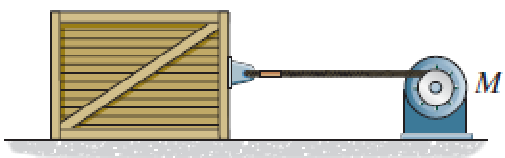
F13–2. If motor M exerts a force of $F = (10t^2 + 100)$ N on the cable, where t is in seconds, determine the velocity of the 25-kg crate when $t = 4$ s. The coefficients of static and kinetic friction between the crate and the plane are $\mu_s = 0.3$ and $\mu_k = 0.25$, respectively. The crate is initially at rest.



Prob. F13–2

$\mu_s := 0.3$

$\mu_k := 0.25$

$m := 25\ kg$

$N := m \cdot 9.81 \frac{m}{s^2} = 245.25\ N$

Primero nos aseguramos que la caja se mueva:

$F_{fricción} := \mu_s \cdot N = 73.575\ N$

Viendo nuestra función de fuerza, observamos que para t=0, F=100.

$F(t) := \left(10 \cdot t^2 + 100\right) N$

$F(0) = 100\ N$

Por lo tanto, desde el primer instante, la caja se moverá.

$\Sigma F_x := m \cdot a_x$

$10 \cdot t^2 + 100 - \mu_k \cdot N = m \cdot a_x$

$a_x := \frac{10 \cdot t^2 + 100 - 0.25 \cdot 25 \cdot 9.81}{25}$

$a_x := 0.4 \cdot t^2 + 1.5475$

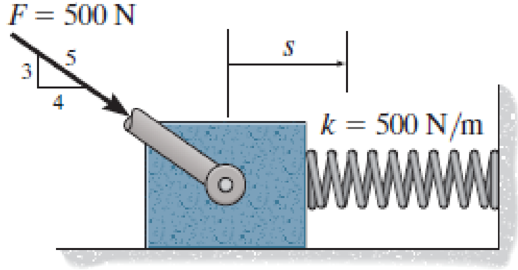
$a := \frac{dv}{dt}$

$dv := a \cdot dt$

$\int_0^v 1\, dv$ es igual a $\int_0^4 a_x\, dt = 14.7233$

$v := 14.7233 \frac{m}{s}$ Hacia la derecha.

F13–3. A spring of stiffness $k = 500$ N/m is mounted against the 10-kg block. If the block is subjected to the force of $F = 500$ N, determine its velocity at $s = 0.5$ m. When $s = 0$, the block is at rest and the spring is uncompressed. The contact surface is smooth.



Prob. F13–3

$$\Sigma F_x := m \cdot a_x \qquad m := 10\ kg$$

$$F_x := 500\ N \cdot \left(\frac{4}{5}\right) = 400\ N \qquad k := 500\ \frac{N}{m}$$

$$F_x - k \cdot s = m \cdot a_x$$

$$a_x := 40 - 50 \cdot s$$

$$v \cdot dv = a \cdot ds$$

$$\int_0^v v\, d v = \int_0^{0.5} 40 - 50 \cdot s\, d s$$

$$\frac{v^2}{2} \qquad \int_0^{0.5} 40 - 50 \cdot s\, d s = 13.75$$

$$v := \sqrt{13.75 \cdot 2} = 5.244$$

$$v := v\ \frac{m}{s} = 5.244\ \frac{m}{s}$$

F13–4. The 2-Mg car is being towed by a winch. If the winch exerts a force of $T = 100(s + 1)$ N on the cable, where s is the displacement of the car in meters, determine the speed of the car when $s = 10$ m, starting from rest. Neglect rolling resistance of the car.

Prob. F13–4

$$m := 2\ Mg = 2000\ kg$$

$$\Sigma F_x := m \cdot a_x$$

$$100(s+1)\ N = 2000\ kg \cdot a$$

$$1\ N = 1\ \frac{kg\ m}{s^2}$$

$$a := \frac{100(s+1)\ N}{2000\ kg}$$

$$a := 0.05(s+1)\ \frac{m}{s^2}$$

$$v \cdot dv = a \cdot ds$$

Integrando ambos lados:

$$\int_0^v v\ d\ v = \int_{0\ m}^{10\ m} 0.05(s+1)\ d\ s$$

$$\frac{v^2}{2}$$

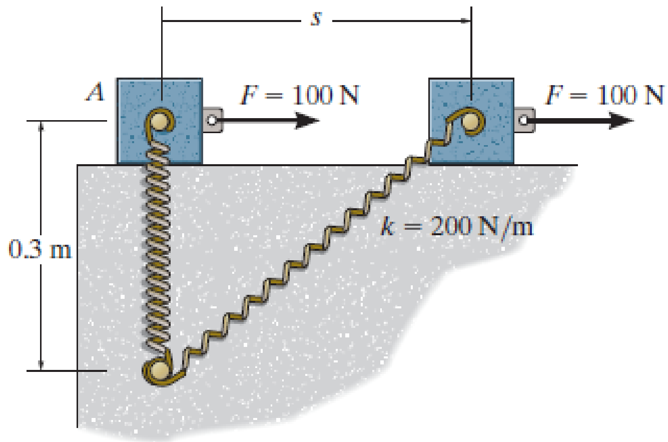
$$\int_{0\ m}^{10\ m} 0.05 \cdot (s+1)\ d\ s = 3$$

$$\frac{v^2}{2} = 3$$

$$v := \sqrt{3 \cdot 2} = 2.4495$$

$$v := v\ \frac{m}{s} = 2.4495\ \frac{m}{s}$$

F13–5. The spring has a stiffness $k = 200\ \text{N/m}$ and is unstretched when the 25-kg block is at A. Determine the acceleration of the block when $s = 0.4$ m. The contact surface between the block and the plane is smooth.



Prob. F13–5

$m := 25\ kg$

$k := 200\ \frac{N}{m}$

$l_{estirada} := \sqrt{(0.3\ m)^2 + (0.4\ m)^2} = 0.5\ m$

$l_{inicial} := 0.3\ m$

$F_{resorte} := k \cdot (l_{estirada} - l_{inicial}) = 40\ N$

$\theta := \tanh\left(\frac{0.3}{0.4}\right) = 36.3914\ deg$ Ángulo entre la horizontal y la hipotenusa.

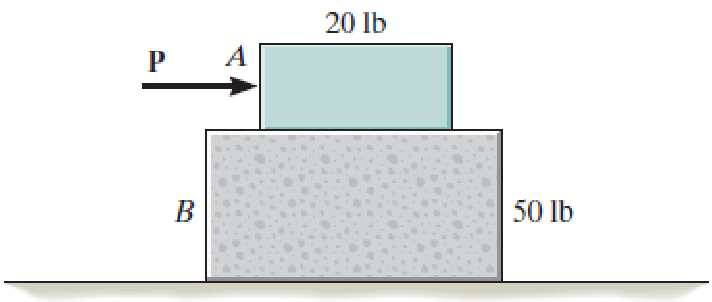
$F_{derecha} := 100\ N$

$\Sigma F_x := m \cdot a_x$

$F_{derecha} - F_{resorte} \cdot \cos(\theta) = 67.8007\ N$ $m \cdot a_x$

$$a_x := \frac{F_{derecha} - F_{resorte} \cdot \cos(\theta)}{m} = 2.712\ \frac{m}{s^2}$$

F13–6. Block B rests upon a smooth surface. If the coefficients of static and kinetic friction between A and B are $\mu_s = 0.4$ and $\mu_k = 0.3$, respectively, determine the acceleration of each block if $P = 6$ lb.



Prob. F13–6

$\Sigma F_x := m \cdot a_x$

$P := 6\ lbf$ $\qquad m_{2bloques} := \dfrac{20\ lbf + 50\ lbf}{32.2 \dfrac{ft}{s^2}} = 2.1739\ slug$

$a_x := \dfrac{P}{m_{2bloques}} = 2.76 \dfrac{ft}{s^2}$

¿Hay deslizamiento relativo entre los dos bloques?

$\Sigma F_x := m \cdot a_x$

$\mu_s := 0.4$ $\qquad N_{bloqueA} := 20\ lbf$

$F_{fricción} := \mu_s \cdot N_{bloqueA} = 8\ lbf$

$m_{bloqueA} := \dfrac{20\ lbf}{32.2 \dfrac{ft}{s^2}} = 0.6211\ slug$

$6 - F_{aExceder} = m_{bloqueA} \cdot a_x$

$F_{aExceder} := 6\ lbf - m_{bloqueA} \cdot a_x = 4.2857\ lbf$

Pero nuestra fuerza de fricción estática es mayor.
Entonces, no hay deslizamiento entre las dos cajas
y sus aceleraciones serán iguales.