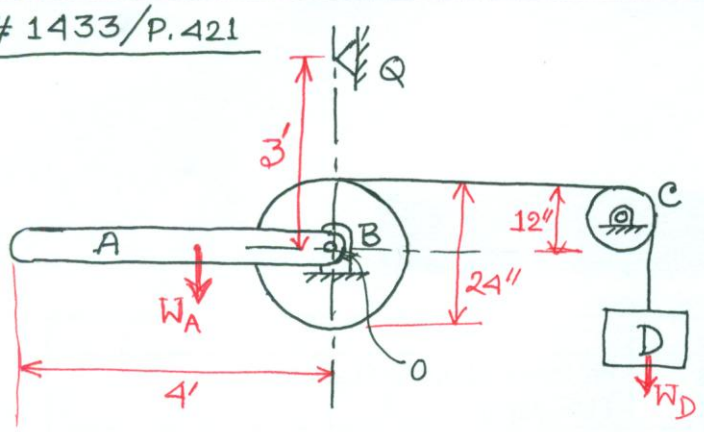
1433/P.421



$W_A = 48.3$ lb
$W_B = 128.8$ lb
$\bar{k}_B = 10$ inch
$W_D = 644$ lb
Start from rest.
$\theta_B = \theta_A = \frac{\pi}{2}$ rad.

(a) KE = ? when A strikes Q
(b) v_D = ?

Soln

For the entire system

$U_{net} = W_D \times S_D - W_A \times \frac{L_A}{2}$

$= 644 \times \frac{\pi}{2} - 48.3 \times \frac{4}{2}$

$= 914.99$ ft-lb

$S_D = r_B \theta_B = 1 \times \frac{\pi}{2} = \frac{\pi}{2}$ ft

$\Delta KE = \frac{1}{2} \cdot \frac{W_D}{g} v_D^2 + \frac{1}{2} I_0 \omega_0^2$

$= \frac{1}{2} \times \frac{644}{32.2} \times v_D^2 + \frac{1}{2} \times 10.78 \times v_D^2$

$= 10 v_D^2 + 5.39 v_D^2$

$= 15.39 v_D^2$

$I_0 = I_{A0} + I_{B0}$

$I_{A0} = \frac{1}{3} m_A L_A^2 = \frac{1}{3} \times \frac{48.3}{32.2} \times 4^2$

$= 8$ slug-ft^2

$I_{B0} = m_B k_B^2 = \frac{128.8}{32.2} \times \left(\frac{10}{12}\right)^2$

$= 2.78$ slug-ft^2

$\therefore I_0 = 8 + 2.78 = 10.78$ slug-ft^2

$\omega_0 = \frac{v_D}{r_B} = \frac{v_D}{1} = v_D$

According to principles of work and kinetic energy

$U_{net} = \Delta KE$

$\Rightarrow 914.99 = 15.39 v_D^2$

$\therefore v_D = \boxed{7.71 \text{ fps}}$

K.E. when A strikes Q $= \Delta KE$

$= 15.39 v_D^2$

$= 15.39 \times 7.71^2$

$= \boxed{914.84 \text{ lb-ft}}$