Exercise

A. ✓Multiple Choice Questions (MCQs)

Tick (✓) the correct answer.

2.1 The numerical ratio of displacement to distance is:
✓(d) **equal to or less than one**

Displacement is either equal to or less than distance depending on the path taken.

2.2 If a body does not change its position with respect to some fixed point, then it will be in a state of:
✓(a) **rest**

2.3 A ball is dropped from the top of a tower. Distance covered in first second is:
✓(c) **5 m**

Use $s = ½gt^2 = ½ \times 10 \times 1^2 = 5$ m

2.4 A body accelerates from rest to 144 km/h in 20 seconds. Distance covered is:
✓(b) **400 m**

Convert 144 km/h = 40 m/s; Use $s = ½at^2 = ½ \times 2 \times 20^2 = 400$ m

2.5 A body covers distance S in 4 s with constant acceleration. Time to cover S/4 is:
✓(a) **1 s**

2.6 Displacement-time graph of object A has a steeper slope than object B. Then:
✓(a) **The velocity of A is greater than B**

2.7 Area under the speed-time graph represents:
✓(d) **distance covered**

2.8 Gradient of speed-time graph represents:
✓(c) **acceleration**

2.9 Gradient of distance-time graph is:
✓(b) **velocity**

2.10 A car accelerates from 80.5 to 113 km/h in 9 s. Which graph represents this?
✓(a) **Velocity-time graph with positive slope**

B. ✍ Short Answer Questions

2.1 Define scalar and vector quantities.

- **Scalar**: Quantity with only magnitude (e.g., speed, mass)
- **Vector**: Quantity with magnitude and direction (e.g., velocity, force)

2.2 Five examples each of scalar and vector quantities.

- **Scalar**: Time, Mass, Temperature, Speed, Distance
- **Vector**: Velocity, Displacement, Force, Acceleration, Weight

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

- Place tail of second vector at the head of the first.
- Draw resultant from tail of first to head of last vector.

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

- **Distance-time graph**: Shows how distance changes over time.
- **Speed-time graph**: Shows how speed changes over time.

2.5 Do heavier objects fall faster than lighter ones?

- No. All objects fall with same acceleration ($g = 10\ m/s^2$) without air resistance.

2.6 How is direction indicated in scalar notation for vectors?

- Direction is shown using angles or directions like "30° East".

2.7 If speed is uniform, will velocity also be uniform?

- Only if direction remains constant. If direction changes, velocity changes.

2.8 Can a body have acceleration when moving with:
(i) Constant velocity – ✗No
(ii) Constant speed – ✓Yes, if direction changes (e.g., in circular motion)

C. ? Constructed Response Questions

2.1 Explain why distance and displacement may or may not be equal.

- **Equal**: When motion is in a straight line without change in direction.
- **Not equal**: When path is curved or returns to starting point.

2.2 Which gun gives more acceleration: longer or shorter barrel? Why?

- **Shorter barrel** gun gives more acceleration if it produces more velocity in less time.

2.3 Can average velocity be positive and instantaneous velocity negative?

- **Yes**. On a return journey, overall displacement may be positive, but instantaneous velocity can be negative.

2.4 Graph of a ball thrown upward and returning in time T:

- **Correct graph**: (c)
- Velocity decreases to zero at T/2, then becomes negative as it returns.

2.5 Find velocities in segments a, b, c of a cyclist's distance-time graph.

- Use: Velocity = ΔDistance / ΔTime
- a: (1.6 – 1.0)/(6 – 2) = 0.6/4 = **0.15 km/min = 2.5 m/s**
- b: Flat ⇒ **0 m/s**
- c: (2.0 – 1.6)/(18 – 10) = 0.4/8 = **0.83 m/s**

2.6 Can velocity be zero but acceleration not zero?

- Yes. At highest point of upward throw: $v = 0$, but $a = -10\ m/s^2$

D. 📓 Comprehensive Questions

2.1 How is a vector represented graphically?

- As an arrow:
  - Length = magnitude
  - Arrowhead = direction
  - Example: Force of 20 N at 45°

2.2 Differentiate between:
(i) **Rest vs Motion**:

- Rest: No change in position
- Motion: Change in position with time
  (ii) **Speed vs Velocity**:
- Speed: Scalar
- Velocity: Vector (with direction)

2.3 Types of motion with examples:

1. **Translational** – Car moving
2. **Rotational** – Wheel spinning
3. **Oscillatory** – Pendulum swinging

2.4 Difference between distance and displacement:

Quantity	Distance	Displacement
Type	Scalar	Vector
Path	Total path	Shortest path
Can be zero?	No	Yes (if returns)

2.5 What do gradients represent?

- **Distance-time graph**: Gradient = **velocity**
- **Speed-time graph**: Gradient = **acceleration**

2.6 Area under speed-time graph = distance

- **Area = speed × time**
- Use rectangle and triangle areas

2.7 Using equations of motion under gravity:

- Replace a with g
- Use:
  - $Vf = Vi + gt$
  - $s = Vit + \frac{1}{2}gt^2$
  - $Vf^2 = Vi^2 + 2gS$

E. 📐 Numerical Problems (With Solutions)

- $\mathbf{v_i}$ → *Initial velocity*
- $\mathbf{v_f}$ → *Final velocity*
- **s** → *Displacement / distance*
- **a** → *Acceleration*
- **t** → *Time*
- **g** → *Acceleration due to gravity (10 m/s²)*

2.1 Draw the representative lines of the following vectors:

(a) A velocity of 400 m/s making an angle of 60° with x-axis
(b) A force of 50 N making an angle of 120° with x-axis

Solution:

- Choose a scale (e.g., 1 cm = 100 m/s or 10 N).
- Use ruler and protractor:

- (a) Draw 4 cm arrow at 60° from x-axis
- (b) Draw 5 cm arrow at 120° from x-axis

2.2 A car moves at an average speed of 72 km/h. How much time will it take to cover 360 km?

Given:
Average speed = 72 km/h
Distance, s = 360 km
Time, t = ?

Formula:

$t = S / V$

Solution:

$t = 360 / 72 = 5$ hours

✓**Answer:** 5 hours

2.3 A truck starts from rest and reaches a velocity of 90 km/h in 50 s. Find its average acceleration.

Given:
$v_i = 0$
$v_f = 90$ km/h = 25 m/s
t = 50 s
a = ?

Formula:

$a = v_f - v_i / t$

Solution:

$a = 25 - 0 / 50 = 0.5\ m/s^2$

✓**Answer:** 0.5 m/s^2

2.4 A car passes a signal at 5 m/s and accelerates at 1.5 m/s^2 for 5 seconds. Find its final velocity.

Given:
$v_i = 5$ m/s
$a = 1.5$ m/s²
$t = 5$ s
$v_f = ?$

Formula:

$v_f = v_i + at$

Solution:

$v_f = 5 + (1.5 \times 5) = 5 + 7.5 = 12.5$ m/s

✓**Answer:** 12.5 m/s

2.5 A motorcycle initially at 18 km/h accelerates at 2 m/s². Find distance covered in 10 seconds.

Given:
$v_i = 18$ km/h $= 5$ m/s
$a = 2$ m/s²
$t = 10$ s
$s = ?$

Formula:

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

Solution:

$s = 5 \times 10 + \frac{1}{2} \times 2 \times 10^2 = 50 + 100 = 150$ ms

✓**Answer:** 150 m

2.6 A wagon is moving at 54 km/h and stops after 25 m. Find the acceleration.

Given:
$v_i = 54$ km/h $= 15$ m/s
$v_f = 0$
$s = 25$ m
$a = ?$

Formula:

$v_f^2 = v_i^2 + 2as \Rightarrow a = v_f^2 - v_i^2 / 2S$

Solution:

$a = 0 - (15)^2 / 2 \times 25 = -225 / 50 = -4.5\ m/s^2$

✓**Answer:** –4.5 m/s² (*Negative sign = deceleration*)

2.7 A stone is dropped from 45 m. How long does it take to reach the ground and what is v_f?

Given:
$v_i = 0$
$s = 45\ m$
$g = 10\ m/s^2$
$t = ?,\ v_f = ?$

(i) Time:

$s = 1 / 2\ gt^2 \Rightarrow 45 = 5t^2 \Rightarrow t^2 = 9 \Rightarrow t = 3\ s$

(ii) Final velocity:

$v_f = v_i + gt = 0 + 10 \times 3 = 30\ m/s$

✓**Answer:** $t = 3\ s,\ v_f = 30\ m/s$

2.8 A car travels 10 km at 20 m/s, then 0.8 km at 4 m/s. Find average velocity for total journey.

Step 1: Convert distances to meters
10 km = 10,000 m
0.8 km = 800 m

Step 2: Find time for each part

- $t1 = 10000 / 20 = 500\ s$
- $t2 = 800 / 4 = 200\ s$

Total distance = 10,800 m
Total time = 700 s

Formula:

$V_{av} = \text{Total distance} / \text{Total time} = 10800 / 700 \approx 15.43\ m/s$

✓**Answer:** 15.4 m/s

2.9 A ball is dropped and hits the ground in 5 s. Find the height and velocity just before impact.

Given:
$v_i = 0$
$t = 5$ s
$g = 10$ m/s²
$s = ?$, $v_f = ?$

(i) Height:

$s = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 25 = 125$ ms

(ii) Final velocity:

$v_f = v_i + gt = 0 + 10 \times 5 = 50$ m/s

✓**Answer:** Height = 125 m, Final velocity = 50 m/s

2.10 A cricket ball reaches the highest point in 3 s. What is v_i and how high did it rise (from 1 m above ground)?

Given:
$t = 3$ s
$g = 10$ m/s²
$v_f = 0$
$v_i = ?$
$s = ?$

(i) Initial velocity (v_i):

$v_f = v_i - gt \Rightarrow 0 = v_i - 10 \times 3 \Rightarrow v_i = 30$ m/s

(ii) Height from point of throw:

$s = v_i t - \frac{1}{2}gt^2 = 30 \times 3 - 5 \times 9 = 90 - 45 = 45$ ms

Total height from ground:
1 + 45 = ✓**46 m**

✓**Answer:**

- Initial velocity (v_i) = 30 m/s & Maximum height from ground = 46 m