MOTION

In daily life we observe that some substances are in rest & some are in motion. Study of Motion of objects is very important in physics.

1. Mechanics:-

Mechanics is that branch of physics which deals with the motion of objects and the equilibrium of the object under many forces.

- **Statics:-**

It deals with the objects which are at rest or we can say that it deals with the object which is under equilibrium under many force

- **Kinematics:-**

It deals with the motion of object without considering the cause of motion.

- **Dynamics:-**

It deals with the motion of object along with the cause of motion of object.

2. REST AND MOTION:-

- **REST:-**

If an object does not change its position of rest with respect to surrounding than it is called in rest.

E.g.:- a book placed on the table.

- **Motion:-**

If an object changes its position w.r.t to surrounding than it is called in motion.

E g, A moving car on the road etc.

- **Rest & motion are relative terms explain**

Sometimes we see that objects are in rest but actually they are in motion like a person sitting in train see that another persons are in rest but they are in motion.

Similarly sometimes we see that objects are in motion but they found in rest, like a person in vehicle see that trees are moving but actually they are in rest.

Hence we cannot say that an object is in rest or in motion. These are relative term.

3. Motion in one, two & three dimensions:-

- **ONE DIMENSION MOTION:**

A particle moving along a straight line or path is said to be posses' one dimensional motion. I,e only one co- ordinate axis changes w.r.t time. E.g- Motion of train on straight track, motion of bus on straight road etc.

- **TWO DIMENSIONAL MOTIONS:-**

A particle moving in a plane is said to be passes two dimensional motion I.e. only two co-ordinate axis changes w.r.t time. e.g. - Motion of insect on the floor, motion of earth around the sun.

- **THREE DIMENSIONAL MOTIONS:-**

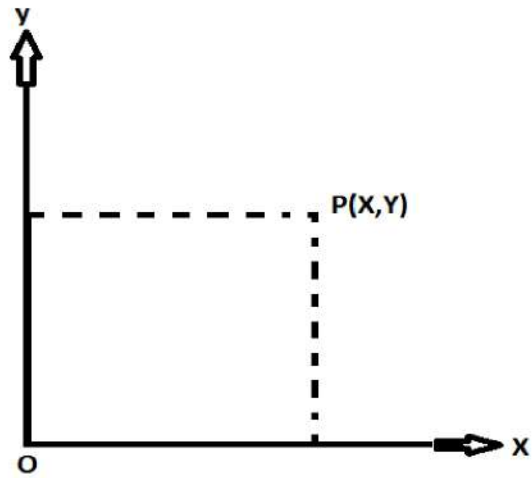
A particle moving in space is said to be passes three dimensional motion I.e. all the three co-ordinate axis changes with respect to time e.g- A bird, an aero plane flying in the sky etc.

4. Frame of reference:-

The fixed point or place with respect to which the position, velocity or acceleration of an object is measured is called frame of reference.

Cartesian co-ordinate system:-

Draw two mutually perpendicular line OX & OY meeting at a point O. Here O is called origin & OX & OY called co-ordinate axis. And the region covered by OX & OY is a plane. This system is called Cartesian co-ordinate system.



5. TYPES OF MOTION:-

A body can have three type of motion:-

(i)- Translational motion:-

If line joining the two points remains parallel to itself throughout the motion is called translational motion. e.g. A bus moving on straight road.

(ii)- Rational motion:-

If a body moving around a fixed axis is called rotational motion. E.g. Motion of earth around sun etc.

(iii)- Vibration motion:-

If a body moves to & fro about a mean position after a regular interval of time is called Vibration motion. E.g.- Motion of pendulum. **Scalar and Vectors**

6.PHYSICAL QUANTITY

In the study of the two dimensional motion of the physical quantity we need sometime both magnitude and the direction of the quantity so introduced a new term vector.

A physical quantity may be divided into two types

Scalar Quantity:-

Physical quantities that have only magnitude and no direction are called scalar quantities or scalars. Eg: mass, time, speed etc.

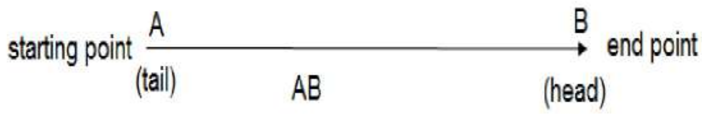
Vector Quantity:-

Physical quantities that have both magnitude and direction are called vector quantities or vectors. Eg: displacement, weight, velocity, force etc.

Difference between scalar and vector quantity

Scalar quantity	*Vector quantity*
1.Scalar quantity have only magnitudes	1.Vector quantity have both magnitude and direction
2.Scalar quantity changes when magnitude of the quantity changes	2.Vector quantity changes when either magnitude or direction changes
3.Scalar can be added by the ordinary laws of the algebra	3.Vectors can be added by only special laws of vector addition

16 **Representation of vectors** A vector is represented by using a straight line with an arrowhead at one end. The length of the line represents the magnitude of the vector and the arrowhead gives its direction.



7. DISTANCE AND DISPLACEMENT:-

DISTANCE:-

The length or actual path followed by an object between two points in a given interval of time is called distance.

DISPLACEMENT:-

The straight line path between any two objects is called displacement.

***Give any five differences between distance and displacement**

Distance	Displacement
1 Distance is actual path followed by an object between two points.	1 Displacement is the straight line distance followed by the object.
2 It is a scalar quantity	2 It is a vector quantity.
3 It is always +ve	3 It may be +ve, -ve or zero.
4 Distance may be equal to or Greater than displacement	4 Displacement may be equal to or smaller than distance
5 Distance per unit time is speed.	5 Displacement per unit time is velocity.

QUESTION 1: A person moves on a semi-circular track of radius 40.0 m during a morning walk. If he starts at one end of the track and reaches at the other end, find the distance covered and the displacement of the person.

Solution : The distance covered by the person equals the length of the track.

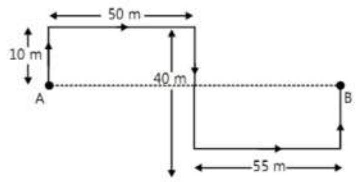
It is equal to $\pi R = \pi \times 40.0\, m = 126\, m.$

The displacement is equal to the diameter of the semi-circular track joining the two ends. It is $2\, R = 2 \times 40 = 80m$

QUESTION 2: Find the distance and displacement of a particle travelling from one point to another, say from pt. A to B, in a given path.

Sol: Total distance travelled = 10+50+40+55+ (40 - 10) = 185 m

Total Displacement = 50 + 55 =105 m



8. SPEED AND VELOCITY:-

(a) Speed:-

The distance travelled by the body per unit time is called speed.

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

Unit of speed:- m/s in **S.I,** in c,g,s system cm/sec.

*speed is a scalar quantity. It may be +ve or zero

Types of speed

1. **Uniform Speed:-**

A particle or body is said to be moving with uniform speed if it cover equal distance in equal interval of time. Sometime it is called constant speed.

2. **Variable velocity:-**

Particle or body is said to be moving with variable speed if it cover unequal distance in equal interval of time or equal distance in unequal interval of time.

3. **Average speed:-**

Average speed of a body is defined as the ratio of total distance travelled by the body to the total time taken.

$$V_{av} = \frac{\text{total distance travelled}}{\text{Total time taken}}$$

*It may be noted that particle may or may not have speed equal to average speed at any instant.

*Speed is equal to average speed only when particle moves with uniform speed.

QUESTION 3: A man walks at a speed of 6 km/hr for 1 km and 8 km/hr for the next 1 km. What is his average speed for the walk of 2 km ?

Solution : Distance travelled is 2 km. Time taken $\frac{1\,km}{6\,km/hr} + \frac{1\,km}{8km/hr} = \left(\frac{1}{6}+\frac{1}{8}\right) = \frac{7}{24}hr$

Average speed $= \frac{2\,km \times 24}{7\,hr} = \frac{48}{7} km/hr = 7\,km/hr.$

4. **Instantaneous speed:-**

The speed of an object at any instant of time is called instantaneous speed To calculate Instantaneous we have to make Δx as small as possible so that the speed of the body does not change during interval. Hence $V_{ins} = \text{Lim} \frac{\Delta x}{\Delta t}$

(B) Velocity:-

The displacement of a particle or body per unit time is called velocity of the body.

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

Velocity is a vector quantity. It can be +ve, -ve & zero.

Types of velocity:-

(1)- Uniform velocity (ii) variable velocity (iii) Average velocity (iv) Instantaneous Velocity.

* All these velocities can be defined by types of speed by only replacing speed by velocity & distance by displacement.

9. Difference between speed & velocity

Speed	Velocity
It is the ratio of distance to the time.	It is the ratio of displacement to the time.
It is a scalar quantity.	It is a vector quantity.
It may be +ve or zero.	It may be +ve,-ve or zero
It has only magnitude.	It has both magnitude & direction.
Speed may be equal to or greater than velocity.	Velocity may be equal to or smaller than speed

QUESTION 4: If a train moves from station A to B with a constant speed v =40 km/h and returns back to the initial point A with a constant speed V2=30 km/h, then calculate the average speed and average velocity.

Sol: Average speed is distance covered divided by time taken. Distance is length of the path travelled. Average velocity is displacement divided by time taken. Displacement is the vector from initial point to final point.

Let the distance AB = s, Time taken by train from A to B, $t_1 = \frac{s}{v_1}$

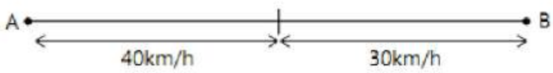
Time taken by train FromB to A, $t_2 = \frac{s}{v_2}$

$$Average\ speed = \frac{Total\ distance}{Total\ time\ taken} = \frac{s+s}{t_1+t_2} = \frac{2s}{\frac{s}{v_1}+\frac{s}{v_2}}$$

$$v_{av} = \frac{2s}{\frac{s}{v_1}+\frac{s}{v_2}} = \frac{2v_1v_2}{v_1+v_2} = \frac{2\times40\times30}{40+30} = 34.3km/h$$

$$Average\ velocity = \frac{Net\ displacement}{Total\ time} = \frac{0}{t_1+t_2} = 0$$

QUESTION 7: Consider a train moving from station A to B with a constant speed of 40 km/h for half the time and with constant speed of 30 km/h for the next half time of that journey. Calculate the average speed of the whole journey.



Sol: Let AB = s and T = Total time of journey.

Distance travelled in first half time $\frac{T}{2}$ is, $s_1 = v_1\frac{T}{2}$.

Distance travelled in second half time is, $s_2 = \frac{v_2T}{2}$

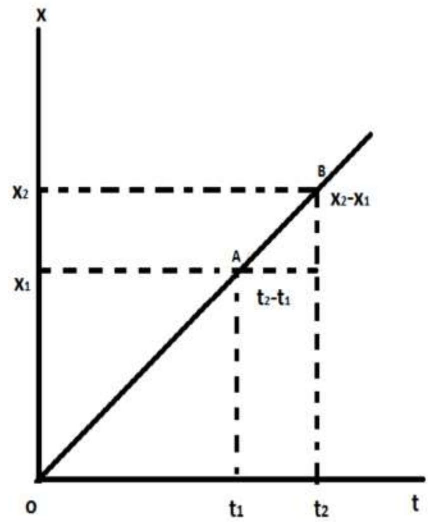
Or $$Average\ speed = \frac{Total\ distance}{Total\ time}$$

Or $$v_{av} = \frac{v_1(T/2) + v_2(T/2)}{T} = 35\ km/h$$

10. DISPLACEMENT TIME GRAPH

For uniform motion displacement time graph or position time graph is a straight line making an angle O with X axis.

Determination of velocity from position-time graph



Consider two points A & B on the straight line the position & time corresponding to A & B are (T_1, X_1) & (T_2,x_2) respectively.

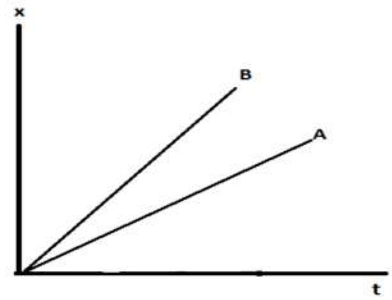
Now the displacement of the body co-responding to time interval (T_2-T_1) is (X_2-X_1)

So, Velocity of the body= $\frac{\text{displacement}}{\text{time}}$

OR $$v = \frac{X_2 - X_1}{T_2 - T_1} = \frac{BC}{AC} = \tan\theta$$

$$\frac{BC}{AC} = \tan\Theta \text{ Represents the slop of the line}$$

Hence we can say that velocity of a body having uniform motion = Slope of the displacement time graph

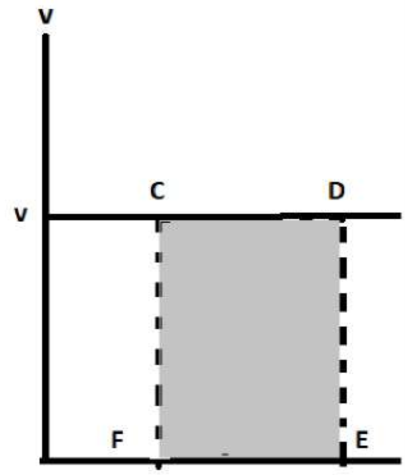


QUESTION 8: Two bodies having their displacement time graph as shown in fig. which one have larger velocity.

Ans:- Slope of B is greater so B have larger velocity.

11. VELOCITY-TIME GRAPH FOR UNIFORM MOTION:-

Velocity time graph for uniform motion is a straight line parallel to time axis. The area under the velocity time graph gives the displacement of the particle. Consider any two points C & D on the line corresponding to time T_1&T_2.Then the area of CDEF can be given as



Area of CDEF= CD x CF = $(t_2 - t_1)$ V –(i)

As we know $V = \frac{X_2 - X_1}{t_2 - t_1}$

So from eqn (i)

Area of CDEF = $\frac{X_2 - X_1}{t_2 - t_1}(t_2 - t_1)$=$X_2 - X_1$ = displacement

Hence area under velocity time graph = displacement of the body.

12. Acceleration:-

The rate of change of velocity is defined as the acceleration of the body

I,e $a = \frac{dv}{dt}$

- If the speed is increasing then it is called +ve acceleration & if the speed is decreasing than it is called –ve acceleration.
- It is a vector quantity.
- c,g,s unit – cm/sec^2, S.I unit - m/s^2, dimention formula [$M^o \ L^1 \ T^{-2}$]
- Retardation: If speed of a body decreases then acceleration of the body is called retardation
  - Negative acceleration does not imply retardation.
  - Retardation refers to decrease in speed and not velocity.

*** Types:-**

Uniform acceleration, non uniform acceleration, average acceleration, instantaneous acceleration.

13. DIFFERENT TYPES OF ACCELERATION:-

(i)- Uniform acceleration:-

The acceleration of an object is said to be uniform if its velocity changes by equal amount in equal interval of time. However small these interval may be.

(ii)- Variable acceleration:-

The acceleration of ab object is said to be non uniform or variable if its velocity changes by unequal amount in equal interval of time.

(iii)- Average Acceleration:-

Average Acceleration is defined as the ratio of total change in velocity of the object to the total time taken.

$$a_{av} = \frac{V_2 - V_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$$

(iv)- Instantaneous Acceleration:-

The acceleration of an object at a given instant of time is called instantaneous acceleration.

$$a = \lim \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

As $$V = \frac{dx}{dt}$$

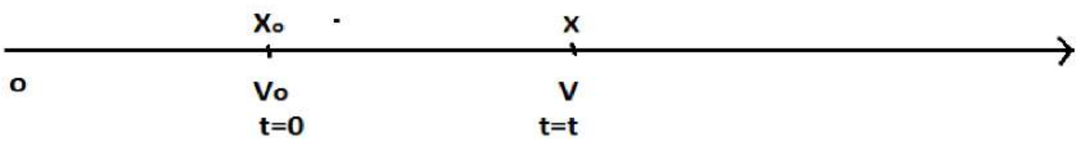
$$\Rightarrow \quad a = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

* Thus acceleration is the first order derivative of velocity & second order derivative of displacement with respect to time.

14. Kinematic equation for uniformly accelerated motion along straight line:-

Let us consider an object moving with constant acceleration along +ve direction of X axis as shown in fig.



Let x_o= Position of object at time t = 0 X = Position of object at time t = t.

U or V_o= Velocity of object at time t=0 V= Velocity of object at time t=t.

(a)- VELOCITY – TIME RELATIONSHIP-

As we know Acceleration = $\frac{\text{change in velocity}}{\text{Time taken}}$

or $a = \frac{v - v_o}{t - 0}$

Or $a = \frac{v - v_o}{t}$

Or $at = v - v_o$

(b)- POSITION TIME RELATIONSHIP:-

As average velocity of an object in the time interval o to t can be given as :

$$v_{av} = \frac{\text{Displacement}}{\text{time}} = \frac{x - x_o}{t - 0}$$

Or $x - x_o = v_{av} \cdot t$ ----- (i)

Also $v_{av} = \frac{\text{initial velocity} + \text{final veloci ty}}{2}$

Or $v_{av} = \frac{v_o + v}{2}$ ----………………… (ii)

Putting in eq^n (i) we have $x - x_o = (\frac{v_o + v}{2})\,t$

Or, $x - x_o = (\frac{2v_o + at}{2})\,t$ $(\because v = v_o + at)$

$x - x_o = v_o t + \frac{1}{2}at^2$

Here $x - x_o$ = distance travelled in t times = S

So, $S = ut + \frac{1}{2}at^2$

POSITION VELOCITY RELATIONSHIP:-

We know that $v = v_o + at$ or $v - v_o = at$ ---(i)

Also average velocity × time = displacement

Or $(\frac{v + v_o}{2})\,t = x - x_o$

$= v + v_o = \frac{2}{t}(x - x_o)$ --- (2)

Multiply eqn (1) & (2) $(v - v_o)(v + v_o) = at \times \frac{2}{t}(x - x_o)$

$v^2 - v^2o = 2a(x - x_o)$

Or $v^2 - u^2 = 2as$

QUESTION 12 : A car moving along a straight highway with speed of 126 kmh^{-1} is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform) and how long does it take for the car to stop ?

Ans. Initial velocity of car, $u = 126\,kmh^{-1} = 126 \times \frac{5}{18}\,ms^{-1} = 35\,ms^{-1}$ ...(i)

Since, the car finally comes to rest, $v = 0$ Distance covered, $s = 200\,m, a = ?, t = ?$

From equation of motion $v^2 = u^2 - 2as$ or, $a = \frac{v^2 - u^2}{2s}$ ……… …(ii)

Substituting the values from eq. (i) in eq.(ii) $a = -\,3.06ms^{-2}$

Negative sign shows that car is uniformly retarded at $-\,a = 3.06\,ms^{-2}$.

To find t, let us use the relation $v = u + at$ or $t = \frac{v - u}{a}$

Here, $a = -\,3.06\,ms^{-2}, v = 0, u = 35\,ms^{-1}$ so $t = 11.44\,sec.$

13. MOTION UNDER GRAVITY

When body is thrown upwards or body is falling freely under gravity than acceleration of the body changes into acceleration due to gravity.

Equation of motion for a freely falling body:-

For a freely falling body, the following equation of motion hold good.

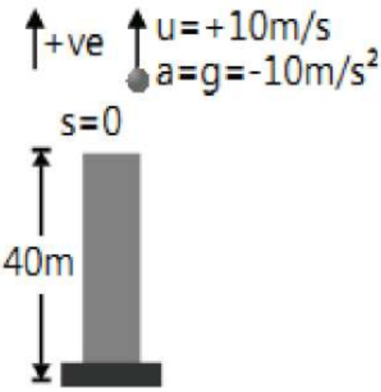
(i) $v=u+gt$ (ii) $s= ut + \frac{1}{2}gt^2$ (iii) $v^2-u^2= 2gs$ (iv) $S_{nth} = u + \frac{g}{2}(2n-1)$

When a body is thrown vertically upwards then eq^n of motion becomes:-

(i) $v= u-gt$ (ii) $S= ut - \frac{1}{2}gt^2$ (iii) $v^2 - u^2 = -2gs$ (iv) $S_{nth} = u - \frac{g}{2}(2n-1)$

When body is falling freely than acceleration is taken +ve & when body is thrown vertically upwards then acceleration is taken negative.

QUESTION 15: A ball is thrown upwards from 40 m high tower with a velocity of 10 m/s. Calculate the time when it strikes the ground. ($g = 10\ m/s^2$)



Sol: $u = +10\ m/s,\ a = -10\ m/s^2\ s = -40\ m$ (at the point where the ball strikes the ground) as $s = ut + \frac{1}{2}gt^2 \implies -40 = 10t - 5t^2$

$\implies t = 4\ s, -2\ s\ .\ Considering\ the\ positive\ value, t = 4\ s$

14. DERIVATION OF EQUATION OF MOTION BY GRAPHICAL METHOD:-

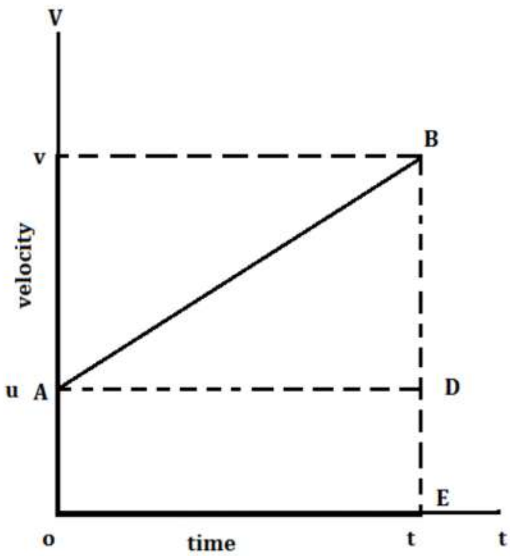
Equation of motion by graphical method:-

Consider an object moving along a straight line with initial velocity u and uniform acceleration a. suppose it travels s distance in t time. Here,

OA = ED = u,

OC = EB = v,

OE = AD = t



(a)First eq^n of motion:-

We know that Acceleration = slop of velocity time graph AB

Or $$a = \frac{DB}{AD} = \frac{DB}{OE} = \frac{EB-ED}{OE} = \frac{v-v}{t}$$

Or $$v=u+at$$

(b)Second eq^n of motion:-

As $$a= \frac{DB}{AD} = \frac{DB}{t} \rightarrow DB = at$$

Distance travelled by the object in t time is

S = Area under the trapezium OABE

= Area of rectangle OADE + area of triangle ADB

$$= OA\times OE + \frac{1}{2} DB \times AD$$

$$= ut + \frac{1}{2} at \times t$$

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

(C)Third equation of motion:-

Distance travelled by object in time t is

S = area of trapezium OABE

$$S= \frac{1}{2}(EB + OA) \times OE = \frac{1}{2}(EB + ED) \times OE$$

Also acceleration a= slope of velocity time graph AB

Or $$a = \frac{DB}{AD} = \frac{EB-ED}{OE} \quad \text{or} \quad OE = \frac{EB-ED}{a}$$

So $$s = \frac{1}{2}(EB + ED)\frac{EB-ED}{a}$$

Or $$2as = (EB)^2 - (ED)^2$$

$$2as = v^2 - u^2$$

Or $$v^2 - u^2 = 2as$$

:- CIRCULAR MOTION :-

17. Angular Displacement:-

Suppose a body moves in circular path from P to Q making angle θ at the centre of a circle of radius r.

Then angular displacement θ of object in time t is given by $\theta = \frac{arc}{radius}$

$$\theta = \frac{s}{r}$$

Here S is linear displacement covered by the body.

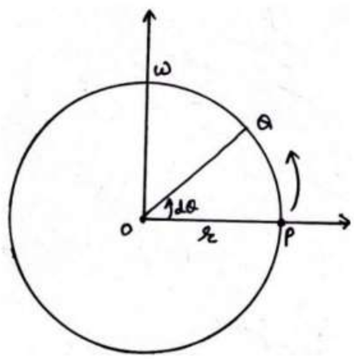
Or $\boldsymbol{S = r\theta}$

- ✓ Angular displacement is a vector quantity and its direction may be given by right hand thumb rule.
- ✓ Angular displacement is dimensionless having unit radian.

18. Angular velocity (ω):-

The time rate of change of angular displacement of a body is called angular velocity. It is denoted by omega (ω)

Suppose an object moves in circular path from P to Q in small time Δt and covers a angular displacement $d\theta$. Then angular velocity ω may be given as



$$\omega = \frac{d\theta}{dt}$$

- ☞ Angular velocity is a vector quantity,
- ☞ for anticlockwise rotation ω is in upward direction and for clockwise direction ω is in downward direction. Its direction can be given by right hand thumb rule.
- ✓ Unit of ω is rad s^{-1}

Relation between angular velocity and linear velocity:-

As we know $\omega = \frac{d\theta}{dt}$

$\omega = \frac{d}{dt}\left(\frac{S}{r}\right)$ $\left(\because \theta = \frac{s}{r}\right)$

Or $\omega = \frac{1}{r}\frac{ds}{dt}$ here r is radius which is constant

$\omega = \frac{v}{r}$ $\left(\because v = \frac{ds}{dt}\right)$

$$\Rightarrow \boldsymbol{v = r\omega}$$

19. Angular Acceleration:-

The time rate of change of angular velocity of the body is called angular acceleration. It is denoted by α

As $$\alpha = \frac{d\omega}{dt}$$

S.I. unit of angular acceleration is rad s^{-2}

Relation between linear acceleration a and angular acceleration α :-

As $$\alpha = \frac{d\omega}{dt}$$

Or $$\alpha = \frac{d}{dt}\left(\frac{v}{r}\right) \qquad (\because v = r\omega)$$

Or $$\alpha = \frac{1}{r}\frac{dv}{dt}$$

Or $$\alpha = \frac{a}{r}$$

Or $$\boldsymbol{a = r\alpha}$$

20. Uniform circular motion:-

If a point object moves on a circular path with a constant speed, then the motion of the body is called uniform circular motion.

(a) Time period:-

The time taken by the object to complete one revolution on its circular path is called time period. It is denoted by T.

(b) Frequency:-

Number of revolution completed by the body in one second is called its frequency. It is denoted by ν

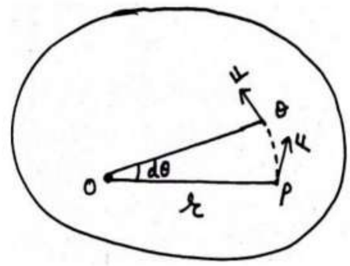
i.e $$\nu = \frac{1}{T}$$

✓ Relation between angular velocity, frequency and time period.

As $$\boldsymbol{\omega = \frac{\theta}{T} = \frac{2\pi}{T} = 2\pi\upsilon}$$

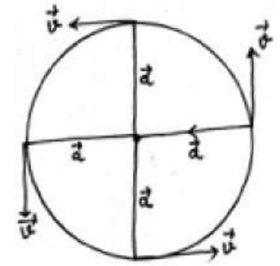
21. Centripetal Acceleration:-

The acceleration acting on the body undergoing uniform circular motion is called centripetal acceleration. It acts on the object along the radius toward the centre of circular path as shown in fig.



$$a = \frac{v^2}{r}$$

Direction of $\vec{a}$



As $\Delta\vec{v}$ act along the centre of circle, so that centripetal acceleration act toward centre along radius of circle, its direction changes according to velocity at every point remains ⊥ to velocity & toward centre. The magnitude of $\vec{a}$ remains constant at all point.

Q.9 Calculate the angular speed of flywheel making 420 revolutions per minutes?

Here $v = 420\, revolution\ minute = \frac{420}{60} = \frac{r}{s}$ so $\omega = 2\pi v = 44 rads^{-1}$

Q.10 a body of mass 10kg revolves in a circle of diameter 0.40m making 1000 revolutions per minute. Calculate its linear velocity & centripetal acceleration?

Here m=10kg r = 0.20m, $v = \frac{100}{60} s^{-1}$

Angular speed $\omega = 2\pi v = \frac{100\pi}{3}\ so\ v = r\omega = \frac{20\pi}{3} ms^{-1}$ & $a = r\omega^2 = \frac{2000\pi^2}{9}$m

Q.11 an insect trapped in a circular groove of radius 12cm moves along the groove steadily & completes revolution in 100sec. (i) $\omega = ?$ $(ii) v = ?$ (iii) is acceleration vector a constant vector, what is its linear displacement.

Here r=12cm $v = \frac{7}{100} s^{-1}, \omega = 2\pi v = 0.44\, rads^{-1}, v = r\omega = 12.0.44 = 5.28$

$\vec{a}$ is not constant vector, $\vec{a} = r\omega^2 = 12 \times (0.44)^2 = 2.31 cms^{-2}$

Linear displacement is zero, as insect completing its revolution, comes on same point.

22. Centripetal Force:-

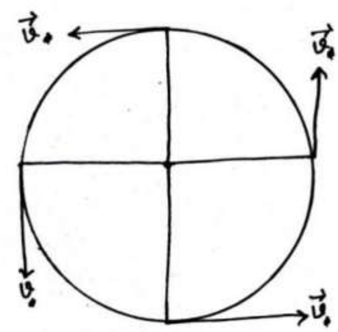
A force required to move a body in a circular path with uniform speed is called centripetal force.

It always acts along the radius & toward the centre of circular path.

Expression for centripetal force

As we know if a body is moving in circular path with $\vec{v}$ velocity, than its centripetal acceleration may be given as

$$a = \frac{v^2}{r} = \mathrm{r}\omega^2 \qquad (\because v = r\omega)$$



If m is the mass of the body than centripetal force may be given as

$$\mathrm{F} = \mathrm{m} \times \frac{v^2}{r}$$

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

$$\mathrm{F} = \frac{mv^2}{r} = \mathrm{m}\mathrm{r}\omega^2$$

Application of centripetal force

- ✓ The tension provides a necessary centripetal force to a stone rotating in circular path.
- ✓ The centripetal force is provided by the gravitational force of sun to the planets for their circular motion around sun.
- ✓ The frictional force provides the necessary centripetal force to car taking circular turn on a road.
- ✓ To e^- the centripetal force is provided by the electrostatic force between e^- and P.

23. Centrifugal Force

While moving in a circular path the body has a constant tendency to regain its natural straight line path, this nature gives rise to a force called centrifugal force.

Hence a force that arises when a body is moving actually along a circular path, by virtue of which it regain its natural straight line path.

This force acts along the radius & away from the centre of the circle.

Now we will discuss some application of centripetal & centrifugal force.