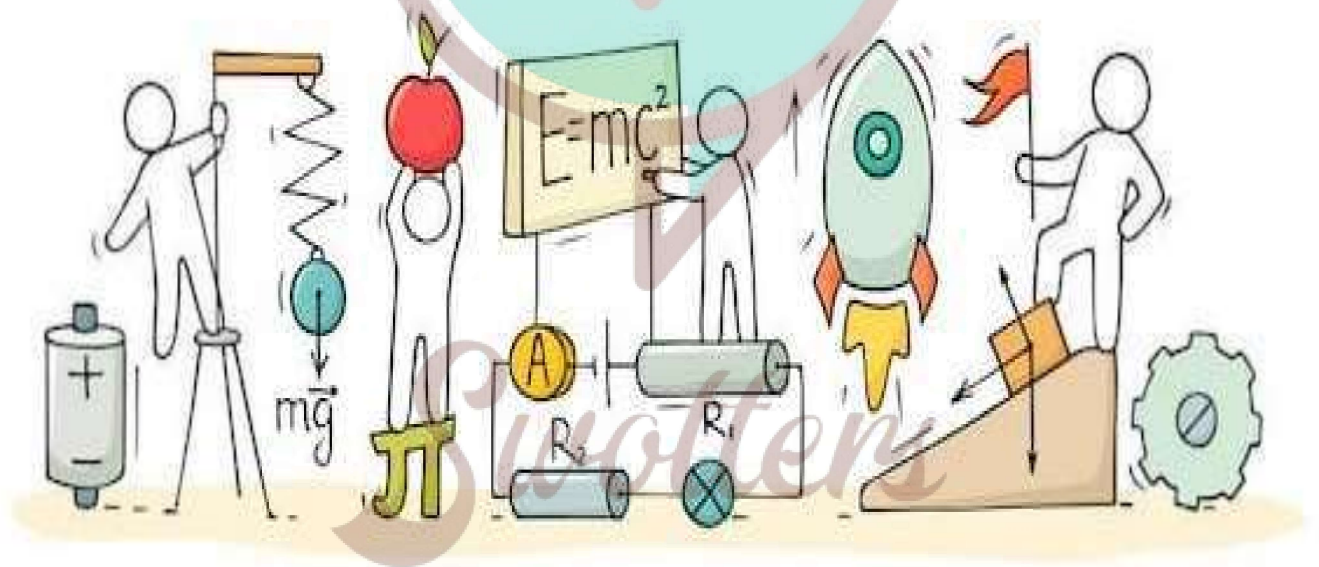


# PHYSICS

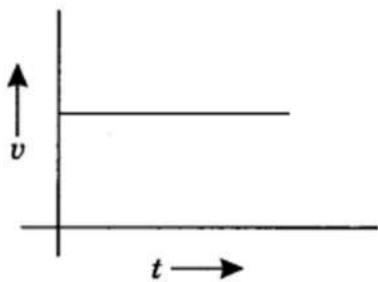
## Chapter 8: Motion



## Important Questions

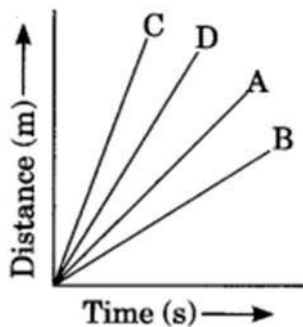
### ➤ Multiple Choice Questions:

1. A particle is moving in a circular path of radius  $r$ . The displacement after half a circle would be:
  - (a) Zero
  - (b)  $\pi r$
  - (c)  $2r$
  - (d)  $2\pi r$
2. A body is thrown vertically upward with velocity  $u$ , the greatest height  $h$  to which it will rise is,
  - (a)  $u/g$
  - (b)  $u^2/2g$
  - (c)  $u^2/g$
  - (d)  $u/2g$
3. The numerical ratio of displacement to distance for a moving object is
  - (a) always less than 1
  - (b) always equal to 1
  - (c) always more than 1
  - (d) equal or less than 1
4. If the displacement of an object is proportional to square of time, then the object moves with
  - (a) uniform velocity
  - (b) uniform acceleration
  - (c) increasing acceleration
  - (d) decreasing acceleration
5. From the given  $u - t$  graph, it can be inferred that the object is

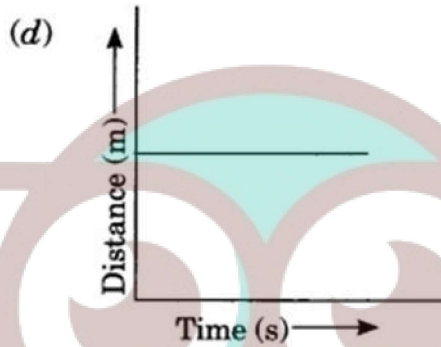
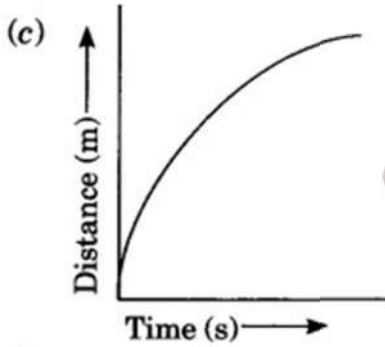
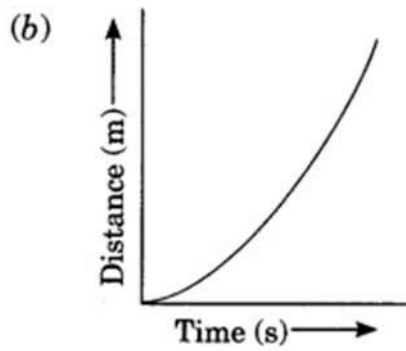
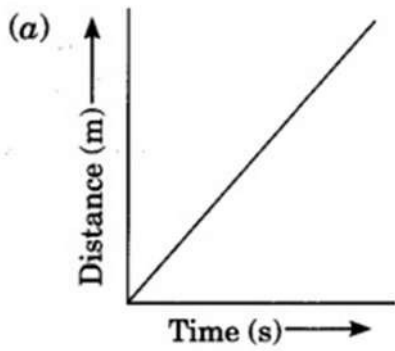


- (a) in uniform motion

- (b) at rest
- (c) in non-uniform motion
- (d) moving with uniform acceleration
6. Suppose a boy is enjoying a ride on a merry-go-round which is moving with a constant speed of  $10 \text{ ms}^{-1}$ . It implies that the boy is
- (a) at rest
- (b) moving with no acceleration
- (c) in accelerated motion
- (d) moving with uniform velocity
7. Area under a  $v-t$  graph represents a physical quantity which has the unit
- (a)  $\text{m}^2$
- (b)  $\text{m}$
- (c)  $\text{m}^3$
- (d)  $\text{ms}^{-1}$
8. Four cars A, B, C and D are moving on a levelled road. Their distance versus time graphs are shown in the adjacent figure. Choose the correct statement.



- (a) Car A is faster than car D.
- (b) Car B is the slowest.
- (c) Car D is faster than car C.
- (d) Car C is the slowest.
9. Which of the following figures correctly represents uniform motion of a moving object?



10. Slope of a velocity-time graph gives

- (a) the distance
- (b) the displacement
- (c) the acceleration
- (d) the speed

11. In which of the following cases of motions, the distance moved and the magnitude of displacement are equal?

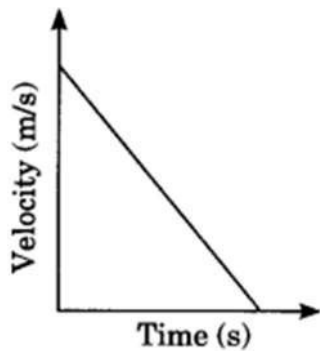
- (a) If the car is moving on a straight road
- (b) If the car is moving in Circular path
- (c) The pendulum is moving to and from
- (d) The earth is revolving around the sun.

12. A boy goes from A to B with a velocity of 20 m/min and comes back from B to A with a velocity of 30 m/min. The average velocity of the boy during the whole journey is

- (a) 24 m/min
- (b) 25 m/s
- (c) Zero
- (d) 20 m/min

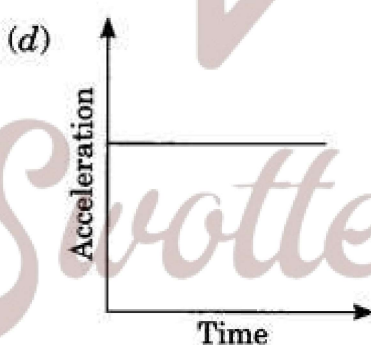
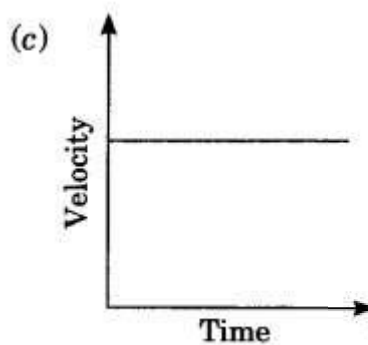
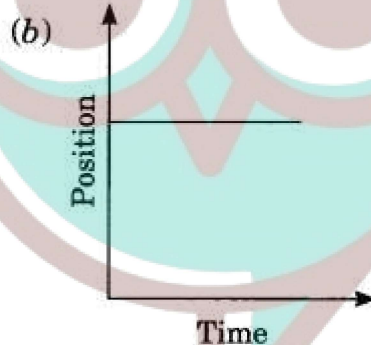
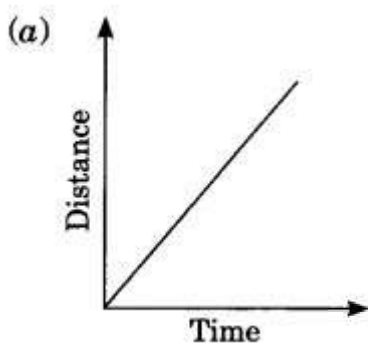
13. Velocity-time graph of an object is given below. The object has





- (a) Uniform velocity
- (b) Uniform speed
- (c) Uniform retardation
- (d) Variable acceleration

14. Which one of the following graphs shows the object to be stationary?



15. A body is projected vertically upward from the ground. Taking vertical upward direction as positive and point of projection as origin, the sign of displacement of the body from the origin when it is at height  $h$  during upward and downward journey will be

- (a) Positive, positive
- (b) Positive, negative
- (c) Negative, negative
- (d) Negative, positive

➤ **Very Short Question:**

1. An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.
2. What do you mean by a body in rest?
3. Are motion and rest absolute or relative? Explain with an example.
4. What is meant by scalars and vectors?
5. A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds?
6. 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.
7. What does the odometer of an automobile measure?
8. Distinguish between speed and velocity.
9. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?
10. What does the path of an object look like when it is in uniform motion?

### ➤ Short Questions:

1. Distinguish between distance and displacement.
2. Write down the SI unit of the following quantities:
  - (a) Displacement
  - (b) Speed
  - (c) Velocity
  - (d) Acceleration
3. Distinguish between uniform motion and non-uniform motion.
4. Distinguish speed at any instant and average speed.
5. Draw a velocity versus time graph of a stone thrown vertically upwards and then coming downwards after attaining the maximum height.
6. What is uniform circular motion? How is uniform circular motion regarded as an acceleration motion? Explain.
7. A person travels a distance of 4.0 m towards the east, then turns left and travels 3.0 m towards the north.
8. A person travels on a semi-circular track of radius 50 m during a morning walk. If he starts from one end of the track and reaches the other end, calculate the distance traveled and displacement of the person.

### ➤ Long Questions:

1. Derive an expression for three equations of motion for uniform accelerated motion graphically.

### ➤ Assertion Reason Questions:

1. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- Both Assertion and Reason are correct, and reason is the correct explanation for assertion.
- Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.
- Assertion is true but Reason is false.
- Both Assertion and Reason are false.

**Assertion:** An object may acquire acceleration even if it is moving at a constant speed.

**Reason:** With change in the direction of motion, an object can acquire acceleration.

2. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- Both Assertion and Reason are correct, and reason is the correct explanation for assertion.
- Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.
- Assertion is true but Reason is false.
- Both Assertion and Reason are false.

**Assertion:** Displacement of an object may be zero even if the distance covered by it is not zero.

**Reason:** Displacement is the shortest distance between the initial and final position.

### ➤ Case Study Based Question:

1. Read the following and answer any four questions from (i) to (v)

One day Rahul decided to go his office by his car. He is enjoying the driving along with listening the old songs. His car is moving along a straight road at a steady speed. On a particular moment, he notices that the car travels 150 m in 5 seconds.



(i) What is its average speed?

- (a) 20 m/s
- (b) 30 m/s
- (c) 10 m/s
- (d) 40 m/s

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

- (a) 20 m
- (b) 30 m
- (c) 10 m
- (d) 40 m

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

- (a) 120 m
- (b) 130 m
- (c) 180 m
- (d) 140 m

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

- (a) 2s
- (b) 4s
- (c) 6s
- (d) 8s

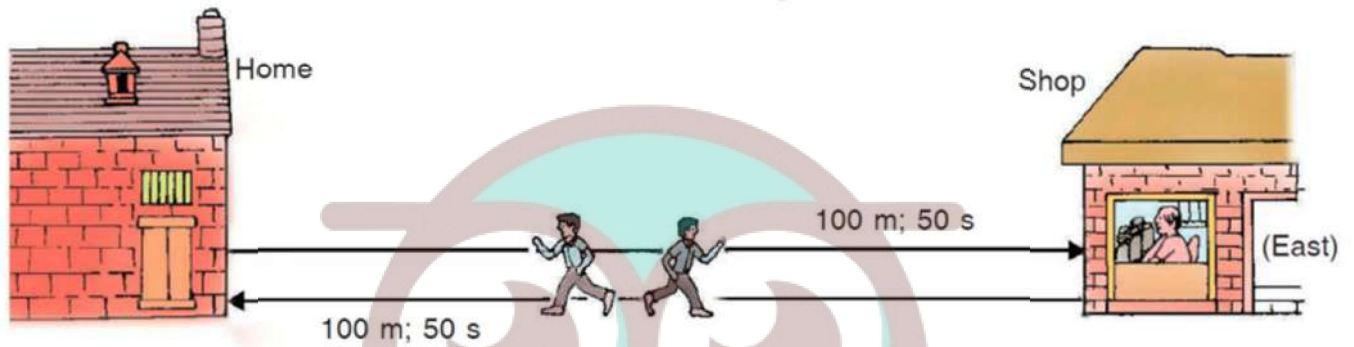
(v) Which of the following statement is correct regarding velocity and speed of a moving body?

- (a) velocity of a moving body is always higher than its speed
- (b) speed of a moving body is always higher than its velocity
- (c) speed of a moving body is its velocity in a given direction

(d) velocity of a moving body is its speed in a given direction

2. Read the following and answer any four questions from (i) to (v)

Suppose the boy first runs a distance of 100 metres in 50 seconds in going from his home to the shop in the East direction, and then runs a distance of 100 metres again in 50 seconds in the reverse direction from the shop to reach back home from where he started (see Figure 21).



(i) Find the speed of the boy.

- (a) 1 m/s
- (b) 2 m/s
- (c) 3 m/s
- (d) none of these

(ii) Find the Velocity of the boy.

- (a) 1 m/s
- (b) 2 m/s
- (c) 3 m/s
- (d) 0 m/s

(iii) A boy is sitting on a merry-go-round which is moving with a constant speed of 10m/s. This means that the boy is:

- (a) at rest
- (b) moving with no acceleration
- (c) in accelerated motion
- (d) moving with uniform velocity

(iv) In which of the following cases of motion, the distance moved and the magnitude of displacement are equal?

- (a) if the car is moving on straight road
- (b) if the car is moving on circular road

(c) if the pendulum is moving to and from

(d) if a planet is moving around the sun

(v) A particle is moving in a circular path of radius  $r$ . The displacement after half a circle would be:

(a) 0

(b)  $\pi r$

(c)  $2r$

(d)  $2\pi r$

✓ Answer Key-

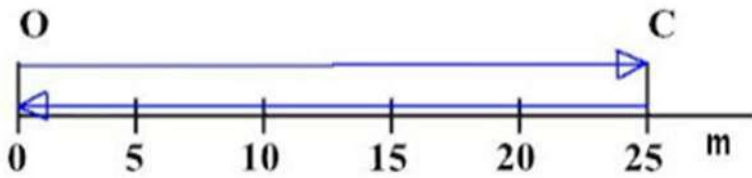
### ➤ Multiple Choice Answers:

1. (c)  $2r$
2. (b)  $u^2/2g$
3. (d) equal or less than 1
4. (b) uniform acceleration
5. (a) in uniform motion
6. (c) in accelerated motion
7. (b)  $m$
8. (b) Car B is the slowest.
9. (a)
10. (c) the acceleration
11. (a) If the car is moving on a straight road
12. (a) 24 m/min
13. (c) Uniform retardation
14. (b)
15. (a) Positive, positive

### ➤ Very Short Answers:

1. Answer: Yes an object can have zero displacement even though it has moved through a distance. It happens when the object moves back to its original position i.e. final position coincides with the starting position.





Example: Suppose an object travels from O to C and then comes back to original position O.

Total distance traveled = actual path covered =  $OC + CO = 25 + 25 = 50\text{m}$

Total displacement = shortest distance between final position and initial position =  $0\text{m}$

2. Answer: A body is said to be at rest, if it does not change its position with respect to a fixed point in its surroundings.
3. Answer: No these terms rest and motion are relative. For example, a person inside a car, carrying a ball in his hand will see the ball is at rest. While for another person, outside the car will see the ball is also moving.
4. Answer:

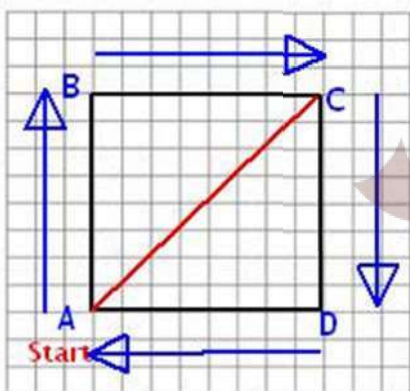
Scalar Quantities: Quantities that require magnitudes only to specify them are called scalar quantities or scalars. Mass, length, time, temperature, angle, area, speed, distance, volume and density are examples of scalar quantities.

Vector Quantities: Quantities that require both magnitudes and direction to specify them are called vector quantities or vectors. Displacement, velocity, force, momentum, weight etc. are the examples of vectors.

5. Answer: As shown in figure, let us assume, the farmer starts from A.

Given, length of each side =  $10\text{m}$

Distance covered in 1 lap = Perimeter of ABCD =  $4 \times 10 = 40\text{m}$



Time taken by farmer to cover 1 lap =  $40\text{s}$

Speed of farmer = Distance  $\div$  Time Taken for one lap =  $40/40\text{s} = 1\text{m/s}$

Distance covered by farmer in 2min 20 secs = Speed  $\times$  Time =  $1 \times 140\text{s} = 140\text{m}$

Number of laps covered =  $140 \div 40 = 3.5$  laps.

$\Rightarrow$  After 140s, the farmer will be at position C (i.e. 3 and  $\frac{1}{2}$  laps).

Displacement = AC =  $(AB^2 + BC^2)^{\frac{1}{2}}$   
 (applying Pythagoras theorem)  
 =  $(100+100)^{\frac{1}{2}} = 10\sqrt{2} = 10 \times 1.414 = 14.14\text{m}$

Note: Displacement is a vector quantity that measures the shortest distance (straight line) between the starting point and ending point, not taking the actual path traveled into account.

6. Answer:

(a) False. Displacement can be zero. (See Q1).

(b) False. Displacement is less than or equal to the distance travelled by the object.

7. Answer: Odometer is used to measure the distance covered by the automobile. It also tells the instant speed of the vehicle. It can be mechanical or electronic or electro-mechanical.

8. Answer:

Speed	Velocity
It is distance traveled by an object per unit time.	It is the displacement covered by an object per unit of time.
Speed = distance ÷ time	Velocity = displacement ÷ time
It is scalar quantity i.e. it has magnitude only.	It is vector quantity i.e. has both magnitude and direction.

9. Answer: When a body is in rectilinear motion i.e. moves in straight line, the magnitude of average velocity of an object is equal to its average speed.

10. Answer: When an object is in uniform motion, it means its speed is constant. Or it travels equal distance in equal intervals of time. The path may be a straight line or curved or zig-zag. Its direction may also vary but the magnitude is fixed.

➤ **Short Answers:**

1. Answer:

**Distance:**

- It is the actual length of the path covered by a moving body.
- It is always positive or zero.
- It is a scalar quantity.

**Displacement:**

- It is the shortest distance measured between the initial and final positions.
- It may be positive, negative, or zero.
- it is a vector quantity.

2. Answer:

- (a) m
- (b) m/s
- (c) m/s
- (d)  $m/s^2$

3. Answer:

Uniform motion: A body moving in a straight line has a uniform motion if it travels the equal distance in equal intervals of time

Non-uniform motion: A body has a non-uniform motion if it travels the unequal distance in equal intervals of time

4. Answer:

1. Instantaneous speed:

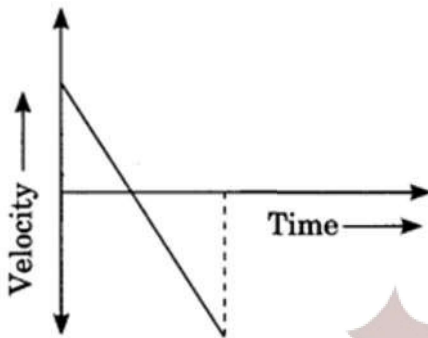
The speed at any particular instant is known as instantaneous speed.

2. Average speed:

Average speed is the ratio of total distance traveled by a body and time taken to travel that distance.

5. Answer:

velocity-time graph

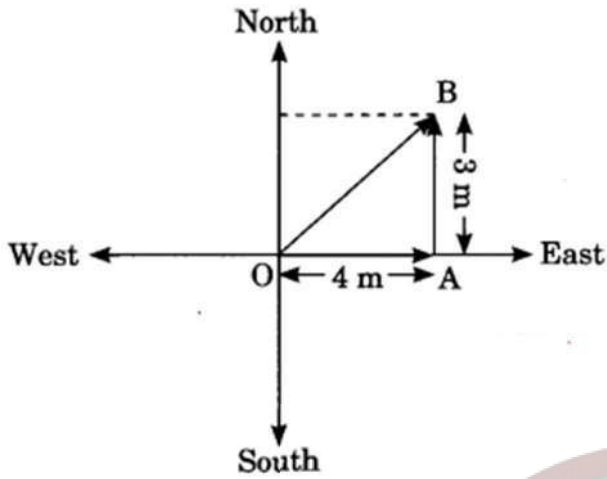


6. Answer: When an object is moving in a circular path with a constant speed, the motion of an object is said to be uniform circular motion. When a body has a uniform circular motion, its velocity changes due to the continuous change in the direction of its motion. Hence, the motion of the body is accelerated motion.

7. Answer:

$$\begin{aligned} 1. \text{ Total distance} &= OA + AB \\ &= 4m + 3m \end{aligned}$$

$$\text{Total distance} = 7m$$



2. Total displacement =  $OB = \sqrt{(OA)^2 + (AB)^2}$   
 $= \sqrt{(4)^2 + (3)^2} = \sqrt{25} = 5$   
 Displacement = 5 m

8. Answer:

Let the person start moving from A and reach B via O.

The distance travelled by the person

= Length of track =  $\pi r$

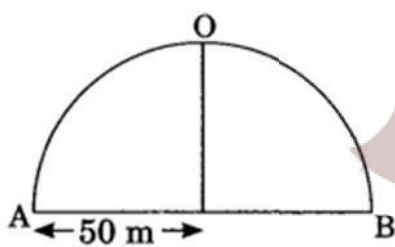
=  $227 \times 50 \text{ m} = 157.14 \text{ m}$

Distance = 157.14 m

The displacement is equal to the diameter of the semi-circular track joining A to B via O.

=  $2r = 2 \times 50 \text{ m} = 100 \text{ m}$

$\therefore$  Displacement = 100 m

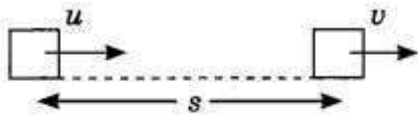


➤ Long Answers:

1. Answer:

Equation of motion by graphical method

Let us consider a body is moving with acceleration where  $u$  is initial velocity and  $v$  is final velocity,  $s$  is the displacement of object and  $t$  is a time interval.



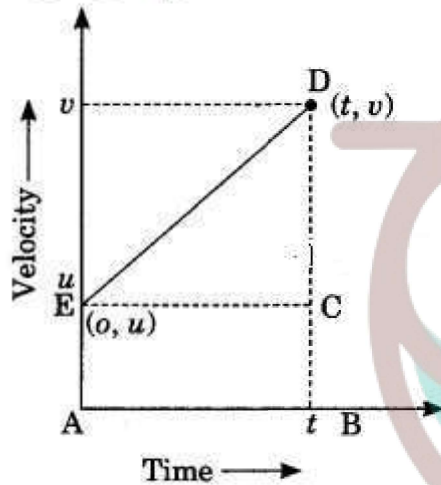
1.  $v = u + at$

We know that slope of  $v - t$  graph gives acceleration so slope

$$= a = \frac{v-u}{t-0}$$

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

$$\therefore v = u + at$$



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

We know that area under  $u - t$  graph gives the displacement.

Area =  $s$  = area of triangle  $CDE$  + area of rectangle  $ABCE$

$$s = ut + \frac{1}{2} \times t \times (v - u) \text{ from } (v - u = at)$$

Putting the value of  $v - u$

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

3.  $v^2 - u^2 = 2as$

We know that area under  $v - t$  graph gives displacement

Area =  $s$  = area of trapezium  $ABDE$

$$s = \frac{1}{2} \times (v+u) \times t \text{ From I } (t = \frac{v-u}{a})$$

Putting the value of  $t$ .

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

➤ **Assertion Reason Answer:**

1. (a) Both Assertion and Reason are correct, and reason is the correct explanation for assertion.
2. (a) Both Assertion and Reason are correct, and reason is the correct explanation for

assertion.

### ➤ Case Study Answer:

#### 1. Answer:

(i) (b) 30 m/s

**Solution:**

$$\begin{aligned} \text{Average speed} &= \text{total distance travelled} / \text{total time taken} \\ &= 150 / 5 \\ &= 30 \text{ m/s} \end{aligned}$$

(ii) (b) 30 m

**Solution:**

$$\begin{aligned} \text{Time} &= 1 \text{ s} \\ \text{Distance} &= (\text{average speed})(\text{time}) \\ &= 30 \text{ m/s} \times 1 \text{ s} \\ &= 30 \text{ m} \end{aligned}$$

(iii) (c) 180 m

**Solution:**

$$\begin{aligned} \text{Time} &= 6 \text{ s} \\ \text{Distance} &= (\text{average speed})(\text{time}) \\ &= 30 \text{ m/s} \times 6 \text{ s} \\ &= 180 \text{ m} \end{aligned}$$

(iv) (d) 8s

**Solution:**

$$\begin{aligned} \text{Distance} &= 240 \text{ m} \\ \text{Time} &= \text{Distance} / \text{average speed} \\ &= 240 / 30 \\ &= 8 \text{ s} \end{aligned}$$

(v) (d) velocity of a moving body is its speed in a given direction.

#### 2. Answer:

(i) (b) 2 m/s

**Solution:**

Total distance travelled is  $100 \text{ m} + 100 \text{ m} = 200 \text{ m}$  and



Swotters



the total time taken is  $50 \text{ s} + 50 \text{ s} = 100 \text{ s}$ .

$$\text{Speed of boy} = \frac{\text{Distance travelled}}{\text{Time taken}} = \frac{200 \text{ m}}{100 \text{ s}} = 2 \text{ m/s}$$

(ii) (d)  $0 \text{ m/s}$

**Solution:**

The boy runs  $100 \text{ m}$  towards East and then  $100 \text{ m}$  towards West and reaches at the starting point, his home. So, the displacement will be  $100 \text{ m} - 100 \text{ m} = 0 \text{ m}$ .

The total time taken is  $50 \text{ s} + 50 \text{ s} = 100 \text{ s}$ .

$$\text{Velocity of boy} = \frac{\text{Displacement}}{\text{Time taken}} = \frac{0 \text{ m}}{100 \text{ s}} = 0 \text{ m/s}$$

(iii) (c) in accelerated motion

(iv) (a) if the car is moving on straight road

(v) (c)  $2r$

