PHYSICS 2204
Unit 2: Dynamics
Core Lab #2: Exploring Friction

STUDENT NAME:_____

DATE:_____

GROUP MEMBERS:

_____ _____

PURPOSE: The purpose of this activity is to explore carry out an experiment that will lead to a relationship between the frictional force and the normal force. You will also be able to determine the coefficient of friction for a particular object.

BACKGROUND:

This lab was designed to have students notice the difference between static friction and sliding friction. They will change the mass of an object that is being pulled across a surface and plot out the changes to friction vs. normal. They will use the slope of this graph to determine the coefficient of friction for their surface..

PROCEDURE:

You need to click on the link in the dynamics section found on Mr Fifield's Corner

DATA/ CALCULATIONS:

PART 1: Exploring Friction

First let's briefly define something called the "normal force" as the force that presses two surfaces together. In this course we will work with horizontal surfaces. As long as this is the case, the normal force will be the weight of an object that is resting on the surface. Later we'll refine this definition.

The normal force is simply the weight, in newtons, of the block. A vernier meter is attached to the block to measure force, Pressing "start" will apply an increasing horizontal force to the block. At some point the force will be sufficient to just barely overcome friction and the mass will begin to move uniformly across the surface.

At this point the applied force, Fapp will just balance the frictional force F_f.

Since the two forces are acting in opposite directions (friction ALWAYS opposes motion) you can write:

$$F_{app} = -F_f$$

While the block is moving uniformly across the surface a Force -Time graph is created. will allow you to get a precise reading of Fapp from the spring scale.

To complete the table on page 2:

- Use 6 different masses for an object

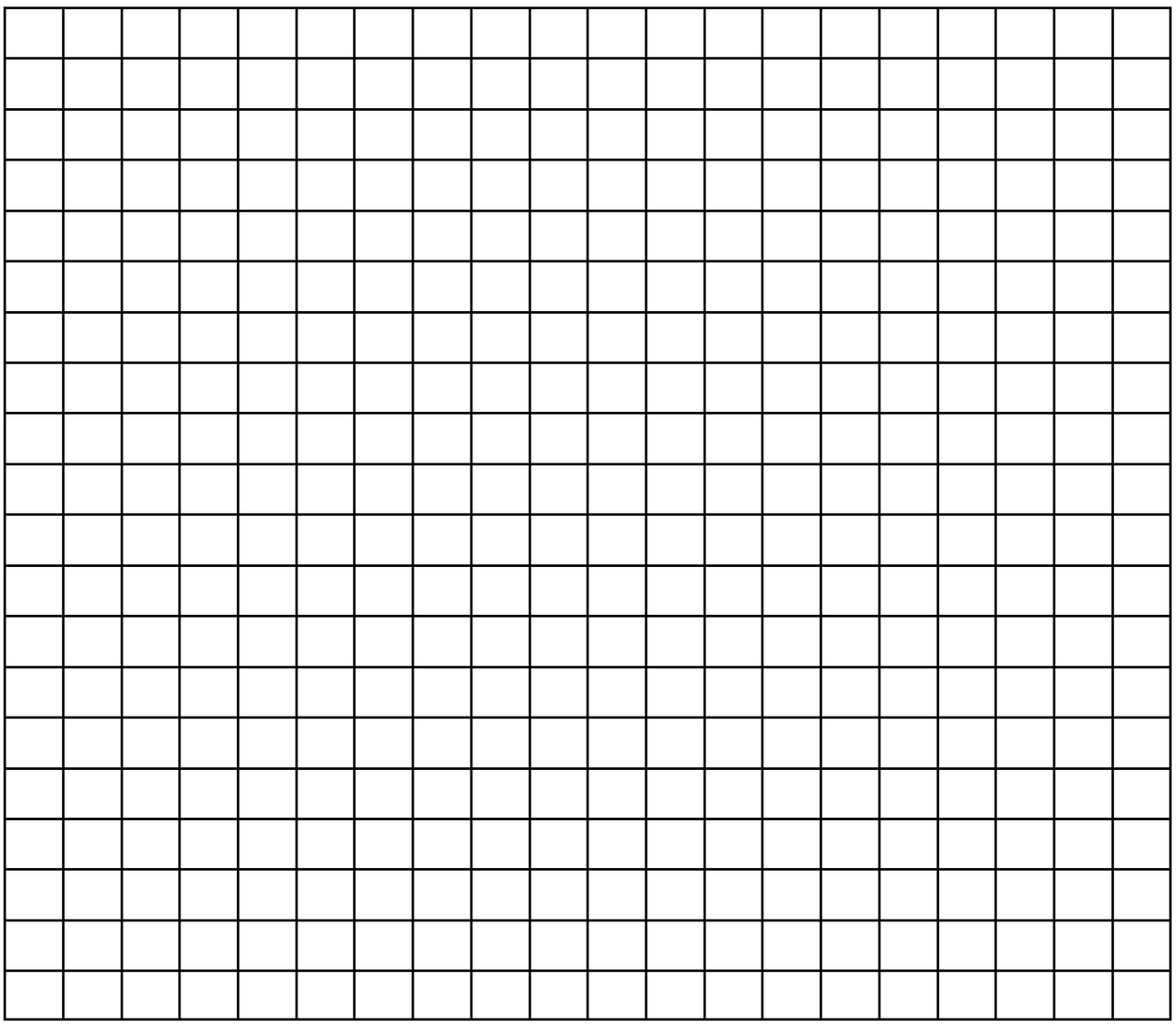
- Calculate the force normal for each mass

- Use the force - time graph to determine the force of kinetic friction the

Complete the table below

Trial	Mass	Force Normal	Friction Force
1			
2			
3			
4			
5			
6			

Use the data from the table to construct a graph. Put Ffr on the vertical axis and the normal force on the horizontal axis.



1. Look closely at your data and explain why it is reasonable to say that the frictional force is directly proportional to the normal force.

2. What is the value of the slope of your line.

3. What does the slope represent

4. Why is it reasonable to write the following equation?

$$\text{frictional force} = \mu \times (\text{normal force})$$

A note about two kinds of friction

Place your calculator on the nearest table. Push gently on it until it starts to move uniformly. Notice that it didn't move smoothly--instead it starts with a bit of a jerk. When this happens you slightly decrease the applied force and the calculator keeps on moving.

This is because the frictional force for a stationary object (the static friction) is greater than the frictional force for an object that is moving (the kinetic friction).

Play any part of the animation again--higher values of the normal force are better. Look closely at the behavior of the vernier at the instant the object starts to move. Play the animation several times if need be--in that way you'll be able to predict when the motion will start.

5. How does the behavior of the spring scale (at the moment the object starts moving) illustrate the difference between static and kinetic friction?

DISCUSSION/ANALYSIS:

1. Examine the following:

(A) A concrete block has a mass of 15.0 kg. The coefficient of friction between the block and the floor is 0.90. Calculate the frictional force required to keep the block moving uniformly.

(B) The coefficient of friction between a pair of sneakers and the floor is 1.2. If you have a mass of 65 kg and are standing (in your sneakers) on a horizontal floor, what force will be needed to drag you along the floor?

(C) The coefficient of friction between the tires of your bike and the road is 0.90. If you lock the wheels what frictional force will be required to drag you along? Assume that you and the bike have a combined mass of 120 kg.

2. The coefficient of kinetic friction between the tires of a sports car and the TCH is 1.20. The car has a mass of 950.0 kg. Suppose that the driver "locks" the wheels. What frictional (braking) force will be applied to the car as a result?

3. A skater has a mass of 72.0 kg. The coefficient of friction between the skates and the ice is 0.012. What force is needed to keep the skater moving uniformly across the ice?

4. An applied force of 400.0 N is needed to keep a sled-load of firewood moving uniformly across the snow. What is the coefficient of friction between the sled runners and the snow if the mass is 200.0 kg?**ANSWER 0.20 N**

5. Here's something to think about. You may recall that at the end of Part 1 it was mentioned that static friction is greater than kinetic friction. When you "lock" the wheels of a car during emergency braking the braking force is the kinetic frictional force between the tires and the road. When the tires are rolling, however, the braking force is actually static friction since the tires are not actually slipping. With this in mind, why are antilock brakes a good idea?

CONCLUSION: