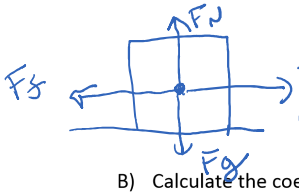
Thursday, November 01, 2018 8:08 AM

Additional Newton's Laws and Friction Problems

Directions: Solve for the problems below using Newton's Second Law of Motion and the friction equation. **Complete a free-body diagram for each problem.**

1. A refrigerator has a mass of 119 kg and is initially at rest on a horizontal floor. It takes a horizontal force of 428 N to set it in motion. Once the refrigerator is moving, it takes a horizontal force of 401 N to keep it moving at a constant velocity.
   A) Calculate the coefficient of static friction between the refrigerator and the floor.



$F_A = F_{fs} = \mu F_N$ (INITIAL)

$\mu = \frac{F_{fs}}{F_N} = \frac{428N}{1167N} = 0.366$

$F_N = F_g = mg = (119kg)(9.81 m/s^2) = 1167N$

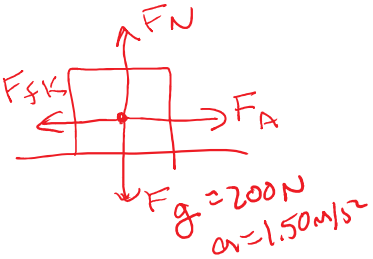
   B) Calculate the coefficient of kinetic friction between the refrigerator and the floor.

$F_A = F_{fK} = \mu_K F_N \rightarrow \mu_K = \frac{F_{fK}}{F_N} = \frac{401N}{1167N} = 0.344$

NOW 401N

2. A student wishes to pull a 200. N *steel* box across on a *steel* surface at a constant acceleration of 1.50 m/s^2.
   A) Calculate the amount of friction between the box and the surface.
   B) Calculate the net force acting on the box.
   C) Calculate the force needed to be applied in order for it to accelerate it at this rate.

KINETIC



A) $F_{fK} = \mu F_N = (0.57)(200N) = 114N$

$F_N = F_g = 200N$

$m = \frac{F_g}{g} = \frac{200N}{9.81 m/s^2} = 20.4kg$

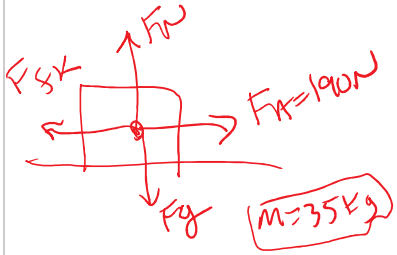
B) $F_{NET} = ma = (20.4kg)(1.5 m/s^2)$

$F_{NET} = 30.58N$

C) $F_{NET} = F_A + (-F_g) \rightarrow F_A = 30.58N + 114N$

$F_A = 144.58N$

3. A clerk moves a box of cans down an aisle by pulling horizontally on a rope attached to the box. The clerk pulls with a force of 190. N. The box has a mass of 35.0 kg and the coefficient of kinetic friction between the box and floor is 0.450.
   A) Calculate the amount of friction between the box and the floor.
   B) Calculate the acceleration of the box.



$F_N = F_g = mg = (35kg)(9.81 m/s^2) = 343N$

A) $F_f = \mu F_N = (0.450)(343N) = 155N$

B) $a = \frac{F_{NET}}{m} = \frac{35N}{35kg} = 1 m/s^2$ RIGHT

$F_{NET} = 190N + (-155N) = 35N$