

## Introduction

Welcome to your first Introduction to Physics lab. Each week you and your lab partners will work together designing experiments to accomplish specific goals. You will also have a virtual partner this semester who will not be present in the lab but will want to learn about it by reading your lab notes and lab reports. Their name is Sara. Sara has knowledge of mathematics but not of physics, so you'll have to be clear and complete in your writing.

**Note:** Where there are questions in the handout, make sure you clearly label and answer these in your lab notes.

## Learning Goals of this Lab

- 1) Observe, record, and represent different types of motion.
- 2) Represent your ideas in multiple ways to help understand what you are trying to describe.

## A) Observation Experiment: Recording and Representing Motion

The goal of the experiment is to learn how to record the motion of an object and represent its motion using a motion diagram.

**Available equipment:** You have a ramp, a green 3D printed stand for the ramp, a croquet ball, sugar packets, a meter stick and a metronome.

## Motion of a Croquet Ball

In your lab notebook draw a figure of what you are doing and write notes. Remember, you will hand the carbon copies of these pages in as you leave the lab. Record any significant items of information. Remember that your imaginary friend Sara wants to read your notes! Your lab notes should “stand alone”, that is Sara will not have this handout to help her understand what you did. Each group member must record their own notes.

Practice dropping a sugar packet every second when one group member calls out a signal every second, for example “Now!”. Get the ball moving in a straight line on the floor by having one group member let it go off of the top of the ramp. You want the speed of the ball to be reproducible. Another group member will walk beside it and when they hear the signal, place sugar packets to mark the locations of the ball each second. **Make a table and record your data in your lab notes.**

Questions:

- a) Where you will place the origin of your coordinate system? Measure the positions of the sugar packets relative to that origin and record the data. Explain in detail the things you had to consider in doing this. There's more to it than you might think! (You probably made several decisions subconsciously. Learn to be conscious of the decisions you make so you can think carefully about them.)
- b) If you repeat the experiment, will you would get the same results? Is it worth repeating the experiment again? Explain.
- c) How would you classify the object's motion: motion with constant rate, increasing rate/decreasing rate? Explain how you decided.
- d) Now imagine that you want to describe the experiment to Sara, so Sara can understand both the procedure and the results. Is it better to use words or there is another, more concise way? Think about which parts of the experiment and the results are important and which are not. Once you have thought about this, describe the outcome of the experiment to Sara in an efficient way.

**Representing Motion**

There are many ways to represent motion. Here are three: 1) Describe the motion in words, 2) Describe the motion by a data table, and 3) Describe the motion with a graph. In your notes represent the motion in each of these three ways.

**Drawing a Motion Diagram**

A fourth way to represent motion is with a *motion diagram*. In a motion diagram you graph a dot for the position of the object at equal intervals of time. Read the handout *Constructing a Motion Diagram*. Then draw a motion diagram for the croquet ball. Remember to include dots,  $\vec{v}$  arrows and  $\Delta\vec{v}$  arrows.

**Quick Guide to Graphing with Logger Pro**

One common way to represent scientific data is by graphing it. We will be using Logger Pro in this course to assist you in taking and analyzing data.

- 1) Open Logger Pro. The icon should be on the desktop. Double click it to open Logger Pro.
- 2) The default view has an empty data table and a blank graph. Double-click on the "X" at the top of the first column. In the dialog box that comes up, give the column a name and units. Do the same for the "Y" column.
- 3) Enter the data. You can move to the next cell by clicking, tabbing, or hitting <Enter>. As you enter data, points appear on the graph.

e) Which representation is more informative? Which is more efficient? Explain your reasoning.

f) What is your main conclusion? State it clearly for your friend Sara.

**Using a White Board**

Divide the whiteboard into four quadrants. In each quadrant draw or write a different representation of the motion of the ball. If we have time, you will share part of your whiteboard with the whole class.

**C) Homework**

See handout.