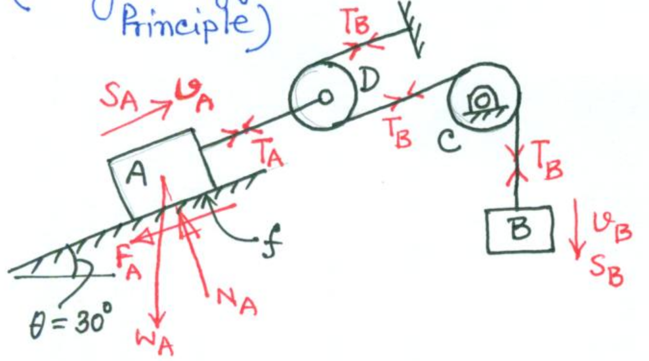
1402/P. 418

(Using Energy Principle)



$W_A = 1000$ lb
$f = \frac{1}{3}$
$S_A = 60$ ft
$t = 12$ s.
$v_{oA} = 0$

(a) $W_B = ?$
(b) $T_A = ?$ $T_B = ?$
(c) $\Delta PE_A = ?$
$\Delta PE_B = ?$

Pulleys C & D are weightless & frictionless.

Sol^n For the entire system, considering $U_{net} = \Delta KE$

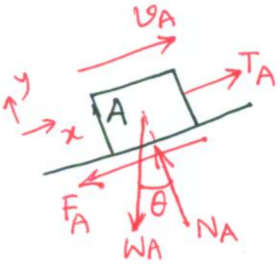
$$-F_A \cdot S_A - W_A \sin\theta \cdot S_A + W_B \cdot S_B = \frac{1}{2}\cdot\frac{W_A}{g} v_A^2 + \frac{1}{2}\cdot\frac{W_B}{g}\cdot v_B^2 \quad \text{—— (1)}$$

$$S_A = v_{oA} t + \frac{1}{2} a_A t^2 \Rightarrow 60 = 0 + \frac{1}{2} \times a_A \times 12^2 \quad \therefore a_A = \frac{5}{6} \text{ fps}^2$$

$$v_A = v_{oA} + a_A t = 0 + \frac{5}{6} \times 12 = 10 \text{ fps}$$

$$v_B = 2 v_A = 2 \times 10 = 20 \text{ fps}$$

$$S_B = 2 S_A = 2 \times 60 = 120 \text{ ft}$$



From the freebody of A, $\Sigma F_y = 0$ +ve y direct^n +ve

$$N_A - W_A \cos\theta = 0 \quad \Rightarrow N_A = 1000 \cos 30^\circ = 866 \text{ lb}$$

$$\therefore F_A = N_A \cdot f_A = 866 \times \frac{1}{3} = 288{\cdot}68 \text{ lb}$$

Now from eq^n (1)

$$-288{\cdot}68 \times 60 - 1000 \sin 30^\circ \times 60 + W_B \times 120 = \frac{1}{2} \times \frac{1000}{32{\cdot}2} \times 10^2 + \frac{1}{2} \times \frac{W_B}{32{\cdot}2} \times 20^2$$

$$\Rightarrow 113{\cdot}78 \, W_B = 48873{\cdot}6$$

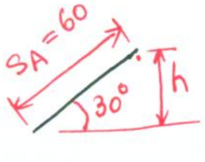
$$\therefore W_B = \boxed{429{\cdot}54 \text{ lb}}$$

$\Sigma F_x = m_A a_A$, +ve x direct^n as +ve

$$\Rightarrow T_A - F_A - W_A \sin\theta = \frac{W_A}{g} \cdot a_A$$

$$\Rightarrow T_A - 288{\cdot}68 - 1000 \sin 30^\circ = \frac{1000}{32{\cdot}2} \times \frac{5}{6}$$

$$\therefore T_A = \boxed{814{\cdot}55 \text{ lb.}} \qquad T_B = T_A/2 = \frac{814{\cdot}55}{2} = \boxed{407{\cdot}28 \text{ lb}}$$



$$\Delta PE_A = +\frac{W_A}{g} \cdot g \cdot h = W_A \cdot h = 1000 \times 60 \sin 30^\circ = \boxed{30000 \text{ lb, increase}}$$

$$\Delta PE_B = -\frac{W_B}{g} \cdot g \cdot S_B = -W_B S_B = -429{\cdot}54 \times 120 = \boxed{-51545 \text{ lb, decrease}}$$