## CBSE Class 9 Science <br> Important Questions <br> Chapter 8 <br> Motion

## 5 Marks 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 minutes 20 s ?

Ans. circumference of circular track $=2 \pi \mathrm{r}$
$=2 \times \frac{22}{7} \times \frac{\text { diameter }}{2}$
$=2 \times \frac{22}{7} \times \frac{200}{2}=4400 / 7 \mathrm{~m}$
rounds completed by athlete in $2 \mathrm{~min} 20 \mathrm{sec}=\mathrm{s}=140 / 40=3.5$
Therefore, total distance covered $=\frac{4400}{7} \times 3.5=2200 \mathrm{~m}$


## Final Position of arhlete after 3 t/2 roumd

$-X Y$ - Diameter of circle $=200 \mathrm{~m}$
since one complete round of circular track needs 40 s so he will complete 3rounds in 2 mins and in next 20s he can complete half round
Therefore, displacement $=$ diameter $=200 \mathrm{~m}$.
2. Joseph jogs from one end $A$ to the other end $B$ of a straight 300 m road in 2 minutes 50 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?

Ans. (a) distance $=300 \mathrm{~m}$
time $=2$ min30seconds $=150$ seconds
average speed from $A$ to $B=$ average velocity from $A$ to $B$
$=300 \mathrm{~m} / 150 \mathrm{~s}=2 \mathrm{~m} / \mathrm{s}$
(b) average speed from A to $C=(300+100) \mathrm{m} /(150+60) \mathrm{sec}$
$=400 \mathrm{~m} / 210 \mathrm{~s}=1.90 \mathrm{~m} / \mathrm{s}$

displacement from A to $\mathrm{C}=(300-100) \mathrm{m}=200 \mathrm{~m}$
time $=2 \mathrm{~min} 30 \mathrm{sec}+1 \mathrm{~min}=210 \mathrm{~s}$
velocity $=$ displacement/time $=200 \mathrm{~m} / 210 \mathrm{~s}=0.95 \mathrm{~m} / \mathrm{s}$
3. Abdul, while driving to school, computes the average speed for his trip to be $20 \mathrm{~km} \mathrm{~h}^{-1}$. On his return trip along the same route, there is less traffic and the average speed is $40 \mathrm{~km} \mathrm{~h}^{-1}$. What is the average speed for Abdul's trip?

Ans. If we suppose that distance from Abdul's home to school = x km s
while driving to school: speed $=20 \mathrm{~km}^{-1}$,
velocity = displacement/time
$20=x / t$, or, $t=x / 20 h r$
on his return trip: speed $=40$ lon $h^{-1}, 40=x / t$
or, $\mathrm{t}^{\prime}=\mathrm{x} / 40 \mathrm{hr}$
total distance travelled $=\mathrm{x}+\mathrm{x}=2 \mathrm{x}$
total time $=\mathrm{t}+\mathrm{t}^{\prime}=\mathrm{x} / 20+\mathrm{x} / 40=(2 \mathrm{x}+\mathrm{x}) / 40=3 \mathrm{x} / 40 \mathrm{hr}$
average speed for Abdul's trip $=2 \mathrm{x} /(3 \mathrm{x} / 40)=80 \mathrm{x} / 3 \mathrm{x}=26.67 \mathrm{~km} / \mathrm{hr}$
4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of $3.0 \mathrm{~m} \mathrm{~s}^{-2}$ for $\mathbf{8 . 0} \mathbf{~ s}$. How far does the boat travel during this time?

Ans. since the motorboat starts from rest so $u=0$
time ( t ) $=8 \mathrm{~s}, a=3 \mathrm{~m} / \mathrm{s}^{2}$
distance(s) $=u t+\frac{1}{2} a t^{2}=0+\frac{1}{2} \times 3 \times 8^{2}=96 m$
5. A driver of a car travelling at $52 \mathrm{~km} \mathrm{~h}^{-1}$ applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at $3 \mathrm{~km} \mathrm{~h}^{-1}$ in another car applies is 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.


As given in the figure below AB (in red line) and CD (in red line) are the Speed-time graph for given two cars with initial speeds $52 \mathrm{kmh}^{-1}$ and $3 \mathrm{~km}^{-1}$ respectively.

Distance Travelled by first car before coming to rest=Area of $\triangle O A B$
$=(1 / 2) \times O B \times O A$
$=(1 / 2) \times 5 \mathrm{~s} \times 52 \mathrm{kmh}^{-1}$
$=(1 / 2) \times 5 \times(52 \times 1000) / 3600) \mathrm{m}$
$=(1 / 2) \times 5 \times(130 / 9) m$
$=325 / 9 \mathrm{~m}$
$=36.11 \mathrm{~m}$

Distance Travelled by second car before coming to rest=Area of $\triangle O C D$
$=(1 / 2) \times O D \times O A$
$=(1 / 2) \times 10 s \times 3 \mathrm{kmh}^{-1}$
$=(1 / 2) \times 10 \times(3 \times 1000) / 3600) m$
$=(1 / 2) \times 10 \times(5 / 6) \mathrm{m}$
$=5 \times(5 / 6) \mathrm{m}$
$=25 / 6 \mathrm{~m}=4.16 \mathrm{~m}$
$\therefore$ Clearly the first car will travel farther ( 36.11 m ) than the first car ( 4.16 m ).
6. Fig 8.11 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? Fig. 8.11
(c) How far has $C$ travelled when $B$ passes $A$ ?
(d) How far has B travelled by the time it passes C?

Ans.

(a) It is clear from graph that $B$ covers more distance in less time. Therefore, $B$ is the fastest.
(b) All of them never come at the same point at the same time.
(c) According to graph; each small division shows about 0.57 km .

A is passing $B$ at point $S$ which is in line with point $P$ (on the distance axis) and shows about 9.14 km

Thus, at this point C travels about
$9.14-(0.57 \times 3.75) \mathrm{km}=9.14 \mathrm{~km}-2.1375 \mathrm{~km}=7.0025 \mathrm{~km} \approx 7 \mathrm{~km}$

Thus, when A passes B, C travels about 7 km .
(d) B passes C at point Q at the distance axis which is $\approx 4 \mathrm{kn}+0.57 \mathrm{~km} \times 2.25=5.28 \mathrm{~km}$

Therefore, B travelled about 5.28 km when passes to C.
7. A ball is gently dropped from a height of $\mathbf{2 0} \mathbf{~ m}$. If its velocity increases uniformly at the rate of 10 ms -2, with what velocity will it strike the ground? After what time will it strike the ground?

Ans. Let us assume, the final velocity with which ball will strike the ground be 'v' and time it takes to strike the ground be 't'

Initial Velocity of ball $u=0$

Distance or height of fall $s=20 \mathrm{~m}$

Downward acceleration $a=10 \mathrm{~m} \mathrm{~s}^{-2}$

As we know, $v^{2}=u^{2}-2 a s$
or, $2 a s=v^{2}-u^{2}$
$v^{2}=2 a s+u^{2}$
$=2 \times 10 \times 20+0$
$v=\sqrt{400} \mathrm{~ms}^{-1}$
$\therefore$ Final velocity of ball, $v=20 \mathrm{~ms}^{-1}$
$t=(v-u) / a$
$\therefore$ Time taken by the ball to strike= $(20-0) / 10$
$=20 / 10$
$=2$ seconds
8. The speed-time graph for a car is shown is Fig. 8.12.


Fig. 8.12
(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?

Ans.

(a) Distance travelled by car in the 4 second

The area under the slope of the speed - time graph gives the distance travelled by an object.
In the given graph

56 full squares and 12 half squares come under the area slope for the time of 4 second.
Total number of squares $=56+12 / 2=62$ squares
The total area of the squares will give the distance travelled by the car in 4 second. on the time axis,

5 squares $=2$ seconds, therefore 1 square $=2 / 5$ seconds
on speed axis there are 3 squares $=2 \mathrm{~m} / \mathrm{s}$
therefore, area of one square $=2 / 5 s \times 2 / 3 m / s=4 / 15 m$
so area of 62 squares $=4 / 15 m \times 62=248 / 15 m=16.53 m$
Hence the car travels 16.53 m in the first 4 seconds.
(b) The straight line part of graph, from point A to point B represents a uniform motion of car.
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.

Ans. (a) An object with a constant acceleration can still have the zero velocity. For example, an object which is at rest on the surface of earth will have zero velocity but still being acted upon by the gravitational force of earth with an acceleration of $9.81 \mathrm{~ms}^{-2}$ towards the center of earth. Hence when an object starts falling freely can have constant acceleration but with zero velocity.
(b) When an athlete moves with a velocity of constant magnitude along the circular path, the only change in his velocity is due to the change in the direction of motion. Here, the motion of the athlete moving along a circular path is, therefore, an example of an accelerated motion where acceleration is always perpendicular to direction of motion of an object at a given instance. Hence it is possible when an object moves on a circular path.
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. Let us assume An artificial satellite, which is moving in a circular orbit of radius 42250 km covers a distance 's' as it revolve around earth with speed 'v' in given time 't' of 24 hours.
$=42250 \mathrm{~km}$

Radius of circular orbit $r$
$=42250 \times 1000 \mathrm{~m}$ Time taken by artificial satellite $t=24$ hours
$=24 \times 60 \times 60 s$ Distance covered by satellite $s=$ circumference of circular orbit
$=2 \pi r$
$\therefore$ Speed of sattellite $\mathrm{v}=(2 \pi \mathrm{r}) / \mathrm{t}$
$=\frac{[2 \times(22 / 7) \times 42250 \times 1000]}{(24 \times 60 \times 60)}$
$=\frac{(2 \times 22 \times 42250 \times 1000)}{(7 \times 24 \times 60 \times 60) \mathrm{ms}^{-1}}$
$=3073.74 \mathrm{~m} \mathrm{~s}^{-1}$
$=3.073 \mathrm{~km} / \mathrm{s}$
13. The position of a body at different times are recorded in the table given below:

| Time (s) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Displacement <br> $(\mathrm{m})$ | 0 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |

(a) Draw the displacement time graph for the above data?
(b) What is the slope of graph?

What is the speed of the motion?
Ans. (a)

(b) Slope of the graph $=\frac{y_{2}-y_{1}}{x_{2}-x_{1}}$
$=\frac{(36-24) m}{(6-4) \mathrm{sec}}=\frac{12 m}{2 \mathrm{sec}}=6 \mathrm{~m} / \mathrm{sec}$
(c) Slope of the graph of a displacement-time graph = speed

Hence speed $=6 \mathrm{~m} / \mathrm{sec}$

