

Cart Data Detectives

Use motion data to connect distance, speed, velocity, and acceleration.

S8P3.a "Analyze and interpret data to identify patterns in the relationships between speed and distance, and velocity and acceleration."

NAME _____ DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline statements that describe a distance or velocity pattern, and circle words that tell direction or a change in velocity so you can connect speed, distance, velocity, and acceleration.

A Cart on the Test Track

- ① Speed tells how much distance an object covers in a certain time, without giving a direction. A runner who covers equal distances in equal time intervals keeps a constant speed. When distance increases by larger and larger amounts during equal time intervals, the runner's speed is increasing. Scientists compare distance changes and time intervals, not just total distance, to identify the pattern.
- ② Velocity includes both speed and direction. Acceleration is a change in velocity over time. A cart can accelerate when it speeds up, slows down, or turns, because any of these changes velocity. In a straight test track, a cart travels east and does not reverse. The data table records its position and eastward velocity at one-second intervals.

CART TEST DATA

Time (s)	Position East of Start (m)	Velocity East (m/s)
0	0	0
1	1	2
2	4	4
3	9	6
4	16	8

- ③ To find acceleration, subtract earlier velocity from later velocity and divide by elapsed time. In the table, compare several time intervals rather than relying on one measurement. Because the cart moves only east, its position changes describe distance traveled as well as eastward displacement. If it reversed, total distance would still grow, but displacement could decrease or change direction.

2 ANSWER WITH EVIDENCE Use the passage

- 1 Compare the first one-second interval with the last one-second interval. How much distance does the cart travel in each interval, and what happens to its speed?

- 2 Calculate the cart's acceleration from 1 s to 4 s. Include the direction.

- 3 Why can the position changes in this table also be used as the cart's distance traveled?

- 4 If the cart turned west after 4 s, how could its total distance and its displacement differ?

3 YOUR TURN Your own words

Create five time rows, from 0 s through 4 s, for a cart moving east without reversing. Choose values that show increasing speed with constant acceleration, then write one sentence explaining how your distance and velocity data show that pattern.

TIME (S)	POSITION EAST OF START (M)	VELOCITY EAST (M/S)	ACCELERATION EAST (M/S ²)

PART 1 • READ AND MARK

Underline statements that describe a distance or velocity pattern, and circle words that tell direction or a change in velocity so you can connect speed, distance, velocity, and acceleration. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	Compare the first one-second interval with the last one-second interval. How much distance does the cart travel in each interval, and what happens to its speed?	It travels 1 m from 0 to 1 s and 7 m from 3 to 4 s. Its speed increases.
2	Calculate the cart's acceleration from 1 s to 4 s. Include the direction.	2 m/s² east, because $(8 \text{ m/s} - 2 \text{ m/s}) \div 3 \text{ s} = 2 \text{ m/s}^2$.
3	Why can the position changes in this table also be used as the cart's distance traveled?	The cart travels only east on a straight track and does not reverse direction.
4	If the cart turned west after 4 s, how could its total distance and its displacement differ?	Its total distance could continue increasing while its displacement decreases or changes direction.

PART 3 • YOUR TURN (SAMPLE ANSWER)

0 s | 0 m | 0 m/s | 2 m/s² 1 s | 1 m | 2 m/s | 2 m/s² 2 s | 4 m | 4 m/s | 2 m/s² 3 s | 9 m | 6 m/s | 2 m/s² 4 s | 16 m | 8 m/s | 2 m/s² The position increases by larger amounts each second while velocity rises by 2 m/s each second, so the cart has constant eastward acceleration.

Accept equivalent calculations and descriptions for the questions. For the open task, accept different coherent data sets if velocity changes by an equal amount each second, position changes match the motion, and the cart remains moving east.