Horizontal Motion of a Rolling Ball
Measurement and Graphing

In this exercise, you and your partners will record the motion of a bowling ball rolling on a smooth horizontal surface. This data will then be graphed and analyzed.

To perform this exercise, each group will need: a ball, a stopwatch for all but two group members, a 30-meter measuring tape and a roll of blue masking tape.

Procedure:

1. Using the measuring tape and the blue masking tape make a number line on the floor. Pieces of tape should be placed every 2 meters between 0 m and 8 m.
2. Assign one member of the group to roll the ball and one to stop the ball. The other group members will each be assigned a position along the number line. They will record the time for the ball to travel each distance. The timers will all start their stopwatches when the ball passes the zero mark. They will stop their stopwatches as the ball rolls past their assigned distance. Practice until all timers at a particular distance have reasonably close times. (What are reasonably close times?) You should include the time for the ball to roll a distance of zero meters in your data table.
3. Record one set of data for the ball being rolled at a slower speed and one set of data for the ball rolled at a faster speed.

	Slow Ball	Fast Ball
Distance (m)	Time (s)	Time (s)

Plot your data points on graph paper. Graph both sets of data on the same graph. Use different symbols and/or different colors to distinguish the data for the slow ball from the data for the fast ball.

Recall, the general rules for graphing you should follow are:

Graphs should always be done on graph paper and should take up most of the space on the page. An appropriate range and scale must be chosen for each axis.

Graphs should always have a descriptive title summarizing what the graph represents.

Each axis should be clearly labeled with the name or symbol of the quantity being plotted along with the appropriate units.

When graphing data the independent variable is plotted on the horizontal axis and the dependent variable is plotted on the vertical axis.

Your data table has a column for distance and a column for time to travel this distance for each ball. Which is the independent variable and which is the dependent variable?

Once you have determined which information is to be plotted on each axis, you must determine the best way to set up your graph. Some questions to be asked include:

What is an appropriate title for the graph?

Should the horizontal axis or the vertical axis be longer?

What is an appropriate range for each axis?

What is an appropriate scale for each axis?

You will be using this graph to predict the time to travel 10 meters, so your range and scale should allow for this. It is often a very good idea to know exactly how a graph will be used before actually creating a graph.

What type of smooth curve seems to best fit your data points? (Remember that, mathematically speaking, a straight line is a curve.)

If effects of friction and non-level floors are ignored, the data is expected to be linear. Use a ruler to draw in a best-fit line

How does the distance traveled for each case depend on the elapsed time? (Does the distance increase or decrease with time? Does the distance seem to be changing uniformly with time?).

Discuss any differences in the graphs for the slow and fast balls.

From your graphs, estimate the time it would take for each ball to travel 10 meters.

From your graphs, determine the distance traveled by each ball in the first second.

From your graph, determine the distance traveled by each ball in the second second. (that is, the distance traveled between t = 1s and t = 2s)

From your graphs, determine the distance traveled by each ball in the third second.

Does the distance traveled by each ball in one second depend on which one second interval is chosen?