Motion

Question 1:

Is displacement a scalar quantity ?

Solution :

No, displacement is a vector quantity.

Question 2:

State whether distance is a scalar or a vector quantity.

Solution :

Distance is a scalar quantity.

Question 3:

Change the speed of 6 m/s into km/h.

Solution :

6 m/s

= 6 x (3600/1000) km/hr = 21.6km/hr

Question 4:

What name is given to the speed in a specified direction ?

Solution :

Speed of a body in a specified direction is called velocity.

Question 5:

Give two examples of bodies having non-uniform motion.

Solution :

(a) Motion of a bus on a road

(b) Motion of a racing horse

Question 6:

Name the physical quantity obtained by dividing 'Distance travelled' by 'Time taken' to travel that distance.

Solution :

Speed is defined as the distance travelled per unit time.

Question 7:

What do the following measure in a car ?

(a) Speedometer (b) Odometer

Solution :

(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.

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Question 8:

Name the physical quantity which gives us an idea of how slow or fast a body is moving.

Solution :

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

Question 9:

Under what conditions can a body travel a certain distance and yet its resultant displacement be zero ?

Solution :

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

Question 10:

In addition to speed, what else should we know to predict the position of a moving body ?

Solution :

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

Question 11:

When is a body said to have uniform velocity ?

Solution :

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.

Question 12:

Under which condition is the magnitude of average velocity equal to average speed ?

Solution :

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

Question 13:

Which of the two can be :zero under certain conditions : average speed of a moving body or average velocity of a moving body ?

Solution :

Average velocity of a moving body can be zero.

Question 14:

Give one example of a situation in which a body has a certain average speed but its average velocity is zero.

Solution :

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.

Question 15:

What is the acceleration of a body moving with uniform velocity ?

Solution :

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

Question 16:

What is the other name of negative acceleration ?

Solution :

Negative acceleration is also called retardation.

Question 17:

Name the physical quantity whose SI unit is :

(a) m/s (b) m/s^2

Solution :

(a) Speed (or Velocity)

(b) Acceleration

Question 18:

What type of motion is exhibited by a freely falling body ?

Solution :

Uniformly accelerated motion

Question 19:

What is the SI unit of retardation ?

Solution :

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

Question 20:

Fill in the following blanks with suitable words :

(a) Displacement is a…… quantity whereas distance is a……

(b) The physical quantity which gives both, the speed and direction of motion of a body is called its……..

(c) A motorcycle has a steady…… of 3 m/s^2. This means that every…… its……. increases by…….

(d) Velocity is the rate of change of…… It is measured in .

(e) Acceleration is the rate of change of…… It is measured in

Solution :

(a) vector, scalar

(b) velocity

(c) acceleration, second, velocity, 3m/s

(d) displacement, m/s

(e) velocity, m/s^2

Question 21:

What type of motion, uniform or non-uniform, is exhibited by a freely falling body ? Give reason for your answer.

Solution :

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.

Question 22:

State whether speed is a scalar or a vector quantity. Give reason for your choice.

Solution :

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

Question 23:

Bus X travels a distance of 360 km in 5 hours whereas bus Y travels a distance of 476 km in 7 hours. Which
bus travels faster ?

Solution :

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.

Question 24:

Arrange the following speeds in increasing order (keeping the least speed first):

1. An athlete running with a speed of 10 m/s.
2. A bicycle moving with a speed of 200 m/min.
3. A scooter moving with a speed of 30 km/h.

Solution :

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

Question 25:

(a) Write the formula for acceleration. Give the meaning of each symbol which occurs in it.
(b) A train starting from Railway Station attains a speed of 21 m/s in one minute. Find its acceleration.

Solution :

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

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

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

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

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

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

Question 26:

(a) What term is used to denote the change of velocity with time ?
(b) Give one word which means the same as 'moving with a negative acceleration'.

(c) The displacement of a moving object in a given interval of time is zero. Would the distance travelled by the object also be zero ? Give reason for your answer.

Solution :

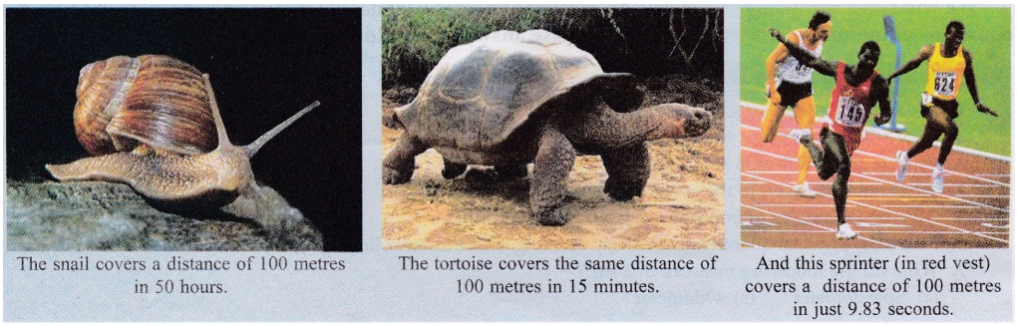
(a) Acceleration

(b) Retardation

(c) No, because if 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.

Question 27:

A snail covers a distance of 100 metres in 50 hours. Calculate the average speed of snail in km/h.



The snail covers a distance of 100 metres in 50 hours.

The tortoise covers the same distance of 100 metres in 15 minutes.

And this sprinter (in red vest) covers a distance of 100 metres in just 9.83 seconds.

Solution :

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

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Question 28:

A tortoise moves a distance of 100 metres in 15 minutes. What is the average speed of tortoise in km/h ?

Solution :

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

Question 29:

If a sprinter runs a distance of 100 metres in 9.83 seconds, calculate his average speed in km/h.

Solution :

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

Question 30:

A motorcyclist drives from place A to B with a uniform speed of 30 km h^{-1} and returns from place B to A with a uniform speed of 20 km h^{-1}. Find his average speed.

Solution :

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

Question 31:

A motorcyclist starts from rest and reaches a speed of 6 m/s after travelling with uniform acceleration for 3 s. What is his acceleration ?

Solution :

Initial velocity= 0m/s

Final velocity=6m/s

Time=3 sec

Initial velocity= 0m/s
Final velocity=6m/s
Time=3 sec

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

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

Question 32:

An aircraft travelling at 600 km/h accelerates steadily at 10 km/h per second. Taking the speed of sound as 1100 km/h at the aircraft's altitude, how long will it take to reach the 'sound barrier' ?

Solution :

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

Question 33:

If a bus travelling at 20 m/s is subjected to a steady deceleration of 5 m/s^2, how long will it take to come to rest ?

Solution :

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=?

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

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

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

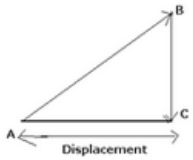
Question 34:

(a) What is the difference between 'distance travelled' by a body and its 'displacement' ? Explain with the
help of a diagram.

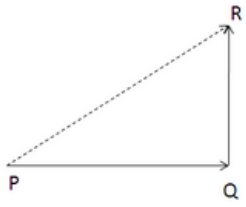
(b) An ant travels a distance of 8 cm from P to Q and then moves a distance of 6 cm at right angles to PQ. Find its resultant displacement.

Solution :

(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 = $\sqrt{8^2+6^2}=\sqrt{100}=10cm$

Question 35:

Define motion. What do you understand by the terms 'uniform motion' and 'non-uniform motion' ? Explain with examples.

(a) Define speed. What is the SI unit of speed ?

(b) What is meant by (i) average speed, and (ii) uniform speed ?

Solution :

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 .

Question 36:

(a) Define velocity. What is the SI unit of velocity ?

(b) What is the difference between speed and velocity ?

(c) Convert a speed of 54 km/h into m/s.

Solution :

(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.

(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.

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

(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.

Question 37:

(a) What is meant by the term 'acceleration' ? State the SI unit of acceleration.

(b) Define the term 'uniform acceleration'. Give one example of a uniformly accelerated motion.

Solution :

(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

Question 38:

The distance between Delhi and Agra is 200 km. A train travels the first 100 km at a speed of 50 km/h. How fast must the train travel the next 100 km, so as to average 70 km/h for the whole journey ?

Solution :

(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.

Question 39:

A train travels the first 15 km at a uniform speed of 30 km/h; the next 75 km at a uniform speed of 50 km/h; and the last 10 km at a uniform speed of 20 km/h. Calculate the average speed for the entire train journey.

Solution :

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

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

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

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

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

$$700 = 6x$$

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

Question 40:

A train travels the first 15 km at a uniform speed of 30 km/h; the next 75 km at a uniform speed of 50 km/h; and the last 10 km at a uniform speed of 20 km/h. Calculate the average speed for the entire train journey.

Solution :

(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

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

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

Question 41:

A car is moving along a straight road at a steady speed. It travels 150 m in 5 seconds :

(a) What is its average speed ?

(b) How far does it travel in 1 second ?

(c) How far does it travel in 6 seconds ?

(d) How long does it take to travel 240 m ?

Solution :

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

(b) Time=1s

Distance = v_{av} x time = 30 x 1 = 30 m/s

(c) Time=6s

Distance = v_{av} x time = 30 x 6 = 180 m/s

(d) Distance=240m

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

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Question 55:

A body is moving along a circular path of radius R. What will be the distance travelled and displacement of the body when it completes half a revolution ?

Solution :

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

Question 56:

If on a round trip you travel 6 km and then arrive back home :

(a) What distance have you travelled ?

(b) What is your final displacement ?

Solution :

(i) Distance travelled = 6 km

(ii) Displacement = zero(since final position is same as initial position)

Question 57:

A body travels a distance of 3 km towards East, then 4 km towards North and finally 9 km towards East.

(i) What is the total distance travelled ?

(ii) What is the resultant displacement ?

Solution :

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

Question 58:

A boy walks from his classroom to the bookshop along a straight corridor towards North. He covers a distance of 20 m in 25 seconds to reach the bookshop. After buying a book, he travels the same distance in the same time to reach back in the classroom. Find (a) average speed, and (b) average velocity, of the boy.

Solution :

(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

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

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

Question 59:

A car travels 100 km at a speed of 60 km/h and returns with a speed of 40 km/h. Calculate the average speed for the whole journey.

Solution :

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

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

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

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

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

Question 60:

A ball hits a wall horizontally at 6.0 m s^{-1}. It rebounds horizontally at 4.4 m s^{-1}. The ball is in contact with the wall for 0.040 s. What is the acceleration of the ball ?

Solution :

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

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

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Question 1:

(a) What remains constant in uniform circular motion ?

(b) What changes continuously in uniform circular motion ? '

Solution :

(a)Speed

(b)Direction of motion

Question 2:

State whether the following statement is true or false :

Earth moves round the sun with uniform velocity.

Solution :

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

Question 3:

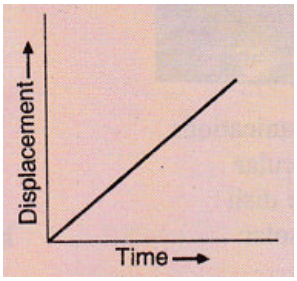
A body goes round the sun with constant speed in a circular orbit. Is the motion uniform or accelerated ?

Solution :

The motion is accelerated.

Question 4:

What conclusion can you draw about the velocity of a body from the displacement-time graph shown below :



Solution :

It represents uniform velocity.

Question 5:

Name the quantity which is measured by the area occupied under the velocity-time graph.

Solution :

Distance travelled by the moving body .

Question 6:

What does the slope of a speed-time graph indicate ?

Solution :

The slope of a speed-time graph indicates acceleration.

Question 7:

What does the slope of a distance-time graph indicate ?

Solution :

The slope of a distance-time graph indicates speed.

Question 8:

Give one example of a motion where an object does not change its speed but its direction of motion changes continuously.

Solution :

Motion of moon around the earth.

Question 9:

Name the type of motion in which a body has a constant speed but not constant velocity.

Solution :

Uniform circular motion.

Question 10:

What can you say about the motion of a body if its speed-time graph is a straight line parallel to the time axis ?

Solution :

The Speed of the body is constant or uniform.

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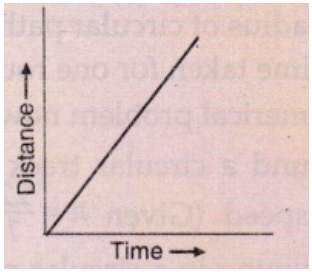
Question 11:

What conclusion can you draw about the speed of a body from the following distance-time graph ?



Solution :

The body has uniform speed.

Question 12:

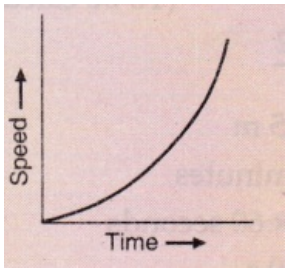
What can you say about the motion of a body whose distance-time graph is a straight line parallel to the time axis ?

Solution :

The body is not moving. It is stationary.

Question 13:

What conclusion can you draw about the acceleration of a body from the speed-time graph shown below ?

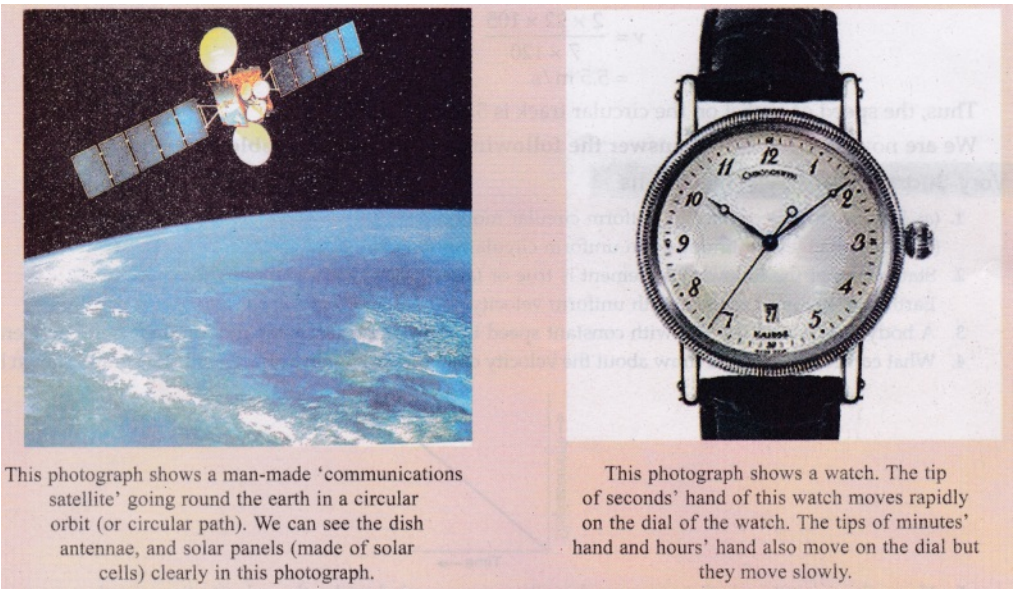


Solution :

It represents non-uniform acceleration.

Question 14:

A satellite goes round the earth in a circular orbit with constant speed. Is the motion uniform or accelerated ?



This photograph shows a man-made 'communications satellite' going round the earth in a circular orbit (or circular path). We can see the dish antennae, and solar panels (made of solar cells) clearly in this photograph.

This photograph shows a watch. The tip of seconds' hand of this watch moves rapidly on the dial of the watch. The tips of minutes' hand and hours' hand also move on the dial but they move slowly.

Solution :

It is accelerated motion as the velocity is changing continuously.

Question 15:

What type of motion is represented by the tip of the 'seconds' hand' of a watch ? Is it uniform or accelerated ?

Solution :

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

Question 16:

Fill in the following blanks with suitable words :

(a) If a body moves with uniform velocity, its acceleration is……..

(b) The slope of a distance-time graph indicates…….. of a moving body.

(c) The slope of a speed-time graph of a moving body gives its……..

(d) In a speed-time graph, the area enclosed by the speed-time curve and the time axis gives the…….. by the body.

(e) It is possible for something to accelerate but not change its speed if it moves in a……..

Solution :

(a) zero

(b) speed

(c) acceleration

(d) distance travelled

(e) circular path

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Question 17:

Is the uniform circular motion accelerated ? Give reasons for your answer

Solution :

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

Question 18:

Write the formula to calculate the speed of a body moving along a circular path. Give the meaning of each symbol which occurs in it.

Solution :

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

Question 19:

Explain why, the motion of a body which is moving with constant speed in a circular path is said to be accelerated.

Solution :

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.

Question 20:

What is the difference between uniform linear motion and uniform circular motion ? Explain with examples.

Solution :

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.

Question 21:

State an important characteristic of uniform circular motion. Name the force which brings about uniform circular motion.

Solution :

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.

Question 22:

Find the initial velocity of a car which is stopped in 10 seconds by applying brakes. The retardation due to brakes is 2.5 m/s^2.

Solution :

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

Question 23:

Describe the motion of a body which is accelerating at a constant rate of 10 m s^{-2}. If the body

starts from rest, how much distance will it cover in 2 s ?

Solution :

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

$= 0x2 + \frac{1}{2} x10 \ x2x2$

$= 0 + 20 = 20$ m

Question 24:

A motorcycle moving with a speed of 5 m/s is subjected to an acceleration of 0.2 m/s^2. Calculate the speed of the motorcycle after 10 seconds, and the distance travelled in this time.

Solution :

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=0.2m/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;

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

$s = 5x10 + \frac{1}{2} \ x0.2x10x10$

$s = 50 + 10 = 60$ m

Question 25:

A bus running at a speed of 18 km/h is stopped in 2.5 seconds by applying brakes. Calculate the retardation produced.

Solution :

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.

Question 26:

A train starting from rest moves with a uniform acceleration of 0.2 m/s^2 for 5 minutes. Calculate the speed acquired and the distance travelled in this time.

Solution :

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

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

$$s = 0x300 + \frac{1}{2} x0.2x300x300$$

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

Question 27:

Name the two quantities, the slope of whose graph gives :

(a) speed, and

(b) acceleration

Solution :

(a) Distance and Time

(b) Speed (or velocity) and Time

Question 28:

A cheetah starts from, rest, and accelerates at 2 m/s^2 for 10 seconds. Calculate :

(a) the final velocity

(b) the distance travelled.

Solution :

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:

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

$$s = 0x10 + \frac{1}{2} x2x10x10$$

$$s = 0 + 100 = 100\ m$$

Question 29:

A train travelling at 20 m s^{-1} accelerates at 0.5 m s^{-2} for 30 s. How far will it travel in this time ?

Solution :

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:

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

$$s = 20x30 + \frac{1}{2} x0.5x30x30$$

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

Question 30:

A cyclist is travelling at 15 m s^{-1}. She applies brakes so that she does not collide with a wall 18 m away. What deceleration must she have ?

Solution :

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

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

$$-225 = 36 a$$

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

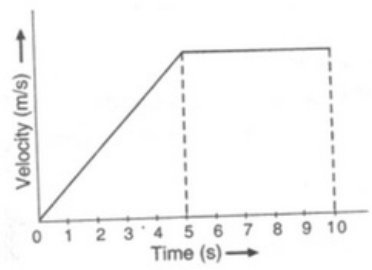
So, deceleration is 6.25 m/s^2.

Question 31:

Draw a velocity-time graph to show the following motion :

A car accelerates uniformly from rest for 5 s ; then it travels at a steady' velocity for 5 s.

Solution :



Question 32:

The velocity-time graph for part of a train journey is a horizontal straight line. What does this tell you about

(a) the train's velocity, and (b) about its acceleration ?

Solution :

(a) The train has a uniform velocity.

(b) There is no acceleration.

Question 33:

(a) Explain the meaning of the following equation of motion :v = u + at, where symbols have their usual meanings.

(b) A body starting from rest travels with uniform acceleration. If it travels 100 m in 5 s, what is the value of acceleration ?

Solution :

(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=?

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

$$100 = 0x5 + \frac{1}{2} xax5x5$$

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

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

Question 34:

(a) Derive the formula : v = u + at, where the symbols have usual meanings.

(b) A bus was moving with a speed of 54 km/h. On applying brakes it stopped in 8 seconds. Calculate the acceleration.

Solution :

(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=?

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

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

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

$$at = v - u$$

$$\text{and,} \quad v = u + at$$

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=?

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

Question 35:

(a) Derive the formula :$s = ut + \frac{1}{2}at^2$, where the symbols have usual meanings.

(b) A train starting from stationary position and moving with uniform acceleration attains a speed of 36 km per hour in 10 minutes. Find its acceleration.

Solution :

(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 x 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

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

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

Question 36:

(a) Write the three equations of uniformly accelerated motion. Give the meaning of each symbol which occurs in them.

(b) A car acquires a velocity of 72 km per hour in 10 seconds starting from rest. Find

(i) the acceleration,

(ii) the average velocity, and

(iii) the distance travelled in this time.

Solution :

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

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

(iii) Distance travelled = Average velocity x Time

= 10 m/s × 10s = 100m

Question 37:

(a) What is meant by uniform circular motion ? Give two examples of uniform circular motion.

(b) The tip of seconds' hand of a dock takes 60 seconds to move once on the circular dial of the clock. If the radius of the dial of the clock be 10.5 cm, calculate the speed of the tip of the seconds' hand of the clock. (Given $\pi = \frac{22}{7}$).

Solution :

(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

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

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Question 38:

Show by means of graphical method that: v = u + at, where the symbols have their usual meanings.

Solution :

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

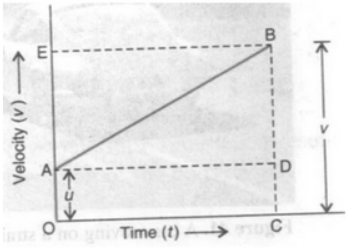
But AD =OC= t, so putting t in place of AD in the above relation, we get:

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

Question 39:

Show by using the graphical method that: $s = ut + \frac{1}{2}at^2$ where the symbols have their usual meanings.

Solution :

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

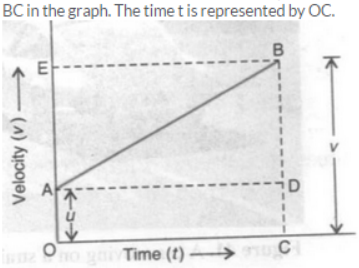
= $_{(1/2)}$ x AD x BD

= $_{(1/2)}$ 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.



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

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

Question 40:

Derive the following equation of motion by the graphical method : $v^2 = u^2 + 2as$, where the symbols have their usual meanings.

Solution :

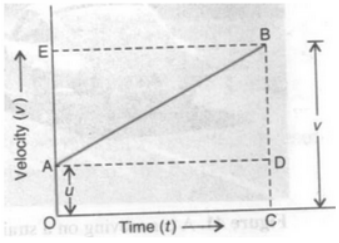
Consider the velocity-time graph of a body shown in figure. The body has an initial velocity u at a point A and then its velocity changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final velocity becomes v which is equal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

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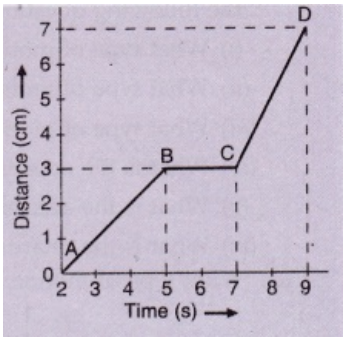
Question 53:

The graph given alongside shows the positions of a body at different times. Calculate the speed of the body as it moves from :

(i) A to B,

(ii) B to C, and

(iii) C to D.



Solution :

(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

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

Question 54:

What can you say about the motion of a body if:

(a) its displacement-time graph is a straight line ?

(b) its velocity-time graph is a straight line ?

Solution :

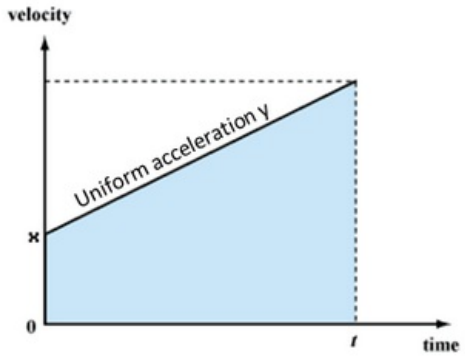
(a) The body has a uniform velocity if its displacement-time graph is a straight line.

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

Question 55:

A body with an initial velocity x moves with a uniform acceleration y. Plot its velocity-time graph.

Solution :



Question 56:

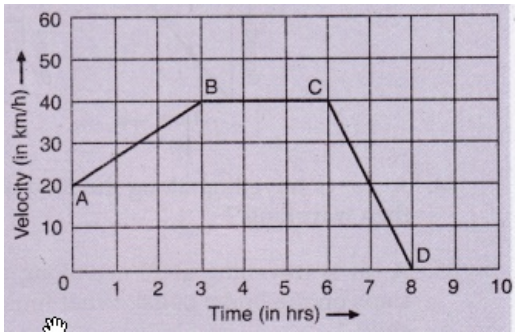
Given alongside is the velocity-time graph for a moving body :

Find :

(i) Velocity of the body at point C.

(ii) Acceleration acting on the body between A and

(iii) Acceleration acting on the body between B and C.



Solution :

(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

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

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

Question 57:

A body is moving uniformly in a straight line with a velocity of 5 m/s. Find graphically the distance covered by it in 5 seconds.

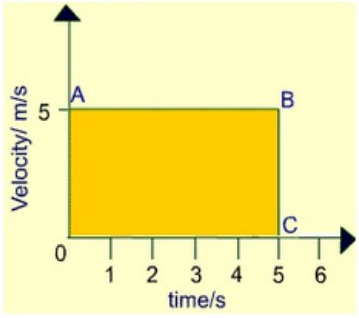
Solution :

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



Question 58:

The speed-time graph of an ascending passenger lift is given alongside.

What is the acceleration of the lift:

(i) during the first two seconds ?

(ii) between second and tenth second ?

(iii) during the last two seconds ?

Solution :

(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.

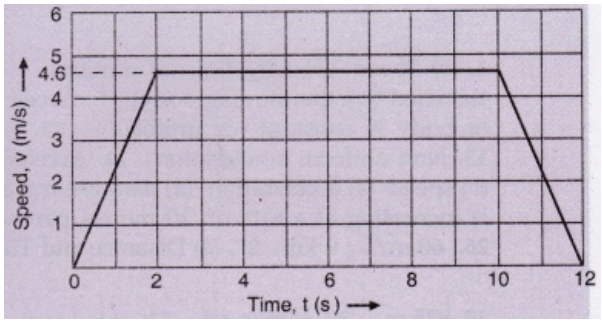
(iii) Acceleration during last two seconds $= \frac{0-4.6}{12-10} = -2.3 m/s^2$

Question 59:

A car is moving on a straight road with uniform acceleration. The speed of the car varies with time as follows :

Time (s)	:	0	2	4	6	8	10
Speed (m/s)	:	4	8	12	16	20	24

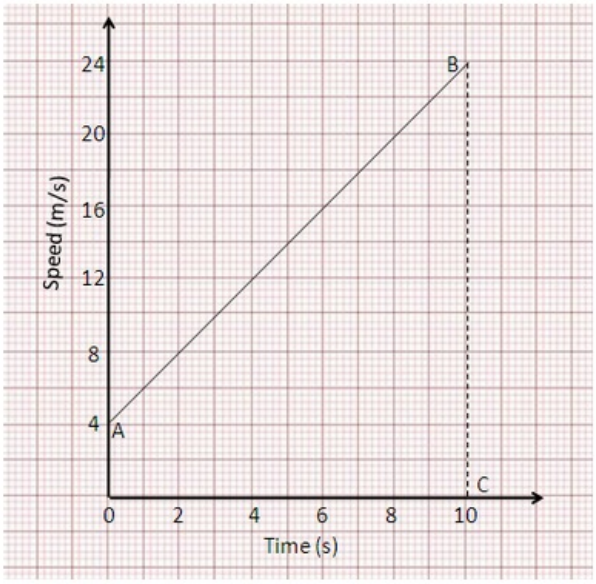
Draw the speed-time graph by choosing a convenient scale. From this graph :



(i) Calculate the acceleration of the car.

(ii) Calculate the distance travelled by the car in 10 seconds.

Solution :



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

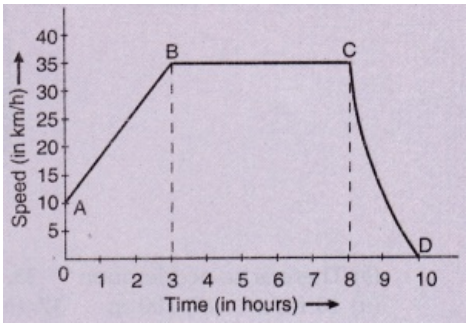
(ii) Distance travelled by the car in 10 s = area of trapezium OABC

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

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

Question 60:

The graph given alongside shows how the speed of a car changes with time:



(i) What is the initial speed of the car ?

(ii) What is the maximum speed attained by the car ?

(iii) Which part of the graph shows zero acceleration ?

(iv) Which part of the graph shows varying retardation ?

(v) Find the distance travelled in first 8 hours.

Solution :

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

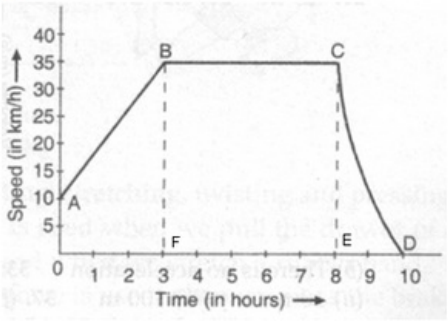
(ii) Maximum speed attained by the car= 35km/h

(iii) BC represents zero acceleration.

(iv) CD represents varying retardation.

(v)

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



Distance travelled in first 8 hrs:

s=Area of trapezium OABF + Area of rectangle BCEF

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

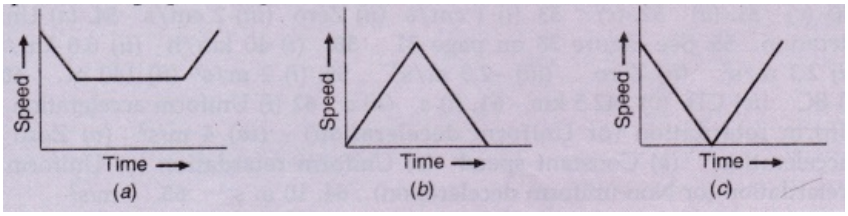
$$= \frac{1}{2} \times (10 + 35) \times 3 + (35 \times 5)$$

$$= 67.5 + 175$$

$$= 242.5 km$$

Question 61:

Three speed-time graphs are given below :



Which graph represents the case of:

(i) a cricket ball thrown vertically upwards and returning to the hands of the thrower ?

(ii) a trolley decelerating to a constant speed and then accelerating uniformly ?

Solution :

(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.

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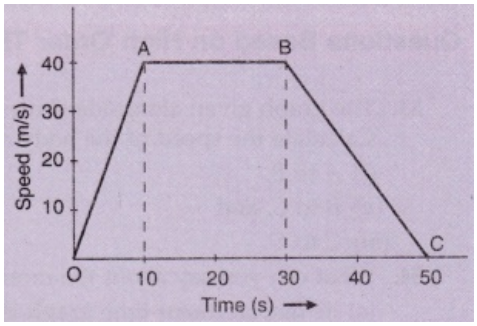
Question 62:

Study the speed-time graph of a car given alongside and answer the following questions:



(i) What type of motion is represented by OA ?

(ii) What type of motion is represented by AB ?

(iii) What type of motion is represented by BC ?

(iv) What is the acceleration of car from O to A ?

(v)What is the acceleration of car from A to B ?

(vi) What is the retardation of car from B to C ?

Solution :

(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

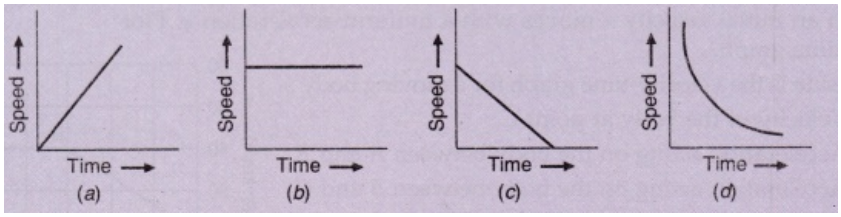
$$a = \frac{40 - 0}{10 - 0} = 4\,m/s^2$$

(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

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

Question 63:

What type of motion is represented by each one of the following graphs ?



Solution :

(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.

Question 64:

A car is travelling along the road at 8 ms^{-1}. It accelerates at 1 ms^{-2} for a distance of 18 m. How fast is it then travelling ?

Solution :

Initial velocity, u=8m/s

Acceleration, a=1m/s^2

Distance, s=18m

Initial velocity, u=8m/s
Acceleration, a=1m/s^2
Distance, s=18m

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

$$v^2 = (8)^2 + 2 \times 1 \times 18$$

$$v^2 = 64 + 36 = 100$$

$$v = \sqrt{100} = 10 m/s$$

Question 65:

A car is travelling at 20 m/s along a road. A child runs out into the road 50 m ahead and the car driver steps on the brake pedal. What must the car's deceleration be if the car is to stop just before it reaches the child ?

Solution :

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

$$0^2 = (20)^2 + 2 \times a \times 50$$

$$0^2 = 400 + 100a$$

$$-400 = 100\, a$$

$$a = \frac{-400}{100} = -4 m/s^2$$

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

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