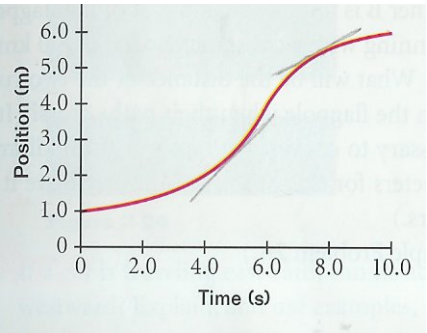
Motion in One Dimension Homework Problems

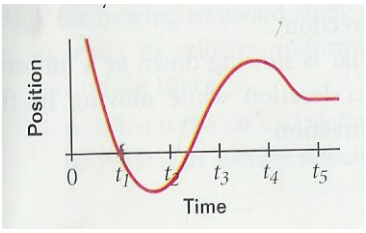
1. On the graph below what is the total distance traveled during the recorded time interval? What is the displacement?



2. On a position-time graph such as the one above, what represents the instantaneous velocity?

3. Sketch a position-time graph for each of the following situations:
   a. an object at rest
   b. an object with constant positive velocity
   c. an object with constant negative velocity

4. The position-time graph for a bug crawling along a line is shown in the graph below. Determine whether the velocity is positive, negative or zero at each of the times marked on the graph.



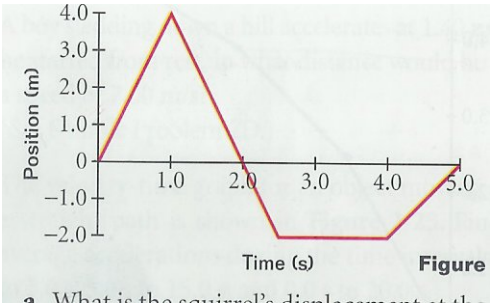
5. Use the position-time graph above to answer the following questions:
   a. During which time interval(s) does the velocity decrease?
   b. During which time interval(s) does the velocity increase?

6. If the average velocity of a duck is zero in a given time interval, what can you say about the displacement of the duck for that interval?

7. Velocity can be either positive or negative, depending on the direction of the displacement. The time interval, Δt, is always positive. Why?

8. A school bus takes 0.530 h to reach the school from your house. If the average velocity of the bus is 19.0 km/h to the east, what is the displacement? *(380 km)*

9. Below is the position-time graph for a squirrel running along a clothesline.



Figure

a. What is the squirrel's displacement at the time t = 3.0 s?

b. What is the squirrel's average velocity during the time interval between 0.0 s and 3.0 s?

10. Two cars are traveling on a desert road, as shown in the picture below. After 5.0 s, they are side by side at the next telephone pole. The distance between the poles is 70.0 m. Identify the following quantities:

a. the displacement of car A after 5.0 s
b. the displacement of car B after 5.0 s
c. the average velocity of car A during 5.0 s
d. the average velocity of car B during 5.0 s

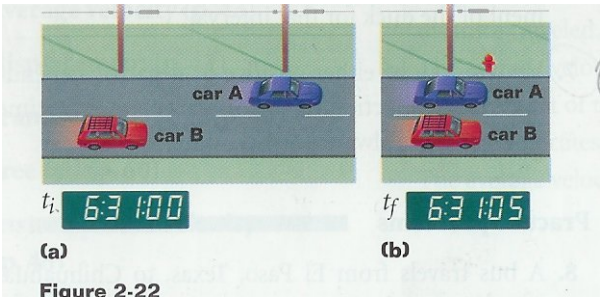


Figure 2-22

(a. +70.0 m b. +140.0 m c. +14 m/s d. +28 m/s)

11. This graph shows the position of a runner at different times during a run.

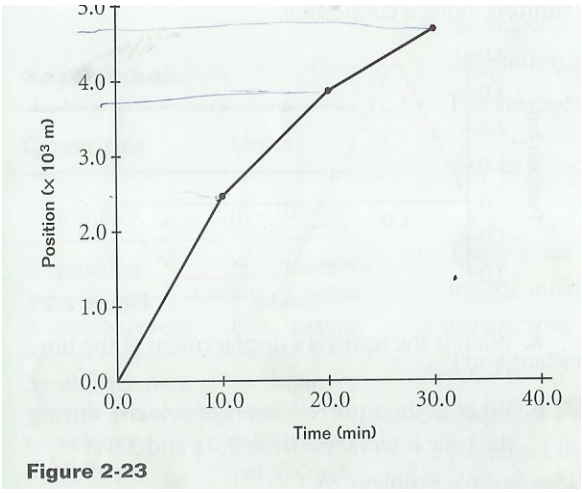


Figure 2-23

a. For the time interval between t = 0.0 min and t = 10.0 min, what is the runner's displacement and average velocity?

b. For the time interval between t = 10.0 min and t = 20.0 min, what is the runner's displacement? What is the runner's average velocity?

c. For the time interval between t = 20.0 min and t = 30.0 min, what is the runner's displacement? What is the runner's average velocity?

d. What is the runner's displacement for the total run? What is the runner's average velocity for the total run?

12. Runner A is initially 6.0 km west of a flagpole and is running with a constant velocity of 9.0 km/h due east. Runner B is initially 5.0 km east of the flagpole and is running with a constant velocity of 8.0 km/h due west. What will be the distance of the two runners from the flagpole when their paths cross? (It is not necessary to convert your answer from km to m for this problem.) (*0.2 km west of the flagpole)*

13. What would be the acceleration of a turtle that is moving with a constant velocity of 0.25 m/s to the right?

14. Sketch the velocity-time graphs for the following motions.

a. a city bus that is moving with a constant velocity
b. a wheelbarrow that is speeding up at a uniform rate of acceleration while moving in the positive direction
c. a tiger that is speeding up at a uniform rate of acceleration while moving in the negative direction
d. an iguana that is slowing down at a uniform rate of acceleration while moving in the positive direction
e. a camel that is slowing down at a uniform rate of acceleration while moving in the negative direction

15. The strobe photographs below show a disk moving from left to right under different conditions. The time interval between images is constant. Assuming that the direction to the right is positive, identify the following types of motion in each photograph.

a. the acceleration is positive
b. the acceleration is negative
c. the velocity is constant

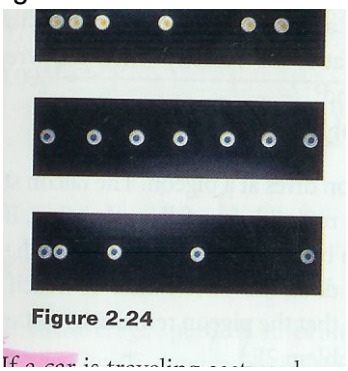


Figure 2-24

16. If a car is traveling eastward, can its acceleration be westward? Explain, and use examples.

17. A car traveling at +7.0 m/s accelerates at the rate of +0.80 m/s² for an interval of 2.0 s. Find final velocity. *(+8.6 m/s)*

18. A car moving westward along a straight, level road increases its velocity uniformly from +16 m/s to +32 m/s in 10.0 s.

a. What is the car's acceleration? *(+1.6 m/s²)*
b. What is the average velocity? *(+24 m/s)*
c. How far did it move during while accelerating? *(240 m)*

19. A bus slows down uniformly from 75.0 km/h (21m/s) to 0 km/h in 21 s? How far does it travel before stopping? (*2.2 x 10²m)*

20. A car accelerates uniformly from rest to a speed of 65 km/h (18 m/s) in 12 s. Find the distance the car travels during this time. *(110 m)*

21. A boy sledding down a hill accelerates at 1.40 m/s². If he started from rest, in what distance would he reach a speed of 7.00 m/s? *(17.5 m)*

22. A plane lands with a velocity of +120 m/s and accelerates at a maximum rate of -6.0 m/s².

a. From the instant the plane touches the runway, what is the minimum time needed before it can come to rest? *(2.0 x 10^1 s)*

b. Can this plane land on a naval aircraft carrier where the runway is 0.80 km long? *(No, needs at least 1.2 km to land)*

23. An elevator is moving upward 1.20 m/s when it experiences an acceleration of 0.31 m/s² downward, over a distance of 0.75 m. What will its final velocity be? *(0.99 m/s)*

24. A ball is thrown vertically upward.

a. What happens to the ball's velocity while the ball is in the air?
b. What is its velocity when it reaches its maximum altitude?
c. What is its acceleration when it reaches its maximum altitude?
d. What is its acceleration just before it hits the ground?
e. Does its acceleration increase, decrease, or remain constant?

25. A small fish is dropped by a pelican that is rising steadily at 0.50 m/s.

a. After 2.5 s, what is the velocity of the fish? *(-24 m/s)*
b. How far below the pelican is the fish after 2.5 s? *(31 m)*

26. A parachutist descending at a speed of 10.0 m/s loses a shoe at an altitude of 50.0 m.

a. When does the shoe reach the ground? *(2.33 s)*
b. What is the velocity of the shoe just before it hits the ground? *(-32.9 m/s)*

27. A mountain climber stands at the top of a 50.0 m cliff hanging over a calm pool of water. The climber throws two stones vertically 1.0 s apart and observes that they cause a single splash when they hit the water. The first stone has an initial velocity of +2.0 m/s.

a. How long after release of the first stone will the two stones hit the water? *(3.40s)*
b. What is the initial velocity of the second stone when it is thrown? *(-9.2 m/s)*
c. What will the velocity of each stone be at the instant both stones hit the water? *(-31 m/s ; -33 m/s)*

28. A model rocket is launched straight upward with an initial speed of 50.0 m/s. It accelerates with a constant upward acceleration of 2.00 m/s² until its engines stop at an altitude of 150 m.

a. What is the maximum height reached by the rocket? *(310 m)*
b. When does the rocket reach maximum height? *(8.5 s)*
c. How long is the rocket in the air? *(16.4 s)*