Conservation of Momentum:—

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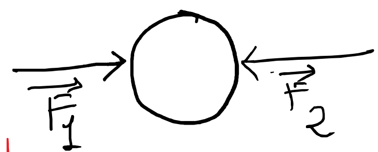
To know the Conservation of angular momentum we must find the variations of momentum with time.

$$\frac{d\vec{p}}{dt} = \frac{d(mv)}{dt}$$

$ma \to F$

$$\Rightarrow \boxed{\frac{d\vec{p}}{dt} = F_{Extn}}$$

The External force is zero



$$\boxed{\vec{F_2} = -F_1}$$

$$\boxed{\begin{aligned} F &= F_1 + F_2 \\ &= F_1 - F_1 = 0 \end{aligned}}$$

$$\Rightarrow \boxed{dp} \Rightarrow \vec{p} = \text{Constant}$$

$ Impulse:— Product of force and the time over which it acts is defined as the impulse $\vec{I}$.

$$\boxed{\text{Impulse} = \text{force} \times \text{time Interval}}$$

$$\vec{I} = \vec{F}\,\Delta t \quad \text{—— (1)}$$

$\vec{I}$ = Vector

Direction of $\vec{I}$ = Direction of force

Unit = N·S

$$\vec{F} = \frac{\Delta\vec{p}}{\Delta t} \Rightarrow \underbrace{\vec{F}\Delta t}_{\vec{I}} = \Delta\vec{p} \quad \text{—— (2)}$$

$$\boxed{\vec{I} = \Delta\vec{p}}$$

Impulse is the change in Momentum

NP

Shopping Cart – ~~22 kg~~ 50 kg, $\vec{F} = 6.5N$, $t = 1.9$ Seconds

What will be the impulse?

$$\boxed{I \approx 12 \cdot kg\,m/sec}$$

Rotational Mechanics :-

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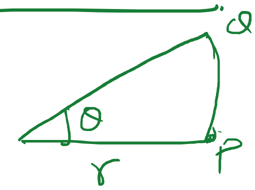
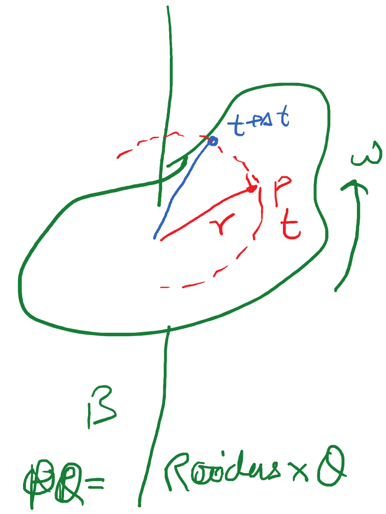
$$\boxed{\omega = \frac{d\theta}{dt}}$$

Unit - Radian/sec

(i) Rigid body

(ii) Axis of Rotation





$\Rightarrow PQ = \text{Radius} \times \theta$

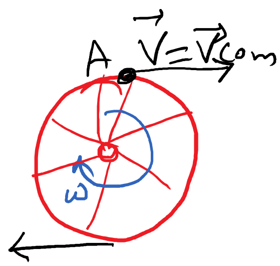
$\Rightarrow \theta = \frac{PQ}{R} = \frac{\text{Length}}{\text{Length}}$

$$\boxed{\theta = M^0 L^0 T^0}$$

$ Rolling Motion :→

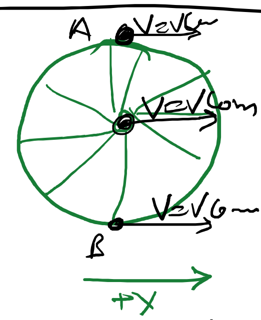
Motion of wheel of your bicycle

Rotational + Translational Motion

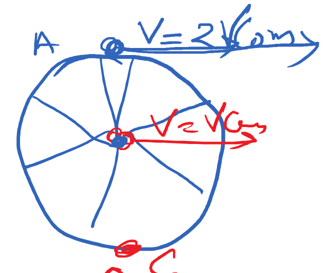


Pure Rotational motions

+



Pure translational Motion



$$\boxed{\vec{V} = -V_{com} + V_{com} = 0}$$

Newton's laws of Motion (Rotational Mechanics)

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$ Motions under uniform angular velocity

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

$$\int \omega\, dt = \int d\theta$$

$$\Rightarrow \omega \int dt = d\theta \Rightarrow \boxed{\theta = \omega t}$$

$\Rightarrow$ Angular accelration

$$\boxed{\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}}$$

If α is Constant

Newton's Equation of Motion (Linear)

$v = u + at$ — $\boxed{v = u + gt}$

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

$v^2 = u^2 + 2as$

Angular Rotation

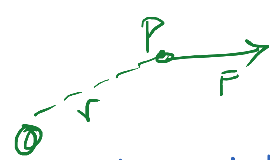
$a = \alpha$, $v = \omega$, $u = \omega_0$, $s = \theta$

$$\boxed{\begin{aligned} \omega &= \omega_0 + \alpha t \\ \theta &= \omega_0 t + \tfrac{1}{2}\alpha t^2 \\ \omega^2 &= \omega_0^2 + 2\alpha\theta \end{aligned}}$$

$ Torque :-

We define torque of the force F about O

$$\boxed{\vec{\tau} = \vec{r} \times \vec{F}}$$



$\vec{\tau}$ is a vector Quantity.

$\perp$ to the plane formed by vector $\vec{r}$ and $\vec{F}$

$ Angular Momentum :-

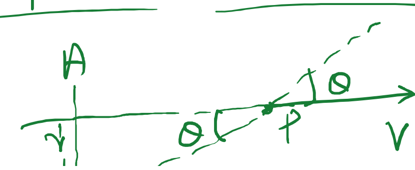
$$\boxed{\vec{l} = \vec{r} \times \vec{p}}$$

$\vec{p}$ = linear momentum

$\vec{r}$ = distance of particle from O.

$$L_{total} = \sum_i l_i \qquad \sum_i (\vec{r}_i \times \vec{p}_i)$$

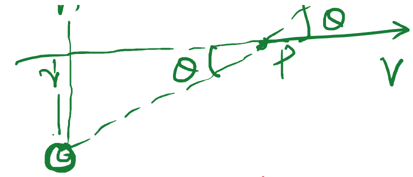
$$\boxed{\vec{l} = \vec{r} \times \vec{p}} \qquad \vec{r} = ? = \vec{OP}$$



$$\boxed{\vec{l} = \vec{r} \times \vec{p}}$$

$$\vec{r} = ? = \vec{OP}$$

$$\vec{p} = m\vec{v}$$



$$\vec{l} = \vec{OP} \times m\vec{v}$$

$$= OP\, mv \sin\theta$$

$$AO = r = OP\sin\theta$$

$$\boxed{\vec{l} = mvr}$$

$\vec{A}$ $\vec{B}$

$$R = \vec{A} \times \vec{B}$$

$$= |A||B|\sin\theta$$