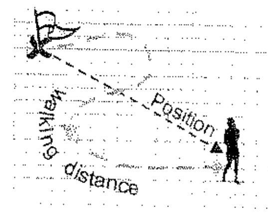
Activity 9 Lab 2

B2 Position, Time, and Speed

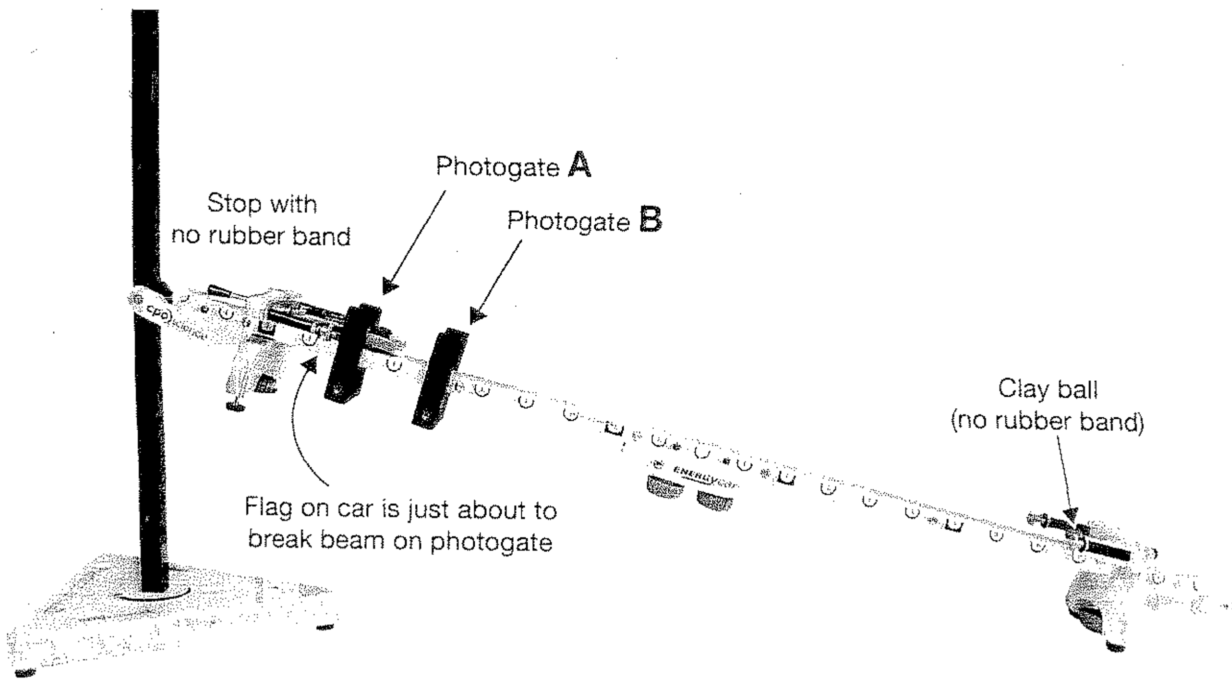
How do you model the motion of the car?

In physics, the word *position* is used to describe the location of an object relative to the origin. *Distance* is an interval of length between two positions. As an object moves, its position changes. If you are 7 kilometers north of school, that is a statement of your position. If you walk back towards your school, your position decreases. If you get back to where you started, your position is zero even though the distance you walked is 14 kilometers (7 km away plus 7 km back)!



In this investigation, you will model the motion of a car with a position vs. time graph. By measuring how long it takes the car to reach different points on the ramp, you will be able to create a graph of the car's trip down the ramp.

1 Setting up the experiment



You will be releasing the car from the top of the ramp and using the photogates to measure the time it takes the car to get to different positions. If you look at the car, you will see a small "flag" sticking up on the top. This is the part of the car that breaks the beam in the photogate.

As you collect data, you want the upper photogate (A) to begin timing the instant after you let go of the car. This starts the timer. When the car gets to the second photogate (B), the timer stops. By moving photogate B to different positions on the track, you can measure the time for the car to move different distances.

1. Connect the two parts of the track so they make one continuous ramp. Attach the top of the ramp to the sixth hole on the physics stand.
2. Hold the car at the top of the ramp so it is pressed against the bumper. Position Photogate A so it is attached at the first round mark just below the car.
3. Adjust the screw on the top bumper so it pushes the car down the track a small distance until the car's flag is just about to break the beam on the photogate. The photogate's indicator light turns red when the beam is blocked. Use the light as a guide to help you set the car's position. Keep photogate A and the screw in these positions for the whole experiment.
4. Place photogate B 10 cm down the hill from photogate A (two round marks downhill).
5. Connect the timer to the two photogates, and press the A and B buttons so both of the lights are lit.

2 Collecting data

1. Once the car is in place, press the reset button on the timer. Release the car from the top of the ramp. Record the time for the car to move from photogate A to B in Table 1. This time is displayed on the timer when both the A and B lights are on.
2. Move photogate B 10 cm down the ramp. Release the car in the same manner as you did for the previous step. Record the time.
3. Repeat for all of the distance in Table 1. You will have to skip one location where the photogate is not able to attach.

Table 1: Distance and time data

Distance from A to B (cm)	Time from A to B (s)
10	
20	
30	
50	
60	
70	

3 Graphing and analyzing your data

a. Make a position vs. time graph using your data. Plot the time from A to B on the *x*-axis and the distance from A to B (*position* of photogate B) on the *y*-axis. Be sure to label the axes and title the graph.

b. Is the graph a straight line with a constant slope or is it a curve with a changing slope?

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c. The slope of a line is found by dividing the rise (vertical change) by the run (horizontal change). What is the meaning of the slope of your position vs. time graph?

d. What does your answer to the previous two questions tell you about the speed of the car as it rolled down the ramp?

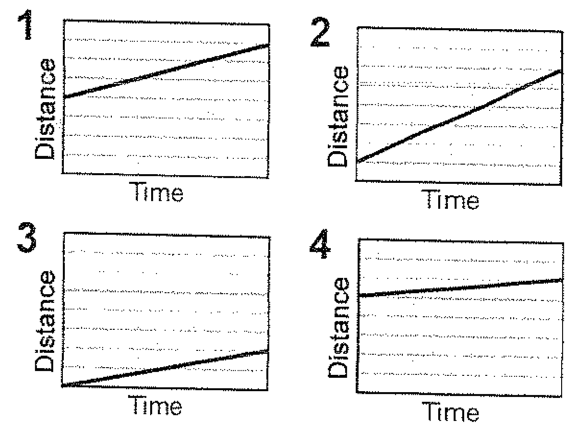
e. Suppose the car had moved at a constant speed as it rolled along the ramp. What would the position vs. time graph have looked like?

f. Suppose the car had slowed down as it rolled along the ramp. What would the position vs. time graph have looked like?

g. Choose two points at the beginning of the graph and use them to find the speed of the car near the top of the hill by calculating the slope. Repeat with two points at the middle of the graph and two points at the end of the graph. Do the three calculated speeds confirm your answer to question d above?

Assessment

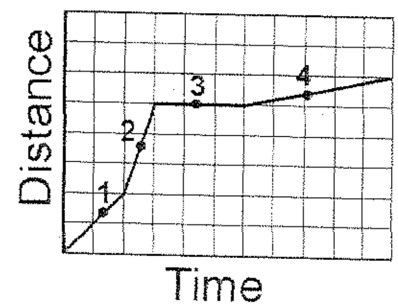
1. Arrange the four graphs in order from slowest speeds to fastest speeds.



Slowest **Fastest**

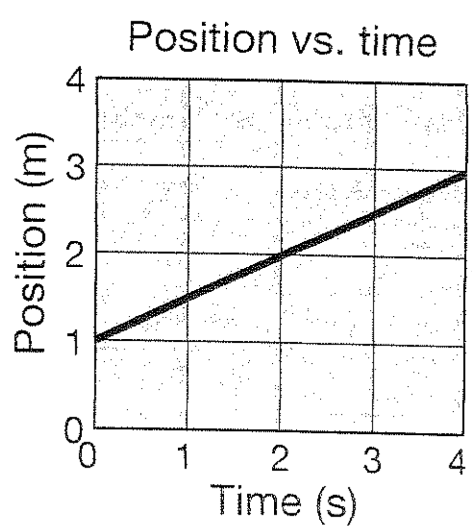
2. Speed is the ______________________ of the position vs. time graph.

3. Arrange the four points on the distance vs. time graph in order from slowest to fastest.



Slowest **Fastest**

4. Calculate speed from the position vs. time graph. Show all of your work.



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