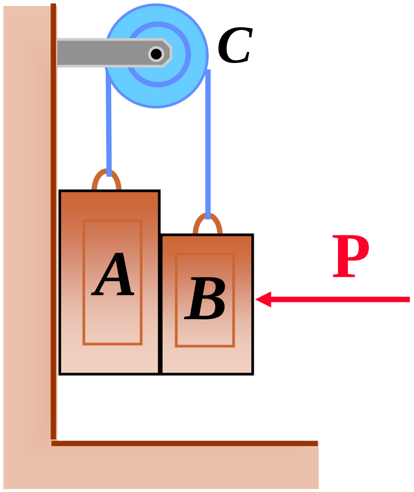
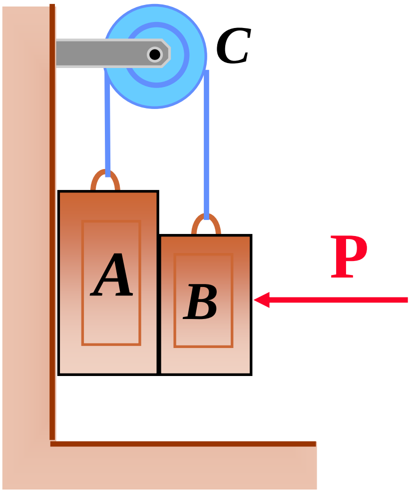
Problem 8.150



Block *A* of mass 12 kg and block *B* of mass 6 kg are connected by a cable that passes over pulley *C* which can rotate freely. Knowing that the coefficient of static friction at all surfaces of contact is 0.12, determine the smallest value of *P* for which equilibrium is maintained.



Solving Problems on Your Own

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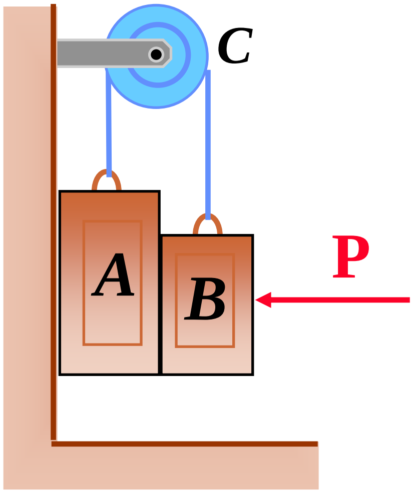
When the motion is impending and μ_s is known; you must find some unknown quantities, such as a distance, an angle, the magnitude of a force, or the direction of a force.

a. *Assume a possible motion of the body* and, on the free-body diagram, draw the friction force in a direction opposite to that of the assumed motion.



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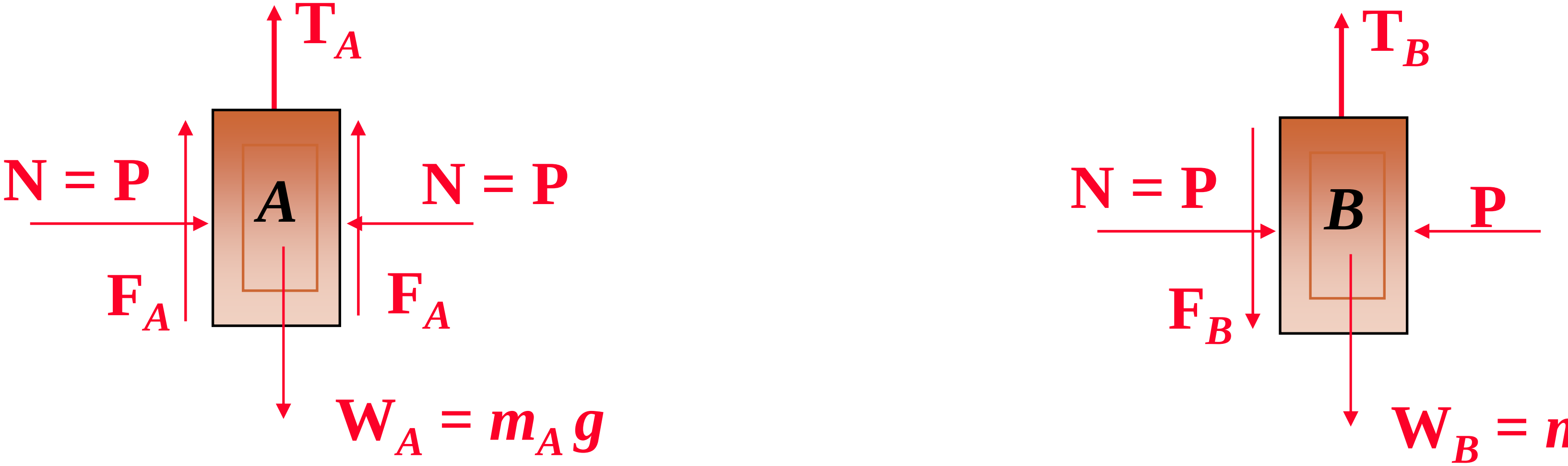
When the motion is impending and μ_s is known; you must find some unknown quantities, such as a distance, an angle, the magnitude of a force, or the direction of a force.

b. *Since motion is impending, $F = F_m = \mu_s N$.* Substituting for μ_s its known value, you can express *F* in terms of *N* on the free-body diagram, thus eliminating one unknown.

c. *Write and solve the equilibrium equations for the unknown you seek.*

Assume a possible motion of the body and, on the free-body diagram, draw the friction force in a direction opposite to that of the assumed motion.

Impending Motion: Block *A* ↓ Block *B* ↑ Free-Body Diagrams



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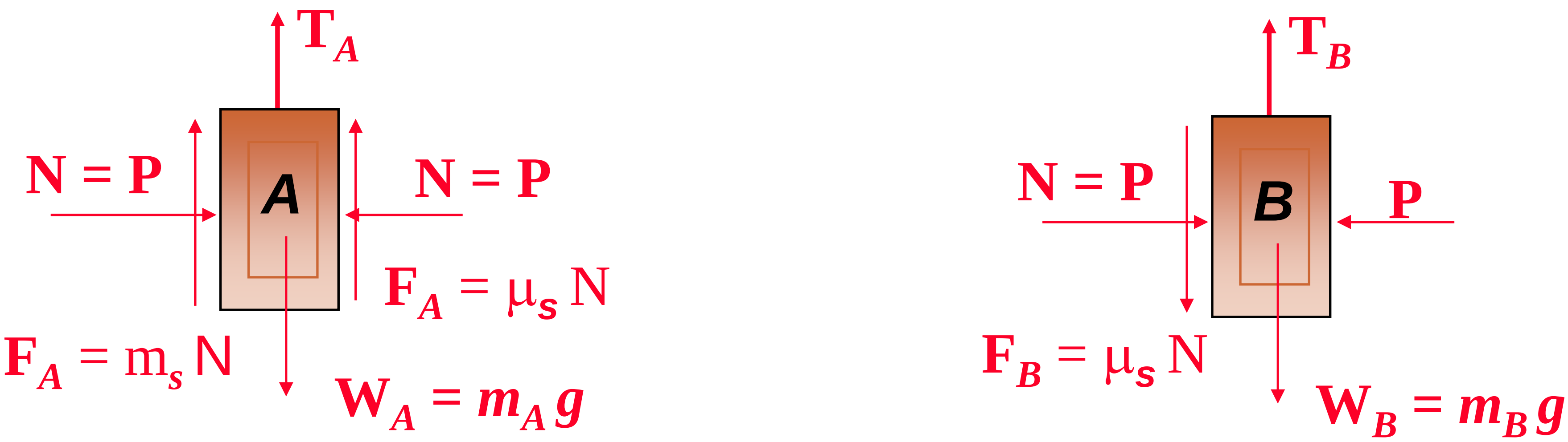

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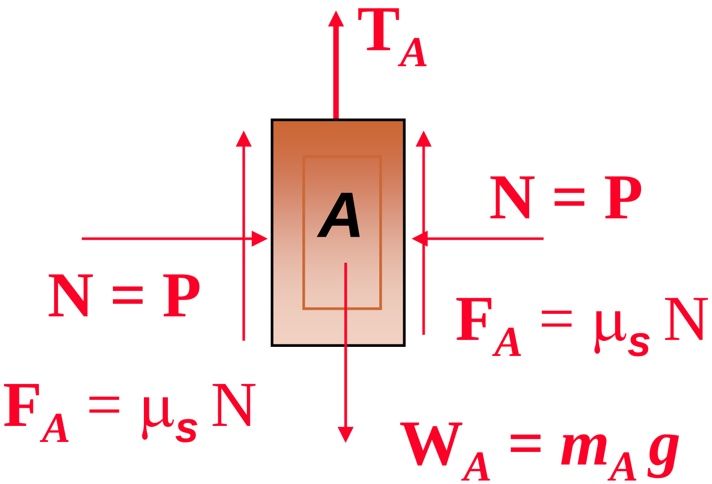
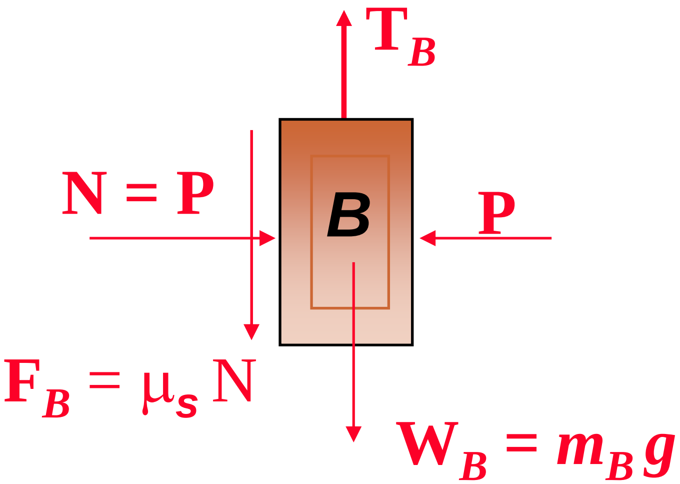
Write and solve the equilibrium equations for the unknown.





$$+\uparrow \Sigma F_y = 0 : T_A + 2F_A - W_A = 0 \qquad +\uparrow \Sigma F_y = 0 : T_B - F_B - W_B = 0$$

$$T_A + 2\mu_s N - m_A g = 0 \qquad T_B - \mu_s N - m_B g = 0$$

$$T_A = m_A g - 2\mu_s N \qquad T_B = m_B g + \mu_s N$$

But, $T_A = T_B$: $\quad m_A g - 2\mu_s N = m_B g + \mu_s N$

Write and solve the equilibrium equations for the unknown.

$$m_A g - 2\mu_s N = m_B g + \mu_s N$$

$$(m_A - m_B)\, g = 3\mu_s N$$

$$(12 \text{ kg} - 6 \text{ kg})g = 3(0.12)N$$

$$N = \frac{6\, g}{0.36} = 16.667g = 16.667(9.81 \text{ m/s}^2) = 163.5 \text{ N}$$

Since $P = N$, we have

$$P = 163.5 \text{ N}$$