1.2 Velocity: Rate of Change of Position

1. A car travels to the right at a steady speed for a few seconds, then brakes for a stop sign. Use the particle model to draw a motion diagram of the car for the entire motion described here. Number the dots in order, starting with zero.

2. Write a sentence or two describing the difference between speed and velocity. Give one example of each.

3. Which of the following motions is described by the motion diagram of the figure below?

   a. An ice skater gliding across the ice.
   b. An aeroplane braking to a stop after landing.
   c. A car pulling away from a stop sign.
   d. A pool ball bouncing off a cushion and reversing direction.

4. Which of the following motions is described by the motion diagram of the figure below?

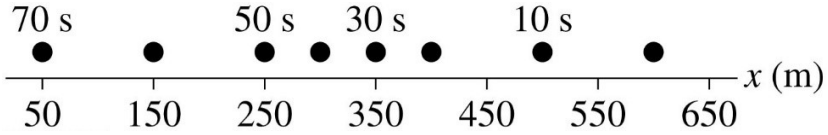
   a. A hockey puck sliding across smooth ice.
   b. A cyclist braking to a stop.
   c. A sprinter starting a race.
   d. A ball bouncing off a wall.

5. Weddell seals make holes in the sea ice so that they can swim down to forage on the ocean floor. Measurements for one seal showed that it dived straight down from such an opening, reaching a depth of 0.3 km in a time of 5.0 min. What was the speed of the diving seal?

6. A security guard walks at a steady pace, travelling 110 m in one trip around the perimeter of a building. It takes him 240 s to make this trip. What is his speed?

7. List the following items in order of decreasing speed, from greatest to least: (i) A wind-up toy car that moves 0.15 m in 2.5 s. (ii) A soccer ball that rolls 2.3 m in 0.55 s. (iii) A bicycle that travels 0.60 m in 0.075 s. (iv) A cat that runs 8.0 m in 2.0 s.

8. The figure below shows the motion diagram for a horse galloping in one direction along a straight path. Not every dot is labelled, but the dots are at equally spaced instants of time.



What is the horse's velocity

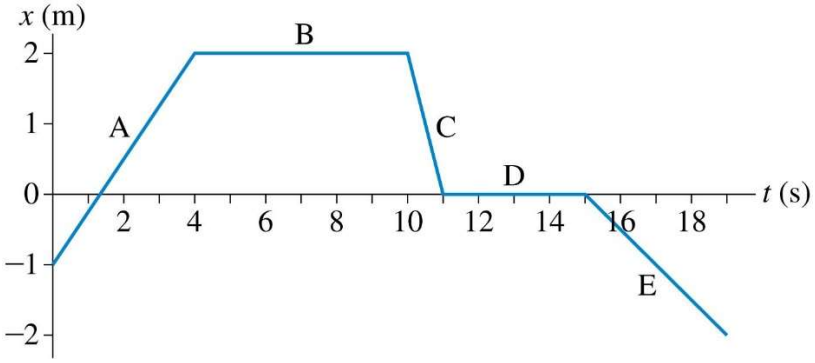
   a. During the first ten seconds of its gallop?
   b. During the interval from 30 s to 40 s?
   c. During the interval from 50 s to 70 s?

9. It takes Harry 35 s to walk from x = -12 m to x = -47 m. What is his velocity?

10. A dog trots from x = -12 m to x = 3 m in 10 s. What is its velocity?

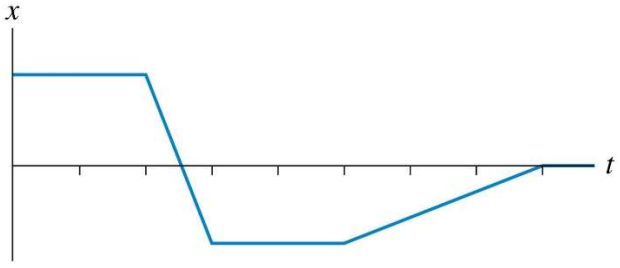
11. A ball rolling along a straight line with velocity 0.35 m/s goes from x = 2.1 m to x = 7.3 m. How much time does this take?

12. The figure shows an object's position-versus-time graph. The letters A to E correspond to various segments of the motion in which the graph has constant slope.



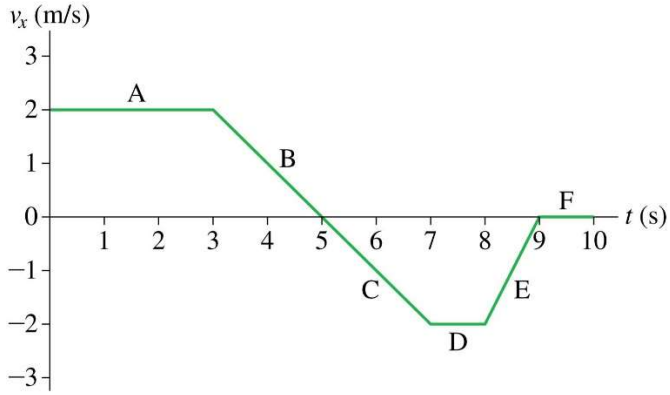
   a. In which segment(s) is the object at rest?
   b. In which segment(s) is the object moving to the right?
   c. Is the speed of the object during segment C greater than, equal to, or less than its speed during segment E? Explain.

13. The figure shows the position graph for an object moving along the horizontal axis.



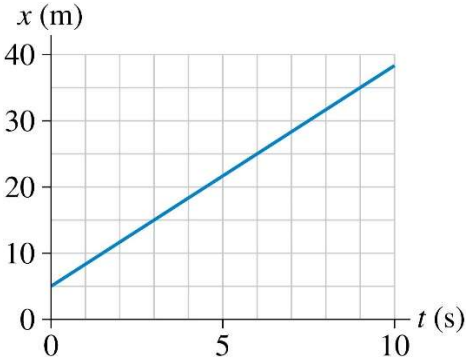
Draw the corresponding velocity graph.

14. The figure is the velocity-versus-time graph for an object moving along the *x*-axis.



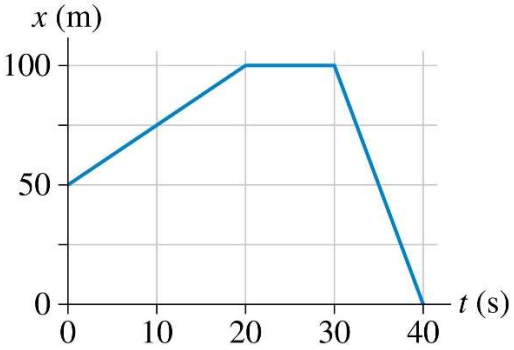
a. During which segment(s) is the velocity constant?
b. During which segment(s) is the object speeding up?
c. During which segment(s) is the object slowing down?
d. During which segment(s) is the object standing still?
e. During which segment(s) is the object moving to the right?

15. The figure shows an object's position-versus-time graph. What is the velocity of the object at t = 6 s?



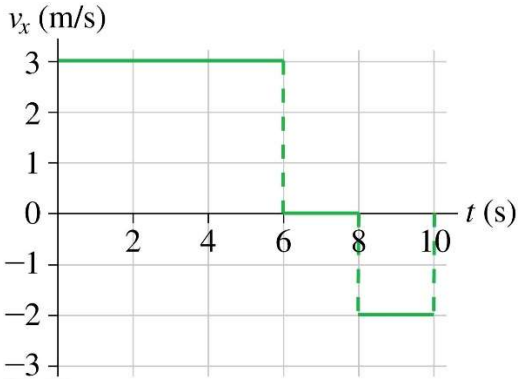
a. 0.67 m/s
b. 0.83 m/s
c. 3.3 m/s
d. 4.2 m/s
e. 25 m/s

16. A bicyclist has the position-versus-time graph shown below. What is the bicyclist's velocity at t = 10 s, at t = 25 s, and at t = 35 s?



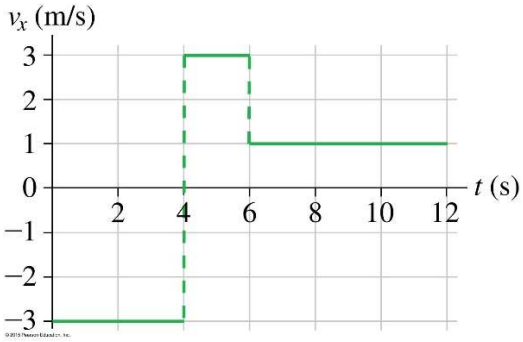
17. In an 8.00 km race, one runner runs at a steady 11.0 km/h and another runs at 14.0 km/h. How far from the finish line is the slower runner when the faster runner finishes the race?

18. A mail carrier is driving slowly, putting mail in mail boxes near the road. He overshoots one mailbox, stops, shifts into reverse, and then backs up until he is at the right spot. The velocity graph below represents his motion.



a. Draw the mail carrier's position-versus-time graph. Assume that x = 0 m at t = 0 s.
b. What is the position of the mail box?

19. For the velocity-versus-time graph below:



a. Draw the corresponding position-versus-time graph. Assume that x = 0 m at t = 0 s.
b. What is the object's position at t = 12 s.

20. The wicket-to-wicket length of a cricket pitch is 20.12 m. If the ball leaves the bat at 241.4 km/h, how long does it take the ball to reach the bowler at the other end of the pitch?