

• Newton's 1st Law :-

Law of inertia

$$F_{net} = 0 \rightarrow \text{Rest}$$

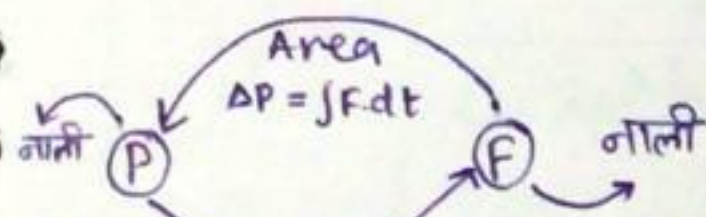
$$\rightarrow a = 0$$

• Reading of spring :-

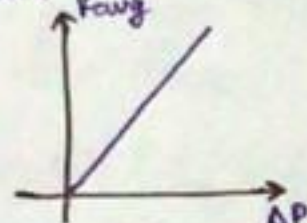
For ideal spring, replace it by ~~spring~~ string and find tension, that will be equivalent to spring force.

Ideal spring - force is same at all points.

• Newton's 2nd Law :-



$$\text{slope } \vec{F} = \frac{d\vec{P}}{dt}$$



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

$$\vec{F} = m \frac{d\vec{v}}{dt} + \vec{v} \cdot \frac{dm}{dt}$$

$m = \text{const}$

$$\vec{F} = m\vec{a}$$

$v = \text{const}$
(m variable)

$$\vec{F} = \vec{v} \cdot \frac{dm}{dt}$$

Ex - Rocket Propulsion

Ball Rebounds with same speed. find change in momentum.

$$\Delta \vec{P} = 2m\vec{v}_1$$

$\perp$ to surface

Bullet Plate Question :-

$$\vec{F} = \frac{2nm\vec{u}}{\Delta t}$$

$$\vec{P} = 2nm\vec{u}$$

Impulse (change in Momentum)

$$I = \int F dt = \Delta \vec{P} = \vec{F}_{avg} \cdot t$$

• Newton's 3rd Law :-

→ Action Rxn pair acts on 2 diff. body but they should be of same nature.

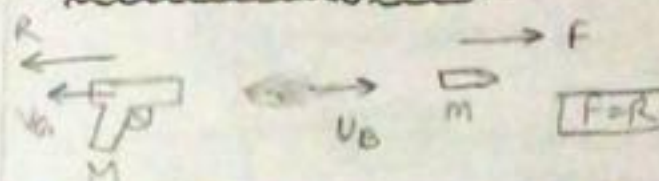
• Conservation of Momentum :-

→ Based on 3rd Law.

$$F_{ext} = 0$$

$$P = \text{constant}$$

* Gun Bullet System :-



$$\vec{V}_G = -\frac{m}{M} \vec{V}_B$$

$$|F_N| = nmV_B$$

$$\left\{ n = \frac{N}{\Delta t} = \text{No. of Bullets fired per second} \right\}$$

$$|\vec{P}_G| = |\vec{P}_B|$$

$$\frac{(KE)_G}{(KE)_B} = \frac{M}{m} \quad (K_B > K_G)$$

Rocket Problem :-

$$F_{up} = v \left(\frac{dm}{dt} \right)$$

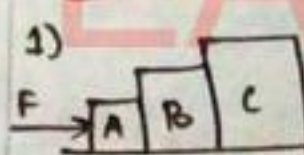
$$a = \frac{v \frac{dm}{dt}}{M_0} - g$$

$$a_t = \frac{v \cdot \frac{dm}{dt}}{M_0 - \left(\frac{dm}{dt} \right) t} - g$$

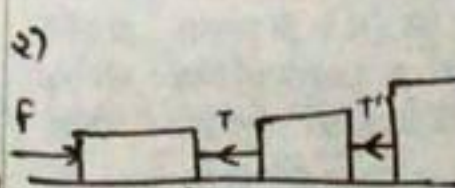
$$M_t = M_0 - \frac{dm(t)}{dt}$$

Remaining Mass

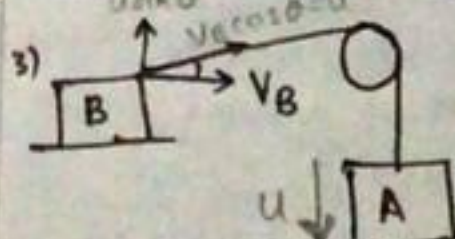
Connected body dynamics



$$N = \text{Front mass} \times \text{Common acc}$$



$$T = \text{backside Mass} \times \text{Common Acc}$$



$$V_B = \frac{V}{\cos \theta}$$

* Lift Sawal :-



$$\textcircled{1} T = m(g+a) = \text{Acc } \uparrow$$

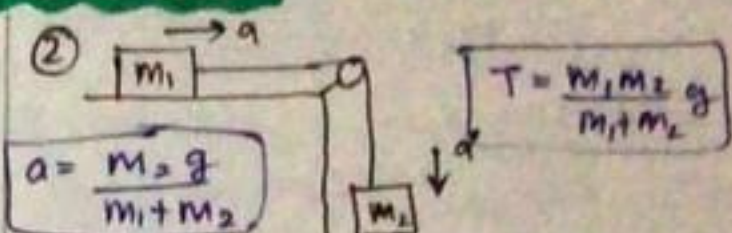
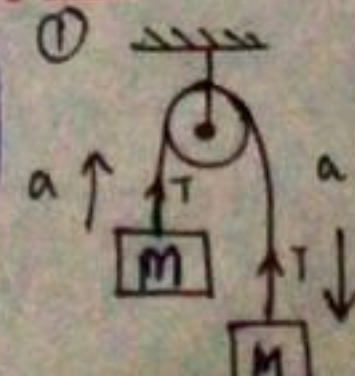
$$\textcircled{2} T = m(g-a) = \text{Acc } \downarrow$$

$$\textcircled{3} T = mg = \left(\begin{array}{l} \text{Acc} = 0 \\ v = \text{constant} \end{array} \right)$$

Pulley Block System :-

$$a_{sys} = \frac{(M-m)g}{(M+m)}$$

$$T = \left(\frac{2Mm}{M+m} \right) g$$



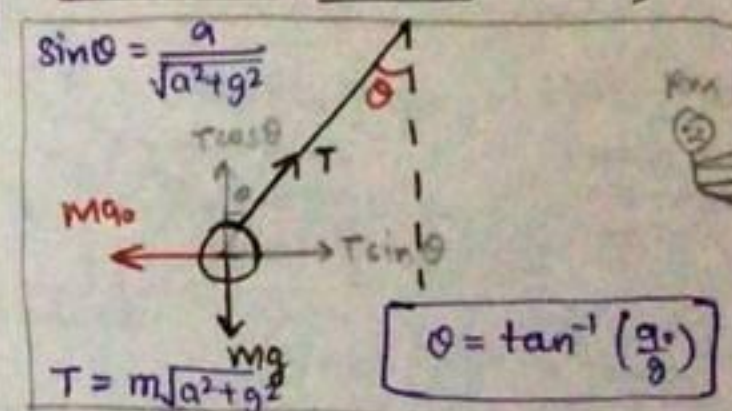
Pseudo force Concept

→ Used to valid laws of motion in non-inertial frame

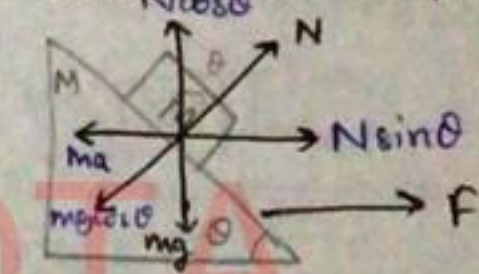
$$\vec{F}_{pseudo} = -m\vec{a}_{frame}$$

→ Weight change nai hoga agar inertial / non inertial frame ho

Pendulum in Car → a



→ Accⁿ of inclined plane so that block does not slip :-

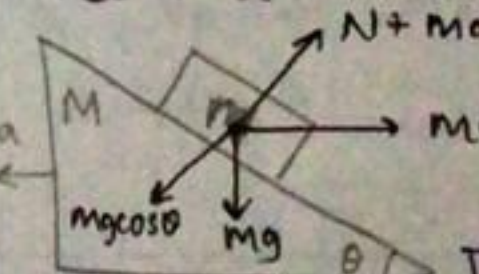


$$N = \frac{mg}{\cos \theta}$$

$$a = g \tan \theta$$

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

→ Acc so that block can free fall :-

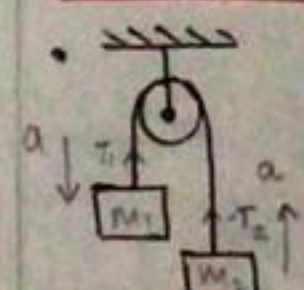


$$a = g \cot \theta$$

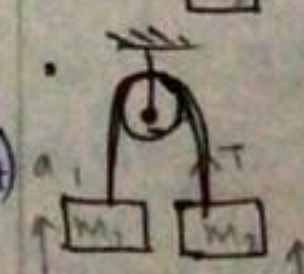
$$F = Mg \cot \theta$$

$$N = m(g \cos \theta - a \sin \theta)$$

Constraint Relation

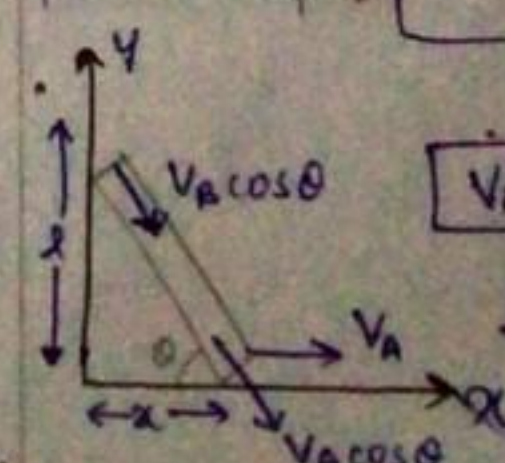


$$\left\{ \begin{array}{l} T_1 a_1 = T_2 a_2 \\ T_1 v_1 = T_2 v_2 \\ T_1 x_1 = T_2 x_2 \end{array} \right\}$$



$$\vec{a} = \frac{\vec{a}_1 + \vec{a}_2}{2}$$

$$T = \frac{2m_1 m_2 (g+a)}{m_1 + m_2}$$



$$V_A \cos \theta = V_B \cos \theta$$

$$V_A = V_B \tan \theta$$