.

**Rolling Ball – TI-84 + and CBR-2**

In this activity you will roll a ball down a ramp and examine a graph that results from the data collection.

**Equipment & Materials**

* CBR-2 unit
* TI-84 + calculator and Standard-B to Mini-A USB cable (square end and small trapezoidal end)
* Two 1 by 2 boards at least 8 feet long
* Smooth ball (approximately 8” in diameter - play balls from Stop & Shop work well)

**CBR Setup**

1. With the calculator turned off, connect the CBR-2 to the calculator using the link cable. The square plug goes into the side of the CBR-2, and the trapezoidal plug goes into the top of the calculator.
2. The Tic-Tic-Tic sound and light indicates that there is a connection but data are not being collected.
3. The EasyData app is already installed in TI-84 calculators. The calculator may turn on and automatically launch the program when the CBR-2 motion detector is connected. If the calculator doesn’t turn on, turn it on, find the key marked APPS and select #6 – Easy Data. The CBR-2 will be flashing.
4. From the MAIN MENU, select SETUP by pushing the WINDOW button.

Choose Time Graph by pressing 2. Then push the ZOOM button to edit the Time Graph Settings.

1. Set the sample interval to .02. Push ZOOM to get to the Number of Samples window. Set the number of samples to collect to 100.
2. Push ZOOM to see the final settings. Note that the experiment length will be 2 seconds (the number of samples multiplied by the sample interval). Note the flashing light and the ticking only indicate the CBR-2 is ready to collect data. It is not collecting data.
3. Select OK by pressing the GRAPH key.

Respond START by pressing Zoom. The CBR-2 will stop ticking.

A Data Deletion window will appear reminding you that the selected function will overwrite any prior data collection. Be prepared to collect the data before pressing GRAPH. **The device will start collecting the data as soon as you press the GRAPH button to respond OK.**

So you can see how it works you will collect some data just for a trial. Put the CBR-2 data collector facing up and the calculator on a table next to it. Hold one of your hands over the data collector screen, press GRAPH and move your hand up and down slowly. After a while the CBR-2 will stop collecting data, transfer the data to the calculator and show you a graph.

To use the app again after you see a graph press TRACE to select the Main menu and then ZOOM to select Start.

**Create a Ramp and Set up the Experiment**

Find a low step with space in front of it. Create a ramp by placing the boards parallel to each other about 4” inches apart with one end of each board on the step. Place the ball at the top of the ramp and release it to test how smoothly it rolls.

Place the CBR-2 at the bottom of the ramp hinged at approximately 90° to the ramp.

In this activity, you will roll a ball down the ramp and record its motion with the CBR-2.

1. Have one person at the top to let go of the ball and another at the bottom with the calculator and CBR-2.
2. Have the person with the calculator count down to release the ball at the same time he or she presses GRAPH to start collecting the data.
3. When the CBR-2 stops collecting the data, it will transfer it to the calculator and display a graph.
4. When you have a satisfactory graph, press TRACE to select the Main menu and select GRAPH to quit the app. Disconnect the cable from the calculator.

**Modeling the Data with a Quadratic Function**

You are going to use the collected data that are stored in L1 and L6. There are data in L7 and L8 that you will ignore for this experiment.

Press 2nd Y= to be certain that your Plot1 is turned on and that it is showing the data in L1 and L6.

Press STAT, select CALC, and 5: QuadReg. Scroll down to Xlist and Ylist making sure that entries are L1 and L6 respectively. Scroll down to Store RegEQ: enter VARS,

Y-VARS, 1: Function and 1:Y1. Scroll down to CALCULATE and hit ENTER.

When the QuadReg appears, the parameters for the quadratic function are shown. Now go to Y=, Y1 will now contain the quadratic function from the quadratic regression formula in your calculator. Scroll left until you reach the column before Y1. Hit enter until you see –O. Press ZOOM and 9 for StatPlot.