Car Motion

Teacher Notes

Introduction

In this activity students collect distance-time data for different types of toy cars as they move away from the CBR2. Velocity and acceleration are also automatically calculated by the software.

It is interesting to compare the data for a car driven by an elastic band and for a spring-driven one. Students can identify the point at which motive power is lost and the vehicle begins to slow down.

Resources

There is a TI-Nspire document entitled carmotion.tns that illustrates the type of data and analysis that can be carried out.

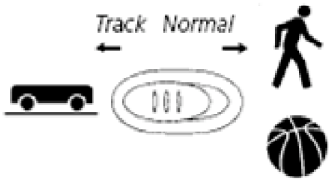
The activity

Step 1

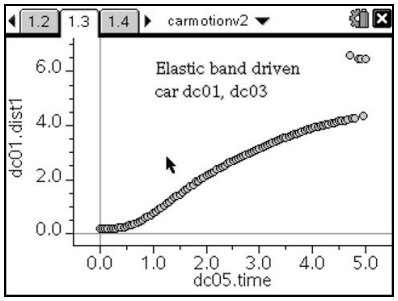
1. Place the CBR2 on the floor and connect it directly to a TI-Nspire handheld. Ensure the sensitivity switch on the CBR2 is set to *Track,* pointing towards the image of a vehicle, and that the sensor itself is rotated through 90° to face the direction of travel.

Sensitivity switch

The sensitivity switch has two modes—Track and Normal. The Track mode is intended for activities using dynamics tracks and carts; the Normal mode is intended for all other activities, such as, walking, ball toss, bouncing ball, pendulum, etc.

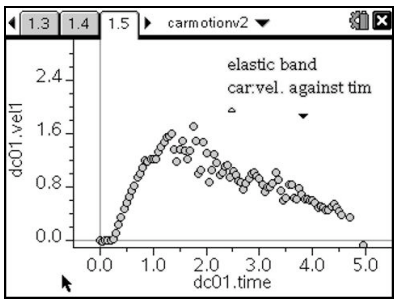


2. Select Data & Statistics, *tab* to *OK* and press *enter*.
3. Press *menu*, then *Sensors/Zero* and press *enter*.
4. Press *tab* to return to the main screen.
5. Press *ctrl* and *tab* to make the metering console active.
6. Press *menu*, then select *Experiment/Set Up Collection/Time Graphs*.
7. Press *enter* and set the *Experiment Length* between 5 and 10 seconds, depending on run length and windings of elastic bands.
8. Place the car about 30cm in front of the CBR 2 and press *enter.*
9. Release the car when rapid clicking is heard.
10. Store, or discard to repeat. To store, press *menu*, then *Data/Store Run* or *Clear All Data* then press *enter*.



Step 2

Now plot velocity against time. To do that, move the cursor over the y-axis, select the variable *dcol.vel1* and press *enter*.



At what point did the elastic band go slack?

After about 4m or 5 seconds the CBR 2 begins to lose sight of the car. Why is this?

What maximum speed was reached?

Step 3

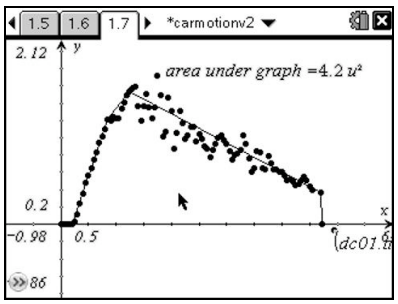
1. Press the *Home* key, select the icon for a Graphs page and press *enter*.

2. Press *menu*, and choose *Graph Type/Scatter Plot*. To plot velocity against time, press *var* and select *dco1.time* as the x-axis and press *enter*. Repeat the process by pressing *var* again and select *dc01.vel1* as the y-axis.

3. Press *enter* to view the graph. If desired, press *menu*, then *Window/Zoom/Zoom – Data* to show an appropriate scale.

4. Construct a polygon around the points. To do that, press *menu* then *Shapes/Polygon* and *enter*.

5. Press *enter* to start the polygon and at each change of direction. Remember to close the polygon by connecting back to the beginning. Once completed, the polygon will be highlighted.



6. Measure the area inside the polygon. To do that, press *menu* then *Measurements/Area* and then *enter*. The area should equal the maximum distance in the first graph. If it does not, you will need to adjust the polygon by moving one or more of the points. The area will be recalculated automatically.

Step 4

Repeat what you have done with a spring-driven car.
How does the shape of the distance curve compare to that of the elastic-band-driven car?
Which one reached the higher speed? Why?
At what point did the spring go slack in the motor?