

Laboratory #1

Newton's First Two Laws

Part A. How Fast is Your Grab??

Concepts

Reaction time; Human Error; Acceleration; Basic Algebra; Acceleration Due to Gravity

Introduction

How accurate are you with a stopwatch? Most people think that the accuracy of a stopwatch depends on the accuracy of the clock itself, but that is not the case. To use a stopwatch, you have to see what you are timing, which means that light has to travel from the object you are timing to your eyes. Then the image of the event is sent to the brain, the brain interprets the image, and decides what action to take based on the interpretation. Finally, the brain sends an action command through a series of neural connections to the thumb muscle, and the muscle has to push the button. This all takes place in a split second, but nonetheless your thumb reaction is not instantaneous. This experiment gives you a feel for how fast you can react to an observed event.

Procedure

- Have your lab partner hold a ruler just above your clenched hand, so that the numbers count up as the ruler falls through your fingers.
- Try to grab the ruler as soon as possible after your partner drops it.
- Note where the upper edge of your thumb is on the ruler, and mark it on the chart below.
- In the space provided rearrange the equation $d = \frac{1}{2}gt^2$ to solve for the time of fall, which is also your reaction time.
- Use the resultant equation for time to determine your reaction time.
- Repeat the process 3 times (you don't have to rearrange the equation 3 times) to get an accurate average reaction time for yourself.

Part B: What?? A Cup With a Hole That Doesn't Leak??? Momma Will Never Believe This

Concepts

Newton's 1st Law; Free Fall; Relative Motion; Support Force; Astronaut sensation.

Introduction

The effects of gravity can be felt millions of miles away. If this were not the case, the Earth would not rotate around the Sun, nor would the Moon around the Earth. How is it then that whenever we see pictures of astronauts in space they are floating inside of the space ship and appear weightless?

Procedure

- Poke a hole (about 5 mm wide) near the bottom, in the side of a Styrofoam cup. Cover the hole with your finger.
- Fill the cup with water (with your finger still covering the hole).
- Walk outside.
- Uncover the hole for just a second to observe what happens to the water in the cup.
- Drop the cup off the edge of the bridge across from 212 Allison Lab. (take an umbrella if it is raining)
- Pick up the smashed cup, and throw it away. Keep AU beautiful.
- Do it again if you missed it.



Part C. Can You Say "Gloria Estafan" ???

Concepts

Acceleration; Relationship Between Acceleration, Distance, and Time

Introduction

In this experiment you will attach 6 bobbles to a string. The goal is to tie the weights so that when the string is dropped the weights hit the ground with a steady beat. By doing this you will learn an important lesson about the relationship between acceleration, distance, and time.

As we saw in Part A, timing falling objects with a stopwatch is not a very good idea when extreme accuracy is necessary. However, unless you have Motown-deficit disorder, all humans have a fairly accurate sense of beat. Most of us can tell when a rhythm is not steady (some people are better than others, but we all have this sense). So this experiment is pretty accurate even though there are no fancy gadgets used to take measurements.

Procedure

- As a group: decide how you want to attach the bobbles on the string so it makes a steady beat.
- Tell the instructor about your plan.
- Attach the bobbles, just like you decided.
- Wait for all the groups to finish before you drop the string.
- Place an upside down pie plate on the ground so that you can easily hear when the weights hit the ground.
- Drop your string and listen to the beat.

HINT!! You have learned an important tool in class ($d = \frac{1}{2}gt^2$). Be sure to use it!

CAUTION: the string tangles very easily!

Lab Reporting Sheet

Laboratory #1

Name: _____

Date: _____

Part A: How Fast is Your Grab?

- Algebraically solve for 't' (do it without numbers and show the steps!)

Trial	Distance Fallen (m)	Reaction Time (s)
1		
2		
3		

- Was YOUR reaction time the same for every trial?
- Was your reaction time the same as your PARTNERS? Why do you think differences occur?
- Why do important sporting events (like the Olympics) use automated timing devices?
- How far would the ruler fall if your reaction time were 1 whole second?

Part B: The Holey Cup

- **Before you drop the cup, what force(s) are acting on the water (there are 2)?**
- **Before you drop the cup, what force(s) are acting on the cup (there are 3)? Draw a picture.**
- **After you dropped the cup, what force(s) are acting on the water?**
- **After you dropped the cup, what force(s) are acting on the cup? Draw a picture.**
- **Explain why the water stops coming out of the hole after the cup is dropped (what is the difference between the 1st and the 3rd questions?).**
- **Why do astronauts feel weightless when they orbit the earth? Are they really weightless? Massless?**

Part C: Can You Say "Gloria Estafan" ???

- **What was the pattern that you tried and how did the beat sound?**
- **What was the pattern that worked (describe how to get that pattern)?**
- **What is the relationship between distance, and time?**