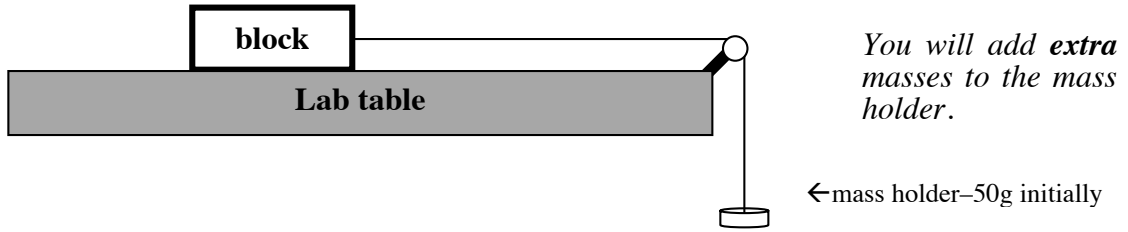


**I. Static friction**

- A. Attach a string to one end of the block and drape the other end over the pulley on the end of the table as shown below. Attach a mass holder (it has a mass of 50g!) to the end of the string.



[12 pts] In the spaces below, draw the free body diagram for the block as you add the specified amount of mass to the mass holder.

Calculate the magnitudes of the forces so that you can draw your vectors the appropriate lengths.

	•	•	•
<i>total</i> mass on string:	50g	150g	200g
weight force (remember units!)			
normal force			
tension force			
friction force			

[2 pts] List which forces remain **constant** and which forces **change** as you add mass to the holder.

Constant magnitude:

Change magnitude:

- C. Attach the computer-controlled force probe to the end of the string in place of the mass holder. Determine the magnitude of the frictional force required to **just start** the block sliding. Do this 10 times by **slowly** increasing your pull until the block suddenly moves. Then, let the string go slack and repeat. Record your measurements below.

Trial #	Frictional force (Newtons)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
<b>Average:</b>	

[4 pts] Draw and **correctly** label the free body diagram for the block when it is **just about** to break free and move.

[2 pts] Calculate the coefficient of static friction,  $\mu_s$  for the block and the surface.

- D. Place a 1.0-kg mass on top of your block. As before, determine the magnitude of the frictional force that just starts the block moving. Record your data in the table for the 10 measurements. Then, repeat your measurements with a 2.0-kg mass on top of your block.

Trial #	Frictional force (Newtons) 1.0-kg added	Frictional force (Newtons) 2.0-kg added
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
<b>Average:</b>		

[4 pts] Calculate the coefficient of static friction,  $\mu_s$  for the block and the surface for **both** cases.

[2 pts] How does your number for  $\mu_s$  in this case compare to that obtained before? Pay attention to the general size only.

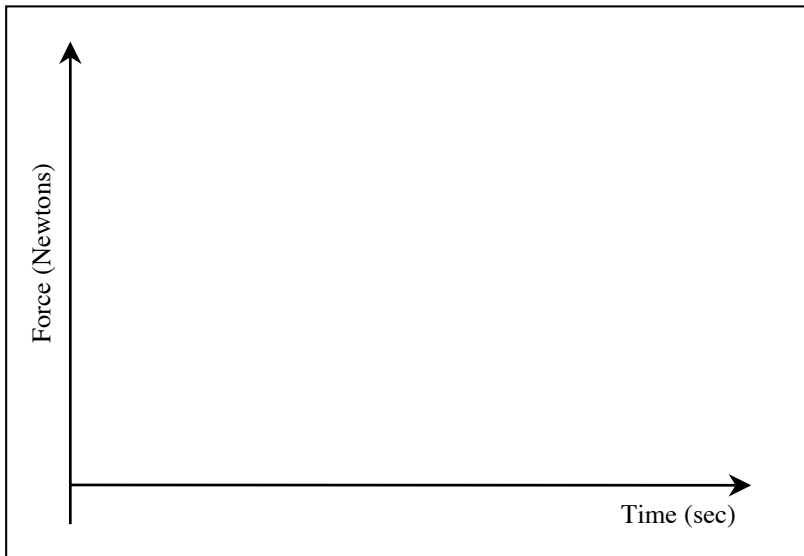
**II. Kinetic friction**

- A. [6 pts] Starting from rest, apply enough force to the block (no added mass) to start it moving, and then to keep it moving at a *constant* speed across the table for a few seconds.

After letting the string go slack, add a 1.0-kg mass and repeat your measurements. Let the computer keep taking data.

After letting the string go slack again, add a 2.0-kg mass and repeat your measurements.

- [3 pts] On the graph below, carefully (don't get sloppy) draw what you see on the screen for these three measurements.



- [4 pts] Draw and correctly label the free body diagram for the block when it is *moving at constant speed*.

- [3 pts] On the graph above, circle the three locations where the static frictional force was broken and the block began to slide.

[2 pts] Which coefficient of friction is larger: static  $\mu_s$  or kinetic  $\mu_k$ ? (circle one)

- [6 pts] Calculate the coefficient of kinetic friction,  $\mu_k$  for the block on the surface for all three cases above. Use the “stats” button in the program to take the average of the points while the block was sliding at constant speed.

- [3 pts] How do your coefficients,  $\mu_s$  and  $\mu_k$ , compare to each other?

*Have your answers checked before turning this lab in for a grade.*