

Chapter 2: MOTION ALONG A STRAIGHT LINE

1. A particle moves along the x axis from x_i to x_f . Of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?
- A. $x_i = 4 \text{ m}, x_f = 6 \text{ m}$
 - B. $x_i = -4 \text{ m}, x_f = -8 \text{ m}$
 - C. $x_i = -4 \text{ m}, x_f = 2 \text{ m}$
 - D. $x_i = 4 \text{ m}, x_f = -2 \text{ m}$
 - E. $x_i = -4 \text{ m}, x_f = 4 \text{ m}$

ans: E

2. A particle moves along the x axis from x_i to x_f . Of the following values of the initial and final coordinates, which results in a negative displacement?
- A. $x_i = 4 \text{ m}, x_f = 6 \text{ m}$
 - B. $x_i = -4 \text{ m}, x_f = -8 \text{ m}$
 - C. $x_i = -4 \text{ m}, x_f = 2 \text{ m}$
 - D. $x_i = -4 \text{ m}, x_f = -2 \text{ m}$
 - E. $x_i = -4 \text{ m}, x_f = 4 \text{ m}$

ans: B

3. The average speed of a moving object during a given interval of time is always:
- A. the magnitude of its average velocity over the interval
 - B. the distance covered during the time interval divided by the time interval
 - C. one-half its speed at the end of the interval
 - D. its acceleration multiplied by the time interval
 - E. one-half its acceleration multiplied by the time interval.

ans: B

4. Two automobiles are 150 kilometers apart and traveling toward each other. One automobile is moving at 60 km/h and the other is moving at 40 km/h mph. In how many hours will they meet?
- A. 2.5
 - B. 2.0
 - C. 1.75
 - D. 1.5
 - E. 1.25

ans: D

5. A car travels 40 kilometers at an average speed of 80 km/h and then travels 40 kilometers at an average speed of 40 km/h. The average speed of the car for this 80-km trip is:
- A. 40 km/h
 - B. 45 km/h
 - C. 48 km/h
 - D. 53 km/h
 - E. 80 km/h

ans: D

6. A car starts from Hither, goes 50 km in a straight line to Yon, immediately turns around, and returns to Hither. The time for this round trip is 2 hours. The magnitude of the average velocity of the car for this round trip is:
- A. 0
 - B. 50 km/hr
 - C. 100 km/hr
 - D. 200 km/hr
 - E. cannot be calculated without knowing the acceleration

ans: A

7. A car starts from Hither, goes 50 km in a straight line to Yon, immediately turns around, and returns to Hither. The time for this round trip is 2 hours. The average speed of the car for this round trip is:
- A. 0
 - B. 50 km/h
 - C. 100 km/h
 - D. 200 km/h
 - E. cannot be calculated without knowing the acceleration

ans: B

8. The coordinate of a particle in meters is given by $x(t) = 16t - 3.0t^3$, where the time t is in seconds. The particle is momentarily at rest at $t =$
- A. 0.75 s
 - B. 1.3 s
 - C. 5.3 s
 - D. 7.3 s
 - E. 9.3 s

ans: B

9. A drag racing car starts from rest at $t = 0$ and moves along a straight line with velocity given by $v = bt^2$, where b is a constant. The expression for the distance traveled by this car from its position at $t = 0$ is:
- A. bt^3
 - B. $bt^3/3$
 - C. $4bt^2$
 - D. $3bt^2$
 - E. $bt^{3/2}$

ans: B

10. A ball rolls up a slope. At the end of three seconds its velocity is 20 cm/s; at the end of eight seconds its velocity is 0. What is the average acceleration from the third to the eighth second?
- A. 2.5 cm/s^2
 - B. 4.0 cm/s^2
 - C. 5.0 cm/s^2
 - D. 6.0 cm/s^2
 - E. 6.67 cm/s^2

ans: B

11. The coordinate of an object is given as a function of time by $x = 7t - 3t^2$, where x is in meters and t is in seconds. Its average velocity over the interval from $t = 0$ to $t = 4$ s is:
- A. 5 m/s
 - B. -5 m/s
 - C. 11 m/s
 - D. -11 m/s
 - E. -14.5 m/s
- ans: B
12. The velocity of an object is given as a function of time by $v = 4t - 3t^2$, where v is in m/s and t is in seconds. Its average velocity over the interval from $t = 0$ to $t = 2$ s:
- A. is 0
 - B. is -2 m/s
 - C. is 2 m/s
 - D. is -4 m/s
 - E. cannot be calculated unless the initial position is given
- ans: A
13. The coordinate of an object is given as a function of time by $x = 4t^2 - 3t^3$, where x is in meters and t is in seconds. Its average acceleration over the interval from $t = 0$ to $t = 2$ s is:
- A. -4 m/s^2
 - B. 4 m/s^2
 - C. -10 m/s^2
 - D. 10 m/s^2
 - E. -13 m/s^2
- ans: C
14. Each of four particles move along an x axis. Their coordinates (in meters) as functions of time (in seconds) are given by
- particle 1: $x(t) = 3.5 - 2.7t^3$
 - particle 2: $x(t) = 3.5 + 2.7t^3$
 - particle 3: $x(t) = 3.5 + 2.7t^2$
 - particle 4: $x(t) = 3.5 - 3.4t - 2.7t^2$
- Which of these particles have constant acceleration?
- A. All four
 - B. Only 1 and 2
 - C. Only 2 and 3
 - D. Only 3 and 4
 - E. None of them
- ans: D

15. Each of four particles move along an x axis. Their coordinates (in meters) as functions of time (in seconds) are given by

particle 1: $x(t) = 3.5 - 2.7t^3$

particle 2: $x(t) = 3.5 + 2.7t^3$

particle 3: $x(t) = 3.5 + 2.7t^2$

particle 4: $x(t) = 3.5 - 3.4t - 2.7t^2$

Which of these particles is speeding up for $t > 0$?

- A. All four
- B. Only 1
- C. Only 2 and 3
- D. Only 2, 3, and 4
- E. None of them

ans: A

16. An object starts from rest at the origin and moves along the x axis with a constant acceleration of 4 m/s^2 . Its average velocity as it goes from $x = 2 \text{ m}$ to $x = 8 \text{ m}$ is:

- A. 1 m/s
- B. 2 m/s
- C. 3 m/s
- D. 5 m/s
- E. 6 m/s

ans: E

17. Of the following situations, which one is impossible?

- A. A body having velocity east and acceleration east
- B. A body having velocity east and acceleration west
- C. A body having zero velocity and non-zero acceleration
- D. A body having constant acceleration and variable velocity
- E. A body having constant velocity and variable acceleration

ans: E

18. Throughout a time interval, while the speed of a particle increases as it moves along the x axis, its velocity and acceleration might be:

- A. positive and negative, respectively
- B. negative and positive, respectively
- C. negative and negative, respectively
- D. negative and zero, respectively
- E. positive and zero, respectively

ans: C

19. A particle moves on the x axis. When its acceleration is positive and increasing:

- A. its velocity must be positive
- B. its velocity must be negative
- C. it must be slowing down
- D. it must be speeding up
- E. none of the above must be true

ans: E

20. The position y of a particle moving along the y axis depends on the time t according to the equation $y = at - bt^2$. The dimensions of the quantities a and b are respectively:
- A. $L^2/T, L^3/T^2$
 - B. $L/T^2, L^2/T$
 - C. $L/T, L/T^2$
 - D. $L^3/T, T^2/L$
 - E. none of these
- ans: C
21. A particle moves along the x axis according to the equation $x = 6t^2$, where x is in meters and t is in seconds. Therefore:
- A. the acceleration of the particle is 6 m/s^2
 - B. t cannot be negative
 - C. the particle follows a parabolic path
 - D. each second the velocity of the particle changes by 9.8 m/s
 - E. none of the above
- ans: E
22. Over a short interval near time $t = 0$ the coordinate of an automobile in meters is given by $x(t) = 27t - 4.0t^3$, where t is in seconds. At the end of 1.0 s the acceleration of the auto is:
- A. 27 m/s^2
 - B. 4.0 m/s^2
 - C. -4.0 m/s^2
 - D. -12 m/s^2
 - E. -24 m/s^2
- ans: E
23. Over a short interval, starting at time $t = 0$, the coordinate of an automobile in meters is given by $x(t) = 27t - 4.0t^3$, where t is in seconds. The magnitudes of the initial (at $t = 0$) velocity and acceleration of the auto respectively are:
- A. $0; 12 \text{ m/s}^2$
 - B. $0; 24 \text{ m/s}^2$
 - C. $27 \text{ m/s}; 0$
 - D. $27 \text{ m/s}; 12 \text{ m/s}^2$
 - E. $27 \text{ m/s}; 24 \text{ m/s}^2$
- ans: C
24. At time $t = 0$ a car has a velocity of 16 m/s . It slows down with an acceleration given by $-0.50t$, in m/s^2 for t in seconds. It stops at $t =$
- A. 64 s
 - B. 32 s
 - C. 16 s
 - D. 8.0 s
 - E. 4.0 s
- ans: D

25. At time $t = 0$ a car has a velocity of 16 m/s. It slows down with an acceleration given by $-0.50t$, in m/s^2 for t in seconds. At the end of 4.0 s it has traveled:
- A. 0
 - B. 12 m
 - C. 14 m
 - D. 25 m
 - E. 59 m
- ans: E
26. At time $t = 0$ a car has a velocity of 16 m/s. It slows down with an acceleration given by $-0.50t$, in m/s^2 for t in seconds. By the time it stops it has traveled:
- A. 15 m
 - B. 31 m
 - C. 62 m
 - D. 85 m
 - E. 100 m
- ans: D
27. Starting at time $t = 0$, an object moves along a straight line with velocity in m/s given by $v(t) = 98 - 2t^2$, where t is in seconds. When it momentarily stops its acceleration is:
- A. 0
 - B. -4.0 m/s^2
 - C. -9.8 m/s^2
 - D. -28 m/s^2
 - E. 49 m/s^2
- ans: D
28. Starting at time $t = 0$, an object moves along a straight line. Its coordinate in meters is given by $x(t) = 75t - 1.0t^3$, where t is in seconds. When it momentarily stops its acceleration is:
- A. 0
 - B. -73 m/s^2
 - C. -30 m/s^2
 - D. -9.8 m/s^2
 - E. $9.2 \times 10^3 \text{ m/s}^2$
- ans: C
29. A car, initially at rest, travels 20 m in 4 s along a straight line with constant acceleration. The acceleration of the car is:
- A. 0.4 m/s^2
 - B. 1.3 m/s^2
 - C. 2.5 m/s^2
 - D. 4.9 m/s^2
 - E. 9.8 m/s^2
- ans: C

30. A racing car traveling with constant acceleration increases its speed from 10 m/s to 50 m/s over a distance of 60 m. How long does this take?
- A. 2.0 s
 - B. 4.0 s
 - C. 5.0 s
 - D. 8.0 s
 - E. The time cannot be calculated since the speed is not constant
- ans: B
31. A car starts from rest and goes down a slope with a constant acceleration of 5 m/s². After 5 s the car reaches the bottom of the hill. Its speed at the bottom of the hill, in meters per second, is:
- A. 1
 - B. 12.5
 - C. 25
 - D. 50
 - E. 160
- ans: C
32. A car moving with an initial velocity of 25 m/s north has a constant acceleration of 3 m/s² south. After 6 seconds its velocity will be:
- A. 7 m/s north
 - B. 7 m/s south
 - C. 43 m/s north
 - D. 20 m/s north
 - E. 20 m/s south
- ans: A
33. An object with an initial velocity of 12 m/s west experiences a constant acceleration of 4 m/s² west for 3 seconds. During this time the object travels a distance of:
- A. 12 m
 - B. 24 m
 - C. 36 m
 - D. 54 m
 - E. 144 m
- ans: D
34. How far does a car travel in 6 s if its initial velocity is 2 m/s and its acceleration is 2 m/s² in the forward direction?
- A. 12 m
 - B. 14 m
 - C. 24 m
 - D. 36 m
 - E. 48 m
- ans: E

35. At a stop light, a truck traveling at 15 m/s passes a car as it starts from rest. The truck travels at constant velocity and the car accelerates at 3 m/s^2 . How much time does the car take to catch up to the truck?
- A. 5 s
 - B. 10 s
 - C. 15 s
 - D. 20 s
 - E. 25 s

ans: B

36. A ball is in free fall. Its acceleration is:
- A. downward during both ascent and descent
 - B. downward during ascent and upward during descent
 - C. upward during ascent and downward during descent
 - D. upward during both ascent and descent
 - E. downward at all times except at the very top, when it is zero

ans: A

37. A ball is in free fall. Upward is taken to be the positive direction. The displacement of the ball during a short time interval is:
- A. positive during both ascent and descent
 - B. negative during both ascent and descent
 - C. negative during ascent and positive during descent
 - D. positive during ascent and negative during descent
 - E. none of the above

ans: D

38. A baseball is thrown vertically into the air. The acceleration of the ball at its highest point is:
- A. zero
 - B. g , down
 - C. g , up
 - D. $2g$, down
 - E. $2g$, up

ans: B

39. Which one of the following statements is correct for an object released from rest?
- A. The average velocity during the first second of time is 4.9 m/s
 - B. During each second the object falls 9.8 m
 - C. The acceleration changes by 9.8 m/s^2 every second
 - D. The object falls 9.8 m during the first second of time
 - E. The acceleration of the object is proportional to its weight

ans: A

40. A freely falling body has a constant acceleration of 9.8 m/s^2 . This means that:
- A. the body falls 9.8 m during each second
 - B. the body falls 9.8 m during the first second only
 - C. the speed of the body increases by 9.8 m/s during each second
 - D. the acceleration of the body increases by 9.8 m/s^2 during each second
 - E. the acceleration of the body decreases by 9.8 m/s^2 during each second
- ans: C
41. An object is shot vertically upward. While it is rising:
- A. its velocity and acceleration are both upward
 - B. its velocity is upward and its acceleration is downward
 - C. its velocity and acceleration are both downward
 - D. its velocity is downward and its acceleration is upward
 - E. its velocity and acceleration are both decreasing
- ans: B
42. An object is thrown straight up from ground level with a speed of 50 m/s . If $g = 10 \text{ m/s}^2$ its distance above ground level 1.0 s later is:
- A. 40 m
 - B. 45 m
 - C. 50 m
 - D. 55 m
 - E. 60 m
- ans: B
43. An object is thrown straight up from ground level with a speed of 50 m/s . If $g = 10 \text{ m/s}^2$ its distance above ground level 6.0 s later is:
- A. 0.00 m
 - B. 270 m
 - C. 330 m
 - D. 480 m
 - E. none of these
- ans: E
44. At a location where $g = 9.80 \text{ m/s}^2$, an object is thrown vertically down with an initial speed of 1.00 m/s . After 5.00 s the object will have traveled:
- A. 125 m
 - B. 127.5 m
 - C. 245 m
 - D. 250 m
 - E. 255 m
- ans: B

45. An object is thrown vertically upward at 35 m/s. Taking $g = 10 \text{ m/s}^2$, the velocity of the object 5 s later is:
- A. 7.0 m/s up
 - B. 15 m/s down
 - C. 15 m/s up
 - D. 85 m/s down
 - E. 85 m/s up
- ans: B
46. A feather, initially at rest, is released in a vacuum 12 m above the surface of the earth. Which of the following statements is correct?
- A. The maximum velocity of the feather is 9.8 m/s
 - B. The acceleration of the feather decreases until terminal velocity is reached
 - C. The acceleration of the feather remains constant during the fall
 - D. The acceleration of the feather increases during the fall
 - E. The acceleration of the feather is zero
- ans: C
47. An object is released from rest. How far does it fall during the second second of its fall?
- A. 4.9 m
 - B. 9.8 m
 - C. 15 m
 - D. 20 m
 - E. 25 m
- ans: C
48. A heavy ball falls freely, starting from rest. Between the third and fourth second of time it travels a distance of:
- A. 4.9 m
 - B. 9.8 m
 - C. 29.4 m
 - D. 34.3 m
 - E. 39.8 m
- ans: D
49. As a rocket is accelerating vertically upward at 9.8 m/s^2 near Earth's surface, it releases a projectile. Immediately after release the acceleration (in m/s^2) of the projectile is:
- A. 9.8 down
 - B. 0
 - C. 9.8 up
 - D. 19.6 up
 - E. none of the above
- ans: A

50. A stone is released from a balloon that is descending at a constant speed of 10 m/s. Neglecting air resistance, after 20 s the speed of the stone is:
- A. 2160 m/s
 - B. 1760 m/s
 - C. 206 m/s
 - D. 196 m/s
 - E. 186 m/s
- ans: C
51. An object dropped from the window of a tall building hits the ground in 12.0 s. If its acceleration is 9.80 m/s^2 , the height of the window above the ground is:
- A. 29.4 m
 - B. 58.8 m
 - C. 118 m
 - D. 353 m
 - E. 706 m
- ans: E
52. Neglecting the effect of air resistance a stone dropped off a 175-m high building lands on the ground in:
- A. 3 s
 - B. 4 s
 - C. 6 s
 - D. 18 s
 - E. 36 s
- ans: C
53. A stone is thrown vertically upward with an initial speed of 19.5 m/s. It will rise to a maximum height of:
- A. 4.9 m
 - B. 9.8 m
 - C. 19.4 m
 - D. 38.8 m
 - E. none of these
- ans: C
54. A baseball is hit straight up and is caught by the catcher 2.0 s later. The maximum height of the ball during this interval is:
- A. 4.9 m
 - B. 7.4 m
 - C. 9.8 m
 - D. 12.6 m
 - E. 19.6 m
- ans: A

55. An object is thrown straight down with an initial speed of 4 m/s from a window which is 8 m above the ground. The time it takes the object to reach the ground is:
- A. 0.80 s
 - B. 0.93 s
 - C. 1.3 s
 - D. 1.7 s
 - E. 2.0 s

ans: B

56. A stone is released from rest from the edge of a building roof 190 m above the ground. Neglecting air resistance, the speed of the stone, just before striking the ground, is:
- A. 43 m/s
 - B. 61 m/s
 - C. 120 m/s
 - D. 190 m/s
 - E. 1400 m/s

ans: B

57. An object is thrown vertically upward with a certain initial velocity in a world where the acceleration due to gravity is 19.6 m/s^2 . The height to which it rises is _____ that to which the object would rise if thrown upward with the same initial velocity on the Earth. Neglect friction.
- A. half
 - B. $\sqrt{2}$ times
 - C. twice
 - D. four times
 - E. cannot be calculated from the given data

ans: A

58. A projectile is shot vertically upward with a given initial velocity. It reaches a maximum height of 100 m. If, on a second shot, the initial velocity is doubled then the projectile will reach a maximum height of:
- A. 70.7 m
 - B. 141.4 m
 - C. 200 m
 - D. 241 m
 - E. 400 m

ans: E

59. One object is thrown vertically upward with an initial velocity of 100 m/s and another object with an initial velocity of 10 m/s. The maximum height reached by the first object will be _____ that of the other.
- A. 10 times
 - B. 100 times
 - C. 1000 times
 - D. 10,000 times
 - E. none of these

ans: B

60. The area under a velocity-time graph represents:

- A. acceleration
- B. change in acceleration
- C. speed
- D. change in velocity
- E. displacement

ans: E

61. Displacement can be obtained from:

- A. the slope of an acceleration-time graph
- B. the slope of a velocity-time graph
- C. the area under an acceleration-time graph
- D. the area under a velocity-time graph
- E. the slope of an acceleration-time graph

ans: D

62. An object has a constant acceleration of 3 m/s^2 . The coordinate versus time graph for this object has a slope:

- A. that increases with time
- B. that is constant
- C. that decreases with time
- D. of 3 m/s
- E. of 3 m/s^2

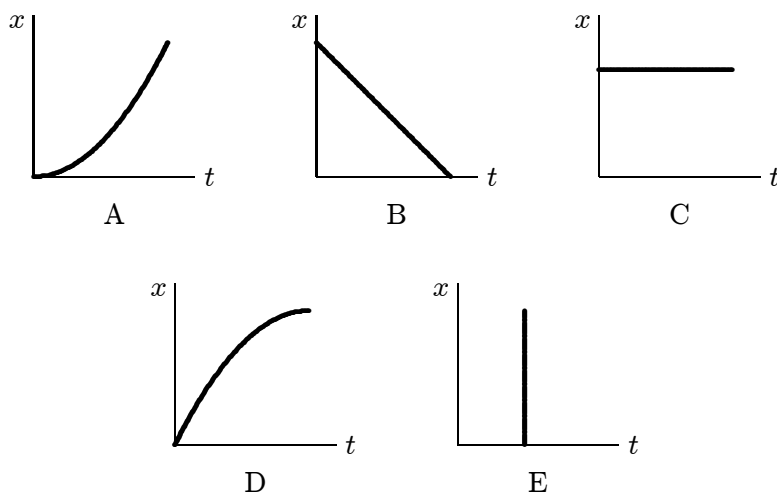
ans: A

63. The coordinate-time graph of an object is a straight line with a positive slope. The object has:

- A. constant displacement
- B. steadily increasing acceleration
- C. steadily decreasing acceleration
- D. constant velocity
- E. steadily increasing velocity

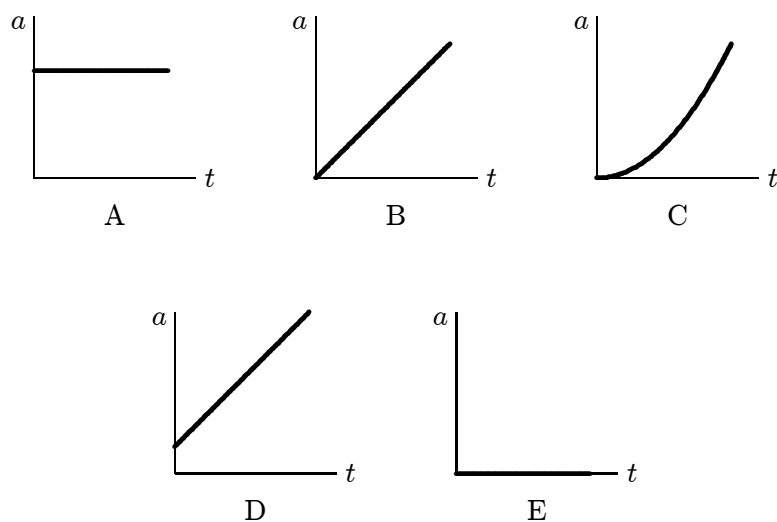
ans: D

64. Which of the following five coordinate versus time graphs represents the motion of an object moving with a constant nonzero speed?



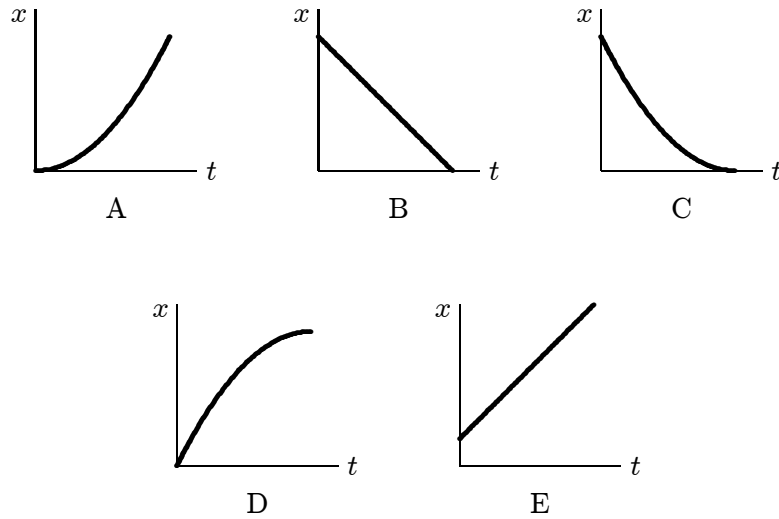
ans: B

65. Which of the following five acceleration versus time graphs is correct for an object moving in a straight line at a constant velocity of 20 m/s?



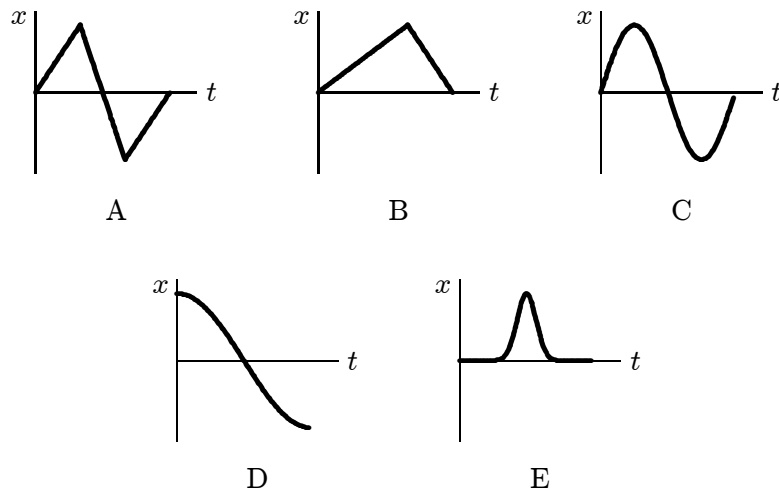
ans: E

66. Which of the following five coordinate versus time graphs represents the motion of an object whose speed is increasing?



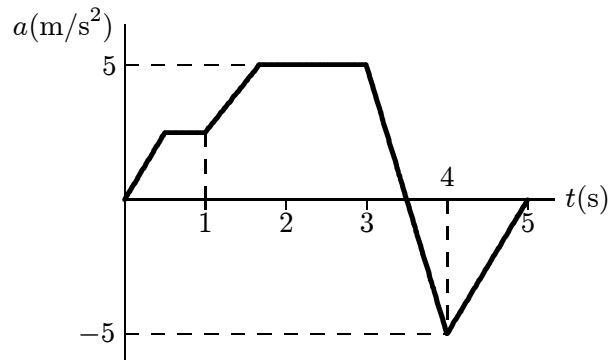
ans: A

67. A car accelerates from rest on a straight road. A short time later, the car decelerates to a stop and then returns to its original position in a similar manner, by speeding up and then slowing to a stop. Which of the following five coordinate versus time graphs best describes the motion?



ans: E

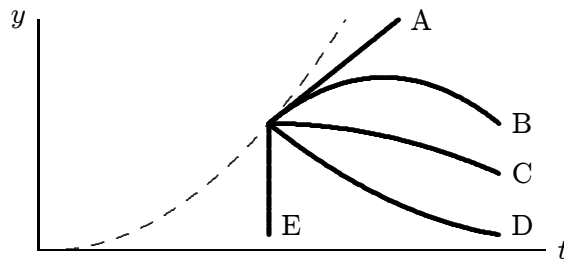
68. The acceleration of an object, starting from rest, is shown in the graph below. Other than at $t = 0$, when is the velocity of the object equal to zero?



- A. During the interval from 1.0 s to 3.0 s
- B. At $t = 3.5$ s
- C. At $t = 4.0$ s
- D. At $t = 5.0$ s
- E. At no other time less than or equal to 5 s

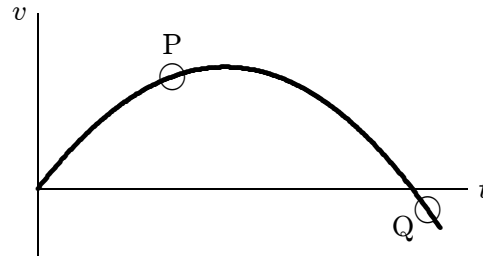
ans: E

69. An elevator is moving upward with constant acceleration. The dashed curve shows the position y of the ceiling of the elevator as a function of the time t . At the instant indicated by the dot, a bolt breaks loose and drops from the ceiling. Which curve best represents the position of the bolt as a function of time?



ans: B

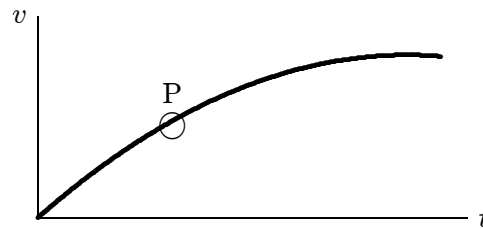
70. The diagram shows a velocity-time graph for a car moving in a straight line. At point Q the car must be:



- A. moving with zero acceleration
- B. traveling downhill
- C. traveling below ground-level
- D. reducing speed
- E. traveling in the reverse direction to that at point P

ans: E

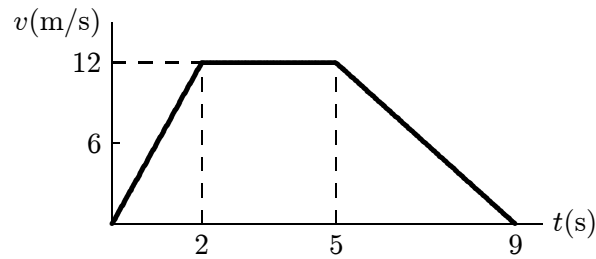
71. The diagram shows a velocity-time graph for a car moving in a straight line. At point P the car must be:



- A. moving with zero acceleration
- B. climbing the hill
- C. accelerating
- D. stationary
- E. moving at about 45° with respect to the x axis

ans: C

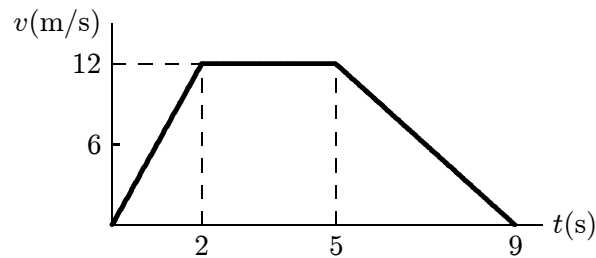
72. The graph represents the straight line motion of a car. How far does the car travel between $t = 2$ s and $t = 5$ s?



- A. 4 m
- B. 12 m
- C. 24 m
- D. 36 m
- E. 60 m

ans: D

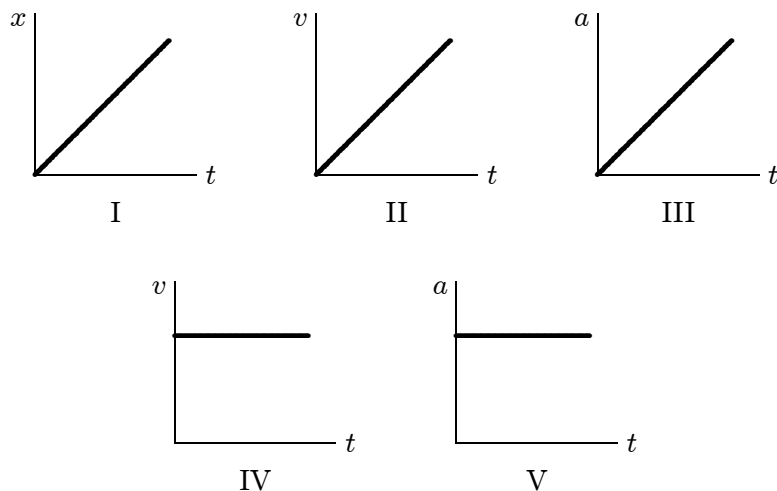
73. The diagram represents the straight line motion of a car. Which of the following statements is true?



- A. The car accelerates, stops, and reverses
- B. The car accelerates at 6 m/s^2 for the first 2 s
- C. The car is moving for a total time of 12 s
- D. The car decelerates at 12 m/s^2 for the last 4 s
- E. The car returns to its starting point when $t = 9$ s

ans: B

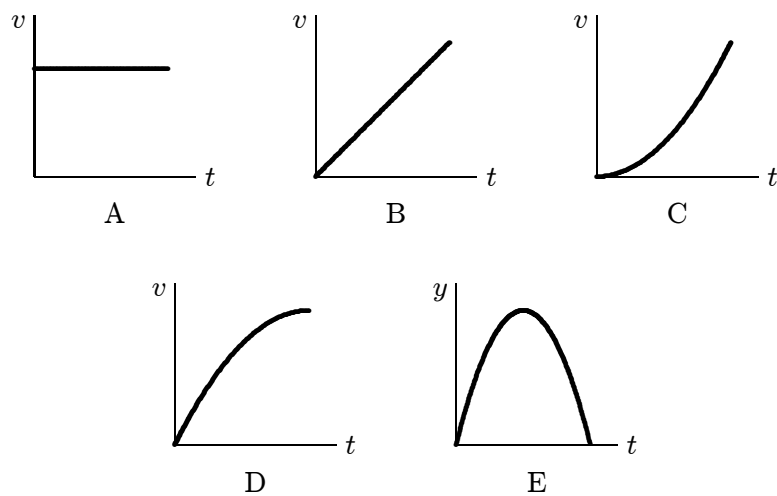
74. Consider the following five graphs (note the axes carefully). Which of these represents motion at constant speed?



- A. IV only
 B. IV and V only
 C. I, II, and III only
 D. I and II only
 E. I and IV only

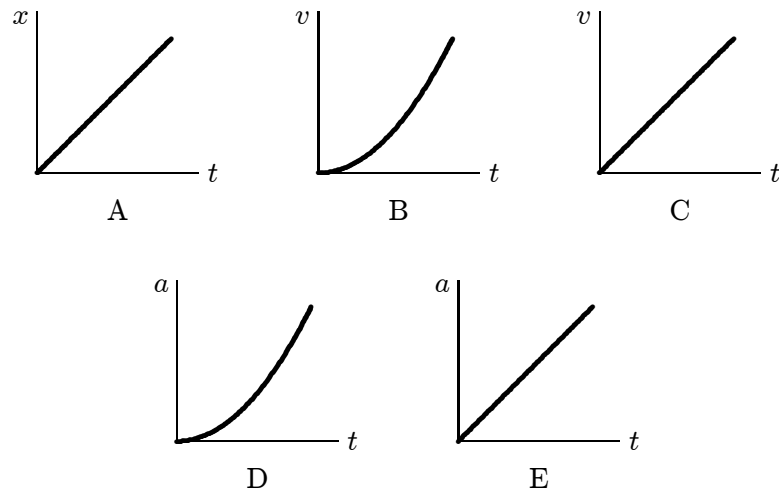
ans: E

75. An object is dropped from rest. Which of the following five graphs correctly represents its motion? The positive direction is taken to be downward.



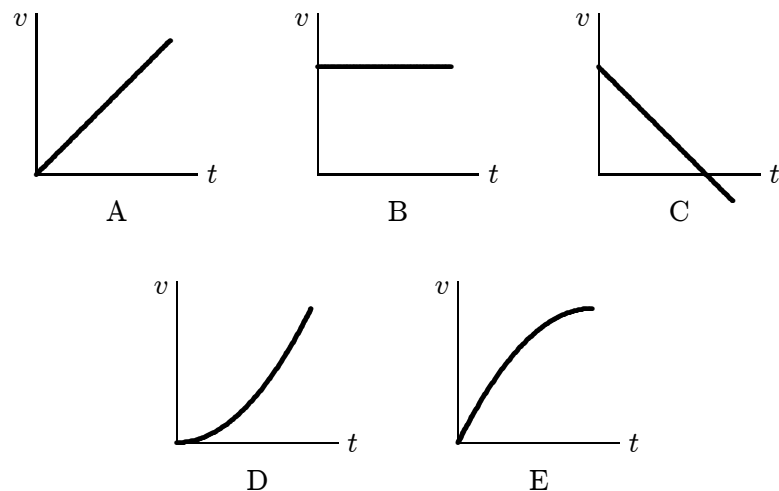
ans: B

76. A stone is dropped from a cliff. The graph (carefully note the axes) which best represents its motion while it falls is:



ans: C

77. An object is thrown vertically into the air. Which of the following five graphs represents the velocity (v) of the object as a function of the time (t)? The positive direction is taken to be upward.



ans: C