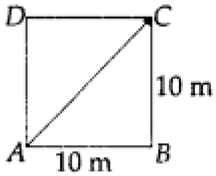
INTEXT Questions Answers

Question 1.
An object has moved through a distance. Can it have zero displacement? If yes support your answer with an example.
Solution:
Yes, an object moving through a distance can have zero displacement. This happens when final position of the object coincides with its initial position. Example : If an object travels from point A and reaches to the same point A, then its displacement is zero.

Question 2.
A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds?
Solution:
Figure ABCD is a square field of side 10 m.



Time for one round = 40 s
Total time = 2 min 20 s
$= (2 \times 60 + 20)\ \text{s} = 140\ \text{s}$

Number of round completed $= \dfrac{140}{40} = 3.5$

If farmer starts from A, it will complete 3 rounds ($A \to B \to C \to D \to A$) at A.
In the last 0.5 round starting from A, he will finish at C.
Displacement of farmer

$$= AC = \sqrt{AB^2 + AC^2} = \sqrt{10^2 + 10^2} = 10\sqrt{2}\ \text{m}$$

Question 3.
Which of the following is true for displacement?
(a) It cannot be zero.
(b) Its magnitude is greater than the distance travelled by the object.
Solution:
(a) False
(b) False

Question 4.
Distinguish between speed and velocity.
Solution:

Speed	Velocity
The distance travelled by a moving body per unit time is called its speed.	The distance travelled by a moving body in a particular direction per unit time is called its velocity.
It is a scalar quantity.	It is a vector quantity.

Question 5.
Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?
Solution:
The magnitude of average velocity of an object is equal to its average speed if the object moves in a straight line in a particular direction.

Question 6.
What does the odometer of an automobile measure?
Solution:
The odometer of an automobile measures the distance travelled by a vehicle.

Question 7.
What does the path of an object look like when it is in uniform motion?
Solution:
In uniform motion, the path of an object can be a straight line, curved line or a circle. It can have any shape. This is because in uniform motion, speed is constant, the direction of motion may change.

Question 8.
During an experiment, a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light, that is 3 × 108 m s-1.
Solution:

Time taken = 5 minutes = 5×60 s = 300 s

Speed of signal, $u = 3 \times 10^8$ m s^{-1}

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

$$\therefore \text{ Distance} = \text{speed} \times \text{time}$$

$$= 3 \times 10^8 \times 300 = 9 \times 10^{10} \text{ m}$$

Question 9.
When will you say a body is in

1. uniform acceleration
2. non-uniform acceleration

Solution:

1. **Uniform acceleration :** When a body travels with thp same velocity in the given time, then the acceleration is said to be uniform.
2. **Non-uniform acceleration :** When a body moves with unequal velocity in the equal interval of time, the body is said to be moving with non-uniform acceleration.

Question 10.
A bus decreases its speed from 80 km h’1 to 60 km h^{-1} in 5 s. Find the acceleration of the bus.
Solution:

Initial velocity, $u = 80 \text{ km h}^{-1}$

$$= \frac{(80 \times 1000) \text{ m}}{(60 \times 60) \text{ s}} = \text{m s}^{-1} = 22.22 \text{ m s}^{-1}$$

Final velocity, $v = 60 \text{ km h}^{-1}$

$$= \frac{(60 \times 1000) \text{ m}}{(60 \times 60) \text{ s}} = 16.66 \text{ m s}^{-1}$$

Time taken, $t = 5$ s

$$\text{Acceleration, } a = \frac{v-u}{t} = \frac{16.66 - 22.22}{5}$$
$$= -1.11 \text{ m s}^{-2}$$

$\therefore$ The acceleration of bus is -1.11 m s^{-2}.

Negative sign shows retardation.

Question 11.
A train starting from a railway station and moving with uniform acceleration attains a speed 40 kmh^{-1} in 10 minutes. Find its acceleration.
Solution:
Here, initial speed, u = 0

Final speed, $v = 40 \text{ km h}^{-1}$

$$= \frac{40 \times 1000}{60 \times 60} = 11.11 \text{ m s}^{-1}$$

Time taken, $t = 10 \times 60 \text{ s} = 600 \text{ s}$

Acceleration,

$$a = \frac{v-u}{t} = \frac{11.11 - 0}{600} = 1.85 \times 10^{-2} \text{ m s}^{-2}$$

Question 12.
What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?
Solution:
When the motion is uniform, the distance-time graph is a straight line with some slops. When the motion is non-uniform, the distance time graph is not a straight line.

Question 13.
What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time axis?
Solution:
When distance-time graph of an object is a straight line parallel to the time axis, distance of the object at every instant of time is the same. Therefore, the object must be at rest.

Question 14.
What can you say about the motion of an object if its speed-time graph is a straight line parallel to the time axis?
Solution:
When speed-time graph of a body is a straight line parallel to the time axis, speed of the body at every instant of time is the same. It means the body is moving with a uniform speed. There is no acceleration at all.

Question 15.
What is the quantity which is measured by the area occupied below the velocity-time graph ?
Solution:
Area occupied below the velocity-time graph is a measure of the distance travelled by the body or the displacement of the body.

Question 16.
A bus starting from rest moves with a uniform acceleration of 0.1 m s^{-2} for 2 minutes. Find
(a) the speed acquired,
(b) the distance travelled.
Solution:
Here, $u = 0$, $a = 0.1\ m\ s^{-2}$,
$t = 2\ min = 2 \times 60\ s = 120\ s$
(a) From $v = u + at$, $v = 0 + 0.1 \times 120 = 12\ m\ s^{-1}$
(b) From $s = ut + \frac{1}{2}at^2$,
$$s = 0 \times 120 + \frac{1}{2} \times 0.1(120)^2 = 7.2 \times 10^2\ m$$

Question 17.
A train is travelling at a speed of 90 km h^{-1}. Brakes are applied so as to produce a uniform acceleration of – 0.5 m s^{-2}. Find how far the train will go before it is brought to rest.
Solution:
Here, initial speed,

$$u = 90\text{km h}^{-1} = \frac{90 \times 1000}{60 \times 60\text{s}} = 25\text{ m s}^{-1}$$

Acceleration, $a = -0.5$ m s^{-2}, final velocity, $v = 0$

From

$v^2 - u^2 = 2as$,

Distance travelled

$$s = \frac{v^2 - u^2}{2a} = \frac{0-(25)^2}{2\times(-0.5)} = 625\text{m}$$

Question 18.

A trolley, while going down an inclined plane, has an acceleration of 2 cm/s^2 starting from rest, what will be its velocity 3 s after the start?

Solution:

Here, acceleration, $a = 2$ m s^{-2},

Time taken, $t = 3$ s

Initial velocity, $u = 0$

Final velocity, $v = u + at = 0 + 2 \times 3 = 6$ cm s^{-1}

Question 19.

A racing car has a uniform acceleration of 4 m s'2. What distance will it cover in 10 s after start?

Solution:

Here, a = 4 m s^{-2}, t = 10 s, u = O.

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

$$= 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2 = 0 + \frac{1}{2} \times 4 \times 100$$

$$\therefore \quad s = 200\text{ m}$$

The distance covered in 10 s by the car is 200 m.

Question 20.

A stone is thrown in vertically upward direction with a velocity of 5 m s^{-1}. If the acceleration of the stone during its motion is 10 m s^{-2} in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

Solution:

u = 5 m s^{-1}, v = 0, a = -10 m s^{-2}

$u = 5$ m s^{-1}, $v = 0$, $a = -10$ m s^{-2}

(i) $v = u + at$

$0 = 5 + (-10)t$

$$-5 = -10t \quad \therefore \quad t = \frac{5}{10} = 0.5\text{ s}$$

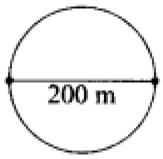
(ii) $v^2 - u^2 = 2as$

$(0)^2 - (5)^2 = 2(-10) \times s$

$$-25 = -20 \times s \quad \therefore \quad s = \frac{25}{20} = 1.25\text{ m}$$

NCERT Exercises

Question 1.
An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?
Solution:



Diameter, $d = 200$ m, $r = \frac{d}{2} = 100$ m

Time for one round = 40 s
Distance travelled in 2 minutes and 20 s

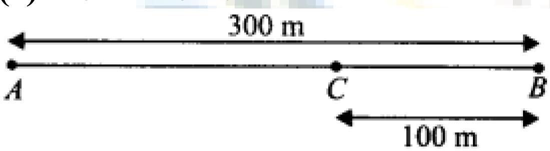
$(2 \times 60 + 20 = 140 \text{ s}) = \frac{140}{40} = 3.5$ rounds

Distance travelled = Circumference of the circle × 3.5
$= 2\pi r \times 3.5$

$$= 2 \times \frac{22}{7} \times 100 \times 3.5 = 2200 \text{ m}$$

Displacement after 3.5 rounds = diameter of the track = 200 m

Question 2.
Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging, (a) from A to B and (B) from A to C?
Solution:
(a) From A to B.



Time for A to B = 2 min 30 s
$= 2 \times 60 + 30 = 150$ s

$$\text{Average speed} = \frac{\text{total distance}}{\text{time interval}}$$

$$= \frac{300}{150} = 2 \text{ m s}^{-1}$$

$$\text{Average velocity} = \frac{\text{displacement}}{\text{time interval}}$$

$$= \frac{300}{150} = 2 \text{ m s}^{-1}$$

(b) From A to C.

Time taken = A to B + B to C, 150 + 60 = 210 s Total distance = 300 + 100 = 400 m

$$\therefore \text{ Average speed} = \frac{\text{total distance}}{\text{time interval}}$$

$$= \frac{400}{210} = 1.9 \text{ m s}^{-1}$$

$$\therefore \text{ Average velocity} = \frac{\text{displacement}}{\text{time interval}}$$

$$= \frac{200}{210} = 0.95 \text{ m s}^{-1}$$

Question 3.

Abdul, while driving to school, computes the average speed for his trip to be 20 km h^{-1}. On his return trip along the same route, there is less traffic and the average speed is 30 km h^{-1} What is the average speed for Abdul's trip?

Solution:

Let the school be at a distance of x km. If t is time taken to reach the school, then

$$t_1 = \frac{\text{distance}}{\text{average speed}} = \frac{x}{20}$$

If t_2 is time taken to reach back, then

$$t_2 = \frac{\text{distance}}{\text{average speed}} = \frac{x}{30}$$

Total time,

$$t = t_1 + t_2 = \frac{x}{20} + \frac{x}{30} = x\left[\frac{1}{20} + \frac{1}{30}\right] = \frac{5x}{60} = \frac{x}{12}$$

Total distance $x + x = 2x$

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$= \frac{2x}{x/12} = 24 \text{ km h}^{-1}$$

Question 4.

A motorboat starting from rest on a lake accelerates in a straight tine at a constant rate of 3.0 m s^{-2} for 8.0 s. How far does the boat travel during this time?

Solution:

$u = 0$, $a = 3.0 \text{ m s}^{-2}$, $t = 8$ s

$$s = ut + \frac{1}{2}at^2 = 0 \times t + \frac{1}{2}(3) \times (8)^2$$

$$s = \frac{1}{2} \times 3 \times 64 = 96 \text{ m}$$

$\therefore$ Boat travelled a distance of 96 m.

Question 5.

A driver of a car travelling at 52 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km h^{-1} in another car applies his brakes slowly and stops in 10 s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?

Solution:

The data given in this numerical problem are in different units. So, we should first convert km h^{-1} unit into m s^{-1} unit.

For first car:

Initial velocity $u = 52 \text{ km h}^{-1}$

$$= \frac{52 \text{ km}}{1 \text{ h}} = \frac{52 \times 1000 \text{ m}}{1 \times 3600 \text{ s}} = 14.4 \text{ m s}^{-1}$$

Final velocity, $v = 0 \text{ km h}^{-1} = 0.0 \text{ m s}^{-1}$

Time taken, $t = 5$ s

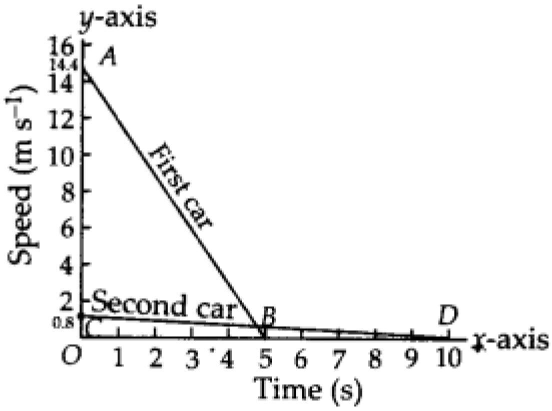
For second car :

Initial velocity, $u = 3 \text{ km h}^{-1}$

$$= \frac{3 \text{ km}}{1 \text{ h}} = \frac{3 \times 1000 \text{ m}}{1 \times 3600 \text{ s}} = 0.8 \text{ m s}^{-1}$$

Final velocity, $v = 0 \text{ km h}^{-1} = 0.0 \text{ m s}^{-1}$

Time taken, $t = 10$ s



The distance traveled by a moving body is given by the area under its speed-time graph. so, Distance traveled by the first car=Area of the triangle AOB

$$= \frac{1}{2} \times OB \times AO = \frac{1}{2} \times 14.4 \text{ m s}^{-1} \times 5 \text{ s}$$

$$= \frac{1}{2} \times 14.4 \times 5 \text{ m} = 36 \text{ m}$$

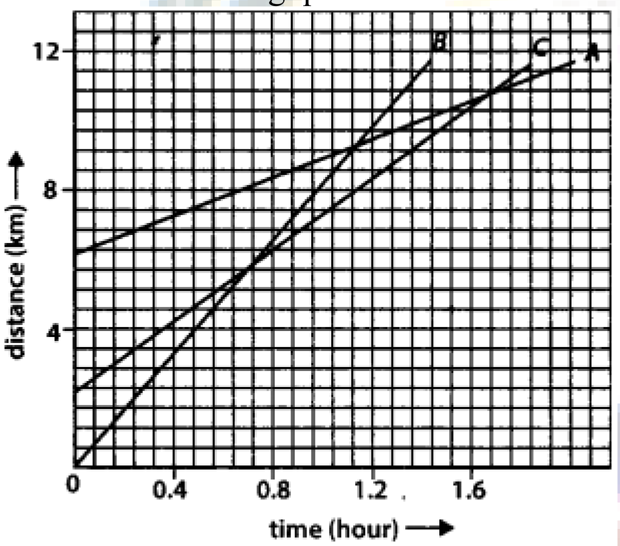
Similarly, Distance travelled by the second car = Area of triangle COD

$$= \frac{1}{2} \times OD \times CO = \frac{1}{2} \times 0.83 \text{ m s}^{-1} \times 10 \text{ s}$$

$$= \frac{1}{2} \times 0.83 \times 10 \text{ m} = 4.1 \text{ m}$$

Thus, the second car travels 4.1 m and the first car travels 36 m before coming to rest. So, the second car traveled farther after the brakes were applied.

Question 6.
Figure given below shows the distance-time graph of three objects A, B and C. Study the graph and answer the following questions?



(a) Which of the three is travelling the fastest?
(b) Are all three ever at the same point on the road?
(c) How far has C travelled when B passes A?
(d) How far has B travelled by the time it passes C?
Solution:
(a) B is travelling fastest.
(b) As three lines do not meet at any point, the three objects never meet on the road.
(c) B passes A at D. At this time, C is at E, which corresponds to 7 km. Hence when B crosses A, then C is at 7 km from the origin.
(d) By the time B passes C, it has travelled 4.5 km.

Question 7.
A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of 10 m s^{-2}, with what velocity will it strike the ground? After what time will it strike the ground?
Solution:

Here $s = 20$ m, $u = 0$, $a = 10$ m s^{-2}

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

$\therefore \quad (20) = 0 \times t + \frac{1}{2}(10)t^2 \Rightarrow 20 = \frac{1}{2} \times 10t^2$

$\frac{20 \times 2}{10} = t^2 \Rightarrow t^2 = 4$

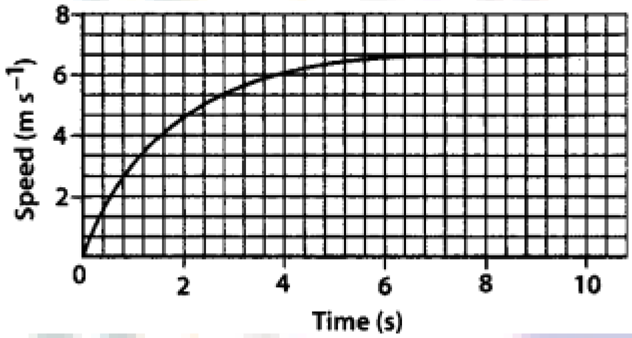
$\therefore \quad t = 2$ s

$v = u + at = 0 + 10 \times 2 = 20$ m s^{-1}

The ball strike the ground after 2 s with the velocity of 20 m s^{-1}.

Question 8.

The speed-time graph for a car is shown in the figure.

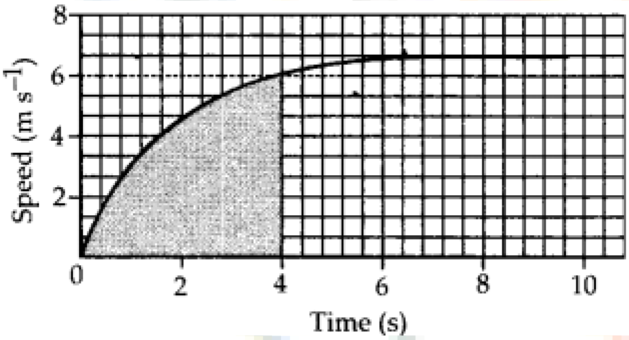


(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.

(b) Which part of the graph represents uniform motion of the car?

Solution:

The motion during first 4 seconds is not uniformly accelerated. So, distance travelled by car in first 4 seconds is calculated by graphical method.



(a) Number of squares in shaded part of the graph = 320.5 one small square in x axis represent t = $\frac{2}{5}s$

One small square on y axis represent $v = \frac{2}{3}$ m s^{-1}

$\therefore \quad$ area of each square, $v \times t = \frac{2}{3} \times \frac{2}{5} = \frac{4}{15}$ m

Total area $= 61.5 \times \frac{4}{15} = 16.4$ m

(b) The limiting flat portion of the curve describes the constant speed of the car, i.e., a speed of 6.0 m

s^{-1}. At this stage, the acceleration of the car is zero.
Therefore, portion of the graph between t = 6 s to 10 s, describes the uniform motion of the car.

Question 9.
State which of the following situations are possible and give an example for each of these:
(a) an object with a constant acceleration but with zero velocity
(b) an object moving in a certain direction with an acceleration in the perpendicular direction.
Solution:
(a) Free fall of an object.
(b) Object moving in a circular path

Question 10.
An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth.
Solution:
Radius of the orbit = 42250 km
= 42250 × 1000 m Time taken for one revolution = 24 hours
= 24 × 60 × 60 s

$$\therefore \text{ Speed} = \frac{\text{distance}}{\text{time}} = \frac{2\pi r}{\text{time}}$$

$$= 2 \times \frac{22}{7} \times \frac{42250 \times 1000}{24 \times 60 \times 60}$$

Speed = 3073.74 m s^{-1}
= 3.07 km s^{-1}.

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Multiple Question Answers

1. **Rate of change of displacement is called**

   (a) Speed
   (b) Deceleration
   (c) Acceleration
   (d) Velocity

   Answer. d) Velocity
2. **Acceleration is a vector quantity, which indicates that its value**

   (a) Is always negative
   (b) Is always positive
   (c) Is zero
   (d) Can be positive, negative or zero

Answer. (d) Can be positive, negative or zero

3. **SI Unit of measurement of acceleration is**

(a) m/s
(b) m/s^2
(c) m/hr
(d) M

Answer. (b) m/s^2

4. **The acceleration of a body from a velocity –time graph is**

(a) Is denoted by a line parallel to the time axis at any point on the distance axis
(b) Equal to the slope of the graph
(c) Area under the graph
(d) Is denoted by a line parallel to the distance axis at any point on the time axis

Answer. (b) Equal to the slope of the graph

5. **Distance covered by a body from velocity-time graph is**

(a) Is denoted by a line parallel to the distance axis at any point on the time axis
(b) Is denoted by a line parallel to the time axis at any point on the distance axis
(c) Equal to the slope of the graph
(d) Area under the graph

Answer. (d) Area under the graph

6. **What does the slope of distance - time graph give?**

(a) Acceleration
(b) Uniform speed
(c) Speed
(d) both[b] and [c] depending upon the time of graph

Answer. (c) Speed

7. **An example of a body moving with constant speed but still accelerating is**

(a) A body moving with constant speed on a straight road
(b) A body moving in a helical path with constant speed
(c) A body moving with constant speed in a circular path
(d) A body moving with constant speed on a straight railway track

Answer. (c) A body moving with constant speed in a circular path

8. **The average velocity of a body is given by the expression :**

(a) $V = u + at$
(b) $2as = v^2 - u^2$
(c) $V_{av} = (u + v)/2$
(d) $S = ut + ½ a t^2$

Answer. (c) $V_{av} = (u + v)/2$

9. **A worker covers a distance of 40 km from his house to his place of work, and 10 km towards his house back. Then the displacement covered by the worker in the whole trip is**

(a) zero km
(b) 10 km
(c) 30 km
(d) 50 km

Answer. (c) 30 km

10. . **Rate of change of displacement is called**

(a) Speed
(b) Deceleration
(c) Acceleration
(d) Velocity

Answer. d) Velocity

11. **Acceleration is a vector quantity, which indicates that its value**

(a) Is always negative
(b) Is always positive
(c) Is zero
(d) Can be positive, negative or zero

Answer. (d) Can be positive, negative or zero

12. **A player moves along the boundary of a square ground of side 50 m in 200 sec.The magnitude of displacement of the farmer at the end of 11 minutes 40 seconds from his initial position is**

(a) 50 m
(b) 150 m
(c) 200 m

(d) $50\sqrt{2}$ m

Answer. (d) $50\sqrt{2}$ m

13. An object travels 40m in 5 sec and then another 80m in 5 sec. What is the average speed of the object?

(a) 12 m/s
(b) 6 m/s
(c) 2 m/s
(d) 0 m/s

Answer. (a) 12m/s

14. SI Unit of measurement of acceleration is

(a) m/s
(b) m/s^2
(c) m/hr
(d) M

Answer. (b) m/s^2