Spark Timer Motion Teacher's Notes

Main Topic	Motion
Subtopic	Velocity, Acceleration, Graphing
Learning Level	Middle
Technology Level	Mid
Activity Type	Student

Description: Record the motion of two different toy cars (constant velocity and accelerating) using a spark timer. Graph and analyze the motion.

Required Equipment	Spark Timer, Spark Timer Tape, Battery-operated Car, Pull-Back Car, Ruler (with mm marks), Graph paper
Optional Equipment	Computer with graphing capability

Educational Objectives

- To record and analyze the motion of constant-velocity and accelerating toy cars, using a spark timer.

Concept Overview

Students will use a spark timer to record the motion of two toy cars. The spark timer produces a physical record of the motion by making a mark on tape at set intervals (10 times each second, in this case). Students measure the distance between the marks and graph the motion.

For constant velocity motion, the marks on the tape will be evenly spaced. The position vs. time graph will be a straight line with positive slope. The velocity vs. time graph will be a horizontal line.

The pull-back car will accelerate and then decelerate. The acceleration will appear on the position vs. time graph as a parabola, and on the velocity vs. time graph as a line with positive slope.

Lab Tips

Show students beforehand the proper, safe use of the spark timer. Improper use can result in a painful shock.

This lab is data-intensive. Compiling data – measuring the distances between the dots – is time-consuming. Depending on the speeds of your cars and timers, you may tell students to only measure every 5^{th} dot. (For a 10 Hz timer in that case, the time interval between dots would be 0.5s.) Use of a spreadsheet such as Excel will greatly speed the graphing and calculation, if students are already familiar with the software.

Spark Timer Motion

Name: _____

Class: _____

Pre-Lab Questions:

1. Sketch a position vs. time graph for an object moving at constant velocity.

2. Sketch a velocity vs. time graph for an object moving at constant velocity.

3. Sketch a position vs. time graph for an object with increasing velocity.

4. Sketch a position vs. time graph for an object with decreasing velocity.

5. Your teacher will instruct you in how to count the dots on the tape. Record the instructions here: Count every _____th dot when analyzing the tape.

Goal:

To record and analyze the motion of two different toy cars, using a spark timer.

Materials:

Spark Timer, Spark Timer Tape, Battery-operated Car, Pull-Back Car, Ruler (with mm marks), Graph paper or Graphing software

Procedure:

1. Pay careful attention as your teacher shows how to safely use the spark timer. If used improperly, it can give you a painful shock. Set the timer frequency to 10 Hz (10 sparks per second).
2. With the timer turned off, load the tape.
3. Connect the end of the tape to the battery-operated car. Turn on the timer, and then turn on the car.
4. Let the car go about 2 meters. Turn off the car and timer. Remove the tape and examine the dots. Describe the pattern of dots on the tape.

5. Create a data table and record the distance between every _____th dot (from pre-lab question 5), and the total elapsed time. The time interval for each distance traveled is _____s.
6. Add a column to the data table for the car's velocity at each interval.

7. Create graphs of position vs. time (total time elapsed) and velocity vs. time. Sketch the graphs' basic shapes here.

Non-Constant Motion

8. Practice using the pull-back car. Be sure you can make it go straight, and that you have enough space to capture its motion for at least 3 meters (or until it stops).
9. With the timer turned off, load the tape.
10. Pull the car back, and hold it. Connect the end of the tape to the pull-back car. Turn on the timer, and then let go of the car.
11. Let the car go until it stops, or 3 meters. Turn off the timer. Remove the tape and examine the dots. Describe the pattern of dots on the tape.

12. Create a data table and record the distance between every _____th dot (from pre-lab question 5). The time interval for each distance traveled is _____s.
13. Add a column to the data table for the car's velocity at each interval.
14. Create graphs of position vs. time (total time elapsed) and velocity vs. time. Sketch the graphs' basic shapes here.

Optional Activities

15. Load the tape, and hold the end in your hand. Turn on the timer, and pull the tape with as constant a velocity as you can for about one meter. Examine the dots, graph the motion, and describe the results.

16. Load the tape, and hold the end in your hand. Turn on the timer, and pull the tape with as constant an acceleration as you can for about one meter. Examine the dots, graph the motion, and describe the results.