Friction [NOTEBOOK LAB]

Purpose:

- To learn how to measure the coefficient of frictions for various materials
- To explore the relationship between static and kinetic friction.

Pre-lab

What is the coefficients of kinetic friction and the coefficient of static friction for the pair of materials you are investigating? (Note you will use these objects for Table D1, D2, and E)

Theory:

There are two kinds of friction: static and kinetic. For static friction, the maximum force of friction is equal to the coefficient of friction times the contact force between the body and the surface. For kinetic friction, the force of friction is equal to a coefficient of friction times the contact force between the body and the surface. In this experiment, you will determine the coefficients of static and kinetic friction and compare the two coefficients of friction.

The apparatus you will be using will be a horizontal plan with a pulley at one end. You will test for both coefficients of friction for 2 different types of materials on wood. Then you will use the air track to test the amount of friction between the glider and the track.

1. Clean off the surface remove excess dust and oils. You don't need a smooth surface, but a uniform surface is key.
2. Select the block with no pads on the bottom.
3. Determine the mass of the block.
4. Connect a string to the block and pass the string over the pulley wheel so a hooked slotted mass hanger can be connected to the string.
5. Determine the mass of the slotted mass hanger.
6. Your configuration should look like the picture below

m_{cart}

$m_{hanging}$
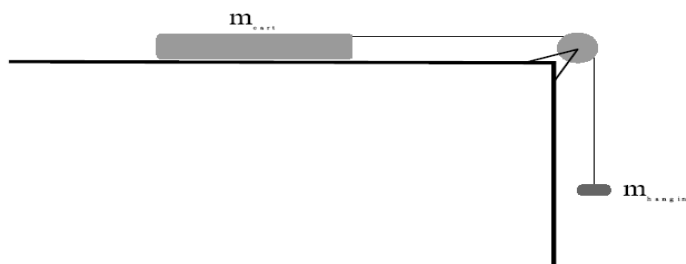
For static friction,
$f_s^{max} = T_{wire}^{max}$
$f_s^{max} = \mu_s N$

Procedure A1:

Static Friction on a Flat Surface

1. Carefully add masses to the hanger to determine the amount of mass required to make the block start to slide.
2. Note the mass of the block and the amount of hanging mass need to start the block moving. Enter the two pieces of data in the table. Make sure to use a digital balance to determine these masses.

3. Now add 200 grams to the top of the block and determine the new required hanging mass to make the block just start to move. End the data in the data table in row 2.
4. Now add 200 more grams or 400 total grams to the top of the block and determine the new required hanging mass to make the block just start to move. Again enter the data into the data table.
5. Calculate the coefficient of friction using the equation $F_F = F_n * \mu$. Enter these values in the table.
6. Average the coefficients of friction.

Procedure A2:
<div align="center">

Kinetic Friction on a Flat Surface
</div>

For measure the kinetic friction, you must tap the block to just have the block overcome static friction. Remember you want the block to slide with a constant speed. You must make this determination. You must figure out when it seems the block slides with constant speed. \

1. Start with just the block and the slotted mass hanger.
2. Add masses to the hanger until when you tap the block the block appears to slide with a constant velocity.
3. Note the block's mass and the hanging mass. Enter the data into the data table provided.
4. Now add 200 grams to the block and repeat steps 2 and 3.
5. Add 200 more grams and repeat steps 2 and 3.
6. Calculate the coefficient of friction using the equation $F_F = F_n * \mu$. Enter these values in the table.
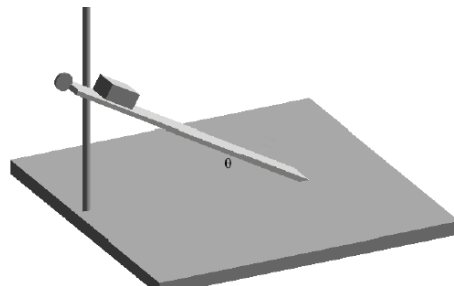7. Average the coefficients of friction.

Procedure B1 and B2:
Repeat procedures A1 and A2 with the block with the pads on the bottom.

Procedure C:
Using only glider and the air track used in procedure B1. For the mass to slide down the incline at constant speed the net force (parallel to the plane) must be zero. This is, the weight component of the mass down the incline ($mg \sin\theta$) must equal the kinetic friction f_k. The kinetic friction, $f_k = \mu_k (mg \cos\theta)$. Determine μ_k as a function of θ.

1. Using the same masses as in part d of the kinetic friction, measure the angle for which the masses will slide down at a constant speed. Remember that you will need to lightly tap the cart to start it sliding (to overcome static friction).
2. Average the values of the coefficient of kinetic friction and compare as a % error with part d values.

Table A1

	$m_{block\ (kg)}$	$m_{hanging}$	$F_{app} = F_f$	F_n	μ_s
Block					
Block + 0.2kg					
Block + 0.4kg					
				Average=	

Table A2

	$m_{block\ (kg)}$	$m_{hanging}$	$F_{app} = F_f$	F_n	μ_k
Block					
Block + 0.2kg					
Block + 0.4kg					
				Average=	

Table B1

	$m_{block\ (kg)}$	$m_{hanging}$	$F_{app} = F_f$	F_n	μ_s
Block					
Block + 0.2kg					
Block + 0.4kg					
				Average=	

Table B2

	$m_{block\ (kg)}$	$m_{hanging}$	$F_{app} = F_f$	F_n	μ_k
Block					
Block + 0.2kg					
Block + 0.4kg					
				Average=	

Table C

	$m_{block\ (kg)}$	θ	$F_p = F_f$	F_n	μ_k
Block					
Block + 0.2kg					
Block + 0.4kg					
				Average=	

1. Compare the average of D2 with E.
2. How does μ_s compare to μ_k.

Name:_____   Date:_____

Dr. Croom's Physics   Lab 06-9

Questions/Things you need to do individually:

Purpose (5pt)
      Include

Hypothesis (5pt)
      Based on the coefficient of friction tables you have previously used, estimate the coefficient of kinetic and static friction for wooden block on wood.

Data (10pt)
      Print and attach the data tables into your notebook.

Calculations (5pt)
      Show an example of how the last three columns of row 1 of tables D1, D2, and E are calculated.

Error Analysis (10pt)
      Write a strong error analysis section explain causes of error

Results (10pt)
      State the coefficients of friction for each material pair and explain why they are not the same.
      Compare the coefficients of kinetic friction and static friction for each of the materials.
      Compare your hypothesis to the results
      Compare the results in Table D with Table E