## RADAR RACERS STUDENT ACTIVITY

## Prelab Background

Speed is defined as the distance an object travels per unit time. The rate of speed can be expressed in kilometers per hour, meters per second, meters per millisecond, and so on. In most cases, moving objects do not travel at a constant speed. The speed of an object usually increases and/or decreases as it moves. Therefore, the average speed is used to describe the motion. Average speed is a ratio of the total distance to the total time that the object traveled.

## average speed = total distance/total time

Acceleration is the rate at which an object's speed increases. You can express the rate of acceleration using meters per second  $(m/s^2)$ . This unit represents the change in speed each second. Forces cause objects to accelerate or to decelerate (decrease the rate of speed). If a car averages 80 kilometers per hour on a hilly road, it probably changes speed many times. The car accelerates and decelerates. If the care is traveling at a constant speed of 80 kilometers per hour on a level road, it is not changing speed. The acceleration or deceleration of the car is zero.

The Motion Detector used in the lab emits short bursts of ultrasonic sound waves from the gold foil of the transducer. These waves fill a con-shaped area about 15 to 20° off the axis of the center line of the beam. The Motion Detector than "listens" for the echo of these ultrasonic waves returning to it. The CBL is programmed to know the speed of the ultrasound in air. By timing how long it takes for the ultrasonic waves to make the trip from the Motion Detector to an object and back, the CBL can then determine the distance to the object. This is the same principle by which a police radar detector works.

## **Procedure**

- Assign duties.
- Clear a runway about 4 meters.
- At one end of the runway, set up a launching ramp. (See diagram) Put one end of the ramp on a stack of a 5 books (approximately 15cm) and the other end on the floor. You will launch the car on its test runs from the top of this ramp.
- Locate the **CBL motion detector** at the top of the ramp.
- Hold car in place on ramp 50cm from the motion detector.
- Place a board or book to stop the car at the end of the ramp.
- Practice running the car down the ramp several times to observe the motion and path.
- Attach the EA-100 data collector to the CBL motion detector in the sonic port.
- Program EA-100 as follows:
  - Depress red on/off switch.
  - Depress shift, and then mode buttons.
  - Depress **DATALOG** until 200 msec is displayed. (=time intervals between measurements)

Depress Trigger.

Depress DATALOG until 30 is displayed. (=number of measurements taken) Depress Trigger. (Display should read "1")

- Prepare to launch the vehicle. Depress Trigger **only once -IMPORTANT!** displaying "ready"
- Simultaneously, depress Trigger and launch the car.
- At the conclusion of the run, the display should read DONE.
- Link the EA-100 to the CASIO graphing calculator.
- On the calculator, Press AC/On.
- On the main menu, select PRGM
- Highlight RECEIVE and depress EXE.
- Press MENU.
- Select STAT.
- Press F1 twice and the graph should appear.
- Press Exit and record the data on your worksheet.
- Repeat the experiment using a height double the previous one.