INERTIA

Resistive property of an object while change in it's state of motion or rest is called Inertia.

INERTIA OF REST

The property of a body due to which it cannot change its state of rest by itself.

INERTIA OF MOTION

The tendency of a body to remain in a state of uniform motion in a straight Line.

INERTIA OF DIRECTION

The property due to which a body cannot change its direction of motion by itself.

NEWTON'S 1ST LAW

Every body continues in its sate of rest or uniform motion unless an external force is acted on it.

NEWTON'S 2ND LAW

The rate of change of linear momentum of a body is directly proportional to the external force applied on the body and it takes place in the direction of force.

$$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a}$$

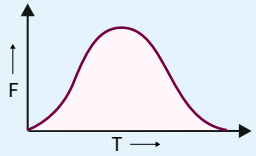
S.I . Unit of force = Newton (N)

$$\vec{v} = \text{constant} \Rightarrow \vec{F} = \vec{v}\frac{dm}{dt}$$

Impulse

$$\vec{J} = \vec{F}_{avg}\,\Delta t = \Delta\vec{P}$$

$\Rightarrow J = \Delta P = \int F.dt$ = area under F– t curve



4. LAWS OF MOTION

NEWTON'S 3RD LAW

To every action there is always an equal and opposite reaction.

$$\vec{F}_{AB} = -\vec{F}_{BA}$$

- Action & Reaction act on different bodies and not on the same body.
- **Action** – reaction forces are of same type.

Conditions for action-reaction pairs

- Equal magnitude and nature.
- Act along the same line.
- Act in opposite direction on different objects.
- Occur simultaneously.

Conservation of linear momentum

When net external force on system is zero, the total linear momentum of an isolated system of interacting particles is conserved.

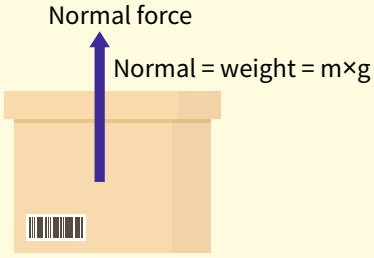
$$\vec{F}_{ext} = 0 \Rightarrow p = \text{constant}$$

$$\therefore p_{initial} = p_{final}$$

FORCES

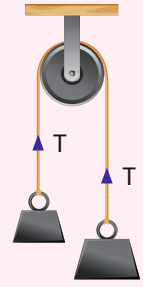
i) Normal Contact force

1) always acts along the common Normal of two surface in contact.
2) Always directed towards the system.
3) Normal force on block is N. N = mg



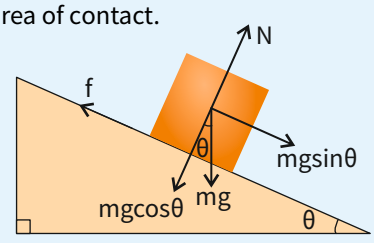
ii) Tension Force

1) Acts along the string and away from the system on which it acts.
2) Tension in a massless string remains constant throughout the string if no tangential force acts along the string.
3) This is force applied by a string on an object or force applied by one part of string on the remaining part of string.



iii) Frictional Force

The force which opposes the relative motion of two contact surfaces is friction. That is a frictional force.
The frictional force depends upon the nature of surfaces in contact and independent of the area of contact.



Static friction

acts when a body is at rest on application of a force. $f_s < \mu_s N$

Limiting friction

acts when a body is just at the verge of movement. $f_l = \mu_s N$

Kinetic friction

acts when a body is actually moving. $f_k = \mu_k N$

Rolling friction

The force of friction which comes into play when one body rolls or tends to roll on the surface of another body.

For Non – inertial frame

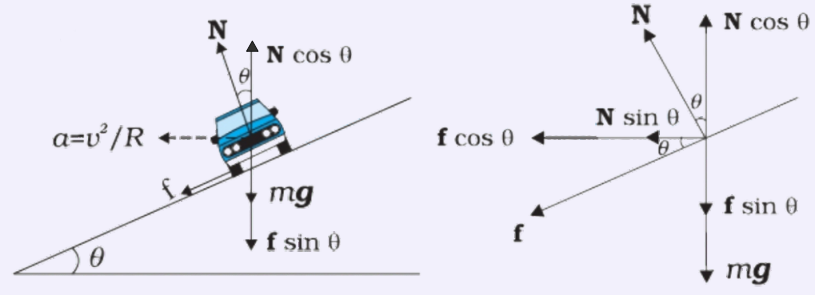
$\vec{F}_{ext} + \vec{F}_{Pseudo} = m\vec{a}$

$\vec{F}_{pseudo} = -M\vec{a}_{frame}$

Motion of a Car on Level Road (by Friction Only)

$V_{max} = \sqrt{\mu_s Rg}$

Motion of a Car on Banked Road



(i) Optimum speed of a vehicle on a banked road. $V = \sqrt{rg\tan\theta}$

(ii) maximum safe speed on a banked frictional road. $V_{max} = \sqrt{\frac{rg(\mu + \tan\theta)}{1 - \mu\tan\theta}}$