Chapter-7
Motion

EXERCISE-7.1
1 mark

1. 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. Both a as well as b are false with respect to concept of displacement.

2. Distinguish between speed and velocity.
Ans. Speed of a body is the distance travelled by it per unit time while velocity is displacement per unit time of the body during movement.

3. Under what conditions is the magnitude of average velocity of an object equal to its average speed?
Ans. If distance travelled by an object is equal to its displacement then the magnitude of average velocity of an object will be equal to its average speed.

4. What does the odometer of an automobile measure?
Ans. The odometer of an automobile measures the distance covered by that automobile.

5. What does the path of an object look like when it is in uniform motion?
Ans. Graphically the path of an object will be linear i.e. look like a straight line when it is in uniform motion.

EXERCISE-7.2
2 mark

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

Ans. Yes, if an object has moved through a distance it can have zero displacement because displacement of an object is the actual change in its position when it moves from one position to the other. So if an object travels from point A to B and then returns back to point A again, the total displacement is zero.

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?

Ans. Distance covered by farmer in 40 seconds $= 4 \times (10)m = 40$ m

Speed of the farmer = distance/time = 40m/40s = 1 m/s.

Total time given in the question = 2min 20seconds = 60+60+20 =140 seconds

Since he completes 1round of the field in 40seconds so in he will complete 3rounds in 120seconds 2mins or 120m distance is covered in 2minutes. In another 20seconds will cover another 20m so total distance covered in 2min20sec = 120 +20 =140m.

Displacement $= \sqrt{10^2 + 10^2} \ 200 = 10\sqrt{2}$ m as per diagram $= 10 \times 1.414 = 14.14$ m.
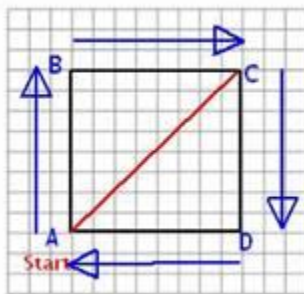
3. When will you say a body is in
i uniform acceleration?
ii non-uniform acceleration?

Ans. i uniform acceleration: When an object travels in a straight line and its velocity changes by equal amount in equal intervals of time, it is said to have uniform acceleration.

ii non uniform acceleration: It is also called variable acceleration. When the velocity of an object changes by unequal amounts in equal intervals of time, it is said to have non uniform acceleration.

4. A bus decreases its speed from $80km\ h^{-1}$ to $60km\ h^{-1}$ in 5 s. Find the acceleration of the bus.

Ans. Initial speed of bus u $= 80km\ h^{-1} = 80 \times 1000 / 60 \times 60 seconds = 200/9 ms^{-1}$ $= 22.22\ ms^{-1}$ final speed of bus v= $60km\ h^{-1} = 60 \times 1000 / 60 \times 60 seconds = 50/3\ ms^{-1}$ $= 16.67\ ms^{-1}$ time t = 5 s

acceleration a = v − u /t = 16.67 − 22.22/5 = -5.55/5 = $-1.11\ m/s^2$

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

Ans. Since the train starts from restrailway station = u = zero
Final velocity of train $= v = 40\ km\ h^{-1}$

$= (40 \times 1000)/60 \times 60\ ms^{-1}$
$= 100/9\ ms^{-1}$
$= 11.11\ ms^{-1}$

time t = 10 min $= 10 \times 60 = 600$ seconds

Since a = v − u /t $= 11.11\ ms^{-1}/600sec = 0.018\ m/s^2$

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

Ans. If an object has a uniform motion then the nature of distance time graph will be linear i.e. it would a straight line and if it has non uniform motion then the nature of distance time graph is a curved line.

5. 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 object's distance time graph is a straight line parallel to the time axis indicates that with increasing time the distance of that object is not increasing hence the object is at rest i.e. not moving.

Distance-time graph of an object at rest
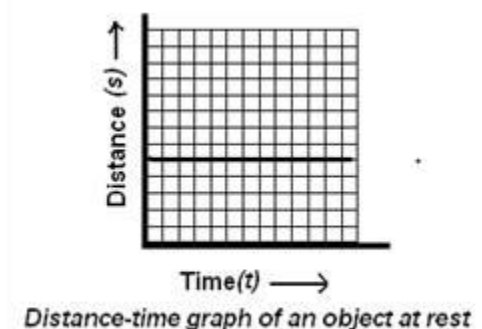
6. What can you say about the motion of an object if its speed time graph is a straight line parallel to the time axis?

Ans. Such a graph indicates that the object is travelling with uniform velocity.

Speed-time graph of an object moving with uniform speed
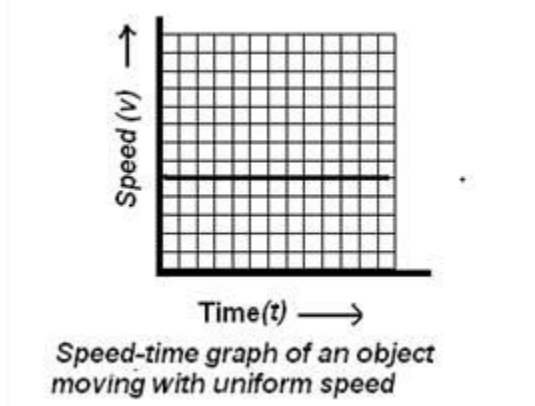
EXERCISE-7.3
4 mark

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

Ans. The area occupied below the velocity-time graph measures the distance moved by any object.

2. A bus starting from rest moves with a uniform acceleration of 0.1m s^{-2} for 2 minutes. Find athe speed acquired, b the distance travelled.

Ans. a u=o, $a = 0.1 ms^{-2}$, t= 2min = 120 seconds.

v=u+at $= 0 + 0.1 \times 120 = 12 ms^{-1}$

so a speed acquired = $v = 12 ms^{-1}$

b $s = ut + \frac{1}{2} at^2 = 0 \times 120 + \frac{1}{2} 0.1 \times 120^2 = 720$ m.

3. A train is travelling at a speed of 90 km h^{-1}. Brakes are applied so as to produce a uniform acceleration of $- 0.5 \text{ m s}^{-2}$. Find how far the train will go before it is brought to rest.

Ans. $u = 90 \, km \, h^{-1} = (90 \times 1000)/ 60 \times 60 = 25 ms^{-1}$

$a = -0.5 \, m \, s^{-2}$, v =0train is brought to rest

v= u+at $= 25 + (-0.5) \times t$

0 =25 – 0.5 x

0.5t = 25, or t = 25/0.5 = 50seconds

$s = ut + \frac{1}{2} at^2 = 25 \times 50 + \frac{1}{2} \times (-0.5) \times 50^2$

= 1250 – 625 = 625m

4. 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. $u = 0, a = 2cm/s^2$, t= 3s

v= u +at $= 0+ 2\times3 = 6$ cm/s

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

Ans. u = 0, $a = 4m/s^2$, t= 10 s

$s = ut + \frac{1}{2} at^2 = 0\times10+\frac{1}{2}\times4\times10^2 = 200$ m

6. A stone is thrown in a 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. $u = 5 \, m \, s^{-1}, a = -10 \, m \, s^{-2}$

v = 0 since at maximum height its velocity will be zero

v = u + at $= 5+(-10)\times t$

0 = 5 – 10t

10t = 5, or, t = 5/10 =0.5second.

$s = ut + \frac{1}{2} at^2 = 5\times0.5+\frac{1}{2}\times(-10)\times0.5^2$

= 2.5 – 1.25 = 1.25m

EXERCISE-7.4
Frequently Asked 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?
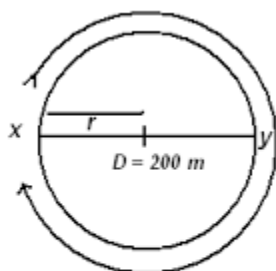
Ans. circumference of circular track $= 2\pi r$

$= 2 \times 22/7 \times diameter / 2$

$= 2 \times 22/7 \times 200/2 = 4400/7$ m

rounds completed by athlete in 2min20sec $=$ s$= 140/40 = 3.5$

therefore, total distance covered $= 4400/7 \times 3.5 = 2200$ m

Final Position of athlete after 3 1/2 round
=XY = Diameter of circle = 200 m

Since one complete round of circular track needs 40s so he will complete 3 rounds in 2mins and in next 20s he can complete half round therefore displacement $=$ diameter $= 200$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 = 300m

time = 2min30seconds = 150 seconds

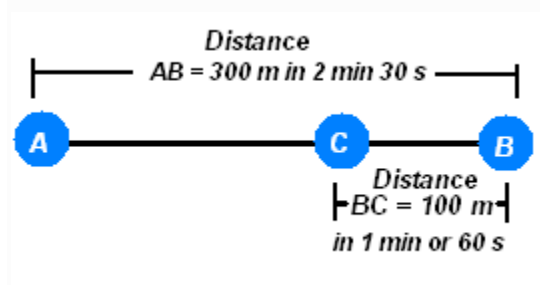average speed from A to B = average velocity from A to B

= 300m/150s = 2m/s

b average speed from A to C = 300+100m/150+60sec

= 400m/210s = 1.90m/s

displacement from A to C = 300 – 100m =200m

time =2min30sec + 1min = 210s

velocity = displacement/time = 200m/210s = 0.95m/s

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** 40 km h^{-1} **. What is the average speed for Abdul's trip?**

Ans. If we suppose that distance from Abdul's home to school = x kms

while driving to school :-

$speed = 20 \text{ km } h^{-1}$,

velocity = displacement/time

$20 = x/t$, or, $t=x/20$ hr

on his return trip :-

speed $= 40$ km h^{-1},
$40= x /t'$

or, $t' =x/40$ hr

total distance travelled $= x + x = 2x$

total time $= t + t' = x/20 + x/40 =2x + x/40 = 3x/40$ hr

average speed for Abdul's trip $= 2x/3x/40 = 80x/3x = 26.67$km/hr

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. since the motorboat starts from rest so u= 0

time t = 8s, $a = 3m/s^2$

distance $(s) = ut + \frac{1}{2}at^2 = 0+\frac{1}{2}\times 3\times 8^2 = 96$m

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?

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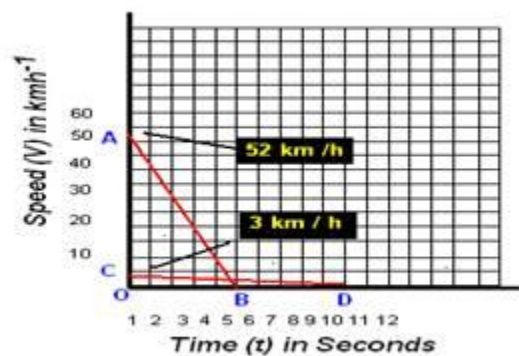
As given in the figure below AB in red line and CDin red line are the Speed-time graph for given two cars with initial speeds $52\ kmh^{-1}$ and $3\ kmh^{-1}$ respectively.

Distance Travelled by first car before coming to rest =Area of ΔOAB

$= (1/2) \times OB \times OA$

$= (1/2) \times 5\,s \times 52\ kmh^{-1}$

$= (1/2) \times 5 \times (52 \times 1000)/3600)\,m$

$= (1/2) \times 5 \times (130/9)\ m$

$= 325/9\ m$

$= 36.11\ m$

Distance Travelled by second car before coming to rest =Area of ΔOCD

$= (1/2) \times OD \times OA$

$= (1/2) \times 10\,s \times 3\ kmh^{-1}$

$= (1/2) \times 10 \times (3 \times 1000)/3600)\ m$

$= (1/2) \times 10 \times (5/6)\ m$

$= 5 \times (5/6)\ m$

$= 25/6\ m$

$= 4.16\ m$

∴ Clearly the first car will travel farther 36.11 m than the first car 4.16 m.

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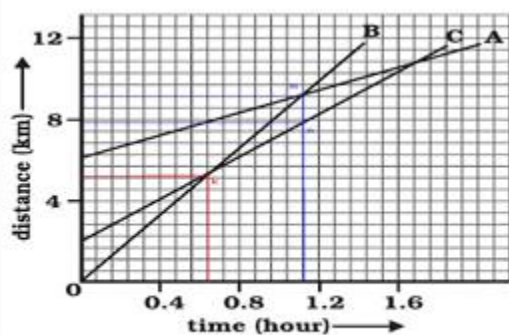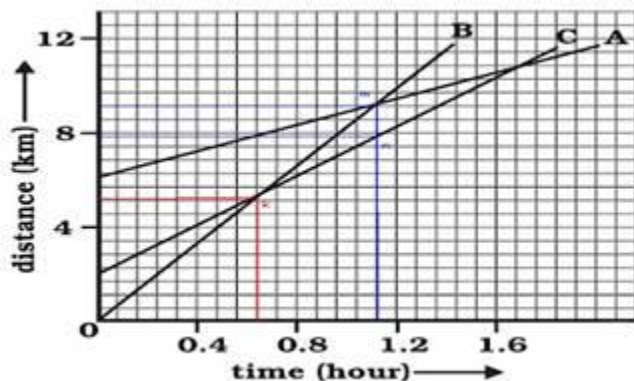

Fig. 8.11

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 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

$9.14 - (0.57 \times 3.75)$ km = 9.14 km – 2.1375 km = 7.0025 km $\approx 7\ km$

Thus, when A passes B, C travels about 7 km.

d B passes C at point Q at the distance axis which is $\approx 4km + 0.57km \times 2.25 = 5.28\ km$
Therefore, B travelled about 5.28 km when passes to C.