

STRUCTURE QUESTIONS

REST AND MOTION

a) Define rest and motion. (see notes page 1,2)

ANS:

Rest:

An object is said to be at **rest** if it does not change its position with time with respect to a chosen reference point or observer.

Motion:

An object is said to be in **motion** if it changes its position with time with respect to a chosen reference point or observer.

b) What is meant by relative motion.

Ans **Relative Motion** is defined as the motion of an object when observed with respect to another object which may be either at rest or in motion.

Example of Relative Motion:

Suppose you and your friend are traveling on a train sitting together and a boy standing alongside the track is observing you. Both of you don't change your position with respect to each other hence both of you are at rest with respect to each other but with respect to the boy who was standing outside you and your friend are in motion because your position is changing with time.

TYPES OF MOTION

a) Define speed and velocity (see notes page 6,)

b) What is difference between distance and displacement. (see notes page 6)

c) Define acceleration (see notes page 7)

d) Calculate the acceleration of a bus that speed up from 20ms^{-1} to 40ms^{-1} in 8 seconds.

DATA

$$v_i = 20 \text{ m/s}$$

$$v_f = 40 \text{ m/s}$$

$$t = 8 \text{ sec}$$

$$a = ?$$

$$a = \frac{v_f - v_i}{t}$$
$$a = \frac{40 - 20}{8}$$
$$a = \frac{20}{8}$$
$$a = 2.5 \text{ m/s}^2$$

SCALARS AND VECTORS

a) Define scalar and vector quantities?

ANS:

SCALARS DEFINITION

Physical quantities that are completely specified by their magnitude (a number with suitable unit) are called scalars.

VECTORS DEFINITION

Physical quantities that have both magnitude and direction and that follow the laws vector addition are called vectors.

b) How represent vector quantities are represented graphically?

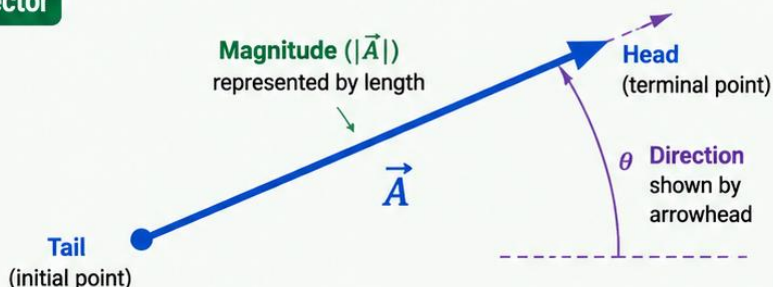
How Vector Quantities Are Represented Graphically

A vector is represented by a directed line segment (an arrow).
It has both **magnitude** (length) and **direction**.

Basic Rules

- **Length of the arrow** → represents the **magnitude** (scale chosen appropriately).
- **Arrowhead** → shows the direction of this vector.
- **Tail (initial point)** → starting point of the vector.
- **Head (terminal point)** → ending point; the vector is drawn from tail to head.

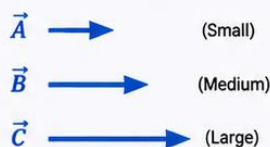
Single Vector



\vec{A} : vector A
 $|\vec{A}|$: magnitude
 θ : direction (angle)

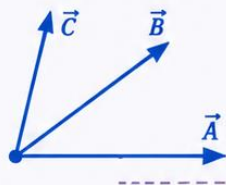
Multiple Vectors – Examples

1. Different Magnitudes (Same Direction)



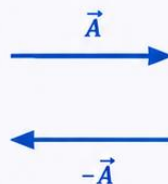
Longer arrow → greater magnitude

2. Different Directions (Different Angles)



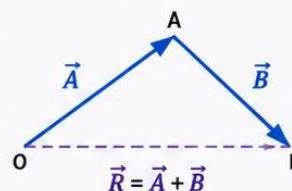
Direction is shown by the orientation of the arrow.

3. Opposite Vectors (Same Magnitude)



Equal length, opposite → direction.

4. Vector Addition (Triangle Law)



Place tail of \vec{B} at head of \vec{A} .
Resultant \vec{R} goes from O to B.



Key Idea: A vector is completely specified by its **magnitude** and **direction**, and is graphically represented by an arrow.

EQUATION OF MOTION

- a) A bus is moving on a road with 15ms^{-1} and it accelerates at 5ms^{-2} . Find the final velocity of bus after 6 seconds.

DATA $v_i = 15\text{ms}^{-1}$ $a = 5\text{ms}^{-2}$ $v_f = ?$ $t = 6\text{sec}$	$v_f = v_i + a t$ $v_f = 15 + (2)(6)$ $v_f = 15 + 12$ $v_f = 22\text{ms}^{-1}$
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- b) A car starts moving from rest with an acceleration of 5ms^{-2} . Find out the time to travel 50 m distance.

DATA $v_i = 0\text{m/s}$ $a = 5\text{ms}^{-2}$ $t = ?$ $S = 50\text{m}$	SOLUTIONS $S = v_i t + \frac{1}{2} a t^2$ $50 = (0)(t) + \frac{1}{2} (5) t^2$ $50 = 0 + 2.5 t^2$ $\frac{50}{2.5} = t^2$ $20 = t^2$ $\sqrt{20} = \sqrt{t^2}$ $4.47\text{s} = t$
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MOTION DUE TO GRAVITY

- a) Define motion under gravity?
b) **Why gravity is taken negative for an object moving in upward direction?**

Ans

- c) A ball is dropped from a height of 50m. What will be its velocity before touching ground?

DATA $v_i = 0\text{m/s}$ $h = 50\text{m}$ $v_f = ?$ $g = 9.8\text{m/s}^2$	SOLUTIONS $2 g h = v_f^2 - v_i^2$ $2(9.8)(50) = v_f^2 - (0)^2$ $980 = v_f^2$ $\sqrt{980} = \sqrt{v_f^2}$ $31.33\text{m/s} = v_f$
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- d) If a body is thrown up ward with vertical velocity 50 ms^{-1} . Calculate maximum height which body can reach.

DATA $v_i = 50 \text{ m s}^{-1}$ $h = ?$ $v_f = 0$ (at maximum height $v = 0$) Upward motion g taken as negative $g = -9.8 \text{ m s}^{-2}$	SOLUTIONS $2 g h = v_f^2 - v_i^2$ $2 (-9.8) h = (0)^2 - (50)^2$ $-19.6 h = -2500$ $h = \frac{-2500}{-19.6}$ $h = 127.55 \text{ m}$
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- e) A ball falls down from top of height of 70m. How much time the ball will take to reach the ground.

DATA $v_i = 0 \text{ m/s}$ $h = 70 \text{ m}$ $t = ?$ $g = 9.8 \text{ m s}^{-2}$	SOLUTIONS $h = v_i t + \frac{1}{2} g t^2$ $70 = (0)(t) + \frac{1}{2} (9.8) t^2$ $70 = 0 + 4.9 t^2$ $\frac{70}{4.9} = t^2$ $14.28 = t^2$ $\sqrt{14.28} = \sqrt{t^2}$ $3.778 \text{ s} = t$
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