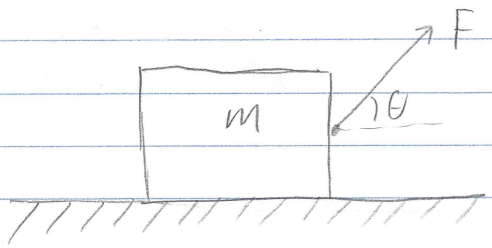
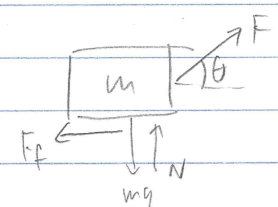
20-P-MOM-D4-28

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 velocity when time $t = 7$ s. if the angle $\theta = 30°$



Solution:



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

ΣF_x: $(20+5t)\cos\theta - F_f = ma_x$

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

$$mv_1 + \int_{t_1}^{t_2} F\,dt = mv_2$$

$$(10)(0) + \int_{t_1}^{t_2} [20\cos\theta + 5t\cos\theta - \mu mg + \mu 20\sin\theta + \mu 5t\sin\theta]\,dt = mv_2$$

$$\int_{t_1}^{t_2} [(20\cos\theta - \mu mg + \mu 20\sin\theta) + 5t(\cos\theta + \mu\sin\theta)]\,dt = mv_2$$

$$[20\cos\theta - \mu mg + \mu 20\sin\theta]\,t\Big|_0^7 + \frac{5t^2}{2}[\cos\theta + \mu\sin\theta]\Big|_0^7 = mv_2$$

$v_2 = 2.87$ m/s