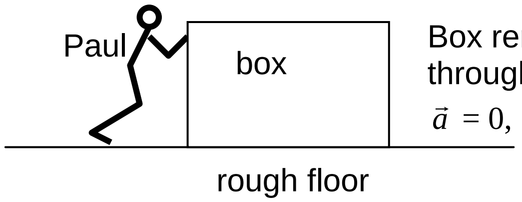
Static Friction

Friction is a sticky issue (pardon the pun) and warrants some thought and discussion. This first page considers the "Not Sliding" (static) case. The back-side considers the "Sliding" (kinetic) case.



Box remains at rest and throughout this page, $\vec{a} = 0,\ \vec{F}_{net} = 0$

1) Draw a free body diagram of the box before Paul starts pushing on it.

   a) Is there a friction force on the box? Explain.

2) Draw a free body diagram for the box while Paul pushes with a force of 5 Newtons. The box remains at rest.

   a) Is there a friction force on the box? Explain.

   b) How many Newtons is it and which way does it point? How do you know?

3) Draw a free body diagram for the box while Paul pushes with a force of 8 Newtons. The box remains at rest.

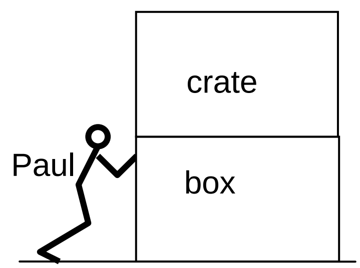
   a) Is there a friction force on the box? Explain.

   b) How many Newtons is it and which way does it point? How do you know?

1
$\vec{F}_{net}$ = $\vec{a}$ =

2
$\vec{F}_{net}$ = $\vec{a}$ =

3
$\vec{F}_{net}$ = $\vec{a}$ =



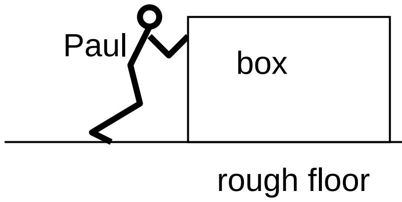
As Paul pushes on the box a crate of identical mass is placed on top. Paul continues to push with a force of 8 Newtons as before.

4) Draw a new free body diagram of the *lower* box. Hint: The 3rd Law, with a FBD of the *crate*, is useful.

   a) Does the length (size) of $\vec{f}_{F,B}$ depend on the Normal force the floor puts on the box, $\vec{N}_{F,B}$? Explain.

4
$\vec{F}_{net}$ = $\vec{a}$ =

Now let's draw free body diagrams after Paul gets the box moving at *constant speed* across the rough floor to study "Sliding" (kinetic) friction.



Box moves at constant speed acceleration = 0, $\vec{F}_{net} = 0$

$\vec{F}_{net}$ =	1
$\vec{a}$ =	

1) Draw a free body diagram for the box while Paul pushes with a force of 10 Newtons.

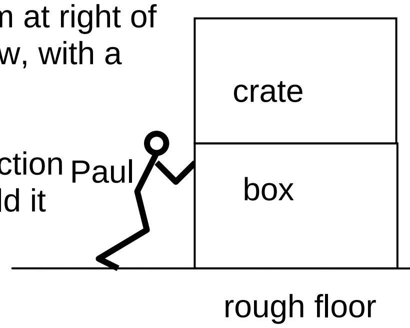
   a) Is there a friction force on the box? Explain.

   b) How many Newton's is it and which way does it point? How do you know?

As Paul pushes the box across the floor at constant speed a crate of identical mass is placed on top. Paul continues to push with a force of 10 Newtons as before. Indicate the direction of $\vec{F}_{net}$ and $\vec{a}$. (Does the box continue at constant speed?)

2) Draw the new free body diagram at right of the *lower* box. Hint: The 3rd Law, with a FBD of the *crate*, is useful.

   a) What happens to size the friction force? By what factor should it increase?



$\vec{F}_{net}$ =	2
$\vec{a}$ =	

   b) Are things still moving at constant speed? Explain.

$\vec{F}_{net}$ =	3
$\vec{a}$ =	

3) Draw a free body diagram at right that shows how hard Paul must push on the box *now* to move at constant speed. Explain.

Summarize the difference between Static and Kinetic friction. Pay special attention to *how* each is calculated.

1) Does ***static*** friction increase as $N_{\mathrm{F,B}}$ increases? See page 1 and explain.

2) Does ***kinetic*** friction increase $N_{\mathrm{F,B}}$ increases? See page 2 and explain.

3) Does ***static*** friction always equal $N_{\mathrm{P,B}}$? See page 1 and explain.

4) Does ***kinetic*** friction always equal $N_{\mathrm{P,B}}$? See page 2 and explain.

5) How should one find Static friction? How many ways are there?

6) How should one find Kinetic friction? How many ways are there?