Cart Motion Clues

Use position data to investigate changing motion.

PHY.1.1 "Investigate and analyze evidence gained through observation or experimental design regarding the one-dimensional (1-D) motion of objects. Design and conduct experiments to generate and interpret graphical evidence of distance, velocity..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline how the cart's position is measured, circle statements that explain how to read motion graphs, and number the steps used to turn position data into evidence of acceleration.

A Cart on a Sloped Track

1 A student tests a cart on a straight, gently sloped track. She tapes a meter stick beside the track and marks a start at zero meters. A phone records the cart after she lets go without pushing. She reads the cart's position at each whole second. The track angle stays the same for every run.

CART POSITION IN ONE RUN

Time (s)	Position from start (m)
0	0.0
1	0.1
2	0.4
3	0.9
4	1.6

2 The table shows one run. Because the cart never reverses direction, its position measured from the start also gives its total distance traveled. On a distance-time graph, time goes on the horizontal axis and distance on the vertical axis. A steeper section means more distance covered per second. Compare equal time intervals rather than looking at distance alone.

3 A velocity-time graph shows motion changes. Find each interval's average velocity by dividing its distance change by its time change. Plot each value at the middle of its interval. If these values rise by equal amounts over equal time steps, the cart has approximately constant positive acceleration. Repeat the run to test the pattern.

2 ANSWER WITH EVIDENCE

Use the passage

1. How far does the cart travel from 0 to 1 second and from 3 to 4 seconds? What do those distances tell you about its speed?

2. Calculate the cart's average velocity from 2 to 3 seconds. Show the distance change you used.

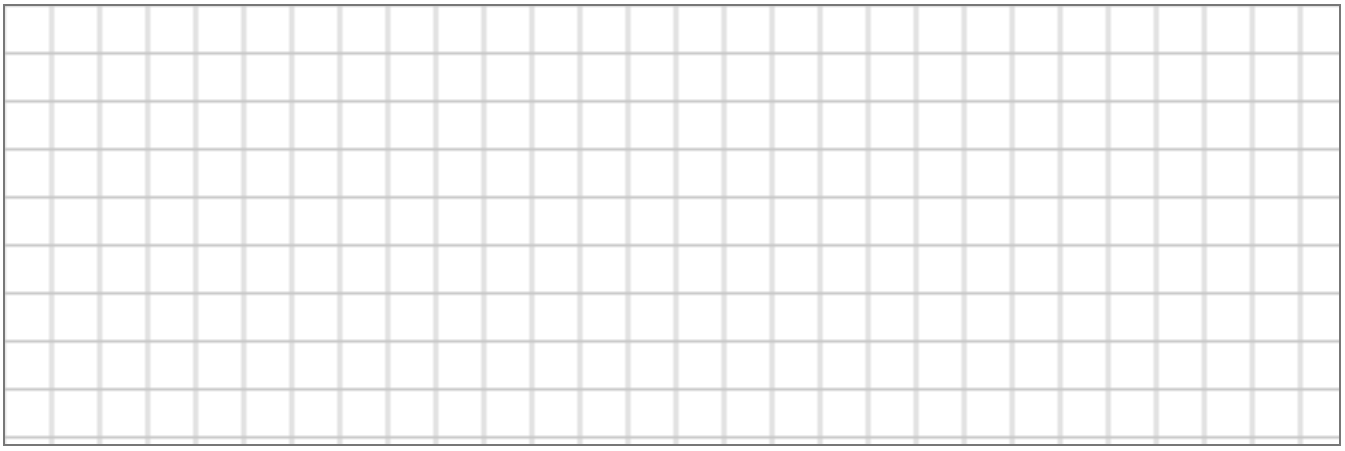
3. Find the average velocities from 0 to 1 second and from 1 to 2 seconds. What acceleration do these values suggest?

4. For a second run, name one condition the student should keep unchanged. What would a similar velocity-time graph in both runs suggest?

3 YOUR TURN

Your own words

Design a trial with a different object moving in one direction and slowing down. On the grid, sketch a predicted distance-from-start versus time graph from 0 to 4 seconds, label both axes with units, and write two sentences explaining how you would measure distance and what the graph shows about velocity and acceleration.



ANSWER KEY

Cart Motion Clues

PART 1 · READ AND MARK

Underline how the cart's position is measured, circle statements that explain how to read motion graphs, and number the steps used to turn position data into evidence of acceleration. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How far does the cart travel from 0 to 1 second and from 3 to 4 seconds? What do those distances tell you about its speed?	**It travels 0.1 m in the first interval and 0.7 m in the last. It speeds up because it covers more distance in the same amount of time.**
2	Calculate the cart's average velocity from 2 to 3 seconds. Show the distance change you used.	**The distance change is 0.9 m − 0.4 m = 0.5 m. Over 1 s, the average velocity is 0.5 m/s.**
3	Find the average velocities from 0 to 1 second and from 1 to 2 seconds. What acceleration do these values suggest?	**The average velocities are 0.1 m/s and 0.3 m/s. They rise by 0.2 m/s over 1 s, suggesting an acceleration of about 0.2 m/s^2.**
4	For a second run, name one condition the student should keep unchanged. What would a similar velocity-time graph in both runs suggest?	**Keep the track angle unchanged. Similar velocity-time graphs would suggest the acceleration pattern can be repeated.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Graph: The horizontal axis is time (s), and the vertical axis is distance from start (m). Plot (0, 0), (1, 0.8), (2, 1.4), (3, 1.8), and (4, 2.0), then connect them with a smooth curve that becomes less steep. I would film a toy car moving along a straight floor and measure its distance from the start at each whole second. The graph becomes less steep, showing decreasing velocity and negative acceleration.

Accept equivalent calculations and controlled conditions supported by the passage, such as releasing the cart without a push. In Your Turn, the graph should keep rising while becoming less steep, and the explanation should connect that shape to decreasing velocity.