Simple Machines: The Inclined Plane Lab

Introduction:

A simple machine can be used to make work easier. This doesn't mean that you can get by with less work. If fact, you <u>always</u> will have to do more work when you use a simple machine than if you don't use one!

Remember: a simple machine reduces the **force** you have to use; it does not reduce the amount of work you must do. With simple machines we are able to reduce the force that must be used by exerting that force through a larger distance. When the force is less we say the job is "easier."

You have learned that scientists describe the helpfulness of simple machines in terms of **Mechanical Advantage**. A machine's mechanical advantage is the number of times the machine multiplies force. (It compares the input force with the output force) For example, imagine that you had to push a 500 N weight up a ramp and only needed to push with 50 N of force the entire time. The mechanical advantage would be the output force (500 N) divided by the input force (50 N) for a mechanical advantage of 10. A machine that has a mechanical advantage that is greater than 1 can help move or lift heavy objects because the output force is greater than the input force.

There are two types of mechanical advantage. An **Ideal Mechanical Advantage** (if everything worked perfectly) and the **Actual Mechanical Advantage** (the mechanical advantage you actually get).

People also tend to be interested in the **efficiency** of the simple machines they use. Efficiency compares how much work goes <u>into</u> a simple machine with how much work comes <u>out</u>.

In this lab you will be finding the mechanical advantage and efficiency of an inclined plane. You will see if changing the angle (by changing the height) of the inclined plane or adding mass to the resistance will change any of these.

Remember to record all data and answer all questions on the lab write-up.

Purpose: In your own words, state the purpose of this lab.

Lab Formulas:

Work = Force X Distance

$$IMA = \frac{\text{Distance In (length of ramp)}}{\text{Distance Out (height of ramp)}}$$

$$AMA = \frac{\text{Force Out (weight of cart)}}{\text{Force In (effort force)}}$$

$$\text{Efficiency (in \%)} = \frac{\text{Work Out}}{\text{Work In}} \times 100$$

Lab Materials:

Inclined plane	2 ring stands	ring stand clamp
Cart	meter stick	5 N & 10 N spring scale

Procedure:
1) Set up the inclined plane so the height of the ramp is 30 centimeters. (I recorded the height on the lab write-up for you).
2) Measure the length of the ramp (inclined plane) in meters; record.
3) Attach one end of the string to the cart and the other end to the spring scale.
4) Measure the weight of the cart.
5) Pulling parallel (along the ramp angle), pull the cart up the ramp at a constant speed with the spring scale. Record the effort force needed.

Calculations: Use the formula to calculate the work done in lifting the cart 30 cm without the ramp. (That will be the "Work Out" in your calculations.) Then calculate the ideal mechanical advantage (IMA), actual mechanical advantage (AMA), the work required to raise the cart ("Work In"), and the efficiency of the ramp.

Predictions:
1) Will the ideal mechanical advantage increase, decrease, or remain the same if you make the inclined plane steeper?
2) Will the efficiency increase, decrease, or remain the same if you make the inclined plane steeper?

6) Now, raise the ramp height to 45 centimeters and fill in the data table for that height.

Analysis and Conclusions: Answer the questions on the lab write-up.

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Name: _____

Purpose(What is the point?): _____

_____

Lab Materials (What was used):

Predictions:

1) Will the ideal mechanical advantage increase, decrease, or remain the same if you make the inclined plane steeper? _____

2) Will the efficiency increase, decrease, or remain the same if you make the inclined plane steeper? _____

Data:

	Ramp (30 cm height)	Ramp (45 cm height)
Height	.3 m	.45 m
Length	.61 m	.61 m
Weight of cart	5 N	5 N
Effort force	3 N	4 N
Calculations (use the equations):		
Work (no ramp) = Work Out		
IMA		
AMA		
Work In		
Efficiency		

Lab Formulas (What formulas did we use?):

Simplified Procedure (What did you do?) :
1.
2.
3.
4.
5.

Analysis and Conclusions:

1) How does a ramp (inclined plane) make a job easier? _____

   _____

2) Does it require more or less force to lift the cart using the ramp?_____

3) Is more or less work done in lifting the cart using the ramp? _____

4) How does the ideal compare with the actual mechanical advantage?_____

   _____

5) What force causes a difference between the ideal and actual mechanical advantage?

   _____

   How could this force be reduced?_____

6) Which is easier (requires less force): using a short, inclined plane or using a long not-

   so-steep inclined plane? _____

7) Which requires less work: using a short, inclined plane or using a long not-so-steep

   inclined plane? _____

8) List the six types of simple machines:

   _____   _____   _____

   _____   _____   _____