MOTION

NCERT Textbook Questions

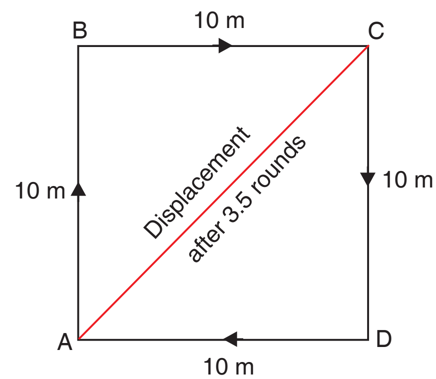
Q.1. An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.

Ans. Yes, even if an object has moved through a distance, it can have zero displacement. This can happen if, after moving through a certain distance, the moving object comes back to its starting position. For example, if an athlete runs along a circular track and after completing one round, comes back to his starting position, then the distance moved by the athlete will be equal to the circumference of circular track but his displacement will be zero (because the straight line distance between his initial and final positions will be zero).

Q.2. A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitudeof displacement of the farmer at the end of 2 minutes 20 seconds from his initial position?

Ans. First of all we will convert the total time of 2 minutes 20 seconds into seconds.

Total time = 2 minutes 20 seconds
= 2 × 60 seconds + 20 seconds
= 120 seconds + 20 seconds
= 140 seconds



Now, In 40 s, number of rounds made = 1

So, In 140 s, number of rounds made $= \frac{1}{40} \times 140$
$= 3.5$

Thus, the farmer will make three and a half rounds (3.5 rounds) of the square field. If the farmer starts from position A (see Figure), then after three complete rounds, he will reach at starting position A. But in the next half round, the farmer will move from A to B, and B to C, so that his final position will be at C. Thus, the net displacement of the farmer will be AC. Now, ABC is a right angled triangle in which AC is the hypotenuse. So,

$$(AC)^2 = (AB)^2 + (BC)^2$$
$$(AC)^2 = (10)^2 + (10)^2$$
$$(AC)^2 = 100 + 100$$
$$(AC)^2 = 200$$
$$AC = \sqrt{200}$$
$$AC = 14.143 \text{ m}$$

Thus, the magnitude of displacement of the farmer at the end of 2 minutes and 20 seconds will be 14.143 metres.

Q.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.

Ans. (*a*) The displacement can be zero. So, the first statement is not true.

(*b*) The magnitude of displacement can never be greater than the distance travelled by the object. So, thesecond statement is also not true.

Q.4. Distinguish between speed and velocity.

Ans.

Speed	Velocity
1. Speed of a body is the distance travelled by it per unit time 2. In speed, the direction of motion of the body is not specified 3. Speed has only magnitude, so speed is a scalar quantity	1. Velocity of a body is the distance travelled by it per unit time in a given direction 2. In velocity, the direction of motion of the body is specified 3. Velocity has both, magnitude as well as direction, so velocity is a vector quantity

Q.5. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?

Ans. The magnitude of average velocity of an object is equal to its average speed only when the object moves along a straight line path.

Q.6. What does the odometer of an automobile measure?

Ans. The odometer of an automobile measures the distance travelled by the automobile (or vehicle).

Q.7. What does the path of an object look like when it is in uniform motion?

Ans. An object has a uniform motion if it travels equal distances in equal intervals of time, no matter how small these time intervals may be. This means that in uniform motion, speed is constant but the direction of motion may change. As long as the speed remains constant, the path of an object in uniform motion can have any shape: it can be a straight line path, a curved path, a circular path or even a zig-zag path.

Q.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, 3×10^8 m s^{-1}.

Ans. We know that: $\text{Speed} = \dfrac{\text{Distance travelled}}{\text{Time taken}}$

Here, Speed = 3×108 m s^{-1}

Distance travelled =? (To be calculated)

And, Time taken= 5 minutes

= 5×60 seconds

= 300 s

Now, putting the values of speed and time in the above formula, we get:

$$3 \times 10^8 = \frac{\text{Distance travelled}}{300}$$

So, Distance travelled = $3 \times 10^8 \times 300$ m

= 9×10^{10} m

Thus, the distance of spaceship from the ground station is 9×10^{10} metres.

Q.9. When will you say a body is in:

(*i*) uniform acceleration?

(*ii*) non-uniform acceleration?

Ans. (*i*) A body has a uniform acceleration if its velocity changes by equal amounts in equal intervals of time. The motion of a freely falling body is an example of uniform acceleration.

(*ii*) A body has a non-uniform acceleration if its velocity changes by unequal amounts in equal intervals of time. The motion of a car on a crowded city road is an example of non-uniform acceleration.

Q.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.

Ans. In this problem, we will have to change the speeds of bus from km h^{-1} (kilometres per hour) to m s^{-1} (metres per second) because the time is given in seconds.

Now, Initial speed of bus, u = 80 km h^{-1}

$$= \frac{80 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 22.22 \text{ m s}^{-1} \quad \dots (1)$$

Final speed of bus, v = 60 km h^{-1}

$$= \frac{60 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 16.66 \text{ m s}^{-1} \quad \dots (2)$$

And, Time taken, t = 5 s ...(3)

Now, Acceleration, $= a = \dfrac{v-u}{t}$

$$a = \frac{16.66 - 22.22}{5}$$

$$a = \frac{-5.56}{5}$$

$$a = -1.11 \text{ m s}^{-2}$$

Thus, the acceleration of the bus is, -1.11 m s^{-2}. The minus sign for acceleration shows that it is actually negative acceleration or retardation.

Q.11. A train starting from a railway station and moving with uniform acceleration attains a speed of 40 km h^{-1} in 10 minutes. Find its acceleration.

Ans. Here, Initial speed of train, $u = 0$ (Starts from rest)

Final speed of train, $v = 40$ km h^{-1}

$$= \frac{40 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 11.11 \text{ m s}^{-1}$$

And, Time taken, $t = 10$ minutes

$= 10 \times 60$ seconds

$= 600$ s

Now, Acceleration, $a = \dfrac{v-u}{t}$

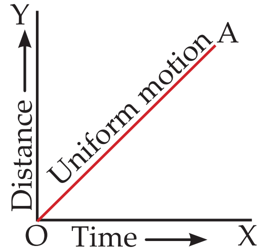
$$a = \frac{11.11 - 0}{600}$$

$$a = \frac{11.11}{600} \text{ m s}^{-2}$$

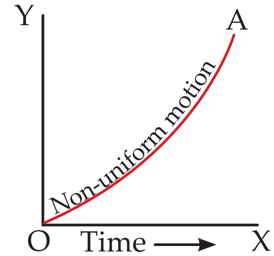
$a = 0.0185$ m s^{-2} (or 1.85×10^{-2} m s^{-2})

Q.12. What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?

Ans. (*i*) The distance-time graph for an object having uniform motion is a straight line with some slope [see Figure (i)]



(*i*)



(*ii*)

(*ii*) The distance-time graph for an object having non-uniform motion is a curved line [see Figure (ii)]

Q.13. What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time-axis?

Ans. If the distance-time graph of an object is a straight line parallel to the time axis, it shows that the distance of the object from its starting position is just the same at all times. Since the object remains at the same distance from the starting position, it is not moving. The object is stationary.

Q.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?

Ans. If the speed-time graph of an object is a straight line parallel to the time axis, then the speed of the object at every instant of time is just the same. So, the object is moving with constant speed (or uniform speed). There is no acceleration at all.

Q.15. What is the quantity which is measured by the area occupied below the velocity-time graph?

Ans. Distance travelled by the object.

Q.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.

Ans. (*a*) Calculation of speed acquired

Here, Initial speed, $u = 0$ (Bus starts from rest)

Final speed, $v = ?$ (To be calculated)

Acceleration, $a = 0.1 \text{ m s}^{-2}$

And, Time, $t = 2$ minutes

$= 2 \times 60$ seconds

$= 120$ s

Now, Final velocity, $v = u + at$

So, $v = 0 + 0.1 \times 120$

$v = 12 \text{ m s}^{-1}$

Thus, the speed acquired by the bus is 12 metres per second.

(*b*) Calculation of distance travelled

Now, Distance travelled, $s = ut + \frac{1}{2}at^2$

So, $s = 0 \times 120 + \frac{1}{2} \times 0.1 \times (120)^2$

$$s = 0 + \frac{1}{2} \times 0.1 \times 14400$$

$$s = 720 \text{ m}$$

Thus, the distance travelled by the bus is 720 metres.

Q.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.

Ans. Here, Initial speed, $u = 90 \text{ km h}^{-1}$

$$= \frac{90 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 25 \text{ m s}^{-1}$$

Final speed, $v = 0$ (The train stops)

Acceleration, $a = -0.5 \text{ m s}^{-2}$

And, Distance travelled, s =? (To be calculated)

Now, $v^2 = u^2 + 2as$

So, $(0)2 = (25)2 + 2 \times (-0.5) \times s$

$0 = 625 - 1 \times s$

$s = 625$ m

Thus, the train will travel a distance of 625 metres before it is brought to rest.

Q.18. A trolley, while going down an inclined plane, has an acceleration of 2 cm s^{-2}. What will be its velocity 3 s after the start?

Ans. Here, Initial velocity, $u = 0$

Final velocity, v =? (To be calculated)

Acceleration, $a = 2 \text{ cm s}^{-2}$

And, Time, $t = 3\ s$

Now, $v = u + \text{at}$

So, $v = 0 + 2 \times 3$

or $v = 6 \text{ cm s}^{-1}$

Thus, the velocity of trolley after 3 s will be 6 centimetres per second.

Q.19. A racing car has a uniform acceleration of 4 m s^{-2}. What distance will it cover in 10 s after start?

Ans. Here, Distance covered, s =? (To be calculated)

Initial velocity, $u = 0$

Acceleration, $a = 4 \text{ m s}^{-2}$

And, Time, $t = 10$ s

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

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

$s = 0 + 2 \times 100$

$s = 200$ m

Thus, the distance covered by the racing car in 10 s is 200 metres.

Q.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?

Ans. When the stone is thrown vertically upwards, then the velocity of stone goes on decreasing because of force of gravity of earth acting on it in the downward direction. So, the acceleration produced in the stone is negative and hence it is to be written with a minus sign (as, – 10 m s^{-2}).

Now,	Initial velocity of stone,	$u = 5$ m s^{-1}	
	Final velocity of stone,	$v = 0$	(It stops at the top)
	Acceleration,	$a = -10$ m s^{-2}	
And,	Distance travelled, (or Height attained)	$s = ?$	(To be calculated)

Now, $v^2 = u^2 + 2as$

So, $(0)2 = (5)2 + 2 \times (-10) \times s$

$0 = 25 - 20s$

$20s = 25$

$s = \frac{25}{20}$

$s = 1.25$ m

Thus, the height attained by the stone will be 1.25 metres.

Let us find out the time now. We know that:

$v = u + at$

So, $0 = 5 + (-10) \times t$

$0 = 5 - 10t$

$10t = 5$

$t = \frac{5}{10}$

$t = 0.5$ s

Thus, the time taken by the stone to reach at the top will be 0.5 second.

NCERT Exercises

Q.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?

Ans. Here, Total time = 2 minutes 20 seconds

= 2 × 60 seconds + 20 seconds

= 120 seconds + 20 seconds

= 140 s

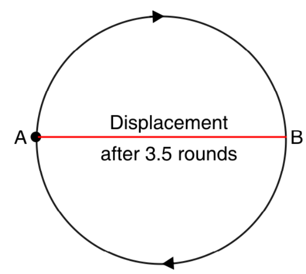
Now In 40 s, the number of rounds completed = 1

So, In 140 s, the number of rounds completed $= \frac{1}{40} \times 140$

= 3.5

(*a*) Calculation of distance covered in 3.5 rounds

The diameter of circular track is given to be 200 m, so the radius (r) of the circular track will be half of it, which is $= \frac{200}{2} = 100$ m.



Now, Distance covered in 1 round = Circumference of circular track

$= 2\pi r$

$= 2 \times \frac{22}{7} \times 100$ m $\left(\text{Because } \pi = \frac{22}{7}\right)$

= 628.57 m

And, Distance covered in 3.5 rounds = 628.57 × 3.5 m

= 2200 m

(*b*) *Calculation of displacement in 3.5 rounds*

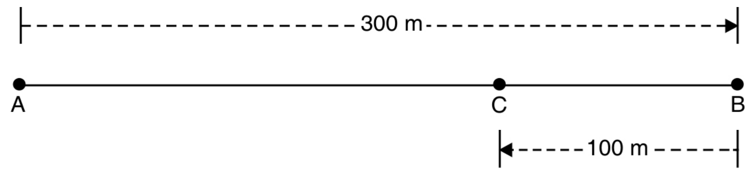
The athlete makes three and a half rounds (3.5 rounds) of the circular track. Now, if the athlete starts from point A (see Figure), then after three complete rounds, he will reach at the same point A. And when the athlete again starts from point A and makes the remaining half round, he will reach point B (which is diametrically opposite to point A). So, the displacement of athlete will be equal to diameter of the circular track which is 200 m.

Q.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?

(*b*) from A to C?

Ans. We will first draw a line diagram to show the movement of Joseph during jogging. This is given below:



(*a*) Calculation of average speed and average velocity from A to B

Total distance from A to B = 300 m

Total time taken from A to B = 2 minutes 30 seconds

= 2 × 60 seconds + 30 seconds

= 120 s + 30 *s*

= 150 s

Now, $$\underset{\text{(from A to B)}}{\text{Average speed}} = \frac{\text{Total distance}}{\text{Total time taken}}$$

$$= \frac{300 \text{ m}}{150 \text{ s}}$$

$$= 2.0 \text{ m/s} \qquad \text{...(1)}$$

In going from A to B, the displacement of Joseph is also 300 m and the time taken is also 150 s.

Now, $$\underset{\text{(from A to B)}}{\text{Average velocity}} = \frac{\text{Displacement}}{\text{Total time taken}}$$

$$= \frac{300 \text{ m}}{150 \text{ s}}$$

$$= 2.0 \text{ m/s} \qquad \text{...(2)}$$

Thus, when Joseph jogs from A to B, then the average speed and average velocity, both are equal in magnitude (each being 2.0 m/s).

(*b*) Calculation of average speed and average velocity from A to C

Now, Total distance from A to C = 300 m + 100 m

(which is A to B to C) = 400 m

Total time from A to C = 2 minutes 30 seconds + 1 minute

(which is A to B to C) = 150 *s* + 60 *s*

= 210 *s*

So, $$\underset{\text{(from A to C)}}{\text{Average speed}} = \frac{\text{Total distance}}{\text{Total time taken}}$$

$$= \frac{400 \text{ m}}{210 \text{ s}}$$

$$= 1.90 \text{ m/s} \quad ...(3)$$

Thus, the average speed of Joseph from A to C is 1.90 m/s

We will now calculate the average velocity of Joseph from A to C

Here, Displacement (from A to C) = 300 m – 100 m = 200 m

Total time (from A to C) = 210 s (Same as above)

Now, $$\text{Average velocity (from A to C)} = \frac{\text{Displacement}}{\text{Total time taken}}$$

$$= \frac{200 \text{ m}}{210 \text{ s}}$$

$$= 0.95 \text{ m/s} \quad ...(4)$$

Thus, the average velocity of Joseph from A to C is 0.95 m/s. This is different from his average speed (1.90 m/s) from A to C.

Q.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?

Ans. Suppose the school is at a distance of x km.

(*i*) While driving to school, the average speed is 20 km h^{-1}. Suppose the time taken while driving to school is t_1.

Now, $$\text{Speed} = \frac{\text{Distance}}{\text{Time taken}}$$

So, $$20 = \frac{x}{t_1}$$

And, Time taken, $$t_1 = \frac{x}{20} \text{ h} \quad ..(1)$$

(*ii*) On the return trip, the average speed is 30 km h^{-1}. Suppose the time taken for the return trip is t_2.

Now, $$\text{Speed} = \frac{\text{Distance}}{\text{Time taken}}$$

So, $$30 = \frac{x}{t_2}$$

And, Time taken, $$t_2 = \frac{x}{30} \text{ h} \quad ...(2)$$

We will now consider the whole trip (going to school and coming back).

$$\text{Total distance} = x + x$$
$$\text{(both ways)} = 2x \text{ km} \quad ...(3)$$

And, Total time taken $= \dfrac{x}{20} + \dfrac{x}{30}$

$$= \frac{3x + 2x}{60}$$

$$= \frac{5x}{60}$$

$$= \frac{x}{12} \text{ h} \quad ...(4)$$

Now, Average speed (for whole trip) $= \dfrac{\text{Total distance covered}}{\text{Total time taken}}$

$$= \frac{2x \times 12}{x}$$

$$= 24 \text{ km h}^{-1}$$

Thus, the average speed for Abdul's trip is 24 kilometres per hour.

Q.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?

Ans. Here, Distance travelled, s =? (To be calculated)

Initial speed, $u = 0$

Time, $t = 8.0$ s

And Acceleration, $a = 3.0 \text{ m s}^{-2}$

Now, $s = ut + \dfrac{1}{2}at^2$

So, $s = 0 \times 8.0 + \dfrac{1}{2} \times 3 \times (8.0)^2$

$s = 0 + \dfrac{1}{2} \times 3 \times 64$

$s = 96$ m

Thus, the boat travels a distance of 96 metres.

Q.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 34 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?

Ans. (*a*) *For first car:*

$$\text{Initial speed, } u = 52 \text{ km h}^{-1} = \frac{52 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 14.4 \text{ m s}^{-1} \quad \text{... (1)}$$

Final speed, $v = 0$ (The car stops) ...(2)

And, Time taken, $t = 5\ s$ ...(3)

(*b*) *For second car:*

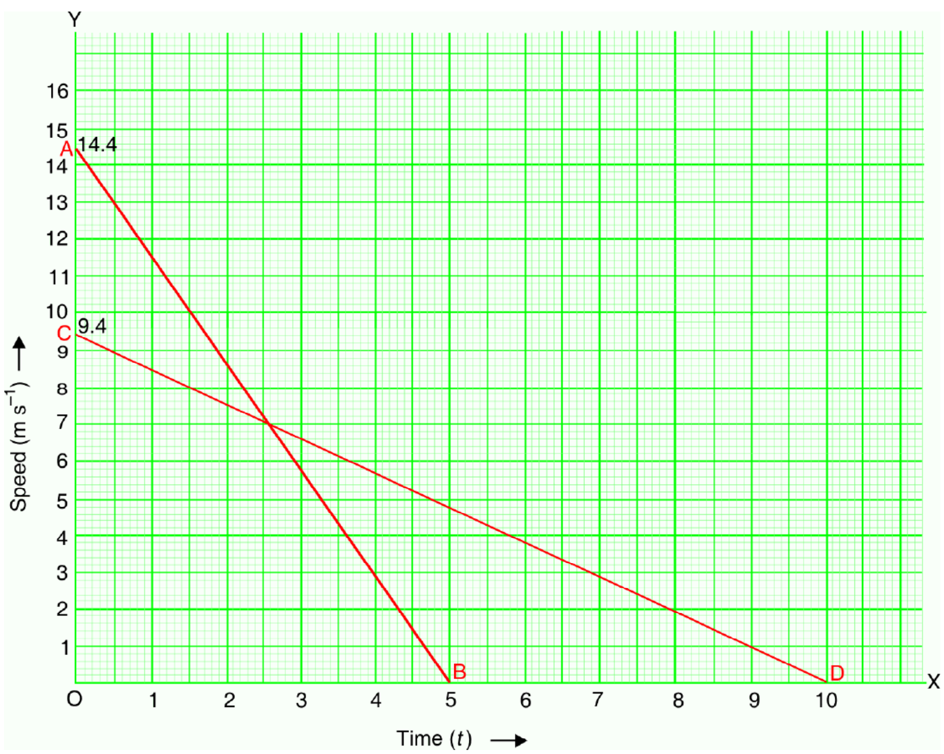
$$\text{Initial speed, } u = 34 \text{ km h}^{-1} = \frac{34 \times 1000 \text{ m}}{60 \times 60 \text{ s}}$$

$$= 9.4 \text{ m s}^{-1} \quad \text{...(4)}$$

Final speed, $v = 0$ (The car stops) ...(5)

And, Time taken, $t = 10\ s$ ...(6)

In order to plot the graph, we take time values on the *X*-axis and speed values on the *Y*-axis.



Now, the initial speed of first car is 14.4 m s^{-1} so, we take point A on the speed axis to represent a speed of 14.4 m s^{-1}. The first car stops in 5 seconds, so we take point B on the time axis to represent the time of 5 s. Let us join the points A and B. The sloping straight line AB is the speed-time graph for the first car. Now, the initial speed of second car is 9.4 m s^{-1}, so we take a point C on the speed axis to represent a speed of 9.4 m s^{-1}. The second car stops in 10 seconds, so we take a point D on time axis to represent the time of 10 s. Let us join the points C and D. The sloping straight line CD is the speed-time graph for second car. Now:

(*i*) Distance travelled = Area under the graph line AB

by first car = Area of triangle OAB

$$= \frac{1}{2} \times \text{base} \times \text{height}$$

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

$$= 36 \text{ m} \quad \text{...(7)}$$

(*ii*) Distance travelled = Area under the graph line CD

by second car = Area of triangle OCD

$$= \frac{1}{2} \times \text{base} \times \text{height}$$

$$= \frac{1}{2} \times 10 \times 9.4 \text{ m}$$

$$= 47 \text{ m} \quad \text{... (8)}$$

From the above calculations we find that the first car travels a distance of 36 metres before coming to a stop whereas the second car travels a distance of 47 metres before coming to a stop. Thus, the second car travelled farther after the brakes were applied.

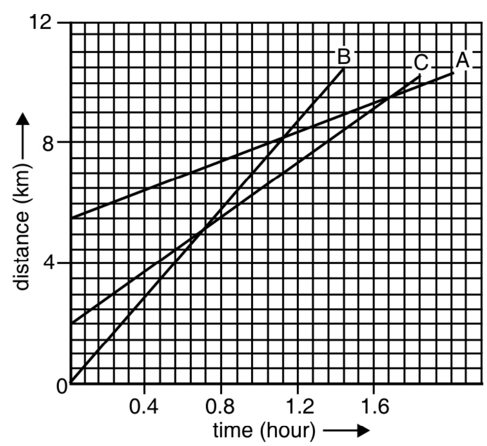
Q.6. Figure shows the distance-time graphs of three objects A, B and C. Study the graphs and answer the following questions:

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

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

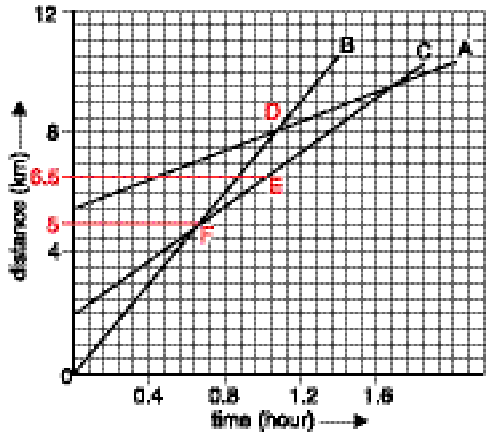
(*c*) How far has C travelled when B passes A?

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



Ans. (*a*) The slope of distance-time graph of a moving object indicates its speed. Greater the slope, higher is the speed. Now, in the given figure, the slope of distance-time graph of object B is the maximum, so the object B has the maximum speed. In other words, the object B is travelling the fastest.

(*b*) In order to be at the same point on the road, the respective distance and time values for all the three moving objects should be the same. Since the distance-time graph lines of the three objects A, B and C do not cross at a single point, therefore, the three objects are never at the same point on the road.



(*c*) We can see from the given figure that when B passes A at point D, then the C is at point E. If we locate the distance corresponding to point E on the *Y*-axis, we find that it is 6.5 km. Thus, C has travelled 6.5 km when B passes A.

(*d*) The distance-time graphs of B and C meet at point F. If we locate the distance corresponding to point F on the *Y*-axis, we will find that it is 5 km. Thus, B has travelled 5 km by the time it passes C.

Q.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?

Ans. Here, Initial velocity, $u = 0$ (Ball dropped from rest)

Final velocity, $v =?$ (To be calculated)

Acceleration, $a = 10 \text{ m s}^{-2}$

And, Distance, $s = 20$ m (or Height)

Now,

$$v^2 = u^2 + 2as$$

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

$$v^2 = 0 + 400$$

$$v^2 = 400$$

$$v = \sqrt{400}$$

$$v = 20 \text{ m s}^{-1}$$

Thus, the ball will strike the ground with a velocity of 20 metres per second. Let us calculate the time now.

We know that: $v = u + at$

So, $20 = 0 + 10 \times t$

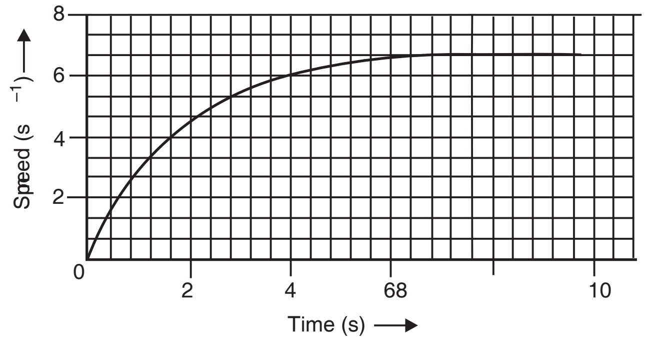
$$10t = 20$$

$$t = \frac{20}{10}$$

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

Thus, the ball will strike the ground after 2 seconds.

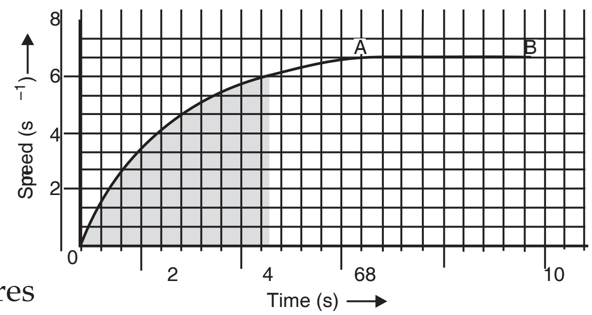
Q.8. The speed-time graph for a car is shown here.



(*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 this period.

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

Ans. (*a*) The distance travelled by the car in the first 4 seconds is given by the area between the speed-time curve and the time axis from $t = 0$ to $t = 4$ s. This area of the distance-time graph which represents the distance travelled by the car has been shaded in the graph shown on the next page. In order to find the distance travelled by the car in the first 4 s econds, we have to count the number of squares in the shaded part of the graph and also calculate the distance represented by one square of the graph paper. While c ounting the number of squares in the shaded part of the graph, the squares which are half or more than half are counted as complete squares but the squares which are less than half are not counted. When counted in this way, the total number of squares in the shaded part of the graph is found to be 63. We will now calculate the distance represented by 1 square of the graph. This can be done as follows : If we look at the *X*-axis, we find that 5 squares on *X*-axis represent a time of 2 seconds.



Now, 5 squares on *X*-axis = 2 *s*

So, 1 square on *X*-axis $= \frac{2}{5}$ s ...(1)

Again, if we look at the *Y*-axis, we find that 3 squares on *Y*-axis represent a speed of 2 m s^{-1}.

Now, 3 squares on *Y*-axis = 2 m s^{-1}

So, 1 square on *Y*-axis $= \frac{2}{3}$ m s^{-1} ...(2)

Since 1 square on *X*-axis represents $\frac{2}{5}$ s and 1 square on *Y*-axis represents $\frac{2}{3}$ m s^{-1}, therefore:

Area of 1 square on graph represents a distance $= \frac{2}{5} \text{ s} \times \frac{2}{3} \text{ m s}^{-1}$

$$= \frac{4}{15} \text{ m}$$

Now, 1 square represents distance $= \frac{4}{15}$ m

So, 63 squares represent distance $= \frac{4}{15} \times 63$ m

$= 16.8$ m

Thus, the car travels a distance of 16.8 metres in the first 4 seconds.

(*b*) In uniform motion, the speed of car becomes constant. The constant speed is represented by a speed-time graph line which is parallel to the time axis. In the given figure, the straight line graph from $t = 6$ s to $t = 10$ s represents the uniform motion of the car. The part of graph representing uniform motion has been labelled AB.

Q.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 zero velocity.

(*b*) an object moving in a certain direction with an acceleration in the perpendicular direction.

Ans. (*a*) An object with a constant acceleration but zero velocity is possible. For example, when an object is just released from a height, then it is being acted upon by a constant acceleration of 9.8 m/s^2 (called acceleration due to gravity) but its initial velocity is zero.

(b) An object moving in a certain direction with an acceleration in the perpendicular direction is possible. For example, when an object is moving with uniform motion in a circle, then the motion of the object at any instant of time is along tangent to the circle at that instant but the (centripetal) acceleration is along the radius of the circle (which is perpendicular to the direction of motion along the tangent).

Q.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.

Ans. The speed of an object moving in a circular orbit (or circular path) is given by the formula:

$$v = \frac{2\pi r}{t}$$

Here, Speed, v =? (To be calculated)

Pi, $\pi = \frac{22}{7}$ (It is a constant)

Radius, $r = 42250$ km

And, Time, $t = 24$ h

Now, putting these values in the above formula, we get:

$$\text{Speed, } v = \frac{2 \times 22 \times 42250}{7 \times 24}$$

$$v = 11065.4 \text{ km h}^{-1}$$

We can convert this speed from kilometres per hour to kilometres per second by dividing it by the number of seconds in 1 hour (which is 60 × 60 s). Thus:

$$v = \frac{11065.4}{60 \times 60} \text{ km s}^{-1}$$

$$v = 3.07 \text{ km s}^{-1}$$