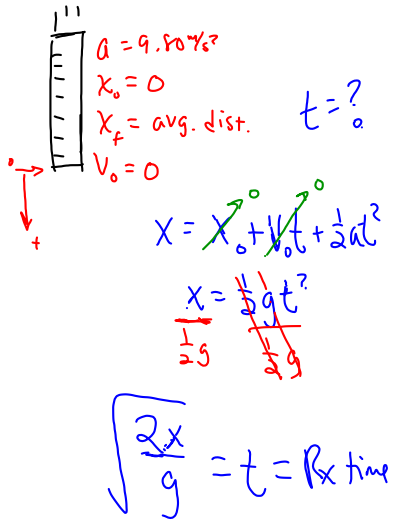


$t = 0.2\ s$

$35\ mph = 15.6\ m/s$

$x = vt = 3\ m$

3.4 Describing Motion with Graphs

STANDARDS

3.2 I can interpret, analyze, and create acceleration vs. time graphs for objects moving with constant acceleration.

Key Concepts

- A motion diagram shows the position of an object at successive times.
- In the particle model, the object in the motion diagram is replaced by a series of single points.
- Change in position is displacement, which has both magnitude and direction.

$$\Delta x = x_f - x_o$$

- The slope of an object's position-time graph is the average velocity of the object's motion.

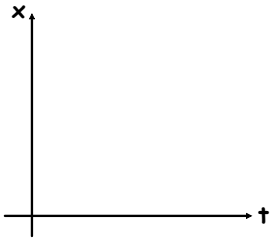
$$\vec{v} = \frac{\Delta \vec{x}}{t} = \frac{x_f - x_o}{t}$$

- The average acceleration of an object is the slope of its velocity-time graph.

$$\vec{a} \equiv \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

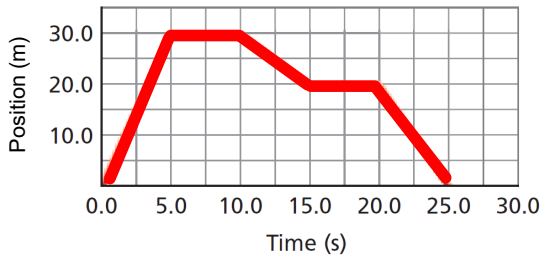
NUMERICAL EXAMPLE

Position-time information are shown in the data table. Assume that the motion is uniform and fill in the blanks of the table.

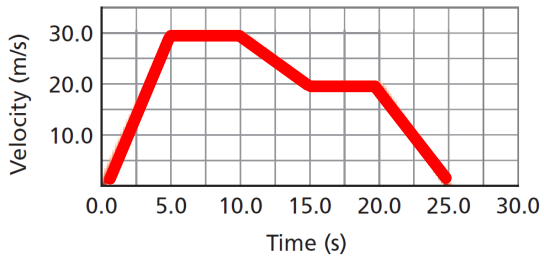


Time (s)	Position (m)
0	0
0.5	12.5
1	25
1.5	37.5
2	50
2.5	62.5
3	75.0

Interpreting Graphs

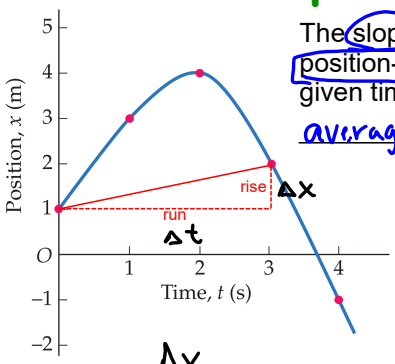


Interpreting Graphs



Slope

The slope of a line on a position-time graph for a given time interval is the average velocity.

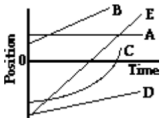


$$v = \frac{\Delta x}{\Delta t}$$

Position vs. Time

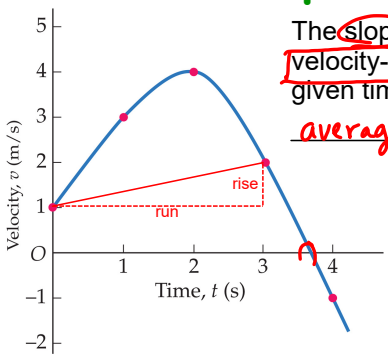
The slope of the line on a position vs. time graph reveals information about an object's velocity. The magnitude (numerical value) of the slope is equal to the object's speed and the direction of the slope (upward/+ or downward/-) is the same as the direction of the velocity vector. Apply this understanding to answer the following questions.

a. A horizontal line means stationary → v
b. A straight diagonal line means constant v
c. A curved line means accelerating
d. A gradually sloped line means small v slow
e. A steeply sloped line means large v fast



Slope

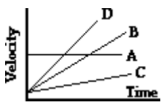
The slope of a line on a velocity-time graph for a given time interval is the average acceleration



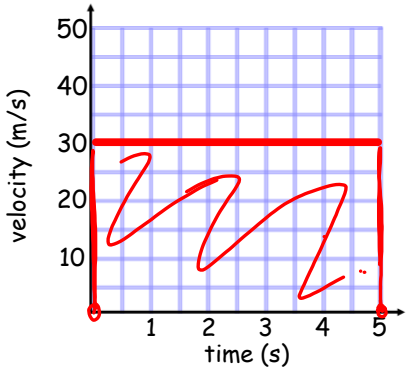
Velocity vs. Time

The slope of the line on a velocity vs. time graph reveals information about an object's acceleration. Furthermore, the area under the line is equal to the object's displacement. Apply this understanding to answer the following questions.

a. A horizontal line means constant v
b. A straight diagonal line means constant a
c. A gradually sloped line means small a
d. A steeply sloped line means large a

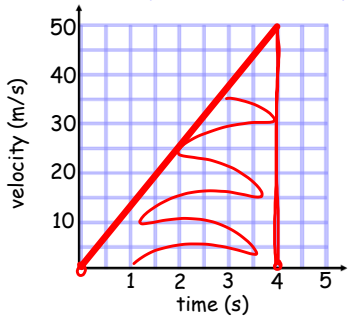


Velocity-Time Graph



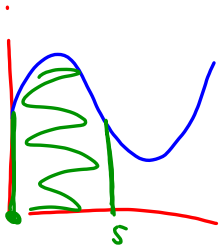
v = 30 m/s
t = 5 s
Δx = 150 m

Velocity-Time Graph



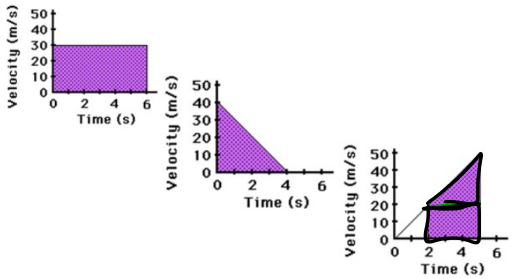
$A = \frac{1}{2}bh = \frac{1}{2}(4s)(50m)$

$\Delta x = 100m$



Velocity-Time Graph

The displacement of an object moving with constant acceleration can be found by computing the **area under the v-t graph**.



PRACTICE

- Unit 3 Practice Problems (6-9)
- Worksheet