + 8T = 17400.75$$

$$\therefore T = \boxed{3425.09 \text{ lb-ft}} \quad \text{Ans.}$$

$$\Delta PE = W_A \times S_A - W_B \times S_B$$

$$= 6000 \times 10 - 5000 \times 10$$

$$= \boxed{10000 \text{ lb-ft}} \quad \text{Ans.}$$