CHAPTER 1 MOTION

Page No:19

Solution 1:
No, displacement is a vector quantity.

Solution 2:
Distance is a scalar quantity.

Solution 3:
6 m/s
= 6 x (3600/1000) km/hr = 21.6km/hr

Solution 4:
Speed of a body in a specified direction is called velocity.

Solution 5:
(a) Motion of a bus on a road
(b) Motion of a racing horse

Solution 6:
Speed is defined as the distance travelled per unit time.

Solution 7:
(a)The speedometer of a car measures instantaneous speed of the car.

(b)Odometer is a device used to record the distance travelled by the car.

Page No:20

Solution 8:
Speed gives an idea of how slow or fast a body is moving.

Solution 9:
When the body comes back to its starting point, it has zero resultant displacement but covers a certain non-zero distance.

Solution 10:
In addition to speed, we should know the direction in which the body is moving.

Solution 11:
When a body covers equal distances in equal intervals of time in a particular

direction however small or big the time interval may be, the object is said to have uniform velocity.

Solution 12:
When the object moves in a single straight line, t he magnitude of average velocity equal to average speed.

Solution 13:
Average velocity of a moving body can be zero.

Solution 14:
Motion of a boy from his home to shop (in one direction) and back to home (in its reverse direction) is an example of a situation in which a body has a certain average speed but its average velocity is zero.

Solution 16:
When a body is moving with uniform velocity, its acceleration is zero.

Solution 16:
Negative acceleration is also called retardation.

Solution 17:
(a) Speed (or Velocity)
(b) Acceleration

Solution 18:
Uniformly accelerated motion

Solution 19:
S.I. unit of retardation is m/s^2.

Solution 20:
(a) vector, scalar
(b) velocity
(c) acceleration, second, velocity, 3m/s
(d) displacement, m/s
(e) velocity, m/s^2

Solution 21:
A freely falling body has non-uniform motion because it covers smaller distances in the initial ‘1 second’ intervals and larger distances in the later ‘1 second’ intervals, i.e., it covers unequal distances in equal intervals of time.

2:
Speed is a scalar quantity as it has magnitude only, it has no specified direction.

Solution 23:
For bus X,
Speed= Distance/Time
Speed=360/5=72km/h
For bus Y,
Speed= Distance/Time
Speed=476/7=68 km/h
Speed of bus X is more than that of bus Y. Hence, bus X travels faster.

Solution 24:
Speed of athelete = 10 m/s
Speed of bicycle = 200 m/min = 200/60 m/s = 3.33 m/s
Speed of scooter = 30 km/h = 30000/3600 m/s = 8.33 m/s
3.33 m/s < 8.33 m/s < 10 m/s
i.e. 200 m/min < 30 km/h < 10 m/s

Solution 25:
(a) $\text{Acceleration} = \dfrac{\text{Final velocity} - \text{Initial velocity}}{\text{Time taken}}$

$$a = \frac{v - u}{t}$$

(b) u = 0 m/s
v = 21 m/s
Time, t = 1 min = 60 sec

$$a = \frac{v - u}{t}$$

$$a = \frac{21 - 0}{60}$$

$$a = \frac{21}{60} = 0.35 m/s^2$$

Solution 26:
(a) Acceleration

(b) Retardation

(c) f a body takes a round trip such that its final position is same as the starting position, then the displacement of the body is zero but the distance travelled is non-zero.

Solution 27:
Average speed = Total distance travelled/ Total time taken
Total distance travelled = 100m = 0.1 km; Total time taken = 50 hr
Average speed= 0.1/50=0.002km/h

Page No:21

Solution 28:
Total distance=100m =0.1 km
Total time taken=15 minutes= 15/60=0.25 hour
Average speed = Total distance travelled/ Total time taken
=0.1/0.25= 0.4km/h

Solution 29:
Total distance travelled =100m
Total time taken = 9.83 sec
Average speed = Total distance travelled/ Total time taken
=100/9.83 =10.172m/s
Averge speed in km/h:
10.172 x(3600/1000)=36.62 km/h

Solution 30:

Speed from A to B= 30km/h

Let the distance from A to B be D.

Time taken to travel from A to B, $T_1 = \frac{\text{Distance travelled}}{\text{Speed}}$

$$T_1 = \frac{D}{30}$$

Speed from B to A=20 km/h

Time taken to travel from B to A, $T_2 = \frac{\text{Distance travelled}}{\text{Speed}} = \frac{D}{20}$

Total time taken ,$T = T_1 + T_2 = \frac{D}{30} + \frac{D}{20} = \frac{D}{12}$

Total distance from A to B and from B to A =2D

Average speed $= \frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{2D}{\frac{D}{12}} = 24 km/h$

Solution 31:

Initial velocity= 0m/s

Final velocity=6m/s

Time=3 sec

Initial velocity= 0m/s

Final velocity=6m/s

Time=3 sec

Acceleration$= \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time taken}}$

$$= \frac{(6-0)}{3} = \frac{6}{3} = 2\ m/sec^2$$

Solution 32:

Initial velocity, u = 600 km/h

Final velocity, v = 1100 km/h

Acceleration = 10 km/h/s = 600 km/h^2

From relation, a = (v-u)/t

t = (v-u)/a

t = (1100-600)/600 = 500/600 = 5/6 hr = 50 sec

Solution 33:

Deceleration, a=-5m/s^2

Initial velocity, u=20m/s

Final velocity, v=0m/s
t=?

Deceleration, a=-5m/s^2
Initial velocity, u=20m/s
Final velocity, v=0m/s
t=?

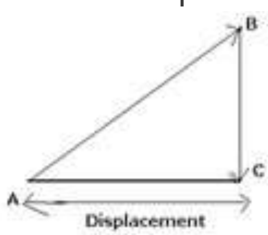
$$a = \frac{v-u}{t}$$

$$-5 = \frac{0-20}{t}$$

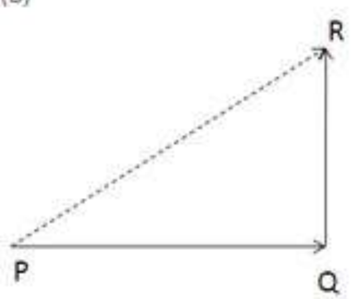
$$t = \frac{20}{5} = 4s$$

Solution 34:

(a) Distance travelled is the actual length of the indirect path covered by the body whereas displacement refers to the straight line path between the initial and final positions. For e.g. In the figure given below, a body moves from point A to point B and then from point B to point C. Here, the distance travelled by the body is AB + BC and displacement is AC.



(b)



PQ=8cm
QR=6 cm
Resultant Displacement PR = $\sqrt{8^2+6^2} = \sqrt{100} = 10cm$

Solution 35:
A body is said to be in motion when its position changes continuously with respect to a stationary object taken as reference point.
A body has uniform motion if it travels equal distances in equal intervals of time, no matter how small these time intervals may be. For example: a car running at a constant speed of 10m/s, will cover equal distance of 10m every second, so its motion will be uniform.
Non-uniform motion: A body has a non-uniform motion if it travels unequal distances in equal intervals of time. For example: dropping a ball from the roof of a tall building.

Solution 36:
(a) Speed of a body is the distance travelled by it per unit time. The SI unit of speed is m/s.

(b) (i) Average speed of a body is the total distance travelled divided by the total time taken to cover this distance.
(ii) Uniform speed refers to the constant speed of a moving body. A body has a uniform speed if it travels equal distance in equal intervals of time, no matter how small these time intervals may be.

Solution 37:
(a) Velocity of a body is the distance travelled by it per unit time in a given direction. SI unit of velocity is m/s.

(b)(i)Speed is a scalar quantity whereas velocity is a vector quantity.
(ii) Speed of a body is distance travelled by it per unit time whereas velocity of a body is the distance travelled by it per unit time in a given direction.
(iii)Speed is always positive whereas velocity can be both positive as well as negative.

(c) Speed = 54km/h = 54 x (1000/3600) = 15m/s

Solution 38:
(a) Acceleration of a body is defined as the rate of change of its velocity with time. SI unit of acceleration is m/s^2.
(b) A body has uniform acceleration if it travels in a straight line and its velocity

increases by equal amounts in equal intervals of time. For example: Motion of a freely falling body.

Solution 39:

Total distance = 200 km

Average speed = 70 km/h

$$\text{Total time taken} = \frac{\text{Total distance}}{\text{Average speed}} = \frac{200}{70} = \frac{20}{7}\text{h}$$

For first part of the journey,

Distance = 100 km

Speed = 50 km/h

$$\text{Time taken, } t_1 = \frac{100}{50} = 2\text{h}$$

For second part of the journey,

Distance = 100 km

Speed = x km/h

$$\text{Time taken, } t_2 = \frac{100}{x}\text{h}$$

$$t_1 + t_2 = \frac{20}{7}$$

$$2 + \frac{100}{x} = \frac{20}{7}$$

$$\frac{100}{x} = \frac{6}{7}$$

$$700 = 6x$$

$$\Rightarrow x = 116.6\text{km/h}$$

Solution 40:

(i) In the first part, train travels at a speed of 30 km/h for a distance of 15 km.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$t_1 = \frac{15}{30} = \frac{1}{2}\text{h}$$

(ii) In the second part, train travels at a speed of 50 km/h for a distance of 75 km.

$$t_2 = \frac{75}{50} = \frac{3}{2}\text{h}$$

(iii) In the third part, train travels at a speed of 20 km/h for a distance of 10 km.

$$t_3 = \frac{10}{20} = \frac{1}{2}\text{h}$$

Total distance covered= 15+75+10=100 km

$$\text{Total time taken} = \frac{1}{2} + \frac{3}{2} + \frac{1}{2} = \frac{5}{2}\text{h}$$

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{100}{5/2} = 40\text{km/h}$$

Solution 41:

(a) Average speed, $v_{av} = \frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{150}{5} = 30\,\text{m/s}$

(b) Time=1s

Distance = v_{av} x time = $30 \times 1 = 30\,\text{m/s}$

(c) Time=6s

Distance = v_{av} x time = $30 \times 6 = 180\,\text{m/s}$

(d) Distance=240m

$$\text{Time} = \frac{\text{Distance}}{v_{av}} = \frac{240}{30} = 8\,\text{s}$$

Page No:22

Solution 55:

Distance travelled in half a rotation of a circular path is equal to the circumference of semi-circle, i.e.,

Distance travelled in half a rotation of a circular path is equal to the circumference of semi-circle, i.e., $= \pi R$.

Displacement= diameter of circle= 2R

Solution 56:
(i) Distance travelled = 6 km
(ii) Displacement = zero(since final position is same as initial position)

Solution 57:
(i) Total distance travelled= 3 + 4 +9=16 km
(ii) The body travels a total distance of 12 km in east direction i.e. towards x-axis. And it travels a distance of 4 km in North direction, i.e. towards y-axis. Hence, resultant displacement is

(i) Total distance travelled= 3 + 4 +9=16 km
(ii) The body travels a total distance of 12 km in east direction i.e. towards x-axis.
And it travels a distance of 4 km in North direction, i.e. towards y-axis.
Hence, resultant displacement is

$$= \sqrt{12^2 + 4^2} = \sqrt{144+16} = \sqrt{160} = 12.6 km$$

Solution 58:
(a) Total distance covered in going to the bookshop and coming back to the classroom = 20 + 20 = 40m
Total time taken= 25 + 25 = 50 sec

(a) Total distance covered in going to the bookshop and coming back to the classroom = 20 + 20 = 40m
Total time taken= 25 + 25 = 50 sec

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{40}{50} = 0.8 \, m/s$$

$$\text{(b) Average velocity} = \frac{\text{Total displacement}}{\text{Total time}} = \frac{0}{50} = 0 \, m/s$$

Solution 59:
In the first case, car travels at a speed of 60 km/h for a distance of 100 km
In the second case, car travels at a speed of 40 km/h for a distance of 100 km

Total distance travelled = 200 km

In the first case, car travels at a speed of 60 km/h for a distance of 100 km

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$t_1 = \frac{100}{60}h$$

In the second case, car travels at a speed of 40 km/h for a distance of 100 km

$$t_2 = \frac{100}{40}h$$

Total distance travelled = 200 km

$$\text{Total time taken} = \frac{100}{60} + \frac{100}{40}$$

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

$$= \frac{200}{\frac{100}{60} + \frac{100}{40}} = \frac{2}{\frac{1}{60} + \frac{1}{40}}$$

$$= \frac{240}{5} = 48km/h$$

Solution 60:

Initial velocity, u=6m/s

Final velocity ,v=-4.4m/s(the ball rebounds in opposite direction)

Time, t = 0.040 s

Initial velocity, u=6m/s

Final velocity ,v=-4.4m/s (the ball rebounds in opposite direction)

Time, t = 0.040 s

$$\text{Acceleration velocity} = \frac{u-v}{t} = \frac{-4.4-6}{0.040} = -260m/s^2$$

Page No:39

Solution 1:

(a)Speed

(b)Direction of motion

Solution 2:

No, earth moves round the sun with uniform speed, but its velocity changes continuously.

Solution 3:
The motion is accelerated.

Solution 4:
It represents uniform velocity.

Solution 5:
Distance travelled by the moving body .

Solution 6:
The slope of a speed-time graph indicates acceleration.

Solution 7:
The slope of a distance-time graph indicates speed.

Solution 8:
Motion of moon around the earth.

Solution 9:
Uniform circular motion.

Solution 10:
The Speed of the body is constant or uniform.

Page No:40

Solution 11:
The body has uniform speed.

Solution 12:
The body is not moving. It is stationary.

Solution 13:
It represents non-uniform acceleration.

Solution 14:
It is accelerated motion as the velocity is changing continuously.

Solution 15:
The tip of the 'seconds' hand' of a watch represents uniform circular motion. It is an accelerated motion.

Solution 16:
(a) zero
(b) speed
(c) acceleration
(d) distance travelled
(e) circular path

Page No:41

Solution 17:
Yes, uniform circular motion is accelerated because the velocity changes due to continuous change in the direction of motion.

Solution 18:
The speed of a body moving along a circular path is given by the formula:
where, v= speed
=3.14 (it is a constant)
r = radius of circular path
t= time taken for one round of circular path

The speed of a body moving along a circular path is given by the formula:

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

where, v= speed
π=3.14 (it is a constant)
r= radius of circular path
t= time taken for one round of circular path

Solution 19:
The motion of a body which is moving with constant speed in a circular path is said to be accelerated because its velocity changes continuously due to the continuous change in the direction of motion.

Solution 20:
Uniform linear motion is uniform motion along a linear path or a straight line. T he direction of motion is fixed. So, it is not accelerated. For e.g.: a car running with uniform speed of 10km/hr on a straight road.
Uniform circular motion is uniform motion along a circular path. T he direction of motion changes continuously. So, it is accelerated. For e.g.: motion of earth around the sun.

Solution 21:
An important characteristic of uniform circular motion is that the direction of

motion in it changes continuously with time, so it is accelerated.
Centripetal force brings about uniform circular motion.

Solution 22:
Initial velocity, u=?
Final velocity, v=0m/s (car is stopped)
Retardation, a=-2.5 m/s^2
Time, t=10s
v=u + at
0=u +(-2.5)x 10
u=25m/s

Solution 23:
The velocity of this body is increasing at a rate of '10 metres per second' every second.
Initial velocity, u=0m/s
Time, t=2s
Acceleration, a=10m/s^2

The velocity of this body is increasing at a rate of '10 metres per second' every second.
Initial velocity, u=0m/s
Time, t=2s
Acceleration, a=10m/s^2
Using, $s = ut + \frac{1}{2}at^2$

$= 0 \times 2 + \frac{1}{2} \times 10 \times 2 \times 2$

$= 0 + 20 = 20$ m

Solution 24:
Initial velocity, u=5m/s
Final velocity, v=?
Acceleration, a=0.2m/s^2
Time, t=10 sec
Using , v=u + at
v=5 + 0.2 x 10
v=5 + 2 =7 m/s

Now distance travelled in time is calculated;

Initial velocity, u=5m/s
Final velocity, v=?
Acceleration, $a=0.2 m/s^2$
Time, t=10 sec
Using, $v=u+at$
$v=5+0.2 \times 10$
$v=5+2=7$ m/s
Now distance travelled in time is calculated;

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

$$s = 5\times10 + \frac{1}{2} \times 0.2\times10\times10$$

$$s = 50 + 10 = 60 \text{ m}$$

Solution 25:
Initial velocity, u=18km/h
Final velocity, v=0m/s
Time, t=2.5 sec
Acceleration, a=?
Using , v= u + at

Initial velocity, u=18km/h

$$u = 18 \times \frac{1000}{3600} = \frac{18000}{3600} m/s = 5m/s$$

Final velocity, v=0m/s
Time, t=2.5 sec
Acceleration, a=?
Using , v= u + at

$$a = \frac{v-u}{t} = \frac{0-5}{2.5} = -2m/s^2$$

So, retardation is $2m/s^2$.
So, retardation is $2m/s^2$.

Solution 26:
Initial velocity, u=0m/s
Final velocity, v=?
Acceleration, $a=0.2 m/s^2$
Time, t=5min= 5 x60=300 sec
Using, v = u + at
v =0 + 0.2 x 300=60m/s

And the distance travelled is

Initial velocity, u=0m/s
Final velocity, v=?
Acceleration, $a=0.2\ m/s^2$
Time, t=5min= 5 x60=300 sec
Using, v = u + at
v =0 + 0.2 x 300=60m/s
And the distance travelled is

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

$$s = 0\times300 + \frac{1}{2}\times0.2\times300\times300$$

$$s = 0 + 9000 = 9000\ m = 9km$$

Solution 27:
(a) Distance and Time
(b) Speed (or velocity) and Time

Solution 28:
Initial velocity,
u=0m/s
Final velocity, v=?
Acceleration, $a=2m/s^2$
Time, t=10s
(a) Using,
v = u + at
v=0 + 2 x 10= 20 m/s

(b) Distance travelled is:

Initial velocity, u=0m/s
Final velocity, v=?
Acceleration, a=2m/s^2
Time, t=10s
(a) Using, v = u + at
v=0 + 2 x 10= 20 m/s
(b) Distance travelled is:

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

$$s = 0 \times 10 + \frac{1}{2} \times 2 \times 10 \times 10$$

$$s = 0 + 100 = 100 \text{ m}$$

Solution 29:
Initial velocity, u=20m/s
Time, t=30 s
Acceleration,
a=0.5m/s^2
Distance travelled is:

Initial velocity, u=20m/s
Time, t=30 s
Acceleration, a=0.5m/s^2
Distance travelled is:

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

$$s = 20 \times 30 + \frac{1}{2} \times 0.5 \times 30 \times 30$$

$$s = 600 + 225 = 825 \text{ m}$$

Solution 30:
Initial velocity, u=15m/s
Final velocity, v=0m/s
Distance, s=18m
Acceleration, a=?

So, deceleration is 6.25 m/s^2.

Initial velocity, u=15m/s
Final velocity, v=0m/s
Distance, s=18m
Acceleration, a=?

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

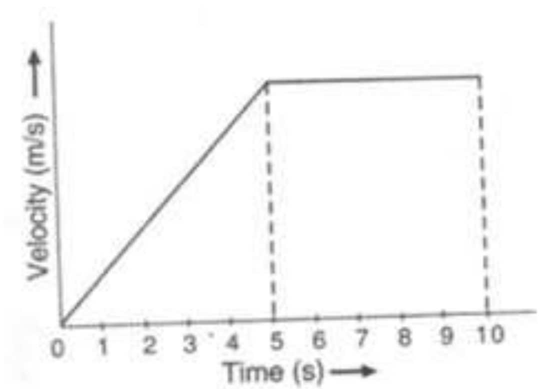
$$0^2 - (15)^2 = 2\,a \times 18$$

$$-225 = 36\,a$$

$$a = \frac{-225}{36} = -6.25 m/s^2$$

So, deceleration is 6.25 m/s^2.

Solution 31:



Solution 32:
(a) The train has a uniform velocity.

(b) There is no acceleration.

Solution 33:
(a) v=u + at is the first equation of motion. It gives the velocity acquired by a body in time t when the body has initial velocity u and uniform acceleration a.

(b)Initial velocity, u=0m/s
Time, t=5 s
Distance, s=100m

Acceleration, a=?

Time, t=5 s

Distance, s=100m

Acceleration, a=?

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

$$100 = 0 \times 5 + \frac{1}{2} \times a \times 5 \times 5$$

$$100 = 0 + \frac{25a}{2}$$

$$a = \frac{200}{25} = 8 m/s^2$$

Solution 34:

(a) Consider a body having initial velocity ‘u’. Suppose it is subjected to a uniform acceleration ‘a’ so that after time’t’ its final velocity becomes ‘v’. Now, from the definition of acceleration we know that:

(b) Initial velocity, u=54km/h= 15m/s

Final velocity, v=0m/s

Time, t=8s

Acceleration, a=?

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken}}$$

$$\text{or Acceleration} = \frac{\text{Final velocity- Initial velocity}}{\text{time taken}}$$

So, $a = \frac{v-u}{t}$

$at = v - u$

and, $v = u + at$

where v=final velocity of the body

u= initial velocity of the body

a= acceleration

and t= time taken

(b) Initial velocity, u=54km/h= 15m/s

Final velocity, v=0m/s

Time, t=8s

Acceleration, a=?

$$a = \frac{v-u}{t} = \frac{0-15}{8} = \frac{-15}{8} m/s^2 = -1.875 m/s^2$$

Solution 35:

(a) Suppose a body has an initial velocity ‘u’ and a uniform acceleration’ a’ for time ‘t’ so that its final velocity becomes ‘v’. Let the distance travelled by the body in this time be ‘s’. The distance travelled by a moving body in time ‘t’ can be found out by considering its average velocity. Since the initial velocity of the body is ‘u’ and its final velocity is ‘v’, the average velocity is given by:

(b) Initial velocity, u=0m/s
Final velocity, v=36km/h=10m/s
Time, t=10min =10 x 60=600 sec

$$\text{Average velocity} = \frac{\text{Initial velocity} + \text{Final velocity}}{2}$$

That is, $\text{Average velocity} = \frac{u + v}{2}$

Also, Distance travelled = Average velocity × Time

So, $s = \left(\frac{u + v}{2}\right) \times t$ ----------(1)

From the first equation of motion ,we have, $v = u + at$.

Put this value of v in equation (1), we get:

$$s = \left(\frac{u + u + at}{2}\right) \times t$$

or $s = \frac{(2u + at) \times t}{2}$

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

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

where, s= distance travelledby the body in time t
u = initial velocity of the body
and a= acceleration

$$\text{Acceleration} = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{time taken}}$$

So, $a = \frac{v-u}{t} = \frac{10-0}{600} = \frac{10}{600} m/s^2 = \frac{1}{60} m/s^2 = 0.016 m/s^2$

Solution 36:

(b) Initial velocity, u=0m/s
Final velocity, v=72km/h=20m/s
Time, t=10s

(i) $\text{Acceleration} = \frac{\text{Final velocity- Initial velocity}}{\text{time taken}}$

So, $a=\frac{v-u}{t}=\frac{20-0}{10}=\frac{20}{10}\,m/s^2=2m/s^2$

(ii) $\text{Average velocity} = \frac{\text{Initial velocity + Final velocity}}{2}$

$\text{Average velocity}=\frac{0+20}{2}=\frac{20}{2}m/s=10m/s$

(iii) Distance travelled = Average velocity × Time
= 10 m/s × 10s = 100m

Solution 37:

(a) When a body moves in a circular path with uniform speed (constant speed), its motion is called uniform circular motion. For e.g.
(i) Artificial satellites move in uniform circular motion around the earth.
(ii) Motion of a cyclist on a circular track.

(b) The speed of a body moving along a circular path is given by the formula:
Given, t=60 sec
Radius, r=10.5cm=0.105 m

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

Given, t=60 sec
Radius, r=10.5cm=0.105 m

$$v=\frac{2\pi r}{t}=\frac{2\times 22\times 0.105}{7\times 60}=\frac{4.62}{420}=0.011m/s$$

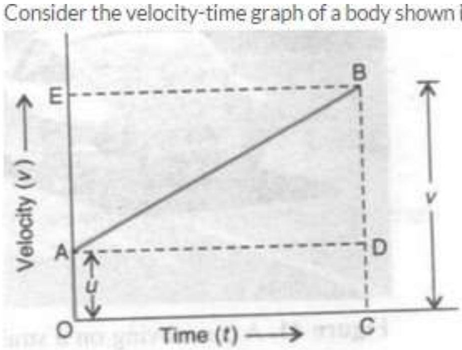
Page No:42

Solution 38:

Consider the velocity-time graph of a body shown in figure.
The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the

perpendicular from point B to OE.
Now, Initial velocity of the body, u= OA —–(1)
And, Final velocity of the body, v=BC ——(2)
But from the graph BC =BD + DC
Therefore, v=BD + DC ——(3)
Again DC = OA
So,v =BD + OA
Now, from equation (1), OA =u
So, v=BD + u ——(4)
We should find out the value of BD now. We know the slope of a velocity-time graph is equal to the acceleration, a.
Thus,Acceleration, a= slope of line AB
or a = BD/AD
But AD =OC= t, so putting t in place of AD in the above relation, we get:
or BD=at
Now, putting this value of BD in equation(4), we get:
v= u+ at

Consider the velocity-time graph of a body shown in figure.



The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.
Now, Initial velocity of the body, u= OA -----(1)
And, Final velocity of the body, v=BC ------(2)
But from the graph BC =BD + DC
Therefore, v=BD + DC ------(3)
Again DC = OA
So, v =BD + OA
Now, from equation (1), OA =u
So, v=BD + u ------(4)
We should find out the value of BD now. We know the slope of a velocity-time graph is equal to the acceleration, a.
Thus, Acceleration, a= slope of line AB
or a = BD/AD
But AD =OC= t, so putting t in place of AD in the above relation, we get:

$$a = \frac{BD}{t}$$

or BD=at
Now, putting this value of BD in equation(4), we get:
v= u+ at

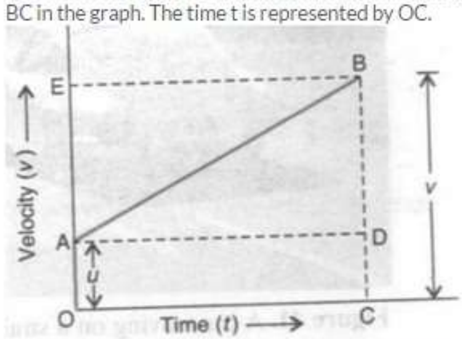
Solution 39:
Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A

to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC.
Suppose the body travels a distance s in time t. In the figure, the distance travelled by the body is given by the area of the space between the velocity-time graph AB and the time axis OC, which is equal to the area of the figure OABC.
Thus:
Distance travelled = Area of figure OABC
= Area of rectangle OADC + area of triangle ABD
Now, we will find out the area of rectangle OADC and area of triangle ABD.

(i) Area of rectangle OADC =OA x OC
= u x t
=ut

(ii) Area of triangle ABD= $(1/2)$x Area of rectangle AEBD
= $(1/2)$x AD x BD
= $(1/2)$x t x at
= $(1/2)$ at^2
Distance travelled, s = Area of rectangle OADC + area of triangle ABD

Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC.



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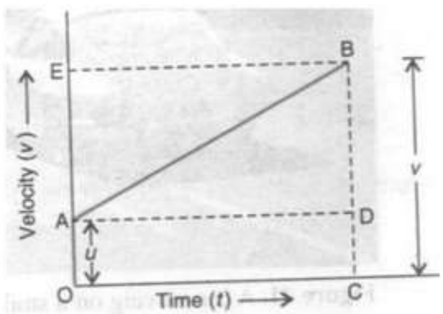
=$(1/2)$ x AD x BD
=$(1/2)$ x t x at
=$(1/2)at^2$
Distance travelled, s = Area of rectangle OADC + area of triangle ABD

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

Solution 40:
Consider the velocity-time graph of a body shown in figure. The body has an

initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.
The distance travelled s by a body in time t is given by the area of the figure OABC which is a trapezium.
Distance travelled, s= Area of trapezium OABC
Now, OA + CB = u + v and OC =t Putting these values in the above relation, we get:
Eliminate t from the above equation. This can be done by obtaining the value of t from the first equation of motion.



Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal to BC in the graph. The time t is represented by OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.
The distance travelled s by a body in time t is given by the area of the figure OABC which is a trapezium.
Distance travelled, s= Area of trapezium OABC

$$s = \frac{(\text{Sum of parallel sides}) \times \text{Height}}{2}$$

$$s = \frac{(OA + CB) \times OC}{2}$$

Now, OA + CB = u + v and OC =t Putting these values in the above relation, we get:

$$s = \left(\frac{u+v}{2}\right) \times t \qquad \text{----------(1)}$$

Eliminate t from the above equation. This can be done by obtaining the value of t from the first equation of motion.
Thus, v = u + at (first equation of motion)
And, at = v

Page No:43

Solution 53:
(i) The distance covered from A to B is(3-0) =3 cm
Time taken to cover the distance from A to B =(5 -2) =3s
(ii) The speed of the body as it moves from B to C is zero.
(iii) The distance covered from C to D is (7-3)=4 cm

Time taken to cover the distance from C to D = (9-7)=2s

(i) The distance covered from A to B is (3-0) =3 cm

Time taken to cover the distance from A to B =(5 -2) =3s

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Speed} = \frac{3\text{cm}}{3\text{sec}} = 1 \text{ cm/s}$$

(ii) The speed of the body as it moves from B to C is zero.

(iii) The distance covered from C to D is (7-3)=4 cm

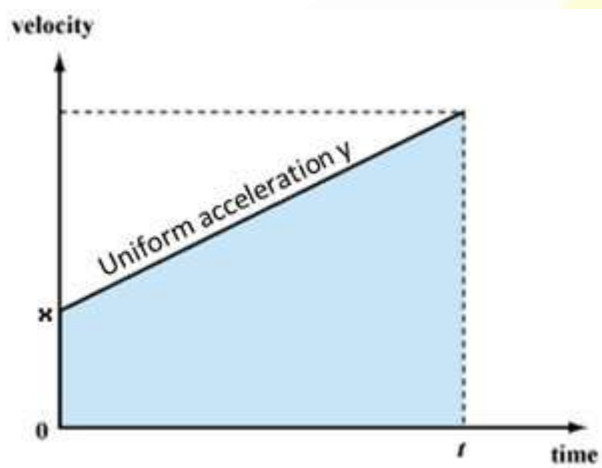
Time taken to cover the distance from C to D = (9-7)=2s

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{4\text{cm}}{2\text{ sec}} = 2\text{cm/s}$$

Solution 54:
(a) The body has a uniform velocity if its displacement-time graph is a straight line.

(b) The body has a uniform acceleration if its velocity-time graph is a straight line.

Solution 55:



Solution 56:
(i) BC represents uniform velocity. From graph, we see that the velocity of the body at point C = 40km/h
(ii) Acceleration between A and B = slope of line AB
(iii) BC represents uniform velocity, so acceleration acting on the body between B

and C is zero.

(i) BC represents uniform velocity. From graph, we see that the velocity of the body at point C = 40km/h
(ii) Acceleration between A and B = slope of line AB

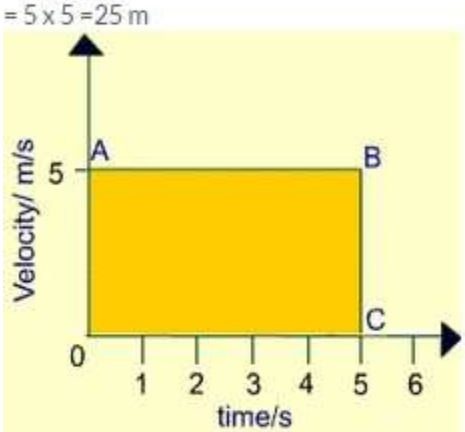
$= \frac{(40-20)km/h}{(3-0)h} = 6.66 km/h^2$

(iii) BC represents uniform velocity, so acceleration acting on the body between B and C is zero.

Solution 57:

Distance travelled = Area of rectangle OABC
= OA x OC
= 5 x 5 =25 m

Distance travelled = Area of rectangle OABC
= OA x OC
= 5 x 5 =25 m



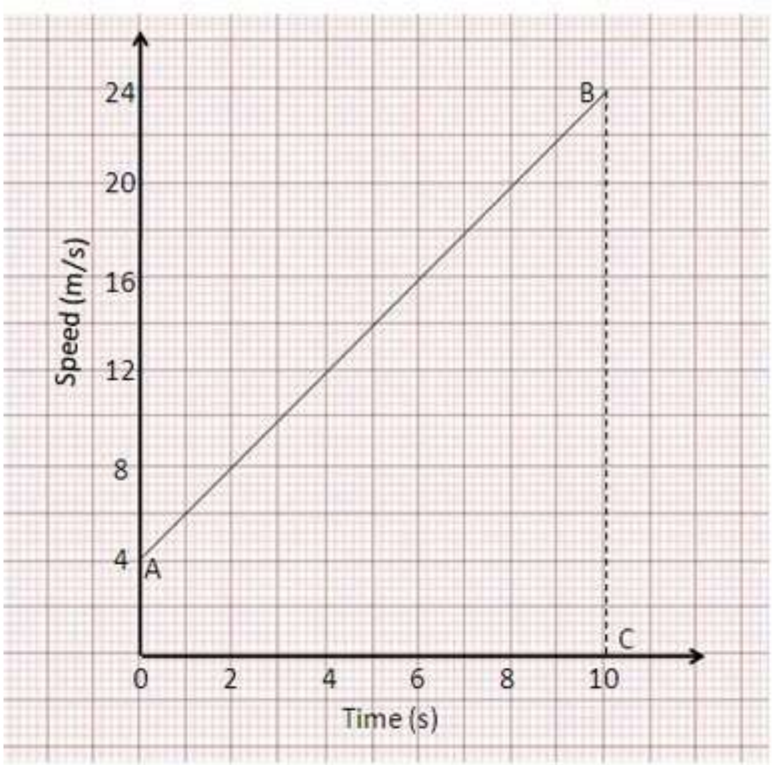
Solution 58:

(i) Acceleration during first two seconds $= \frac{4.6-0}{2-0} = 2.3 m/s^2$

(ii) Acceleration between second and tenth second is zero, since the velocity is constant during this time.

(iii) Acceleration during last two seconds $= \frac{0-4.6}{12-10} = -2.3 m/s^2$

Solution 59:



(i) Acceleration of the car = slope of line AB $= \frac{24-4}{10-0} = \frac{20}{10} = 2\,m/s^2$

(ii) Distance travelled by the car in 10 s = area of trapezium OABC

$$= \frac{1}{2} \times (OA + BC) \times OC$$

$$= \frac{1}{2} \times (4 + 24) \times 10 = 140\,m$$

Solution 60:

(i) Initial speed of the car=10km/h
(ii) Maximum speed attained by the car= 35km/h
(iii) BC represents zero acceleration.
(iv) CD represents varying retardation.

(v)

(i) Initial speed of the car=10km/h
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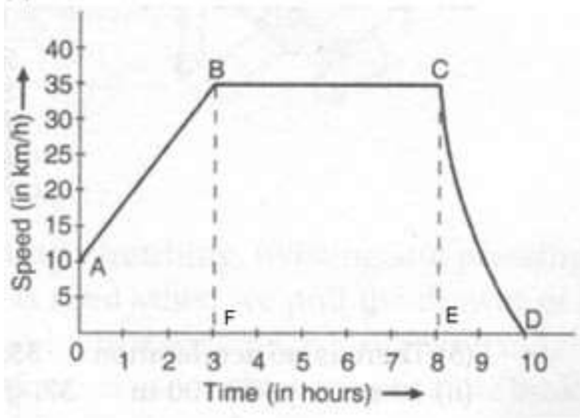
(v)



Distance travelled in first 8 hrs:

s=Area of trapezium OABF + Area of rectangle BCEF

$= \frac{1}{2} \times (OA + BF) \times OF + BF \times FE$

$= \frac{1}{2} \times (10 + 35) \times 3 + (35 \times 5)$

$= 67.5 + 175$

$= 242.5km$

Solution 61:

(i) Graph (c): The speedof the ball goes on decreasing uniformly as it moves upward, reaches zero at the highest point, and then increases uniformly as it moves downward.

(ii) Grap(a): The speed of the trolley decreases uniformly, then it moves at a constant speed, and then the speed increases uniformly.

Page No:44

Solution 62:

(i) OA represents uniform acceleration
(ii) AB represents constant speed.
(iii) BC represents uniform retardation.
(iv) Acceleration of car from O to A = slope of line OA
(v) Acceleration of car from A to B is zero as it has uniform speed during this time.

(vi) Retardation of car from B to C = slope of line BC

(i) OA represents uniform acceleration
(ii) AB represents constant speed.
(iii) BC represents uniform retardation.
(iv) Acceleration of car from O to A = slope of line OA

$$a = \frac{40-0}{10-0} = 4\,m/s^2$$

(v) Acceleration of car from A to B is zero as it has uniform speed during this time.
(vi) Retardation of car from B to C = slope of line BC

$$a = \frac{0-40}{50-30} = \frac{-40}{20} = -2\,m/s^2$$

Solution 63:
(i) Graph (a) represents uniform acceleration.
(ii) Graph (b) represents constant speed.
(iii) Graph (c) represents uniform retardation.
(iv) Graph (d) represents non-uniform retardation.

Solution 64:
Initial velocity, u=8m/s
Acceleration, a=1m/s2
Distance, s=18m

Initial velocity, u=8m/s
Acceleration, a=1m/s^2
Distance, s=18m
using relation, $v^2 = u^2 + 2as$

$$v^2 = (8)^2 + 2 \times 1 \times 18$$
$$v^2 = 64 + 36 = 100$$
$$v = \sqrt{100} = 10\,m/s$$

Solution 65:
Initial velocity, u=20m/s
Final velocity, v=0m/s
Distance, s=50m

Initial velocity, u=20m/s
Final velocity, v=0m/s
Distance, s=50m

using relation, $v^2 = u^2 + 2as$

$$0^2 = (20)^2 + 2 \times a \times 50$$
$$0^2 = 400 + 100a$$
$$-400 = 100a$$
$$a = \frac{-400}{100} = -4 m/s^2$$

The car's deceleration must be 4 m/s^2.

The car's deceleration must be 4 m/s^2.