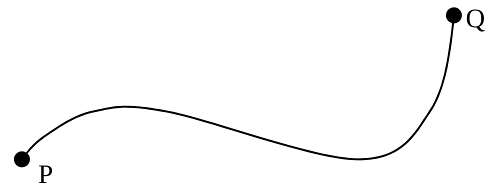
chapter 2 KINEMATICS IN ONE DIMENSION

Section 2.1 Displacement
Section 2.2 Speed and Velocity

◘ 1. A particle travels along a curved path between two points P and Q as shown. The displacement of the particle does *not* depend on
(a) the location of P.
(b) the location of Q.
(c) the distance traveled from P to Q.
(d) the shortest distance between P and Q.
(e) the direction of Q from P.



☐ 2. For which one of the following situations will the path length equal the magnitude of the displacement?
(a) A jogger is running around a circular path.
(b) A ball is rolling down an inclined plane.
(c) A train travels 5 miles east before it stops. It then travels 2 miles west.
(d) A ball rises and falls after being thrown straight up from the earth's surface.
(e) A ball on the end of a string is moving in a vertical circle.

☐ 3. Which one of the physical quantities listed below is *not* correctly paired with its SI unit and dimension?

	Quantity	Unit	Dimension
(a)	velocity	m/s	[L]/[T]
(b)	path length	m	[L]
(c)	speed	m/s	[L]/[T]
(d)	displacement	m/s^2	$[L]/[T]^2$
(e)	speed × time	m	[L]

☐ 4. A car travels in a straight line covering a total distance of 90.0 miles in 60.0 minutes. Which one of the following statements concerning this situation is *necessarily* true?
(a) The velocity of the car is constant.
(b) The acceleration of the car must be non-zero.
(c) The first 45 miles must have been covered in 30.0 minutes.
(d) The speed of the car must be 90.0 miles per hour throughout the entire trip.
(e) The average velocity of the car is 90.0 miles per hour in the direction of motion.

◘ 5. At time $t = 0$ s, an object is observed at $x = 0$ m; and its position along the x axis follows this expression: $x = -3t + t^3$, where the units for distance and time are meters and seconds, respectively. What is the object's displacement Δx between $t = 1.0$ s and $t = 3.0$ s?
(a) +20 m
(b) –20 m
(c) +10 m
(d) +2 m
(e) –2 m

Questions 6 and 7 pertain to the situation described below:

Peter noticed a bug crawling along a meter stick and decided to record the bug's position in five-second intervals. After the bug crawled off the meter stick, Peter created the table shown.

time (s)	position (cm)
0.00	49.6
5.00	39.2
10.0	42.5
15.0	41.0
20.0	65.7

☐ 6. What is the displacement of the bug between t = 0.00 s and t = 20.0 s?
(a) +39.9 cm (c) +65.7 cm (e) +16.1 cm
(b) –39.9 cm (d) –16.1 cm

◘ 7. What is the total distance that the bug traveled between t = 0.00 s and t = 20.0 s? Assume the bug only changed directions at the end of a five-second interval.
(a) 39.9 cm (c) 16.1 cm (e) 26.5 cm
(b) 65.7 cm (d) 47.1 cm

☐ 8. In the process of delivering mail, a postal worker walks 161 m, due east from his truck. He then turns around and walks 194 m, due west. What is the worker's displacement relative to his truck?
(a) 33 m, due west (c) 194 m, due west (e) 355 m, due west
(b) 33 m, due east (d) 252 m, due east

◘ 9. A Canadian goose flew 845 km from Southern California to Oregon with an average speed of 30.5 m/s. How long, in hours, did it take the goose to make this journey?
(a) 27.7 h (c) 66.1 h (e) 7.70 h
(b) 8.33 h (d) 462 h

☐ 10. When the outdoor emergency warning siren at Cheryl's school was tested, the sound from the siren took 7.0 s to reach her house located 2.40 km from the school. What is the speed of sound in air?
(a) 240 m/s (c) 440 m/s (e) 640 m/s
(b) 340 m/s (d) 540 m/s

☐ 11. A bus leaves New York City, takes a non-direct route and arrives in St. Louis, Missouri 23 hours, 16 minutes later. If the distance between the two cities is 1250 km, what is the magnitude of the bus' average velocity?
(a) 37.2 km/h (c) 46.0 km/h (e) 58.1 km/h
(b) 41.4 km/h (d) 53.7 km/h

◘ 12. Carole's hair grows with an average speed of 3.5×10^{-9} m/s. How long does it take her hair to grow 0.30 m? Note: 1 yr = 3.156×10^{7} s.
(a) 1.9 yr (c) 0.37 yr (e) 2.7 yr
(b) 1.3 yr (d) 5.4 yr

■ 13. Carl Lewis set a world record for the 100.0-m run with a time of 9.86 s. If, after reaching the finish line, Mr. Lewis walked directly back to his starting point in 90.9 s, what is the magnitude of his average velocity for the 200.0 m?
(a) 0 m/s (c) 1.98 m/s (e) 10.1 m/s
(b) 1.10 m/s (d) 5.60 m/s

■ 14. During the first 18 minutes of a 1.0-hour trip, a car has an average speed of 11 m/s. What must the average speed of the car be during the last 42 minutes of the trip be if the car is to have an average speed of 21 m/s for the entire trip?

(a) 21 m/s (c) 25 m/s (e) 29 m/s
(b) 23 m/s (d) 27 m/s

■ 15. A turtle takes 3.5 minutes to walk 18 m toward the south along a deserted highway. A truck driver stops and picks up the turtle. The driver takes the turtle to a town 1.1 km to the north with an average speed of 12 m/s. What is the magnitude of the average velocity of the turtle for its entire journey?

(a) 3.6 m/s (c) 6.0 m/s (e) 11 m/s
(b) 9.8 m/s (d) 2.6 m/s

Questions 16 through 19 pertain to the situation described below:

A racecar, traveling at constant speed, makes one lap around a circular track of radius r in a time t. Note: The circumference of a circle is given by $C = 2\pi r$.

☐ 16. When the car has traveled halfway around the track, what is the magnitude of its *displacement* from the starting point?

(a) r (c) πr (e) zero meters
(b) $2r$ (d) $2\pi r$

◘ 17. What is the *average speed* of the car for one complete lap?

(a) $\frac{r}{t}$ (c) $\frac{\pi r}{t}$ (e) zero meters/second
(b) $\frac{2r}{t}$ (d) $\frac{2\pi r}{t}$

◘ 18. Determine the *magnitude* of the *average velocity* of the car for one complete lap.

(a) $\frac{r}{t}$ (c) $\frac{\pi r}{t}$ (e) zero meters/second
(b) $\frac{2r}{t}$ (d) $\frac{2\pi r}{t}$

◘ 19. Which one of the following statements concerning this car is true?

(a) The displacement of the car does not change with time.
(b) The instantaneous velocity of the car is constant.
(c) The average speed of the car is the same over any time interval.
(d) The average velocity of the car is the same over any time interval.
(e) The average speed of the car over any time interval is equal to the magnitude of the average velocity over the same time interval.

Section 2.3 Acceleration

☐ 20. In which one of the following situations does the car have a westward acceleration?

(a) The car travels westward at constant speed.
(b) The car travels eastward and speeds up.
(c) The car travels westward and slows down.
(d) The car travels eastward and slows down.
(e) The car starts from rest and moves toward the east.

21. An elevator is moving upward with a speed of 11 m/s. Three seconds later, the elevator is still moving upward, but its speed has been reduced to 5.0 m/s. What is the average acceleration of the elevator during the 3.0 s interval?
(a) 2.0 m/s^2, upward
(b) 2.0 m/s^2, downward
(c) 5.3 m/s^2, upward
(d) 5.3 m/s^2, downward
(e) 2.7 m/s^2, downward

22. A landing airplane makes contact with the runway with a speed of 78.0 m/s and moves toward the south. After 18.5 seconds, the airplane comes to rest. What is the average acceleration of the airplane during the landing?
(a) 2.11 m/s^2, north
(b) 2.11 m/s^2, south
(c) 4.22 m/s^2, north
(d) 4.22 m/s^2, south
(e) 14.3 m/s^2, north

23. A pitcher delivers a fast ball with a velocity of 43 m/s to the south. The batter hits the ball and gives it a velocity of 51 m/s to the north. What was the average acceleration of the ball during the 1.0 ms when it was in contact with the bat?
(a) 4.3×10^4 m/s^2, south
(b) 5.1×10^4 m/s^2, north
(c) 9.4×10^4 m/s^2, north
(d) 2.2×10^3 m/s^2, south
(e) 7.0×10^3 m/s^2, north

24. A car is moving at a constant velocity when it is involved in a collision. The car comes to rest after 0.450 s with an average acceleration of 65.0 m/s^2 in the direction opposite that of the car's velocity. What was the speed, in km/h, of the car before the collision?
(a) 29.2 km/h
(b) 44.8 km/h
(c) 80.5 km/h
(d) 105 km/h
(e) 144 km/h

25. A train approaches a small town with a constant velocity of +28.6 m/s. The operator applies the brake, reducing the train's velocity to +11.4 m/s. If the average acceleration of the train during braking is –1.35 m/s^2, for what elapsed time does the operator apply the brake?
(a) 8.44 s
(b) 12.7 s
(c) 3.38 s
(d) 5.92 s
(e) 10.4 s

Section 2.4 Equations of Kinematics for Constant Acceleration
Section 2.5 Applications of the Equations of Kinematics

26. Which one of the following is *not* a vector quantity?
(a) acceleration
(b) average speed
(c) displacement
(d) average velocity
(e) instantaneous velocity

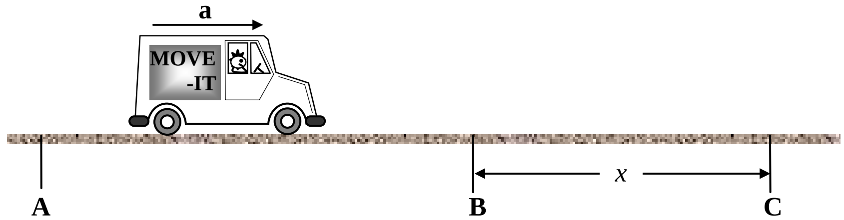
27. In which one of the following cases is the displacement of the object directly proportional to the elapsed time?
(a) a ball rolls with constant velocity
(b) a ball at rest is given a constant acceleration
(c) a ball rolling with velocity $\mathbf{v}_0$ is given a constant acceleration
(d) a bead falling through oil experiences a decreasing acceleration
(e) a rocket fired from the earth's surface experiences an increasing acceleration

28. Which one of the following statements must be true if the expression $x = v_0 t + \frac{1}{2}at^2$ is to be used?
(a) *x* is constant.
(b) *v* is constant.
(c) *t* is constant.
(d) *a* is constant.
(e) Both v_0 and *t* are constant.

29. Starting from rest, a particle confined to move along a straight line is accelerated at a rate of 5.0 m/s^2. Which one of the following statements accurately describes the motion of this particle?
(a) The particle travels 5.0 m during each second.
(b) The particle travels 5.0 m *only* during the first second.
(c) The speed of the particle increases by 5.0 m/s during each second.
(d) The acceleration of the particle increases by 5.0 m/s^2 during each second.
(e) The final speed of the particle will be proportional to the distance that the particle covers.

30. Which one of the following situations is *not* possible?
(a) A body has zero velocity and non-zero acceleration.
(b) A body travels with a northward velocity and a northward acceleration.
(c) A body travels with a northward velocity and a southward acceleration.
(d) A body travels with a constant velocity and a time-varying acceleration.
(e) A body travels with a constant acceleration and a time-varying velocity.

31. A truck accelerates from rest at point **A** with constant acceleration of magnitude *a* and, subsequently, passes points **B** and **C** as shown in the figure.



The distance between points **B** and **C** is *x*, and the time required for the truck to travel from **B** to **C** is *t*. Which expression determines the *average speed* of the truck between the points **B** and **C**?
(a) $v^2 = 2ax$
(b) $v = \frac{x}{t}$
(c) $v = xt$
(d) $v = \frac{1}{2}at^2$
(e) $v = at$

32. Two objects A and B accelerate from rest with the same constant acceleration. Object A accelerates for twice as much time as object B, however. Which one of the following statements is true concerning these objects at the end of their respective periods of acceleration?
(a) Object A will travel twice as far as object B.
(b) Object A will travel four times as far as object B.
(c) Object A will travel eight times further than object B.
(d) Object A will be moving four times faster than object B.
(e) Object A will be moving eight times faster than object B.

33. Two cars travel along a level highway. It is observed that the distance between the cars is *increasing*. Which one of the following statements concerning this situation is *necessarily* true?
(a) The velocity of each car is increasing.
(b) At least one of the cars has a *non-zero* acceleration.
(c) The leading car has the greater acceleration.
(d) The trailing car has the smaller acceleration.
(e) Both cars could be accelerating at the same rate.

34. A car, starting from rest, accelerates in a straight-line path at a constant rate of 2.5 m/s^2. How far will the car travel in 12 seconds?
(a) 180 m
(b) 120 m
(c) 30 m
(d) 15 m
(e) 4.8 m

◘ 35. An object moving along a straight line is decelerating. Which one of the following statements concerning the object's acceleration is *necessarily* true?
(a) The value of the acceleration is positive.
(b) The direction of the acceleration is in the same direction as the displacement.
(c) An object that is decelerating has a negative acceleration.
(d) The direction of the acceleration is in the direction opposite to that of the velocity.
(e) The acceleration changes as the object moves along the line.

■ 36. A car starts from rest and accelerates at a constant rate in a straight line. In the *first* second the car covers a distance of 2.0 meters. How fast will the car be moving at the end of the *second* second?
(a) 4.0 m/s (c) 2.0 m/s (e) 8.0 m/s
(b) 16 m/s (d) 32 m/s

■ 37. A car starts from rest and accelerates at a constant rate in a straight line. In the *first* second the car covers a distance of 2.0 meters. How much *additional* distance will the car cover during the *second* second of its motion?
(a) 2.0 m (c) 6.0 m (e) 13 m
(b) 4.0 m (d) 8.0 m

■ 38. A car is initially traveling at 50.0 km/h. The brakes are applied and the car stops over a distance of 35 m. What was magnitude of the car's acceleration while it was braking?
(a) 2.8 m/s^2 (c) 36 m/s^2 (e) 9.8 m/s^2
(b) 5.4 m/s^2 (d) 71 m/s^2

◘ 39. The minimum takeoff speed for a certain airplane is 75 m/s. What minimum acceleration is required if the plane must leave a runway of length 950 m? Assume the plane starts from rest at one end of the runway.
(a) 1.5 m/s^2 (c) 4.5 m/s^2 (e) 7.5 m/s^2
(b) 3.0 m/s^2 (d) 6.0 m/s^2

◘ 40. A car traveling along a road begins accelerating with a constant acceleration of 1.5 m/s^2 in the direction of motion. After traveling 392 m at this acceleration, its speed is 35 m/s. Determine the speed of the car when it began accelerating.
(a) 1.5 m/s (c) 34 m/s (e) 2.3 m/s
(b) 7.0 m/s (d) 49 m/s

◘ 41. A train passes through a town with a constant speed of 16 m/s. After leaving the town, the train accelerates at 0.33 m/s^2 until it reaches a speed of 35 m/s. How far did the train travel while it was accelerating?
(a) 0.029 km (c) 1.5 km (e) 3.0 km
(b) 0.53 km (d) 2.3 km

■ 42. A cheetah is walking at a speed of 1.10 m/s when it observes a gazelle 41.0 m directly ahead. If the cheetah accelerates at 9.55 m/s^2, how long does it take the cheetah to reach the gazelle if the gazelle doesn't move?
(a) 4.29 s (c) 3.05 s (e) 2.82 s
(b) 3.67 s (d) 1.94 s

☐ 43. A body initially at rest is accelerated at a constant rate for 5.0 seconds in the positive *x* direction. If the final speed of the body is 20.0 m/s, what was the body's acceleration?
(a) 0.25 m/s^2 (c) 4.0 m/s^2 (e) 1.6 m/s^2
(b) 2.0 m/s^2 (d) 9.8 m/s^2

◘ 44. A racecar has a speed of 80 m/s when the driver releases a drag parachute. If the parachute causes a deceleration of –4 m/s^2, how far will the car travel before it stops?
(a) 20 m (c) 400 m (e) 1000 m
(b) 200 m (d) 800 m

◘ 45. A car is stopped at a red traffic light. When the light turns to green, the car has a constant acceleration and crosses the 9.10-m intersection in 2.47 s. What is the magnitude of the car's acceleration?
(a) 1.77 m/s^2 (c) 3.60 m/s^2 (e) 9.80 m/s^2
(b) 2.98 m/s^2 (d) 7.36 m/s^2

Questions 46 through 48 pertain to the situation described below:

An object starts from rest and accelerates uniformly in a straight line in the positive *x* direction. After 11 seconds, its speed is 70.0 m/s.

◘ 46. Determine the acceleration of the object.
(a) +3.5 m/s^2 (c) –3.5 m/s^2 (e) +7.7 m/s^2
(b) +6.4 m/s^2 (d) –6.4 m/s^2

◘ 47. How far does the object travel during the first 11 seconds?
(a) 35 m (c) 390 m (e) 770 m
(b) 77 m (d) 590 m

◘ 48. What is the *average velocity* of the object during the first 11 seconds?
(a) +3.6 m/s (c) +35 m/s (e) −140 m/s
(b) +6.4 m/s (d) +72 m/s

Section 2.6 Freely Falling Bodies

◘ 49. Ball A is dropped from rest from a window. At the same instant, ball B is thrown downward; and ball C is thrown upward from the same window. Which statement concerning the balls after their release is necessarily true if air resistance is neglected?
(a) At some instant after it is thrown, the acceleration of ball C is zero.
(b) All three balls strike the ground at the same time.
(c) All three balls have the same velocity at any instant.
(d) All three balls have the same acceleration at any instant.
(e) All three balls reach the ground with the same velocity.

☐ 50. A ball is thrown vertically upward from the surface of the earth. Consider the following quantities:
(1) the speed of the ball; (2) the velocity of the ball; (3) the acceleration of the ball.
Which of these is (are) zero when the ball has reached the maximum height?
(a) 1 and 2 only (c) 1 only (e) 1, 2, and 3
(b) 1 and 3 only (d) 2 only

□ 51. A rock is thrown vertically upward from the surface of the earth. The rock rises to some maximum height and falls back toward the surface of the earth. Which one of the following statements concerning this situation is true if air resistance is neglected?
(a) As the ball rises, its acceleration vector points upward.
(b) The ball is a freely falling body for the duration of its flight.
(c) The acceleration of the ball is zero when the ball is at its highest point.
(d) The speed of the ball is negative while the ball falls back toward the earth.
(e) The velocity and acceleration of the ball always point in the same direction.

□ 52. A brick is dropped from rest from a height of 4.9 m. How long does it take the brick to reach the ground?
(a) 0.6 s (c) 1.2 s (e) 2.0 s
(b) 1.0 s (d) 1.4 s

□ 53. A ball is dropped from rest from a tower and strikes the ground 125 m below. Approximately how many seconds does it take the ball to strike the ground after being dropped? Neglect air resistance.
(a) 2.50 s (c) 5.05 s (e) 16.0 s
(b) 3.50 s (d) 12.5 s

□ 54. Water drips from rest from a leaf that is 20 meters above the ground. Neglecting air resistance, what is the speed of each water drop when it hits the ground?
(a) 30 m/s (c) 40 m/s (e) 20 m/s
(b) 15 m/s (d) 10 m/s

□ 55. Elijah throws a tennis ball vertically upward. The ball returns to the point of release after 3.5 s. What is the speed of the ball as it is released?
(a) 0 m/s (c) 17 m/s (e) 34 m/s
(b) 14 m/s (d) 21 m/s

■ 56. A rock is dropped from rest from a height h above the ground. It falls and hits the ground with a speed of 11 m/s. From what height should the rock be dropped so that its speed on hitting the ground is 22 m/s? Neglect air resistance.
(a) $1.4h$ (c) $3.0h$ (e) $0.71h$
(b) $2.0h$ (d) $4.0h$

□ 57. A 5.0-kg rock is dropped from rest down a vertical mine shaft. How long does it take for the rock to reach a depth of 79 m? Neglect air resistance.
(a) 2.8 s (c) 4.9 s (e) 4.0 s
(b) 9.0 s (e) 8.0 s

□ 58. Neglecting air resistance, what maximum height will be reached by a stone thrown straight up with an initial speed of 35 m/s?
(a) 98 m (c) 41 m (e) 18 m
(b) 160 m (d) 63 m

Questions 59 through 61 pertain to the situation described below:

A ball is shot straight up from the surface of the earth with an initial speed of 19.6 m/s.
Neglect any effects due to air resistance.

59. What is the magnitude of the ball's displacement from the starting point after 1.00 second has elapsed?
(a) 9.80 m (c) 19.6 m (e) 58.8 m
(b) 14.7 m (d) 24.5 m

60. What maximum height will the ball reach?
(a) 9.80 m (c) 19.6 m (e) 58.8 m
(b) 14.7 m (d) 24.5 m

61. How much time elapses between the throwing of the ball and its return to the original launch point?
(a) 4.00 s (c) 12.0 s (e) 16.0 s
(b) 2.00 s (d) 8.00 s

Questions 62 through 65 pertain to the statement below:

A tennis ball is shot vertically upward in an *evacuated chamber* inside a tower with an initial speed of 20.0 m/s at time t = 0 s.

62. How high does the ball rise?
(a) 10.2 m (c) 40.8 m (e) 98.0 m
(b) 20.4 m (d) 72.4 m

63. Approximately how long does it take the tennis ball to reach its maximum height?
(a) 0.50 s (c) 4.08 s (e) 9.80 s
(b) 2.04 s (d) 6.08 s

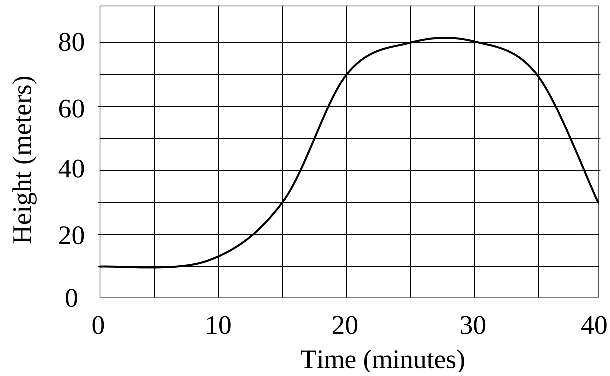
64. Determine the velocity of the ball at t = 3.00 seconds.
(a) 9.40 m/s, downward (c) 29.4 m/s, downward (e) 38.8 m/s, downward
(b) 9.40 m/s, upward (d) 38.8 m/s, upward

65. What is the magnitude of the acceleration of the ball when it is at its highest point?
(a) zero m/s^2 (c) 19.6 m/s^2 (e) 3.13 m/s^2
(b) 9.80 m/s^2 (d) 4.90 m/s^2

Section 2.7 Graphical Analysis of Velocity and Acceleration

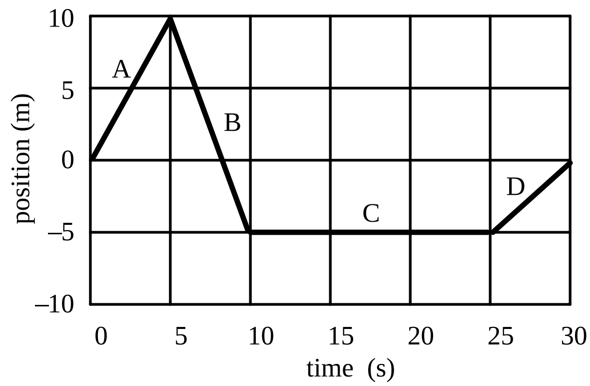
66. Starting from rest, a particle that is confined to move along a straight line is accelerated at a rate of 5.0 m/s^2. Which statement concerning the *slope* of the *position versus time* graph for this particle is true?
(a) The slope has a constant value of 5.0 m/s.
(b) The slope has a constant value of 5.0 m/s^2.
(c) The slope is both constant and negative.
(d) The slope is not constant and *increases* with increasing time.
(e) The slope is not constant and *decreases* with increasing time.

67. The graph shows the height versus time of an object. Estimate the instantaneous velocity, in m/s, of the object at time t = 15 min.
(a) 0.90 m/s
(b) 0.70 m/s
(c) 0.50 m/s
(d) 0.30 m/s
(e) 0.10 m/s



Questions 68 through 70 pertain to the graph below:

An object is moving along the x axis. The graph shows its position from the starting point as a function of time. Various segments of the graph are identified by the letters A, B, C, and D.



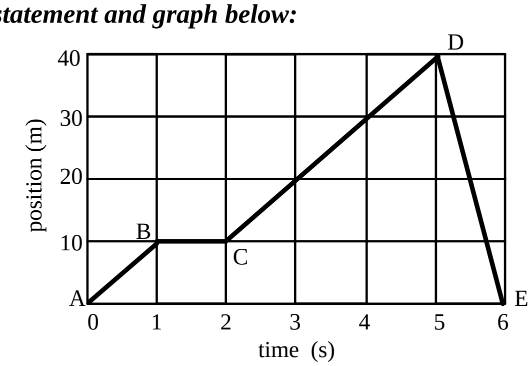
68. During which interval(s) is the object moving in the negative x direction?
(a) during interval B only
(b) during intervals B and C
(c) during intervals C and D
(d) during intervals B and D
(e) during intervals B, C, and D

69. What is the *velocity* of the object at t = 7.0 s?
(a) +3.0 m/s
(b) –1.0 m/s
(c) –2.0 m/s
(d) –3.0 m/s
(e) zero m/s

70. What is the *acceleration* of the object at t = 7.0 s?
(a) zero m/s^2
(b) -2.0 m/s^2
(c) -3.0 m/s^2
(d) $+9.8$ m/s^2
(e) $+4.0$ m/s^2

Questions 71 through 74 pertain to the statement and graph below:

An object is moving along a straight line. The graph shows the object's position from the starting point as a function of time.



☐ 71. In which segment(s) of the graph does the object's *average velocity* (measured from t = 0 s) *decrease* with time?
(a) AB only (b) BC only (c) DE only (d) AB and CD (e) BC and DE

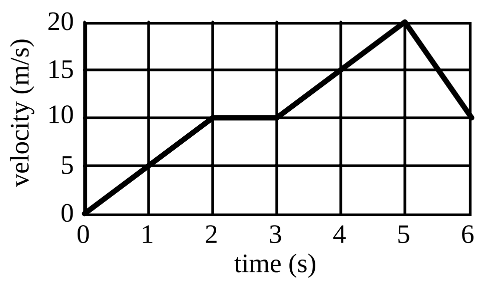
◘ 72. What was the *instantaneous velocity* of the object at t = 4 s?
(a) +6 m/s (b) +8 m/s (c) +10 m/s (d) +20 m/s (e) +40 m/s

☐ 73. In which segments(s) of the graph does the object have the highest speed?
(a) AB (b) BC (c) CD (d) DE (e) AB and CD

◘ 74. At which time(s) does the object reverse its direction of motion?
(a) 1 s and 2 s (b) 2 s and 5 s (c) 1 s (d) 2 s (e) 5 s

Questions 75 through 78 pertain to the statement and graph below:

An object is moving along a straight line. The graph shows the object's velocity as a function of time.



◘ 75. During which interval(s) of the graph does the object travel *equal distances* in *equal times*?
(a) 0 s to 2 s (b) 2 s to 3 s (c) 3 s to 5 s (d) 0 s to 2 s and 3 s to 5 s (e) 0 s to 2 s, 3 to 5 s, and 5 to 6 s

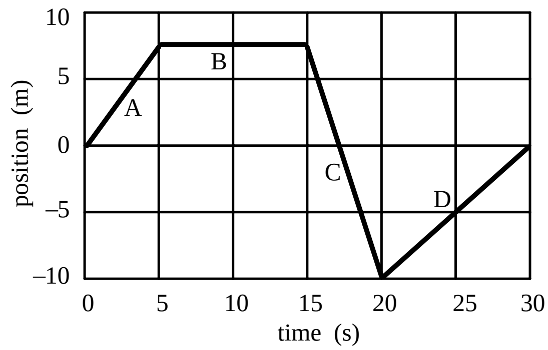
■ 76. During which interval(s) of the graph does the speed of the object *increase by equal amounts* in *equal times*?
(a) 0 s to 2 s (b) 2 s to 3 s (c) 3 s to 5 s (d) 0 s to 2 s and 3 s to 5 s (e) 0 s to 2 s, 3 to 5 s, and 5 to 6 s

◘ 77. How far does the object move in the interval from t = 0 to t = 2 s?
(a) 7.5 m (b) 10 m (c) 15 m (d) 20 m (e) 25 m

◘ 78. What is the acceleration of the object in the interval from t = 5 s to t = 6 s?
(a) -40 m/s^2 (b) +40 m/s^2 (c) -20 m/s^2 (d) +20 m/s^2 (e) -10 m/s^2

Questions 79 through 81 pertain to the situation described below:

An object is moving along a straight line in the positive *x* direction. The graph shows its position from the starting point as a function of time. Various segments of the graph are identified by the letters A, B, C, and D.



◘ 79. Which segment(s) of the graph represent(s) a *constant velocity* of +1.0 m/s?
(a) A
(b) B
(c) C
(d) D
(e) A and C

☐ 80. What was the *instantaneous velocity* of the object at the end of the eighth second?
(a) +7.5 m/s
(b) +0.94 m/s
(c) –0.94 m/s
(d) +1.1 m/s
(e) zero m/s

☐ 81. During which interval(s) did the object move in the negative *x* direction?
(a) only during interval B
(b) only during interval C
(c) only during interval D
(d) during both intervals C and D
(e) The object never moved in the negative *x* direction.

Additional Problems

◘ 82. The rate at which the acceleration of an object changes with time is called the *jerk*. What is the dimension of the jerk?
(a) $\frac{[L]}{[T]}$
(b) $\frac{[L]}{[T]^2}$
(c) $\frac{[L]^2}{[T]^2}$
(d) $\frac{[L]}{[T]^3}$
(e) $\frac{[L]^2}{[T]^3}$

◘ 83. In a race, José runs 1.00 mile in 4.02 min, mounts a bicycle, and rides back to his starting point, which is also the finish line, in 3.02 min. What is the magnitude of José's average velocity for the race?
(a) zero mi/h
(b) 12.1 mi/h
(c) 14.9 mi/h
(d) 17.0 mi/h
(e) 19.9 mi/h

Questions 84 and 85 pertain to the situation described below:

A motorist travels due north at 30 mi/h for 2 hours. She then reverses her direction and travels due south at 60 mi/h for 1 hour.

◘ 84. What is the average speed of the motorist?
(a) zero mi/h
(b) 30 mi/h
(c) 40 mi/h
(d) 50 mi/h
(e) 60 mi/h

■ 85. What is the average velocity of the motorist?
(a) zero mi/h
(b) 40 mi/h, north
(c) 40 mi/h, south
(d) 45 mi/h, north
(e) 45 mi/h, south

Questions 86 through 88 pertain to the statement below:

Starting from rest, a particle confined to move along a straight line is accelerated at a rate of 4 m/s^2.

□ 86. Which statement accurately describes the motion of the particle?
(a) The particle travels 4 meters during each second.
(b) The particle travels 4 meters during the first second only.
(c) The speed of the particle increases by 4 m/s during each second.
(d) The acceleration of the particle increases by 4 m/s^2 during each second.
(e) The final velocity of the particle will be proportional to the distance that the particle covers.

◘ 87. After 10 seconds, how far will the particle have traveled?
(a) 20 m
(b) 40 m
(c) 100 m
(d) 200 m
(e) 400 m

◘ 88. What is the speed of the particle after it has traveled 8 m?
(a) 4 m/s
(b) 8 m/s
(c) 30 m/s
(d) 60 m/s
(e) 100 m/s

Questions 89 through 92 pertain to the situation described below:

A rock, dropped from rest near the surface of an atmosphere-free planet, attains a speed of 20.0 m/s after falling 8.0 meters.

◘ 89. What is the magnitude of the acceleration due to gravity on the surface of this planet?
(a) 0.40 m/s^2
(b) 1.3 m/s^2
(c) 2.5 m/s^2
(d) 25 m/s^2
(e) 160 m/s^2

◘ 90. How long did it take the object to fall the 8.0 meters mentioned?
(a) 0.40 s
(b) 0.80 s
(c) 1.3 s
(d) 2.5 s
(e) 16 s

◘ 91. How long would it take the object, falling from rest, to fall 16 m on this planet?
(a) 0.8 s
(b) 1.1 s
(c) 2.5 s
(d) 3.5 s
(e) 22 s

◘ 92. Determine the speed of the object after falling from rest through 16 m on this planet.
(a) 28 m/s
(b) 32 m/s
(c) 56 m/s
(d) 64 m/s
(e) 320 m/s

Questions 93 through 97 pertain to the situation described below:

A tennis ball is shot vertically upward from the surface of an atmosphere-free planet with an initial speed of 20.0 m/s. One second later, the ball has an instantaneous velocity in the upward direction of 15.0 m/s.

■ 93. What is the magnitude of the acceleration due to gravity on the surface of this planet?
(a) 5.0 m/s^2
(b) 9.8 m/s^2
(c) 12 m/s^2
(d) 15 m/s^2
(e) 24 m/s^2

■ 94. How long does it take the ball to reach its maximum height?
(a) 2.0 s
(b) 2.3 s
(c) 4.0 s
(d) 4.6 s
(e) 8.0 s

■ 95. How high does the ball rise?
(a) 70.0 m
(b) 10.0 m
(c) 50.0 m
(d) 20.0 m
(e) 40.0 m

■ 96. Determine the velocity of the ball when it returns to its original position.
Note: assume the upward direction is positive.
(a) +20 m/s
(b) −20 m/s
(c) +40 m/s
(c) −40 m/s
(e) zero m/s

■ 97. How long is the ball in the air when it returns to its original position?
(a) 4.0 s
(b) 4.6 s
(c) 8.0 s
(d) 9.2 s
(e) 16 s

Questions 98 and 99 pertain to the situation described below:

A small object is released from rest and falls 1.00×10^2 feet near the surface of the earth. Neglect air resistance.

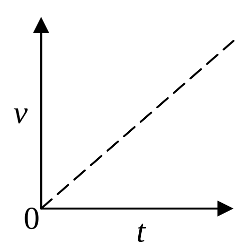
■ 98. How long will it take to fall through the 1.00×10^2 feet mentioned?
(a) 2.49 s
(b) 3.12 s
(c) 4.50 s
(d) 6.25 s
(e) 10.0 s

■ 99. Approximately how fast will the object be moving after falling through the 1.00×10^2 feet mentioned?
(a) 9.8 ft/s
(b) 40 ft/s
(c) 80 ft/s
(d) 160 ft/s
(e) 320 ft/s

Questions 100 through 103 pertain to the situation described below:

The figure shows the speed as a function of time for an object in free fall near the surface of the earth.

The object was dropped from rest in a long evacuated cylinder.



■ 100. Which one of the following statements best explains why the graph goes through the origin?
(a) The object was in a vacuum.
(b) The object was dropped from rest.
(c) The velocity of the object was constant.
(d) All v vs. t curves pass through the origin.
(e) The acceleration of the object was constant.

■ 101. What is the numerical value of the slope of the line?

(a) 1.0 m/s^2
(b) 2.0 m/s^2
(c) 7.7 m/s^2
(d) 9.8 m/s^2
(e) This cannot be determined from the information given since the speed and time values are unknown.

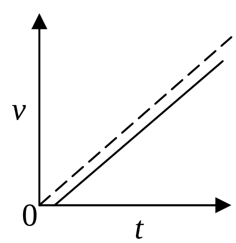
■ 102. What is the speed of the object 3.0 seconds after it is dropped?

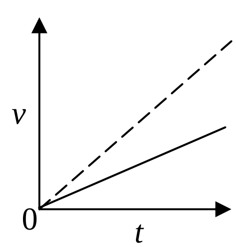
(a) 3.0 m/s
(b) 7.7 m/s
(c) 9.8 m/s
(d) 29 m/s
(e) This cannot be determined since there is no specified value of height.

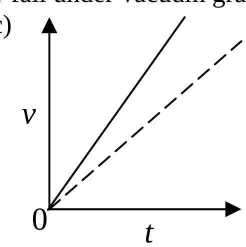
■ 103. If the same object were released in air, the magnitude of its acceleration would begin at the free-fall value, but it would decrease continuously to zero as the object continued to fall.

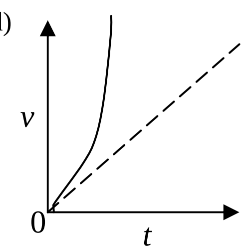
For which one of the choices given does the solid line best represent the speed of the object as a function of time when it is dropped from rest in air?

Note: The dashed line shows the free-fall under vacuum graph for comparison.

(a)


(b)


(c)


(d)


(e)