CBSE NCERT Solutions for Class 9 Science Chapter 8

Back of Chapter Questions

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 min 20 s?

Solution:

Given that the diameter of the circular track (d) = 200 m

The radius of the track, $r = \frac{d}{2} = 100$ m

We know that circumference of a circular path is

$= 2\pi r = 2\pi(100) = 200\pi$ m

And given that athlete complete one round in 40 s

In 40 s, athlete covers a distance of 200π m

In unit time, the athlete will cover a distance $= \frac{200\pi}{40}$

The athlete runs for 2 min 20 s(140 second), hence total distance covered in 140 s is

$$= \frac{200 \times 22}{40 \times 7} \times 140 = 220 \text{ m}$$

The athlete covers one round of the circular track in 40 s. In 120 s he will complete three rounds, and he is taking the fourth round.

In 3 rounds his displacement is zero, and we need to calculate displacement in 20 seconds

In 20 s, he moves at the opposite end of the initial position. Since displacement is equal to the shortest distance between the initial and final position of the athlete, displacement of the athlete will be equal to the diameter of the circular track

Displacement of the athlete = 200 m

Hence Distance covered by the athlete in 2 min 20 s is 220 m and his displacement is 200 m.

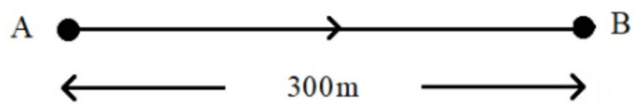
2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 min 30 s and then turns around and jogs 100 m back to point C in another 1 min. What are Joseph's average speeds and velocities in jogging

(a) from A to B and

(b) from A to C?

Solution:

(a) From end A to end B



Distance covered by Joseph while jogging from A to B = 300 m and time took 2 min 30 s (150 seconds)

We know that Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}}$

Total distance covered from A to B=300 m and total time taken= 150 s

Average speed = 300/150 = 2 m/s

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

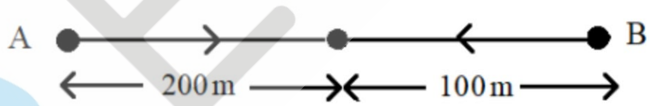
We know that displacement is the shortest distance two points, and Joseph is moving along a straight line then its distance and displacement will be equal

Time taken = 150 s

Average velocity= 300/150 = 2 m/s

As Joseph is moving in a straight line path hence average speed and average velocity of Joseph from A to B is the same and equal to 2 m/s

(b) From end A to end C



Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}}$

Total distance covered by Joseph from A to C=Distance covered from A to B + Distance covered from B to C = 300 + 100 = 400 m

Total time taken by Joseph=Time taken by Joseph to travel from A to B + Time taken by Joseph to travel from B to C = 150 + 60 = 210 s

Average speed $= \frac{400}{210} = 1.90$ m/s

We know that,

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

Displacement is the shortest distance between two points and particle is coming back to C point hence displacement equal to AC

Displacement (AC) $= \text{AB} - \text{BC} = 300 - 100 = 200 \text{ m}$

Time interval=Time taken to travel from A to B + Time taken to travel from

B to C $= 150 + 60 = 210 \text{ s}$

Average velocity $= 200/210 = 0.95 \text{ m/s}$

The average speed of Joseph from A to C is 1.90 m/s, and his average velocity is

0.95 m/s

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

Solution:

Given that while driving to school, the average speed of Abdul's trip= 20 km/h and in return trip average speed of Abdul's is 30 km/h

We know that Average speed $= \frac{\text{Total distance}}{\text{Total time taken}}$

Let's assume d is the distance travelled by Abdul to reach school

Total distance covered in the trip $= d + d = 2d$

Total time taken, t = Time taken to go to school + Time taken to return from school

$= t_1 + t_2$

$$\text{Average speed for Abdul's trip} = \frac{\text{Total distance covered in the trip}}{\text{Total time taken}}$$

$$\text{Average speed} = \frac{2d}{t_1 + t_2}$$

$$\text{Average speed} = \frac{2d}{\frac{d}{20} + \frac{d}{30}} = \frac{2}{\frac{3+2}{60}} = \frac{120}{5} = 24 \text{ km/h}$$

Hence, the average speed for Abdul's trip is 24 km/h

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

Solution:

Given that boat is starting from rest so its initial velocity, $u = 0$

Acceleration of the motorboat, $a = 3\ m/s^2$ (Given)

Time taken by motorboat is, 8 s (Given)

To find the distance covered by motorboat, we will use the second equation of motion:

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

Distance covered by the motorboat, s

$$s = 0 + \frac{1}{2} \times 3 \times 8^2 = 96\ m$$

Hence, the boat travels a distance of 96 m

5. A driver of a car travelling at 52 km/h applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km/h 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:

Given:

For the first car:

The initial speed of the car, $u_1 = 52\ km/h = \frac{52 \times 1000}{3600} = 14.4\ m/s$

Time taken to stop the car, $t_1 = 5\ s$

The final speed of the car becomes zero after 5s of application of brakes

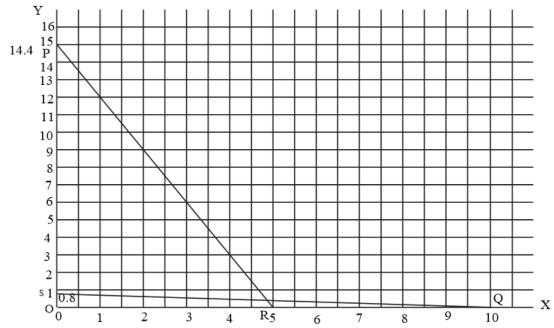
For the second car:

The initial speed of the car, $u_2 = 3\ km/h = 0.8\ m/s$

Time taken to stop the car, $t_2 = 10\ s$

After application of the brake, the final speed of the car becomes zero after 10 s

The plot of the speed versus time graph for the two cars is shown in the following figure:



We know that the area under the speed time graph will give distance covered in the time interval

Distance covered by the first car = Area under the graph line PR

= Area of triangle OPR

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

Distance covered by the second car = Area under the graph line SQ

= Area of triangle OSQ

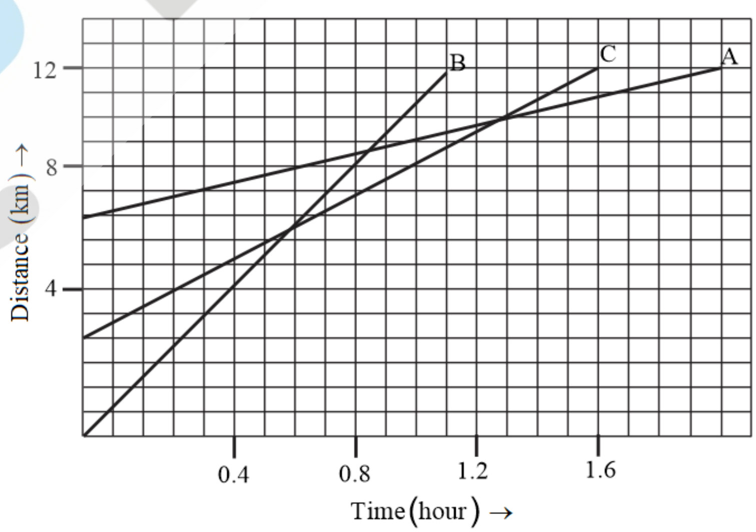
$$= 1/2 \times 10 \times 0.8 = 4 \text{ m}$$

We can see that Area of triangle OPR > Area of triangle OSQ

Thus, the distance covered by the first car is greater than the distance covered by the second car

Hence, the car travelling with a speed of 52 km/h travelled farther after brakes were applied

6. Fig shows the distance-time graph of three objects A, B and C. Study the graph and answers the following questions:



(a) Which of the three is travelling the fastest?

(b) Are all three ever at the same point on the road?

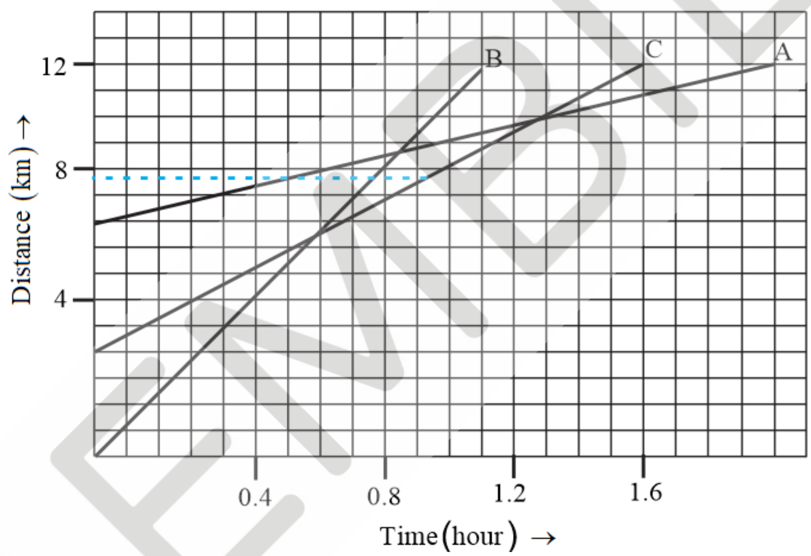
(c) How far has C travelled when B passes A?

(d) How far has B travelled by the time it passes C?

Solution:

(a) We know that the slope of the distance-time graph of an object gives its speed. If the slope will be more, its speed will be more. Among the given graphs, the slope of the distance-time graph of object B is the maximum, so object B is travelling the fastest

(b) We can see in the distance-time graphs of the three objects A, B and C; they will never meet at a single point. Thus, they are never at the same point on the road



(c)

On the distance axis, we can see that height of 7 boxes equal to 4 km

One small box $= \frac{4}{7}$ km

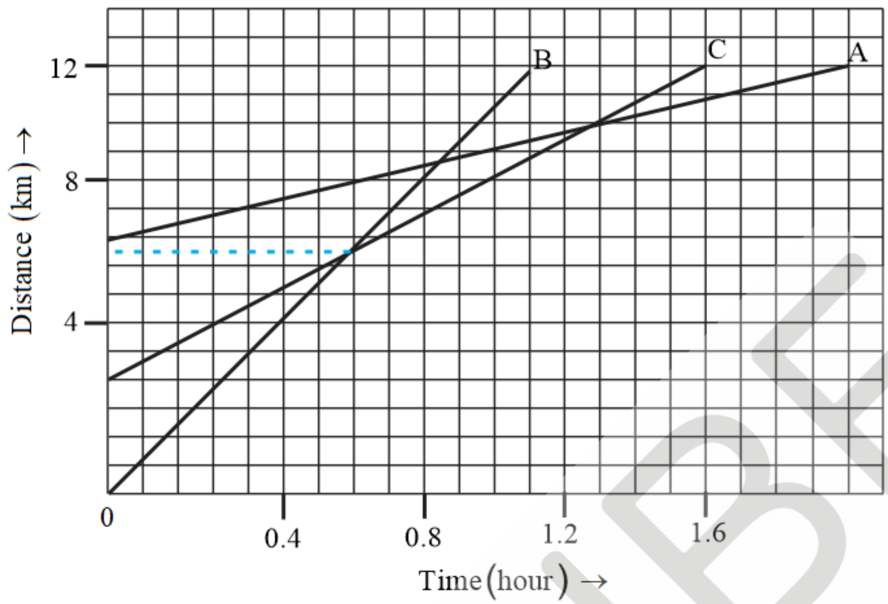
Initially, object C is four blocks away from the origin

The initial distance of object C from origin $= \frac{16}{7}$ km

The distance of object C from the origin when B passes A = 8 km

Distance covered by C $= 8 - \frac{16}{7} = \frac{56-16}{7} = \frac{40}{7} = 5.714$ km

Hence, C has travelled a distance of 5.714 km when B passes A



(d) Distance covered by B at the time it passes C = 9 boxes

$= \frac{4}{7} \times 9 = \frac{36}{7} = 5.143$ km

Hence, B has travelled a distance of 5.143 km when it passes C

7. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of $10\frac{m}{s^2}$. With what velocity will it strike the ground? After what time will it strike the ground?

Solution:

Distance covered by the ball in terms of height is (s) = 20 m

Acceleration of the ball is acceleration due to gravity, a = 10 m/s2

Initial velocity, u = 0 (since the ball was initially at rest)

The final velocity of the ball with which it strikes the ground, v

first, we need to find the final velocity of the ball by the third equation of motion:

$v^2 = u^2 + 2a\,s$

$v^2 = 0 + 2\,(10)(20)$

$v = 20$ m/s

The ball will strike the ground with a velocity of 20 m/s

Now we need to find the time taken by the ball to reach the ground, and we will use the first equation of motion:

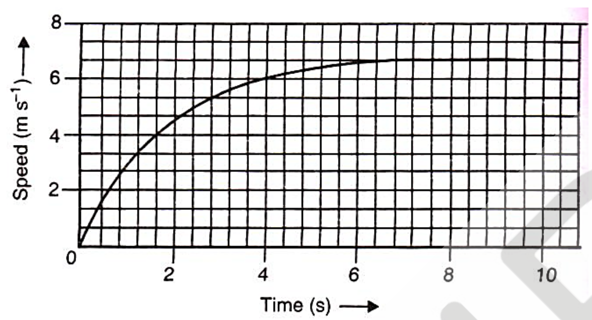
$v = u + at$

$20 = 0 + 10\,(t)$

$t = 2\ s$

Hence, the ball will strike the ground after 2 s with a velocity of 20 m/s

8. The speed-time graph for a car is shown in Figure



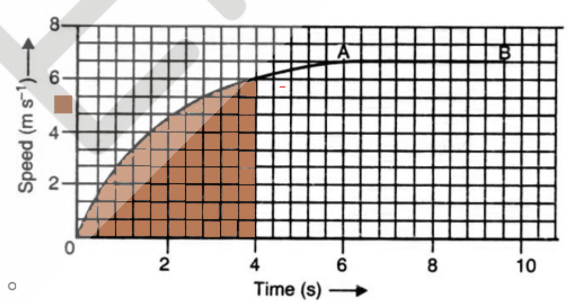
(a) Find how far the car travels in the first 4 seconds. Shade, the area on the graph that represents the distance, travelled by car during the period

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

Solution:

Given:

(a) we know that area under speed and time graph will give distance travelled in a given time interval. The distance travelled by car in the first 4 seconds is given by the area between the curve and the time axis from $t = 0$ to $t = 4\ s$. This area has been shaded in the graph below



First, we need to count the number of square in the shaded part of the graph

Number of squares in the shaded part of the graph = 62

On X-axis,

Five squares represent 2 s

1 square represents $\frac{2}{5}$ s

On Y-axis,

3 squares represent 2 m/s

1 square represents $\frac{2}{3}$ m/s

So, the area of 1 square on the graph = $\frac{2}{5}$s $\times$ $\frac{2}{3}$m/s = $\frac{4}{15}$ m

Area of the shaded region of the graph $62 \times \frac{4}{15} = 16.53$ m

Therefore, the car travels a distance of 16.53 m in the first 4 s

(b) If particle under constant speed during its motion, then particle motion is called uniform motion

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 is moving in a certain direction with an acceleration in the perpendicular direction

Solution:

Given:

(a) Possible

When a ball is released from a height, then its initial velocity is zero but a constant acceleration equal to the acceleration due to gravity, i.e. 9.8 m/s^2

(b) Possible

When a car is moving in a circular road, its acceleration is perpendicular to its direction of motion at each instant.

10. An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to resolve around the earth?

Solution:

Given: an artificial is moving along a circular path, and in one revolution it will cover the circumference of a circle which is given by (2πr) where r is the radius of the circle

Radius of the circular orbit, r = 42250 km

Time taken to revolve around the earth, t = 24 h

Speed of an object moving in a circular orbit = $\frac{\text{Distance}}{\text{time}} = \frac{2\pi r}{t}$

$$v = \frac{2 \times 3.14 \times 42250}{24} = 11055.41 \text{ km/h} = 3.07 \text{ km/s}$$

Hence, the speed of the artificial satellite is 3.07 km/s

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