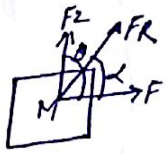
'LAWS OF MOTION'

Force

Any type of push or, pull Wich is tried to change the State of Rest or, uniform Motion.

NOTE → Resultant force on body may change.
* Its shape
* Its direction
* both
* shape of body.

* Force is a vector quantity that's Why vector Addition of Indivisual forces. $\vec{F_R} = \vec{F_1} + \vec{F_2} + \cdots \vec{F_N}$



$N = 2 \Rightarrow \vec{F_R} = \vec{F_1} + \vec{F_2}$

$$|\vec{F_R}| = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

$$\tan\alpha = \frac{F_2\sin\theta}{F_1 + F_2\cos\theta}$$

$F_1 = F_2 = F$

$$F_R = 2F\cos(\theta/2)$$

$$\alpha = \theta/2$$

INERTIA

Property Wich is maintein the state of Rest or State of uniform Motion.

NOTE → * Inertia is directelly propersnal to the mass.
* It only depend on mass. It is independent from shape & state of Body.
* Same mass object (ont in different shape represent same Inertia.
* Same mass object one object (ont in Rest & another Move with uniformally or, in uniform motion Represent same Inertial.
* If two same mass object

NEWTON'S IST LAW

External force is Required to change the state or, state of uniform Motion.

Newton Ist law explain Inertia of body thats why called Law of Inertial.

Types of Inertia

(a) → Inertia of Rest → body can't change its state of Rest by its self.

Ex → * If bus suddenly move forward than passenger In bus moving backward.
* Sudden Jurk is applied on blanket dust particle Removed from it.

(b) → Inertial of Motion → body can't change its state of motion by itself.

Ex → * If bus suddenly stop than passenger moving forward.
* Fast baller transfer its velocity to the ball.

(c) → Inertial of Direction → Body can't change its direction by its self.

Ex → * If bus turns Right than passenger in bus moving left or, outward to the centre of circular path than force Wich is act in outward direction is called centrifugal force.

* Mud particle attached with wheal moving tantential when it is detach from wheel.

NOTE → Newton's Ist law of Introduce force but its measurment or magnitude explain from Newton's 2nd law.

NETONN'S 2nd LAW

External force applied on body is $\propto$ to Rate of change in momentum w.r.t time.

$$\boxed{\vec{F}_{ex} \propto \frac{d\vec{p}}{dt}} \qquad \boxed{\vec{F}_{ex} = K\frac{d\vec{p}}{dt}} \ (K=1) \qquad \boxed{\vec{F}_{ex} = \frac{d\vec{p}}{dt}}$$

Momentum ($\vec{p}$)

$$\boxed{\vec{p} = m\vec{v}} \qquad \boxed{\vec{F}_{ex} = \frac{d\vec{p}}{dt} = \frac{d(m\vec{v})}{dt}}$$

$\vec{p}$ ⇒ direction of momentum in the direction of velo.

change in momentum ($\Delta\vec{p}$)

$$\boxed{d\vec{p} = \vec{F}_{ex}\, dt} \qquad \boxed{\vec{F}_{ex} = \frac{d\vec{p}}{dt} = \frac{d}{dt}(mv)}$$

↓ direction of change in momentum in the direction ext force.

**|a| → $v = c$, $m \to$ change

$$\boxed{\vec{F}_{ex} = v\frac{dm}{dt}}$$

*|b| → m = const., $v \to$ change

$$\boxed{\vec{F}_{ex} = m\frac{dv}{dt} = m\vec{a}}$$

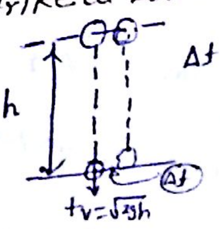
*|c| → $m \to$ change, $v \to$ change.

$$\boxed{\vec{F}_{ex} = ma + v\frac{dm}{dt}}$$

* $\frac{dv}{dt}$ ⇒ Rate of change in velo = a
* $\frac{dm}{dt}$ ⇒ " " " " mass.

Application of newton's 2nd law

|1| → Particle is drop from height it strike at bottom & Rebounce up to same height. [Elastic]



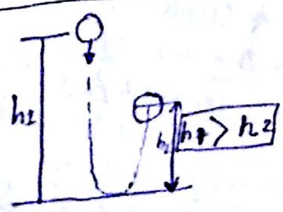
Δt = contact time.

$$\boxed{F_{ex} = \frac{m[-v-v]}{dt} = \frac{-2mv}{dt} = \frac{-2m\sqrt{2gh}}{dt}}$$

Ext. force is applied on ball.

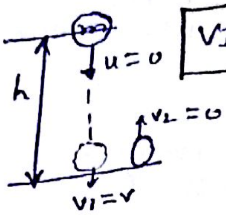
|2| → Ball is drop height & perform Inelastic callision from bottom

$$\begin{cases} v_1 = \sqrt{2gh_1} \\ v_2 = \sqrt{2gh_2} \end{cases}$$



$$\boxed{|F_{ex}| = \frac{m}{dt}\left(\sqrt{2gh_1} + \sqrt{2gh_2}\right)}$$

|3|→ particle is drop from height it strike at bottom & perform perfectly inelastic collision with bottom surface.



$V_1 = \sqrt{2gh}$

$$\vec{F}_{ex} = \frac{d\vec{P}}{dt} = \frac{0-mv}{t} = -\frac{m\sqrt{2gh}}{t}$$

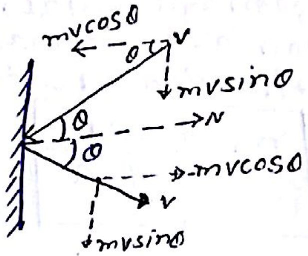
Force on ball

$$\vec{F}_{ex} = \frac{mv}{t} = \frac{m}{t}\sqrt{2gh}$$

Force on surface

|4|→ 'N' particle strike ~~strike~~ per second vertical surface at angle 'θ' from its normal with speed 'v'

|a|→ Surface is Reflecting (Perfectelly)



$$\vec{F}_{ext} = \frac{d\vec{P}}{dt}$$

$$\vec{F}_{\parallel} = \frac{d\vec{P}_{\parallel}}{dt} = \frac{mv\sin\theta - mv\sin\theta}{t} = 0$$

$$\vec{F}_{\perp} = \frac{d\vec{P}_{\perp}}{dt} = \frac{(-mv\cos\theta)-(mv\cos\theta)}{t}$$

$$\vec{F}_{net} = \vec{F}_{\perp} = \left(-\frac{2mv\cos\theta}{t}\right)N$$

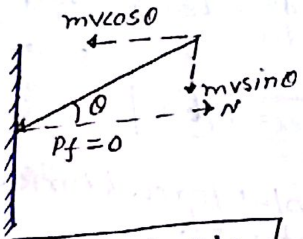
Force on particle.

Force on surface

$$\vec{F}_{ext} = \frac{N}{t}(2mv\cos\theta) = n(2mv\cos\theta)$$

$n = \frac{N}{t}$ = No. of particle incident per unit time.

|b|→ surface is perfectelly Absorbing



$$\vec{F}_{ex} = \frac{dP}{dt}$$

$$\vec{F}_{\parallel} = \frac{d\vec{P}_{\parallel}}{dt} = \frac{0 - mv\sin\theta}{t} \neq 0$$

$$\vec{F}_{\perp} = \frac{d\vec{P}_{\perp}}{dt} = \frac{0-(mv\cos\theta)}{t}$$

$$F_{\perp} = \left(-\frac{mv\cos\theta}{t}\right)N \qquad F_{\parallel} = \left(-\frac{mv\sin\theta}{t}\right)N$$

Force on surface

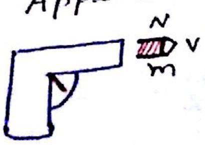
$$\vec{F}_{ex} = -\frac{N}{t}(mv) = -n(mv)$$

$n = \frac{N}{t}$ = No. of particle incident per unit time.

NOTE→ * Surface is partialy Reflecting, partially absorbing then net force applied on surface in Indivisual direction ($\perp$ or $\parallel$ to surface) is scalar addition of absorbing & Reflecting part.

* If particle is tramit than Momentum transfer is zero.

|5|→ 'N' bullet of mass 'm' is fired from Gun with speed 'v' than force Applied on Gun.



* Force on bullet

$$F_{ex} = \frac{dp}{dt} = \frac{mv-0}{t} = \left(\frac{mv}{t}\right)N$$

* Force on Gun

$$F_{ex} = -\left(\frac{mv}{t}\right)N$$

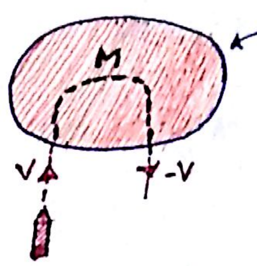
Disc of Mass 'M' is balanced in air when bullet strike normally $\bar{c}$ speed 'v' & Reflect with same speed no. of bullet fired per unit time. (m → mass of bullet).

$$\boxed{F_{surface} = \frac{N}{t}(2mv)}$$

↓ Mg

BHV

$$\boxed{\frac{N}{t} = \frac{Mg}{2mv}}$$



Ballon of Hydrogen Gas Initially has mass 'M' & moves in a upward direction with acceleration 'a'. Some mass is added to the ballon & It will move downward with acceleration 'a' than calculate value of added mass.

* $$\boxed{m = \frac{2Ma}{g-a}}$$

NOTE → upthrust of gases is Independent from suspended mass. It only depend on type of gas & quantity of gas.

H_2-gas ballon of mass 'M' is moves in upward direction with constant acceleration 'a'. If some mass is removed from ballon. It will move with acceleration '2a' in upward direction. Then value of removed mass

$$\boxed{m = \frac{Ma}{g+2a}}$$

Graphical Meaning of Newton 2nd law

Graphical Meaning of Newton 2nd law

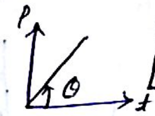
|1| → Slope of momentum time curve represent ext. force on particle.

$$F_{ex} = \frac{dp}{dt} = \frac{dy}{dx} = \tan\theta = \text{slope}.$$

EX →

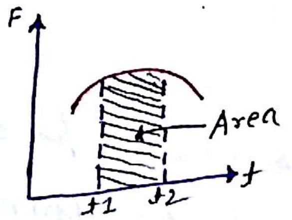
$\boxed{F_{ex} = \text{slope} = 0}$

EX →



$$\boxed{F_{ex} = \frac{dp}{dt} = \text{const}}$$

|2| → Area inclosed b/w force & time curve represent change in momentum in a given interval.



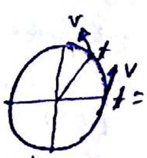
$$\boxed{\text{Area} = \int y\,dx}$$

$$\boxed{\text{Area} = \int_{t1}^{t2} F\,dt = d\vec{p} = \vec{p}f - \vec{p}i}$$

Impulse (I) → In a small time interval change in momentum on particle.

* $$\boxed{I = d\vec{p} = \int_{t1}^{t2} F \cdot dt}$$

Particle of mass 'M' rotate in circular path of Radius 'R' with uniform speed 'v' than Avarage force exerted on particle -



$$\boxed{\vec{\Delta V} = 2v\sin(\theta/2)}$$

$$\boxed{\theta = \frac{R}{v}\theta = t\theta}$$

* $$\boxed{F_{ex} = \frac{mv^2}{R} = \frac{\sin\theta/2}{(\theta/2)}}$$

|i| → $\frac{1}{4}$ Rotn or $\pi/4$

✓ $F_{av} = \frac{2\sqrt{2}\,mv^2}{\pi R}$

|ii| → $\frac{1}{2}$ Rot or $\pi/2$

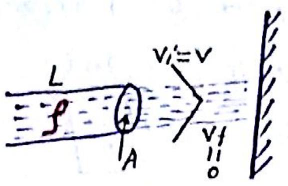
✓ $F_{av} = \frac{2mv^2}{\pi R}$

Liquid of density 'ρ' flow from pipe of crossection area 'A' & Length 'L' with uniform speed 'V'. It strike at vertical surface & come in Rest than Force exerted on surface.

$F_{ex} = \frac{dP}{dt} = \frac{0 - mv}{t}$

$|F_{ex}| = \frac{mv}{t} = \frac{(ALρ)v}{t}$ $\boxed{\frac{L}{t} = velocity}$

* $\boxed{F_{ex} = Aρv^2}$



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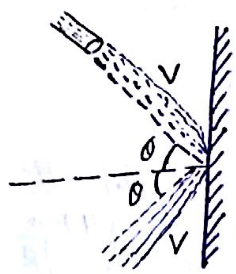
$\boxed{F_{ex} = 2Aρv^2\cos\theta = F_\perp}$

$\boxed{F_{\parallel} = 0}$



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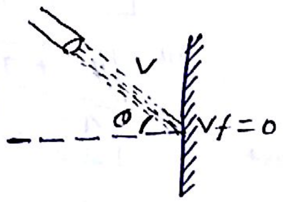
$\boxed{F_{\parallel} = Aρv^2\sin\theta}$

$\boxed{F_\perp = Aρv^2\cos\theta}$

$\boxed{F_R = Aρv^2 = \sqrt{F_{\parallel}^2 + F_\perp^2}}$

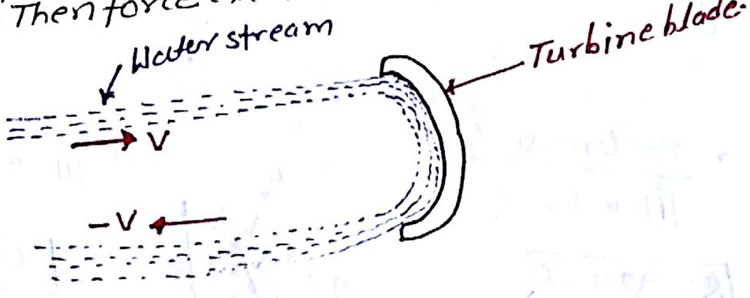


H.R

A Stream of Water impinges on Stationary dished turbine blade. The speed of water is 'V' both before & After strike the curved surface of the blade & the mass of water strike the blade per unit time is constant at value 'u'. Then force exerted by the water on the blade.

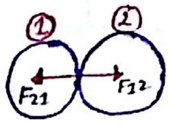
* $\boxed{F_{ex} = 2uV}$

↑ Mass of water strike the blade per unit time.



Newton 3rd law

Every Action produce equal and opposite Reaction.



$\boxed{\vec{F}_{12} = -\vec{F}_{21} \quad \vec{F}_{12} + \vec{F}_{21} = 0}$

Ex → * Walking
* Swimming
* Requiling of Gun when bullet is fired. (JIPMER 2015)
* Propelsion of Rocket

NOTE → * Action Reaction is applied on two diff object.
* In a universe single force is not produce it is possible in pair.
* There is no time lack b/w action & Reaction so be can't say than action is produce by Reaction or vice-versa.
* Action Reaction law is applicable on all natural force. (Gravitational force, EMW, Nuclear force, Weak force)
* Newton 3rd law is applicable in linear momentum conservation.
* From newton 2nd law we explain newton Ist & IIIrd law.

Rocket propulsion [Ex. of Newton's 3rd law]

$\frac{dm}{dt}$ = Rate of change in mass / Rate of gas ejection.

V = velo. of gas.

$$F_{ex} = V\frac{dm}{dt}$$

$$V\frac{dm}{dt} - mg = ma$$ — Acceleration of Rocket.

a = 0 (Move c̄ const velo)

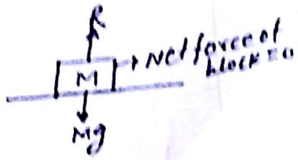
$$V\frac{dm}{dt} - mg = m(0)$$

$$V\frac{dm}{dt} = mg$$

Normal Reaction

|a| → Rest

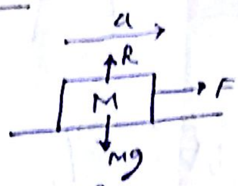
$$R = Mg$$



|b| → Horizontal force

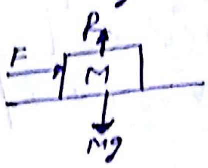
|i| →

$$R = Mg$$
$$a = \frac{F}{M}$$



|ii| →

$$R = Mg$$
$$a = \frac{F}{M}$$



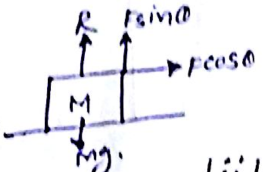
|c| → Force app. at an angle 'θ' from Horizontal.

|i| →

$$F\sin\theta < Mg$$

$$a = \frac{F_{net}}{m_{net}} = \frac{F\cos\theta}{M}$$

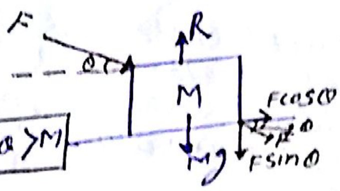
$$R = Mg - F\sin\theta < Mg$$



|ii| →

$$a = \frac{F\cos\theta}{M}$$

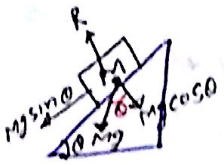
$$R = Mg + F\sin\theta > Mg$$



|d| → Incline surface.

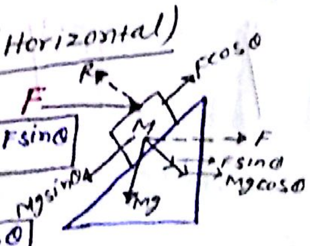
|i| → $F_{ex} = 0$

$$R = Mg\cos\theta$$
$$a = g\sin\theta$$



|ii| → $F_{ex} \neq 0$ (Horizontal)

$$R = Mg\cos\theta + F\sin\theta$$



$$Mg\sin\theta > F\cos\theta$$

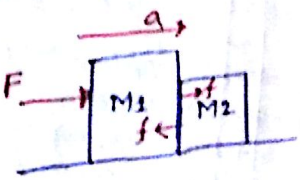
$$a = \frac{F_{net}}{M_{net}} = \frac{F_s - F_a}{M_{net}}$$

$$a = \frac{Mg\sin\theta - F\cos\theta}{M}$$

When object place in a contact in a Smooth Horizontal surface.

|a| → Two object

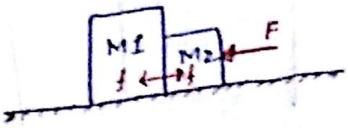
$$a = \frac{F}{M_1 + M_2}$$



contact force(f)

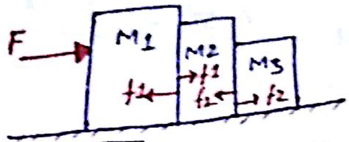
$$f = M_2 a = \frac{M_2 F}{M_1 + M_2}$$

$$a=\frac{F}{M1+M2} \quad , f=\frac{M1F}{M1+M2}$$



|b| → Three object

$$a=\frac{F_{net}}{M_{net}}=\frac{F}{M1+M2+M3}$$



* $$f1=(M_2+M_3)a=\frac{(M_2+M_3)F}{M1+M2+M3}$$

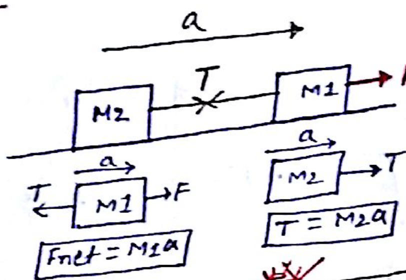
* $$f2=M_3a=\frac{M_3F}{M1+M2+M3}$$

Mass-String system

|1| →

$$a=\frac{F}{M1+M2}$$

$$T=M_2a=\frac{M2}{M1+M2}$$

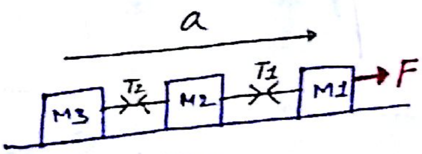


* $$a=\frac{F_{net}}{\Sigma M}=\frac{F_s-F_a}{\Sigma M} \Rightarrow \frac{\text{supporting force} - \text{opposing force}}{\text{Total Mass}}$$

$$T=\frac{F_f M_b+F_b M_f}{\Sigma M} \Rightarrow \frac{\text{Forwar force} \times \text{backward Mass} + \text{backward Force} \times \text{forward Mass}}{\text{Total Mass.}}$$

|2| →

$$a=\frac{F_{net}}{\Sigma M}=\frac{F}{M1+M2+M3}$$

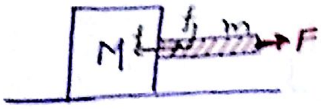


$$T1=\frac{F(M2+M3)+0(M1)}{M1+M2+M3}$$

$$=\frac{(M2+M3)F}{M1+M2+M3}$$ ✓

$$T2=\frac{F(M3)+0(M2+M1)}{M1+M2+M3}=\frac{M3F}{M1+M2+M3}$$ ✓

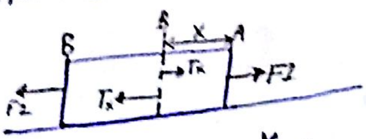
Block of Mass 'M' connect with string of mass 'm' & Force F is applied at free end of string than force applied on Mass M.



$$a = \frac{F}{M+m}$$

$$f = Ma = \frac{MF}{M+m}$$

Rod of length 'L' placed on horizontal surface & F_1 & F_2 force is applied on free end of Rod in opposite direction. Then tension in a Rod at distance 'X' from F_1 force.



$$a = \frac{F_{net}}{\Sigma M} = \frac{F_1 - F_2}{M}$$

$$T = \frac{F_f m_b + F_b m_f}{m_b + m_f}$$

$$T_x = F_1\left(1 - \frac{X}{L}\right) + F\left(\frac{X}{L}\right)$$

$L \to M$

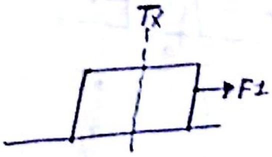
$1 = \frac{M}{L}$

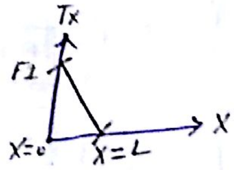
$X = \frac{M}{L}X = M_X$

$L - X = \frac{M}{L}(L-X) = M_{L-X}$

$F_2 = 0$

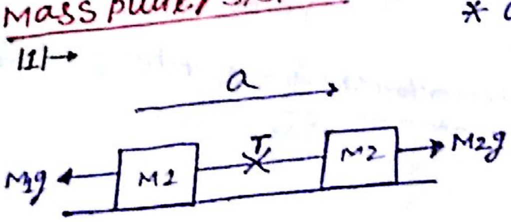
$$T_X = F_1\left(1 - \frac{X}{L}\right)$$





Mass pulley system

|1|→



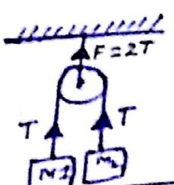
$$* \; a = \frac{F_{net}}{\Sigma M} = \frac{F_s - F_a}{\Sigma M} = \frac{M_2 g - M_1 g}{M_1 + M_2}$$

$$a = \frac{(M_2 - M_1)}{M_1 + M_2}$$

$$* \; T = \frac{F_f m_b + F_b m_f}{\Sigma M} = \frac{(M_2 g)(M_1) (M_1 g)(M_2)}{M_1 + M_2}$$

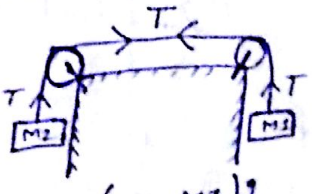
$$T = \frac{2 M_1 M_2 g}{M_1 + M_2}$$

**



$$F = 2T = \frac{4 M_1 M_2 g}{M_1 + M_2}$$

Force on Hook on cealing.



$$a = \frac{(M_2 - M_1)g}{M_1 + M_2}$$

$$T = \frac{2 M_1 M_2 g}{M_1 + M_2}$$

NOTE

Tenson are Internal force.

$\Sigma \vec{T} \cdot \vec{V} = 0$

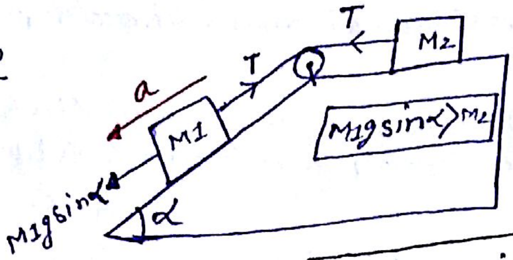
$P = \vec{F} \cdot \vec{V}$

* Internal force never develop power

|2|→

$a = \frac{F_{net}}{\Sigma F} = \frac{M_1 g\sin\alpha - 0}{M_1+M_2}$

$$a = \frac{M_1 g\sin\alpha}{M_1+M_2}$$

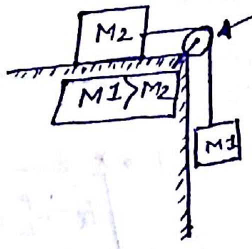


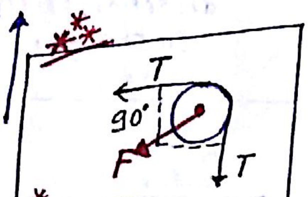
$$T = \frac{M_1 g\sin\alpha(M_2) + 0(M_1)}{M_1+M_2} = \frac{M_1 M_2 g\sin\alpha}{M_1+M_2}$$

|3|→

$$a = \frac{M_1 g}{M_1+M_2}$$

$$T = \frac{M_1 M_2 g}{M_1+M_2}$$

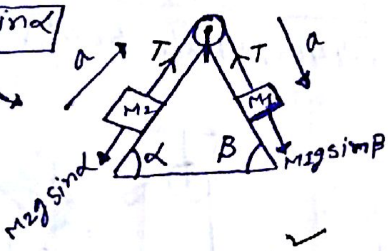




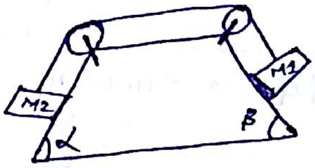
* $F = \sqrt{2}\,T$

* $F = \sqrt{2}\,\frac{M_1 M_2 g}{M_1+M_2}$

|4|→ $M_1 g\sin\beta > M_2 g\sin\alpha$



≡



* $a = \frac{F_{net}}{\Sigma M} = \frac{M_1 g\sin\beta - M_2 g\sin\alpha}{M_1+M_2}$

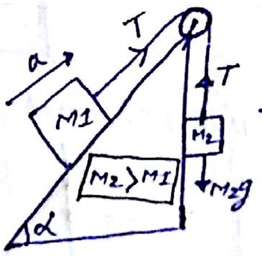
$$T = \frac{(M_1 g\sin\beta)(M_2) + (M_2 g\sin\alpha)(M_1)}{M_1+M_2}$$

* $$T = \frac{M_1 M_2 g(\sin\alpha+\sin\beta)}{M_1+M_2}$$

|5|→ $a = \frac{F_{net}}{\Sigma M} = \frac{M_2 g - M_1 g\sin\alpha}{M_1+M_2}$

$T = \frac{M_2 g(M_1) + (M_1 g\sin\alpha)(M_2)}{M_1+M_2}$

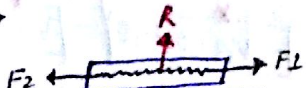
$$T = \frac{M_1 M_2 g(1+\sin\alpha)}{M_1+M_2}$$



|a|→

$R = F$ *

|b|→



* $R = \frac{2F_1F_2}{F_1+F_2}$

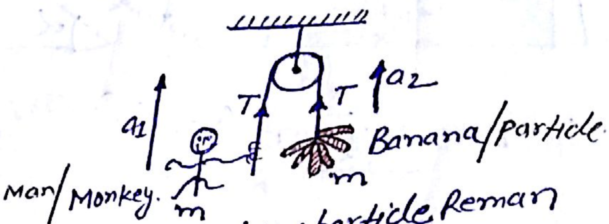
NOTE→ * If person move in a downward direction with const Acceleration than tenson in string is less than from weight of person.
* When a move in a upward direction with accln tenson in string more than weight of person.

\# Mass of person & Banana is 'm' & it is arranged in pulley as shown. If person move upward with const acceleration than distance b/w person & Banana.

$T - mg = ma_1 \rightarrow$ (I)

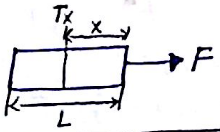
$T - mg = ma_2 \rightarrow$ (II)

$a_1 = a_2$



NOTE→ Both particle moves in same direction with same Accln than Relative distance b/w particle reman unchange.

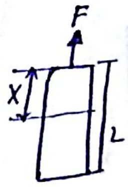
\# |a|→



$T_X = \frac{F}{L}(L-X)$ *

|b|→ *

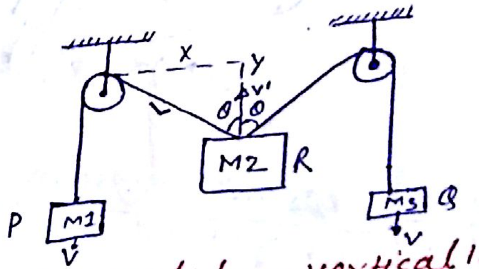
$T_X = \frac{F}{L}(L-X)$



\# Mass 'P' & 'Q' move downward direction with speed 'v' than speed of mas 'R'

$v' = v\left(\frac{L}{y}\right)$

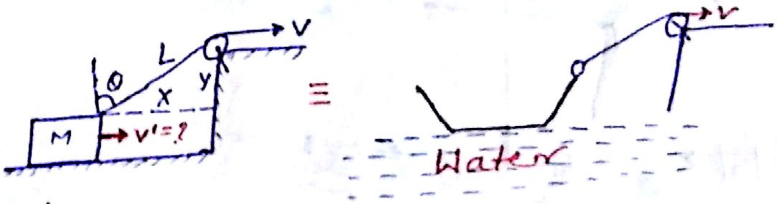
$V' = \frac{V}{\frac{y}{L}} = \frac{V}{\cos\theta}$



\# velocity of mass 'M' on Horizontal plane when angle from vertical is 'θ'

$L^2 = x^2 + y^2$

$V' = \frac{V}{\sin\theta}$ *



AMU

\# velocity of End 'A' in Given Instant.

$L^2 = x^2 + y^2$

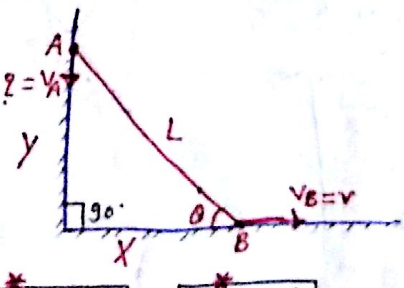
$2L\frac{dL}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$

($\frac{dL}{dt} = 0$, $\frac{dx}{dt} = V_B$, $\frac{dy}{dt} = V_A$)

$2L(0) = 2x(V_B) + 2y(V_A)$

$V_A = -V_B(x/y)$

$V_A = -\frac{V_B}{\frac{y}{x}} = \frac{-V_B}{\tan\theta} = -V_B\cot\theta = V_A\cos\theta$



Frame of Reference

(A) → **Inertial frame of Reference** → If system or frame ⊕nt at Rest & move With const velocity.

* Law of Inertia applicable on Inertial frame of Reference.
* Earth or ground consider as Inertial frame of Reference.

(B) → **Non-Inertial frame of Reference** → If system or frame is Accelerated (Speedup or slowdown).

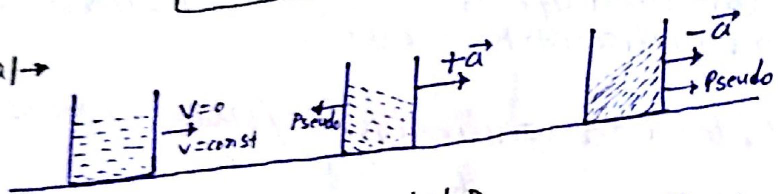
* Law of Inertia is not applicable.
* In a non-Inertial frame Pseudoforce is applicable on ⊕nt particle.

Pseudoforce

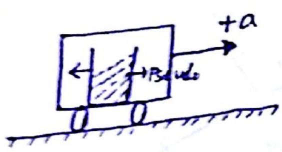
Appear/⊕nt in only non-Inertial frame of Reference & With the help of Pseudoforce We convert Non-Inertial into Inertial frame & direction of Pseudoforce is opposite to the direction of Acceleration.

$$\boxed{\text{Pseudoforce} = F = -ma}$$

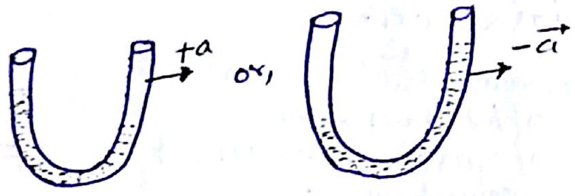
EX → (a) →



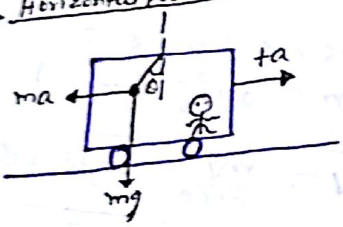
(b) →



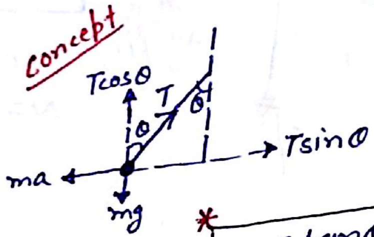
(c) →



(d) → Horizontal path



Concept



$T\cos\theta = ma$ — (I)

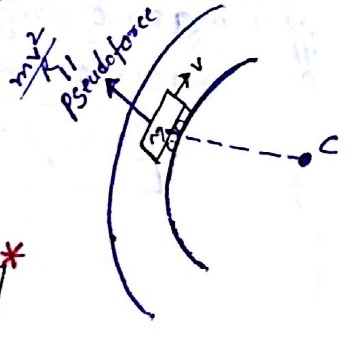
$T\sin\theta = ma$ — (II)

(i) → $\frac{T\sin\theta}{T\cos\theta} = \frac{ma}{mg} = \tan\theta \Rightarrow \frac{a}{g} \Rightarrow \boxed{a = g\tan\theta}$ *

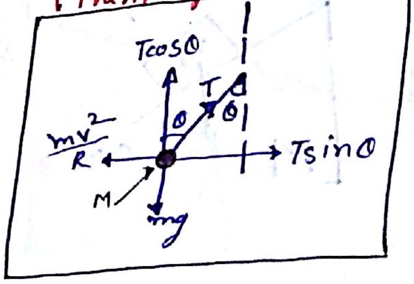
(ii) → $(T\sin\theta)^2 + (T\cos\theta)^2 = (ma)^2 + (mg)^2$

* $\boxed{T = \sqrt{(ma)^2 + (mg)^2}}$

*(e) → circular path



(Thinking)



$T\cos\theta = mg$ — (I)

$T\sin\theta = \frac{mv^2}{R}$ — (II)

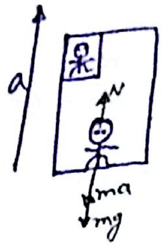
$\tan\theta = \frac{v^2}{Rg} \Rightarrow \theta = \tan^{-1}\left(\frac{v^2}{Rg}\right)$ *

$$\boxed{T = \sqrt{(mg)^2 + \left(\frac{mv^2}{R}\right)^2}}$$

|f| → Motion of Lift

|a| → Moving upward

$N_{up} = \underset{W}{mg} + ma$



$W_{eff} = mg + ma > W$

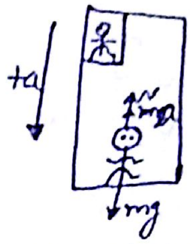
$g_{eff} = \frac{W_{eff}}{m} = g + a$

|b| → Moving downward

$N_{down} = \underset{W}{mg} - ma$

$W_{eff} = mg - ma < W$

$g_{eff} = g - a$



|c| → Moving with const velocity

$a = 0 \Rightarrow$ Pseudoforce $= 0$

$W_{eff} = mg = W$

$g_{eff} = g$

|d| → In downward direction

|i| → Free falling condⁿ. $(a = g)$

$N = 0 = W_{eff}$

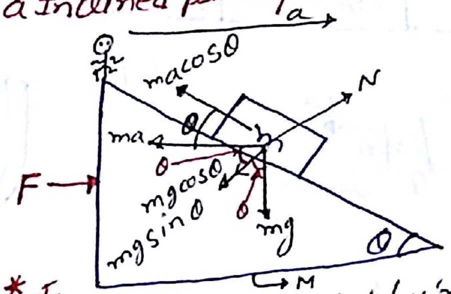
$g_{eff} = 0$

|ii| → $a > g$

$N = \ominus ve = W_{eff}$

BHU
NOTE → * Effective weight of person in a lift is greater than from Actual weight when lift move with upward with const. Accⁿ & downward with const. Retardation.

Body of mass 'm' placed on a Inclined plane/Wedge of mass 'M' as shown.



|i| → Magnitude of Horizontal force applied on wedge 'M' so block of mass 'm' remain in equilibrium.

$ma\cos\theta = mg\sin\theta$

$a = g\tan\theta$ *

$F = (M+m)a$

$F = (M+m)g\tan\theta$

AIPMT * |ii| → Force applied by 'm' on the wedge.

$N = ma\sin\theta + mg\cos\theta$

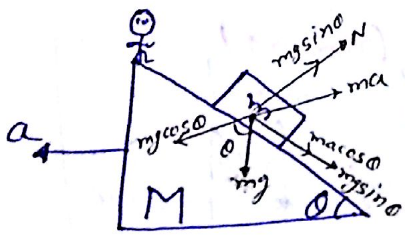
$= mg\left(\frac{\sin^2\theta}{\cos\theta} + \cos\theta\right)$

AIPMT *

$N = \frac{mg}{\cos\theta} = mg\sec\theta$

* **NOTE** → * $a > g\tan\theta \Rightarrow$ block 'm' move upward.
* $a < g\tan\theta \Rightarrow$ block 'm' move downward.

Acceleration of Wedge 'M' If block of mass 'm' fall freely.



$N + ma\sin\theta = mg\cos\theta$ (N = 0)

$ma\sin\theta = mg\cos\theta$ *

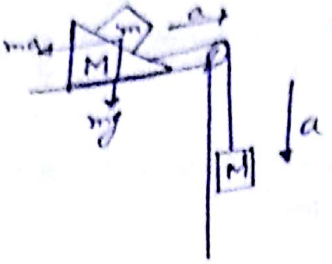
$a = g\cot\theta$

Value of M'. If 'm' at rest in a cart w.r.t mass M.

$a = g\tan\theta$

$a = \frac{M'g}{M+m+M'} = g\tan\theta$

*
$$M' = \frac{(M+m)\tan\theta}{1-\tan\theta}$$

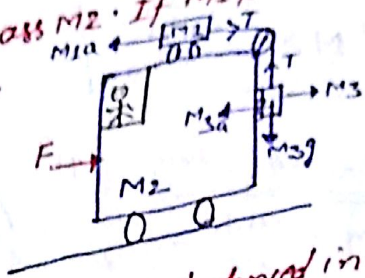


Magnitude of Horizontal force applied on Mass M2. If M1 & M3 at rest in cart.

$T = M_3 g$ —(I)
$T = M_1 a$ —(II)
$M_1 a = M_3 g$

$$a = \left(\frac{M_3}{M_1}\right)g$$

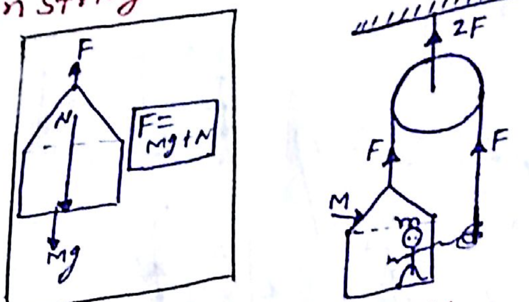
*
$$F = (M_1+M_2+M_3)\left(\frac{M_3}{M_1}\right)g$$



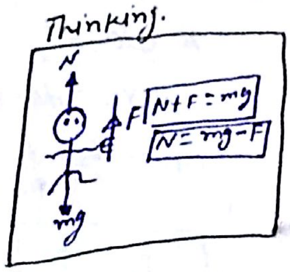
Force Applied by person in String If system Remain balanced in a air.

$F = Mg + N$

*
$$F = \frac{(M+m)g}{2}$$

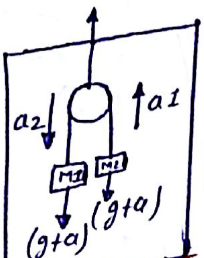


Thinking.



Tenson in a String Wich is connected With mass & lift Moving upward with Acceleration 'a'.

*
$$T = \frac{2M_1M_2}{M_1+M_2}(g+a)$$



$(M_1 > M_2)$

If particle drop along the surface Inclined plane & Incline plane at rest in a lift. Wich is Move With const. Acceleration in upward direction calculate time by particle to Reach at bottom.

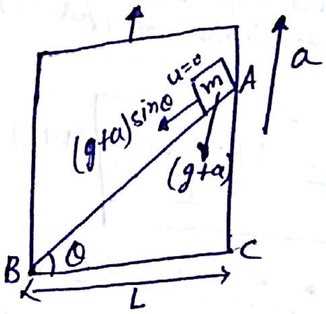
$u = 0,\ a = (g+a)\sin\theta$

$\cos\theta = \frac{BC}{AB} = AB = \frac{L}{\cos\theta} = S$

$S = ut + \frac{1}{2}at^2$

$\frac{L}{\cos\theta} = (0)t + \frac{1}{2}[(g+a)\sin\theta]^2$

*
$$t = \sqrt{\frac{2L}{(g+a)\sin\theta\cos\theta}}$$



concept

When Jump then weight on Head become zero

% change in weight when lift is moving upward & downward with acceleration 'a'

$$\frac{\Delta W}{W_{actual}} = \frac{W_{up} - W_{actual}}{W_{actual}} = \frac{a}{g} \times 100$$

$W_{actual} = mg$
$W_{up} = m(g+a)$

Jipmer 2016

(NOT IN AIPMT) But other PMT—

Simple Machine

|1|→ Mechanical Advantage (M·A)

$$M \cdot E = \frac{Load (L)}{Effort (E)}$$

|2|→ Velocity Ratio (V·R)

$$V \cdot R = \frac{V_E}{V_L} = \frac{dE/t}{dL/t} = \frac{dE}{dL}$$

|3|→ Mechanical Efficiency (η)

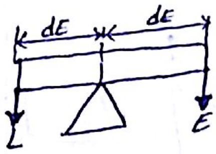
$$\eta = \frac{M \cdot A}{V \cdot R} = \frac{L/E}{LE/dE} = \frac{L dL}{E dE} = \frac{\text{Work done by load}}{\text{Work done by the Effort}}$$

|4|→ Lever System

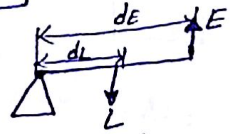
Class I

$dL \times L = dE \times E$

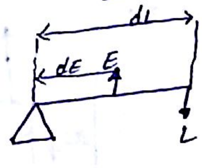
$$M \cdot A = \frac{L}{E} = \frac{dE}{dL}$$
→ may be $M \cdot A > 1$
→ may be $M \cdot A < 1$
→ may be $MA = 1$



$M \cdot A = \frac{L}{E} = \frac{dE}{dL} > 1$

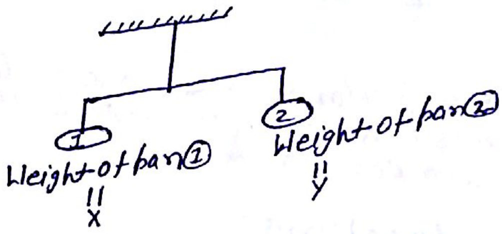


$M \cdot A = \frac{L}{E} = \frac{dE}{dL} < 1$



|5|→ False Balance

case-I → Length same

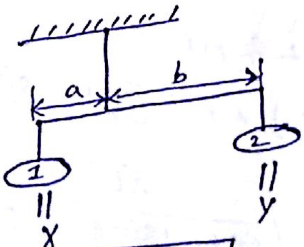


* W = Actual wt of object
* W1 = weight of obj. when place on pan①
* W2 = " " " " " ②

*
$$W = \frac{W_1 + W_2}{2}$$ (A·M)

case-II → Length unequal

*
$$W = \sqrt{W_1 W_2}$$ (G·M)

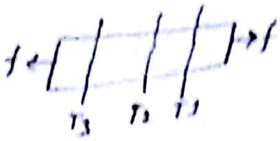


$Xa = Yb$

If $f_1 = f_2 = f$

$$T_x = f\left(1 - \frac{x}{L}\right) + f\left(\frac{x}{L}\right)$$

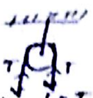
$$\boxed{T_x \propto f \propto x^0}$$



$$\boxed{T_1 = T_2 = T_3 = f}$$

Mass pulley system

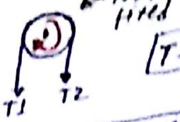
Fixed pulley



$T = f$ $f = T$

$$\boxed{\tau_{net} = Rf - Rf = 0}$$

pulley Rotate



$$\boxed{T_1 > T_2}$$

$$\boxed{\tau_{net} = RT_1 - RT_2 \neq 0}$$