Friction Lab #2: Physics

<u>Purpose</u>: To measure the coefficient of friction between two materials, using two different methods.

Materials: - you write

General Concepts and pre-lab questions:

There are a few ways to measure the coefficient of friction. First, you must know the definition of the coefficient. It is the ratio of the force of friction between two objects that are in contact and the normal force. Therefore, you must figure out a way to measure those two variables, and then calculate the ratio. You must determine whether you are going to measure the *static* or the *kinetic* coefficient of friction. Static friction opposes the movement of objects so this must be measured as the maximum force (on the spring scale) under which the object does not move. Kinetic Friction occurs as the object is being moved across the table. This force is measured as the maximum force (on the spring scale) when the object is moving at a constant velocity.

1. The static coefficient is abbreviated _____, while the kinetic is abbreviated _____

2. The formula for calculating the coefficient of static friction is ______

3. The formula for calculating the coefficient of kinetic friction is ______

Hypothesis: Which coefficient of friction do you expect to be lower, static or kinetic? Why?

Procedure:

- 1. Measure the mass of an object which is to be pulled or dragged along another surface and convert the g to kg
- 2. Use a spring scale (use the unit "pounds" or "lb") to measure the maximum static horizontal force which can be applied before the object starts to slide. Record the force, and the units your scale uses.
- 3. Use the spring scale (in "lbs") to measure the force which is required to drag the object at a slow constant speed along the horizontal surface. This is equal to the kinetic friction. Record the pulling force, including units.
- 4. Increase the normal force between the surfaces by adding mass (200-500g) on top of the dragged object.
- 5. Repeat steps 2 and 3, recording the pulling forces.
- 6. Repeat steps 4, 2, and 3, three more times, for a total of 5 dragged masses.
- 7. If time, pick another set of surfaces and repeat this experiment in the 2nd data table

<u>Data and Results Table</u>: (Dark-bordered cells are for raw lab data. Other cells are results, which can be calculated after data collection is complete.)

Surfaces:							
Mass (kg) (including any added mass)	Weight of the object being dragged (N)	Max static pulling force (Include units!)	Max static pulling force (pounds converted to Newton's)	Constant kinetic pulling force (Include units!)	Constant kinetic pulling force (converted to Newton's)	Static coefficient of friction μ_s	Kinetic coefficient of friction µk

Surfaces:							
Mass (kg) (including any added mass)	Weight of object being dragged (N)	Max static pulling force (Include units!)	Max static pulling force (Newton's)	Constant kinetic pulling force (Include units!)	Constant kinetic pulling force (Newton's)	Static coefficient of friction µs	Kinetic coefficient of friction µk

Data calculations:

- 8. Calculate the weight of the moving mass to get your Fn
- 9. Convert the pounds of force into Newton's of force

10. Use your data and your equations to calculate the coefficients for static and kinetic friction

Lab Questions:

1) Was your hypothesis correct? Explain.

2) Draw and label a free body diagram showing the forces acting on the object as it sits on the table at rest.

3) Draw and label a free body diagram showing the forces acting on the object as it slides across the table

4) Calculate the average static and kinetic coefficients of friction between the surfaces you selected.

5) If a crate with a mass of 68.0kg were sitting on a level surface, and the crate and surface materials were the ones you used for lab, calculate the maximum static and kinetic horizontal frictional forces (use your average coefficients!)

6) How much horizontal applied force would be necessary to accelerate the crate at 0.78 m/s²?

Conclusions:

Explain in regular words what the coefficient of friction is. Explain the difference between static and kinetic friction. Give multiple real life scenarios in which it is important to know the coefficient of friction. State a few ways to increase frictional force, and a few ways to decrease it, in those real life scenarios.