Dynamics 4

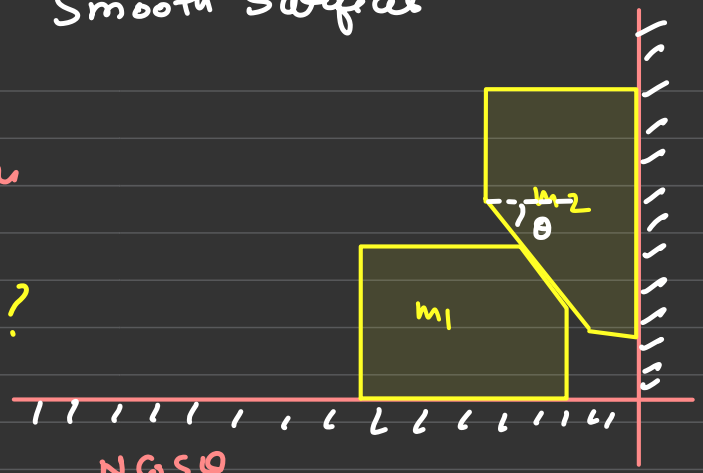

VMC
Vidyamandir
Classes
SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

8)

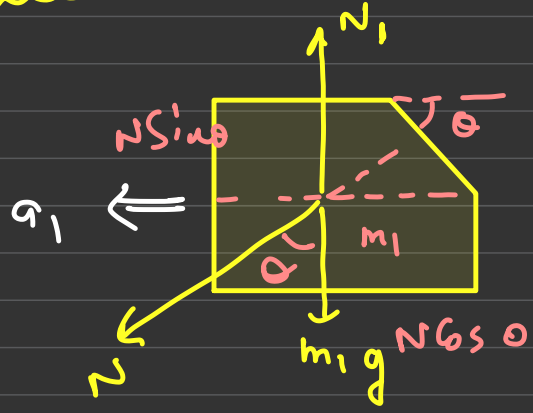
"Smooth Surfaces"

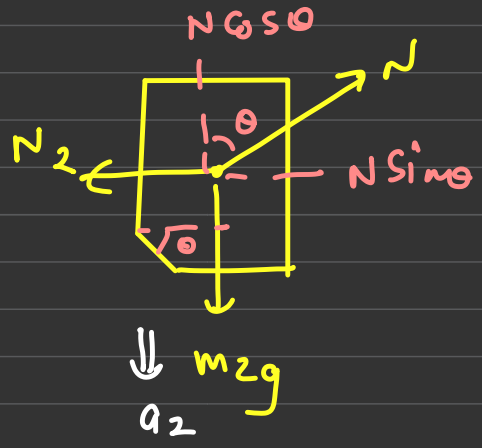
Statement A_1, A_2, A_3 } gives us direction of acceleration

$\Rightarrow$ find acceleration of m_1 and m_2?



FBD!





$N\sin\theta = m_1 a_1$ — (1)

(2) (1)

$m_2 g - N\cos\theta = m_2 a_2$ — (4) (iv)

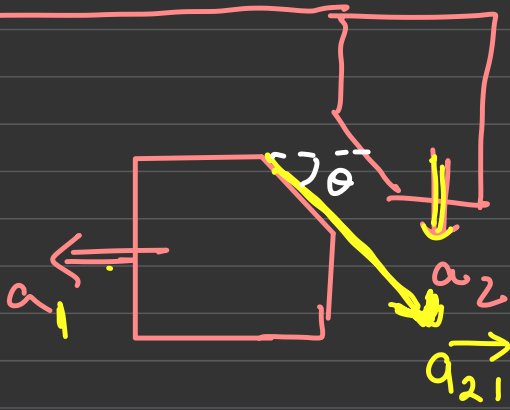
$N_1 = m_1 g + N\cos\theta$ — (II)

(3)

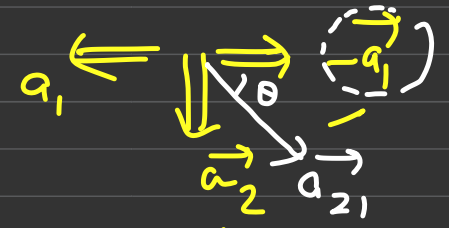
$N_2 = N\sin\theta$ — (III)

(5)

for extra - equation we will statement As



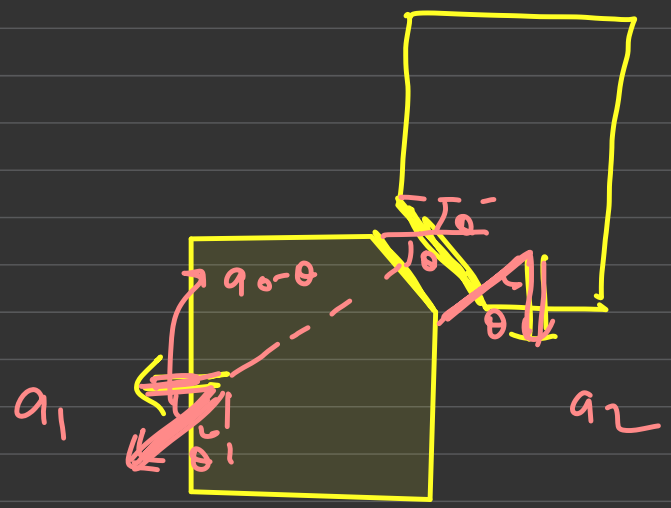
$$\vec{a}_{21} = \vec{a}_2 - \vec{a}_1$$
$$= \vec{a}_2 + (-\vec{a}_1)$$



$a_2 = a_1 \tan\theta$ — (V)

$$\tan\theta = \frac{a_2}{a_1}$$

How to get 5th equation using other force.



if two accelerating blocks are in contact then acceleration ⊥ to surface in contact should be same

$$\vec{a}_{1\perp} = \vec{a}_{2\perp}$$

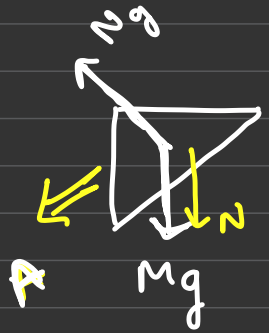
$$\begin{cases} a_{1\perp} = a_1 \sin\theta \\ a_{2\perp} = a_2 \cos\theta \end{cases}$$

$$a_1 \sin\theta = a_2 \cos\theta$$

$$\tan\theta = \frac{a_2}{a_1}$$ ∴

8)

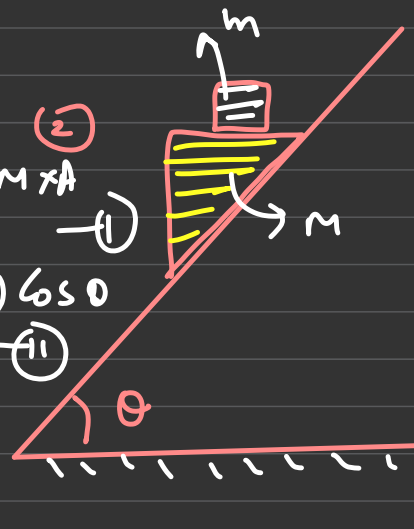
Steps!!



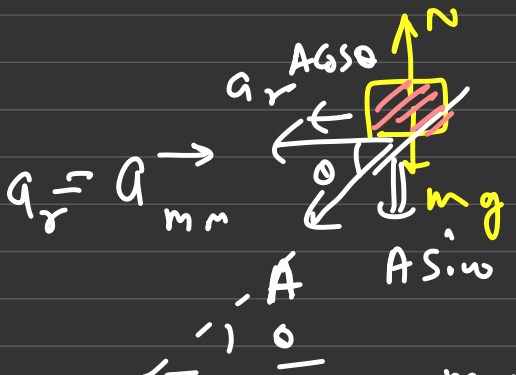
(1) $(Mg + N)\sin\theta = MxA$

(2)

(3) $Ng = (Mg + N)\cos\theta$



all the surfaces are smooth then find acceleration of m and M?

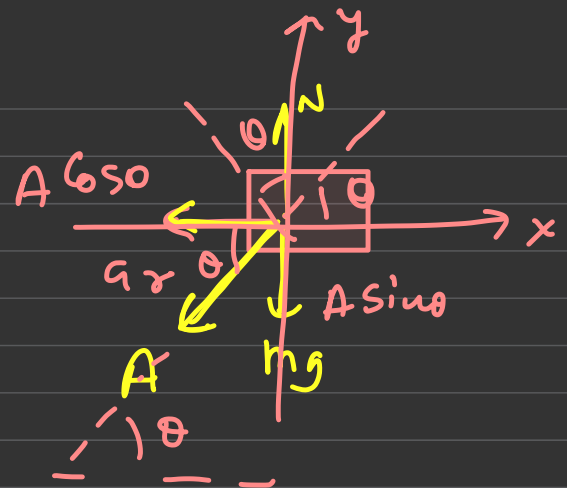


$\vec{a_{m,M}} = \vec{a_m} - \vec{a_M}$

$\vec{a_m} = \vec{a_{m,M}} + \vec{a_M}$

$mg - N = mA\sin\theta$ — (III)

$0 = m \times (a_r + A\cos\theta) = 0 \quad a_r + A\cos\theta = 0$ — (IV)



$$\vec{a}_{mM} = \vec{a}_m - \vec{a}_M$$

$$\vec{a}_m = \vec{a}_{mM} + \vec{a}_M$$

$(a_r$

$$mg - N = m\,(A\sin\theta) \quad \text{—— (III)}$$

$$0 = m\,(a_r + A\cos\theta) \quad \text{(IV)}$$

$$a_r + A\cos\theta = 0$$

Homework: { Solve all three Question } × 3 Solution whatsapp

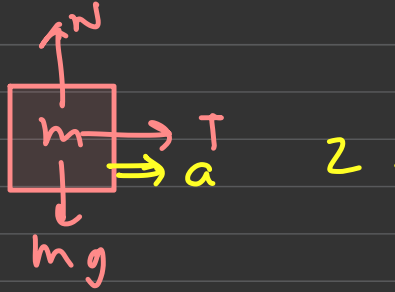
String Constraint:

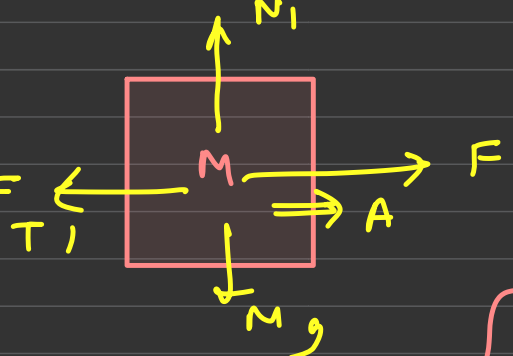
"All smooth surface, friction No-where"

mass

T
T1
T
T' = 2T

find acceleration of m and M ?





$T = ma$ — (III)

(1) (2)

$T' = 2T$

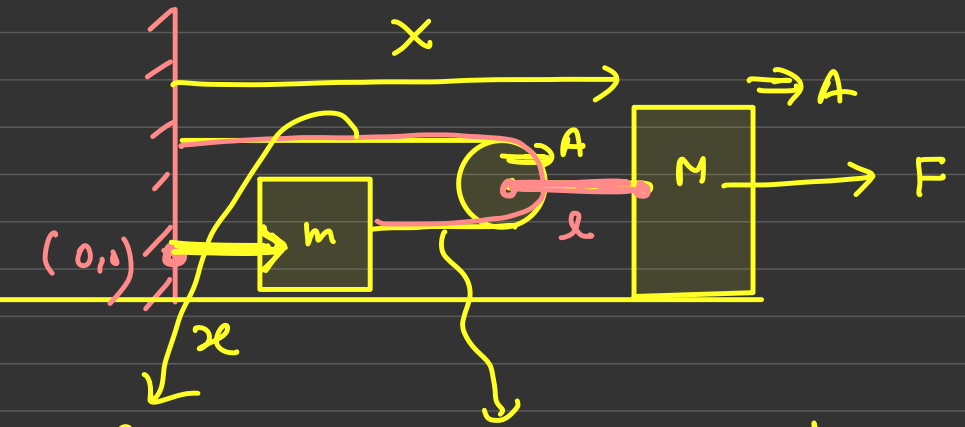
$F - 2T = MA$ (3) (1)

$N_1 = Mg$ (II)

(3) =

$$N = mg \quad (4)$$

Calculation extra equation from "String Constraint"



$$(x-l)+(x-l-x)=L$$

$$2x-x=L+2l$$

"length of string does not change with motion"

(i) assume a fixed

(ii) find position vectors of blocks w.r.t fixed point

(iii) write length of string in terms of position

diff. ijr w.r.t time

$$2\frac{dx}{dt} - \frac{dx}{dt} = 0$$

diff it again w.r.t time

$$2\frac{d^2x}{dt^2} - \frac{d^2x}{dt^2} = 0$$

$$2(+A) - (+a) = 0$$

$$2A = a \quad \text{— (v)}$$

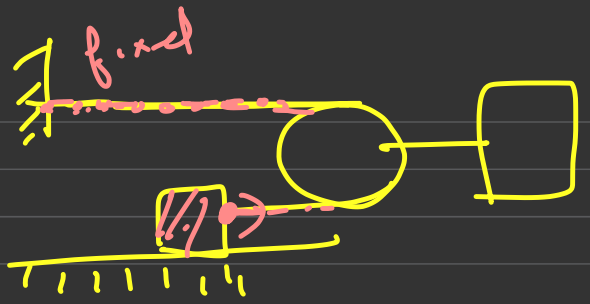
of blocks

(iv) Diff it twice to convert position in acceleration

{ in direction A if x ↑ then A = +ve

{ in direction A x ↓ then A = -ve

#



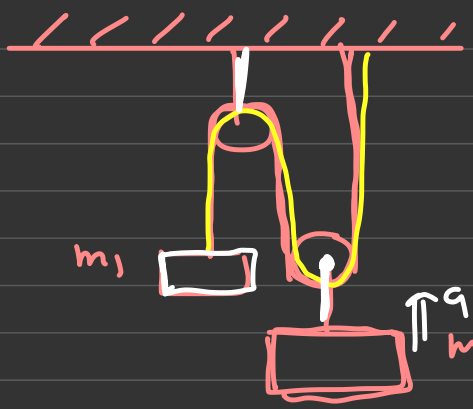
$$A = \frac{0 + a}{2}$$

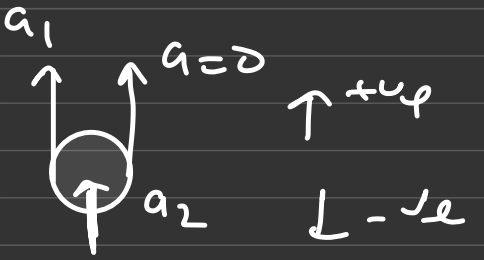
$$a = 2A$$

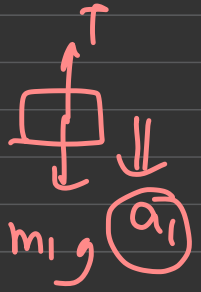
#

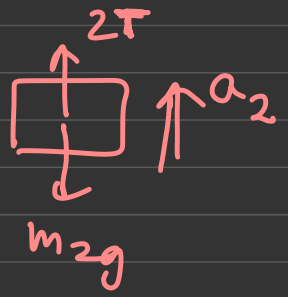
$$+a_3 = \frac{a_2 - a_1}{2}$$

8) – Practice with String Const. find acceleration m_1 and m_2?









$m_1 g - T = m_1 a_1$ — (1)

(2) (1)

$2T - m_2 g = m_2 a_2$ — (11)

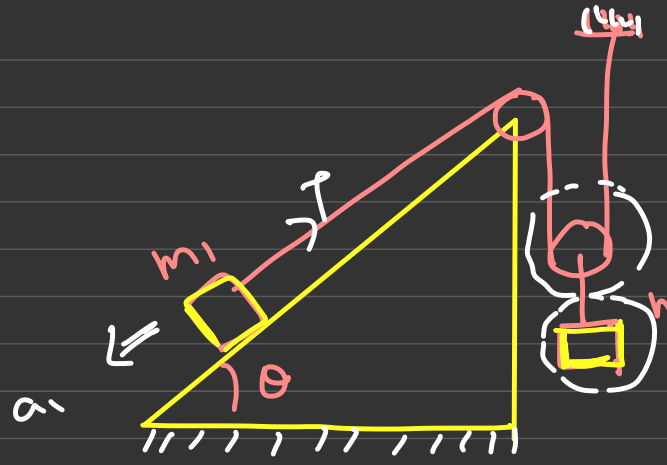
(3)

$+ a_2 = \frac{a_1 + 0}{2}$

$2a_2 = a_1$ Ans

a)

find acceleration of m_1 and m_2



$N = m_1 g \cos\theta$ (iii)

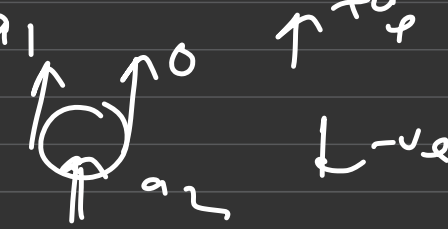
$m_1 g \sin\theta - T = m_1 a_1$ — (i)

(1) (2)

$=$

$2T - m_2 g = m_2 a_2$ (ii)

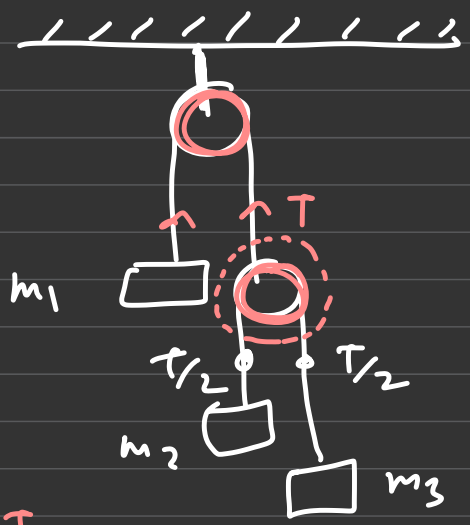
(3)



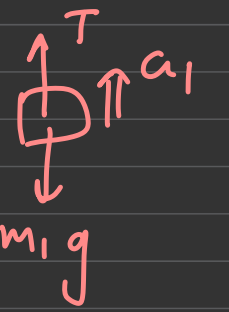
$\frac{a_1 + 0}{2} = a_2$

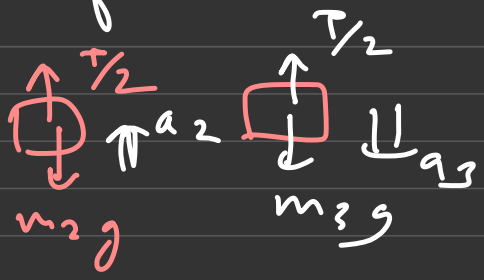
$a_1 = 2a_2$

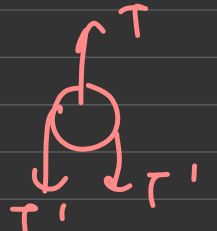
Q)



find acceleration of each block?







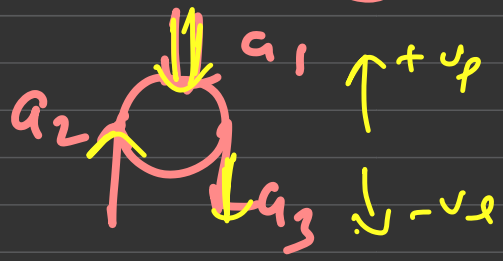
$2T' = T$

$T' = T/2$

$T - m_1 g = m_1 a_1$ ①

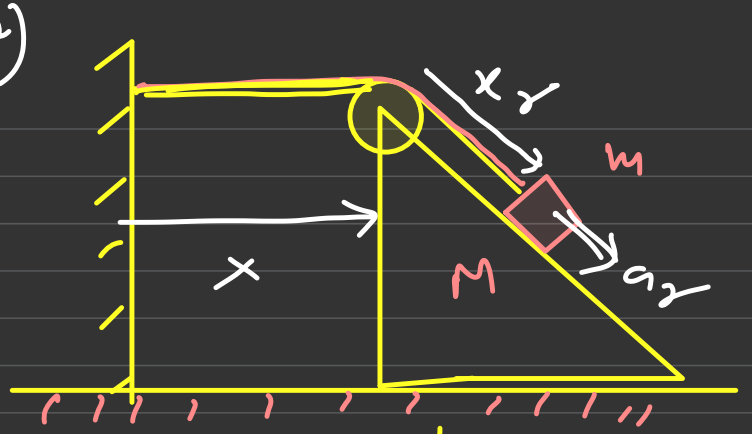
$T/2 - m_2 g = m_2 a_2$ ②

$m_3 g - T/2 = m_3 a_3$ ③

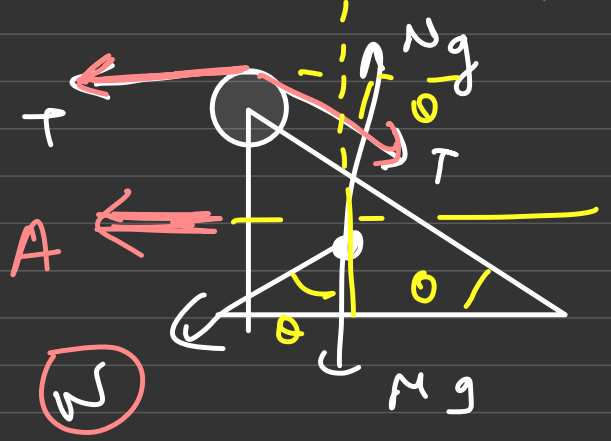


$-a_1 = \frac{a_2 - a_3}{2}$ ④

Q)



All the surfaces are smooth find acceleration of m, and M?



$N\sin\theta + T - T\cos\theta = MA$ —(III)

$N_g = N\cos\theta + Mg$

$(mg\sin\theta - T) = m(a_r - A\cos\theta)$ —(I)

$mg\cos\theta - N = mA\sin\theta$ —(II)

T.S.O - (iv)

$x + x_r = L$ → Relative position

$\frac{d^2x}{dt^2} + \frac{d^2x_r}{dt^2} = 0$

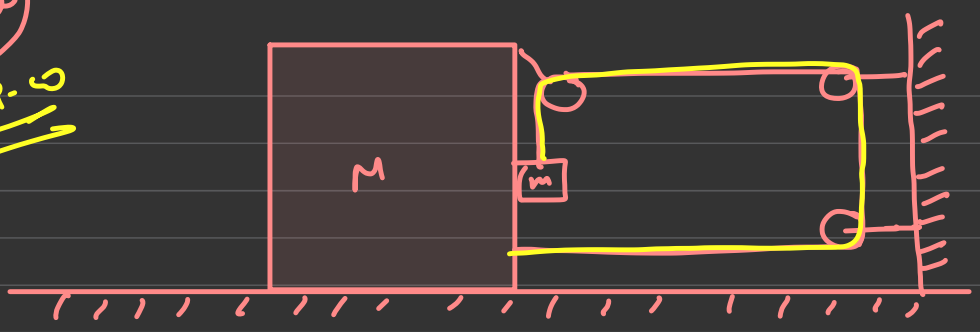
$-A + a_r = 0$

$a_r = A$ - (v)

"Now we can solve it"

9)

H.O



find acceleration of m and M?

all Smooth

b DFS #3 → Level 1 → Level 2

4 Complete module in cabin Pseudo for