Position, Velocity and Time

TOPICS AND FILES

Mechanics Topics

Linear motion; position versus time

Linear motion; velocity versus time

Linear motion; instantaneous and average speed

Capstone Files

04A Position_Time.cap

04B Velocity_Time.cap

05 Average Speed.cap

EQUIPMENT LIST

Qty	Items	Part Numbers
1	PASCO Interface (for one sensor)	
1	Motion Sensor	CI-6742
1	Reflector board (optional)	
1	IDS Photogates and Fences	ME-9471A
1	1.2 m Dynamics Track	ME-9435A
1	Dynamics Cart	ME-9430
1	Meter Stick	SE-8695

INTRODUCTION

This lab has three parts.

The purpose of Experiment 1 is to explore graphs of motion (position versus time). Use the motion sensor to measure your motion as you move back and forth in front of the sensor along a straight line at different speeds. The challenge is to move in such a way that a plot of your motion will 'match' the position versus time graph that is provided for you. Use *Capstone* to record and display the data.

The purpose of Experiment 2 is to explore graphs of motion (velocity versus time). Use the motion sensor to measure your motion as you move back and forth in front of the sensor along a straight line at different speeds. The challenge is to move in such a way that a plot of your motion will 'match' the velocity versus time graph that is provided for you. Use *Capstone* to record and display the data.

The purpose of Experiment 3 is to measure the average speed of an object over decreasing distances and extrapolate the average speeds to find the instantaneous speed of the object. Use

photogates to time the motion of the object. Use *Capstone* to calculate the average speed of the object based on the distance it travels and the time. Plot the values of average speed and determine the instantaneous speed.

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).

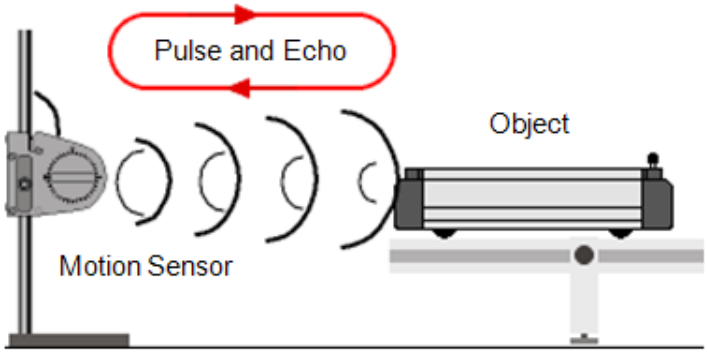

Figure 1

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 motion in real-time, that is, as the motion is happening.

An average speed can be a useful value. It's the ratio of the overall distance an object travels and the amount of time that the object travels. If you know you will average 50 miles per hour on a 200 mile trip, it's easy to predict how long the trip will take. On the other hand, the highway patrol office following you doesn't care about your average speed over 200 miles. The patrol officer wants to know how fast you're driving at the instant the radar strikes your car, so he or she can determine whether or not to give you a ticket. The officer wants to know your *instantaneous* speed.

If you measure average speed of a moving object over smaller and smaller intervals of distance, the value of the average speed approaches the value of the object's instantaneous speed.

