

A Study of Forces

Prelab

1. The force sensor measures forces by the extension of an *internal* spring. Predict whether the relation between force and spring extension obeys a law of the form:
 - a. Force proportional to extension
 - b. Force proportional to square of extension
 - c. Force depends on the extension in some other way
2. When two fans are used to accelerate a cart in the same direction, the combined force is:
 - a. The sum of the two forces
 - b. The product of the two forces
 - c. Some other combination of the two forces
3. When two fans accelerate a cart in opposite directions, the combined force:
 - a. Depends only on the force which is stronger
 - b. Depends only on Gravity
 - c. Is the vector sum of the two forces
4. Draw a labeled FBD for an object sliding down a frictionless incline. Give a symbolic formula for the object's acceleration. Identify all quantities used in the formula.

Experiment

Purpose of Experiment

To study how forces interact with each other. You will also be designing your experiment, setting it up in the Logger Pro software or Graphical GW software, and determining the variables that are important to collect. Before arriving in lab, have a proposed plan for each activity.

Activity 1 ~ Force Sensor

General Procedure

1. You will test the predictions you made in the pre-lab activity.
2. Use known weights and your force sensor.

Analysis

1. How do your findings relate to your predictions? Explain.

Activity 2 ~ Cooperating Fans

General Procedure

1. Use two carts and two fans to demonstrate how the fans can “cooperate”.
2. You will need to measure the acceleration and the force for each cart in the system and for the system.
3. Make sure you carry out enough trials!

Analysis

1. Develop a data collection table in excel for you procedure.
2. Add a column to your table that calculates F/a . Also, find the mean and standard deviation of your trials.
3. Discuss the physical meaning of the calculation in question 2.

Activity 3 ~ Competing Fans

General Procedure

1. Use two carts and two fans to demonstrate how the fans can “compete”.
2. You will need to measure the acceleration and the force for the system.
3. Make sure you carry out enough trials!

Analysis

1. Develop a data collection table in excel for you procedure.
2. Add a column to your table that calculates F/a . Also, find the mean and standard deviation of your trials.
3. Can the relationship in question 2 be shown graphically with your data? How? Show in excel.
4. Compare and contrast your results from activity 2 and 3.

Activity 4 ~ Force observation in the elevator

General Procedure

1. This is a demonstration using a force plate and the elevator in the building.
2. Place the force plate on the floor of the elevator.
3. Have one member of your group stand on the force sensor.
4. Take a ride in the elevator, observing the readings on the sensor.

Analysis

1. Discuss what you observed.
2. Draw a FBD of the person standing on the force sensor. Write equations, using Newton’s Laws for different times of the ride in the elevator. How do they differ?