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 $\mathrm{cm/s^2}$
    B. 4.0 $\mathrm{cm/s^2}$
    C. 5.0 $\mathrm{cm/s^2}$
    D. 6.0 $\mathrm{cm/s^2}$
    E. 6.67 $\mathrm{cm/s^2}$

    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 $t = 4\,\text{s}$ is:

A. $5\,\text{m/s}$
B. $-5\,\text{m/s}$
C. $11\,\text{m/s}$
D. $-11\,\text{m/s}$
E. $-14.5\,\text{m/s}$

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 $t = 2\,\text{s}$:

A. is 0
B. is $-2\,\text{m/s}$
C. is $2\,\text{m/s}$
D. is $-4\,\text{m/s}$
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 $t = 2\,\text{s}$ is:

A. $-4\,\text{m/s}^2$
B. $4\,\text{m/s}^2$
C. $-10\,\text{m/s}^2$
D. $10\,\text{m/s}^2$
E. $-13\,\text{m/s}^2$

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 $4\,\mathrm{m/s^2}$. Its average velocity as it goes from $x = 2\,\mathrm{m}$ to $x = 8\,\mathrm{m}$ is:

    A. $1\,\mathrm{m/s}$
    B. $2\,\mathrm{m/s}$
    C. $3\,\mathrm{m/s}$
    D. $5\,\mathrm{m/s}$
    E. $6\,\mathrm{m/s}$

    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 m/s^2
B. 0; 24 m/s^2
C. 27 m/s; 0
D. 27 m/s; 12 m/s^2
E. 27 m/s; 24 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. 9.2×10^3 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/s^2. 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/s^2 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/s^2 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/s^2 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 $g = 10$ 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 $g = 10$ 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 $g = 9.80$ 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 $g = 10$ 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

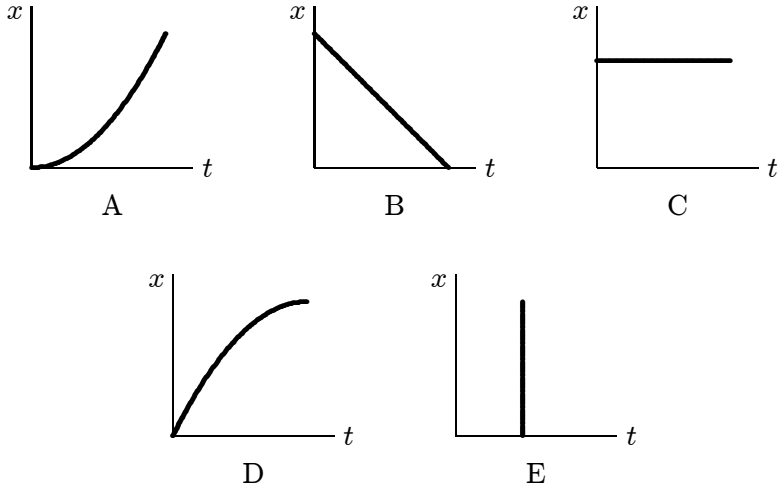
62. An object has a constant acceleration of 3 m/s^2. The coordinate versus time graph for this object has a slope:
    A. that increases with time
    B. that is constant
    C. that decreases with time
    D. of 3 m/s
    E. of 3 m/s^2

    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

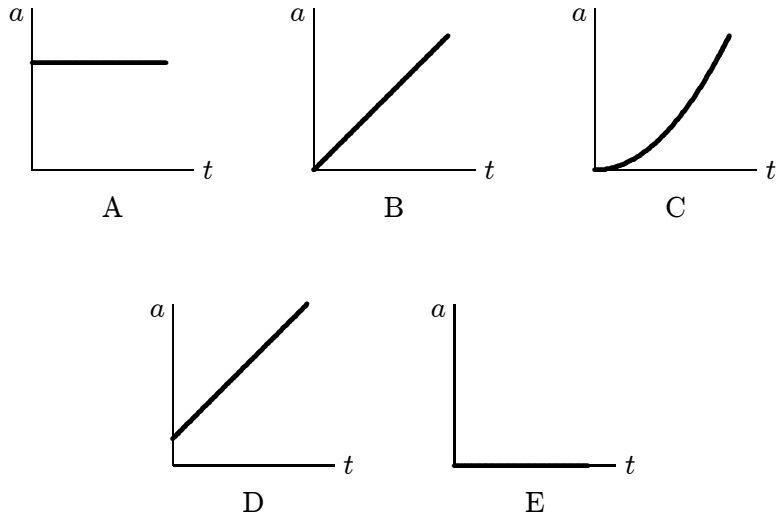
    ans: D

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



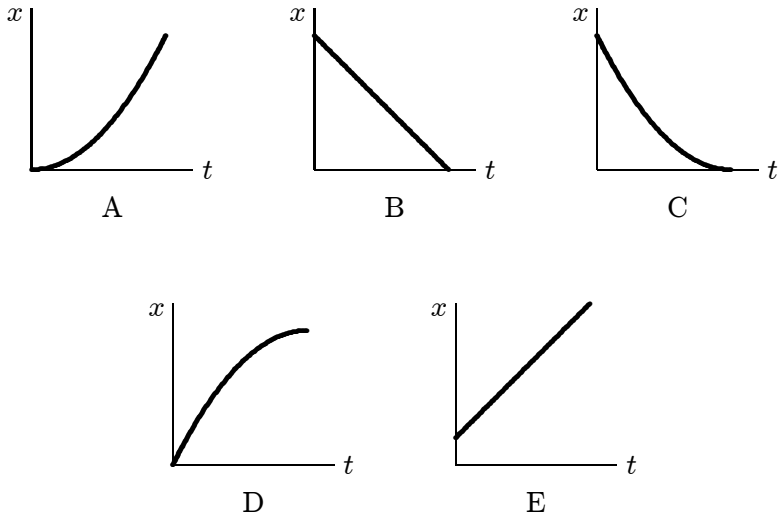
ans: B

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?



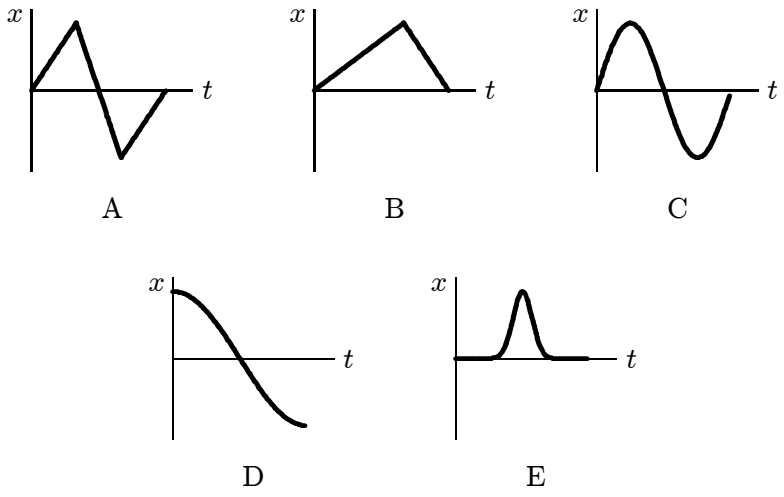
ans: E

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



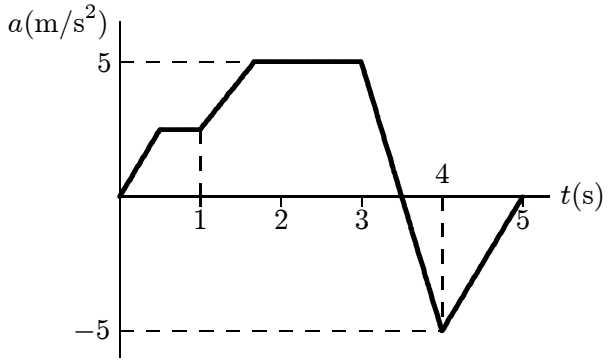
ans: A

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

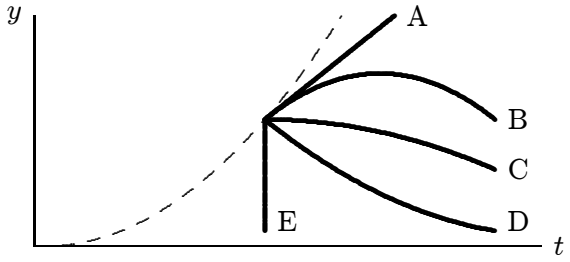
68. The acceleration of an object, starting from rest, is shown in the graph below. Other than at $t = 0$, when is the velocity of the object equal to zero?



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

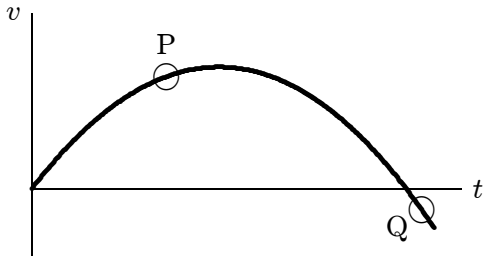
ans: E

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

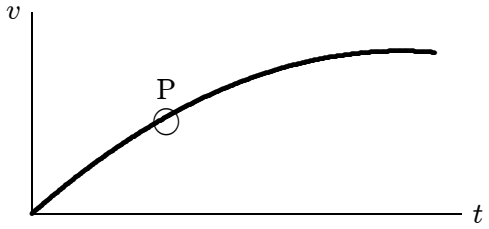
70. The diagram shows a velocity-time graph for a car moving in a straight line. At point Q the car must be:



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

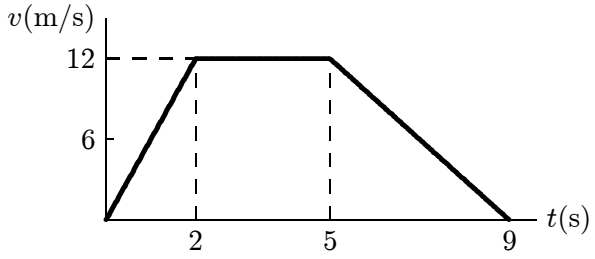
71. The diagram shows a velocity-time graph for a car moving in a straight line. At point P the car must be:



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

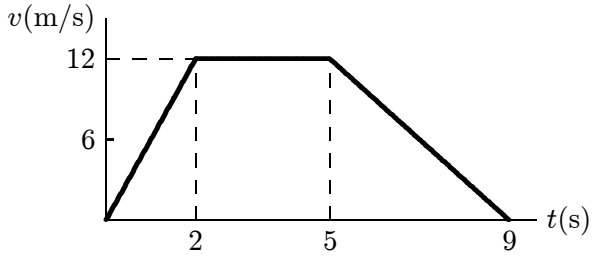
72. The graph represents the straight line motion of a car. How far does the car travel between $t = 2$ s and $t = 5$ s?



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

ans: D

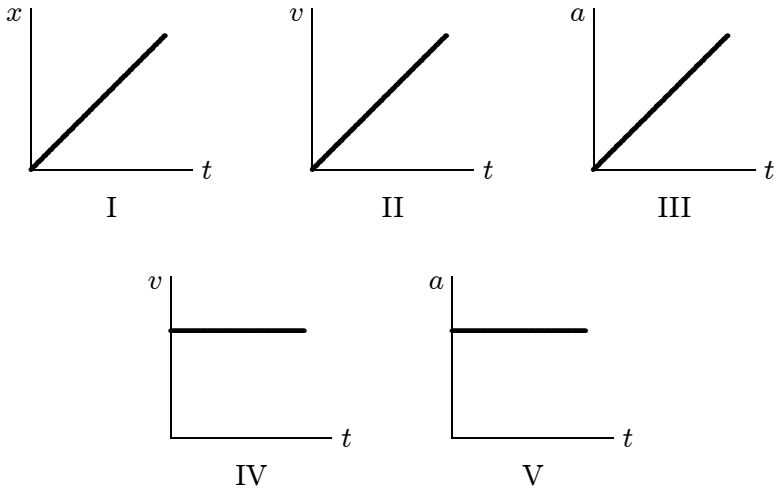
73. The diagram represents the straight line motion of a car. Which of the following statements is true?



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

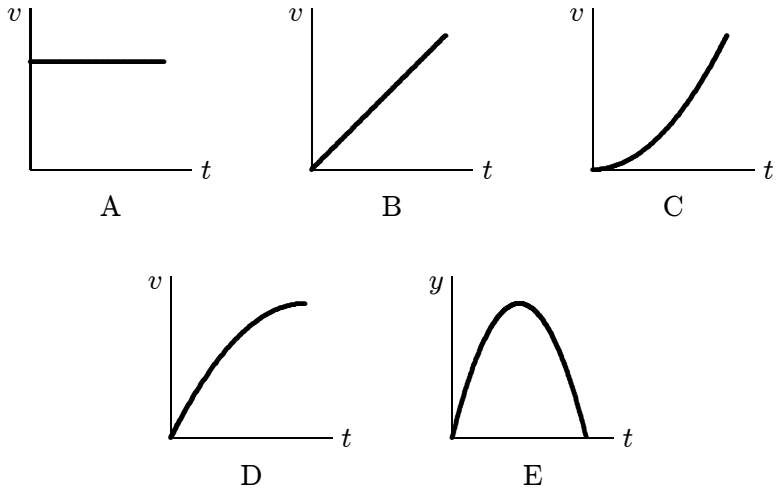
74. Consider the following five graphs (note the axes carefully). Which of these represents motion at constant speed?



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

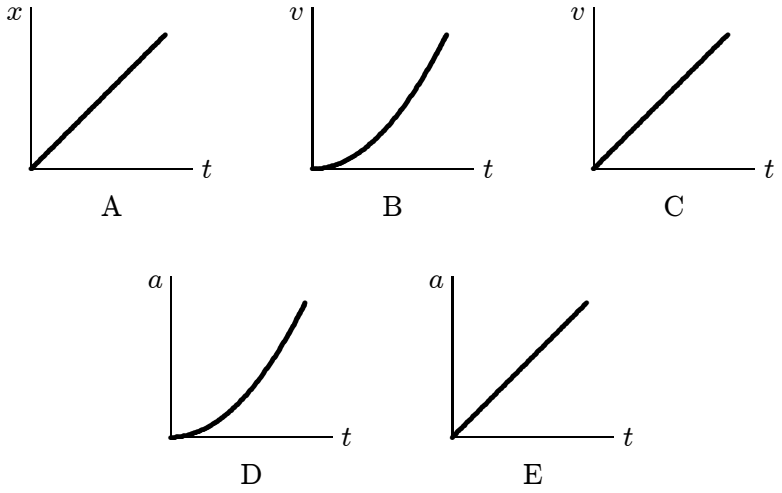
ans: E

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.



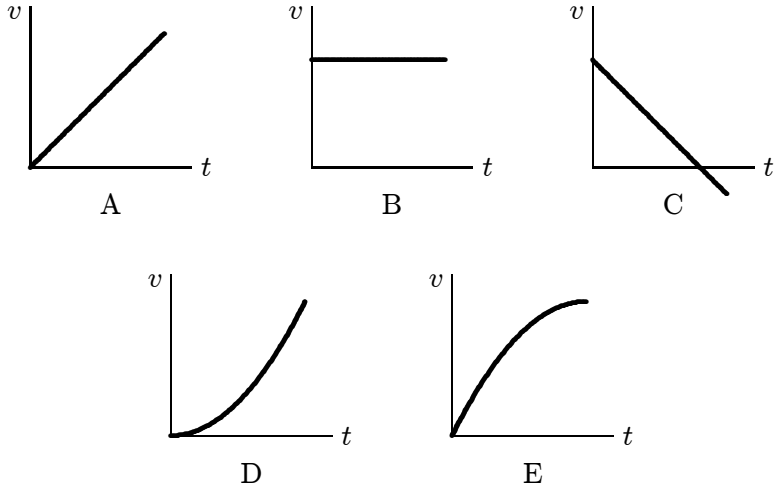
ans: B

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