LESSON MAKER PRO

Motion in Numbers

Find acceleration and displacement from velocity data.

HIGH SCHOOL · PHY.1

PHY.1 "Students will investigate and understand how to analyze and interpret data. Investigate and analyze evidence gained through observation or experimental design regarding the one-dimensional (1-D) motion of objects..."

NAME _____ DATE _____

READ THE CHANGE

On a velocity-time graph, slope gives acceleration. The signed area between the line and the time axis gives displacement. For constant acceleration, $a = (v_f - v_i)/t$ and $\Delta x = (v_i + v_f)t/2$.

WORKED EXAMPLE

A cart accelerates steadily. Find its acceleration and displacement between the two readings.

CART MOTION

Time (s)	Velocity (m/s)
1	5
7	17

1. Elapsed time = 7 - 1 = 6 s.
2. $a = (17 - 5)/6 = 2$ m/s^2.
3. $\Delta x = (5 + 17) \times 6/2 = 66$ m.

Answer: Acceleration: 2 m/s^2; displacement: 66 m.

PRACTICE 4 problems

1 A cart speeds up steadily from 0 to 12 m/s in 4 s. Find its acceleration.

ANSWER _____

2 A cart slows steadily from 10 m/s to rest in 5 s. Find its displacement.

ANSWER _____

3 A cart speeds up steadily from 4 to 16 m/s in 3 s. Find its acceleration and displacement.

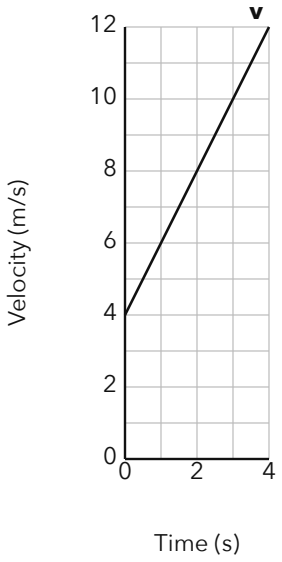
ANSWER _____

4 Taking right as positive, a cart slows steadily from -8 m/s to rest in 4 s. Find its displacement and distance traveled.

ANSWER _____

APPLY IT Show your work

1 The graph shows a skateboarder's velocity. Find the acceleration and displacement from 0 to 4 s.



ANSWER _____

2 A scooter slows steadily from 14 m/s to 4 m/s in 5 s. How far does it travel?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A robot moves right at 8 m/s for 3 s, then left at 4 m/s for 2 s. Taking right as positive, find its total displacement and distance traveled.

WORK SPACE AND ANSWER

Motion in Numbers

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A cart speeds up steadily from 0 to 12 m/s in 4 s. Find its acceleration.	**3 m/s^2**
2	A cart slows steadily from 10 m/s to rest in 5 s. Find its displacement.	**25 m**
3	A cart speeds up steadily from 4 to 16 m/s in 3 s. Find its acceleration and displacement.	**Acceleration: 4 m/s^2; displacement: 30 m.**
4	Taking right as positive, a cart slows steadily from -8 m/s to rest in 4 s. Find its displacement and distance traveled.	**Displacement: -16 m; distance: 16 m.**

PART 2 · APPLY IT

1. **Acceleration: 2 m/s^2; displacement: 32 m.** The line rises from 4 to 12 m/s in 4 s, so its slope is (12 - 4)/4 = 2 m/s^2. Displacement is the area under the line: (4 + 12) × 4/2 = 32 m.
2. **45 m** Average velocity is (14 + 4)/2 = 9 m/s. Distance is 9 × 5 = 45 m.

CHALLENGE

Displacement: 8 × 3 - 4 × 2 = 16 m; distance: 8 × 3 + 4 × 2 = 32 m.

Accept equivalent calculations with correct units. In the challenge, displacement is positive because the robot ends to the right of its starting point.