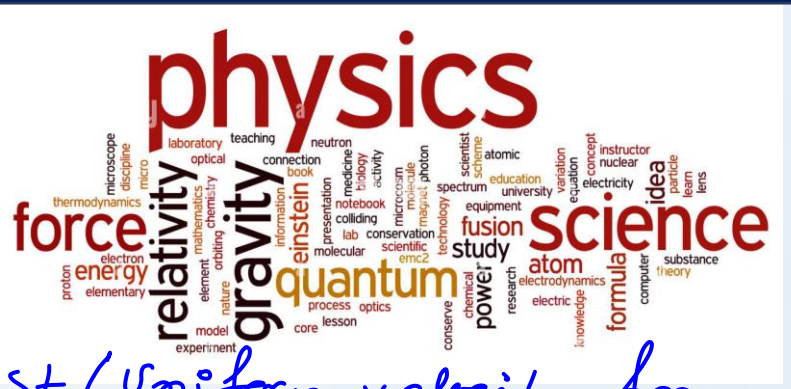


Reference frame

① Inertial frame ⇒ Any Rest / Uniform velocity frame of reference
↳ Newton's laws of Motion applicable.

② Non inertial frame
↳ Any Accelarated / Retardate frame of reference

MODULE-2 CLASS- 3

LAWS OF MOTION , FRICTION

PRESENTED BY- DEPT. OF PHYSICS

TODAY'S LESSON

- Laws of motion.
  - 1st
  - 2nd
  - 3rd
- Reaction in a lift.
- Friction.

Tendency of an object to stay in its own state of rest / motion.

1ST LAW OF MOTION (LAW OF INERTIA)

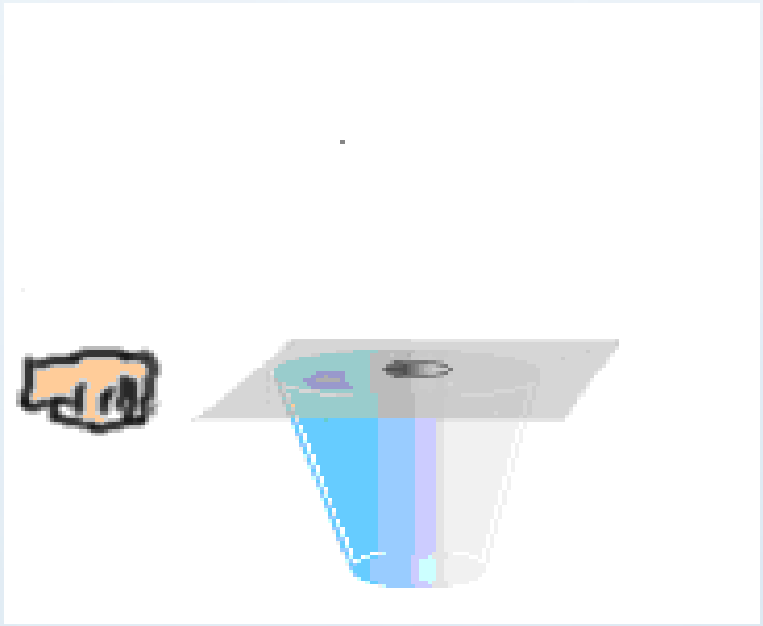
Outcome from the Law :-

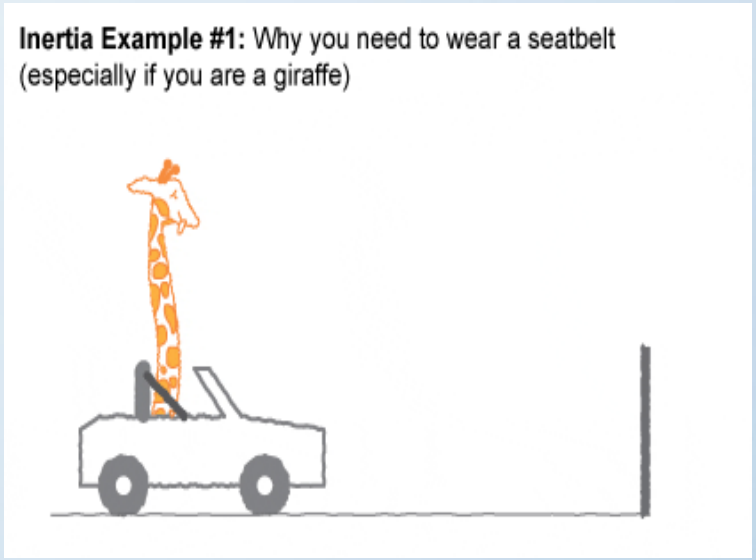
- Definition of force
- Concept of Inertia
- Concept of reference frame

- An object at rest remains at rest, or if in motion, remains in motion at a constant velocity unless acted on by a net external force.

INERTIA

- **Inertia** is a **force** which keeps stationary objects at rest **(Inertia of Rest)** and moving objects in motion at constant velocity **(Inertia of Motion).**
- A more massive object has more **inertia.**





RICE ADAMAS GROUP

$F \propto \frac{(mv - mu)}{t}$ ∝

$F = K\left(\frac{mv - mu}{t}\right) = K\,m\left(\frac{v-u}{t}\right) = K \cdot ma$

2ND LAW OF MOTION

$F = ma$ [when $K = 1$, $a \propto F$]

RICE EDUCATION | ricesmart TOGETHER IN SUCCESS

- The second law states that the rate of change of **momentum** of an object is directly proportional to the force applied, or, for an object with constant mass, that the net **force** on an object is equal to the **mass** of that object multiplied by the **acceleration.**

If $a = 1$, $m = 1$, Then $F = 1$ (unit)

❖ OUT COME:-

- Definition of unit force.
- Concept of momentum
- Measurement of force $(F = ma)$

❖ LINEAR MOMENTUM:-

- **It** is the vector quantity and defined as the product of the mass of an object (m), and its velocity (v)

$p = mv$

Unit:-
Newton (kgm/sec²)
Dyne (gm cm/sec²)
Poundal (lb ft/sec²)
} Absolute system

kg. f
gm-f
lb-f
} Gravitational sys

Relation
1 N = 10^5 dyne
1 kg f = 9.81 N
1 gm f = 981 dyne
1 lb f = 32 Poundal

Dimension = $[MLT^{-2}]$

Impulsive force

Unit:- kg m/sec
gm cm/sec
lb ft/sec

Dimension = $[MLT^{-1}]$
Vector quantity

Impulse of a force or Impulse

$(F \times t) = (mv - mu)$

Unit:- N-sec, dyne-sec,
kg. m/sec, gm cm/sec,
vector quantity

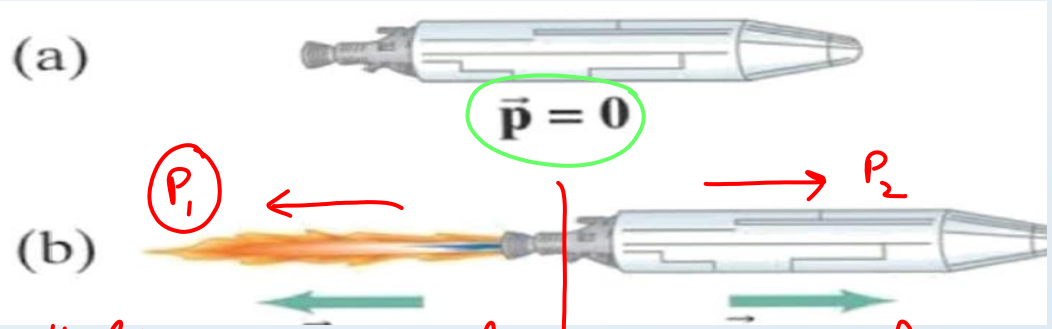
Dimension = (ML^{-1})

RICE ADAMAS GROUP

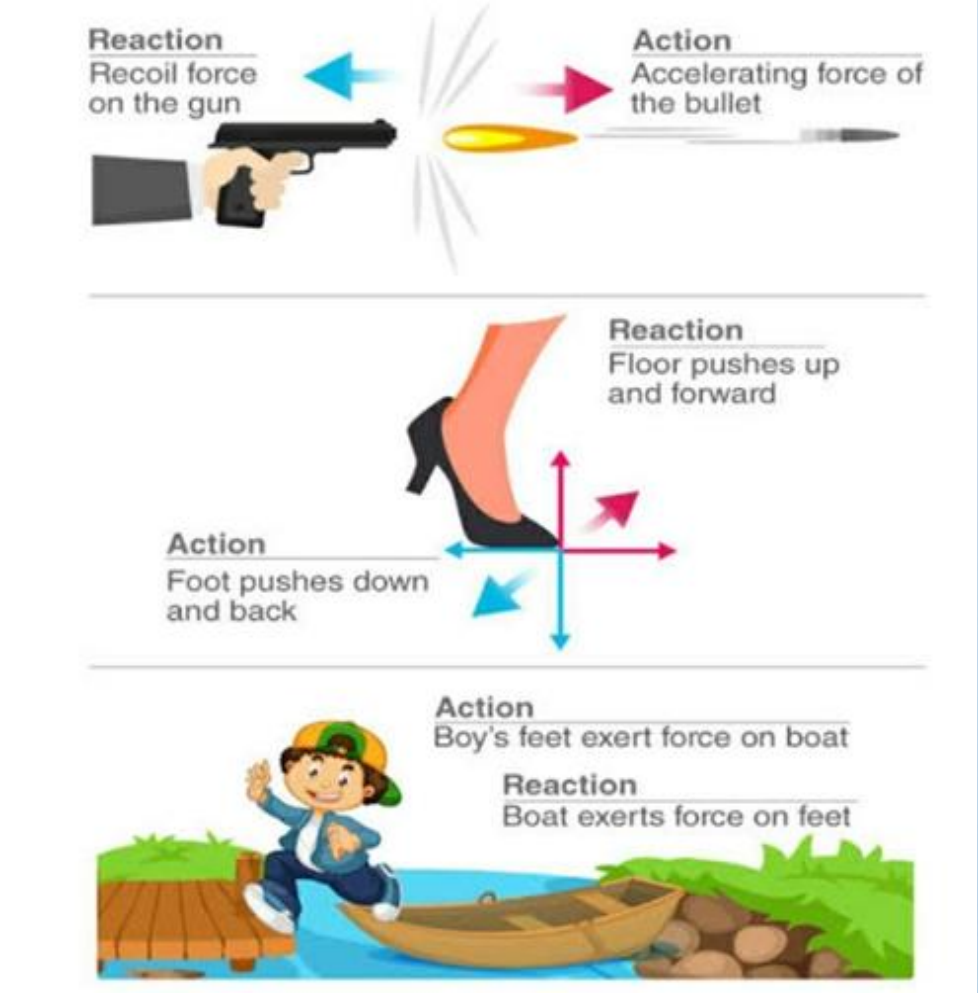
3RD LAW OF MOTION

RICE EDUCATION | ricesmart TOGETHER IN SUCCESS

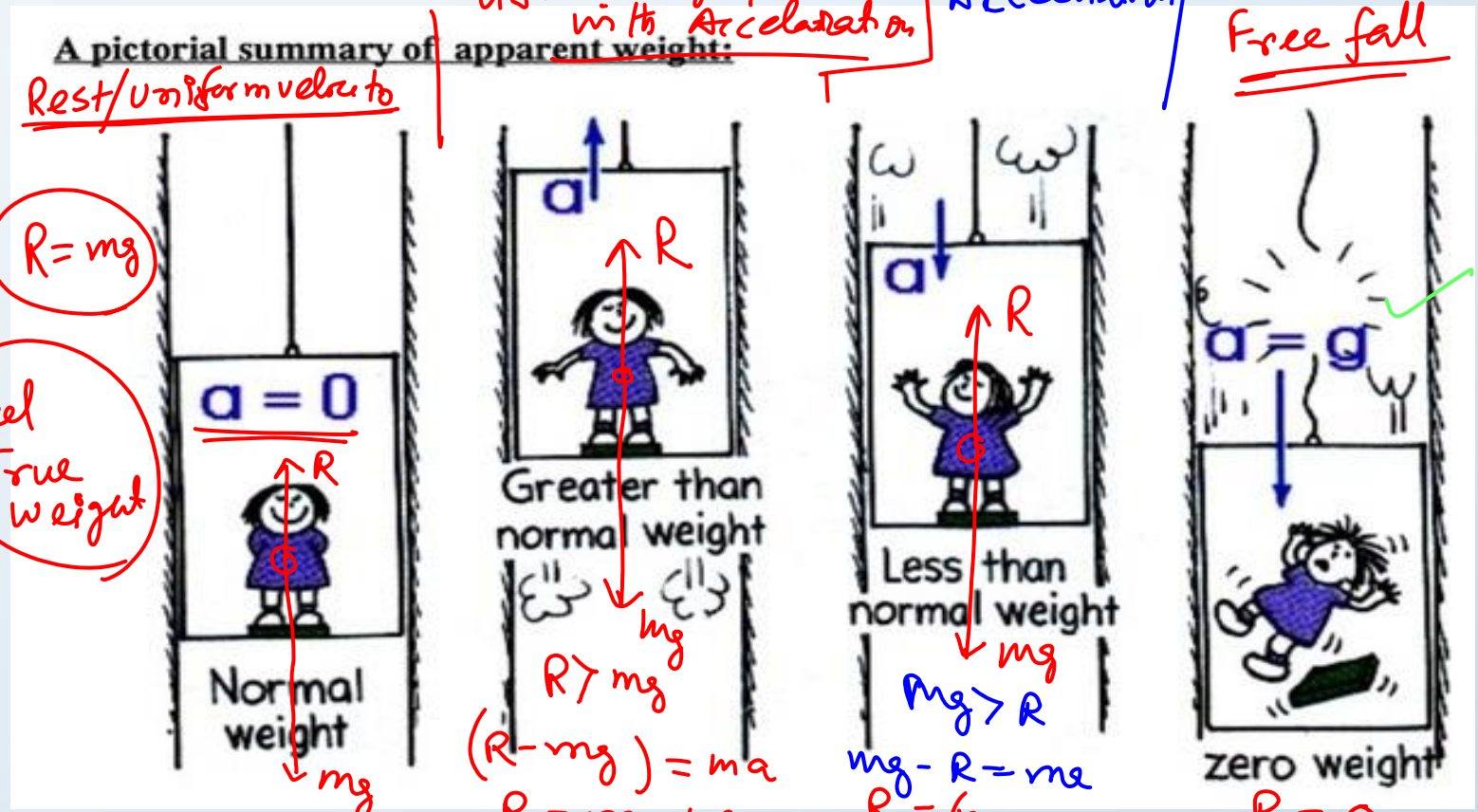
- Every action, there is an equal and opposite reaction.
- Action and reaction acts on different objects.



linear momentum Conservation Principle -



ACTION AND REACTION IN LIFT



downward Acceleration but a > g

mg ↓ R

R = -ve value

Super weightless condition

RICE ADAMAS GROUP

RICE EDUCATION | ricesmart TOGETHER IN SUCCESS

FRICTION

Contact force
Resistive force.
Non Conservative force
Dissipative force
Electromagnetic force

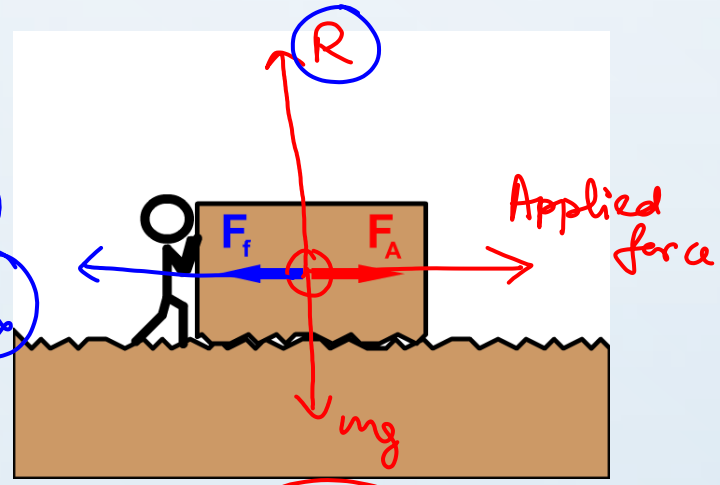
Types of Friction

- Static Friction
- Kinetic of sliding Friction
- Rolling Friction
- Fluid Friction

viscosity

Self adjusted force -

•It is the resistance to motion of one object moving relative to another.



$F_{max} \propto R$

$F_{max} = \mu R$

$\mu = \frac{F}{R}$

μ - coefficient of friction.

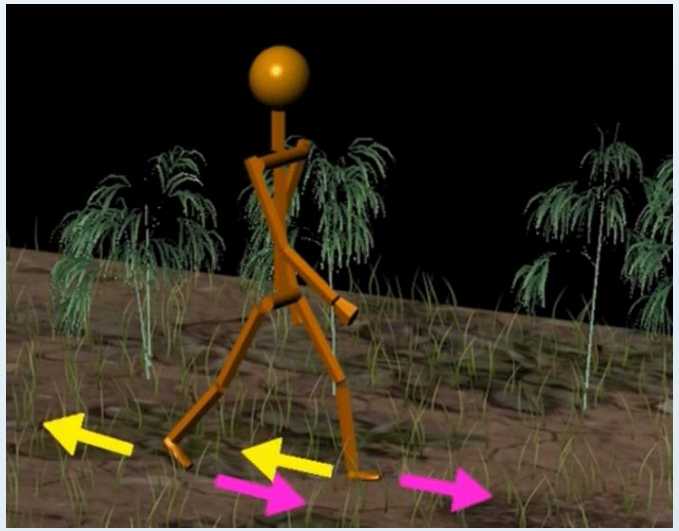
- The maximum value of static friction is called as **limiting friction.** (F_{max})
- **friction** it only depends on normal reaction force.
- The **coefficient of friction** (fr) is a number that is the ratio of the resistive force of **friction** (F) divided by the normal or perpendicular force (N) pushing the objects together. It is represented by the equation: fr = F/N.

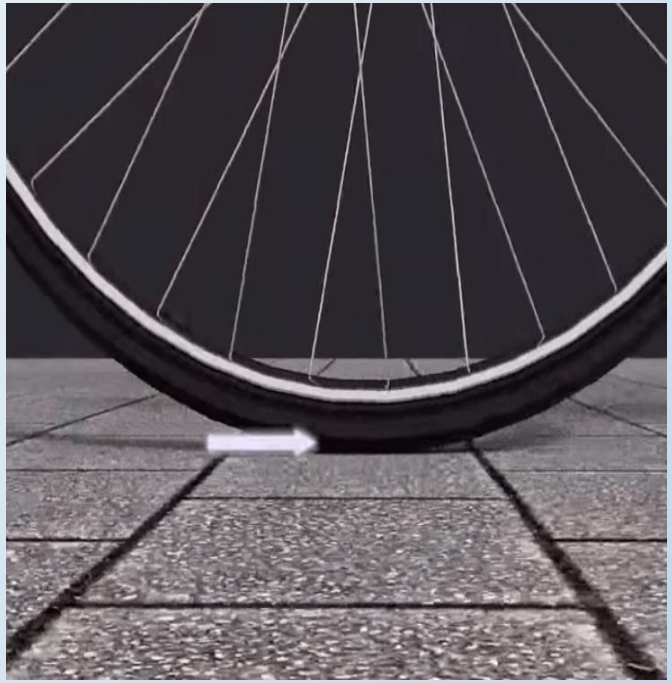
Unit less & dimensionless quantity.

RELATION BETWEEN STATIC, SLIDING AND ROLLING FRICTIONS

- Static friction>Sliding friction>Rolling friction

$$\mu_{st} > \mu_{sl} > \mu_r$$





RICE ADAMAS GROUP

RICE EDUCATION | ricesmart TOGETHER IN SUCCESS

ANGLE OF REPOSE

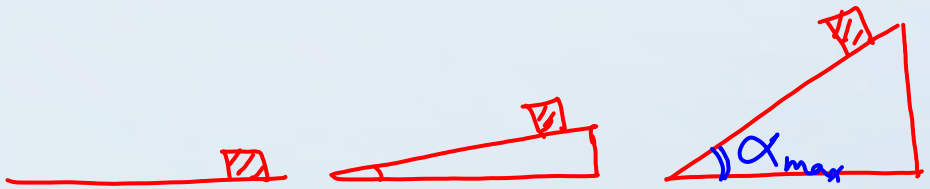
•The maximum slope, measured in degrees from the horizontal, at which loose solid material will remain in place without sliding is called as **Angle of Repose (α).**

•The tangent of the **angle of repose (α)** is the coefficient of static **friction**.

$\tan(\alpha_{max}) = \mu$

$\theta = \alpha$

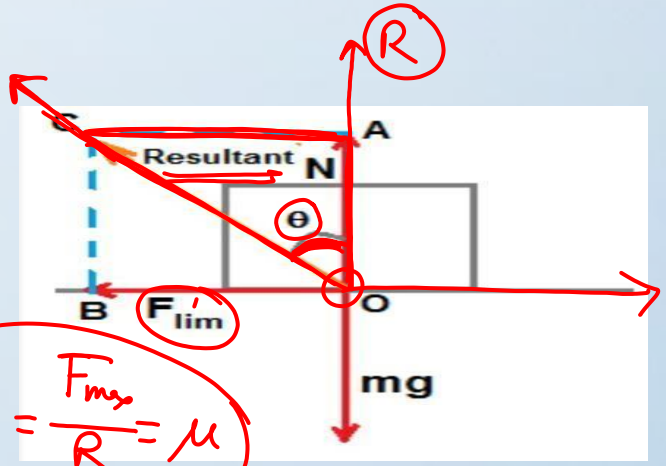
▪ **Angle of Friction and Angle of Repose both are equal magnitude**



ANGLE OF FRICTION

•**Angle** made by the resultant of normal reaction and limiting **friction** with the normal reaction is called **angle of friction (Θ).**

• The tangent of the **angle of friction (Θ)** is the coefficient of static **friction**.



$\tan\theta = \frac{F_{max}}{R} = \mu$

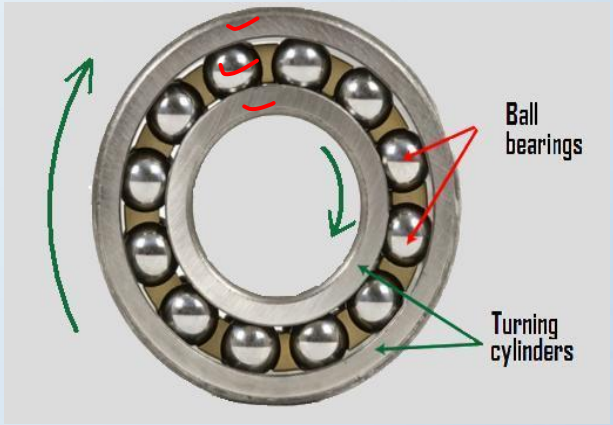
Processes of Increasing Friction

- Adding patterns.
- Over polishing.
- Making the surface rougher.

Processes of Reducing Friction

- Polishing
- Adding lubricants
- Ball bearing

Babiting



PYQ

Q1. Same force is applied to two bodies A and B of masses m and 5 m respectively for the same time. Then—

a) Velocity of A and B will be same

b) Momentum of A and B will be same

c) Momentum of A will be greater

d) Momentum of B will be greater

Q2. A stone tied to a string is whirled in a circle . As it was revolving, the rope suddenly snaps. Then— [WBCS Preli 2018]

a) The stone flies off tangentially

b) The stone moves radially outward

c) The stone moves radially inward

d) None of the above

Q3. The following is not a conservative force ? [WBCS Preli 2016]

a) Gravitational force ***b) Frictional force***

c) Electrostatic force d) Magnetostatic force

Q4. Mass of a body is defined by the following quantity— [WBCS Preli]

a) velocity/acceleration b) applied force/velocity

c) applied force/acceleration d) applied force/increased in momentum

LIBRARY REFERENCE BOOK

- CHAYA PHYSICS(11+12)
- GENERAL SCIENCE ENCYCLOPEDIA(ARIHANT)