nthesis by ... ozone layer. The thickening ... made possible for organisms to be

Angular Position :- (1) Position vector is used to show the position of an object. Angle contribute the angular concept in the given condition.

(3) Therefore, the position vector and angle combinally show the angular position of an object.

→ Angle that is formed when a position vector of a moving object displaces with reference to some chosen point.

Angular Displacement :-

↓

Difference b/w two angular position is called displacement.

Initial − final = Total

$$\boxed{\Delta\theta = \theta_f - \theta_i}$$

Radians $\xrightarrow{\times \pi/180}$ Degree

Degree $\xrightarrow{\times 180/\pi}$ Radians

Angular velocity :-

Instantaneous Angular Velocity (ω)

Angular velocity at any short interval of time is called instantaneous angular velocity.

$$\boxed{\omega_{inst} = \frac{\Delta\theta}{\Delta t}}$$

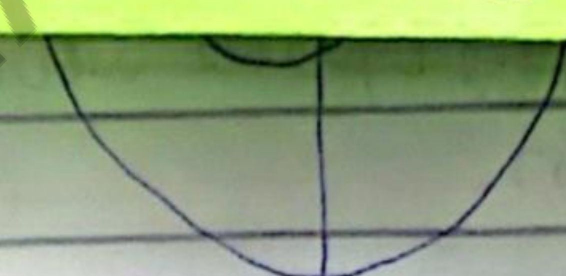
Direction :- As, angular velocity depends on angular displ... then, the direction of angular velocity should be in the direction of angular displacement

Special tip :-
If we want to convert linear quantities to angular quantities, then we have to multiply moment arm (r).

$S = \theta r$

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

How much is one radian
→ One radian is angle b/w two radii which covers an arc on



One radian :- If the arc AB is equal to the radius OA then, the angle subtended in the center will be one radian.

⇒ Arc AB = OA (radians)

SLO Based Question :- How can we find the Direction of Angular Displacement?

Ans:/ If a body is moving in anti-clockwise direction the angular displacement is positive and if the body is moving in clockwise direction then angular dis.. will be negative. (By right hand rule)

Angular Acceleration:-

The time rate of change of angular velocity.

$$\alpha = \frac{\Delta\omega}{\Delta t}$$

Units of angular acceleration:-

(i) Rad/s^2, (ii) $revolution/s^2$, (3) $degree/s^2$

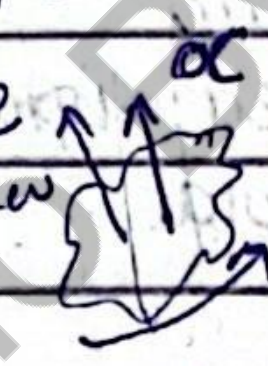
Direction of Angular (α):- −, + ?

→ The direction of angular acceleration depends on whether the object is speeding up or slowing down in its rotation.

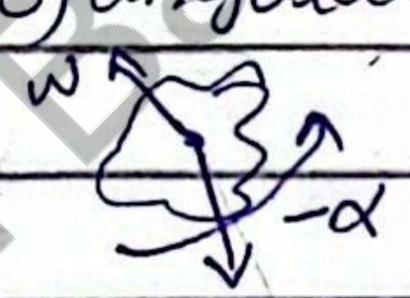
If an object is speeding up, the (α) α points in the same direction as the rotation.

If the object is slowing down the angular α points in opposite direction of the rotation.

→ when the angular velocity (ω) of an object is increased then, it has +ive (α) alpha) acceleration.



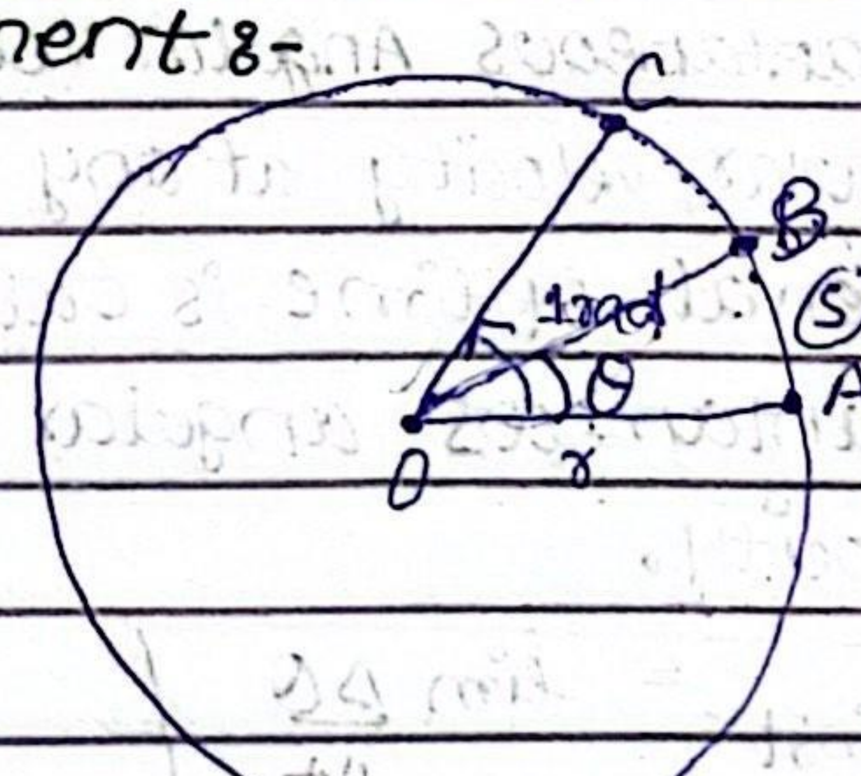
→ when the angular velocity (ω) is decreasing then, it has (−ive) angular acceleration.

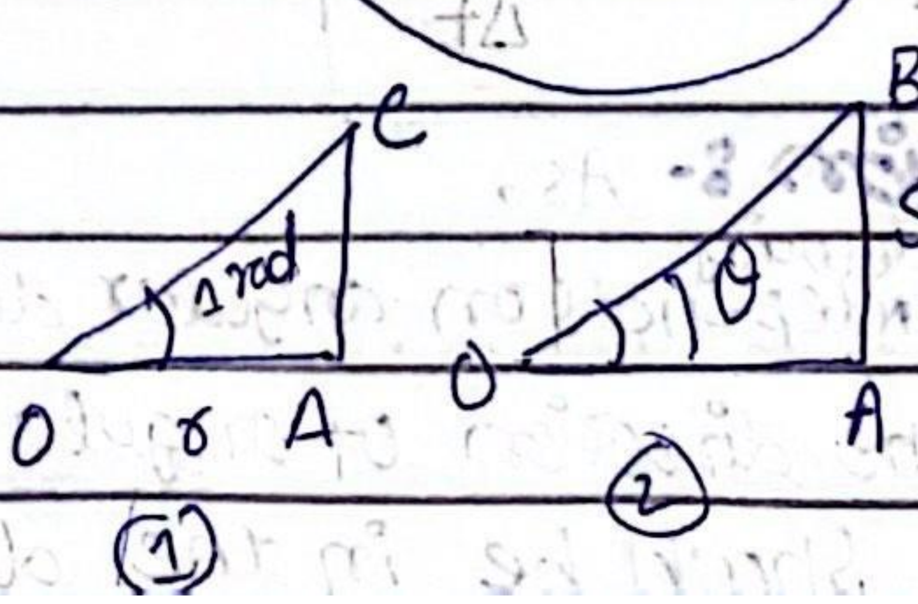


Relationship b/w Linear angular kinematic Quantity:-

(A) Relation b/w linear and angular displacement:-

consider a particle moving on circular path from A and B i.e; distance b/w A and B is equal to radius of a circle, Then the angle covered by particle will be one radian (∠AOC). Consider an other arc AC must be equal to radius "r" and the angle will 1 radian.





By using geometry:

$$\frac{Arc\ AB}{Arc\ AC} = \frac{\angle AOB}{\angle AOC}$$

So, know putting values

$$\frac{S}{r} = \frac{\theta}{1\ rad} \rightarrow (1)$$

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

(b) Relation for angular velocity:-

Since we have,

$S = r\theta$

Dividing Δt on b/s and appling $\lim_{\Delta t \to 0}$:-

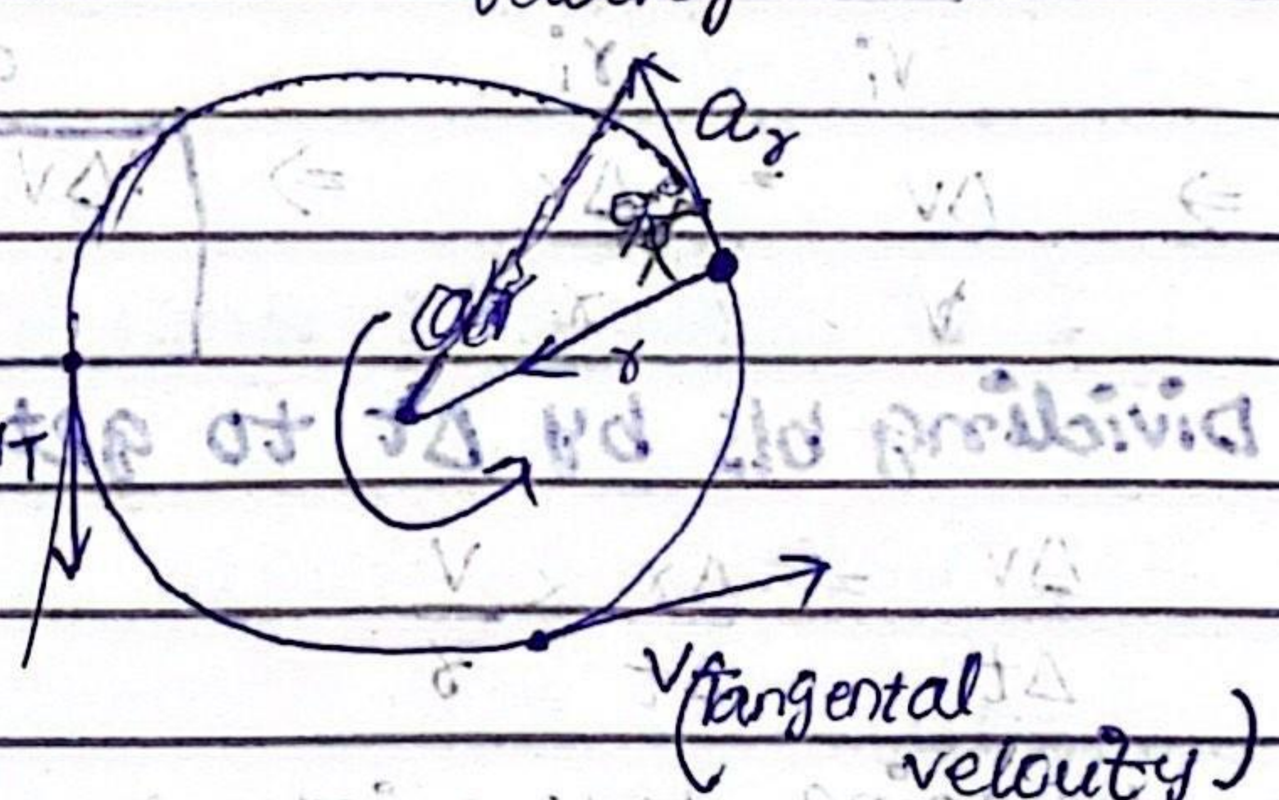
$$\Rightarrow \lim_{\Delta t \to 0} \frac{\Delta S}{\Delta t} = r\left[\frac{\Delta\theta}{\Delta t} \lim_{\Delta t \to 0}\right]$$

$$\because \lim_{\Delta t \to 0} \frac{\Delta S}{\Delta t} = v, \quad \lim_{\Delta t \to 0} \frac{\Delta \theta}{\Delta t} =$$

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

(c) Relation b/w Angular acceleration:-

Q: Briefly explain the partical application where the angular and linear velocity are involved? $\boxed{v = r\omega}$ } Q# related to angular velocity.



Drivation of angular acceleration:-

As we have, $\Rightarrow v = r\omega$

Taking and dividing to sides by $\lim_{\Delta t \to 0} \frac{\Delta}{\Delta t}$;

$$\Rightarrow \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = r \lim_{\Delta t \to 0} \frac{\Delta \omega}{\Delta t}$$

$$a_T = r\alpha$$

Tangential acceleration (a_T):-

Tangential acceleration is produce to change the magnitude of velocity

Angular a:- (α_r):-

Angular acceleration is produce to change in direction of velocity.

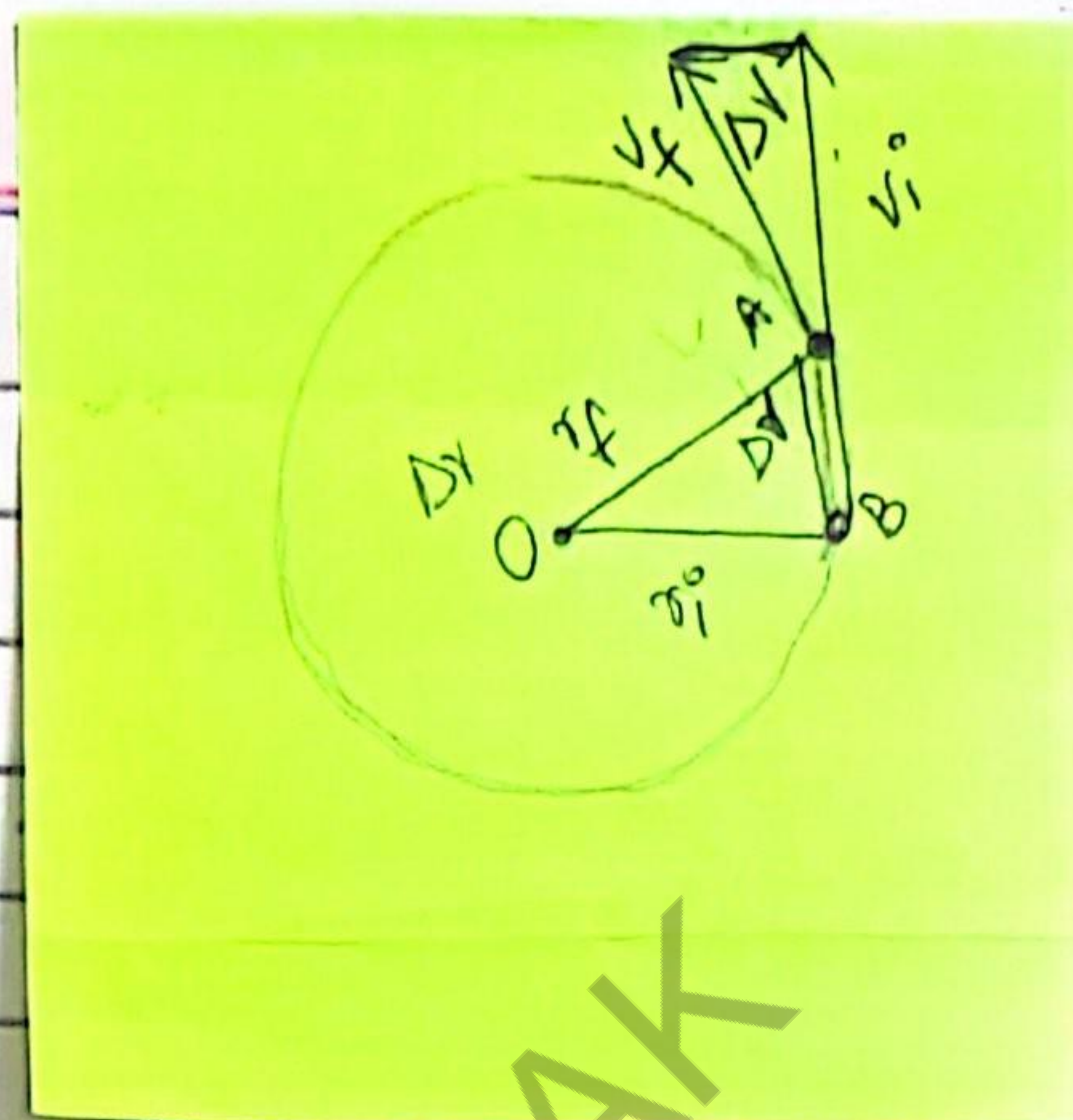
Velocity

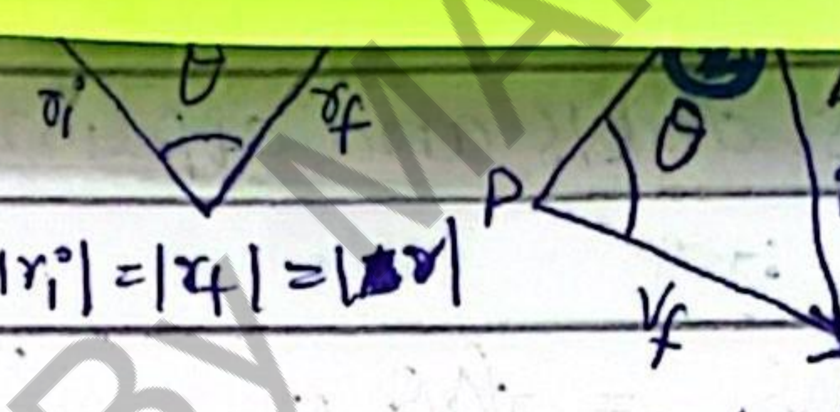
Magnitude → change → acceleration → ~~Translatory~~ linear → Tangental

Direction → change → acceleration → Angular

Centripetal acceleration :-

Diagrams :





$|r_i| = |r_f| = |\Delta r|$

change in velocity due to change in direction / angle

$|v_i| = |v_f| = |\Delta v|$

efinition :-

entripetal acceleration is how

uickly the direction of velocity

f the object changes as it moves

n that circle.

xplanation :-

onsider a body that is moving with niform velocity. The particle is at A at time "ti" with velocity "vi" and at point B at time "tf" with velocity "vf".

Derivation :-

Since, only the direction of v changes :

$$|v_i| = |\cancel{v_f}| = |v|$$

. since radius of a circle remains same :

$$|r_i| = |r_f| = |r|$$

Now, $\Delta AOB \leftrightarrow \Delta QPR$

since these triangles are right angled. ~~at~~ ∠ $\tan\theta = \frac{P}{B}$

$$\frac{\Delta v}{v_i} = \frac{\Delta r}{r_i}$$

ΔV : is showing the change in direction of V, By comparing the value of V at two different points.

$$\Rightarrow \frac{\Delta v}{v} = \frac{\Delta r}{r} \Rightarrow \boxed{\Delta v = v\frac{\Delta r}{r}}$$

Dividing b/s by Δt to get acceleration :

$$\frac{\Delta v}{\Delta t} = \frac{\Delta r}{\Delta t} \times \frac{v}{r}$$

→ Imagine two points A and B extremely close to each other such that Δt apporoches to zero and then acceleration at this stage now be instantaneous acceleration.

So that;

$$\Rightarrow a = \frac{v}{\cancel{r}} \lim_{\Delta t \to 0} \frac{\Delta r}{\Delta t} \qquad \because \frac{\Delta v}{\Delta t} = a$$

$$a_c = \frac{v}{r} \times v \qquad \because \frac{\Delta r}{\Delta t} = v$$

$$\boxed{a_c = \frac{v^2}{r}}$$ → Magnitude of centeripetal acceleration → eq (x)

vectorially, it is given as;

$$\Rightarrow \vec{a_c} = \left(\frac{-v^2}{r}\right)\hat{r} \rightarrow (i)$$

, **Now,** here $(\hat{r})$ is radial unit vector and it has outword direction and (−)ive sign due to being inward,

Since, $\boxed{v = r\omega}$

Putting eq(i) in eq(x) then,

$$\vec{a_c} = \frac{-(r\omega)^2}{r}\hat{r}$$

$$\Rightarrow \vec{a_c} = \frac{-r^2\omega^2}{r}\hat{r}$$

So, $\boxed{\vec{a_c} = -r\omega^2\hat{r}}$ → centripetal acceleration in terms of angular form.

Important points;

→ a_c is prodused through change in direction and constant velocity.

Q; In Linear motion;

can acceleration can be prodused when the velocity is constant?

Ans: Since the acceleration is the rate of change of velocity of a body with time, if the velocity is constant, the a of the body will be zero.

For centripetal (circle):- Same Q#

Q: Ans; Since, velocity is a vector with both magnitude and direction, a change in either the magnitude or the direction constitutes compute two ... one is in terms of radius and the other one is in terms of velocities.

a change in the velocity. For this reason, it can be safely concluded that an object moving in a circle at constant speed/velocity is accelerating.

Centeripetal force:-

→ without this force object will move in a straight line due to inertia.

Definition:- Centripetal force is the push or pull that keeps something moving in a circle.

or

Centripetal force is the force that pulls an object toward the center of a circle, causing it to move in a circular path. Even along the curve path.

Derivation:- $F_c = m a_c$

$F_c = m(r\omega^2)/r$

$\boxed{F_c = -mr\omega^2}$

∴ (-)ive sign indicate the direction toward the center.

$F_c = m a_c$

$\boxed{F_c = \frac{mv^2}{r}}$

→ It is not a separate force. It is the resultant force of g, tension, friction, or any other force depending on situation.

Questions:

why a_c is always directed towards centre?

toward the center of the circular path bcz it is the result of continuous change in the direction of an object moving in a circle. Even though; the speed of the object remains constant, it's direction constantly changing.

→ And this change in direction requires a force that act perp to the object's velocity.

→ The magnitude of centripetal force depends on the speed of the object and radius of the circular path.

Q# Find the maximum speed of car in kmh^{-1} when it is travelling in curved road having 500m radius of curvatures bank at an angle of 15°?

Given:-

Radius $= r = 500m$

Angle $= \theta = 15°$

Acceleration $= g = 9.8m/s^2$

To find:- $v = ?$

Formula:-

Since, according to the given formula;

$$\tan\theta = \frac{v^2}{rg}$$

$$v^2 = \tan\theta rg$$

Taking square root on b/s

$$\sqrt{v^2} = \sqrt{\tan\theta \cdot R \cdot g}$$

$$v = \sqrt{\tan\theta \cdot R \cdot g}$$

Solution:

In order to find $\theta = ?$

$\tan(15°) = 0.2679$

Now, By putting values in given formula;

$$v = \sqrt{\tan\theta \cdot R \cdot g}$$

$$v = \sqrt{(0.2679) \times (9.8) \times (500)}$$

$$v = \sqrt{1314.45}$$

$$v = 36.2m/s$$

Now, converting v into kmh

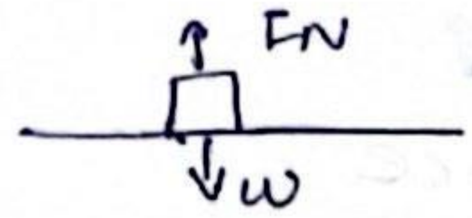
since,

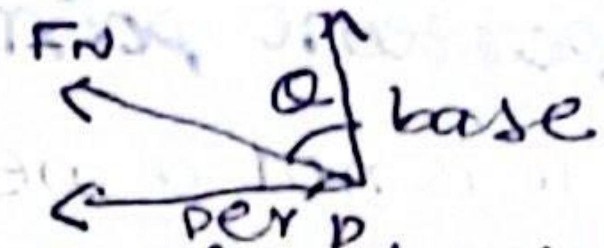
$1m/s = 3.6kmh^{-1}$

$v = 36.2 \times 3.6$

$$\boxed{v = 130.4kmh^{-1}}$$

Application of centripetal force :-





Banking of Roads :- Banking of roads refers to the angle at which ~~road is inclined in order~~ to help vesicles negotiate curves more safely and efficiently.

Centripetal force : when a ~~force~~ vehicle moves in a circular path, it requires centripetal force directed toward the center of the circle.

Banking θ :- The angle at which the road is inclined with respect to the horizontal.

Normal force : The perpendicular force exerted by the surface of the road on the vehicles.

Forces acting on a Vehicle on a Banked curve :-

i) weight (w) (mg) : This force acts downward vertically, due to gravity. It has magnitude of mg, where 'm' is mass and 'g' is gravity a.

ii) This force acts perpendicular to the surface of the road.

Derivation :- vertical component of the normal balance the w.

$$F_N \cos\theta = mg \rightarrow (i)$$

~~The hor~~

The horizontal component of the normal force provide necessary F_c : $F_N \sin\theta = F_c$

$$F_N \sin\theta = \frac{mv^2}{r} \rightarrow (ii)$$

Dividing eq (ii) by eq (i)

$$\frac{\cancel{F_N}\sin\theta}{\cancel{F_N}\cos\theta} = \frac{\cancel{m}v^2/r}{\cancel{m}g}$$

$$\rightarrow \tan\theta = \frac{v^2}{rg}$$

$$\rightarrow \theta = \tan^{-1}\frac{v^2}{rg}$$

$$v^2 = rg\tan\theta$$

$$\sqrt{v^2} = \sqrt{rg\tan\theta}$$

$$\rightarrow \boxed{v = \sqrt{rg\tan\theta}}$$

Centrifuge :-

A centrifuge is a device that uses F_c to separate substances based on density. When device spins, it generates a centripetal force that acts on the substances inside. This force keeps objects moving in a circular path.

Applications :

- cream separator
- washing Machine Dryer.

Moment of Inertia:- (kgm^2)

→ The property of body which resists change in angular motion or rest.

→ The tendency of a body to resist any change due to rotational motion of a body for increase in angular velocity.

For point of mass: It is a property of an object that measures how difficult it is to make it rotate around a certain axis → The larger moment of I harder to change it's rotation.

$$I = mr^2$$

Rigid body:- $\sum_{i=1}^{i=n} m_i r_i^2$ $I = m_1r_1^2 + m_2r_2^2 + m_3r_3^2 \ldots m_nr_n^2$

~~more radius = harder to rotate~~

less radius = easy to rotate

→ If you rotate a rigid body about different axis how does moment of inertia change?

Ans: The moment of inertia depends on how far the mass is distributed from the axis. The farther the mass is from the axis, the greater the moment of inertia.

$\boxed{\text{Angular Momentum}}$: ($kgm^2s^{-1}$), ($ML^2T^{-1}$)

Definitions:

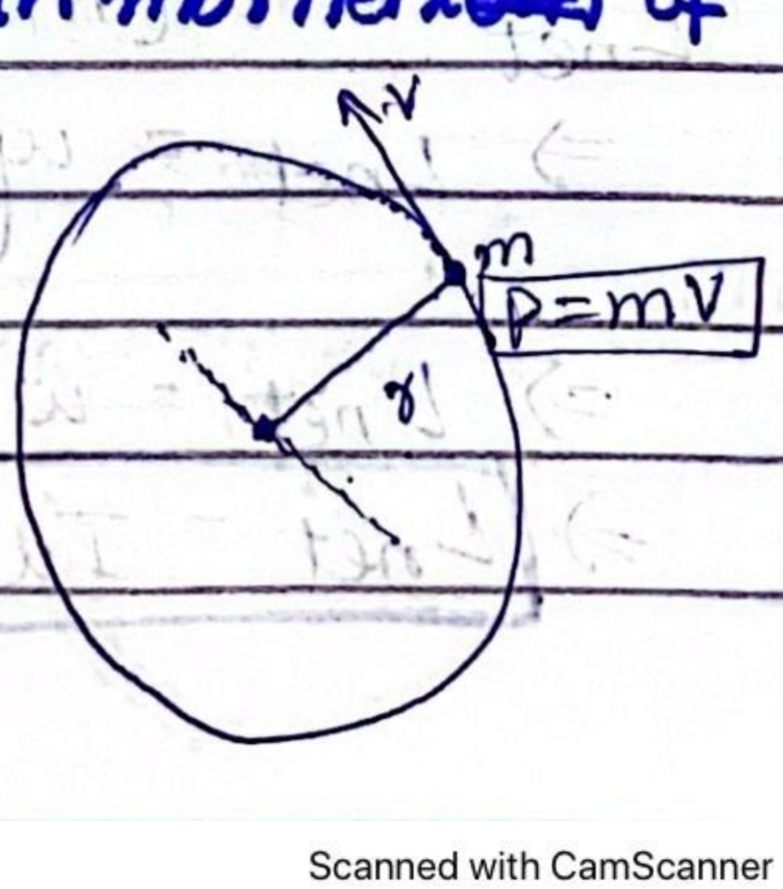
1) The momentum possessed by a body during it's angular motion is called angular Momentum.

2) The cross product of moment arm "$\vec{r}$" with linear momentum "p" is called angular momentum.

$$\vec{L} = \vec{r} \times \vec{p}$$

Derive a relation b/w angular momentum with moment of inertia?

For point mass:- As, we have from Angular momentum:-



$$\vec{L} = \vec{r} \times \vec{p}$$

$$\vec{L} = rp\sin\theta\,\hat{n}$$

$\vec{L} = rp\sin 90^\circ$

$\boxed{L = rp} \longrightarrow (i)$

Since, $\boxed{p = mv} \rightarrow (ii)$

Putting eq(ii) in eq(i) then,

$L = r(mv) = mvr$ so, $\boxed{L = mvr} \rightarrow (3)$

Since, $\boxed{v = r\omega} \rightarrow (iv)$

Putting eq(iv) in eq(iii) then,

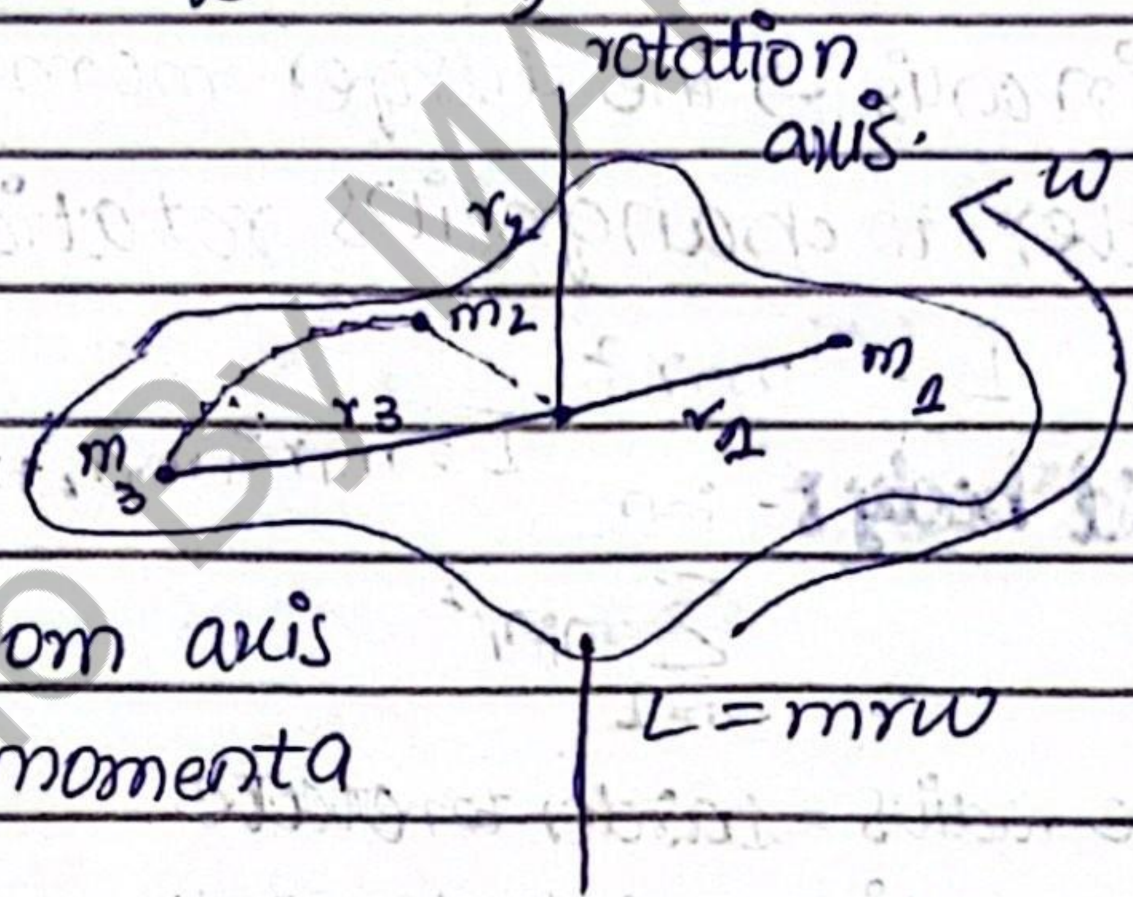
$\Rightarrow \vec{L} = m(r\omega)r \Rightarrow \boxed{L = mr^2\omega} \longrightarrow (v) \rightarrow$ the product of moment of inertia and its angular velocity.

Since from moment of inertia,

$\boxed{I = mr^2} \rightarrow (vi)$ Putting eq(vi) in eq(v) then,

$\Rightarrow \boxed{L = I\omega}$

For a Rigid body :-



consider mass $m_1, m_2 \cdots m_n$ having distance of $r_1, r_2 \cdots r_n$ from axis of rotation. So, the net angular momenta of this system is given as:-

$$L_{net} = L_1 + L_2 + L_3 + \cdots + L_n$$

Since, we know that the angular momentum of single particles is given by:- $\boxed{L = mr\omega}$

$$\Rightarrow L_{net} = m_1r_1^2\omega + m_2r_2^2\omega + m_3r_3^2\omega + \cdots m_nr_n^2\omega$$

Taking common "ω" from the above.

$$\Rightarrow L_{net} = \omega(m_1r_1^2) + \omega(m_2r_2^2) + \omega(m_3r_3^2) \cdots \omega(m_nr_n^2)$$

$$L_{net} = \omega(m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \cdots m_nr_n^2)$$

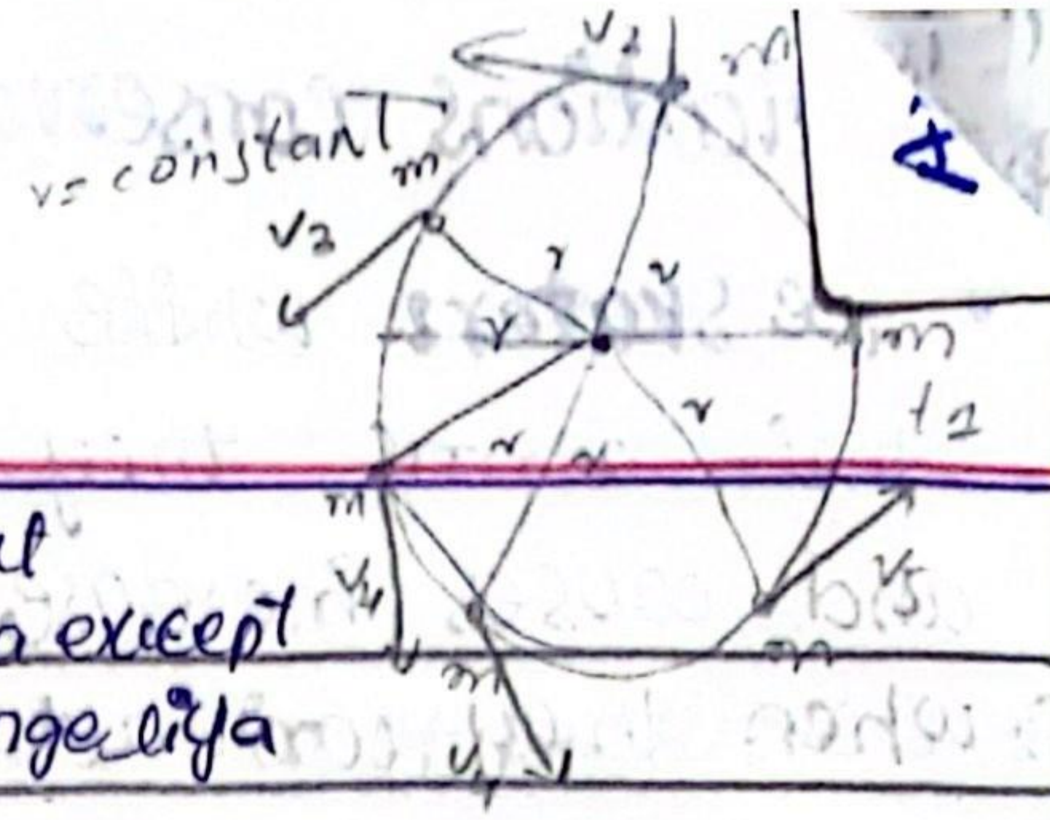
$$\Rightarrow L_{net} = \omega\left(\sum_{i=1}^{i=n} m_ir_i^2\right) \qquad \because I = \sum_{i=1}^{i=n} m_ir_i^2$$

$$\Rightarrow L_{net} = \omega(I)$$

$\Rightarrow \boxed{L_{net} = I\omega}$ Hence, this shows that the total angular momenta of rigid body.

Scanned with CamScanner

Relation b/w Torque and Angular Momentum :-



Since, we have the angular momentum,

$\Rightarrow \vec{L} = \vec{r} \times \vec{P}$

Multipling both sides by " $\frac{\Delta}{\Delta t}$ " :- ↗ ⇒ dono taraf time ka except sa change liya

$$\frac{\vec{\Delta L}}{\Delta t} = \frac{\Delta}{\Delta t}(\vec{r} \times \vec{p})$$

$$\Rightarrow \frac{\vec{\Delta L}}{\Delta t} = \vec{r} \times \frac{\vec{\Delta p}}{\Delta t} \qquad \because \frac{\vec{\Delta P}}{\Delta t} = \vec{F}$$

$$\Rightarrow \frac{\vec{\Delta L}}{\Delta t} = \vec{r} \times \vec{F} \qquad \because \boxed{\vec{\tau} = \vec{r} \times \vec{F}}$$

$$\boxed{\Rightarrow \frac{\vec{\Delta L}}{\Delta t} = \vec{\tau}}$$

Conclusion :- Thus we conclude that the rate of change in angular momentum produce torque.

Special tip :-
(i) linear momentum me change in angular momentum ki value ko change karegi.
(ii) Jab bhi angular momentum change hoga tu torque produce hoga.

SLO Based Questions :-

1) Derive the relation of angular momentum with moment of inertia and angular velocity for a rigid body.

2) Drive $\boxed{L = I\omega}$ for a rigid body. or $\boxed{\frac{\vec{\Delta L}}{\Delta t} = \vec{\tau}}$

Conservation of Angular Momentum :-

As, we know :-

$$\Rightarrow \frac{\vec{\Delta L}}{\Delta t} = \vec{\tau}$$

If we consider an isolated system then the torque (external), $\vec{\tau} = 0$,

$$\Rightarrow \frac{\vec{\Delta L}}{\Delta t} = 0 \Rightarrow \boxed{\vec{\Delta L} = 0} \;\therefore$$

$$\Rightarrow \vec{L_f} - \vec{L_i} = 0$$

$$\Rightarrow \boxed{\vec{L_f} = \vec{L_i}} \rightarrow (i)$$

The final momentum should be equal to initial angular momentum.

Since, $\boxed{L = I\omega}$ then,

$L_i = I_i\omega_i$, $L_f = I_f\omega_f$

$$\boxed{I_i\omega_i = I_f\omega_f} \rightarrow (ii)$$

Since, $I = mr^2$

$I_i = m_i r_i^2$, $I_f = m_f r_f^2 \rightarrow$ (iii)

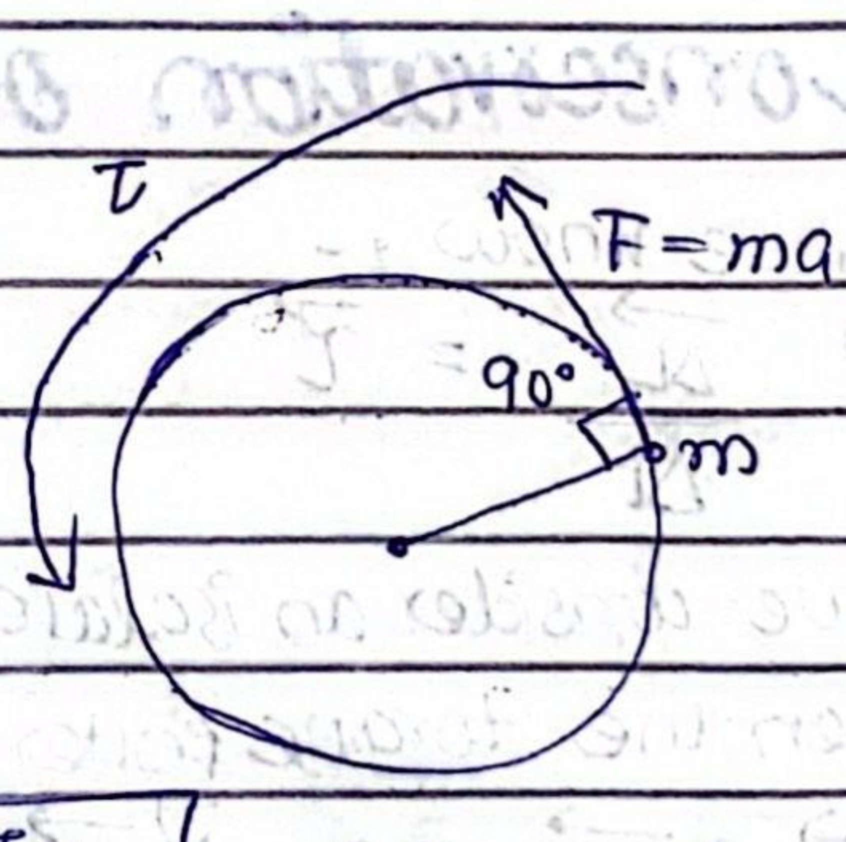
$\Rightarrow m_i r_i^2 \omega_i = m_f r_f^2 \omega_f \rightarrow$

By putting eq 3 in eq

Applications Conservation of Angular Momentum :-

- **Ice Skaters:** while spinning, Ice skaters when pulls in their arms, they reduce their moment of inertia and causes increase in angular velocity. but
→ when they contract their arms this increase their moment of inertia and causes decrease in angular velocity.
- **Borad divers:-** when a diver begin their dive, they pull their limbs close to their body, which reduces their moment of inertia, But According to the conservation of $\vec{L}$ the angular velocity increases.
- **Gyroscope:** Maintain it's orientation due to the momentum. when an external torque is applied, such as when the gyroscope is tilted, it experience a change ΔL.
→ This change doesn't result in a simple shift in direction. instead, it causes precession, where the gyroscope rotates around a vertical axis rather than tipping over.
→ when spinning, they resist changes in direction,
→ It

$r \times F$
$rma \, r$ $\quad \tau = mr$ $\quad \tau = I\alpha$
$rmr\alpha$ $\quad \tau = r^2 m\alpha$



Torque and Angular acceleration:

Since, $\tau = rF\sin\theta\,\hat{n}$ → $\tau = rF\sin 90°$

$\boxed{\tau = rF}$ → (i)

$\because F = ma$ → (ii)

$\Rightarrow a = r\alpha$ → (iii)

Putting eq (3) in eq (ii) then,

$\Rightarrow F = m(r\alpha)$

$\boxed{F = mr\alpha}$ → (iv)

Putting eq (iv) in (i)

$\Rightarrow \tau = r(mr\alpha) \Rightarrow \tau = mr^2\alpha$

$\boxed{\therefore \tau = I\alpha}$ $\quad \because I = mr^2$

SLO Q:-
- How Torque is related with α?
- Derive $\tau = I\alpha$
- Derive the relation b/w Torque and angular acceleration.

4.1)

Artificial Gravity:-

linear velocity:

Since, we have:-

$$\Rightarrow a_c = \frac{V^2}{R} \Rightarrow V^2 = a_c R$$

$$\Rightarrow V = \sqrt{a_c R} \quad \boxed{\Rightarrow V = \sqrt{gR}} \rightarrow (i)$$

Angular velocity of satellite:-

Since, we have $\boxed{V = R\omega} \rightarrow (ii)$

By comparing eq (i) and eq (ii) then,

$$\Rightarrow \sqrt{gR} = R\omega$$

$$\Rightarrow R\omega = \sqrt{gR}$$

$$\Rightarrow \omega = \frac{\sqrt{gR}}{R}$$

$$\Rightarrow \omega = \sqrt{\frac{gR}{R^2}}$$

$$\boxed{\Rightarrow \omega = \sqrt{\frac{g}{R}}} \rightarrow (iii)$$

Freqeney of satellite:-

Since, frequency is required

$$\because f = \frac{1}{T}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{R}} \rightarrow (vi)$$

Time period of satellites:-

The time required by a rise of satellite to complete one rotation is called Time period of Satellite.

Since,

$$\Rightarrow S = VT \Rightarrow T = \frac{S}{V}$$

$$T = \frac{2\pi R}{V} \quad S = \text{circumfarance of circle}$$

$$\Rightarrow T = \frac{2\pi \cancel{R}}{\cancel{R}\omega} \quad \because V = R\omega$$

$$\boxed{\Rightarrow T = \frac{2\pi}{\omega}} \rightarrow (iv)$$

Putting eq (iii) in eq (iv) then,

$$T = 2\pi \times \sqrt{\frac{R}{g}}$$

$$\boxed{T = 2\pi\sqrt{\frac{R}{g}}} \rightarrow (v)$$

Excercise Short Questions:-

(1) Is centripetal force a fondamental force ... ?

Centripetal force is not a fundamental force itself, rather it is a it is the net force required to keep an object moving in a circular path. It arises from other fundamental forces such as: gravitational, electromagnetic or tension forces therefore by combination of these $\vec{F}$, ~~Fc can be provided.~~

5) double tries on one side of axel ... ?

Yes, the moment of inertia for a system with double tires on one side of axel be different from single tire bcz double has larger mass and increase it distorbution of axis of rotation. Therefore moment of intertia will be greater..

6) why it is best to have blades to rotate in oppasite ... ?

Having the bladdes rotate in opposite direction helps contract torque, preventing the helicoptor from spinning and enhancing stability and control.

7) If the diameter of earth become half ..... ?

If Earth's diameter become half while it's mass remain same, it's moment of Inertia decreases, To conserve $\vec{L}$, the rotational speed must increase, causing Earth to spin faster around it's axis.

8) At a_T magnitude is changed but not direction of it's velocity?

In circular motion, tangential acceleration changes the magnitude of the object but not it's direction because it act along the tangent path.

9) why artificial gravity is less than $9.8 m/s^2$?

Artificial gravity is usually small than $9.8 m/s^2$ bcz it is produce by centripetal acceleration in rotating system, like space station; $\left(a_c = \frac{v^2}{R}\right)$ and also prevent discomfort and allow easier movement.

10) How rotation of a flywheel helps to even out the power — ?

The rotation of a flywheel helps even out power delivery from an engine by storing kinetic energy. when the engine produce power, the flywheel absorb some of that energy reducing fluctuation

Numerical problems :-

(1)

Given : $t = 60s$

revolution = 3000 per minute

$= 2\pi$ rad

To find :- $\omega = ?$

Solution : As we know that;

$$\omega = \frac{2\pi}{t} = \frac{2(3.14) \times 3000}{60}$$

$$\boxed{\omega = 314 rad/s}$$

x : ═══ : xx ═══ : xx ═══ :

(2) Given : $r = 14.5m$

$g = 9.81 m/s^2$

To find = $v = ?$

Solution : $v = \sqrt{rg}$, $F_c = \frac{mv^2}{g}$

In order to find (tan θ) =

Here, centripetal force is provided by gravitational force. so,

$F_c = F_g$

$$\frac{\cancel{m}v^2}{r} = \cancel{m}g \quad \boxed{v = \sqrt{rg}}$$

By putting values

=

Now,

$v = \sqrt{(14.5)(9.81)}$

$v = \sqrt{142.245}$

$$\boxed{v = 11.9 ms^{-1}}$$

(3)

200/1000

Given : $m = 200g = 0.2kg$

$l = 0.8m$

Find = $I = ?$

Solution : Since,

$I = \frac{1}{12}ML^2$

so, $I = \frac{1}{12}(0.2)(0.8)^2$

$= \frac{1}{12}(0.2)(0.64)$

$I = \frac{1}{12}(0.2)(0.64)$

$I = 0.128/12$

$$\boxed{I = 0.02 kgm^2}$$

x : ═══ : x ═══ : x ═══

(4) Given : $m = 450g = 0.45kg$

$r = 11cm = 0.11m$

revolution = 10 revolution per second

To find :- L

Solution : - In order to find

$\vec{L} = I\omega$

But to find $I = ?$ (sphere)

$I = \frac{2}{5}mr^2$

$I = \frac{2}{5}(0.45)(0.0121)$

$I = \frac{2}{5}\ 0.002178$

Now, $\omega = 10 \times 2\pi$

$\omega = 10 \times 2(3.14)$

$\omega = 62.8$

So, $L = I\omega$

$\vec{L} = (0.002178)(62.8)$

$\boxed{\vec{L} = 0.1367}$ $\boxed{0.136\ kgm^2s^{-1}}$

x: ═══ X : ═══ : X ═══

5

Given:-

$\omega = 10\ rad/s$

$I' = \frac{1}{3} I$

To find:

$\omega' = ?$

Solution:-

$L = I\omega \rightarrow (i)$

$L' = I'\omega' \rightarrow (ii)$

Since angular momentum is conserved;

$L' = L$

$I'\omega' = I\omega$

$\frac{1}{3}\cancel{I}\omega' = \cancel{I}\omega$

$\omega' = 3\omega$

$\omega' = 3(10)$

$\boxed{\omega' = 30\ rad/s}$

When he close his arm's the angular velocity will be $\boxed{30\ rad/s}$.

Data:- 6

$F = 200N$

$m = 30kg$

$r = 2m$

$m_b = 20kg$

$r_b = 1.5m$

To find:-

(i) $\alpha = ?$

(ii) $\alpha = ?$

Solutions:- $\tau = I\alpha$

(a) $\alpha = \frac{\tau}{I_m \text{ (diskshape)}}$

$\alpha = \frac{\tau}{\frac{1}{2}mr^2} = \left(\frac{r \times F}{\frac{1}{2}mr^2}\right)$

By putting values

$\alpha = \frac{(200)(2)}{\frac{1}{2}(30)(2)^2} = \frac{400}{60}$

$\boxed{\alpha = 6.667\ rad/s^2}$

Now,

(b) $\alpha = \frac{Fr}{I_m + I_{boy}}$

• I_m for marry go round (solid disk) $= \frac{1}{2}mr^2$.

• I for boy $= mr^2$

Formula will be:-

$a = \frac{Fr}{\frac{1}{2}mr^2 + m_b r_b^2}$

By putting value.

$a = \frac{(200)(2)}{60 + (20)(1.5)^2}$

$a = \frac{400}{60 + 45}$

$$\alpha = \frac{400}{60+45}$$

$$\alpha = \frac{400}{105} = 3.81$$

$$\boxed{\alpha = 3.81\ rad/s^2}$$

(7) X : X ═══ : X X ═══ : : X X

Data :-

$g_a = 5ms^{-2}$

$D = 100m$

$R = D/2 \boxed{= 50m}$

To find :-

$\omega = ?$

Solution :

$$\omega = \sqrt{\frac{g}{R}} = \sqrt{\frac{5}{50}}$$

$$\omega = \sqrt{0.1}$$

$$\boxed{\omega = 0.316\ rad/s}$$

rotation per min

Now, converting in rpm

$$= \frac{0.316}{2\pi/60} = \frac{0.316 \times 60}{2(3.14)}$$

$$\omega = 18.96/6.28 = 2.961$$

$$\omega = 3.02$$

$$\boxed{\omega = 3\ rpm}$$