

NCERT QUESTIONS WITH SOLUTIONS

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

Solution

Yes, an object which has moved through a distance can have zero displacement.

Example : When a person, walking along a circular path, returns back to the starting point, after completing a circle, his displacement is zero. But he covers a distance $2\pi r$, where 'r' is the radius of circular path.

2. Which of the following is true for displacement?

- (a) It cannot be zero.
(b) Its magnitude is greater than the distance travelled by the object.

Solution

None of the statements (a) or (b) is true for displacement.

3. Distinguish between speed and velocity.

Solution

Speed is rate of change of distance, while velocity is the rate of change of displacement. Speed is a scalar quantity, while velocity is a vector quantity. Speed is always positive, while velocity is positive, negative or zero.

4. Under what condition is the magnitude of average velocity of an object equal to its average speed?

Solution

When an object moves along a straight path without change in its direction, the average velocity of an object is equal to its average speed.

5. What does the odometer of an automobile measure?

Solution

Odometer measures the distance travelled by the automobile.

6. What does the path of an object look like when it is in uniform motion?

Solution

In uniform motion, the object moves along a straight path i.e. the path of object is a straight line.

7. During an experiment a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light that is, 3×10^8 m/s.

Solution

Let the distance between the spaceship and the ground station be 's'.

Then, $s = v \times t$

where, v = speed of signal = 3×10^8 m/s

t = time taken = 5 min = 5×60 s = 300 s

$\therefore s = 3 \times 10^8 \times 300 = 9 \times 10^{10}$ m

8. When will you say a body is in

- (i) Uniform acceleration?
(ii) Non uniform acceleration?

Solution

(i) A body is in uniform acceleration when it moves in a straight line and equal changes of velocity take place in equal intervals of time.

(ii) A body is said to be possessing non-uniform acceleration when unequal changes in velocity take place in equal intervals of time.

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

Solution

Given $t = 5 \text{ s}$

Initial speed of bus

$$u = 80 \text{ km h}^{-1} = 80 \times \frac{5}{18} = 22.22 \text{ ms}^{-1}$$

Final speed of the bus

$$v = 60 \text{ km h}^{-1} = 60 \times \frac{5}{18} = 16.67 \text{ ms}^{-1}$$

Now acceleration is given by the relation

$$a = \frac{v - u}{t} = \frac{16.67 - 22.22}{5} = -1.11 \text{ ms}^{-2}$$

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

Solution

Given $t = 10 \text{ min} = 10 \times 60 = 600 \text{ s}$

Initial speed of train, $u = 0 \text{ ms}^{-1}$

Final speed of train

$$v = 40 \text{ km h}^{-1} = 40 \times \frac{5}{18} = 11.11 \text{ ms}^{-1}$$

Now acceleration is given by the relation

$$a = \frac{v - u}{t} = \frac{11.11 - 0}{600} = 0.0185 \text{ ms}^{-2}$$

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

Solution

The distance-time graph for uniform motion is a straight line not parallel to the time axis. The distance-time graph for non-uniform motion is not a straight line, it can be a curve or a zigzag line.

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

Solution

The object is stationary.

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

Solution

The object may be in uniform motion.

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

Solution

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

15. A bus starting from rest moves with a uniform acceleration of 0.1 ms^{-2} for 2 minutes. Find

(a) the speed acquired.

(b) the distance travelled.

Solution

Given

Initial speed of bus, $u = 0 \text{ ms}^{-1}$

Final speed of bus, $v = ?$

$a = 0.1 \text{ ms}^{-2}$, $t = 2 \text{ min} = 120 \text{ s}$

$s = ?$

(i) We know, $v = u + at$

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

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

$$s = 0 \times 120 + \frac{1}{2} \times 0.1 \times (120)^2 = 720 \text{ m}$$

Therefore, final speed acquired = 12 ms^{-1}

Distance travelled = 720 m

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

Solution

Given, initial speed of train,

$$u = 90 \text{ km h}^{-1} = 90 \times \frac{5}{18} = 25 \text{ ms}^{-1}$$

Final speed, $v = 0 \text{ ms}^{-1}$,

Acceleration, $a = -0.5 \text{ ms}^{-2}$,

Distance covered, $s = ?$

Using the relation $v^2 - u^2 = 2as$, we have

$$s = \frac{v^2 - u^2}{2a} = \frac{0 - (25)^2}{2 \times (-0.5)} = \mathbf{625 \text{ m}}$$

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

Solution

Given

Initial velocity, $u = 0$

Acceleration, $a = 4 \text{ ms}^{-2}$

Time, $t = 10 \text{ s}$

Distance covered, $s = ?$

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

$$s = 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2$$

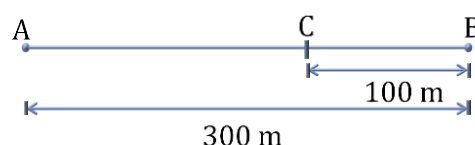
$$= 0 + 200 = \mathbf{200 \text{ m}}$$

Therefore, distance covered = 200 m.

- 18.** Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 50 seconds and then turns around and jogs 100 m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from A to B and (b) from A to C?

Solution

The required figure is as shown



(a) Distance covered = 300 m

Time taken = 2 min and 50 s = 170 s

Now average speed from A to B is given by

$$V_{av} = \frac{\text{distance covered}}{\text{time}} = \frac{300}{170} = \mathbf{1.76 \text{ ms}^{-1}}$$

Now average velocity from A to B is given by

$$V_{av} = \frac{\text{displacement}}{\text{time}} = \frac{300}{170} = \mathbf{1.76 \text{ ms}^{-1}}$$

(b) When Joseph turns around from B to C towards west, then

Distance covered = $300 + 100 = 400 \text{ m}$

Time taken = $170 + 60 = 230 \text{ s}$

Therefore, average speed from A to C is

$$V_{av} = \frac{\text{distance covered}}{\text{time}} = \frac{400}{230} = \mathbf{1.74 \text{ ms}^{-1}}$$

Now displacement from A to C = 200 m

Therefore, average velocity from A to C is

$$V_{av} = \frac{\text{displacement}}{\text{time}} = \frac{200}{230} = \mathbf{0.87 \text{ ms}^{-1}}$$

19. Abdul while driving to school computes the average speed for his trip to be 20 km h^{-1} . On his return trip along the same route, there is less traffic and the average speed is 40 km h^{-1} . What is the average speed for Abdul's trip?

Solution

Let one way distance for his trip be S .

Let t_1 be the time for his trip from home to school and t_2 be the time for his return trip.

$$\text{Then } t_1 = \frac{S}{v_1} = \frac{S}{20} \text{ h, and } t_2 = \frac{S}{v_2} = \frac{S}{40} \text{ h}$$

Therefore, total time of trip is

$$T = t_1 + t_2 = \frac{S}{20} + \frac{S}{40} = \frac{3S}{40} \text{ h}$$

Total distance covered = $2S$

Therefore, average speed of Abdul

$$V_{\text{av}} = \frac{\text{total distance}}{\text{total time}} = \frac{2S \times 40}{3S} = \mathbf{26.6 \text{ kmh}^{-1}}$$

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

Solution

Given, initial velocity of boat, $u = 0$

Acceleration, $a = 3.0 \text{ m s}^{-2}$

Time, $t = 8 \text{ s}$

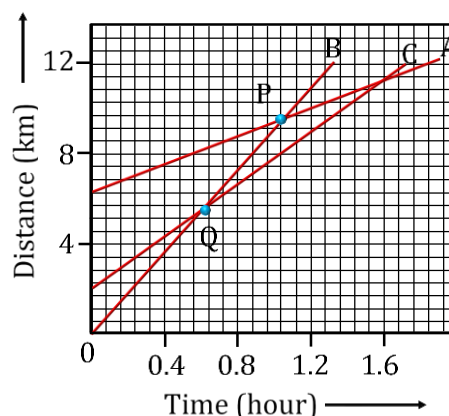
Distance covered, $s = ?$

Using the relation $s = ut + \frac{1}{2} at^2$ we have,

$$s = 0 \times 8 + \frac{1}{2} \times 3 \times 64 = \mathbf{96 \text{ m}}$$

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

- Which of the three is travelling the fastest?
- Are all three ever at the same point on the road?
- How far has C travelled when B passes A?
- How far has B travelled by the time it passes C?

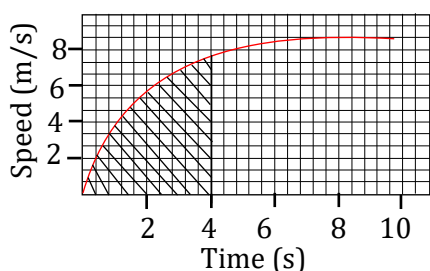


Solution

- Car B is travelling the fastest because its slope is largest among the three.
- No, they are never at the same point because all the graphs of A, B and C do not intersect at one point.
- When car B passes car A at point P, the distance covered by car C = $8 - 2 = 6 \text{ km}$. (approx.)
- Car B and C pass each other at point Q. The distance travelled by B at that point is nearly 5.7 km .

22. The speed-time graph for a car is shown in figure below.

- (a) Shade the area on the graph that represents the distance travelled by the car during the first 4 seconds.
- (b) Which part of the graph represents uniform motion of the car?



Solution

- (a) During first 4 seconds, car is moving with non-uniform acceleration. Area of shaded portion represents distance travelled.
- (b) The straight-line portion of the graph represents uniform motion of the car.

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

- (a) An object with a constant acceleration but with zero velocity.
- (b) An object moving in a certain direction with acceleration in the perpendicular direction.

Solution

- (a) A body with a constant acceleration but with zero velocity is possible. For example, when a body is just released, its initial velocity $u = 0$, but acceleration $g = 10 \text{ ms}^{-2}$.
- (b) It is possible when a stone, tied to a string, is whirled in a circular path, the acceleration acting on it is always at right angle to the direction of motion of stone.

24. 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.

Solution

Distance covered by the satellite in 24 hours.

$$S = 2\pi r$$

$$= 2 \times \frac{22}{7} \times 42250 = \frac{1859000}{7}$$

$$= 265571.43 \text{ km}$$

Therefore speed of satellite

$$v = \frac{\text{distance travelled}}{\text{time taken}}$$

$$= \frac{265571.43}{86400} = 3.07 \text{ kms}^{-1}$$