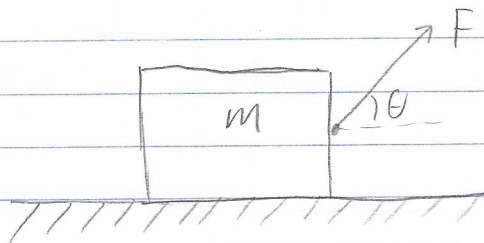
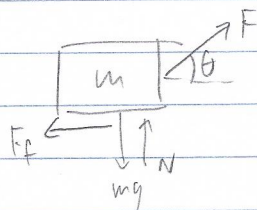


20-P-MOM-D4-28

A $m=10$ kg cargo box is being pulled on a floor with a coefficient of friction $\mu=0.2$. The force can be described as the function $F(t)=20+5t$. Determine the time when velocity $v=7 \frac{m}{s}$ if the angle $\theta=30^\circ$



Solution:



$$\sum F_y: (20+5t) \sin \theta + N = mg \quad N = mg - (20+5t) \sin \theta$$

$$\sum F_x: (20+5t) \cos \theta - F_f = m a_x$$

$$(20+5t) \cos \theta - \mu (mg - [20+5t] \sin \theta) = m a_x$$

$$m v_1 + \int_{t_1}^{t_2} F dt = m v_2$$

$$(10)(0) + \int_0^{t_2} [20 \cos \theta + 5t \cos \theta - \mu mg + \mu 20 \sin \theta + \mu 5t \sin \theta] dt = m v_2$$

$$\int_0^{t_2} [(20 \cos \theta - \mu mg + \mu 20 \sin \theta) + 5t (\cos \theta + \mu \sin \theta)] dt = m v_2$$

$$[20 \cos \theta - \mu mg + \mu 20 \sin \theta] t \Big|_0^7 + \frac{5t^2}{2} [\cos \theta + \mu \sin \theta] \Big|_0^7 = m v_2$$

$$v_2 = \underline{7.87 \frac{m}{s}}$$