IB Physics

**Energy-Force Design Lab**

**You will gather data in groups of 2-6, and write the lab individually. You will choose as a group an independent (manipulated) and dependent (measured) variable, gather data, average it, and graph it, and write a conclusion.**

Directions

1. Pick an independent (manipulated) and dependent (measured) variable, and gather data for 6-12 variations of your independent variable, and at least 3 trials of each variation.
2. Average your trials, and make a graph where the dependent is the y axis, and the independent the x
3. Write (Your very own personal) an appropriate method:

**Stating the problem and listing the variables**

State the problem concisely, and list the independent, dependent and controlled variables. Independent variables (IV) are the ones you manipulate, dependent (DV) are the variables you measure, and controls are the things that stay constant. Controlled variables are not objects, they need to be quantities only, just like the IV and DV.

**Method for control of variables**

Explain how you will manipulate the independent variable, measure the dependent, and make sure that the controlled variables don’t change. Draw a **diagram**, include measurements of anything that matters, tell what equipment and materials you used, and give a step by step description of what you did to actually gather the data.

**Method for collecting sufficient data**

State which variations of the independent variable you chose, and explain why you chose the variations and number of trials that you did. (Variations are like 5o, 10o, 15o, 20o, 25o, etc, and trials are repetitions of the same thing) You need to do a sufficient number of variations (6?, 12?) of the independent variable, do an adequate number of trials (3?) of each variation, and the variations should be if possible well distributed throughout the possible range of variations.

1. Write a conclusion for your lab:
   1. Summarize the trend you see in the data and try to explain it if you can using your by now vast knowledge of Physics.
   2. List the sources of error, and describe what effect they would have on the data
   3. Describe how you could eliminate or mitigate these sources of error

Ideas Energy Force Design lab (Including but not limited to)

|  |  |
| --- | --- |
| **Independent** (Manipulated) | **Dependent** (Measured) |
| Height of ramp | Time to roll down the ramp from rest |
| Length of ramp | Time to roll down the ramp from rest |
| Amount of water in water bottle | Time to roll down the ramp from rest |
| Number of coffee filters | Time to fall a certain distance  Terminal velocity measured by rangefinder |
| Deflection of ruler | Speed of marble launched from table |
| Mass | Period of a mass on a spring |
| Mass | Force of friction |
| Mass | Length of elongation of a spring  Distance of deflection of a cantilevered ruler |
| Position of pivot | Period of a physical pendulum.  Period of a simulated physical pendulum |
| Drop height of a ping pong ball | Time it takes to bounce 5 times |
| Length of cantilevered ruler | Period of vibration |
| Amplitude of swing | Period of a simple pendulum |
| Length of string | Period of a simple pendulum |
| Amount of draw | Force exerted by compound bow |
| Height of ramp | How far a car rolls on the level ground |
| Height of ramp (Motion encoder cart)  Pulling mass | Speed of car at the bottom of the ramp |
| Height of ramp | Terminal speed of cart with magnetic brakes |
| Pulling mass | Terminal speed of cart with magnetic brakes |

**Example:**

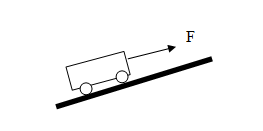
**Suppose I am doing an experiment to see how the parallel force depends on the angle of an incline.**

**Stating the problem and listing the variables (After a bit of introductory information)**

The purpose of this investigation, then, is to determine the relationship between the force necessary to keep a wheeled cart from rolling down an incline, and the degree of that incline. The independent variable is the degree of incline, the angle it makes with the horizontal, the dependent variable is the force needed parallel to the plane to hold the cart stationary on the plane, and the controlled variables include, but are not limited to the mass of the cart, the position on the plane, the type of surface used, and the angle of the force scale used to measure the force.

**Method for control of variables**

Our setup consists of a 2.0 m long inclined plane that we propped up using a pile of books. We kept the mass of the cart constant at 1.85 kg, and always positioned the cart in the middle of the plane. The angle we measured using a protractor placed on the table surface, and we measured the force using a 20 N force scale for all trials.



We took special care to keep the force scale parallel to the surface when we measured the force. To gather a data point, our procedure was this: First, we propped up the plane to the angle we desired, and measured this carefully keeping the protractor level with the table surface. Second, we tipped the force scale parallel to the plane, and made sure the scale read zero. If not, we adjusted the zero. Then we carefully attached the cart in the middle of the plane, and very slowly let it exert a force on the scale. We then read the force on the scale.

**Method for collecting sufficient data**

We chose to try the following angles: 10, 20, 30, 40, 50, 60, and 70 degrees. We could not get the plane to remain stationary for 80 degrees or above. For each variation, we did four trials of each angle to make sure that the measurements were repeatable.