LAB 1
Motion Diagrams

OBJECTIVES
(1) Use the Motion Sensor to measure and plot your position and velocity as you move in a straight line at different speeds.
(2) Understand the concept of position, velocity, and acceleration.
(3) Try and match position vs. time and velocity vs. time graphs.

EQUIPMENT
Pasco 850 Universal Interface, motion sensor, support rod, moving object (you)

BACKGROUND
When describing the motion of an object, knowing where it is relative to a reference point, how fast and in what direction it is moving, and how it is accelerating (changing its rate of motion) is essential. A sonar ranging device such as the PASCO Motion Sensor uses pulses of ultrasound that reflect from an object to determine the position of the object. As the object moves, the change in its position is measured many times each second. The change in position from moment to moment is expressed as a velocity (meters per second). The change in velocity from moment to moment is expressed as an acceleration (meters per second per second). The position of an object at a particular time can be plotted on a graph. You can also graph the velocity and acceleration of the object versus time. A graph is a mathematical picture of the motion of an object. For this reason, it is important to understand how to interpret a graph of position, velocity, or acceleration versus time. In this activity you will plot a graph of position and velocity in real-time, that is, as the motion is happening.

PROCEDURE

Part 1: Position vs. Time

For this activity, you will be the object in motion. Use the Motion Sensor to measure your position as you move in a straight line at different speeds. Use PASCO Capstone to plot your motion on a graph of position and time.

(1) Mount the Motion Sensor on a support rod so that it is aimed at your midsection when you are standing in front of the sensor. Make sure that you can move at least 2 meters away from the Motion Sensor. Connect the Motion Sensor to the PASCO Universal 850 interface. Position the computer monitor so you can see the screen while you move away from the Motion Sensor.
(2) Open up the Motion Diagrams Lab activity. Click on the **Position vs. Time** tab. The graph will plot your position (in meters) vs. time (in seconds).

(3) Experiment with the motion sensor. Move forwards and backwards at different speeds. Try and move at a constant velocity and at a constant acceleration. Notice the shape of the position vs. time plots as you perform different motions.

**Part 2: Velocity vs. Time**

For this activity, you will be using the Motion Sensor to measure your velocity rather than your position.

(1) Click on the **Velocity vs. Time** tab. The graph will plot your velocity (in m/s) vs. time (in seconds).

(2) Experiment with the motion sensor. Move forwards and backwards at different speeds. Stand still. Try and move at a constant velocity and at a constant acceleration. Notice the shape of the velocity vs. time plots as you perform different motions.

**Part 3: Matching Position vs. Time and Velocity vs. Time Graphs**

For this activity, you will be using a motion sensor and equipment available in the physics lab to try and reproduce different position vs. time and velocity vs. time graphs.

(1) Study each of the seven graphs below and discuss with your lab partners what kind of motion the graph represents. Then discuss different ways you might reproduce the motion using equipment that we have available in the physics lab.

(2) Using the motion sensor and any equipment available, try and reproduce each graph.

(3) For each graph, sketch the graph, describe the motion it represents, and describe what you did to reproduce the motion.
Graph 7

A graph showing the velocity (m/s) over time (s) with points plotted at intervals.