Laboratory Investigation Name _____

Physics@Frisch Date _____ Period _____

Friction and the Inclined Plane

Problem

Is it more work lifting or sliding an object?

Introduction

When you do work with a machine, in addition to accomplishing useful work, you do work to overcome friction. The work you do using a machine is the work input (W_i). Work input includes useful work and work done overcoming friction. It is the product of the effort made to move the object and the distance through which the object is moved ($W_i = F_E \text{ X } D_E$). The useful work is the work output (W_o). Work output is the product of the weight of the object, and the height the object is raised ($W_o = F_R \text{ X } D_R$). The difference between the work input and the work output is the work done overcoming friction ($W_F = W_i - W_o$). In this laboratory exercise, you will calculate the work input, work output, work overcoming friction, efficiency, and mechanical advantage of an inclined plane..

Materials (*per group*)

Assorted objects; inclined plane; meter stick; spring scale

Procedure

1. There are several objects at your lab station that you will pull up an inclined plane. Write the names of the objects in the data table on the next page.

2. Adjust your spring scale so it shows a force of zero newtons when it hangs straight down. Using the spring scale, weigh one of the objects and record its weight.

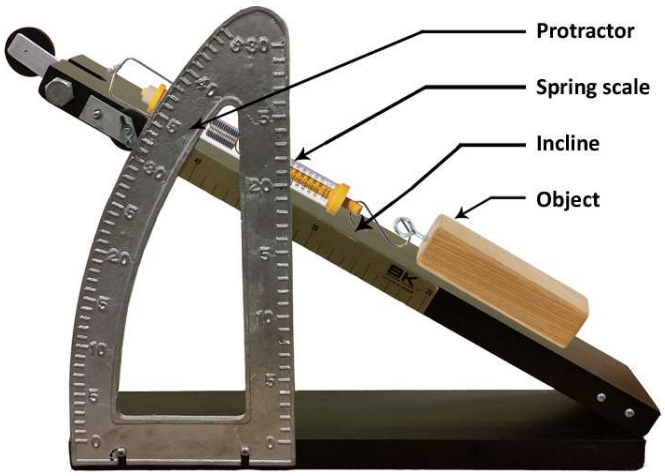
3. Adjust the incline to an angle of 0°. Adjust your spring scale so it shows a force of zero newtons when it is resting on the incline's horizontal surface. Using the spring scale, drag the object you weighed in step 2 along the horizontal incline. Measure the force needed to drag the object and record the result.

4. Measure the length of the incline in meters from its beginning to where it intersects the curve of the protractor. Record the length.

5. Adjust the incline to an angle of 30°. Measure the height of the incline in meters where it intersects the curve of the protractor, and record its height.

6. Adjust your spring scale so it shows a force of zero newtons when it is resting on the 30° incline. Using the spring scale, drag the object you weighed in step 2 up the incline at a constant rate. Record the force needed to drag the object up the incline..

7. Repeat the procedure with each of the other assorted objects.



Calculations

8. Calculate the coefficient of friction by dividing the force of friction (the force needed to slide object horizontally) by the normal force (the object's weight . Record the result.

9. Calculate the work output in each case by multiplying the weight of the object by the height of the incline. Record the result.

10. Calculate the work input in each case by multiplying the force exerted dragging the object up the incline by the length of the incline. Record the result.

11. Calculate the work done overcoming friction (W_F) in each case by subtracting the work output from the work input. Record the result..

12. Calculate the IMA, AMA, and efficiency in each case. Record the result.

$$IMA = \frac{length}{height} \quad AMA = \frac{weight}{effort} \quad Eff = \frac{W_o}{W_i} \times 100$$

OBSERVATIONS

Name of object			
Weight of object			
Force needed to slide object horizontally (friction)			
Coefficient of friction			
Length of incline			
Height of Incline			
Force needed to pull object up incline			
Work output			
Work input			
Work done overcoming friction			
Ideal Mechanical Advantage			
Actual Mechanical Advantage			
Efficiency			

CONCLUSIONS

1. How does the work output compare to the work input? Why? _____

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2. How does the force needed to pull the object up the incline compare to the weight? Why? _____

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3. How does the IMA compare to the AMA? Why? _____

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4. What is the purpose of an inclined plane? _____

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