

PHYSICS

MOTION AND LIQUIDS

Motion Inference

- A body is said to be in the state of motion, when it continuously change its position with respect to time.

Measuring the rate of motion

- The distance covered when traveled along a straight line is known as displacement.

Inference

- The shortest distance, or traveled along a straight line, is known as displacement.

Uniform Motion and Non Uniform Motion

- If an object covers equal distances in equal intervals of time, it is said to be in uniform motion.
- The hare, in its motion, covers different distances in a particular time, it is said to be in non-uniform motion.
- If an object covers unequal distance in equal intervals of time, it is said to be in non-uniform motion.

Measuring the Rate of Motion Speed

- Speed is the quantity used to say whether the motion is slow or fast. Speed is the distance travelled in one second (or) rate of distance traveled.

$$\text{Speed} = \frac{\text{Total Distance travelled}}{\text{Time taken}}$$

- Speed is measured in m/s (or) ms^{-1}

Velocity

- Velocity is the displacement made in one second (or) rate of change of displacement.
- Rate of change means, change per second.

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

Uniform velocity

- Equal displacement covered by a body in equal intervals of time is known as uniform velocity

Rate of Change of Velocity

- Acceleration is the change in velocity of an object per second or rate of change of velocity.

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

- If the velocity of the body decreases with time, the acceleration is negative (retardation) and the motion is called decelerated motion.

Graphical Representation of Motion

Distance – time graph

Equation for velocity at a time

$$v = u + at \dots\dots\dots (I)$$

$$s = ut + \frac{1}{2} at^2 \dots\dots\dots (II)$$

$$v^2 = u^2 + 2as \dots\dots\dots (III)$$

Acceleration due to gravity

- The deceleration or acceleration due to the gravitational force of earth is known as 'g'. The average value of 'g' is 9.8 m/s²

$$v^2 = 2gh$$

- Uniform circular motion, the magnitude of the velocity is constant at all points and the direction of the velocity changes continuously.
- One radian is the angle subtended by an arc of a circle of length equal to its radius at the centre of the circle

Angular displacement

- The angle covered by the line joining, the body and the centre of the circle (radius vector). It is measured in radian.

Angular velocity

$$\text{Angular velocity} = \frac{\text{angular displacement}}{\text{time taken}}$$

$$\omega = \theta/t$$

the unit of angular velocity?

It is radian / second

Relation between linear velocity and angular velocity

- Linear velocity = Radius of the circle x Angular velocity

Centripetal Force and Centrifugal force

- The constant force that acts on the body along the radius towards the centre and perpendicular to the velocity of the body is known as centripetal force

$$F = \frac{mv^2}{r}$$

Again, centripetal force, $F = mr\omega^2$ (since $v = r\omega$)

Sample

- Stone tied to the end of string and rotated in a circular path, the centripetal force is provided by the tension in the string.
- When a car takes a turn on the road, the frictional force between the tyres and the road provides the centripetal force.
- In the case of planets revolving round the sun or the moon revolves around the earth, the centripetal force is provided by the gravitational force of attraction between them.
- For an electron revolving around the nucleus in a circular path.
- The force, which is equal in magnitude but opposite in direction to the centripetal forces is known as centrifugal force.
- While churning curd, butter goes out the side due to centrifugal force.
- A cyclist turning a corner leans inwards. Now the frictional force (centripetal force) is balanced by the centrifugal force $\frac{mv^2}{r}$

Liquids

- Liquids flow from one place to another. They have a definite volume. They take the shape of the container.

- Liquids show very little change in volume.
- Liquids are incompressible.

Upthrust and Buoyancy

- The buoyant force is equal to the weight of the liquid displaced.
- The buoyant force (upthrust) acts through the centre of gravity of the displaced liquid which is known as centre of buoyancy.

Archimedes

- Archimedes discovered many important principles of statics and hydrostatics.

Lever

- He invented the water screw for irrigating the fields of Egypt. He discovered the principle of lever.

Archimedes Principle

- When a body is immersed in fluid (liquid or gas) it experiences an apparent loss of weight which is equal to the weight of the fluid displaced.

Relative Density

- Density of a body is defined as the mass per unit volume of the body.

$$\text{Angular velocity} = \frac{\text{Mass}}{\text{Volume}}$$

Unit of density is Kg m^{-3}

Relative density

- Relative density is defined as the ratio of density of the body to the density of water. It has no unit.
- An iron piece floats in mercury, but sinks in water. This is because the density of mercury (13600 kg m^{-3}) is greater than the density of water (1000 kg m^{-3}).
- A ship made up of iron floats in water. This is because the ship is hollow and contains air.