Part A: One-dimensional motion with constant speed

We begin our investigation of *Kinematics* by studying the motion of objects that travel in a straight line without speeding up or slowing down. This kind of one-dimensional motion is called *uniform motion* or *motion with constant speed*.

Section 2. Uniform motion

Experiment 2.1

Obtain a ball, a starting wedge, and a track from the staff. (Additional equipment is also available to you, if necessary.)

A. Using these materials, try to produce the most uniform, steady motion you can.

Describe what you did to make the motion as uniform as possible.

How can you check whether the motion was uniform? Explain why you believe your method is a good test for uniform motion.

Give quantitative evidence that the motion is uniform.

B. Write an operational definition of uniform motion in one dimension.

Note: Such a definition should include a test that can be used to decide whether a motion is uniform. In principle, the test should be one that could be applied to any moving object. It should not solely depend upon personal judgments about how uniform the motion appears. The test should require making measurements of the motion and include a procedure for using these measurements to decide whether or not the motion is uniform.

✔ Discuss this experiment with a staff member.

Experiment 2.2

Gather together a group of four or more people for this experiment.

The purpose of this experiment is to record the motion of an object. This can be done by noting the time when the object passes each of several checkpoints.

Set up a track at least two meters long so that a ball rolls along the track with nearly uniform motion.

A. Each person should be assigned a checkpoint along the path of the moving ball. What is a good way of describing the location of a checkpoint?

Each person should get a stopwatch or stop clock and start it when the ball passes a particular point on the track designated as the starting point. Each person's clock should be stopped when the ball passes his or her checkpoint.

What will the clock readings tell you?

Set up a starting ramp on the track. Practice rolling the ball a few times until you are able to obtain the same clock readings repeatedly, and then take your data.

Is the motion uniform? How can you tell? If the motion is not uniform, change your apparatus to make the motion more uniform and take additional data until the motion is essentially uniform.

Suppose the motion were perfectly uniform. Describe the measurements you would expect to record.

B. Plot the last set of data you obtained in part A on a graph of distance from the start to the checkpoint *versus* clock reading at the checkpoint. Use graph paper.

C. Would you expect a straight-line graph? Explain. If so, what does the straightness of the graph tell you about the motion?

Draw the best straight line that you can to represent your data.

Compute and interpret the slope of the line.

D. Plot the same data on another graph, this time with the axes reversed. Again compute and interpret the slope.

✔ Discuss this experiment with a staff member.