Teacher Notes

Activity 8

Move My Way—A CBR Analysis of Rates of Change

Objectives

- Explore the relationship between position and velocity
- Explore the relationship between functions and their derivatives
- Connect mathematical relationships to real-world phenomena

Materials

- TI-84 Plus / TI-83 Plus
- Calculator-Based Ranger™ (CBR™)

Teaching Time

- 60 minutes

Abstract

In this activity, students will collect position data using a CBR™ data collection device in realtime. They will use the Δ**List** feature of the graphing handheld to reinforce the idea of velocity being the rate of change of position with respect to time at all points. They will then try to match a given velocity graph and sketch the corresponding position graph.

Management Tips and Hints

Prerequisites

Students should:

- have knowledge about average rates of change.
- know the definition of *derivative*.

Student Engagement

Begin by having a student walk back and forth in front of the CBR, and ask students to predict what the velocity versus time graph will look like. They should think about what velocity means as well as how positive velocity and negative velocity differ. This activity is best done with students working in cooperative groups so that they can compare answers and look for connections. A class discussion of basic concepts after the activity would enhance understanding and ensure that students made correct observations.

Evidence of Learning

Students are asked to make predictions prior to collecting data and graphing equations. This allows them to correct their own thinking. A class discussion or analysis of answered questions will demonstrate student knowledge.

Common Student Errors/Misconceptions

- Many students have difficulties interpreting velocity graphs for a physical situation.
- Many students confuse position graphs with velocity graphs.
- When students see a constant velocity on a velocity graph, they may mistakenly try to match it by standing still.

Extensions

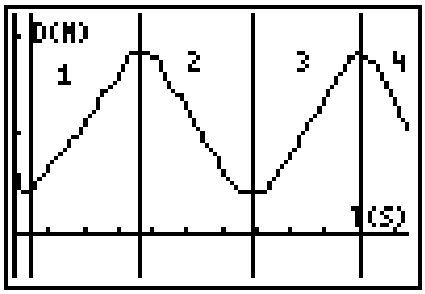
Students could develop velocity graphs for other groups to match. They could also devise a method to get the position versus time graph from the velocity graph using a Riemann Sum formula.

Activity Solutions

1. n/a

2. n/a

3. Results will vary depending on student data. A sample is shown:



4. For the graph given, the velocity is positive for the first region, negative for the second region, positive for the third region, and negative for the last region.

5. Students should label the velocity as zero when the graph has a relative maximum or minimum.

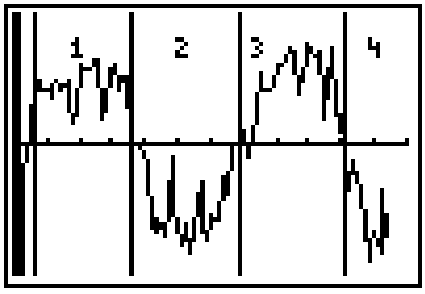
6. Check students' graphs. The zero points on the graph above should correspond to points where the graph crossed the time axis. The velocity should be above the time axis when it is positive and below the time axis when it is negative.

7. n/a

8. The number of differences is 93. Taking the difference between items in a list will always produce a list with one fewer item.

9. n/a

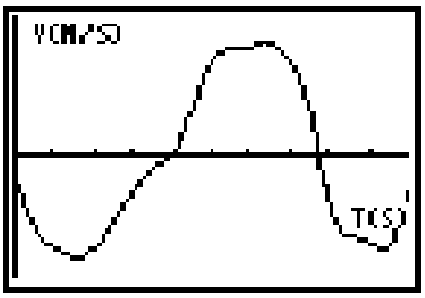
10. Results will vary depending on student data. The velocity graph for the position graph above is shown:



11. On a position versus time graph, the velocity is positive when the graph is increasing.

12. On a velocity versus time graph, the velocity is positive when the graph is above the time horizontal axis.

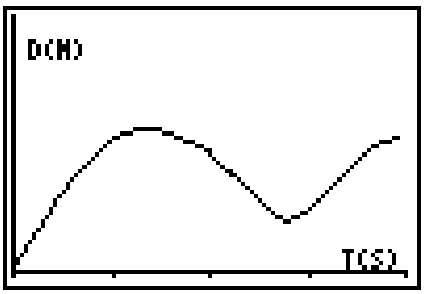
13. The graph should be similar to the one shown. It is correct as long as the graph drawn by the student is above or below the time axis for the time intervals shown. The shape above or below may vary somewhat.



14. The graph is generated by walking away from the CBR™ at a constant rate, then walking toward the CBR at a constant rate, and then walking away for a second before turning around.

15. The starting point does not affect the velocity graph because this graph only shows the rate of change.

16. The graph should show a linear section with positive slope, then a maximum, followed by a linear section with negative slope, then a minimum, then a section that increases, and a maximum at the end. It should be similar to the graph shown:



17.

When the function graph is...	The derivative graph is...
Increasing	positive, above the time axis
Decreasing	negative, below the time axis
Changing from increasing to decreasing	zero, going from positive to negative
Changing from decreasing to increasing	zero, going from negative to positive
A constant value	zero

18. Answers will vary.