Class: 9th

Subject: Physics

Chapter 2: Kinematics

Exercise MCQs:

2.1 The numerical ratio of displacement to distance is:

(a) always less than one

(b) always equal to one

(c) always greater than one

(d) equal to or less than one ✅

2.2 If a body does not change its position with respect to some fixed point, it will be in a state of:

(a) rest ✅

(b) motion

(c) uniform motion

(d) variable motion

2.3 A ball is dropped from the top of a tower. The distance covered by it in the first second is:

(a) 5 m

(b) 10 m ✅

(c) 50 m

(d) 100 m

2.4 A body accelerates from rest to a velocity of 144 km h^{-1} in 20 seconds. The distance covered by it is:

(a) 100 m

(b) 400 m ✅

(c) 1400 m

(d) 1440 m

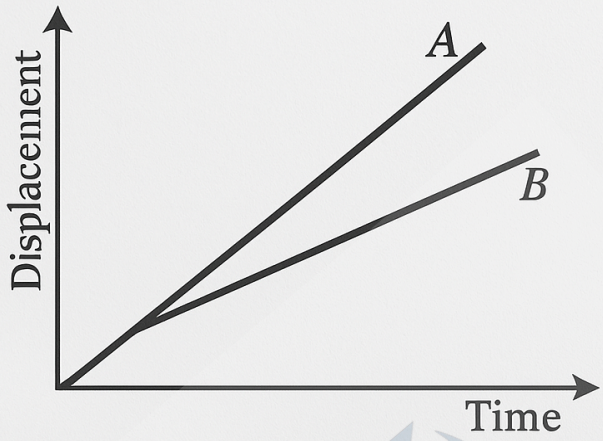
2.5 A body is moving with constant acceleration starting from rest. It covers a distance S in 4 seconds. How much time does it take to cover one-fourth of this distance?

(a) 1s ✅

(b) 2s

(c) 4s

(d) 16s



2.6 The displacement-time graphs of two objects *A* and *B* are shown in the figure. Point out the true statement from the following:
(a) The velocity of *A* is greater than *B*.
(b) The velocity of *A* is less than *B*.
(c) The velocity of *A* is equal to that of *B* ✔
(d) The graph gives no information in this regal.

2.7 The area under the speed-time graph is numerically equal to:

(a) velocity

(b) uniform velocity

(c) acceleration

(d) distance covered ✅

2.8 Gradient of the speed-time graph is equal to:

(a) speed

(b) velocity

(c) acceleration ✅

(d) distance covered

2.9 Gradient of the distance-time graph is equal to the:

(a) speed ✅

(b) velocity

(c) distance covered

(d) acceleration

Important MCQs:

1. Which quantity is completely described by magnitude only?

(a) Vector

(b) Force

(c) Scalar ✅

(d) Velocity

2. Which of the following is a vector quantity?

(a) Speed

(b) Distance

(c) Displacement ✅

(d) Energy

3. Scalars can be added:

(a) By head-to-tail rule

(b) Like simple numbers ✅

(c) Using a graph

(d) Using direction

4. Which of these is not a scalar quantity?

(a) Temperature

(b) Time

(c) Displacement ✅

(d) Mass

5. Which physical quantity requires both magnitude and direction?

(a) Energy

(b) Speed

(c) Vector ✅

(d) Time

6. Which of these is an example of a scalar quantity?

(a) Force

(b) Weight

(c) Velocity

(d) Mass ✅

7. Which of the following represents magnitude of a vector?

(a) Arrow

(b) Italic letter without arrow ✅

(c) Origin

(d) Angle

8. In graphical representation, the direction of vector is shown by:

(a) Length of line

(b) Arrow head ✅

(c) Origin

(d) Axis

9. The reference axes used to represent direction of vectors are:

(a) Diagonal lines

(b) Horizontal and vertical lines ✅

(c) Circular lines

(d) Only y-axis

10. The point where x and y axes intersect is called:

(a) Midpoint

(b) Base

(c) Origin ✅

(d) Direction

11. The direction of a vector is measured with respect to:

(a) y-axis

(b) z-axis

(c) x-axis ✅

(d) Force

12. The graphical method of vector addition is called:

(a) Tail-to-tail rule

(b) Head-to-head rule

(c) Head-to-tail rule ✅

(d) Cross product rule

13. What is a resultant vector?

(a) A vector acting opposite

(b) A vector having no magnitude

(c) A vector equal to force

(d) A single vector having same effect as all combined ✅

14. If 100 N = 1 cm, then 350 N is represented by:

(a) 2.5 cm

(b) 3.5 cm ✅

(c) 4.5 cm

(d) 5.5 cm

15. The angle of a vector with x-axis is always measured:

(a) Clockwise

(b) From left to right

(c) From right side in anti-clockwise direction ✅

(d) Towards y-axis

16. A body is said to be in motion if it:

(a) Does not change its position

(b) Moves randomly

(c) Changes its position with respect to its surroundings ✅

(d) Changes shape

17. Which statement is true about rest and motion?

(a) Rest and motion are absolute terms

(b) A body can be in rest and motion at the same time ✅

(c) Rest and motion are same

(d) Motion has no direction

18. Which of the following is a scalar quantity?

(a) Velocity

(b) Displacement

(c) Distance ✅

(d) Force

19. A man sitting in a moving train is at rest with respect to:

(a) A tree

(b) A car

(c) Another passenger ✅

(d) Station platform

20. The motion of a train on a straight track is:

(a) Circular motion

(b) Random motion

(c) Linear motion ✅

(d) Vibratory motion

21. Random motion is best represented by:

(a) A car on a highway

(b) A bee flying in garden ✅

(c) A clock hand

(d) A fan blade

22. Motion in a circle is called:

(a) Linear motion

(b) Circular motion ✅

(c) Random motion

(d) Vibratory motion

23. The motion of a fan is:

(a) Circular

(b) Translatory

(c) Rotatory ✅

(d) Vibratory

24. Which of the following is not a type of translatory motion?

(a) Linear motion

(b) Circular motion

(c) Random motion

(**d**) Rotatory motion ✅

25. Vibratory motion occurs when a body:

(a) Moves around an axis

(b) Moves randomly

(**c**) Repeats to and fro motion about mean position ✅

(d) Falls freely

26. Example of vibratory motion is:

(a) Blades of fan

(**b**) Swing in park ✅

(c) Moving train

(d) Clock hand

27. The shortest distance between initial and final position is called:

(a) Path length

(b) Distance

(c) Displacement ✅

(d) Direction

28. Speed is defined as:

(a) Distance per unit time ✅

(b) Displacement per unit time

(c) Area per unit time

(d) Direction per unit time

29. Velocity is a vector quantity because it has:

(a) Only speed

(b) Only magnitude

(c) Direction only

(d) Both magnitude and direction ✅

30. If a car moves 300 m in 5 s, what is its average speed?

(a) 30 m/s

(b) 60 m/s ✅

(c) 50 m/s

(d) 75 m/s

31. The quantity which has only magnitude but no direction is called:

(a) Vector

(b) Scalar ✅

(c) Velocity

(d) Acceleration

32. A car is moving at 70 km/h towards north. Its speed is:

(a) Scalar quantity ✅

(b) Vector quantity

(c) Displacement

(d) Force

33. Velocity is said to be uniform when:

(a) Speed changes continuously

(b) Direction keeps changing

(c) Speed and direction both remain constant ✅

(d) Body is at rest

34. Which of the following shows uniform velocity?

(a) A car in traffic

(b) A ball on zig-zag path

(c) A paratrooper after opening parachute ✅

(d) A running horse

35. Acceleration is defined as:

(a) Change in distance per time

(b) Change in velocity per time ✅

(c) Change in speed per distance

(d) Change in direction

36. If a car slows down while applying brakes, the acceleration is:

(a) Zero

(b) Positive

(c) Negative ✅

(d) Constant

37. Negative acceleration is also called:

(a) Force

(b) Displacement

(c) Velocity

(d) Retardation ✅

38. SI unit of acceleration is:

(a) m/s

(b) m/s^2 ✅

(c) km/h

(d) m/h^2

39. Which one is correct about uniform acceleration?

(a) Velocity changes randomly

(b) Direction changes only

(c) Time rate of change of velocity is constant ✅

(d) Speed is constant but direction changes

40. In a distance-time graph, which quantity is plotted on the x-axis?

(a) Speed

(b) Time ✅

(c) Distance

(d) Velocity

41. What does a zero slope in a speed-time graph indicate?

(a) Speed is increasing

(b) Speed is decreasing

(c) Speed is constant ✅

(d) Speed is zero

42. The area under a speed-time graph represents which quantity?

(a) Speed

(b) Time

(c) Distance covered ✅

(d) Acceleration

43. How is acceleration defined?

(a) Change in distance with time

(b) Change in speed with time ✅

(c) Change in direction of speed

(d) Change in distance direction

44. If the velocity of an object is increasing, what is the nature of its acceleration?

(a) Zero

(b) Positive ✅

(c) Negative

(d) Constant

45. In a distance-time graph of uniform speed, what is the shape of the graph?

(a) Curved line

(b) Horizontal line

(c) Straight line with constant slope ✅

(d) Vertical line

46. The gradient of a speed-time graph gives the value of which physical quantity?

(a) Velocity

(b) Acceleration ✅

(c) Distance

(d) Time

47. What is the acceleration due to gravity (g) value commonly used in problems?

(a) 9.8 m/s²

(b) 10 m/s² ✅

(c) 9 m/s²

(d) 8.9 m/s²

48. What does the area of a triangle under a speed-time graph represent when speed increases uniformly?

(a) Average speed

(b) Distance covered ✅

(c) Time taken

(d) Final speed

49. Which equation correctly represents velocity in uniformly accelerated motion?

(a) v = u - at

(b) v = u + at ✅

(c) v = u × at

(d) v = u / at

50. In free fall, if a body is dropped from rest, what is its initial velocity (u)?

(a) 9.8 m/s

(b) 10 m/s

(c) Zero ✅

(d) Depends on height

51. According to special relativity, what is the approximate value of the speed of light?

(a) 3×10^8 m/s ✅

(b) 3×10^6 m/s

(c) 3×10^4 m/s

(d) 3×10^1 m/s

52. According to the theory of special relativity, can any object with mass reach the speed of light?

(a) Yes

(b) No ✅

(c) Only under special conditions

(d) Sometimes

53. When a body is thrown vertically upwards, what is the acceleration due to gravity considered as?

(a) Positive

(b) Zero

(c) Negative ✅

(d) Variable

Exercise Short Questions:

2.1 Define scalar and vector quantities.

- **Scalar Quantity:** A physical quantity that has only magnitude but no direction.
- **Vector Quantity**: A physical quantity that has both magnitude and direction.

2.2 Give 5 examples each for scalar and vector quantities.

Scalars:

1. Speed

2. Distance

3. Time

4. Mass

5. Temperature

Vectors:

1. Velocity

2. Displacement

3. Force

4. Acceleration

5. Momentum

2.3 State head-to-tail rule for addition of vectors.

To add two or more vectors using the head-to-tail rule, place the tail of the next vector at the head of the previous vector. The resultant vector is drawn from the tail of the first vector to the head of the last vector.

2.4 What are distance-time graph and speed-time graph?

- **Distance-Time Graph**: A graph that shows the distance covered by an object over time. It helps determine speed.
- **Speed-Time Graph:** A graph that shows how speed varies with time. It helps determine acceleration and distance.

2.5 Falling objects near the Earth have the same constant acceleration. Does this imply that a heavier object will fall faster than a lighter object?

No. All objects, regardless of mass, fall with the same acceleration due to gravity (9.8 m/s^2), provided there is no air resistance. Therefore, a heavier object does not fall faster than a lighter one.

2.6 The vector quantities are sometimes written in scalar notation (not bold face). How is the direction indicated?

When a vector is written in scalar notation, its direction is shown by:

An arrow above the letter (e.g., $\vec{v}$)

Or by mentioning the direction in words (e.g., "10 m

east")

2.7 A body is moving with uniform speed. Will its velocity be uniform? Give reason.

No, because velocity also depends on direction. If the direction changes, the velocity changes even if the speed is constant. Example: In circular motion, speed is uniform but velocity is not.

2.8 Is it possible for a body to have acceleration when moving with:

(i) **Constant Velocity**: No, because acceleration is the rate of change of velocity. If velocity is constant, acceleration is zero.

(ii) **Constant Speed:** Yes, if the direction is changing, like in circular motion, then acceleration exists even if speed is constant.

Important Short Questions:

1: What is a scalar quantity? Give two examples.

Answer:

A scalar quantity is a physical quantity that is fully described by its magnitude only.

Examples: Mass and Temperature.

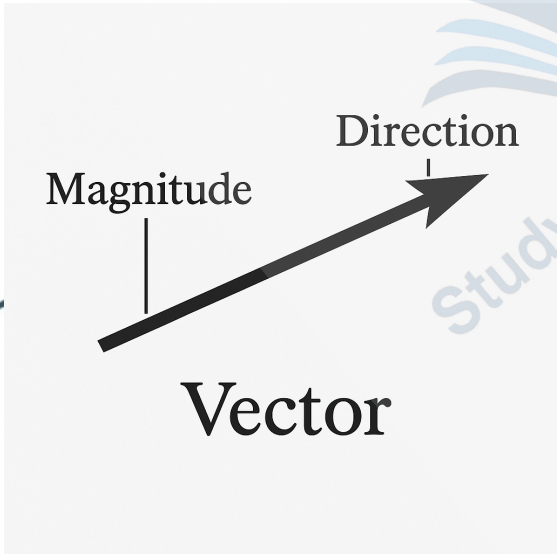
2: What is a vector quantity? Give two examples.

Answer:

A vector quantity is a physical quantity that is described by both magnitude and direction.

Examples: Velocity and Force.

3: How is a vector represented graphically?



Answer:

A vector is graphically represented by a straight line with an arrowhead.

The length of the line shows the magnitude.

The arrow shows the direction.

4: What is the difference between scalar and vector quantities?

Answer:

- **Scalar** quantities have only magnitude, e.g., time, speed.
- **Vector** quantities have both magnitude and direction, e.g., velocity, force.

5: How is the direction of a vector indicated when written in scalar notation?

Answer:

When not using bold or arrow notation, the direction is stated in words or with an angle value to show the orientation of the vector.

6: State the head-to-tail rule for vector addition.

Answer:

The head-to-tail rule states that to add vectors:

- Place the tail of one vector at the head of the

previous vector.

- The resultant vector is drawn from the tail of the first to the head of the last.

7: What is a resultant vector?

Answer:

A resultant vector is the single vector that produces the same effect as all the original vectors acting together.

8: What is the condition for a body to be at rest?

Answer:

A body is at rest if it does not change its position with respect to its surroundings.

9: Define motion with an example.

Answer:

A body is in motion if it continuously changes its position with respect to its surroundings.

Example: A moving motorcycle on the road.

10: Explain how rest and motion are relative terms.

Answer:

- **Rest** and **motion** are relative because they depend on the observer's frame of reference.
- A person may be at rest relative to the train but in motion relative to someone standing outside.

11: What are the three main types of motion?

The three main types of motion are:

1. Translatory motion
2. Rotatory motion
3. Vibratory motion

12: What is translatory motion? Give an example.

When all particles of a body move in the same direction, it is called translatory motion.

Example: Motion of a car or train.

13: Define linear motion with one example.

When a body moves along a straight line, it is called linear motion.

Example: A freely falling body.

14: What is random motion? Give an example.

Motion along an irregular path is called random motion.

Example: The motion of a flying bee.

15: What is circular motion?

The motion of a body along a circular path is called circular motion.

Example: A stone tied with a string and whirled in a circle.

16: Define rotatory motion.

When every point of a body moves around a fixed axis, the motion is called rotatory motion.

Example: Rotation of a fan.

17: What is vibratory motion?

A to and fro motion of a body about a fixed point is called vibratory motion.

Example: Motion of a swing.

18: What is the difference between distance and displacement?

- Distance is the actual path covered (scalar).

- Displacement is the shortest distance between initial and final positions (vector).

19: Define speed and give its formula.

Speed is the distance covered by a body in unit time.

Formula: Speed = Distance / Time

20: What is acceleration?

- Acceleration is the rate of change of velocity with respect to time.
- **Formula**: Acceleration = Change in velocity / Time

21. What is uniform acceleration?

When the velocity of a body changes at a constant rate, the acceleration is called uniform acceleration.

22: What is non-uniform acceleration?

When the rate of change of velocity is not constant, the acceleration is called non-uniform or variable acceleration.

23: What type of acceleration does a freely falling apple experience?

It experiences uniform acceleration due to gravity.

24: Define graph in physics.

A graph is a pictorial representation showing the relationship between two physical quantities using lines or curves.

25: What is meant by the origin of a graph?

The point where the x-axis and y-axis intersect is called the origin.

26: In a distance-time graph, which quantity is taken along the x-axis?

Time is taken along the x-axis (independent variable).

Important Long Questions:

Q1: Explain the difference between scalar and vector quantities with suitable examples.

Answer:

Physical quantities are classified into two types: scalars and vectors, depending on whether they require only magnitude or both magnitude and direction for their complete description.

Scalar Quantities:

A scalar quantity is a physical quantity that can be described completely by its magnitude only. It does not require direction.

- **Examples**: mass, time, temperature, distance, speed, energy, length, etc.
- For instance, if we say a car is moving at 50 km/h, we only know the speed, not the direction. So, speed is a scalar.

Scalars are added like regular numbers:

- **Example**: 5 m + 3 m = 8 m

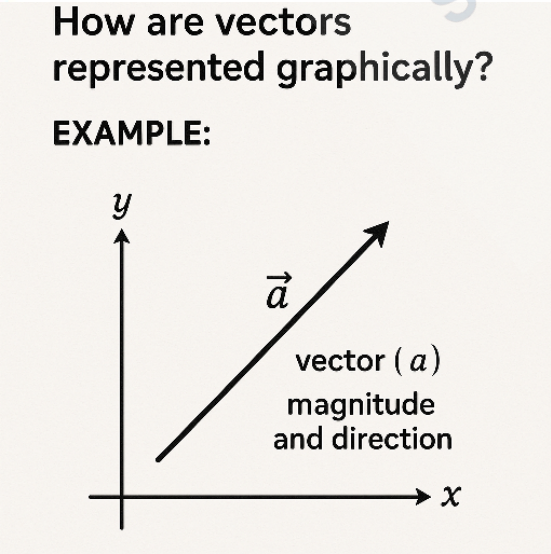
- Vector Quantities:
- A vector quantity is a physical quantity that requires both magnitude and direction to describe it completely.

Examples: velocity, displacement, force, acceleration, weight, etc.

For example, saying a car is moving at 60 km/h north means we know both the speed and direction — this is velocity, a vector quantity.

Vectors cannot be added directly like numbers. Their directions must also be considered.

Q2: How are vectors represented graphically? Explain with the help of an example.



Answer:

Vectors are represented graphically using arrows drawn on a coordinate system.

Representation Method:

1. A vector is shown as a straight line with an arrowhead.
2. The length of the line shows the magnitude, based on a scale.
3. The arrowhead shows the direction.
4. Vectors are drawn from a point called the origin, and direction is measured anticlockwise from the x-axis.

5.The vector symbol is usually written with an arrow on top, like $\vec{v}$

Example: Velocity Vector

Suppose we want to draw a velocity vector of 300 m/s at an angle of 60° east of north.

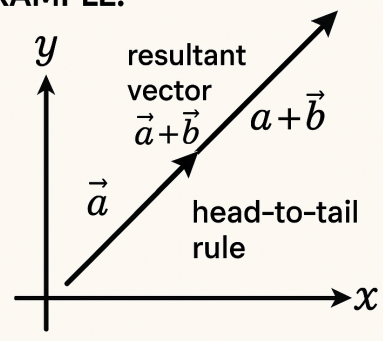
Steps:

- Draw two perpendicular lines to represent N-S and E-W directions.
- Choose a scale: e.g., 100 m/s = 1 cm, so 300 m/s = 3 cm.
- From north, draw a 3 cm line 60° towards east.
- Add an arrowhead to indicate direction.
- Label the vector as v.
- This is how we represent vectors graphically, considering both magnitude and direction.

Q3: What is a resultant vector and how are vectors added graphically? Explain head-to-tail rule with an example.

What is a resultant vector and how are vectors added graphically?

EXAMPLE:



Answer:

When two or more vectors act together, we can replace them with a single vector that has the same effect. This single vector is called the resultant vector.

Head-to-Tail Rule:

This is a graphical method to add vectors.

Steps:

1. Choose a scale to represent the magnitude of vectors.

2. Draw the first vector to scale in the correct direction.

3. From the tip (head) of the first vector, draw the second vector.

4. Continue this for all vectors.

5. Draw a vector from the tail of the first to the head of the last — this is the resultant vector.

Example:

Let vector A = 300 N at 30°, and vector B = 400 N at

60°.

Steps:

- Choose scale: 100 N = 1 cm
- Draw A = 3 cm at 30°

- From the head of A, draw B = 4 cm at 60°
- Join the tail of A to the head of B
- Measured resultant vector = 6.8 cm = 680 N
- Direction = 49° with x-axis

So, the resultant vector has both magnitude (680 N) and direction (49°), representing the combined effect of both vectors.

Q4: Define rest and motion. Explain with examples how the state of rest and motion is always relative.

Rest:

- A body is said to be at rest if it does not change its position with respect to its surroundings.
- **Example**: A motorcyclist standing on the road

appears to be at rest when observed from a nearby building or tree.

Motion:

- A body is said to be in motion if it continuously changes its position with respect to its surroundings.
- **Example**: The same motorcyclist, when riding the bike, is in motion with respect to the surroundings like buildings or poles.

Rest and motion are relative:

The state of rest or motion depends on the observer's point of view.

Example: A person standing inside a moving train is at rest with respect to other passengers but in motion relative to an observer standing on the platform. This shows that motion and rest are not absolute but relative to the observer.

Q5: What is translatory motion? Describe its types with examples.

Translatory Motion:

A body is said to be in translatory motion if it moves such that every part of the body moves the same distance in the same direction in a given time. In translatory motion, all particles of the object follow the same path.

There are three types of translatory motion:

1. Linear Motion:

When a body moves along a straight path, it is called linear motion.

Example: A car moving in a straight line, or a stone falling vertically down.

2. Random Motion:

When a body moves in an irregular or unpredictable path, it is called random motion.

Example: The movement of a butterfly, a bee flying from flower to flower, or dust particles in the air.

3. Circular Motion:

When a body moves along a circular path, it is called circular motion.

Example: A child running around a circular track, or a stone tied to a string and spun in a circle.

Q6: Describe linear motion and give an example from daily life.

Linear Motion:

- **Linear motion** is a type of translatory motion in which a body moves along a straight path. In this motion, all the points of the body move the same distance in the same direction at the same time.
- **This type** of **motion** is the simplest and most common in daily life. It can be either uniform (constant speed) or non-uniform (changing speed).

Examples:

- A ball dropped from the top of a building falls in a straight line towards the ground.
- A person walking straight on a straight road.
- A car moving along a straight highway.

- In all these cases, the object does not change direction and follows a straight path, so the motion is linear.

Q7: Explain the three types of motion (translatory, rotatory, and vibratory) with appropriate examples.

1. Translatory Motion:

A motion in which every part of the body moves in the same direction and covers the same distance.

Example: A car moving on a road.

2. Rotatory Motion:

When every point of a body moves in a circle about a fixed axis, it is called rotatory motion.

Example: The blades of a fan or the wheel of a bicycle.

3. Vibratory Motion:

When a body moves to and fro about a fixed position, it is called vibratory motion.

Example: The motion of a swing or a vibrating guitar string.

Q8: Explain random motion. How does it differ from linear motion? Provide examples.

Random Motion:

Random motion is a type of motion in which the path taken by the body is irregular and unpredictable. The direction and speed of the object change frequently and there is no fixed pattern in its movement.

Examples:

- The motion of a flying bee or butterfly.
- Dust particles moving in the air.
- Molecules of gas moving inside a container.
- Difference Between Random and Linear Motion:

Linear Motion	Random Motion
Motion occurs along a straight path.	Motion occurs along an unpredictable or zigzag path.
Direction remains constant.	Direction changes frequently.
Example: A car on a straight road.	Example: A butterfly flying in a garden.

Q9: What is the difference between speed and velocity? Explain with examples.

Answer:

Speed and velocity are both physical quantities used to describe the motion of a body, but they are different in nature.

Speed:

- **Definition:** Speed is the rate at which a body covers distance in a given time.
- **Formula:**

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \quad \text{or} \quad v = \frac{S}{t}$$

- **SI Unit:** Metres per second (**m/s**) or kilometres per hour (**km/h**).
- **Example:** If a car moves 100 km in 2 hours, its speed is:

$$\frac{100}{2} = 50\,\text{km/h}$$

Velocity:

Definition: Velocity is the rate of change of displacement with respect to time.

Formula:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}} \quad \text{or} \quad v = \frac{d}{t}$$

- **SI Unit:** Metres per second (**m/s**) or kilometres per hour (**km/h**).
- **Example:** If a car moves 100 km to the **north** in 2 hours, then its velocity is:

$$50\,\text{km/h towards north}$$

Real-life Example:

- A car moving in a circular track may have constant speed but changing velocity because its direction is continuously changing.
- An eagle diving 300 m downward in 5 seconds has a speed of 60 m/s, but the velocity is 60 m/s downward.

Q10: Explain the term velocity. How is it different from speed? Support your answer with a suitable diagram and formula.

Answer:

Velocity:

Velocity is the rate of change of displacement with

respect to time. It tells us how fast and in which direction an object is moving.

Formula:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}} \quad \text{or} \quad v = \frac{d}{t}$$

Where:

- v = velocity
- d = displacement (shortest path between two points)
- t = time taken

Nature of Velocity:

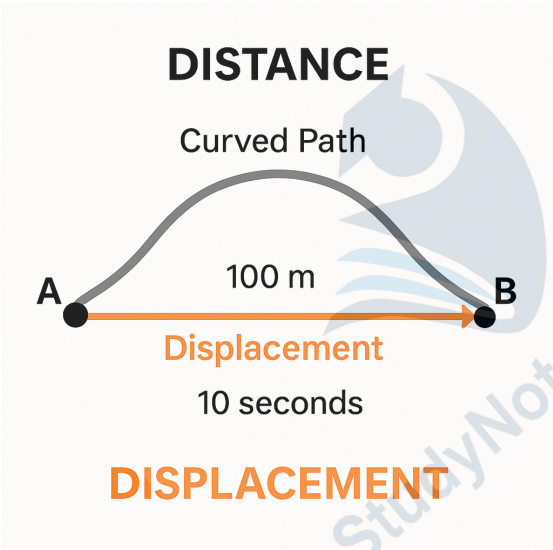
- Velocity is a vector quantity.
- It has both magnitude (numerical value) and direction.

How It Differs From Speed:

- Speed tells us how much distance is covered in a given time, without any concern for direction.
- Velocity tells us the displacement (change in position) in a particular direction in a given time.

Diagram Example:

- Imagine a body moving along a curved path from point A to point B.
- The total length of the path is the distance (used in speed).
- The straight line between A and B is the displacement (used in velocity).



If the time taken from A to B is 10 seconds and the straight-line displacement is 100 meters:

$$\text{Velocity} = \frac{100\,\text{m}}{10\,\text{s}} = 10\,\text{m/s towards B}$$

Real-life Example:

- If a person walks 1 km east and returns back to the starting point in 1 hour:
- Speed = total distance / time = 2 km / 1 hr = 2 km/h
- Displacement = 0 (since final and initial position are the same)
- Velocity = 0 km/h

C: Constructed Response Questions

2.1 Distance and displacement may or may not be equal in magnitude. Explain this statement.

Answer:

- Distance is the total length of the path covered by an object, while displacement is the shortest straight-line distance between the initial and final positions.
- If an object moves in a straight line without changing direction, the distance and

displacement will be equal in magnitude.

- However, if the object moves along a curved path or returns to its starting point, then distance and displacement will be different.

Example:

- If a boy walks 10 meters forward and 10 meters back to his starting point:
- Distance = 10 m + 10 m = 20 meters
- Displacement = 0 meters (because the starting and ending points are the same)

2.2 When a bullet is fired, its velocity with which it leaves the barrel is called the muzzle velocity of the gun. The muzzle velocity of one gun with a longer barrel is lesser than that of another gun with a shorter barrel. In which gun is the acceleration of the bullet larger? Explain your answer.

Answer:

- If the muzzle velocity is greater for the gun with a shorter barrel, then the bullet must be gaining speed more rapidly over a shorter distance.

- Since acceleration is the rate of change of velocity, and the bullet reaches a higher velocity in a shorter distance (and time), this means the acceleration is greater in the shorter barrel.
- Thus, the bullet fired from the gun with the shorter barrel experiences greater acceleration because it achieves a higher velocity over a shorter path.

2.3 For a complete trip, average velocity was calculated. Its value came out to be positive. Is it possible that its instantaneous velocity at any time during the trip had the negative value? Give justification of your answer.

Answer:

Yes, it is possible.

- Average velocity depends on the total displacement and total time of the trip.
- If the displacement is in the positive direction, then the average velocity will also be positive.
- However, instantaneous velocity is the velocity

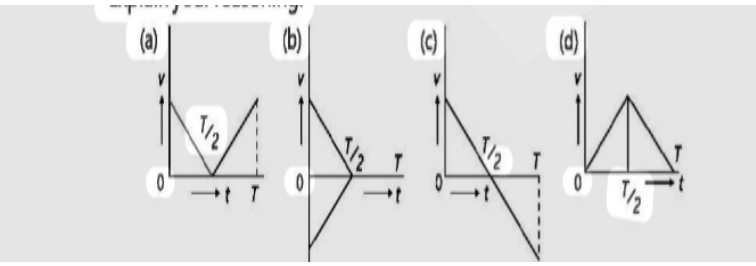
at a specific moment, and the object might have moved in the opposite direction at some point.

Example:

- A car moves 60 km north, stops, then returns 20 km south:
- Displacement = 60 - 20 = 40 km north (positive)
- Average velocity = positive
- But when the car was returning (20 km south), its instantaneous velocity was negative (toward south)

2.4 A ball is thrown vertically upward with velocity v. It returns to the ground in time 7. Which of the following graphs correctly represents the motion?

Explain your reasoning.



The correct graph representing the motion of the

ball is graph (b).

Explanation:

1. Initial motion: The ball starts with an upward velocity "v " As it rises, gravity decelerates it at -g, causing the velocity to decrease.

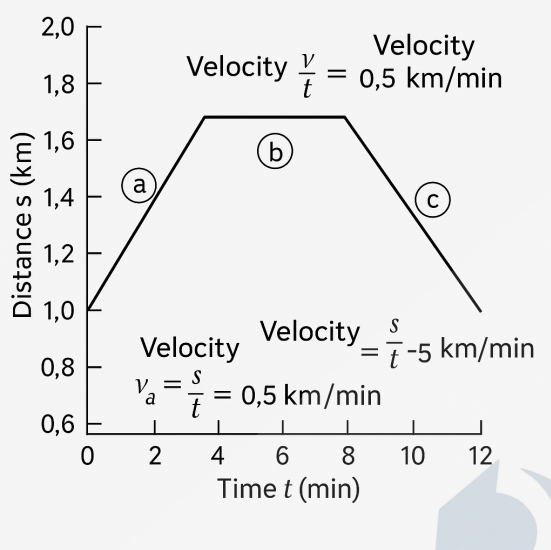
2. At the peak: After T/2, the velocity reaches 0,meaning the ball momentarily stops before descending.

3. Descending motion: The ball accelerates downward under gravity, gaining velocity in the negative direction until it reaches -v just before hitting the ground at time T.

4. Linear velocity change:

- Since gravity applies a constant acceleration, the velocity changes linearly with time.
- Graph (b) correctly illustrates a linear decrease from v to -v over time T, making it the accurate representation of the motion.

2.5 The figure given below shows the distance time graph for the travel of a cyclist. Find the velocities for the segments a, b and c.



To find the velocities for the segments a, b, and c, we need to determine the slopes of each section in the distance-time graph because velocity is the rate of change of distance with respect to time.

Velocity Calculation for Each Segment:

1. Segment a:

- If segment "a"shows "a" straight, upward slope, it indicates the cyclist is moving at a constant velocity.

- Velocity (v_a) = slope of segment a =

(Δdistance)/(Δtime)

2. Segment b:

- If segment "b" is "a" horizontal line, the cyclist is **not moving,** meaning velocity is **zero**.

- Velocity (v_β) = 0 m/s

3. Segment c:

- If segment "c" slopes **downward**, it indicates the cyclist is moving **backwards** (returning).

- The velocity in this case is **negative**, showing movement in the opposite direction.

- **Velocity** (v_c) = slope of segment c = (Δdistance)/(Δtime), but negative

2.6 Is it possible that the velocity of an object is zero at an instant of time, but its acceleration is not zero? If yes, give an example of such a case.

Answer:

Yes, it is possible for an object to have zero velocity at a particular instant and still have a non-zero

acceleration.

Example:

When a ball is thrown vertically upward, at the highest point:

- Its velocity becomes zero (it stops rising)
- But acceleration due to gravity ($g = 9.8\ m/s^2$) is still acting downward
- This acceleration causes the ball to change direction and start falling back down. So, even though the velocity is zero for an instant, acceleration is still present.

D: Comprehensive Questions

2.1 How a vector can be represented graphically?

1. **Definition**: A vector is a quantity that has both magnitude and direction.

2. **Graphical Representation:** A vector is represented by a straight arrow.

3. **Arrow Head**: The direction of the arrow shows the direction of the vector.

4. **Length of Arrow:** The length of the arrow shows the magnitude (size) of the vector.

5. **Example**: If a force of 10 N acts to the right, we draw an arrow pointing right with a length proportional to 10 N.

2.2 Differentiate between:

(i) Rest and Motion

1. A body is at rest if it does not change its position with respect to its surroundings.

2. A body is in motion if it changes its position with respect to its surroundings.

3. Example (Rest): A tree standing still.

4. Example (Motion): A moving car.

(ii) Speed and Velocity

1. Speed is the rate of covering distance; it is a

scalar quantity (no direction).

2. Velocity is the rate of displacement; it is a vector quantity (has direction).

3. **Example** (Speed): Car moving at 60 km/h.

4. **Example** (Velocity): Car moving at 60 km/h towards north.

2.3 Describe different types of motion. Also give examples.

There are three main types of motion:

1. **Translatory Motion**: Every point of the object moves in the same direction.

Example: Moving train.

2. **Rotatory Motion**: Object rotates around a fixed axis.

Example: Blades of a fan.

3. **Vibratory Motion**: Object moves to and fro about a mean position.

Example: Motion of a pendulum or swing.

2.4 Explain the difference between distance and displacement.

1. Distance is the total path covered by a moving object; it is a scalar quantity.

2. Displacement is the shortest straight-line distance from the initial to the final position; it is a vector quantity.

3. Distance is always positive, but displacement can be positive, negative, or zero.

4. **Example**: If a boy walks 5 m east and 5 m back to the starting point,

- Distance = 10 m
- Displacement = 0 m

2.5 What do gradients of distance-time graph and speed-time graph represent?

1. In a distance-time graph, the gradient (slope) shows the speed of the object.

Steeper slope = higher speed.

2. In a speed-time graph, the gradient shows the

acceleration of the object.

- Positive slope = increasing speed (acceleration).
- Negative slope = decreasing speed (deceleration).

2.6 Prove that the area under speed-time graph is equal to the distance covered by an object.

1. In a speed-time graph, the vertical axis represents speed, and the horizontal axis represents time.

2. The area under the graph represents:

Speed × Time = Distance.

3. For example, if speed is constant (a straight line), the graph forms a rectangle.

Area = length × width = speed × time = distance.

4. Even for non-uniform speed, calculating the area gives total distance covered.

2.7 How equations of motion can be applied to the bodies moving under the action of gravity?

1. Bodies moving under gravity experience constant acceleration:

$g = 9.8\ m/s^2$ downward.

2. The equations of motion can be used by replacing a with g:

$v = u + gt$

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

$v^2 = u^2 + 2gs$

3. When a body is thrown upward, g is taken as negative.

4. These equations help find the maximum height, time to reach it, and total time of flight.

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of

deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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