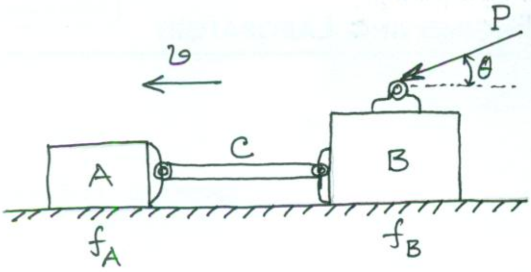
1108. Two bodies A and B, connected by a rod C, Fig. 518, have an initial speed of 6 fps and move 300 ft. in 30 sec. Let $W_A = 966$ lb., $W_B = 1288$ lb., $f_A = 0.04$, $f_B = 0.15$, and $\theta = 15°$. For constant acceleration, determine the force P and the final velocity. *Ans.* 270 lb., 14 fps.

1108/P.325



$v_0 = 6$ fps $W_A = 966$ lb
$S = 300$ ft $W_B = 1288$ lb
$t = 30$ s. $f_A = 0.04$
a = const. $f_B = 0.15$
$\theta = 15^\circ$
$P = ?$ $v_f = ?$

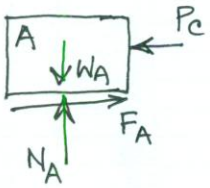
Sol^n

$$S = v_0 t + \frac{1}{2} a t^2$$

$$\Rightarrow 300 = 6 \times 30 + \frac{1}{2} \times a \times 30^2$$

$$\therefore a = 0.267 \text{ fps}^2$$

$$\therefore v_f = v_0 + at = 6 + 0.267 \times 30 = \boxed{14 \text{ fps}}$$ Ans.



Freebody diagram of A

From freebody diagram of A

Taking $\Sigma F_y = 0$ ↑+ve

$$N_A - W_A = 0$$

$$\Rightarrow N_A = W_A = 966 \text{ lb}$$

$$\therefore F_A = N_A \cdot f_A = 966 \times 0.4 = 38.64 \text{ lb}$$

Taking $\Sigma F_H = ma$ ← +ve

$$P_c - F_A = \frac{W_A}{g} \cdot a$$

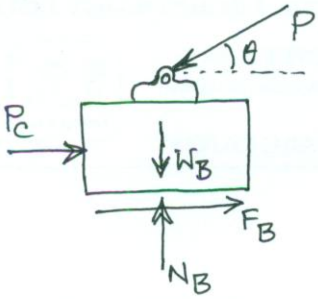
$$\Rightarrow P_c - 38.64 = \frac{966}{32.2} \times 0.267$$

$$\therefore P_c = 46.65 \text{ lb}$$

Note: It is advantageous to consider the direction of motion as +ve.

Note: Inertial force is not included in the freebody of A, so we have used $\Sigma F = ma$. If inertial force is included we shall use $\Sigma F = 0$.

#1108/P.325 ....Contd.



Free body diagram of B

From freebody diagram of B

Taking $\Sigma F_y = 0 \uparrow +ve$

$$-P\sin\theta - W_B + N_B = 0$$

$$\therefore N_B = W_B + P\sin\theta$$

$$= 1288 + P\sin 15^\circ$$

$$F_B = N_B \cdot f_B$$

$$= (1288 + P\sin 15^\circ) \times 0.15$$

$$= 193.2 + 0.039P$$

Now taking $\Sigma F_H = ma \quad \leftarrow +ve$

$$P\cos\theta - P_c - F_B = \frac{W_B}{g} \cdot a$$

$$\Rightarrow P\cos 15^\circ - 46.65 - (193.2 + 0.039P) = \frac{1288}{32.2} \times 0.267$$

$$\Rightarrow \quad 0.927P = 250.53$$

$$\therefore P = \boxed{270.3 \text{ lb}}$$ Ans.