K.E, P.E, Force, mass, types of motion

Line :-

The distance between two points are called Line. e.g 

Angular Motion :-

The motion of rigid body when every point in a body moves in a circular path around a line or axis of rotation is called rotational motion or Angular motion.

The spinning wheel is an example of rotational motion.

Angular displacment :-

The angle formed at the centre of circle between the radii when a body rotates about an axis of rotation is called Angular displacment.

It is denoted by "θ".

The S.I unit of Angular displacement ...

Radian.

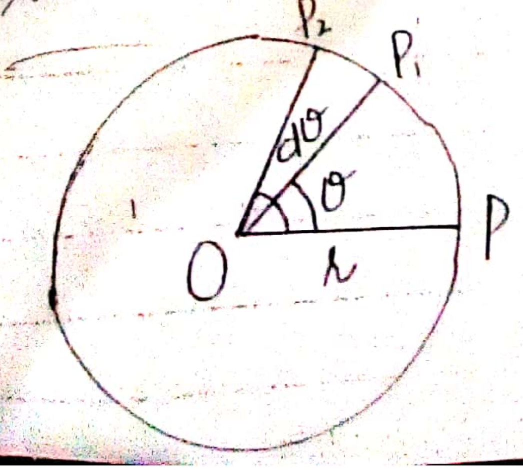
The angle Subtended at the centre of circle between two radii is equal to "One radian" when arc Length equal to the radius of circle.

Displacement: Rate of change of shortest disp. b/w 2 points.

For the direction of Angular displacment :-

Hold the axis of rotation in your right hand in such a way that the fingers are curling in the direction of rotation and the erect thumb is along the direction of Angular displacment

Relation b/w Radian and degree :-



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When arc $PP_1 = r$ (angle formed at the centre of circle) $= 1$ rad

When arc $PP_1 = 1$ (angle formed at the centre of circle) $= \frac{1}{r}$ rad

When arc $PP_1 = 2\pi r$

Angle at the centre of circle $= 2\pi r \times \frac{1}{r}$ rad

$= 2\pi$ rad ——— (1)

When arc $PP_1 = 2\pi r$, Angle at the centre of Circle $= 360^\circ$ — (2

Comparing eq (1) and eq (2)

2π rad $= 360^\circ$

π rad $= \frac{360^\circ}{2} = 180^\circ$

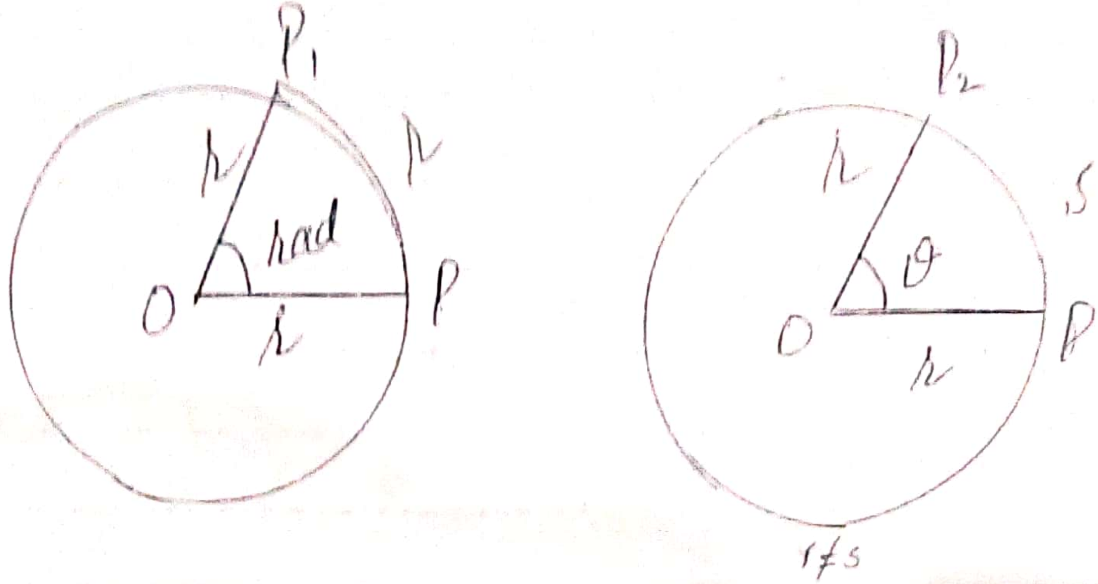
1 rad $= \frac{180^\circ}{\pi}$

1 rad $= 57.3^\circ$

Do all steps in paper

Relation between Arc length and Radius of Circle :-

~~Consider a particle "P" is~~



Consider a particle "P" is attached at the end of massless rod of length "r" pivoted at the centre of circle "O". The axis of rotation passes through the centre "O" and is normal to the plane of rotation.

If rod $\overline{OP}$ describe a circle of radius "r" when allows to rotate the vector $\overline{OP}$ is called reference line.

The arc $PP_1 = r$ subtends angle

1 rad when $\overline{OP}$ moves along the circle and reaches at $\overline{OP_1}$.

Arc $PP_1 = r$ (Arc makes angle at the centre of Circle) = 1 rad

Similarly,

Arc $PP_2 = S$ subtends angle "θ" at the centre of Circle when $\overline{OP_1}$ mov to $\overline{OP_2}$.

Arc $PP_2 = S$ (makes angle at the centre of Circle) = θ rad

From the Geometry of Circle

$$\frac{\text{Arc } PP_1}{\text{Arc } PP_2} = \frac{1 \text{ rad}}{\theta \text{ rad}}$$

$$\frac{r}{S} = \frac{1}{\theta}$$

$$\boxed{S = r\theta}$$

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Angular Velocity :-

Def: The rate of change of Angular displacement is called Angular velocity.

It is denoted by "ω".

The S.I unit is rad/sec

Its non S.I unit are degree/sec and rev/sec.

The average angular velocity is Mathematically

$$\omega_{ave} = \langle \omega \rangle = \frac{\theta_2 - \theta_1}{t_2 - t_1}$$

$$= \frac{\Delta\theta}{\Delta t}$$

The Limit of the ratio $\left(\frac{\Delta\theta}{\Delta t}\right)$ when Δt approaches to zero is called Instantaneous angular velocity.

$$\omega_{inst} = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$$

Relation b/w linear and angular veloci

Consider a particle moves along a circle of radius "r" the arc length "s" and angular displacement "θ" are related as:

$$s = r\theta$$

differentiate above Eq. at both sides with respect to time then:

$$\frac{ds}{dt} = r\frac{d\theta}{dt} \quad \text{---} \quad (1)$$

In Limiting case $\left(\frac{ds}{dt}\right)$ is called linear speed "v" and $\left(\frac{d\theta}{dt}\right)$ is called angular speed "ω" of rotating body.

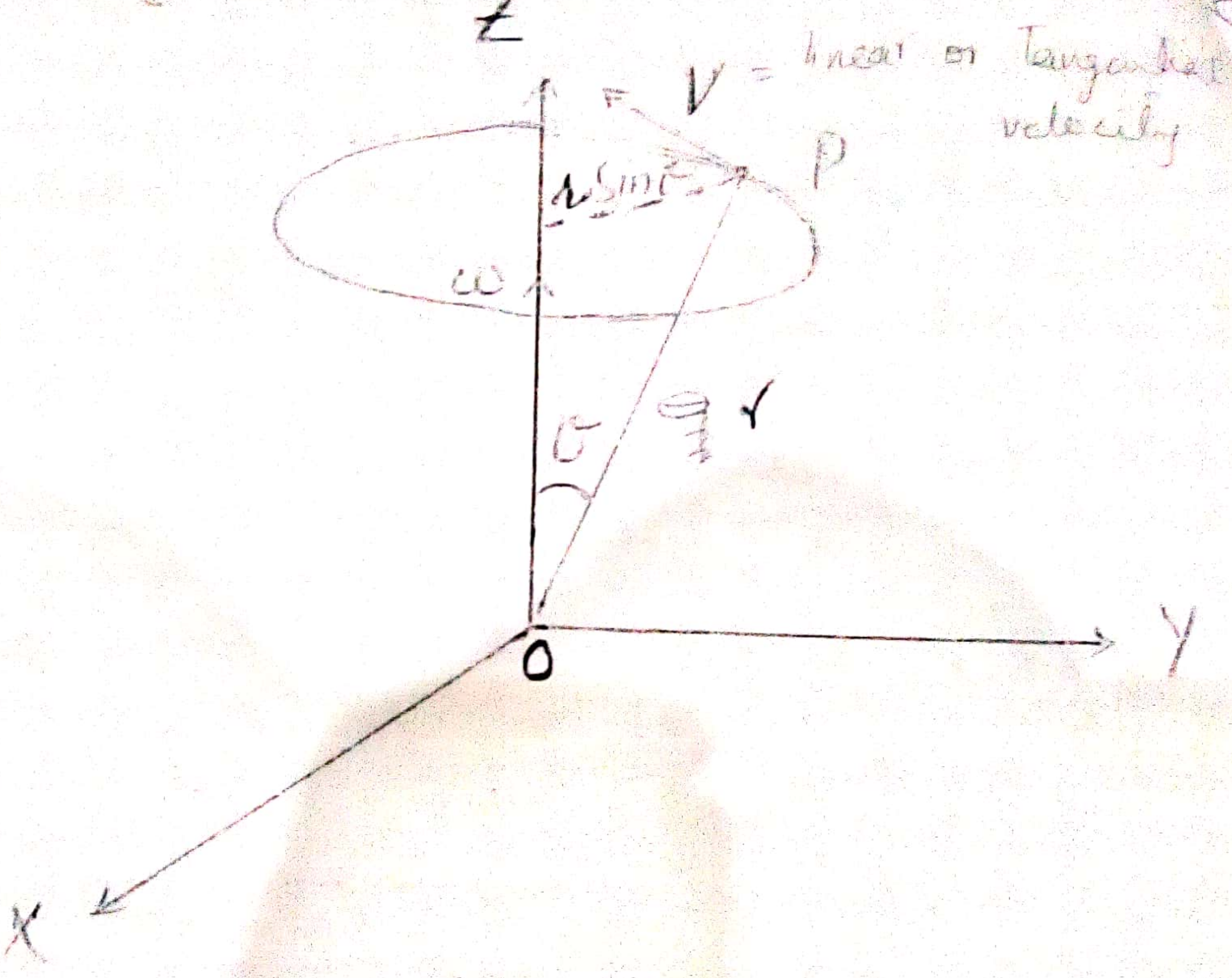
Therefore Eq. (1) becomes

$$\boxed{V = r\omega}$$

Friction

Not actual but a also

Vector form :-



The Linear velocity and angular velocity related as :

$$V = \omega \, (\text{radius of circle})$$

$$V = \omega \, (r \sin \theta)$$

$$\vec{V} = \vec{\omega} \times \vec{r}$$

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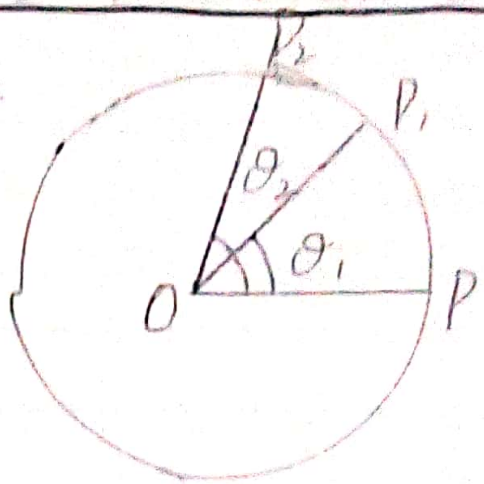
Relation between Linear Accelration and Angular accelration :-



The rate of change of angular velocity is called angular accelration

It is denoted by by "α".

The S.I unit is called rad/sec^2.
Its non S.I unit are degree/sec^2 or rev/sec^2.

The average angular accelration is written as:

$$\langle \alpha \rangle = \frac{\omega_2 - \omega_1}{t_2 - t_1}$$

$$\alpha_{ave} = \frac{\Delta \omega}{\Delta t}$$

The limiting of the ratio [illegible] approaches to zero is called instantaneous angular acceleration.

$$\alpha_{inst} = \lim_{\Delta t \to 0} \frac{\Delta \omega}{\Delta t}$$

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

It can be written as:

$$d\omega = \alpha . dt$$

Integrating both sides:

$$\int d\omega = \alpha \int dt$$

$$|\omega|_{\omega_0}^{\omega} = \alpha t$$

$$\omega - \omega_0 = \alpha t$$

$$\boxed{\omega = \omega_0 + \alpha t}$$

The angular acceleration is a vector quantity. Its direction is given by right

[redacted]

hand rule **Relation between linear acc and angular** Linear velocity "v" and **acceleration**

angular "ω" of a particle when it moves along a circle of radius "r" are related as: We know that

$$V = r\omega$$

differentiate above Eq. on both sides with respect to time.

$$\frac{dv}{dt} = r \cdot \frac{d\omega}{dt}$$

In limiting case $\left(\frac{dv}{dt}\right)$ is called tangential component of linear accelration "a" and $\left(\frac{d\omega}{dt}\right)$ is called angular accelrat "α" of rotating body.

So above relation can be written as:

$$\boxed{a = r\alpha}$$

In vector form $\vec{a} = \vec{\alpha} \times \vec{r}$