When you apply a horizontal force of 48 N to a 11.5-kg block, the block moves across the floor at a constant speed. Suppose that for this particular block and floor, $\mu_s = 0.4$.

(a) What happens if instead you apply a force of 40 N to the block initially at rest?

- ◉ The block doesn't move.
- ○ The block moves at a constant speed, but it moves more slowly.
- ○ The block decelerates (the speed continually decreases).

(b) When you apply a force of 40 N to the block initially at rest, what is the magnitude of the horizontal component of the force that the floor exerts on the block?

F_{hor} = 40 N

(c) What happens if instead you exert a force of 58 N?

- ◉ The block accelerates (the speed continually increases).
- ○ The block doesn't move.
- ○ The block moves at a constant speed, but it moves faster.

(d) When you apply a force of 58 N, what is the magnitude of the horizontal component of the force that the floor exerts on the block?

F_{hor} = 48 N

Bob is pushing a box across the floor at a constant speed of 1.5 m/s, applying a horizontal force whose magnitude is 75 N. Alice is pushing an identical box across the floor at a constant speed of 3 m/s, applying a horizontal force.

(a) What is the magnitude of the force that Alice is applying to the box?

F = 75 N

(b) With the two boxes starting from rest, explain qualitatively what Alice and Bob did to get their boxes moving at different constant speeds.

- ◉ Each initially applied a force bigger than static friction to get the box moving and accelerating, then when the desired final speed was achieved they reduced the force to make the net force zero.
- ○ In order to keep the box moving twice as fast, Alice had to apply a constant force that was twice as large as the force that Bob applied.

A 28 kg box sits on a table. The coefficient of static friction μ_s between table and box is 0.28, and the coefficient of kinetic friction μ_k is 0.21.

(a) What is the force required to start the box moving?

F = 76.832 N

(b) What is the force required to keep it moving at constant speed?

F = 57.624 N

A 6 kg box with an initial speed of 7 m/s slides accross the floor. It comes to rest after 1.8 s. What is the coefficient of static friction?

$$F_N = (6 kg)(9.8 \tfrac{m}{s^2})$$

$$= 58.8 N$$

$$P_f = P_i + F_{net} \Delta t$$

$$0 = (7 m/s)(6 kg) + (-F_f)(1.8 s)$$

$$0 = 42 kg \tfrac{m}{s} + (-F_N \mu_k)(1.8 s)$$

$$-42\,kg\frac{m}{s} = -(58.8N)(1.8s)\mu_k$$

$$\mu_k = 0.3968$$

How far did the box travel?

$$a = \frac{F_{net}}{m}$$

$$= \frac{-F_N \mu_k}{m}$$

$$= \frac{-\cancel{m}g\mu_k}{\cancel{m}}$$

$$= -g\mu_k$$

$$= -3.889\frac{m}{s^2}$$

$$r_f = r_i + v_i t + \frac{1}{2}at^2$$

$$= 0 + (7\tfrac{m}{s})(1.8s) + \frac{1}{2}(-3.889\tfrac{m}{s^2})(1.8)^2$$

$$= 6.3\,m$$

You put a 4 kg block in the box so its total mass is now 10 kg. You launch it with the same initial speed. How long does it take to stop?

$$P_f = P_i + F_{net}t$$

$$V_f = V_i + \frac{F_{net}}{m} t$$

$$= V_i + \frac{-F_N \mu_k}{m} t$$

$$= V_i - \frac{\cancel{m} g \mu_k}{\cancel{m}} t$$

$$= V_i - g \mu_k t$$

Time to stop moving has nothing to do with mass so it remain 1.8s

A 24 kg box is being pushed across the floor by a constant force of $\langle 104, 0, 0 \rangle$ N. The coefficient of kenetic friction is 0.17. At $t = 8s$ the box is at $\langle 12, 3, -2 \rangle$ m with a velocity of $\langle 7, 0, 0 \rangle$. What is the position and velocity at $t = 9.7s$?

$$\Delta t = 1.7s$$

$$F_{net} = \vec{F}_a - F_f$$

$$= \vec{F}_a - F_N \mu_k$$

$$= \vec{F}_a - m g \mu_k$$

$$= \langle 64.016, 0, 0 \rangle N$$

$$\vec{P}_f = \vec{P}_i + F_{net} t \Delta$$

$$\vec{V}_f = \vec{V}_i + \frac{F_{net}}{m} t\Delta$$

$$= \langle 11.534, 0, 0 \rangle \frac{m}{s}$$

$$\vec{r}_f = \vec{r}_i + \vec{V}_{avg} t$$

$$= \vec{r}_i + \frac{\vec{V}_f + \vec{V}_i}{2} t$$

$$= \langle 27.754, 3, -2 \rangle m$$