CHAPTER 7

MOTION

CLASS 9TH

NCERT EXERCISE AND SOLUTIONS - SCIENCE

Q. 1. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?

ANSWER:-

Given- Time taken = 2 min 20 sec = 140 sec. Radius, r = 100 m.
Need to find- distance covered
In 40 sec the athlete complete one round.
So, in 140 sec the athlete will complete = 140 ÷ 40 = 3.5 round.
⇒ Distance covered in 140 sec = $2\pi r \times 3.5 = 2 \times 22/7 \times 100 \times 3.5 = 2200$ m.
At the end of his motion, the athlete will be in the diametrically opposite position.
⇒ Displacement = diameter = 200 m.

Q. 2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from A to B and (b) from A to C?

ANSWER:-

(a) For motion from A to B:

Given- Distance covered = 300 m, Displacement = 300 m, Time taken = 150 sec

We know that,

- Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{300\text{m}}{150\,\text{sec}} = 2\,\text{m/s}$
- Average velocity $= \frac{\text{Net displacement}}{\text{Time taken}} = \frac{300\text{m}}{150\,\text{sec}} = 2\,\text{m/s}$

(b) For motion from A to C:

Given- Distance covered = 300 m + 100 m = 400 m, Displacement = AB – CB = 300 m - 100 m = 200 m, Time taken = 2.5 min + 1 min = 3.5 min = 210 sec

Therefore,

- Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{400\text{m}}{210\,\text{sec}} = 1.90\,\text{m/s}$
- Average velocity $= \frac{\text{Net displacement}}{\text{Time taken}} = \frac{200\text{m}}{210\,\text{sec}} = 0.952\,\text{m/s}$

Q. 3. Abdul, while driving to school, computes the average speed for his trip to be 20 km h^{-1}. On his return trip along the same route, there is less traffic and the average speed is 30 km h^{-1}. What is the average speed for Abdul's trip?

ANSWER:-

Let one side distance = x km.

Time taken for forward trip at a speed of 20 km/h

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{x}{20} \text{ hours}$$

Time taken for return trip at a speed of 30 km/h

$$\text{Time} = \frac{x}{30} \text{ hours}$$

Total time for the whole trip

$$\text{Total time} = \frac{x}{20} + \frac{x}{30} = \frac{5x + x}{60} = \frac{6x}{60} = \frac{x}{10} \text{ hours}$$

Total distance covered

Total distance = 2x km

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{2x}{\frac{x}{10}} = 24 \text{km/h}$$

Q. 4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 m s^{-2} for 8.0 s. How far does the boat travel during this time?

ANSWER:-

Given: Initial velocity, u = 0 m/s, Acceleration, a = 3 m/s^2, Time, t = 8 s

Need to find: Displacement,

Using the equation of motion:

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

Substitute the given values:

$$s = 0 \times 8 + \frac{1}{2} \times 3 \times 8^2$$

$$s = 0 + \frac{1}{2} \times 3 \times 64 = 96 \text{m}$$

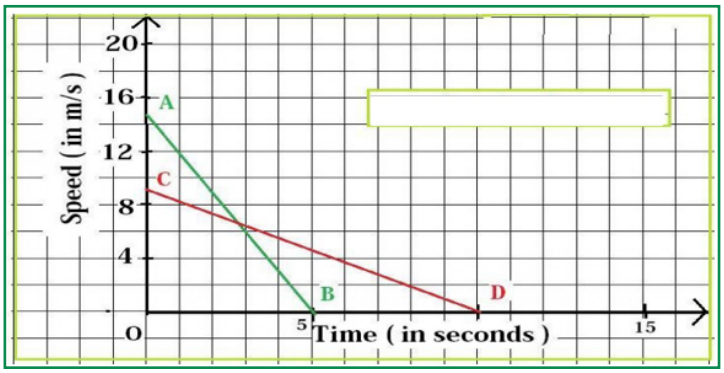
Final Answer: Displacement, s = 96m

Q. 5. A driver of a car travelling at 52 km h^{-1} applies the brakes Shade the area on the graph that represents the distance travelled by the car during the period.

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

ANSWER:-

In the following graph, AB and CD are the time graphs for the two cars whose initial speeds are 52 km/h (14.4 m/s) and 34 km/h(8.9 m/s), respectively.



- Given:

  For the first car:

  Initial velocity of the first car, $v_1 = 52$ km/h

  Time taken to come to rest, $t_1 = 5$ s

  For the second car:

  Initial velocity of the second car, $v_2 = 34$ km/h

  Time taken to come to rest, $t_2 = 10$ s

- Need to find:

  Distance covered by each car before coming to rest.

Solve:

1. Distance covered by the first car

   The distance covered by the first car before coming to rest is the area of the triangle AOB.

$$\text{Distance} = \frac{1}{2} \times \text{ Initial velocity} \times \text{ Time}$$

$$= \frac{1}{2} \times 52\text{km/h} \times 5\text{s}$$

First, convert velocity from km/h to m/s :

$$52\text{km/h} = 52 \times \frac{1000}{3600} = 14.44\text{m/s}$$

Now calculate the distance:

$$\text{Distance} = \frac{1}{2} \times 14.44\text{m/s} \times 5\text{s} = 36.1\text{m}$$

2. Distance covered by the second car

   The distance covered by the second car before coming to rest is the area of the triangle COD.

$$\text{Distance} = \frac{1}{2} \times \text{ Initial velocity} \times \text{ Time}$$

$$= \frac{1}{2} \times 34\text{km/h} \times 10\text{s}$$

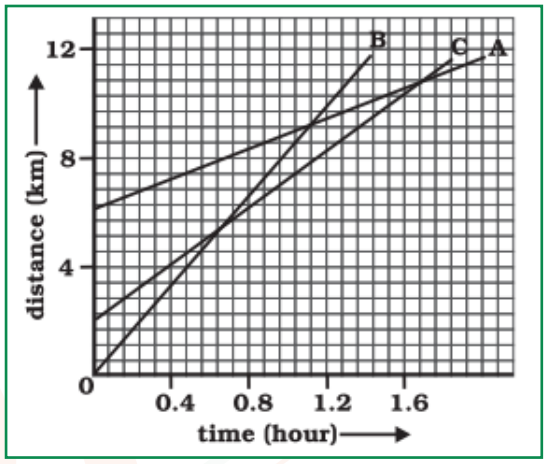
First, convert velocity from km/h to m/s:

$$34\text{km/h} = 34 \times \frac{1000}{3600} = 9.44\text{m/s}$$

Now calculate the distance:

$$\text{Distance} = \frac{1}{2} \times 9.44\text{m/s} \times 10\text{s} = 47.2\text{m}$$

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



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

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

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

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

ANSWER:-

(a) B is travelling fastest as he is taking less time to cover more distance.

(b) All three are never at the same point on the road.

(c) Approximately 6 kms.
[as 8 – 2 = 6]

(d) Approximately 7 kms.
[as 7 – 0 = 7]

Q. 7. A ball is gently dropped from a height of 20 m . If its velocity increases uniformly at the rate of , with what velocity will it strike the ground? After what time will it strike the ground?

ANSWER:-

- Given:
  Initial velocity, u = 0 m/s
  Distance traveled, s = 20 m
  Acceleration, a = 10 m/s^2
  Final velocity, v = ?
  Time, t = ?
- Need to find:
  Final velocity (v) and time (t).
- Solve:

1. Finding Final Velocity (v)
   Using the equation:
   $v^2 - u^2 = 2as$

Substitute the given values:

$v^2 - 0^2 = 2 \times 10 \times 20$

$v^2 = 400$

$v = 20$ m/s

2. Finding Time (t)

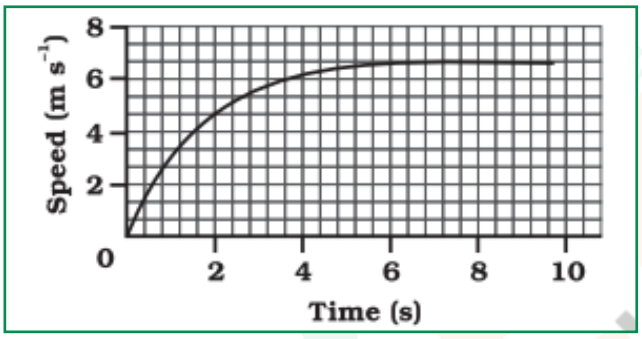
Using the equation:

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

Substitute the given values:

$$t = \frac{20 - 0}{10} = 2s$$

Q. 8. The speed-time graph for a car is shown is Fig. 7.11.



(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.

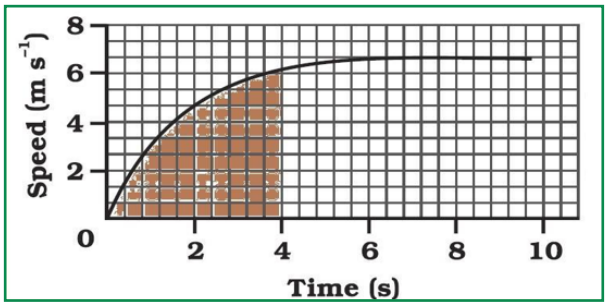
(b) Which part of the graph represents uniform motion of the car?

ANSWER:-

(a) Distance covered = Area under the curve $= \frac{1}{2}$ speed $\times$ Time

$$\Rightarrow \text{Distance} = \frac{1}{2} \times 4 \times 6 = 12\text{m}$$

Shaded area representing the distance travelled is as follows:



(b) After 6 seconds the car moves in uniform motion (at a speed of 6 m/s).

Q. 9. State which of the following situations are possible and give an example for each of these:

(a) an object with a constant acceleration but with zero velocity

(b) an object moving with an acceleration but with uniform speed.

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

ANSWER:-

Part (a) is possible. An object can have zero velocity but a constant acceleration, such as a ball at the peak of its flight after being thrown straight up. At that moment, it stops for an instant, but gravity is still causing it to accelerate downwards.

Part (b) is possible. An object can have uniform speed while accelerating, as speed and velocity are different. For example, a car moving at a constant speed around a circular track is continuously changing direction, which means its velocity is changing and it is therefore accelerating. This is known as centripetal acceleration.

Part (c) is possible. An object can move in one direction while its acceleration is in a perpendicular direction. This happens during uniform circular motion, where the velocity is tangential to the circle, and the acceleration (centripetal acceleration) is directed towards the center, perpendicular to the velocity.

Q. 10. An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth.

ANSWER:-

Given- Radius r = 42,250 km = 42,250,000 m, Time period T = 24 h = 24×60×60 s = 86,400 s

Need to find- Speed v

Using the formula for speed:

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

Substitute the values:

$$v = \frac{2 \times 3.14 \times 42,250,000}{24 \times 60 \times 60} m/s$$

$$v = \frac{2 \times 3.14 \times 42,250,000}{86,400} m/s$$

$$v = 3070.9 m/s = 3.07 km/s$$