Chapter - 8
Motion

Multiple Choice Questions

1. A particle is moving in a circular path of radius r. The displacement after half a circle would be:
(a) Zero
(b) π r
(c) 2 r
(d) 2π r

Soln:

Answer is (c) 2 r

Explanation:

After half revolution

Distance travelled = $\frac{1}{2}$X circumference= πr
Path length

Displacement = Final position- Initial Position

It comes out to be the diameter of the circle = 2R.

2. A body is thrown vertically upward with velocity u, the greatest height h to which it will rise is,
(a) u/g
(b) $u^2/2g$
(c) u^2/g
(d) u/2g

Soln:

Answer is (b) $u^2/2g$

Explanation:
$V^2= u^2+2$ as
here v = 0
a = -g
s = H

$0 = u^2 -2gH$

$H = u^2/2g$

3. The numerical ratio of displacement to distance for a moving object is
(a) always less than 1
(b) always equal to 1
(c) always more than 1
(d) equal or less than 1

Soln:

Answer is (d) equal or less than 1

Explanation:

Shortest distance between initial and end point is called displacement. Distance is the total path length.

Displacement is vector and it may be positive or negative whereas Distance is scalar and it can never be negative.

Distance can be equal or greater than displacement which means ratio of displacement to distance is always equal to or less than 1.

4. If the displacement of an object is proportional to square of time, then the object moves with
(a) uniform velocity
(b) uniform acceleration
(c) increasing acceleration
(d) decreasing acceleration

Soln:
Answer is (b) uniform acceleration

Explanation:
Velocity is measured in distance /second and acceleration is measured in Distance/ second^2. Hence Uniform acceleration is the right answer.

5. From the given v – t graph (Fig. 8.1), it can be inferred that the object is
(a) in uniform motion
(b) at rest
(c) in non-uniform motion
(d) moving with uniform acceleration

Soln:

Answer is (a) in uniform motion

Explanation:

From the above given graph it is clear that velocity of the object remain constant throughout hence the object is in uniform motion.

6. Suppose a boy is enjoying a ride on a merry-go-round which is moving with a constant speed of 10 m s–1. It implies that the boy is
(a) at rest
(b) moving with no acceleration
(c) in accelerated motion
(d) moving with uniform velocity

Soln:

Answer is (c) in accelerated motion

Explanation:

Boy is moving in a circular motion and circular motion is an accelerated motion hence C) is right answer.

7. Area under a v – t graph represents a physical quantity which has the unit
(a) m^2
(b) m
(c) m^3
(d) $m\ s^{-1}$

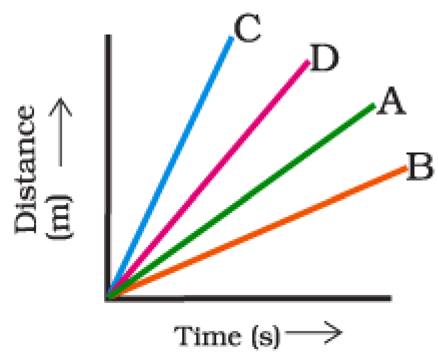
Soln:

Answer is (b) m

Explanation:

Area given in the graph represents Displacement and its unit is meter. Hence the answer is (b) m

8. Four cars A, B, C and D are moving on a levelled road. Their distance versus time graphs are shown in Fig. 8.2. Choose the correct statement
(a) Car A is faster than car D.
(b) Car B is the slowest.
(c) Car D is faster than car C.
(d) Car C is the slowest.



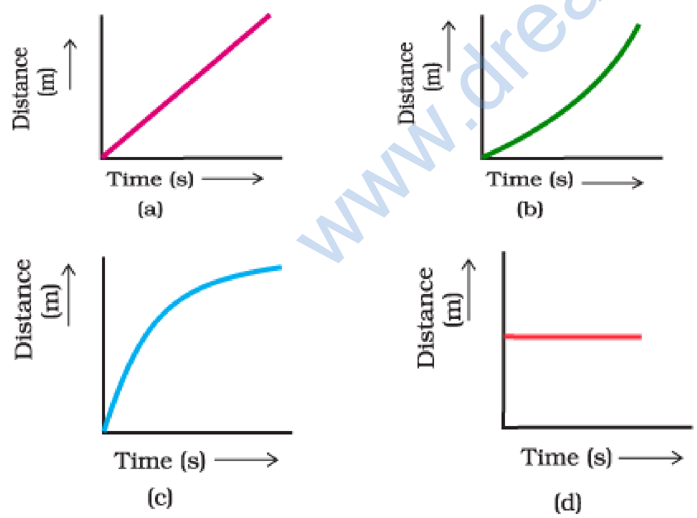
Soln:

Answer is (b) Car B is the slowest.

Explanation:

Graph shows that Car B covers less distance in a given time than A, C and D cars hence it is the the slowest.

9. Which of the following figures (Fig. 8.3) represents uniform motion of a moving object correctly?



Soln:

Answer is (a)

Explanation:

Distance in graph a) is uniformly increasing with time hence it represents uniform motion.

10. Slope of a velocity – time graph gives
(a) the distance
(b) the displacement
(c) the acceleration
(d) the speed

Soln:

Answer is (c) the acceleration

11. In which of the following cases of motions, the distance moved and the magnitude of displacement are equal?
(a) If the car is moving on straight road
(b) If the car is moving in circular path
(c) The pendulum is moving to and fro
(d) The earth is revolving around the Sun

Soln:

Answer is (a) If the car is moving on straight road

Explanation:

In other cases given here displace can be less than distance hence option (a) If the car is moving on straight road is the right answer.

Short Answer Questions

12. The displacement of a moving object in a given interval of time is zero. Would the distance travelled by the object also be zero? Justify you answer.

Soln:

Displace zero does not mean zero distance. Distance can be zero when moving object back to the place it started. Displacement is either equal or less than distance but distance is always greater than one and it cannot be a negative value.

13. How will the equations of motion for an object moving with a uniform velocity change?

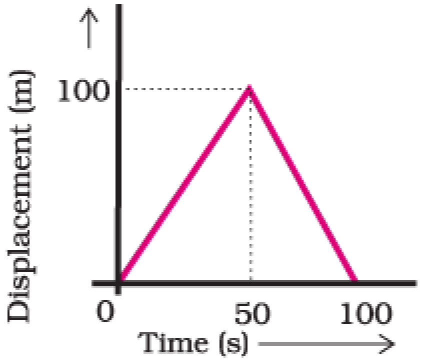
Soln:

If object moving in a uniform velocity then $v=\mu$ and $a=0$. In this scenario equation for distance is given below.

$S= ut$ and $V^2- \mu^2=0$

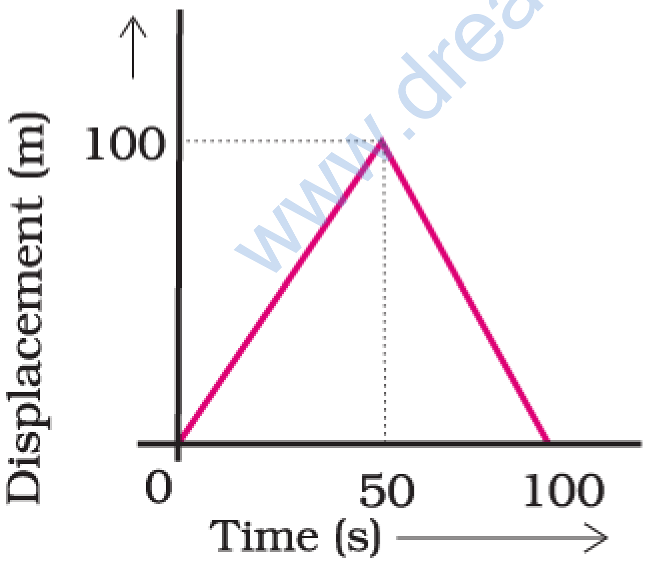
14. A girl walks along a straight path to drop a letter in the letterbox and comes back to her initial position. Her displacement–time graph is shown in Fig.8.4. Plot a velocity–time graph for the same.

Soln:



15. A car starts from rest and moves along the x-axis with constant acceleration 5 m s–2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?

Soln:



Car Starts from rest hence Initial velocity u=o acceleration a=5 ms^2 and time t=8s

v=u+at

v=0+5x8

v= 40ms^{-1}

From second equation

$s= ut+\frac{1}{2}at^2$

$s= 0x8 +\frac{1}{2}x5x(8)^2$

$s=+\frac{1}{2}x5x(8)^2$

$s=\frac{1}{2}x5x64$

s=5x32=160

16. A motorcyclist drives from A to B with a uniform speed of 30 km h–1 and returns back with a speed of 20 km h^{-1}. Find its average speed.

Soln:

Let the distance from A to B is D kms.
Distance for the entire journey is 2D kms.
Time taken to go from A to B is D/30 hr and that of B to A is D/20 hr. So, total time taken T
T = (D/30) + (D/20). By solving, we will get,
T = D/12 hrs.
Average speed = Total distance/Total time.
Av.speed = 2D ÷ D/12
=> 2D x 12/D = 24 km/h.
Hence Average speed of the motocycle is 24 km/h.

17. The velocity-time graph (Fig. 8.5) shows the motion of a cyclist. Find (i) its acceleration (ii) its velocity and (iii) the distance covered by the cyclist in 15 seconds

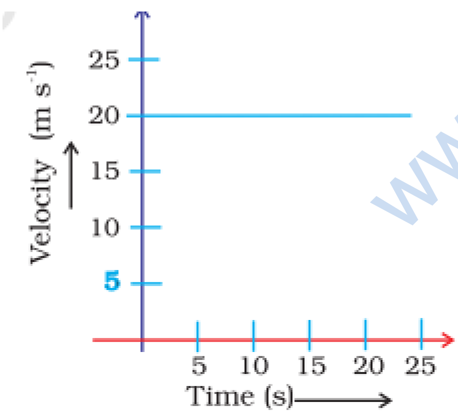


Fig. 8.5

Soln:

Here Velocity is constant hence v=20ms-1

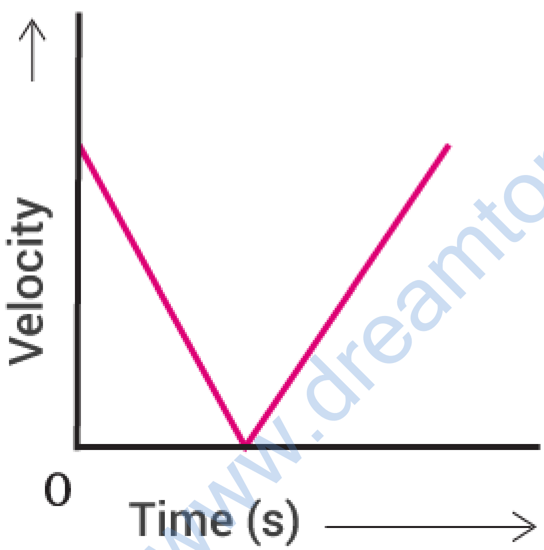
(iii) s = v x t

= 20 x 15

= 300 m

18. Draw a velocity versus time graph of a stone thrown vertically upwards and then coming downwards after attaining the maximum height.

Soln:



19. An object is dropped from rest at a height of 150 m and simultaneously another object is dropped from rest at a height 100 m. What is the difference in their heights after 2 s if both the objects drop with same accelerations? How does the difference in heights vary with time?

Soln:

When two objects fall with same acceleration simultaneously. after 2 seconds the difference in their heights will not change and it remain 50 m.

$d_1 = h_1 - s_1$

$d_1 = 150 - \frac{1}{2}at^2 = 150 - \left(\frac{1}{2} \times 10 \times 4\right)$

$d_1 = 150 - 20 = 130 \text{ m}$

Therefore the height of first object after 2 seconds is 130 m.

In the same way the height of second object is

$d_2 = h_2 - s_2$

$d_2 = 100 - \frac{1}{2}at^2 = 100 - \left(\frac{1}{2} \times 10 \times 4\right)$

$d_1 = 100 - 20 = 80$ m

Therefore, the height of second object after 2 seconds is 80 m.

So, the difference is same, i.e. 50 m.

This concludes that the difference in height of the two objects does not depend on time and will always be same.

20. An object starting from rest travels 20 m in first 2 s and 160 m in next 4 s. What will be the velocity after 7 s from the start.

Soln:

Here Object starts from rest hence initial velocity u=0 t =2s and s=20 m

According to Second equation of motion $s= ut+\frac{1}{2}at^2$

$S=0+\frac{1}{2}a\ x2^2$

$20=2+\frac{1}{2}a\ x2^2= 2a$

=20/2

a=10m/s

According to first equation of motion velocity after 7 s from the start

V=u+at

V=0+10x7

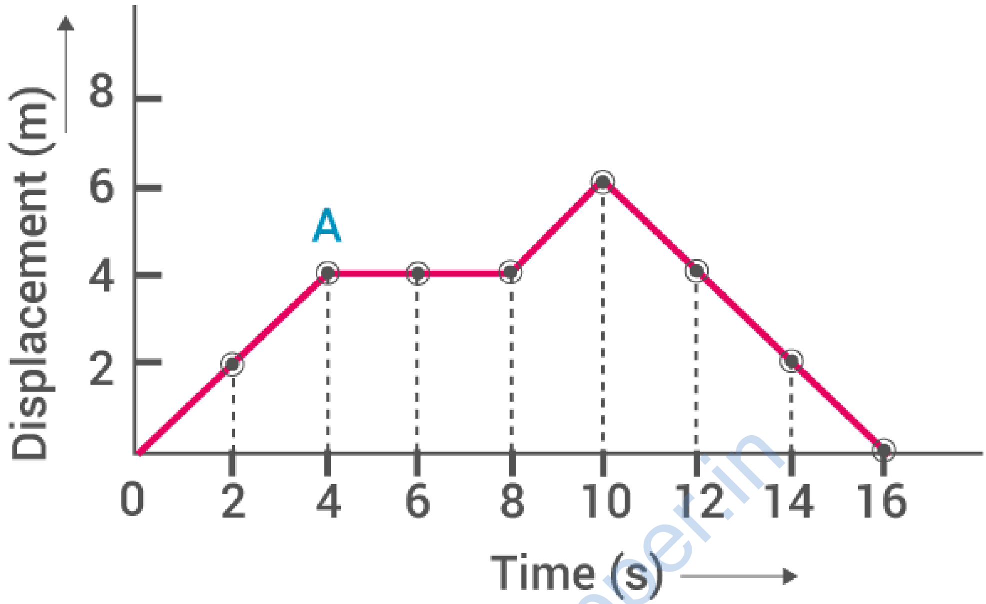
V=70m/s

21. Using following data, draw time - displacement graph for a moving object:

Time(s)	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**
Displacement(m)	**0**	**2**	**4**	**4**	**4**	**6**	**4**	**2**	**0**

Use this graph to find average velocity for first 4 s, for next 4 s and for last 6 s.

Soln



Average velocity for the first 4s=$\frac{Change\ in\ displacement}{Total\ time\ taken}$

Average velocity of next 4 s=V= $\frac{4-4}{8-4}=\frac{0}{4}$

Average velocity for last 6 s=$\frac{(0-6)m}{(16-10)s}=\frac{(-6)}{6}$= 1 ms^{-1}

22. An electron moving with a velocity of 5 × 104 m s-1 enters into a uniform electric field and acquires a uniform acceleration of 104 m s–2 in the direction of its initial motion.
(i) Calculate the time in which the electron would acquire a velocity double of its initial velocity.
(ii) How much distance the electron would cover in this time?

Soln:

Given initial velocity, u = 5 × 104 m s-1 and acceleration, a = 104 m s–2

(i) final velocity = v = 2 u = 2 × 5 ×104 m s–1 =10 × 104 m s–1

To find t, use v = at or t = u - u / a

(ii)

Using $s = ut + \frac{1}{2}at\ 2$ = $(5 \times 10^4) \times 5 + 1/2\ (10) \times (5)\ 2$

$= \frac{25 \times 10^4 + 25}{2 \times 10^4}$

$= 37.5 \times 10^4$ m

23. Obtain a relation for the distance travelled by an object moving with a uniform acceleration in the interval between 4th and 5th seconds.

Soln:

a = dv/dt

Assume that air resistanceis nil.

We can directly contain it by using Newton's equations of motion or from the below mentioned method:

Thus area under the v-t curve and the x-axis where the slope of the curve is the instantaneous acceleration.

In this case acceleration g is constant and due to free fall condition, initial velocity is zero.Therefore the v-t curve is a straight line with a slope equal to g equal to 9.81 m/s passing through origin.

On dividing the total area under the curve into interval of unit seconds, then we initially obtain a triangle followed by trapeziums of increasing height.

The ratio of area of first triangle to second triangle to third triangle is equal to the ratio of displacement in first, second and third second. We get ratio equal to 1:3:5:7:9... and so on.

For 4th & 5th second it is 7:9.

24. Two stones are thrown vertically upwards simultaneously with their initial velocities u1 and u2 respectively. Prove that the heights reached by them would be in the ratio of u 2 2 1 2 :u (Assume upward acceleration is –g and downward acceleration to be +g).

Soln:

We know for upward motion, $v^2 = u^2 - 2gh$ or $h = \dfrac{u^2 - v^2}{2g}$

But at highest point $v = 0$

Therefore, $h = u^2/2g$

For first ball, $h_1 = u_1^2/2g$

and for second ball, $h_2 = u_2^2/2g$

Thus $\dfrac{h_1}{h_2} = \dfrac{u_1^2/\cancel{2g}}{u_2^2/\cancel{2g}} = \dfrac{u_1^2}{u_2^2}$ or $h_1 : h_2 = u_1^2 : u_2^2$