JEE MAIN | IIT JEE

Newton's Laws of Motion

REVISION in 45 Min

Mohit Sir, IIT Kharagpur

EDUNITI

Topics to covered

1. Common Forces acting on a Body
2. Static Equilibrium
3. Pulley Block Systems
4. Concept of Weighing Machine
5. Concept of Spring Balance
6. Spring Cutting & Combination
7. FBD – Most Important Point
8. Pseudo Force
9. Variable Force
10. Important Links for NLM

JOIN

Eduniti for Physics

EDUNITI

Chapter	Formulae_Concept VIDEO LINK
Unit & Dimensions	https://youtu.be/wdd-wlZF4Hk
Errors and Vectors	
Vernier Calliper	https://youtu.be/pVoN045dV8I
Screw Gauge	https://youtu.be/gYd2PtmZ0mw
Kinematics_Motion in 1d	https://youtu.be/U4NNxFaFliE
Kinematics_Motion in 2d	https://youtu.be/4_Zo5WhMf7w
Laws of Motion	
Work Energy Power	https://youtu.be/kjrXoE-kDI8
Centre of Mass	
Centre of Mass of Standard Bodies	https://youtu.be/oCeACfryB-U
Collision	
Rotational Motion_Moment of Inertia	https://youtu.be/9ckZdOhy3z0
Gravitation	https://youtu.be/rAj2huLVaEk
Properties of Solids	https://youtu.be/gSXxjk89I_c
Fluids Statics (Part 1)	https://youtu.be/RFKx9B9yo3M
Fluid Dynamics (Part 2)	https://youtu.be/Y717vQpUEJQ
Fluid Properties (Part 3)	https://youtu.be/V8xUWWK2oT0
Simple Harmonic Motion	https://youtu.be/RIb7ofNG09I
Thermal Properties	
KTG	https://youtu.be/XO1tvFhIa0I
Thermodynamics	https://youtu.be/iz_kf1jRDRw
Wave Motion -Organ Pipes and Resonance Tube	https://youtu.be/fB7pfJ77za8
Wave Motion - Doppler's Effect	https://youtu.be/9-BxOaamnwg
Electrostatics	https://youtu.be/3stXbGRMcrk
Capacitors	https://youtu.be/EXEiickNUkY
Current Electricity	https://youtu.be/gm8FUfjrX18
Moving Charges and Magnetic Effect of Current	https://youtu.be/ULD2Ok1CGJk
Earth's Magnetism	https://youtu.be/a4CT5uVwAK4
Magnetic Properties	https://youtu.be/63cwdYXNlYE
EMI	https://youtu.be/puVavm_GFRM
Alternating Current	https://youtu.be/74dTY-pzM_o
Ray Optics	https://youtu.be/BhnyTWzIlBA
Wave Optics Part 1_Interference	https://youtu.be/LG5nlE8XTeI
Wave Optics Part 2_Diffraction_Polarization	https://youtu.be/ymMyyJGGqnY
Optical Instruments	https://youtu.be/OQssbDH0A4I
Electromagnetic Waves	https://youtu.be/bcVXgEkyQZY
Semiconductors_Basics + Zener Diode	https://youtu.be/_A2JomQ7-50
Semiconductors_Transistors	https://youtu.be/psDwl84Nzb0
Semiconductors_Logic Gates	https://youtu.be/pZdQAzLbFTo
Communication Systems	https://youtu.be/8NgMqK9X79Y
Modern Physics_Part 1_Atomic Physics	https://youtu.be/9VKUnE3mpHk
Modern Physics_Part 2_Photoelectric Effect	https://youtu.be/24oTQp84jrk
Modern Physics_Part 3_Dual Nature of Light	https://youtu.be/0zoR_saMAQY
Modern Physics_Part 4_Radioactivity	https://youtu.be/AdX3YBhQyog
Modern Physics_Part 5_Nuclear Physics	https://youtu.be/VDWqVahGixc
Modern Physics_Part 6_X Rays	https://youtu.be/dSHXdzX7NX0

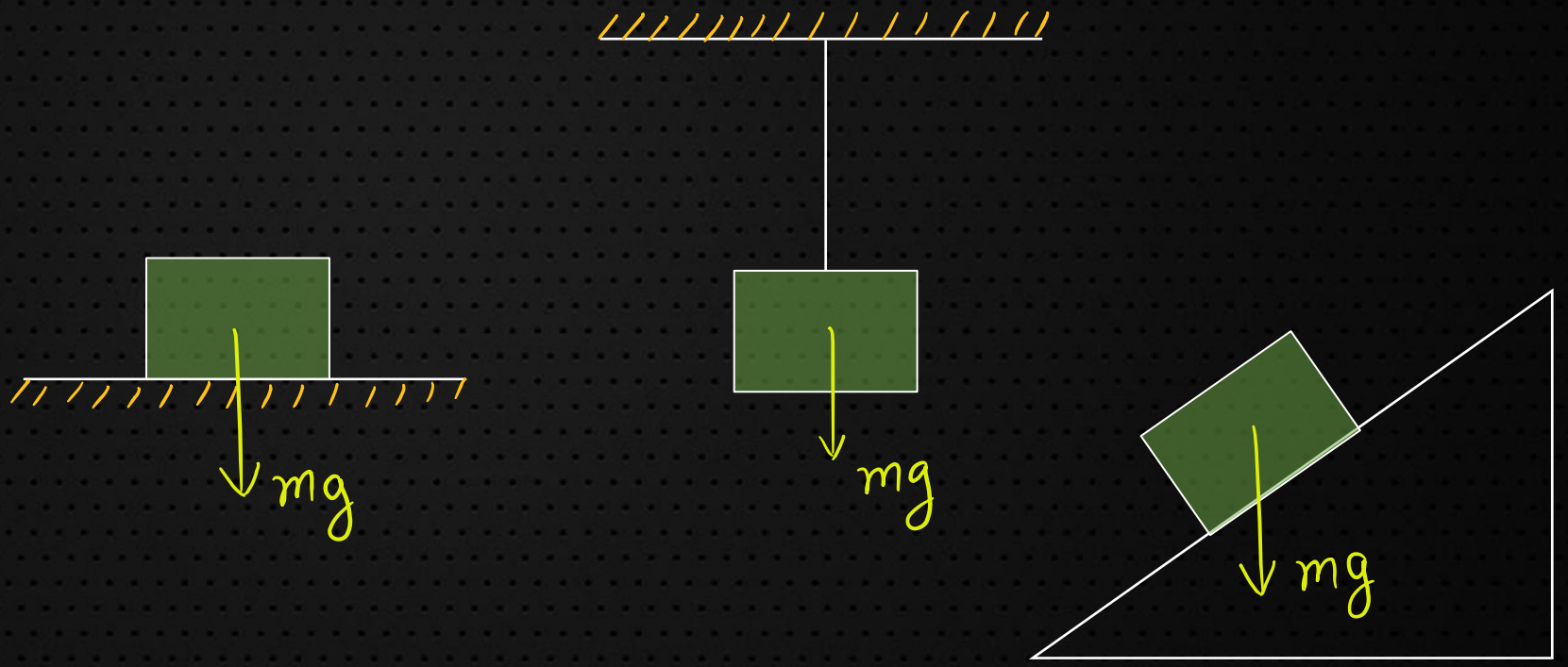
$$\sum \vec{F} = 0 \quad \text{(Static Equillibrium)}$$

OR

$$\sum \vec{F} = M\vec{a} \quad (2^{nd} \text{ Law})$$

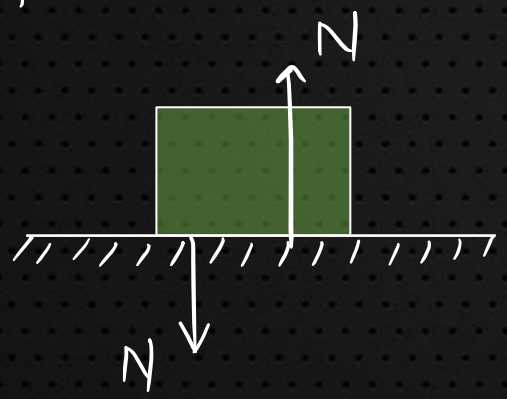
1. Common Forces acting on body

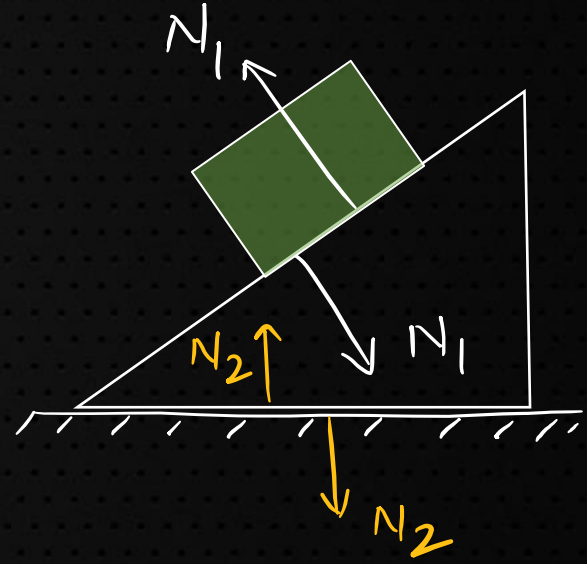
- Weight, mg → Due to Gravitational Pull (acts vertical downwards, towards centre of earth)
- Normal, N
- Tension, T
- friction, f



1. Common Forces acting on body

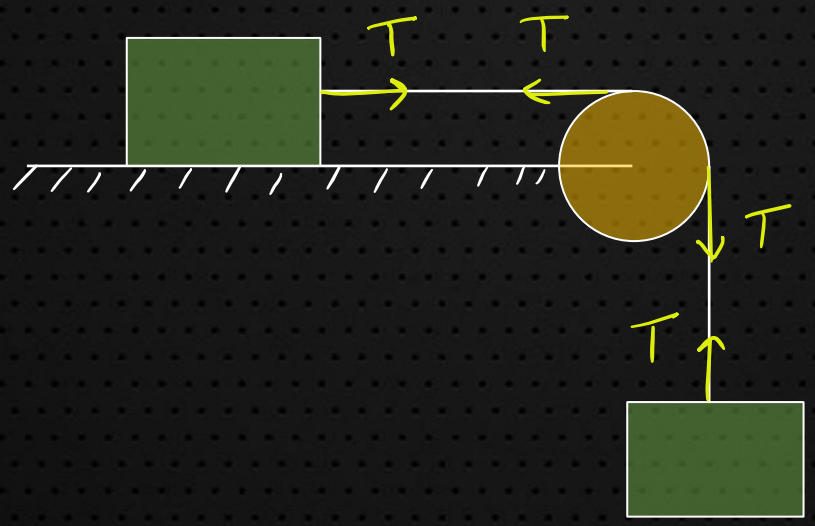
- Weight, mg
- Normal, N → Two bodies in contact press against each other (acts ⊥ to contact surface)
- Tension, T
- friction, f

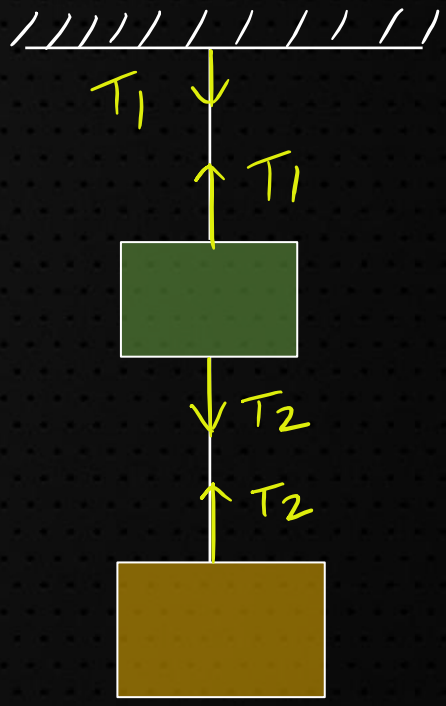




1. Common Forces acting on body

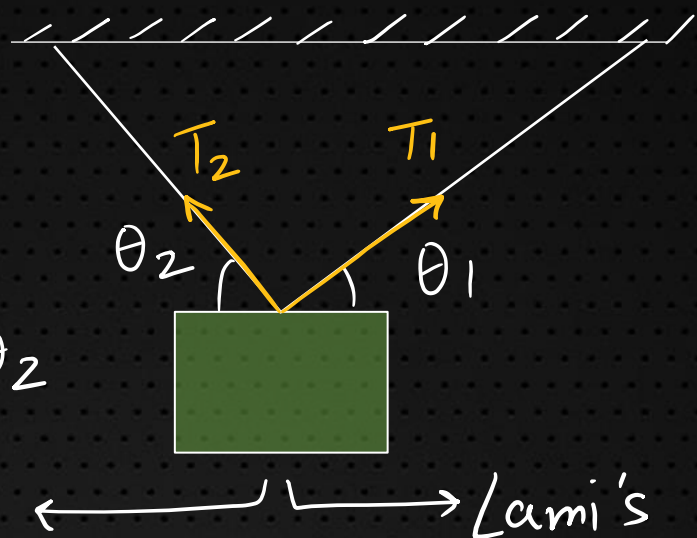
- Weight, mg
- Normal, N
- Tension, T → A taut string is under Tension (pulling force, along the string)
- friction, f

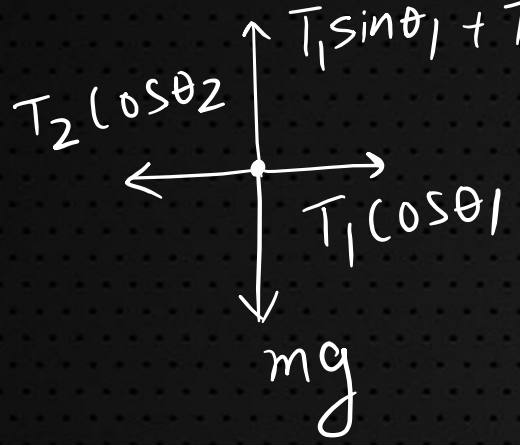




2. Static Equilibrium

↳ $\Sigma \vec{F} = 0$ (body at rest)

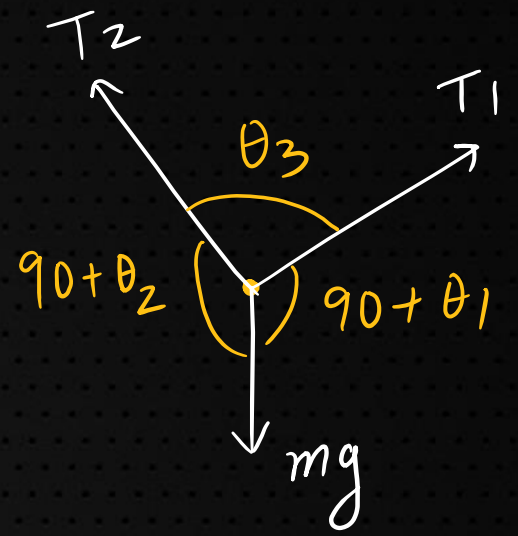




$\Sigma F_x = 0$
& $\Sigma F_y = 0$

Lami's Theorem

$\theta_3 = 180 - \theta_1 - \theta_2$



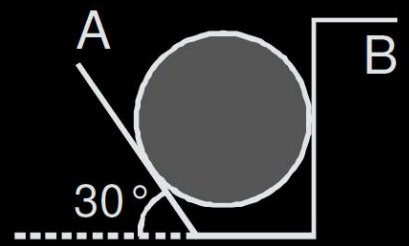
$T_1 \sin\theta_1 + T_2 \sin\theta_2 = mg$

$T_1 \cos\theta_1 = T_2 \cos\theta_2$

$$\frac{mg}{\sin\theta_3} = \frac{T_1}{\sin(90+\theta_2)} = \frac{T_2}{\sin(90+\theta_1)}$$

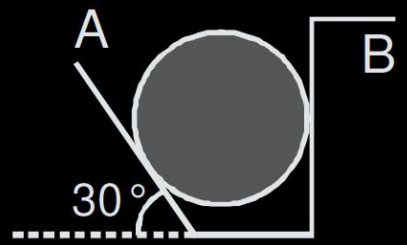
… continued

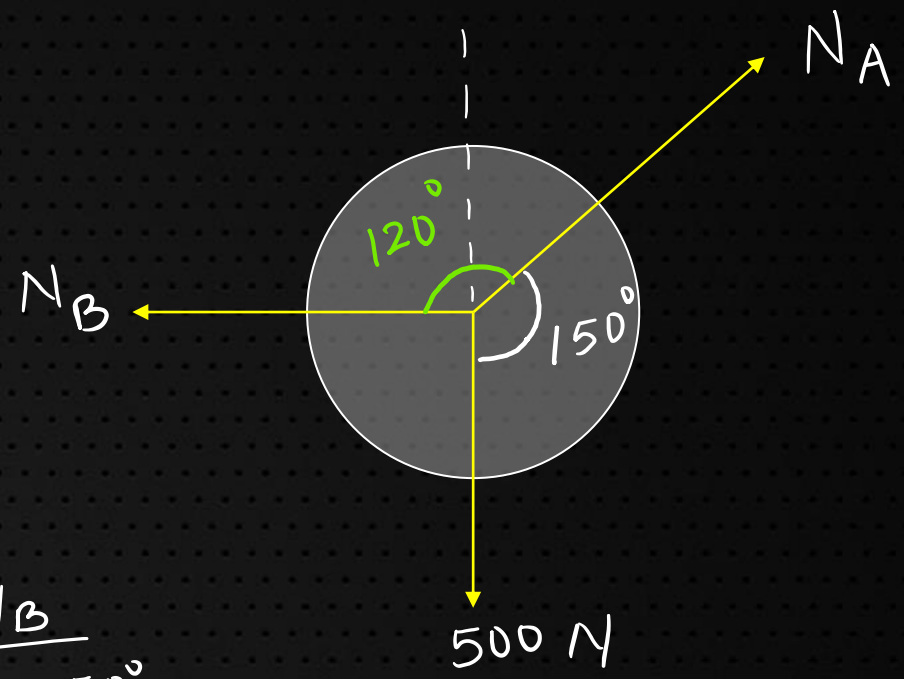
The 50 kg homogeneous smooth sphere rests on the 30° incline A and bears against the smooth vertical wall B. Calculate the contact forces at A and B.



… continued

The 50 kg homogeneous smooth sphere rests on the 30° incline A and bears against the smooth vertical wall B. Calculate the contact forces at A and B.





Soln:

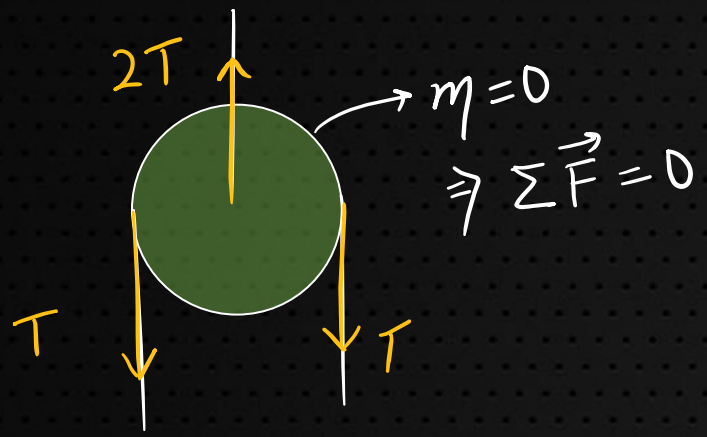
$$\frac{N_A}{\sin 90^\circ} = \frac{500}{\sin 120^\circ} = \frac{N_B}{\sin 150^\circ}$$

(i) $N_A = \dfrac{500 \times 1}{\sqrt{3}/2} = \dfrac{1000}{\sqrt{3}}$ N

(ii) $N_B = \dfrac{500 \times 1/2}{\sqrt{3}/2} = \dfrac{500}{\sqrt{3}}$ N

3. Pulley-Block Systems

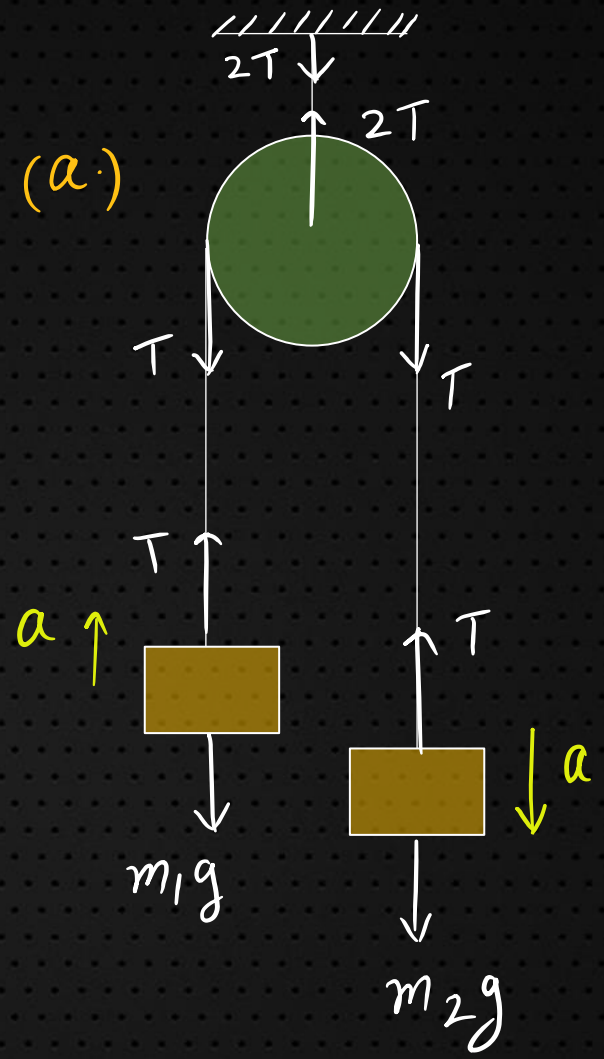
↳ Pulley is massless & smooth



$m = 0$

$\Rightarrow \Sigma \vec{F} = 0$

(a.)



$\Sigma F = ma$

$\downarrow$

$m_2 g - T = m_2 a \quad -(i)$

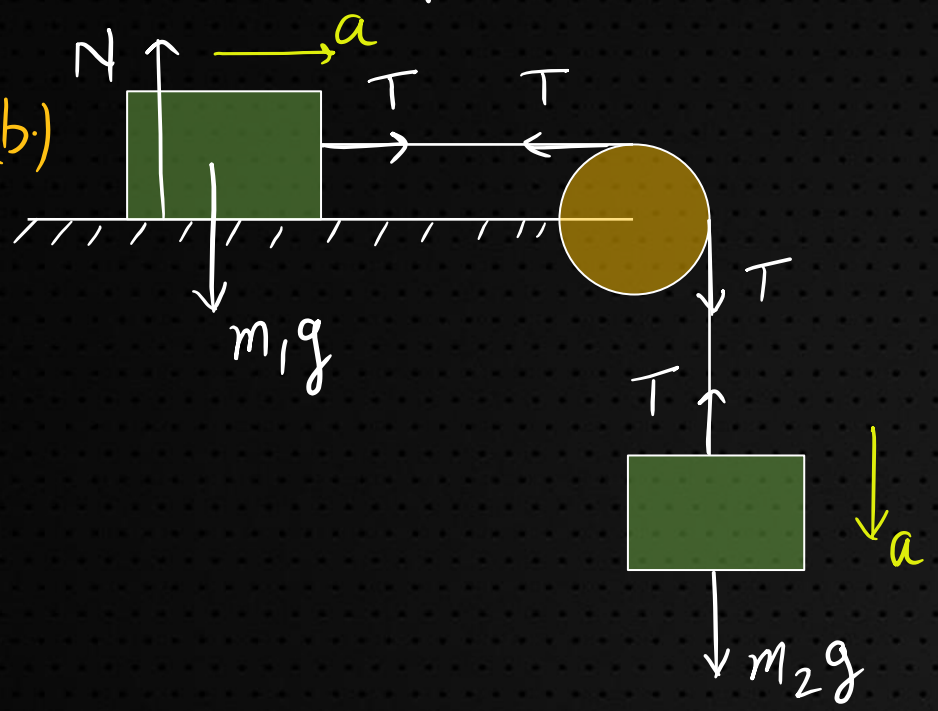
$T - m_1 g = m_1 a \quad -(ii)$

$\therefore T = \dfrac{2 m_1 m_2 g}{m_1 + m_2}$ #

$a = \left(\dfrac{m_2 - m_1}{m_1 + m_2}\right) g$ #

... Continued

(b.)

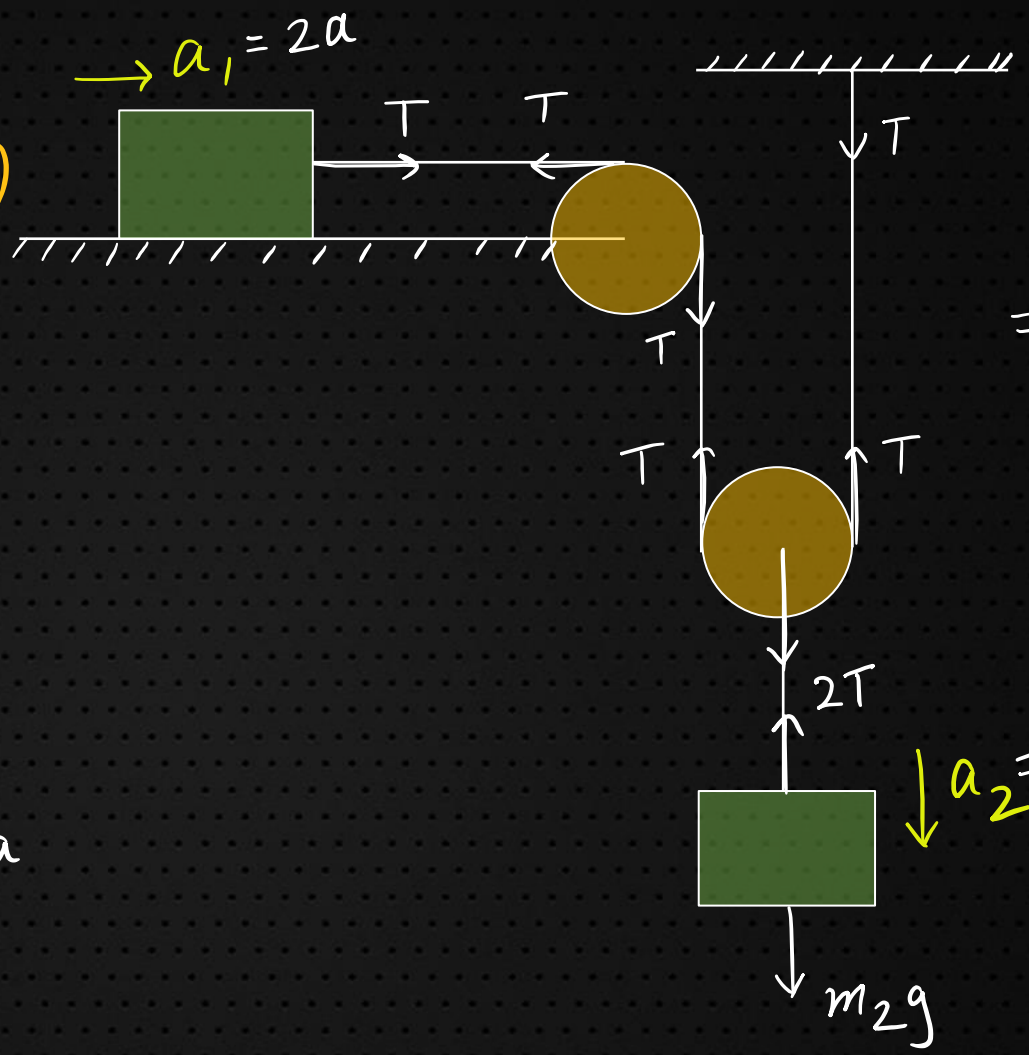


$m_2g - T = m_2a$

$T = m_1a$

$N = m_1g$

(c.)



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

$\Rightarrow T a_1 - 2T a_2 = 0$

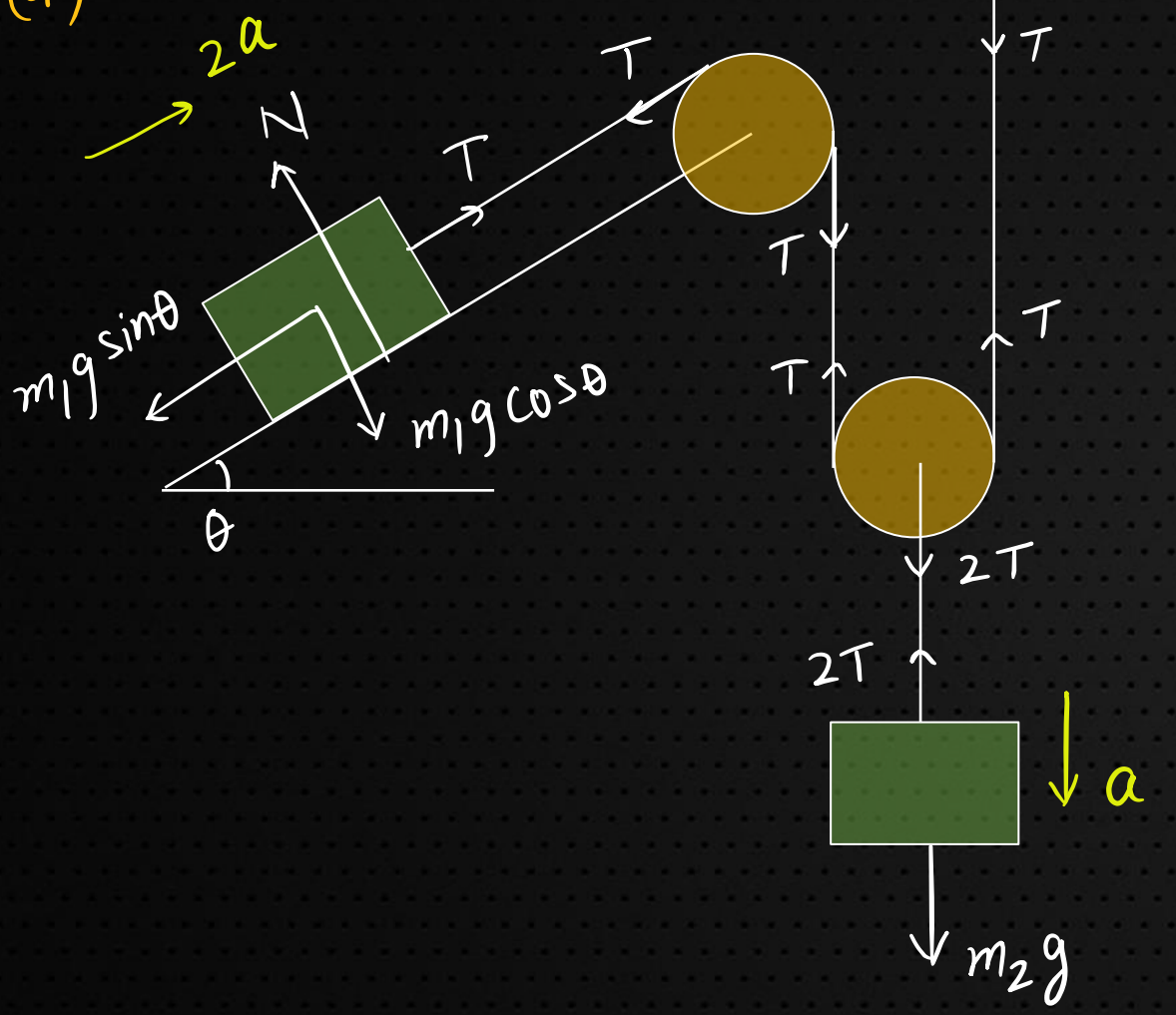
$\therefore a_1 = 2a_2$

$m_2g - 2T = m_2a$ — (i)

$T = m_1 \times 2a$ — (ii)

...Continued

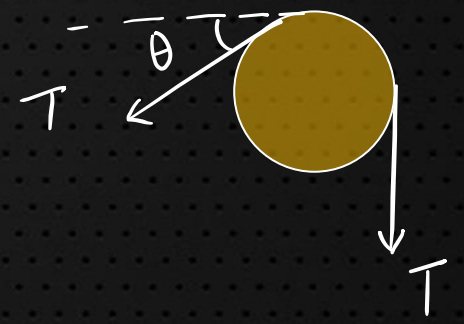
(d.)



$$m_2g - 2T = m_2a \quad --(i)$$

$$T - m_1g\sin\theta = m_1 \times 2a \quad --(ii)$$

$$N = m_1g\cos\theta \quad --(iii)$$

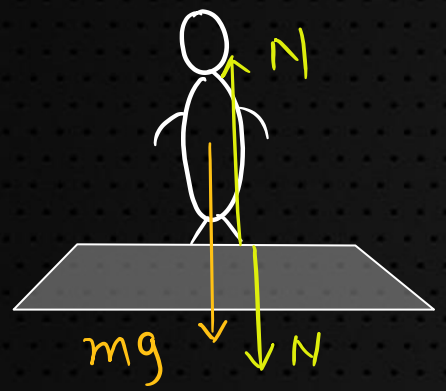


clamp Force

$$= \sqrt{T^2 + T^2 + 2T^2\cos(\pi - \theta)}$$

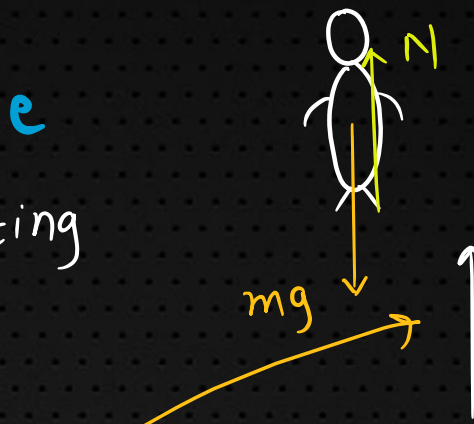
4. Concept of Weighing Machine

↳ Measures Normal reaction acting on surface of m/c.



$N = mg$

$\text{Reading} = \frac{N}{g} = m$

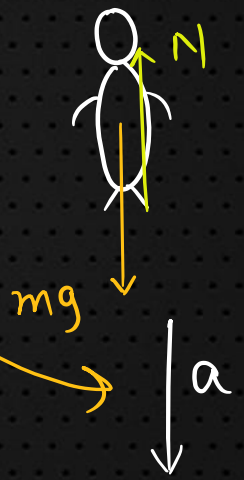


$N - mg = ma$

$\Rightarrow N = m(g+a)$

$\text{Reading} = N/g$

$= m\left(1+\frac{a}{g}\right)$



$mg - N = ma$

$\Rightarrow N = m(g-a)$

$\text{Reading} = N/g$

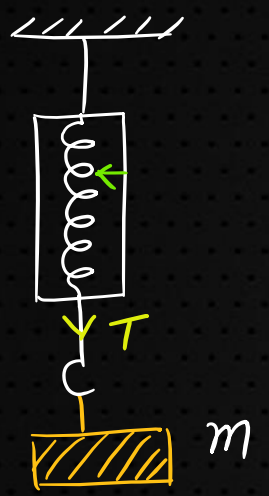
$= m\left(1-\frac{a}{g}\right)$

If $N = 0$

$\Rightarrow$ Weightlessness → Ex: free fall

5. Concept of Spring Balance (massless spring)

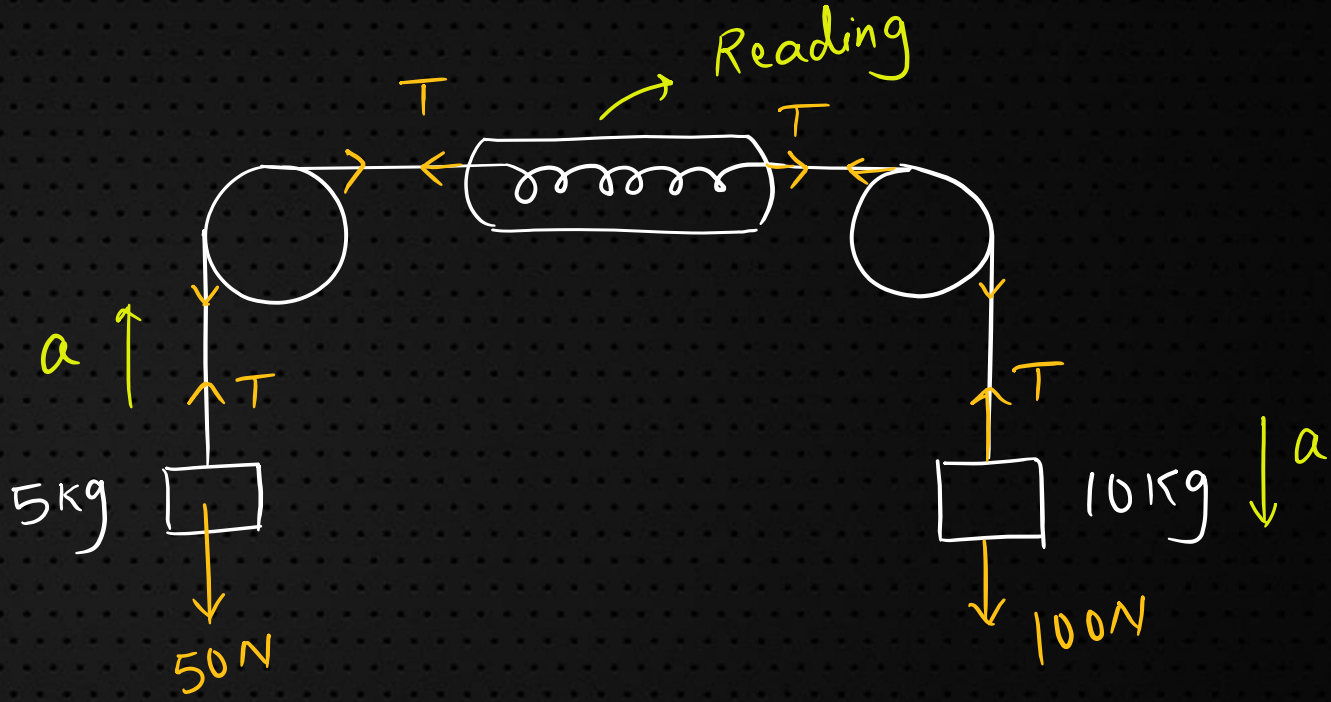
↳ Measures Tension in string attatched to it.



$T = mg$

Reading $= T/g$

$= m$



$100 - T = 10a$ — (i)

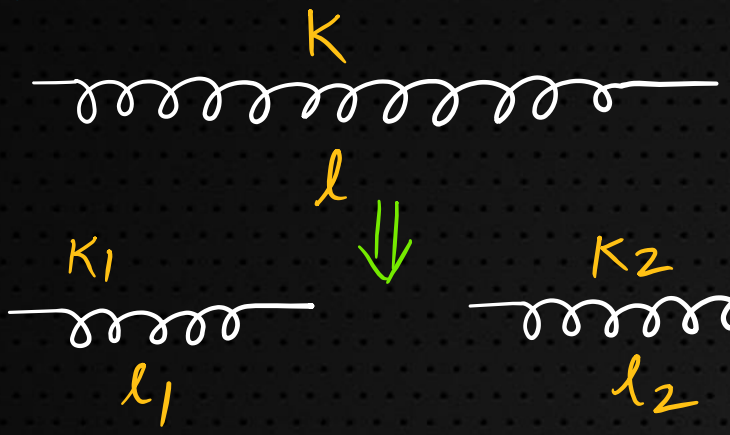
$T - 50 = 5a$ — (ii)

$\therefore T = 200/3$ N

Reading $= \frac{20}{3}$ kg

6. Spring cutting & Combination

Cut



$K \cdot l = \text{const.}$

$K_1 = \frac{Kl}{l_1}$ $\quad K_2 = \frac{Kl}{l_2}$

Combination

(i)

$$\frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2}$$

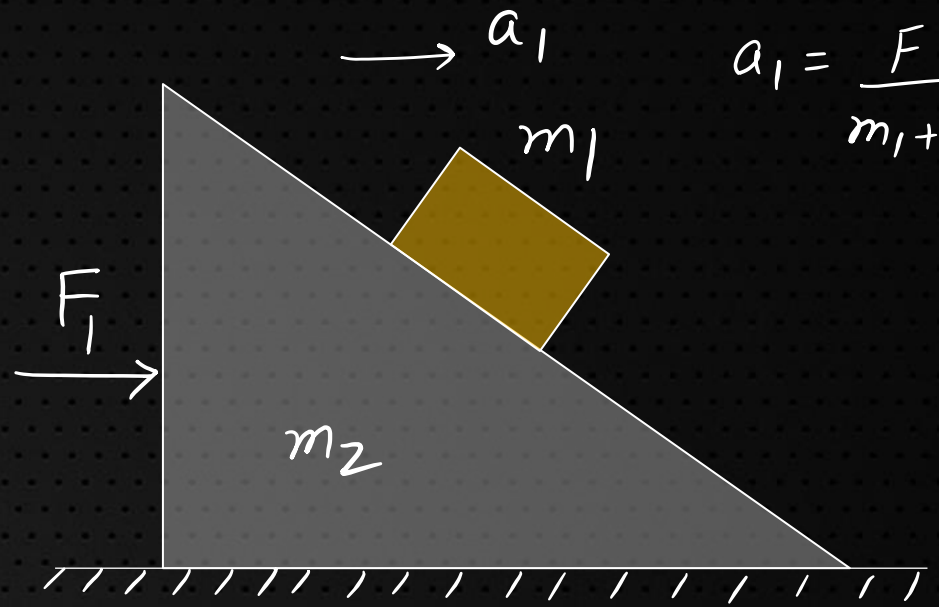
(ii)

$K_{eq} = K_1 + K_2$

7. F.B.D – Most Imp. pt.

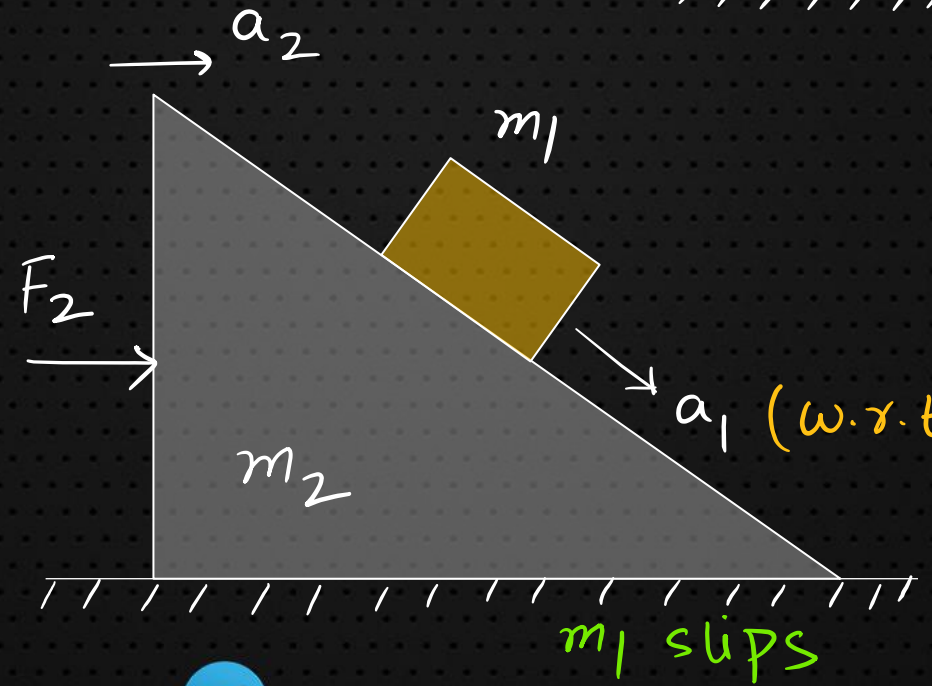
↳ Selection of system

Two or more bodies can be taken as system if all bodies have same $\vec{a}$.



$a_1 = \frac{F}{m_1 + m_2}$

m_1 does not slip



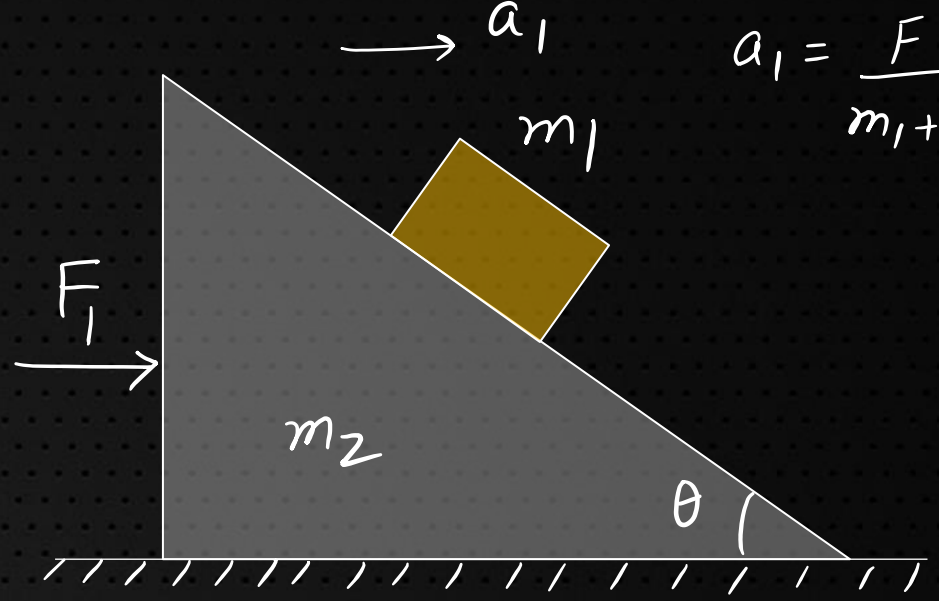
m_1 slips

✗ take m_1 & m_2 as system

7. F.B.D – Most Imp. Pt.

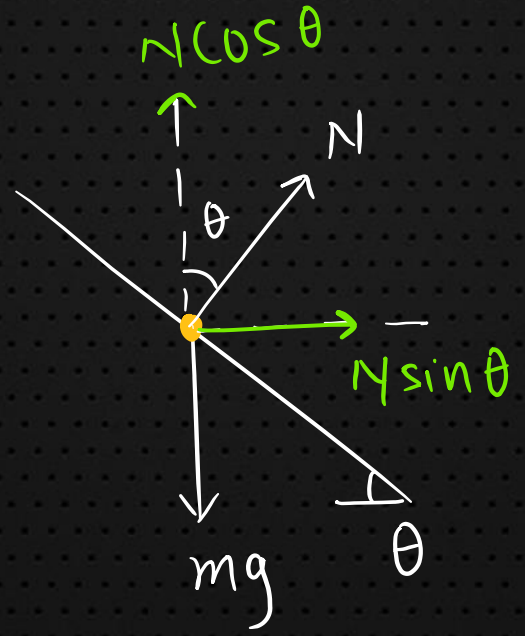
↳ Selection of system

Two or more bodies can be taken as system if all bodies have same $\vec{a}$.



$$a_1 = \frac{F}{m_1 + m_2}$$

m_1 does not slip



$$N\sin\theta = ma_1$$

$$N\cos\theta = mg$$

on dividing

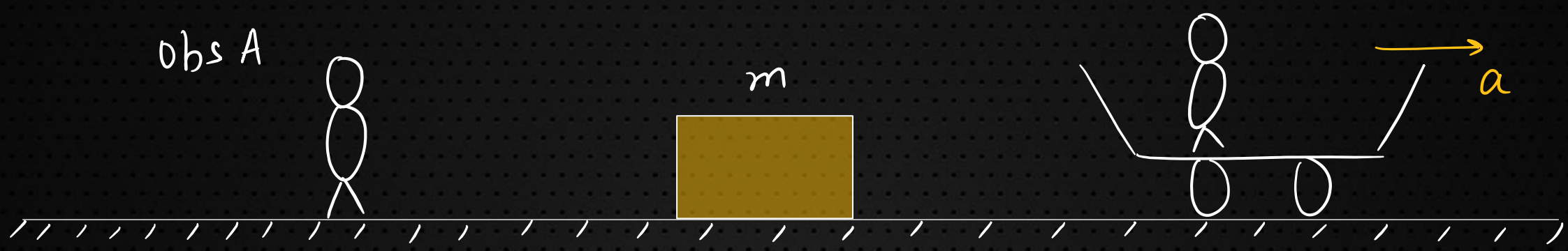
$$\tan\theta = a_1/g$$

$$\Rightarrow \boxed{a_1 = g\tan\theta}$$

8. Pseudo Force

Inertial frame $(a=0)$

Non-Inertial frame $(a \neq 0)$



Obs A. → Body is at rest

Obs B. →

F_p

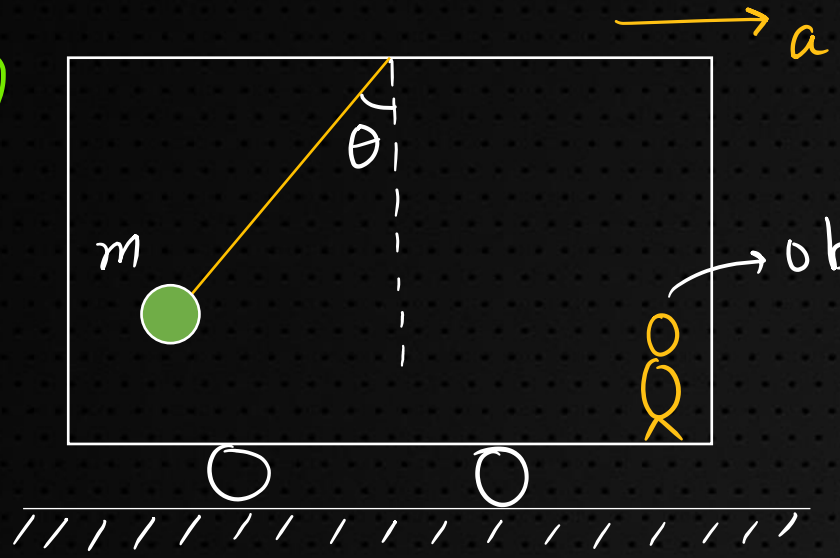
∵ accelerated, thus force acting on it must be

$F_p = ma$

p → false force

... Continued

(a)



To observer, m is at rest.

$$T\sin\theta = ma \quad \text{— (i)}$$

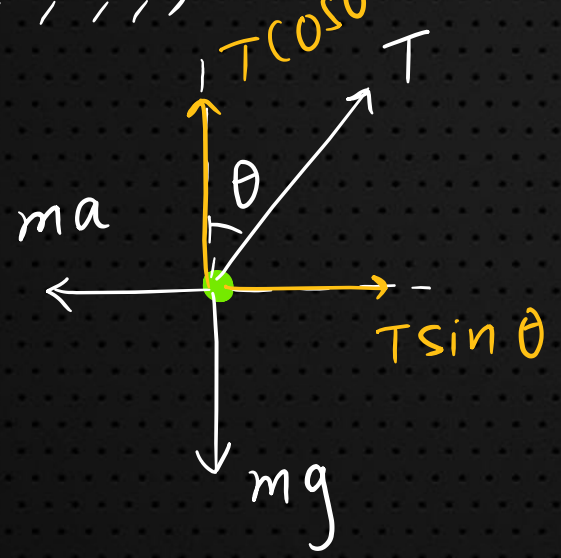
$$T\cos\theta = mg \quad \text{— (ii)}$$

On dividing:

$$\tan\theta = a/g \Rightarrow a = g\tan\theta$$

$$(i)^2 + (ii)^2$$

$$T = m\sqrt{a^2+g^2}$$



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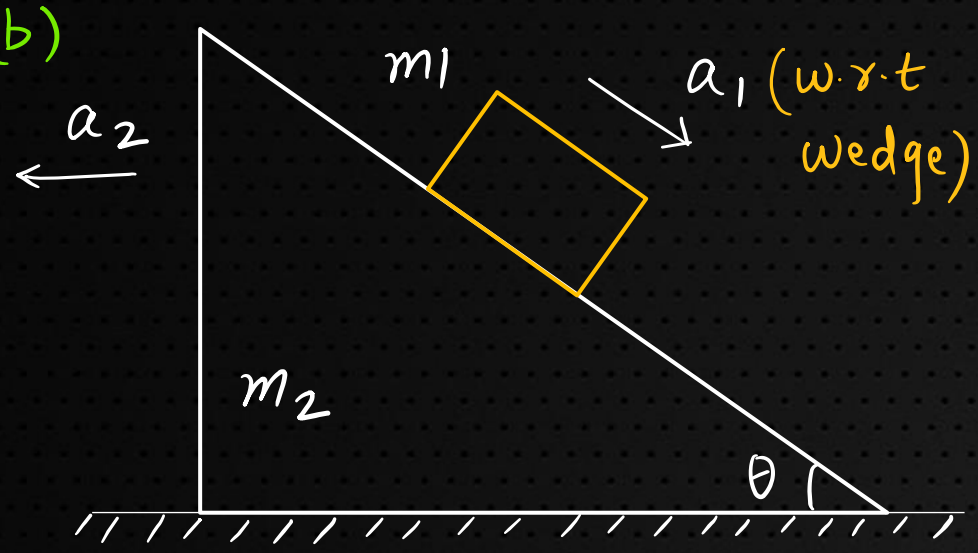
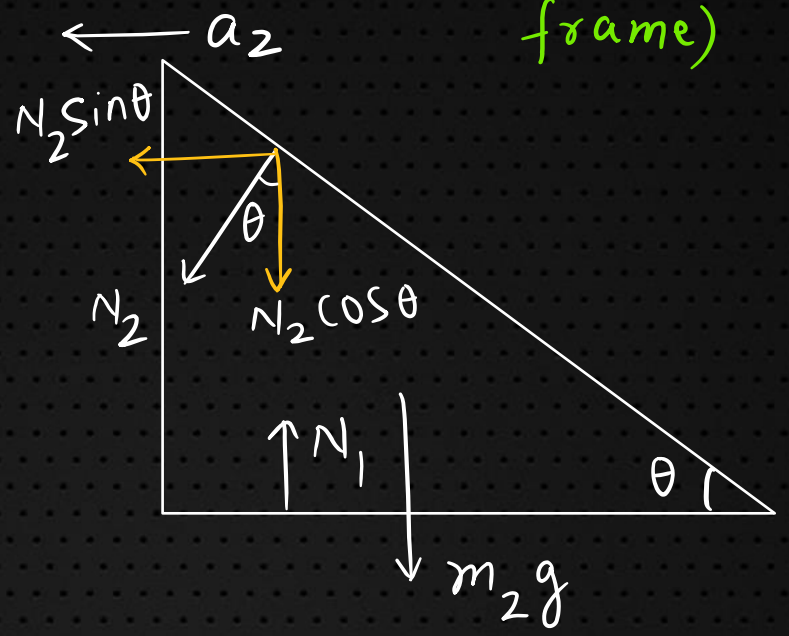
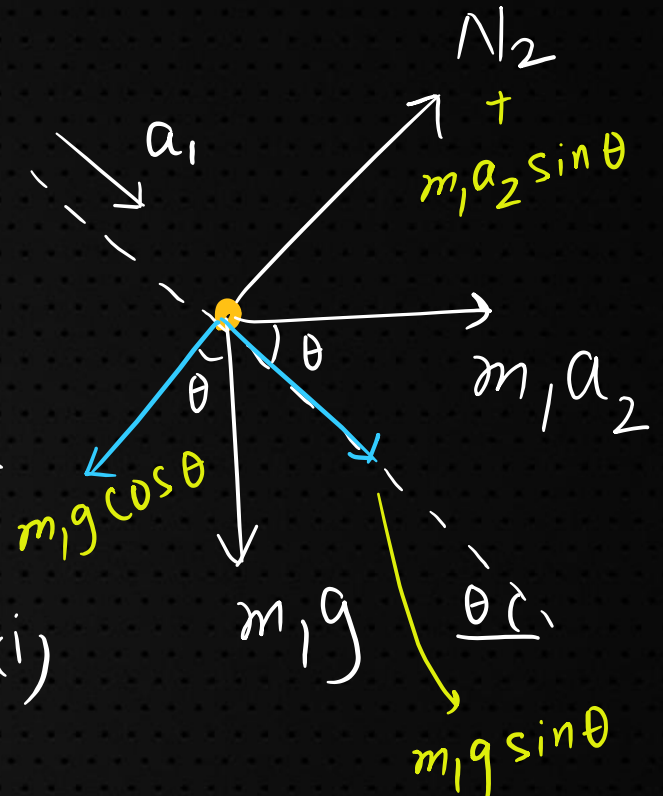
(b)

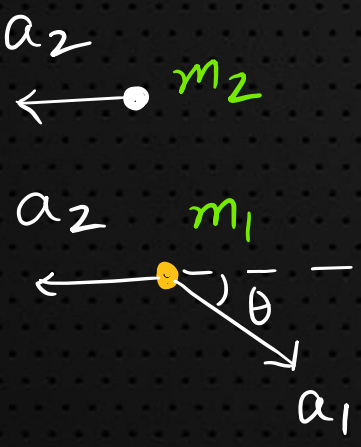


F.B.D of m_2 (ground frame)



F.B.D of m_1 (m_2 frame)





$$N_2 \sin\theta = m_2 a_2 \quad \text{— (i)}$$

$$m_1 g \sin\theta + m_1 a_2 \cos\theta = m_1 a_1 \quad \text{— (ii)}$$

$$N_2 + m_1 a_2 \sin\theta = m_1 g \cos\theta \quad \text{— (iii)}$$

Solve (i), (ii) & (iii).

9. Variable Force

$F(t)$ → $F(t) = m\frac{dv}{dt} \Rightarrow \int_0^t F(t)\,dt = \int_u^v m\,dv$

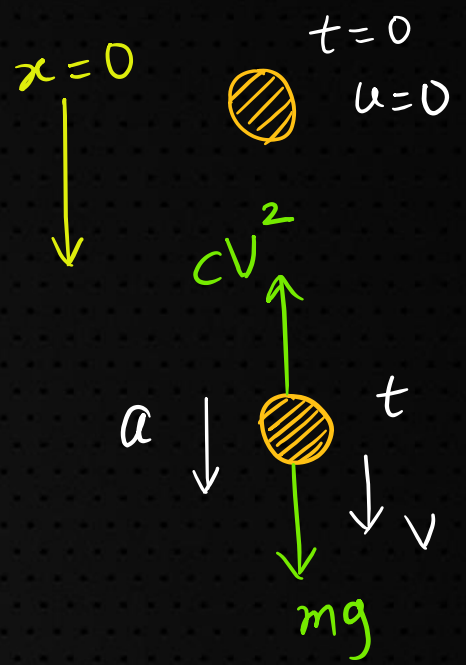
$F(x)$ → $F(x) = mv\frac{dv}{dx} \Rightarrow \int_0^x F(x)\,dx = \int_u^v mv\,dv$

$F(v)$ → $F(v) = mv\frac{dv}{dx} \Rightarrow \int_0^x dx = \int_u^v \frac{mv}{F(v)}\,dv$

$F(v) = m\frac{dv}{dt} \Rightarrow \int_0^t dt = \int_u^v m\frac{dv}{F(v)}$

... Continued

Ex Ball dropped from H height. A air resistive force $f = cV^2$ acts on ball. Find it speed after falling H height.



Soln:

$$mg - cV^2 = ma$$

$$\Rightarrow mg - cV^2 = mV\frac{dV}{dx}$$

$$\Rightarrow \int_0^H dx = m\int_0^{V_0} \frac{V\,dV}{mg - cV^2}$$

↳ Integrate to get V_0

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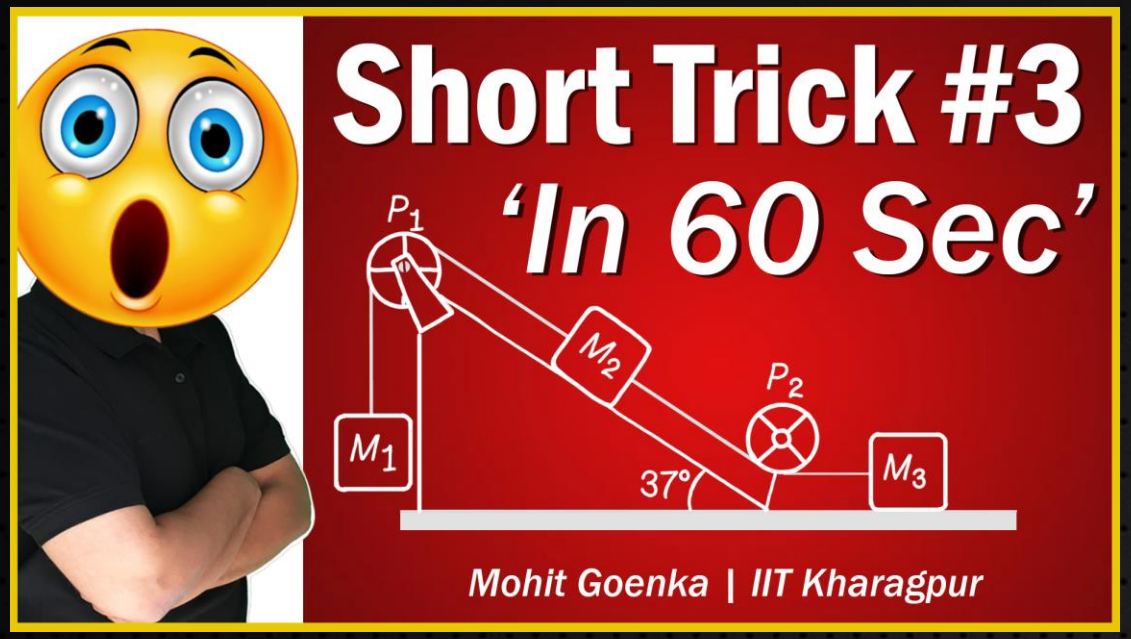

https://youtu.be/MZwkIpJcJKo

Constraint Motion in Rigid Rods	https://youtu.be/42pQCxlhdCQ
Constraint Motion in Wedge	https://youtu.be/Fw8QOdxct18
Constraint Motion in Strings	https://youtu.be/widSCjr_5nE
Constraint Motion in Pulley Block 1	https://youtu.be/MadNy-jmV-8
Constraint Motion in Pulley Block 2	https://youtu.be/bSD16ug4gsk

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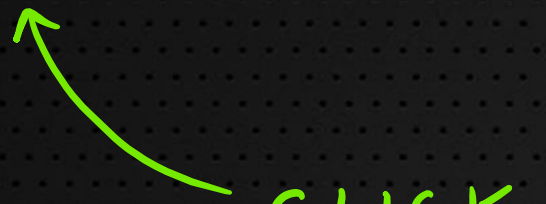
NLM PYQs LINKS (JEE MAIN)

2021 Feb	2021 March	2021 July	2021 August	2020	Top PYQs / Mix Years
https://youtu.be/2xuXY66RQWM	https://youtu.be/zUu5ccnsB_4	https://youtu.be/hCShMjLXnFo	https://youtu.be/VqOrOiq0N_I	https://youtu.be/AxW4Ibc0KkY	https://youtu.be/ZUQ1hfF7Ov4



CLICK (Practice these Questions)

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Revision Series Playlist Link https://bit.ly/3eBbib9

JEE Main PYQs Link https://bit.ly/2S54jzh *Chapter wise 2021, 2020, 2018*

GoldMine Link https://bit.ly/2VhOGFF