

## 4C Studying Two-Part Motion

*What happens to the Energy Car as it travels down a hill and across a flat section of track?*

In the previous chapter 3 investigations, you explored the motion of the car on a flat track and again on a hill. Now, you can put the track together so it has both a hill and a flat section. What will the speed vs. time graph look like? You will soon find out!

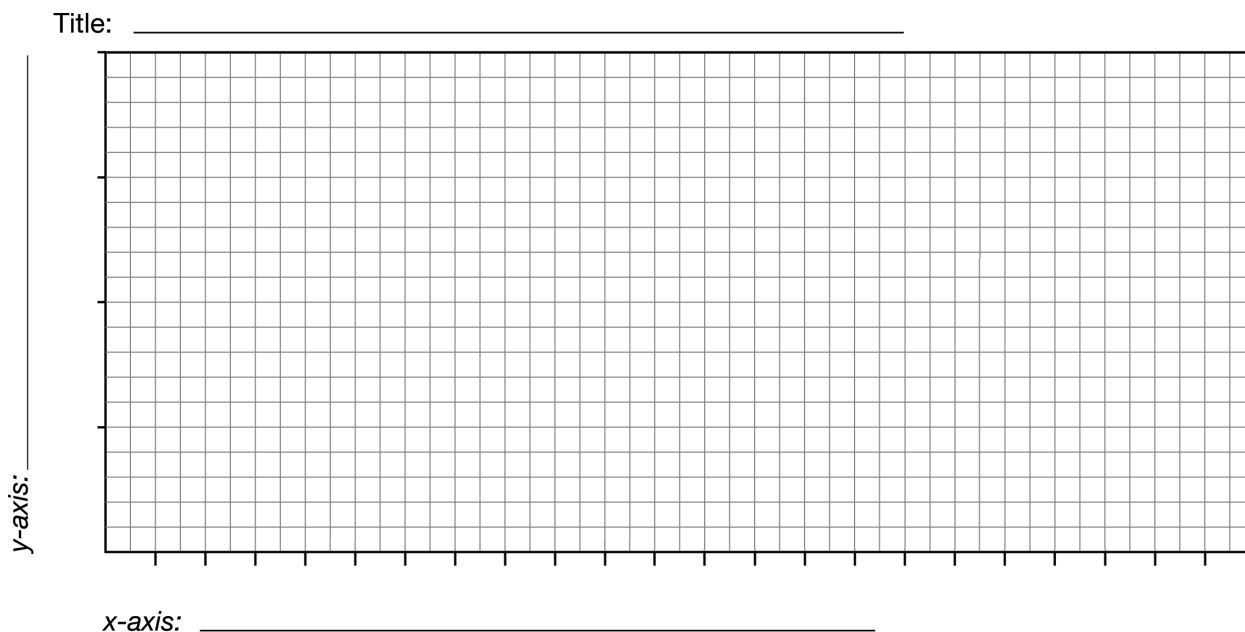
### Materials

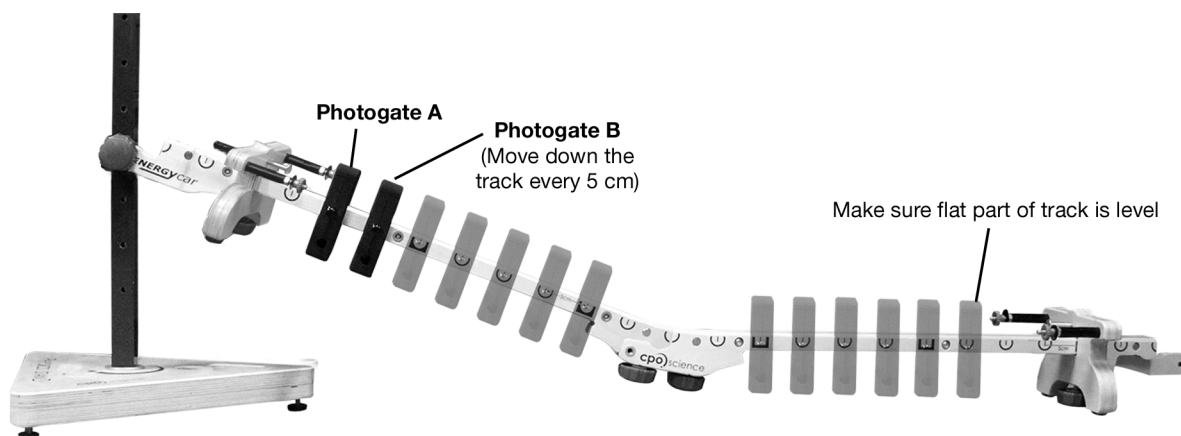
- Data Collector and 2 photogates
- Energy Car
- Physics stand
- 1 steel marble

### 1 Predicting

You will set up the track so it has the steeper hill and flat section joined. What will the speed vs. time graph look like?

- Draw a sketch of what you think the speed vs. time graph will look like. Put *time* on the *x*-axis and *speed* on the *y*-axis.



**2** Setting up the experiment

1. Join the steeper hill with the flat track and attach it to the 4th hole from the bottom.
2. Place a stop at the top of the track with the plunger all the way back so the end is flush with the stop.
3. Place the other stop at the bottom of the track; put a lump of clay on the plunger so the car won't bounce back through photogate B when it is near the end.
4. Attach photogate A as shown in the photo, and leave it there.
5. Photogate B will be placed every five centimeters, as shown in the photo.
6. *Make sure the flat part of the track is level.* Use the leveling feet on the physics stand base and on the bottom stop.
7. Place the Energy Car at the top of the track so it rests against the stop's plunger. Put 1 marble in the center of the car. Photogate B should be 5 cm from photogate A.

**3** Doing the experiment

1. Release the car and record the time through A, the time through B, the time from A to B, and the distance traveled in Table 1.

2. Move the photogate to the next 5-cm mark and repeat step 1. Do this all along the track until you reach the last mark possible. You will not be able to take time measurements at 35, 40, or 45 cm away from photogate A.

**Table 1: Energy Car Data**

Distance A to B (cm)	Time A (s)	Time B (s)	Time AB (s)	Speed A (cm/s)	Speed B (cm/s)
5					
10					
15					
20					
25					
30					
50					
55					
60					
65					
70					
75					

#### **4** Finding the speeds

- a. Find the speed at A and speed at B for each trial and record in Table 1. Remember: to find the speed of the car, use the width of the flag (1.00 cm) for the distance, and the time through the photogate for the time. ( $v = d/t$ )
- b. Look at the A speeds. What does this data tell you in general about the experiment?

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- c. Look at the B speeds. What does this data tell you in general about the motion of the car as it moved down and across the track?

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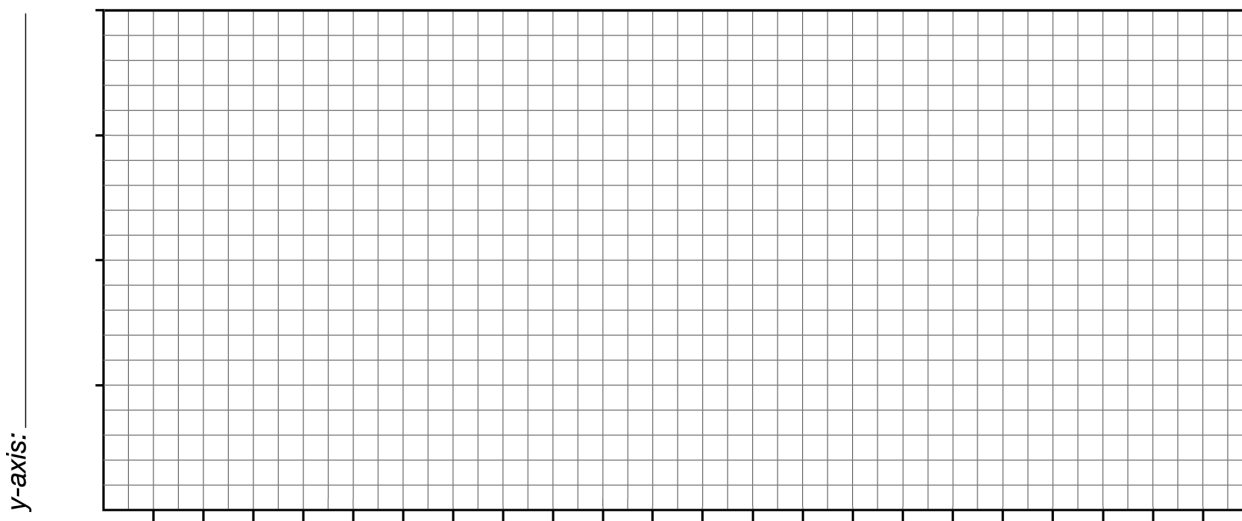
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## 5 Graphing the data

- a. Create a speed vs. time graph for the data. Put *time AB* (s) on the *x*-axis and *speed at B* (cm/s) on the *y*-axis. Draw a best fit line.

Title: \_\_\_\_\_



*x*-axis: \_\_\_\_\_

- b. How does the graph compare to your prediction? Explain.

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## 6 Thinking about what you observed

- a. Where is the car accelerating? Justify your answer with evidence from the experiment.

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- b. Where is the car moving at a constant speed? Justify your answer with evidence.

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