Physics

Friction Lab #1

Objective: As a class, we’ve discussed, diagrammed and calculated different types of forces. To this point, we have yet to discover how frictional forces can be calculated. The goal of this lab is to understand one relationship between kinetic frictional force and normal force.

Pre-Lab: Define the following terms and give their FBD symbols

Normal Force:

Kinetic Friction:

Applied Force:

How do you calculate Fg (weight)?

Part 1: Procedure

1. Log on to the computer.

2. Find the “Forces in 1-Dimension” simulation on the PHeT website.

 A) http://phet.colorado.edu/en/simulation/forces-1d

 or

 B) Search “PHeT Forces in 1 Dimension”

3. Open the simulation

 A) Click in the picture or “Run Now!”

 or

 B) Click ‘download”. Open the file from the bottom tool bar.

4. Set up the following parameters before starting the lab.

 A) Click “Graph Applied Force”

 B)

 C)

 D) Choose the file cabinet from the menu on the right. Draw a FBD of the file cabinet sitting at rest on the ground.

5. Calculate the force of gravity (weight) of the file cabinet and enter it into the data table below. Since each object is on level ground, the force gravity will equal the force normal. Add this to the data table too.

6. Enter “2000” into the box labeled “applied force”

 

7. Click “Go”

8. Record the “Applied Force”, “Frictional Force” and “Total Force” into the data table below.

9. Repeat the process for the other four objects (refrigerator, crate, textbook and sleeping dog)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Object | Mass (kg) | Fg (N) | FN (N) | FA (N)  | Ff (N) | Total F (N) | Ff/FN |
| File cabinet |  |  |  |  |  |  |  |
| Refrigerator |  |  |  |  |  |  |  |
| Textbook |  |  |  |  |  |  |  |
| Crate |  |  |  |  |  |  |  |
| Sleepy Dog |  |  |  |  |  |  |  |

10. Calculate the ratio of frictional force to normal force. (friction divided by normal) Enter this number into the last column of the above data table.

Stop! Answer the following questions before continuing.

1. Why does the last column (right) of the data table not have units?

Part 2: Analysis

1. Open the “more controls” menu on the right side of the screen.

You’ll see you can change the location (gravity), the mass of the object, the coefficient of static friction and the coefficient of kinetic friction. You should notice something about one of these numbers.

2. Change the coefficient of static friction to “0.6” and the coefficient of kinetic friction to “0.3”

3. We will be doing this experiment on the Earth, so change the gravity to ‘9.8.’ or something close

4. Repeat the experiment from part 1 using the new parameters. Applied Force = 2000 N

Data Table #2: Changing Mass

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | Mass (kg) | Fg (N) | FN (N) | FA (N)  | Ff (N) | Total F (N) | Ff/FN |
| 1 | 50 |  |  |  |  |  |  |
| 2 | 100 |  |  |  |  |  |  |
| 3 | 150 |  |  |  |  |  |  |
| 4 | 200 |  |  |  |  |  |  |
| 5 | 250 |  |  |  |  |  |  |
| 6 | 300 |  |  |  |  |  |  |

1. Open LoggerPro software.

2. Create a Ff vs FN graph. Remember to label your title, units and axis.

3. Use “analyze” and “linear fit” to find the line of best fit.

4. Below, sketch a graph your data including max/min values, axis labels, and a title.

5. Write a mathematical model for the line of best fit. (substitute into y=mx+b…. we’ve been doing this for months, there should not be a ‘y’, ‘m’, ‘x’ or ‘b’ written in your equation.)

Stop! Answer the following questions.

1. Make a statement about the slope of the line of best fit and y-intercept.

2. How does the slope of the line of best fit relate to anything on your data table? (Look for similar numbers or a pattern)

Stop! Answer the following questions.

1. If you were to graph Ff vs Fn, what would you expect the slope of the line of best fit to be?

2. Go online and look up “coefficient of friction”. Write down a definition that you can understand, possibly including an example. (Include the source/site information)

Lab Question 1. If the coefficient of friction is changed, how does that affect frictional force? (use the simulation)

Lab Question 2. If the mass of an object changes, how does that affect the frictional force? (Use the simulation)

Part 3: Post Lab Questions (You must show work for calculations and write complete sentences for written answers.)

Review 1. What is the weight of a 70. kg person on the moon?

Review 2. A box weighs 150. N on Earth, what is its mass?

Review 3 (Bonus from Chemistry). A chunk of gold is found on the moon weighing 8.0 N. How many atoms of gold are present in the chunk?

Review 4. Draw a force diagram of a box sliding to the right that is slowing to a stop.

Review 5. Draw and label a FBD (include numbers) for the following situation. A man pulls a 50. kg box with 75 N of force to the left. The box does not move.