RADIANT 2026

Physics

Motion In One Dimension

Lecture - 02

By - Akash Shravan Sir

Topics *to be covered*

1. Scalar and Vector Quantities
2. Rest and Motion
3. Displacement
4. Questions

5) Speed || Velocity || Acceleration

1) 10-20 J

2) 20-30

3) 1 July - 15 July

4) 15 J - 30 J

Distance → Scalar → m → (+)

Displacement → Vector → m → +/-/0

1-Dimension

$$\text{Speed} = \frac{d}{t}$$

$\frac{m}{s}$ or $\frac{km}{s}$

Scalar

Uniform

Non-Uniform

Instantaneous

Average Speed = $\frac{\text{total distance}}{\text{time}}$

$\frac{km}{h} \xrightarrow{5/18} \frac{m}{s}$, $\frac{km}{h} \xleftarrow{18/5} \frac{m}{s}$

Question

A car travels 10 km north, then turns and travels 5 km east. What is the total distance and displacement covered by the car?

Distance = 15 km

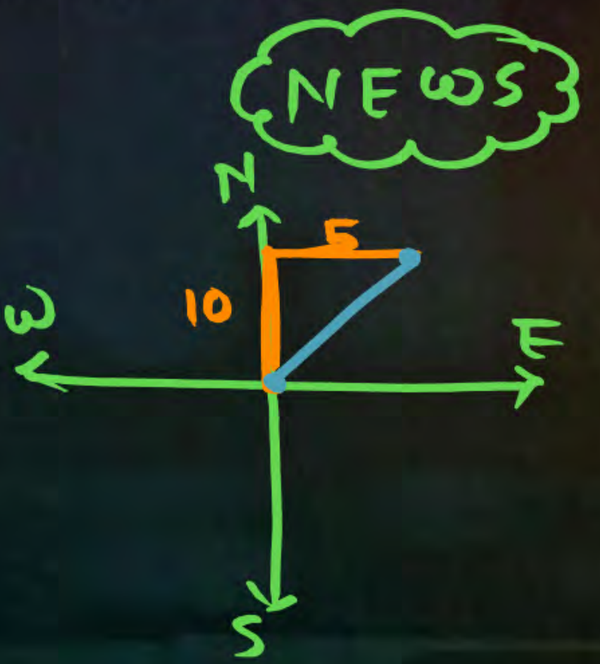
Displacement = $\sqrt{10^2+5^2}$

$= \sqrt{100+25}$

$= \sqrt{125}$

$= \sqrt{5\times5\times5}$

$= 5\sqrt{5}$ km



Question

A car travels 10 km north, then turns and travels 5 km east. What is the total distance and displacement covered by the car?

Solution.

Total distance covered = 10 km + 5 km = 15 km

Displacement = $\sqrt{(10^2 + 5^2)} = \sqrt{125}$ km $\approx$ 11.2 km (in a northeast direction)

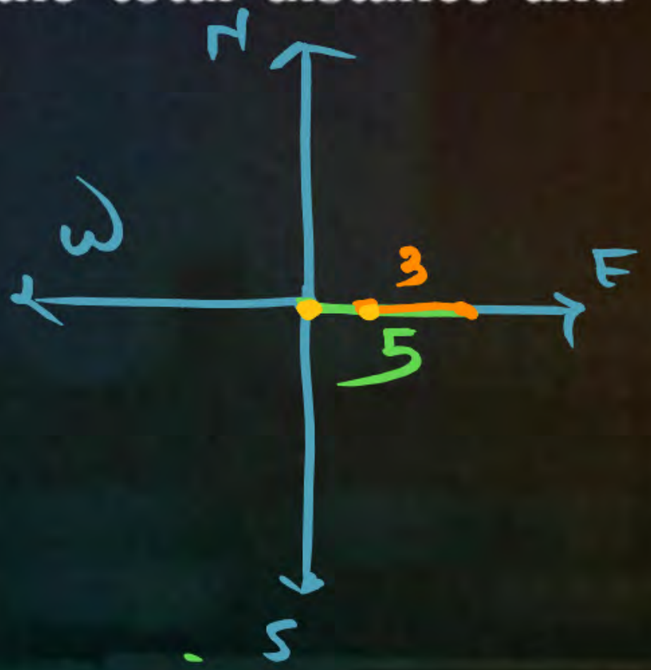
Question

A person walks 5 m east and then 3 m west. What is the total distance and displacement covered by the person?

Distance = 8 m

$S = 5 - 3$

$= 2\,m\ [E]$



Question

A person walks 5 m east and then 3 m west. What is the total distance and displacement covered by the person?

Solution.

Total distance covered = 5 m + 3 m = 8 m

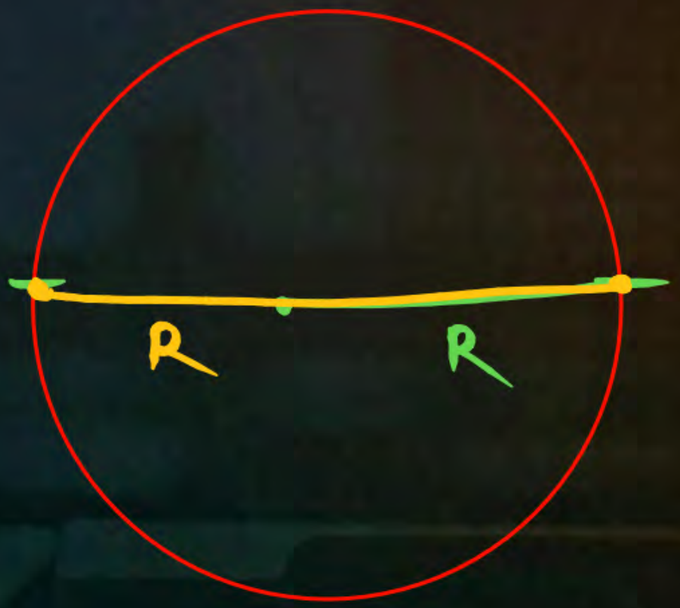
Displacement = 5m – 3 m = 2 m (in the east direction)

Question

A body is moving along a circular path of radius R. What will be the distance travelled and displacement of the body when it completes half a revolution?

$$\text{Distance} = \frac{2\pi r}{2} = \pi r$$

$$\text{Displacement} = 2R$$



Question

If on a round trip you travel 6 km and then arrive back home:

(a) What distance have you travelled? 12 km

(b) What is your final displacement? 0

$$\text{Velocity} = \frac{\text{displacement}}{\text{time}}$$

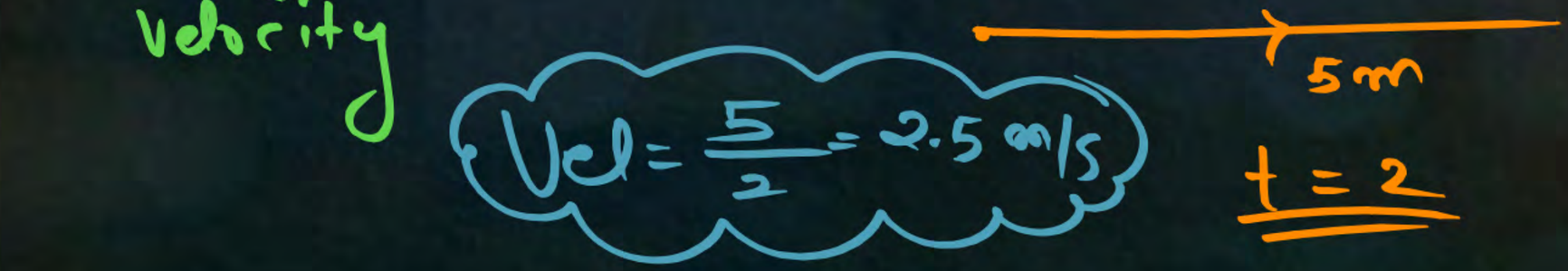
Vector

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

Speed + Direction

↓

Velocity



$Vel = \frac{5}{2} = 2.5\ m/s$

Velocity

The velocity of a body is the distance travelled per second by the body in a specified direction.

$$\vec{V} = \frac{\vec{S}}{t}$$

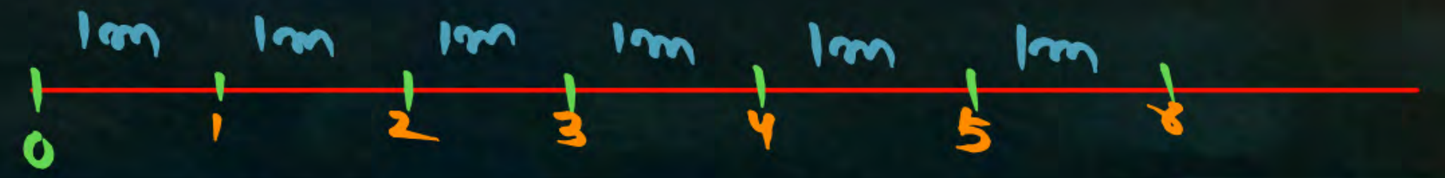
Unit :- m/s or km/h

:- +ve | -ve | Zero

:- Direction

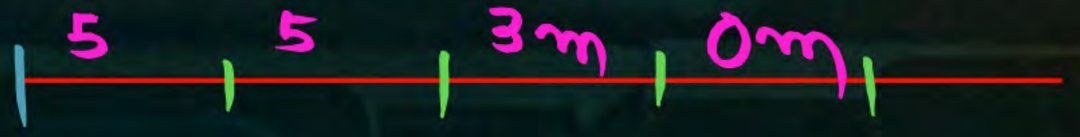
Uniform Velocity

If a body travels equal distances in a particular direction, in equal intervals of time, the body is said to be moving.



Non-uniform or Variable Velocity

The velocity of a body can be variable either due to change in its magnitude or in its direction or in both magnitude and direction. If a body moves unequal distances in a particular direction in equal intervals of time or it moves equal distances in equal intervals of time, but its direction of motion does not remain the same, then the velocity of the body is said to be variable (or non-uniform).



Instantaneous Velocity

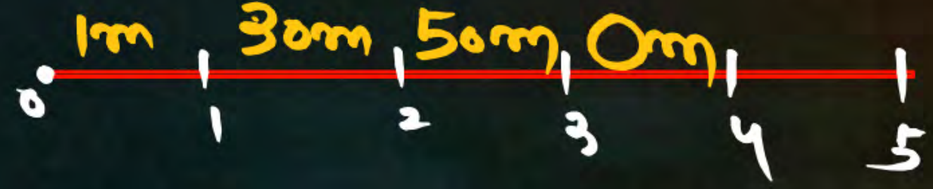
$$v = \frac{ds}{dt}$$

For a body moving with variable velocity, the velocity of the body at any instant is called its instantaneous velocity. It is measured by finding the ratio of the distance travelled in a sufficiently small time interval, to the time interval. It is important to have time interval small enough so that the direction of motion does not change during this interval.

Average Velocity

If the velocity of a body moving in a particular direction changes with time, the ratio of displacement to the time taken in entire journey is called its average velocity. Thus,

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Total time taken}}$$



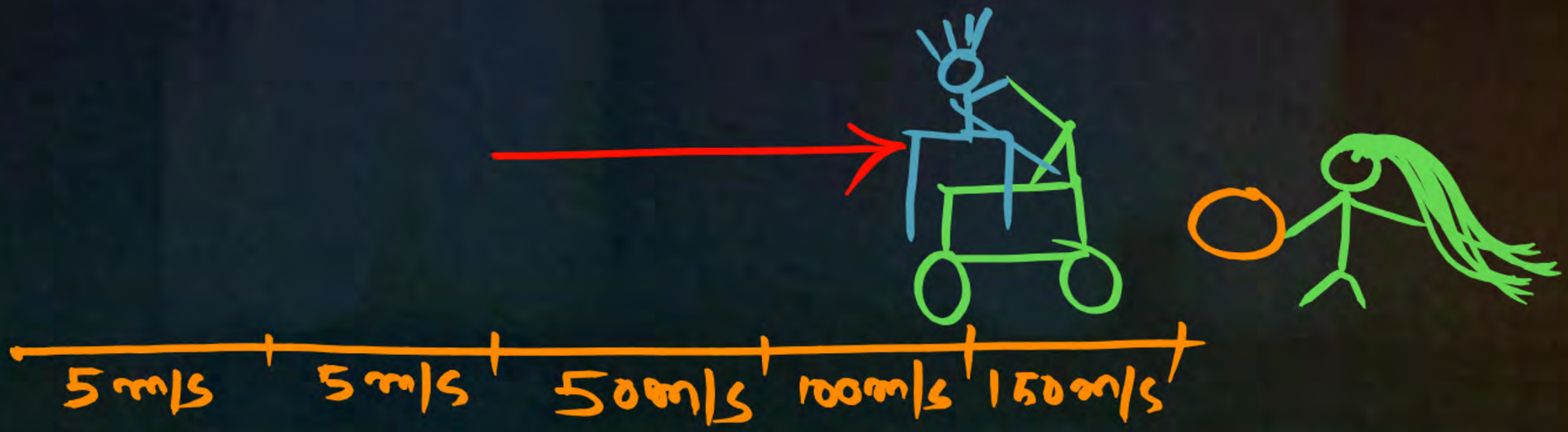
Distinction Between Speed and Velocity

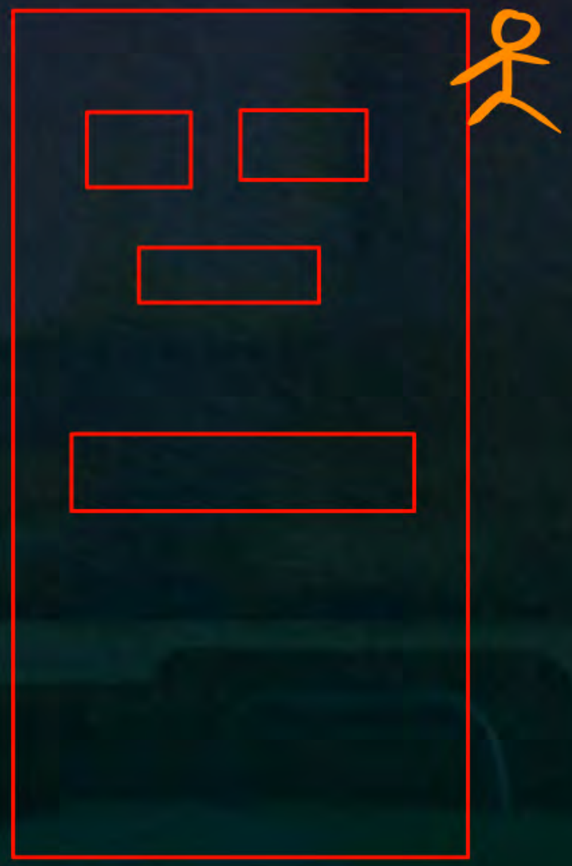
Speed	Velocity
1. The distance travelled per second by a moving object is called its speed.	1. The distance travelled per second by a moving object in a particular direction is called its velocity.
2. It is a scalar quantity. The speed does not tell us the direction of motion.	2. It is a vector quantity. The velocity tells us the speed as well as the direction of motion.
3. The speed is always positive since direction is not taken into consideration.	3. The velocity can be positive or negative depending upon the direction of motion.
4. After one round in a circular path, the average speed is not zero.	4. After completing each round in a circular path, the average velocity is zero.

u = Initial Velocity
t = time
S = Displacement
a = acceleration
V = final Velocity

$$\text{Average Velocity} = \frac{\text{Initial Velocity} + \text{Final Velocity}}{2}$$

$$V_{av} = \frac{u+v}{2}$$


5 m/s
5 m/s
50 m/s
100 m/s
150 m/s



$u = 0$

$V = 10\ m/s$

$V = 20\ m/s$

$V = 30\ m/s$

$V = 40\ m/s$

$V = 50\ m/s$

Acceleration and Retardation

Acceleration

Acceleration is the rate of change of velocity with time.

Thus, acceleration is numerically equal to the change in velocity in 1 s. i.e.,

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Unit of time}}$$

$\frac{m/s}{s} = \frac{m}{s^2}$

Vector

Unit:

$$\text{Unit of acceleration} = \frac{\text{Change in velocity}}{\text{Time interval}}$$

The S.I. unit of velocity is metre per second and of time is second.

$$\therefore \text{ S.I. unit of acceleration is } \frac{\text{metre per second}}{\text{second}}$$

$V = 10\ m/s$

$V = 5\ m/s$

$V = 3\ m/s$

Acceleration and Retardation

Acceleration is a **vector quantity.** It is represented by the symbol $\vec{a}$. The direction of acceleration is the direction of change in velocity. For the motion in a straight line, the acceleration is in direction of motion of the body.

$$\text{acceleration} = \frac{\text{Final Vel} - \text{Initial Vel}}{t}$$

$$a = \frac{V - u}{t} \quad m/s^2$$

$u = 30\ m/s$

$V = 40\ m/s$

Relation for Acceleration

Let a body be moving in a straight line in one direction with an initial velocity u. Its velocity changes in a short time interval t and the final velocity becomes v after time t. Then change in velocity = $(v - u)$ and time taken = t.

$\therefore$ Acceleration $a = \frac{(v-u)}{t}$

or $v = u + a\,t$

If $v > u$, then a is positive, thus a is the acceleration. But if $v < u$, then a is negative, and a is the retardation.

a

$a \rightarrow m/s$

$B \rightarrow s/m$

$C \rightarrow m/s^2$

$D \rightarrow s^2/m$

Speed

$A \rightarrow$ Scalar


Thank you