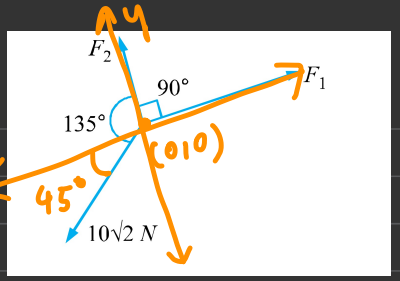
Introduction to Vector and Forces -2

Vector Addition Using Components

Steps:

1. Join tail of all the vectors and assume that point as origin.
2. take Convinient axis { maximum vector lies on the axis }
3. Resolve / take component of all the vector along axis.
4. add vectors along x-axis and y-axis as Now they are Collinear vectors
5. then R_x and R_y must be perpendicular hence $R_{net} = \sqrt{R_x^2 + R_y^2}$ and get angle.

Illustration - 14 *A particle is in equilibrium under the action of three forces as shown. Find the magnitude of forces F_1 and F_2 .*

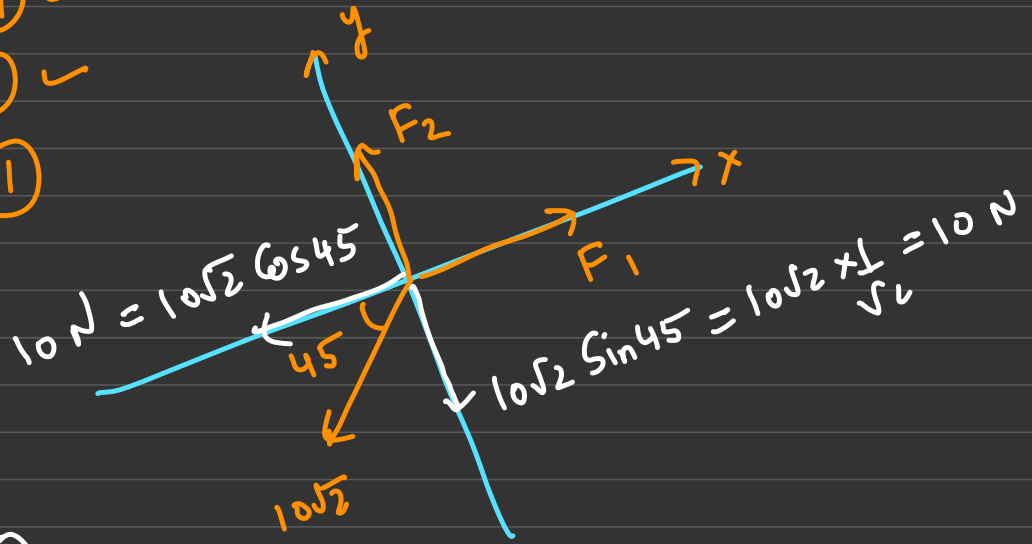


– net force zero –

(i) –

(ii) –

(iii)



$F_1 = 10\ N$

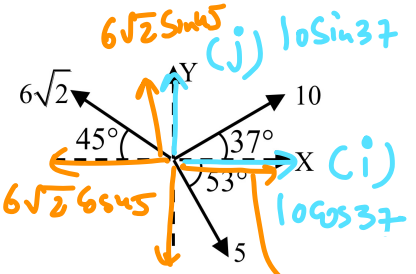
$F_2 = 10\ N$

(iv) as

9. The sum of these three vectors is :

(A) $4\hat{i} + 4j$ **(B)** $5\hat{i} - 2j$

(C) $4\hat{i} + 3j$ **(D)** $5\hat{i} + 8j$



$6\sqrt{2}\sin 45$ (j) $10\sin 37$

$6\sqrt{2}\cos 45$ (i) $10\cos 37$

$5\sin 53$ $5\cos 53$

(I) ✓

(II) ✓

(III) Component

$\sin 37 = \frac{3}{5}$

$\sin(90-53) = \cos 53$

$\vec{F} = 5\hat{i} + 8\hat{j}$

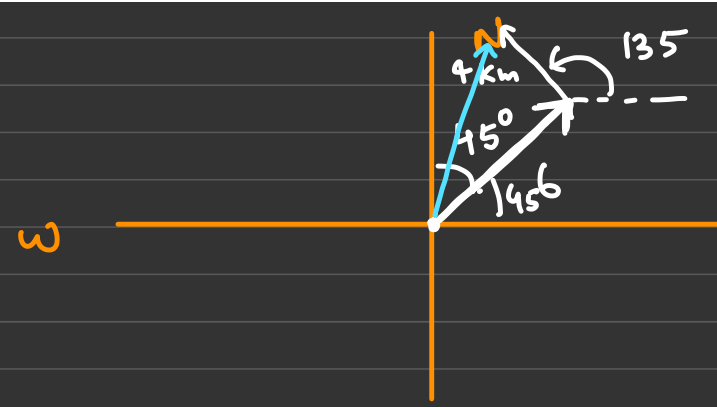
15. A car travels 6 km towards north at an angle of 45° to the east and then travels distance of 4 km towards north at an angle of 135° to the east. How far is the point from the starting point. What angle does the straight line joining its initial and final position makes with the east ?

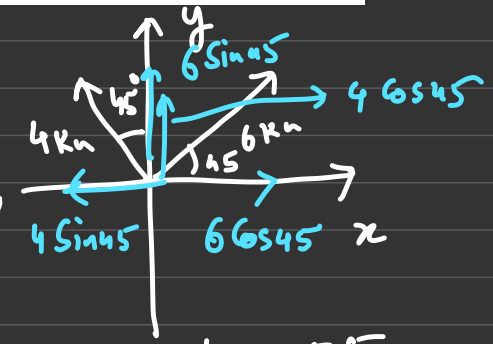
(A) $\sqrt{50}\ km$ and $\tan^{-1}(5)$

(B) $10\ km$ *and* $\tan^{-1}\left(\sqrt{5}\right)$

(C) $\sqrt{52}\ km$ *and* $\tan^{-1}(5)$

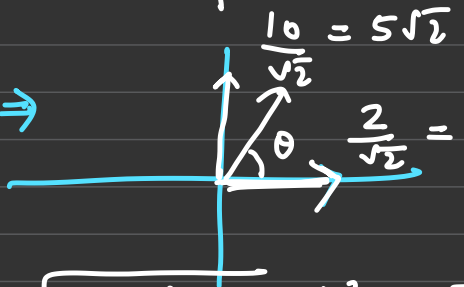
(D) $\sqrt{52}\ km$ *and* $\tan^{-1}(\sqrt{5})$





$\tan\theta = \frac{5\sqrt{2}}{\sqrt{2}} = 5$

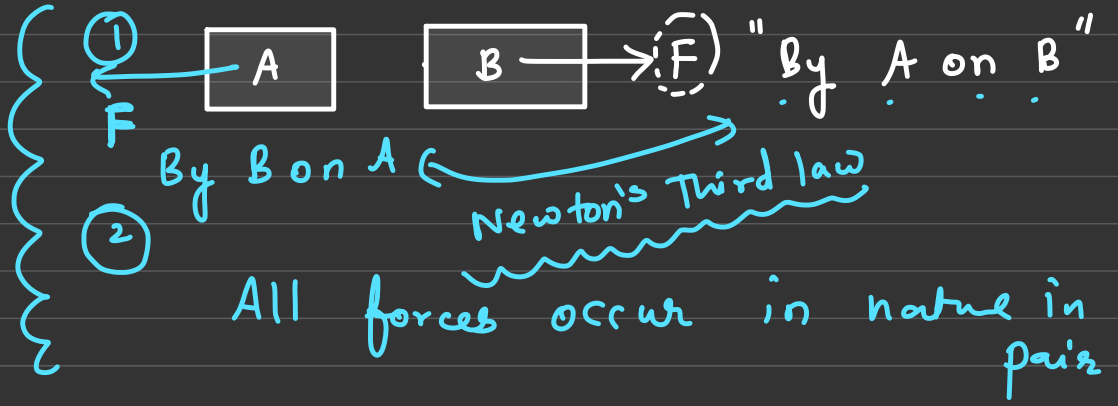
$\theta = \tan^{-1}(5)$



$|\vec{S}| = \sqrt{(\sqrt{2})^2 + (5\sqrt{2})^2} = \sqrt{52}\ km$

Introduction to forces

Force: "A force is push or pull by someone on some."



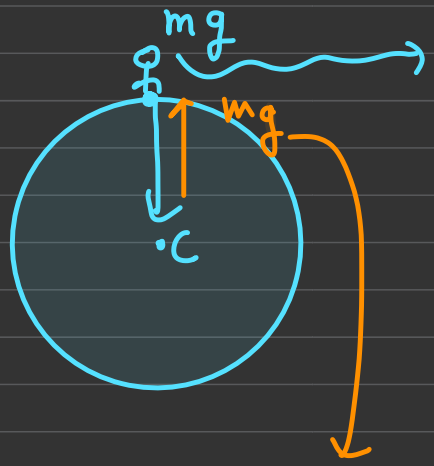
Mag.
Direction
By whom
On whom

Type of forces:

"Non-Contact, pull type of force"

① Weight : (mg)

"gravitational "pull" by earth on any object towards Centre"

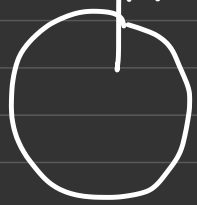


By man on earth

"mg, towards Centre"

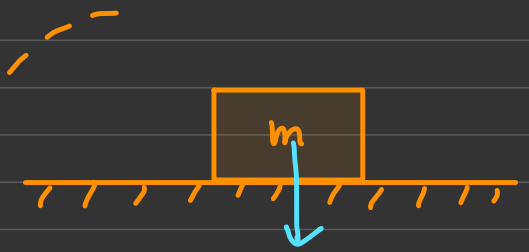
By earth on man

$ma = mg \Leftarrow Q \downarrow mg$

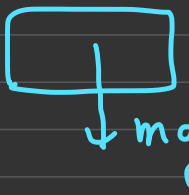


$mg = m_e \times a_e \quad a_e = \frac{mg}{m_e} \simeq 0$

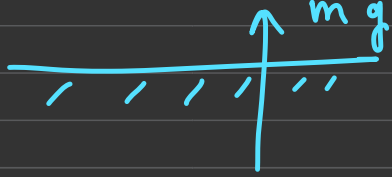
Q)



Draw weight force on m?

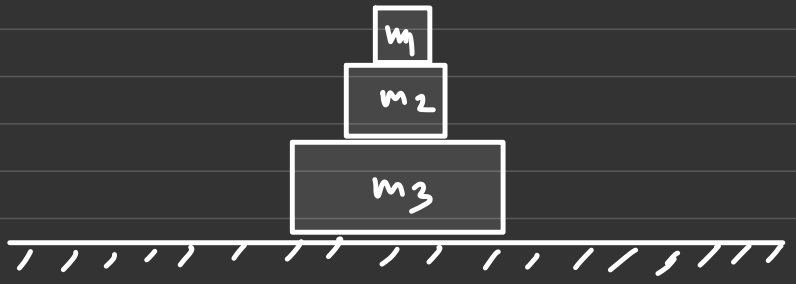


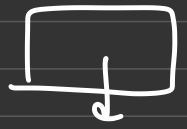
(By earth on objatm)

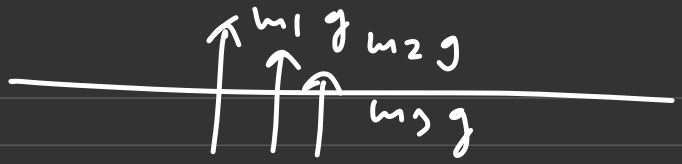


(By objat on man)

Q)





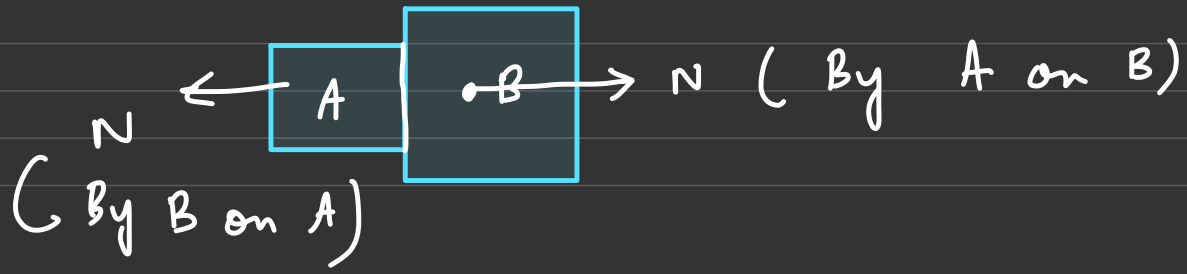


Normal force:

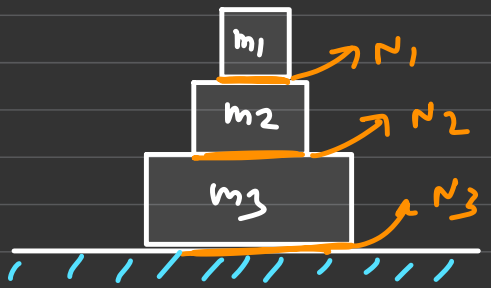
Contact force

push

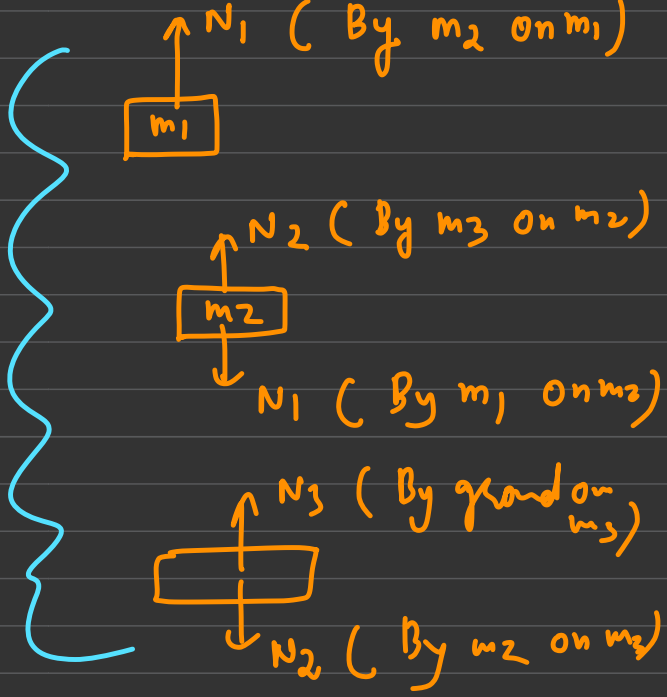
if two bodies are in contact, they try to penetrate into eachother, in order to avoid penetration they exert a force away from it. which is called normal force.



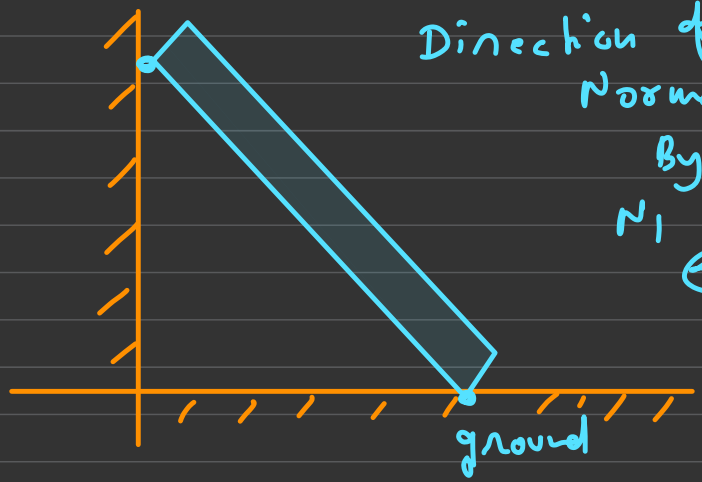
Q)



Draw all the Normal force experienced by m_1, m_2 and m_3?



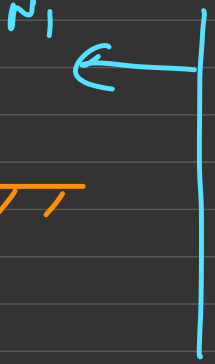
e)



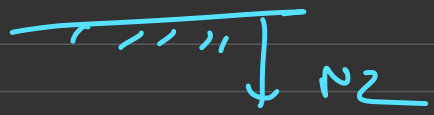
" Common ⊥ " Direction of Normal

Draw Normal force exp. by ladder?

By ladder on wall



(By wall on ladder



→ Equilibrium of forces: (Net force experienced by the body must be zero)

→ Equilibrium of a body:

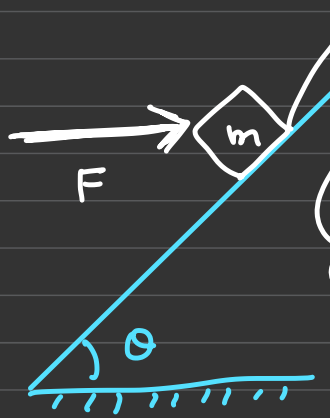
Steps:

(1) Draw FBD of body

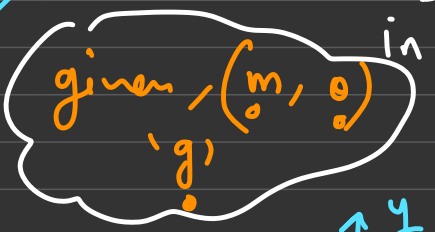
↓

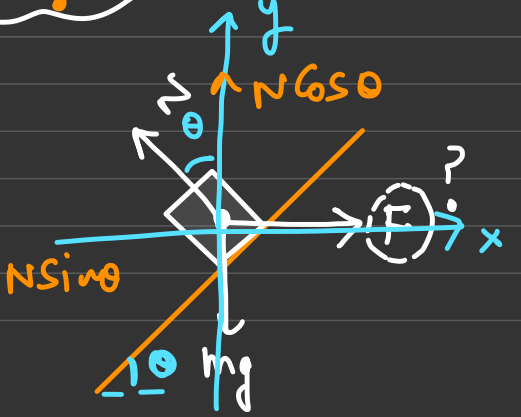
Free body diagram

" you have draw all the force (Ext) experienced by that body "



find F for which body is in equibrium?

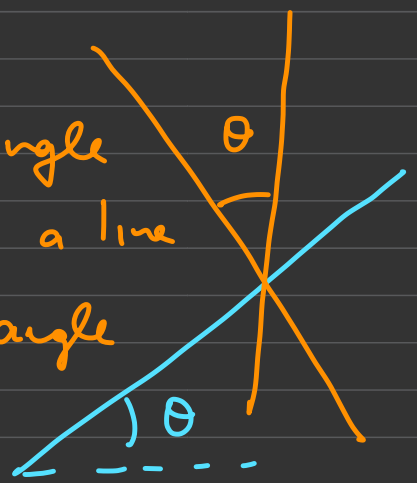




② Assume . con. axis

③ Resolve / take component

"if a line is making angle θ w.r.t Horizontal then a line ⊥ to it always make angle same θ w.r.t vertical"



④ Balance the forces: $|\Sigma F_x| = |\Sigma F_{-ve\,x}|$

Equilibrium ⇐ $|\Sigma F_{+y}| = |\Sigma F_{-y}|$

$= F = N \sin\theta$

$mg = N\cos\theta$

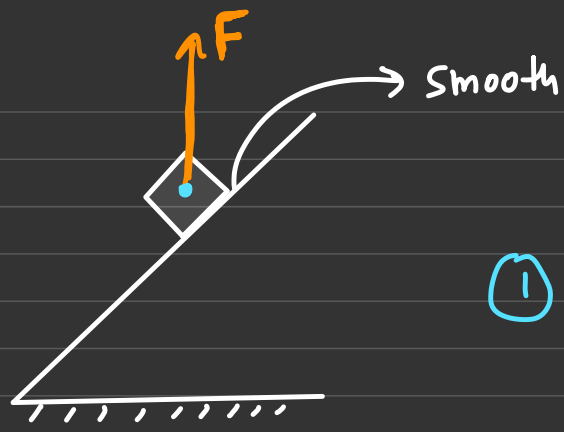
$N = \frac{mg}{\cos\theta}$

$F = \frac{N}{} \sin\theta$

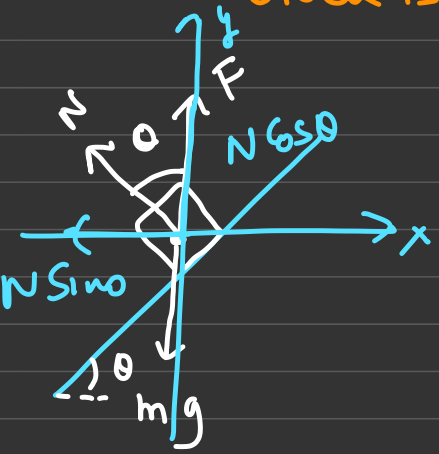
$F = \frac{mg}{\cos\theta} \times \sin\theta$

$F = mg \tan\theta$ Δ

θ)



find F for which block is equilibrium



① $\uparrow 0$ $F + N\cos\theta = mg$

② —

③ $\rightarrow 0$ $N\sin\theta = 0$

④

$N = 0$ { Simply NOT in contact }

$x \neq 0$ $y = 0$

$x \times y = 0$

$F = mg$

Tension :

Contact / pull

"A tight String always produces Tension in the string"

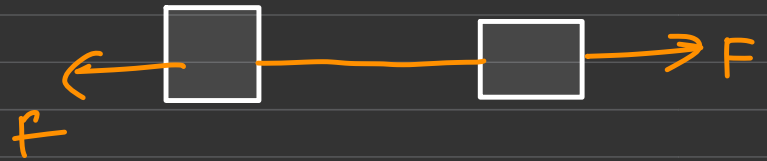
"if string is massless then Tension in string must be same"

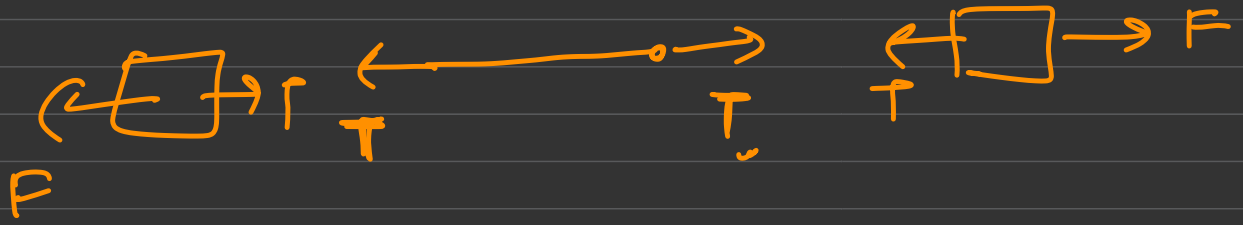
"if Nothing is given in the Question regarding then assume massless

By default, String length does not change

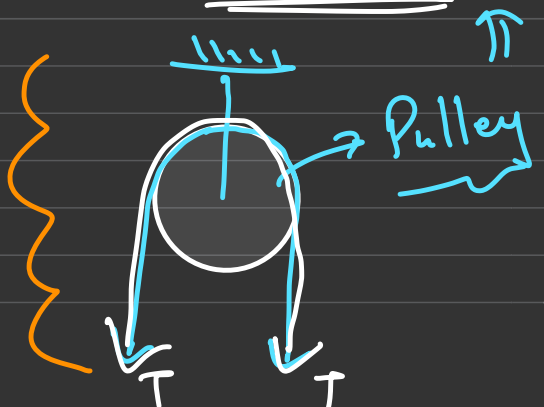
0)

⇓ inextensible





Pulley : " is a machine "

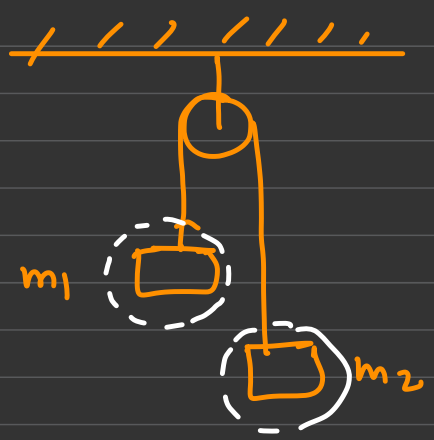


1. # By defaut : we assume massless and frictionless

2 # if a string is = Passing over pully

< then we have assume tension at both ends same

Q)



find relation between m_1 and m_2 for system is in equilibrium

(1) FBD m_1 m_2

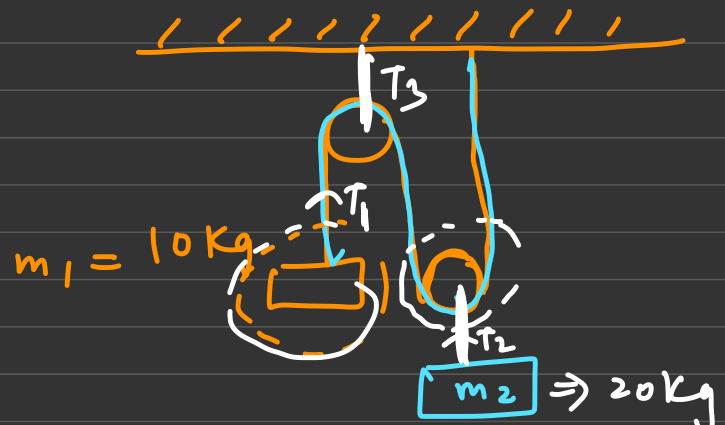
② , ③

④ $T_1 = m_1 g$ —①

$T_1 = m_2 g$ —②

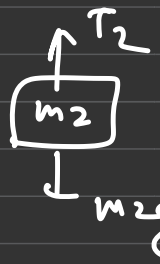
$m_1 = m_2$

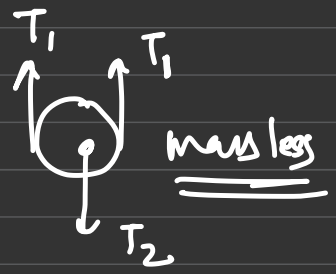
find m_2 for which m_1 and m_2 is in equilibrium?



① FBD

FBD:





$2T_1 = T_2$

②, ③ ✗

④ $T_1 = m_1 g$

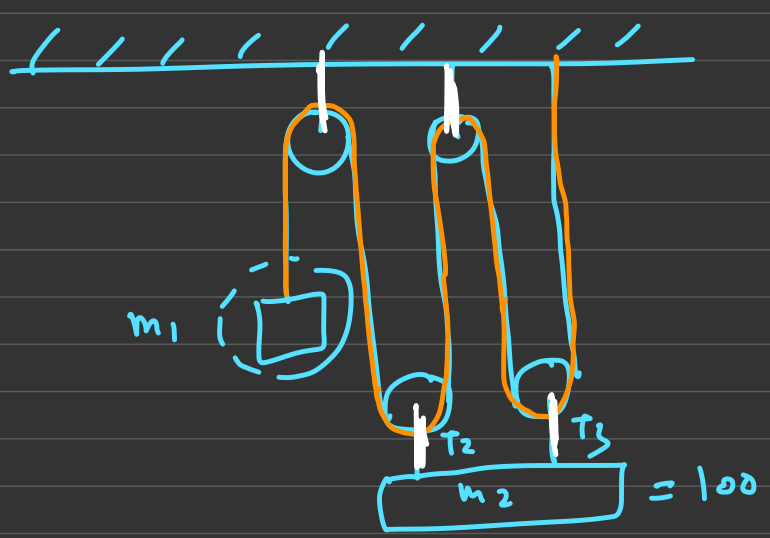
$T_2 = m_2 g$

$$2(m_1 g) = m_2 g$$

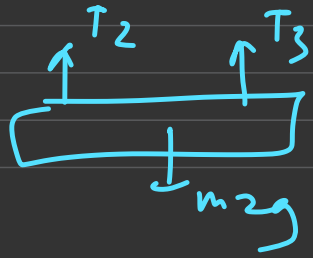
$$2m_1 = m_2$$

$$m_2 = 2 \times 10$$

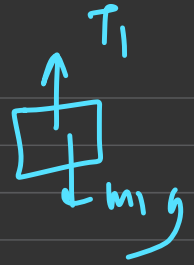
#



find m_1 for which m_1, m_2 is equilibrium



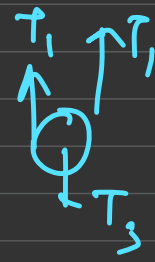
(1)



$T_1 = m_1 g$

$2T_1 = T_2$

$T_2 + T_3 = m_2 g$



$2T_1 = T_3$

$4(m_1 g) = m_2 g$

$4T_1 = m_2 g$

$m_1 = \frac{m_2}{4} = \frac{100\,kg}{4} = 25\,kg$

Section#7 "Faction" { W.B# PTS #2 Level 1 / Level 2 }

Pre-class work

{ module - till section 6 Hour