**Name:**

**Lab Partners:**

**Course: AP Physics**

**Period:**

**Date:**

**AP Lab #4- The Coefficient of Static Friction**

**Purpose/ Problem:** To determine and compare the values of the coefficient of static (non-sliding) friction between a wooden block and a wooden ramp when measured directly with spring scales and when using an alternate method that you will design (and write here instead of calling it an “alternate method”).

**Hypothesis:** The coefficient of static (non-sliding) friction between the wooden block and the wooden ramp when the ramp is horizontal will be greater than/ less than/ the same as (choose **one** of these for **your** hypothesis and do not write the others nor include this parenthetical in your write-up) the coefficient of static friction when using the alternate method (which you will not call “alternate method”, but call it whatever your group did).

**Background:** (Do not include this section in your final write-up). You already know that the coefficient of static friction between two surfaces trying to slide against each other is given by  = Ffriction, maximum / Fnormal. There are other ways to determine this coefficient, however, than to measure the friction force and the normal force then to divide them. You will come up with one and employ it to find the coefficient of static friction here.

This lab is going to be a bit more "inquiry based" than the others so far (i.e. I'm not going to tell you what to do except for a couple of hints—you and your lab partners need to create an experimental design). When you come into class tomorrow, you will be given the following equipment: spring scale [for use in Part 1 ONLY], electronic balance [also for use in Part 1 ONLY], hooked wooden block, wooden board (ramp), vertical stand for metal rod and crossbar with clamps, meter stick/tape measure.

**Materials:** List only the items you actually use, not necessarily all those given to you (unless you use them all).

**Experimental Design & Procedure:**

Use the equipment provided (and anything else you might ordinarily bring to class) to determine the coefficient of static friction between the board and the block. Beyond the initial setup in Part 1 provided for comparison, the experimental design is entirely up to you. I am not going to tell you what to do. Have fun!

Sketch of set up (Part 1):

Sketch of set up (Part 2):

(don’t forget to include your diagrams)

**Part 1:**

1. Zero the spring scale by laying it horizontally and pulling the front scale tab “up” or “down” until it reads “0”.
2. Measure the mass of the metal cube/block on the electronic balance and record it in the data table. This value should be the same for all five trials.
3. Place the wooden block on the ramp with the ramp lying horizontally on the lab table. Slowly pull on the block horizontally by the hook with the spring scale until it just breaks loose from the board and begins to slide. Record the maximum spring scale value just as it breaks loose (as precisely as is justified) in the data table. Repeat this procedure four more times so that you have five trial values in the table. You will use this value to find the “correct” value of the coefficient of static friction for the sake of comparison.

**Part 2**:

1. This part is up to you! Repeat your measurements five times for a good comparison.

**Observations & Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Mass of Wooden Block  (kg) | Spring Scale Reading When Ramp is Horizontal  (N) | ? |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| Average |  |  |  |

**Analysis:**

1. Using the *average* values of the data in the first two columns of the table and showing all relevant work (definitely start with a free body diagram and F equations in both the *x* and *y* directions), **calculate the coefficient of static friction** between the wooden block and the ramp **when the ramp is horizontal**.
2. Using the *average* value of the data in the other column(s) of the table and showing all relevant work, **calculate the coefficient of static friction** between the wooden block and the ramp in whatever arrangement you designed **using your own procedure**.

3. How do the two calculations of the coefficient of static friction compare?

(Remember, "compare" means to **find a percent difference**)

**Conclusion** (Make sure to observe the guidelines given in the previous labs)**:** What do you conclude from your analysis? Is this what you expected? Why?

NOTE:

1. **Please print out and attach the rubric found on the next page**
2. **Also, include the questions in the Analysis section of your lab report**

***Lab Report* Rubric**

**AP Physics 1 Lab #4: Determining Coefficient of Static Friction**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period\_\_\_\_\_\_\_\_\_

**15 pts**

Penalty Box (check means that there are problems in that area)

|  |  |
| --- | --- |
| □ lab notes not attached to lab report  □ doesn’t use third-person voice  □ lab framework is not followed (calculations not in analysis section, data tables not together in proper section, etc) | □ more than a few obvious spelling/grammatical errors  □ math is not easy to follow (original algebra not shown, plug-in not shown, unclear progression) |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Missing** | **Inadequate** | **Needs** **Improvement** | **Adequate** | **Points** |
| **Title, Heading, Purpose, Hypothesis, Materials** (1 pt) | | | | |  |
| **Graphs**  (2 pt) | Concern with 3 or all:  \* correct labels & units \* axes are scaled correctly \* best-fit line \* detailed title | Concern with two:  \* correct labels & units \* axes are scaled correctly \* best-fit line \* detailed title | Concern with one:  \* correct labels & units \* axes are scaled correctly \* best-fit line (points drawn from table rather than line)  \* detailed title | \* correct labels & units  \* axes are scaled correctly  \* best-fit line(s)  \* detailed title(s) |  |
| **Diagrams & Data Tables**  (2 pt) | \* diagram is missing  \* data tables are missing or extremely vague (i.e. numerical values only) | \* diagram is unclear or unrelated  or has major omissions  \* data tables have major omissions  (i.e. table missing for a graphed set of data) | \* diagram is vague or has minor omissions  \* data tables have minor omissions  (i.e. units incorrect or missing) | \* diagram present & clear  \*diagram labeled and captioned as necessary  \* data tables clear and complete  \* tables include labels and proper units |  |
| **Procedure & Conclusion**  (2 pt) | \* procedure or conclusion extremely vague or missing altogether  \*unintelligible  \*missing: no attempt made to explain | \*major problems with procedure and conclusion  \*unclear with important details missing  \*lengthy/unrelated digressions  \*vague or ambiguous statements | \* minor problems with procedure and conclusion: unclear  \*vague details or omissions  \* effort required to comprehend the progression  \*unrelated digressions  \*All logical steps present, but in non-sequential order | \* procedure clear & complete, matching what was actually done  \* conclusion is drawn that is related to the purpose/problem  \* makes sense on 1st read-through  \* organized, sequential, argues from evidence |  |
| **Error Analysis**  (2 pt) | \*error analysis missing  \*emotional response  \*”miscalculation” or ”mistake”  \*”faulty equipment”  \*”human error” | \*estimated values not related to calculated results  \*no attempt/failed attempt to quantify  \*ambiguous, unclear language  \*missing necessary diagrams  \*incorrect statements | \*sources of error identified, but focus on non-major sources  \*estimated values unfounded or unreasonable--related loosely/not related to calculations  \*ambiguous, unclear language  \*incorrect statements | \*major sources identified & explored  \* quantified (amounts estimated)  \*shows effect on calculation  \*diagrams included |  |
| **Analysis Questions**  (6 pt) | These are graded question by question.  -please include questions along with the answers in the lab report- | | | |  |
| **Total :** | | | | |  |