

Motion in One Dimension

Choose the correct answer:

1. An object moves at a constant speed of 6 m/s. This means that the object

- (a) Decreases its speed by 6 m/s every second
(b) Doesn't move
(c) Has a positive acceleration
(d) Moves 6 meters every second

2. A toy car moves 8 m in 4 s at the constant velocity. What is the car's velocity

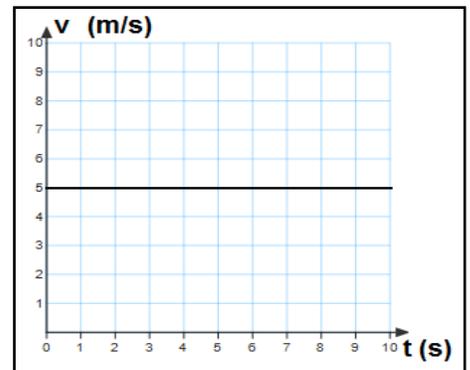
- a) 32 m/sec
(b) 1 m/sec
(c) 4m/sec
(d) 2 m/sec

3. A bicyclist moves at a constant speed of 4 m/s. How long it will take for the bicyclist to move 36 m

- a) 9 sec
b) 144 sec
c) 6 sec
d) 18 sec

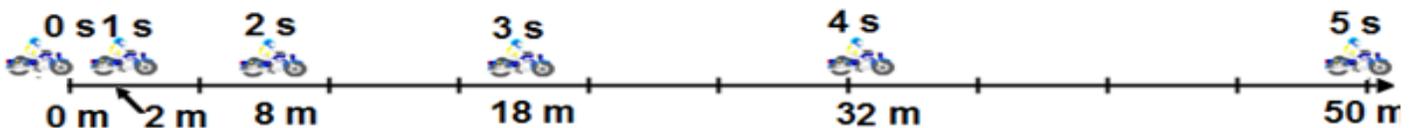
4. The graph represents the relationship between velocity and time for an object moving in a straight line. Which of the following statements is true?

- a) The object speeds up
b) The object slows down
c) The object moves with a constant velocity
d) The object stays at rest



5. What is the average velocity of the motorbike during first 5 sec ?

- a) 5 m/sec
b) 10 m/sec
c) 15 m/sec
d) 20 m/sec



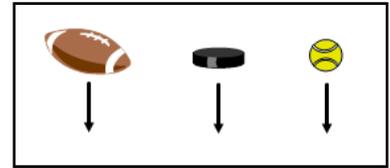
6. How fast you are moving in which direction is a property of motion known as

- a) Speed
b) Velocity
c) acceleration
d) no correct answer

7. How fast you are changing your speed or direction of travel is a property of motion known as

- a) Speed b) Velocity c) acceleration d) no correct answer

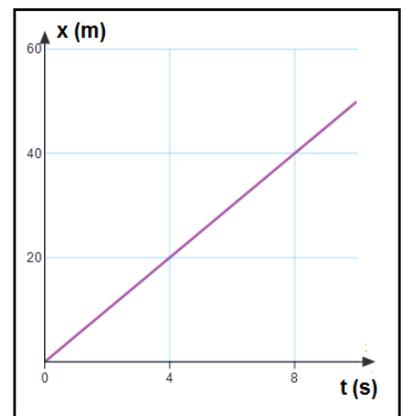
8. A football, a hockey puck, and a tennis ball all fall down in the absence of air resistance. Which of the following is true about their acceleration?



- a) The acceleration of the football is greater than the other two
b) the acceleration of the hockey puck is greater than the other two
c) The acceleration of the tennis ball is greater than the other two
d) They all fall down with the same constant acceleration

9. The following graph represents the position as a function of time for a moving object. Which of the following statements is true?

- a) The object increases its velocity
b) The object decreases its velocity
c) The object's velocity stays unchanged
d) The object stays at rest



The given graph represents the position as a function of time of a moving object. Use this graph to answer questions 10 and 11.

10. What is the initial position of the object?

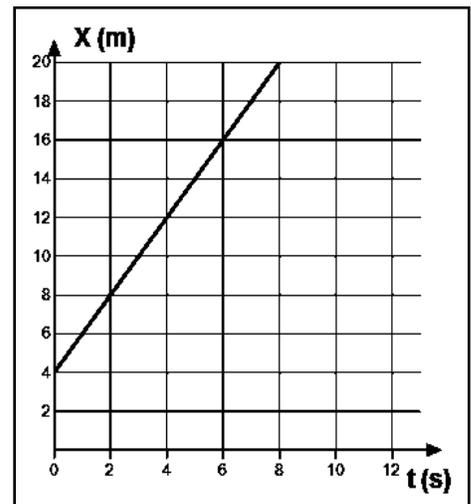
- a) 2 m b) 4 m c) 8 m d) 10 m

11. What is the average velocity of the object?

- a) 2 m/sec b) 4 m/sec c) 6 m/sec d) 10 m/sec

12. An object moves with a constant acceleration of 5 m/s^2 . Which of the following statements is true?

- a) The object's acceleration increases by 5 m/s^2 each second
b) The object's acceleration decreases by 5 m/s^2 each second
c) The object's velocity increases by 5 m/s each second
d) The object's velocity stays the same



22. An object is thrown straight up from ground level with a speed of 30 m/s Its height after 10s is

- a) 15.1 m b) 5.1m c) 45.1 m d) 35.1 m e) 25.1 m

23. A ball is thrown vertically upward at a speed of 21 m/s. It will reach its maximum height in:

- a) 1.8 s b) 2.1 s c) 0.60 s d) 0.33 s e) 1.2 s

24. The velocity of a particle starts from the origin as $v(t) = (3t^2 + 5)$ m/s. The acceleration of the particle after 2 seconds is:

- a) 6m/s^2 b) 12m/s^2 c) 18m/s^2 d) 24m/s^2 e) 30m/s^2

25. A bicycle is moving along x - axis according to the equation $x(t) = 2t + 3t^2$ where x is in meters and t is in seconds. Its instantaneous velocity at $t = 2$ sec. is:

- a) 14m/s b) 26m/s c) 32m/s d) m/s e) 38m/s

26. The initial and final positions of a particle along the X-axis are -3m, 10m, then its displacement ΔX equals:

- a) + 7m b) +13m c) -13m d) -7m e) 4.5m

27. A car is traveling at constant speed of 30m/s for 3 S, the acceleration of the car is

- a) 0 b) 3m/s^2 c) 10m/s^2 d) 9m/s^2

28. A car is traveling at constant speed of 30m/s for 3 S, the distance after that time is

- (a) 90m (b) 50m (c) 33m (d) 27m

A ball is thrown vertically upward. It returns to its starting point after 4s:

29. The initial velocity of the ball is

- (a) 19.6m/s (b) zero (c) 39.2m/s (d) 9.8m/s

30. The maximum height the ball rise is:

- (a) 39.2m (b) 9.8m (c) 196m (d) 19.6m

31. Change in position is called

- A) Velocity B) Displacement C) Rate

32. The change of velocity over time is called

- a) Acceleration b) Speed c) Distance

33.. The speedometer on your car shows your

- a) Average acceleration b) Average velocity c) Instantaneous speed

34. An object in free-fall is undergoing acceleration.

- a) Constant b) Average c) Instantaneous

35. The acceleration due to gravity at or near the earth's surface is _____ m/s^2 .

- a) 3.5 b) 27 c) 9.8

36. When struck by a club, a golf ball initially at rest acquires a speed of 31.0m/s. If the ball is in contact with the club for 1.17 ms, what is the magnitude of the average acceleration of the ball?

- a) 26500 m/s^2 b) 2000 m/s^2 c) 3200 m/s^2 d) 1000 m/s^2

37. A car traveling initially at a speed of 60m/s is accelerated uniformly to a speed 85m/s in 12s. How far ($x - x_0$) does the car travel during the 12s interval?

- a) 770 m b) 640 m c) 540 m d) 870 m

38. A ball is thrown directly downward with an initial velocity of 8m/s from a height of 30m. When does the ball strike the ground?

- a) 1.8 s b) 3.2s c) 4s d) 5 S

39. A car moves along a straight line with velocity in m/s given by $v=2+2t^2$ velocity at $t=0$ is

- a) 3 m/s b) 2 m/s c) 10 m/s d) 5 m/s

40. The velocity of a particle starts from the origin as $v(t)=(6t^2+3) m/s$. The acceleration of the particle after 3 s is:

- a) 30 m/s^2 b) 20 m/s^2 c) 25 m/s^2 d) 36 m/s^2

41. A stone is dropped from rest from the top of a building ,after 5s of free fall , what is the displacement y of the stone? $Y=y_0+v_0t-.5gt^2$

- a)-49m b)35m c)-45 m d)50m

42. A particle moves along the x axis according to the equation $x = 2t + 3t^2$, where x is in meters and t is in seconds. Calculate the instantaneous velocity acceleration at $t = 3.0$ s.

- a)v=20 m/s b)25 m/s c) 35 m/s

43. The Position of a particle along the x -axis is given by $x=3t^3 -7t$ where x in meters and t in seconds. What is the average velocity of the particle during the interval from $t=2$ sec to $t=5$ sec?

- a)130m/s b)110 m/s c)140m/s

44. The initial speed of a body is 5.2m/s. What is its speed after 2.5s if it (a) accelerates uniformly at 3m/s^2 and (b) accelerates uniformly at -3m/s^2 .

- a) v = 12.7 m/s b) 15 m/s c)16.1 m/s d) 17.7m/s

45. Write the position vector for a particle in the rectangular coordinate (x, y, z) for the points $(5, -6, 0)$, $(5, -4)$, and $(-1, 3, 6)$.

Solution

For the point $(5, -6, 0)$ the position vector is $\vec{r} = 5i - 6j$

For the point $(5, -4)$ the position vector is $\vec{r} = 5i - 4j$

For the point $(-1, 3, 6)$ the position vector is $\vec{r} = -i + 3j + 6k$

46. Calculate the displacement vector for a particle moved from the point $(4, 3, 2)$ to a point $(8, 3, 6)$.

Solution

The position vector for the first point is $\vec{r}_1 = 4i + 3j + 2k$

The position vector for the second point is $\vec{r}_2 = 8i + 3j + 6k$

The displacement vector $\Delta\vec{r} = \vec{r}_2 - \vec{r}_1$

$$\therefore \Delta\vec{r} = 4i + 4k$$

47. If the position of a particle is given as a function of time according to the equation $r(t) = 3t^2i + (3t - 2)j$ where t in seconds. Find the displacement vector for $t_1=1$ and $t_2=8$

Solution

First we must find the position vector for the time t_1 and t_2

$$\text{For } t_1 \quad \vec{r}_1(t_1) = 3i + j$$

$$\text{For } t_2 \quad \vec{r}_2(t_2) = 192i + 22j$$

The displacement vector

$$\Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = 192i + 22j - 3i + j$$

$$\Delta\vec{r} = 189i + 21j$$

48. The coordinate of a particle moving along the x-axis depends on time according to the expression $x = 5t^2 - 2t^3$ where x is in meters and t is in seconds.

1. Find the velocity and acceleration of the particle as a function of time.
2. Find the displacement during the first 2 seconds.
3. Find the velocity and acceleration of the particle after 2 seconds

Solution

(a) The velocity and acceleration can be obtained as follow

$$v = \frac{dx}{dt} = 10t - 6t^2$$

$$a = \frac{dv}{dt} = 10 - 12t$$

(b) using the equation $x = 5t^2 - 2t^3$ substitute for $t=2s$

$$x = 4\text{m}$$

(c) using the result in part (a)

$$v = -4 \text{ m/s}$$

$$a = -14 \text{ m/s}^2$$

49. A man swims the length of a 50m pool in 20s and makes the return trip to the starting position in 22s. Determine his average velocity in (a) the first half of the swim, (b) the second half of the swim, and (c) the round trip.

Solution

$$(a) v_1 = \frac{d}{t_1} = \frac{50}{20} = 2.5 \text{ m/s}$$

$$(b) v_2 = \frac{d}{t_2} = \frac{-50}{20} = -2.27 \text{ m/s}$$

(c) Since the displacement is zero for the round trip, $v_{\text{ave}} = 0$

50. A car makes a 200km trip at an average speed of 40 km/h. A second car starting 1h later arrives at their mutual destination at the same time. What was the average speed of the second car?

Solution

$$t_1 = \frac{d}{v_1} = \frac{200}{40} = 5\text{h} \text{ for car 1}$$

$$t_2 = t_1 - 1 = 4\text{h} \text{ for car 2}$$

$$v_2 = \frac{d}{t_2} = \frac{200}{4} = 50\text{km/h}$$

51. A particle moves along the x -axis according to the equation $x=2t+3t^2$, where x is in m and t is in second. Calculate the instantaneous velocity and instantaneous acceleration at $t=3\text{s}$.

Solution

$$v(t) = \frac{dx}{dt} = 2+6(3) = 20\text{m/s}$$

$$a(t) = \frac{dv}{dt} = 6\text{m/s}^2$$

Therefore at $t = 3\text{s}$

$$v = 20\text{m/s}$$

$$a = 6\text{m/s}^2$$

52. A body moving with uniform acceleration has a velocity of 12cm/s when its x coordinate is 3cm. If its x coordinates 2s later is -5cm, what is the magnitude of its acceleration?

Solution

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$
$$-5 = 3 + 12 \times 2 + 0.5 a (2)^2$$
$$a = -16 \text{ cm/s}^2$$

53. A car moving at constant speed of 30m/s suddenly stalls at the bottom of a hill. The car undergoes a constant acceleration of -2m/s^2 while ascending the hill.

1. Write equations for the position and the velocity as a function of time, taking $x=0$ at the bottom of the hill where $v_0 = 30\text{m/s}$.

2. Determine the maximum distance traveled by the car up the hill after stalling.

Solution

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$x = 0 + 30 t - t^2$$

$$x = 30 t - t^2 \text{ m}$$

$$v = v_0 + at$$

$$v = 30 - 2t \text{ m/s}$$

x reaches a maximum when $v = 0$ then,

$$v = 30 - 2t = 0 \quad \text{therefore } t = 15 \text{ s}$$

$$x_{\text{max}} = 30 t - t^2$$

$$x = 30 t - t^2 = 30 (15) - (15)^2 = 225\text{m}$$

54. A stone is dropped from rest from the top of a building. After 3s of free fall, what is the displacement y of the stone?

Solution

$$y = y_0 + v_0 t - \frac{1}{2} g t^2$$

$$y = 0 + 0 - \frac{1}{2} (9.8) \times (3)^2 = -44.1\text{m}$$