

**PROBLEM 8.134**

The coefficients of friction are  $\mu_s = 0.40$  and  $\mu_k = 0.30$  between all surfaces of contact. Determine the smallest force **P** required to start the 30-kg block moving if cable *AB* (a) is attached as shown, (b) is removed.

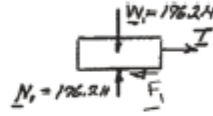
**SOLUTION**

(a) Free body: 20-kg block

$$W_1 = (20 \text{ kg})(9.81 \text{ m/s}^2) = 196.2 \text{ N}$$

$$F_1 = \mu_s N_1 = 0.4(196.2 \text{ N}) = 78.48 \text{ N}$$

$$\overset{+}{\leftarrow} \Sigma F = 0: T - F_1 = 0 \quad T = F_1 = 78.48 \text{ N}$$



Free body: 30-kg block

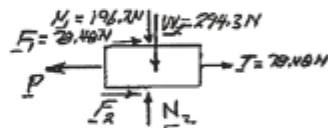
$$W_2 = (30 \text{ kg})(9.81 \text{ m/s}^2) = 294.3 \text{ N}$$

$$N_2 = 196.2 \text{ N} + 294.3 \text{ N} = 490.5 \text{ N}$$

$$F_2 = \mu_s N_2 = 0.4(490.5 \text{ N}) = 196.2 \text{ N}$$

$$\overset{+}{\leftarrow} \Sigma F = 0: P - F_1 - F_2 - T = 0$$

$$P = 78.48 \text{ N} + 196.2 \text{ N} + 78.48 \text{ N} = 353.2 \text{ N}$$



**P = 353 N** ←

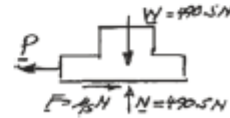
(b) Free body: Both blocks

Blocks move together

$$W = (50 \text{ kg})(9.81 \text{ m/s}^2) = 490.5 \text{ N}$$

$$\overset{+}{\leftarrow} \Sigma F = 0: P - F = 0$$

$$P = \mu_s N = 0.4(490.5 \text{ N}) = 196.2 \text{ N}$$



**P = 196.2 N** ←