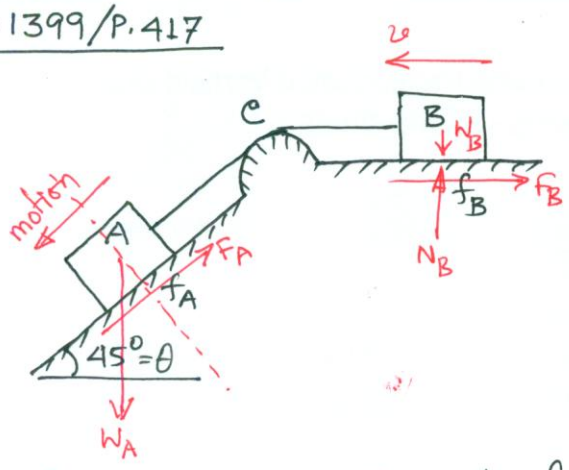
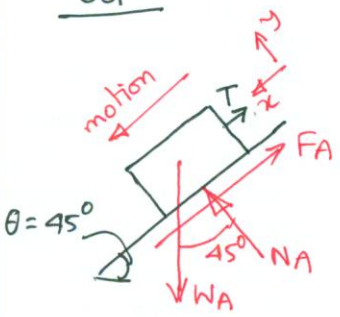
#1399/P.417



$W_A = 1000$ lb
$f_A = 0.15$
$f_B = 0.6$
$v_0 = 20$ fps (to left)
$S = 160$ ft
$v_f = 10$ fps

(a) $W_B = ?$
(b) $T_{BC} = T_{AC} = T = ?$
(c) $\Delta PE = ?$

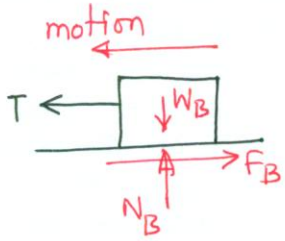
Soln



From the freebody of A, $\Sigma F_y = 0$ gives

$N_A - W_A \cos\theta = 0 \quad \therefore N_A = 1000 \cos 45^0 = 707.11$ lb

$\therefore F_A = N_A \cdot f_A = 707.11 \times 0.15 = 106.07$ lb



From the freebody of B, taking $\Sigma F_v = 0 \uparrow$ +ve

$N_B - W_B = 0 \quad \therefore N_B = W_B$

$F_B = N_B \cdot f_B = W_B \times 0.6 = 0.6 W_B$

Now for the entire system

$$U_{net} = (W_A \sin\theta - F_A) \times S - F_B \times S$$
$$= (1000 \sin 45^0 - 106.07) \times 160 - 0.6 W_B \times 160$$
$$= 96165.88 - 96 W_B$$

$$\Delta KE = \frac{1}{2} \cdot \frac{W_A}{g} (v_f^2 - v_0^2) + \frac{1}{2} \cdot \frac{W_B}{g} (v_f^2 - v_0^2)$$
$$= \frac{1}{2} \times \frac{1000}{32.2} \times (10^2 - 20^2) + \frac{1}{2} \times \frac{W_B}{32.2} \times (10^2 - 20^2)$$
$$= -4658.39 - 4.66 W_B$$

$U_{net} = \Delta KE$

$\Rightarrow 96165.88 - 96 W_B = -4658.39 - 4.66 W_B$

$\therefore W_B = \boxed{1103.8 \text{ lb}}$

Contd....

#1399/P.417 contd..

Using Energy Principle

From the freebody of B

$$U_{net} = -F_B \times S + T \times S$$
$$= -0.6 W_B \times 160 + T \times 160$$
$$= -0.6 \times 1103.8 \times 160 + T \times 160$$
$$= -105964.8 + 160T \quad \text{lb-ft}$$

$$\Delta KE = \frac{1}{2} \cdot \frac{W_B}{g} \left(v_f^2 - v_0^2 \right)$$
$$= \frac{1}{2} \times \frac{1103.8}{32.2} \times \left(10^2 - 20^2 \right)$$
$$= -5141.9 \text{ lb-ft}$$

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

$$\Rightarrow -105964.8 + 160T = -5141.9$$

$$\therefore T = \boxed{630.14 \text{ lb}} \quad \text{Ans.}$$

$$\Delta PE = -W_A \times S \times \sin\theta$$
$$= -1000 \times 160 \sin 45^0$$
$$= \boxed{-113137.09 \text{ lb-ft, -ve sign means decrease in PE.}}$$

Ans.