MOTION

by Sony sir

* **Rest** → When a body does not change it's position with respect to time and their surrounding then body said to be in Rest.
eg (a) A book placed on the table. (b) A boy stand up on the ground. etc

* **Motion** → When a body change it's position with respect to time and their surrounding then body said to be in Motion.
eg (i) A boy runs on the Road. (ii) A car moves on the Road. etc.

* **Types of Motion** → (a) **Linear Motion** → When a body moves on a straight or linear path then it's motion is called Linear Motion. eg- A car runs on straight Road. etc.

(b) **Circular Motion** → When a body moves on a circular path then it's motion is called circular Motion. eg. A boy runs on a circular Track. etc.

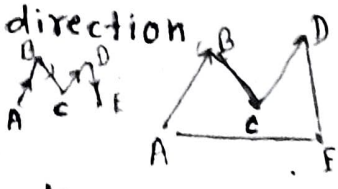
c.) **Periodic Motion** → When a body Repeats it's Motion after a fixed interval of time then it's motion is called Periodic Motion.
ex- (i) Motion of Pendulam.

d.) **Atrandom Motion** → A type of motion in which direction of body be changes at every moment of time, called Atrandom Motion. ex. Motion of Bee.

Sony

* **Distance** → The Actual length of path travelled by a moving body in any Direction, called Distance. Distance is a Scalar P.Q. S.I. unit of Distance is meter (m).

Displacement → The shortest Distance between initial point and Final Point of a moving body, having a fix direction called Displacement. It is a vector P.Q.



Distance = AB + BC + CD + DE, And Displacement = AE

Speed → The Distance travelled per unit time in any direction is called speed. Speed is a Scalar P.Q.

$$\text{Speed} = \frac{\text{Distance}}{\text{time}} \rightarrow V = \frac{D}{t}$$

S I Unit of speed is m/s.

Average Speed → When For a moving body it's total Distance travelled divided by it's total time taken then it's Average speed obtained.

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{total time taken}}$$

$$V_{av} = \frac{V_1 \times t_1 + V_2 \times t_2}{t_1 + t_2}$$

$$V_{av} = \frac{S_1 + S_2}{t_1 + t_2}$$

$$V_{av} = \frac{S_1 + S_2}{\frac{S_1}{V_1} + \frac{S_2}{V_2}}$$

- **Motion.** An object which changes its position with respect to a fixed point is said to be in motion.
- **Motion is a relative term.** An object at rest with respect to one object may also be in motion with respect to another object.
- **Reference point.** A fixed point with respect to which an object changes its position is known as a reference point.
- **Distance.** The length of actual path between the initial position and the final position of a moving object or body is known as distance travelled by the particle.
- **Displacement.** The shortest distance between the initial and final positions of a moving object or body in a direction from initial to the final position of the particle is known as displacement of the particle.
- **Units of distance and displacement.** SI unit of distance and displacement is **metre** (m).
- Distance travelled by a body is always **positive.**
- Displacement of body may be **positive, negative** or **zero.**
- Ratio of the magnitude of displacement and the distance is equal or less than 1.
- **Uniform motion.** The motion of a body is said to be uniform if (*i*) it moves along a straight line and (*ii*) it covers equal distances in equal intervals of time, how-so-ever, small these intervals may be.
- **Non-uniform motion.** The motion of a body is said to be non-uniform if it covers unequal distances in equal intervals to time.
- **Speed.** The distance travelled by a body in unit time is known as the speed of the body. That is

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

Sony by Sony Sir

- **Unit of speed.** SI unit of speed is m s^{-1}.
- **Uniform speed.** If a moving body covers equal distances in equal intervals of time, then speed of body is said to be uniform speed.
- **Non-uniform speed.** If a moving body covers unequal distances in equal intervals of time, the speed of the body is non-uniform.
- **Average speed.** The total distance travelled by a body during non-uniform motion divided by the time taken to travel this distance is called average speed.

i.e. $$\text{Average speed} = \frac{\text{Total distance travelled by body during non-uniform motion}}{\text{Total time taken}}$$

- **Velocity.** The displacement of body per unit time is known as the velocity of the body. That is,

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

- **Unit of velocity.** SI unit of velocity is m s^{-1}.
- **Uniform velocity.** Velocity of a body is said to be uniform velocity if it covers equal displacements in equal intervals of time.
- **Non-uniform velocity.** Velocity of a body is said to be non-uniform if it covers unequal displacements in equal intervals of time.
- **Average velocity** $= \frac{\text{Total displacement of the body}}{\text{Total time taken}}$

Sony

- Speed *is a scalar quantity,* whereas velocity *is a vector quantity.*
- Speed of a body is always **positive.**
- Velocity of body can be positive as well as negative.
- **Acceleration.** Acceleration of a body is defined as the change in velocity per unit time.

i.e. $$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time}}$$

- **Positive acceleration.** When the velocity of a body increases with time, acceleration of body is said to be positive acceleration.
  Or When the change in velocity of a body takes place in the direction of the motion of the body, then the acceleration of the body is positive.
- **Negative acceleration or retardation or deceleration.** If the velocity of the body decreases with time, then acceleration of body is negative acceleration or retardation.
  Or When the change in velocity of a body takes place in a direction opposite is the direction of motion of the body, then the acceleration of the body is negative.
- S.I. unit of acceleration is m s^{-2}.
- Slope or gradient of distance-time graph = speed of body.
- Area under speed-time graph = distance travelled by a body.
- The slope of velocity-time graph = Acceleration of the body.
- Equations of Motion (i) $v = u + at$ (iii) $v^2 = u^2 + 2as$
  (ii) $s = ut + \frac{1}{2}at^2$

- For Fall body ↓
  (a) $v = u + gt$
  (b) $h = ut + \frac{1}{2}gt^2$
  (c) $v^2 = u^2 + 2gh$

For upward moving ↑
(a) $v = u - gt$
(b) $h = ut - \frac{1}{2}gt^2$
(c) $v^2 = u^2 - 2gh$

SONU Kumar Gupta

* **Distance** → The actual length of path travelled by a moving body is called it's Distance (D).

  * S.I. Unit of Distance = meter = m
  * C.G.S Unit of Distance = centimeter = cm.

Speed → The Distance travelled per unit ~~time~~ time is called speed.

(by Sonu sir)

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$V = \frac{D}{t}$$

Jony

* S.I. Unit of speed is = m/s. = ms^{-1}
* C.G.S Unit of speed is = cm/s = cms^{-1}

* Difference betn Distance and Displacement

by Sonu Sir

Distance

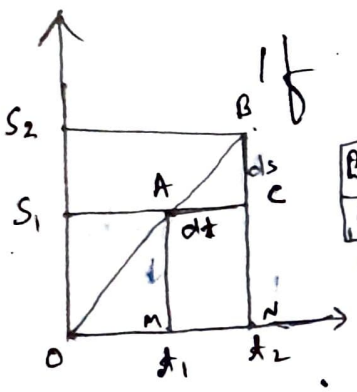
1. It is a scalar P.Q.
2. It is Actual length of path
3. Distance For moving body never be zero.
4. For circular motion, in one Revolution → Distance = $2\pi r$

Displacement

1. It is a Vector P.Q.
2. It is shortest Distance between Initial and Final point
3. Displacement may be zero(0).
4. For circular motion, in one Revolution → Displacement = 0

* **Velocity** → The rate of change of Displacement is called Velocity.

$$\text{Velocity} = \frac{\text{change in Displacement}}{\text{time taken}}$$



If For a moving body, at time = t_1

$BC = S_2 - S_1 = ds$

$AC = t_2 - t_1 = dt$

1st Position = S_1 (at A)

And at time = t_2 2nd position = S_2 (at B)

$$\therefore \text{Velocity} = \frac{S_2 - S_1}{t_2 - t_1} = \frac{ds}{dt}$$

Here $S_2 - S_1$ = change Displacement = ds

$t_2 - t_1$ = change in time = dt

→ ① Velocity is a vector P.Q. (by sonu sir)

→ ② S.I. Unit of Velocity is m/s = $m\,s^{-1}$

→ ③ C.G.S Unit of Velocity is cm/s = $cm\,s^{-1}$.

→ ④ Velocity may be zero, negative and positive that Depends upon Displacement Nature.

→ ⑤ Initial Velocity denoted by = u (by Sonu sir)

→ ⑥ Final Velocity denoted by = v

→ ⑦ When a body start from Rest Position then it's initial Velocity = $u = 0$

→ ⑧ When a body moves on a circular path and complete it's one Revolution → then Displacement = 0

∴ Velocity of body also = $v = 0$

Sonu Kumar Gupta

* **Acceleration** → The rate of change of velocity is called Acceleration (a).

~~If at time = t, velocity.~~

If a body start to move with Initial velocity = u and After time = t it's Final velocity = v

then

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

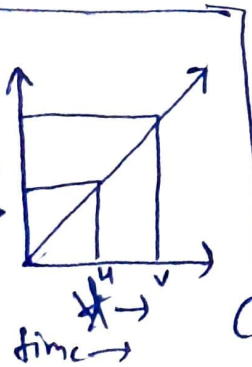
$$a = \frac{v - u}{t}$$

→ Acceleration is a Vector P.Q.

→ S.I. Unit of Acceleration = m/s^2

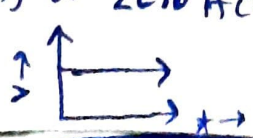
→ C.G.S. Unit of Acceleration = cm/s^2

→ **Uniform Acceleration** → If in equal time-interval the velocity of a body changes Equaly then its Acceleration is Called Uniform Acceleration

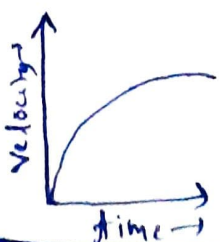


* **Non-Uniform Acceleration** → If in Equal time-Interval the velocity of a body changes Un-Equaly. then it is called Non-Uniform Acceleration.

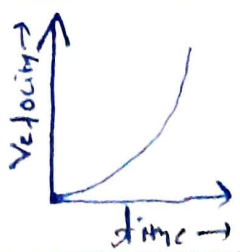
* When with time velocity not be changes then it is called Constant velocity or Zero Acceleration



(i)



(ii)



Sonu Kumar Gupta

(I) To change Km/h into m/s multiply by $\frac{5}{18}$

Q. Express the speed 36 Km/h in m/s.

(II) To change m/s into Km/h → multiply by $\frac{18}{5}$

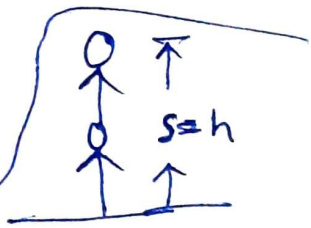
Q. Express the speed 15 m/s into Km/h.

(III) If a body Fall from a height under force of Gravity then in place of $a = g$ (g = Acc. due to gravity) in this case Equations of motion

(I) ∵ $V = u + at$ → $V = u + gt$

(II) ∵ $s = ut + \frac{1}{2}at^2$ → $h = ut + \frac{1}{2}gt^2$

(III) ∵ $v^2 = u^2 + 2as$ → $v^2 = u^2 + 2gh$



(IV) If a body throw up ↑

Here ∵ velocity decreases → ∴ $a = -g$

In this Case For upward motion body.

eqn of motion (I) $V = u - gt$

(II) $h = ut - \frac{1}{2}gt^2$

(III) $v^2 = u^2 - 2gh$

Somu sir

by Sonu Kr. Gupta

Somu Sir

Q. A Car starting from Rest acquires a velocity 180 m/s. in 0.05 hour. Find it's Acceleration.

Q. A bicycle initially moving with a velocity 5 m/s. accelerates for 5 sec. at a rate of 2 m/s². What will be it's Final Velocity?

Note. Write all Notes ~~Ten~~ in a Copy. Somu sir