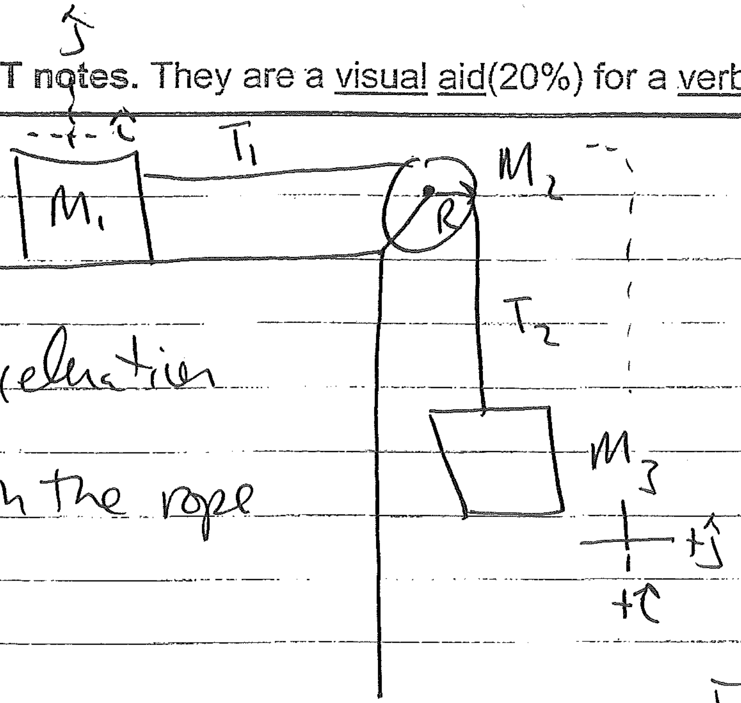
EX.



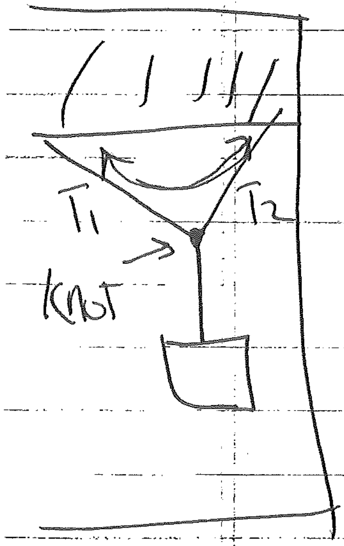
Find the acceleration of system.
Tensions in the rope

Pulley: $M_2 = 2$ kg
$R = 0.05$ meters

$M_1 = 5$ kg
$M_3 = 20$ kg

"Starts from rest"

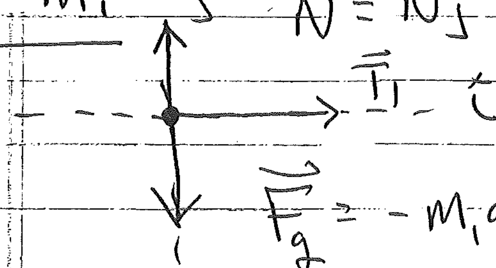
[No friction on table.
Massless rope.



Recall Process

- Choose a mass to which you wish to apply 2nd
  - Show mass as a pt. Choose a coord. System.
  - Identify forces & write as vectors
  - Apply 2nd Law $\sum \vec{F} = m\vec{a}$
  - Algebrate
- Repeat as needed

for m_1



$\vec{N} = N\hat{j}$

$\vec{T_1} = T_1\hat{i}$

$\vec{F_g} = -m_1 g\hat{j}$

2^{nd} $\sum \vec{F} = m_1\vec{a}$

$\boxed{\hat{i}}$ $\sum F_x = m_1 a_x$

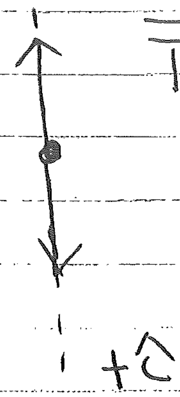
$\boxed{1}$ $\boxed{T_1 = m_1 a_x}$

$\boxed{\hat{j}}$ $\sum F_y = m_1 \cancel{a_y} \rightarrow 0$

$N - m_1 g = 0$

$\underline{N = m_1 g}$

for m_3



$\vec{T_2} = -T_2\hat{i}$

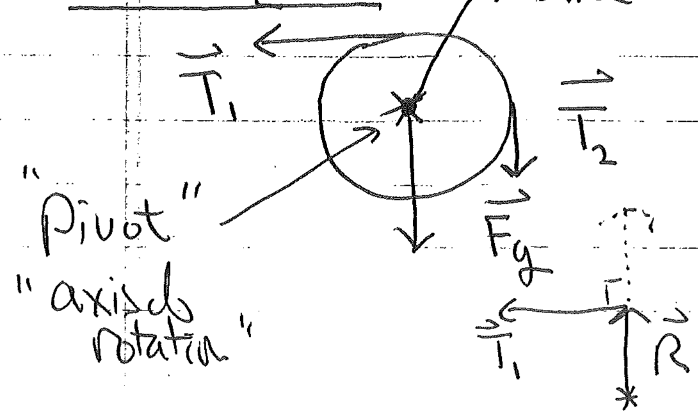
$\vec{F_g} = m_3 g\hat{i}$

2^{nd}

$\boxed{\hat{i}}$ $\sum F_x = m_3 a_x$

$\boxed{2}$ $\boxed{-T_2 + m_3 g = m_3 a_x}$

for M_2



Write a Torque for every force.

$\vec{\tau}_{\vec{F_g}} = \vec{r} \times \vec{F_g} = \cancel{|\vec{r}||\vec{F_g}|\sin\theta} \rightarrow 0$

$\vec{\tau}_{F_{Axle}} = 0$ ☺

$\vec{\tau}_{\vec{T_1}} = \vec{R} \times \vec{T_1} = RT_1\sin(90)$

$\boxed{\text{OUT}}$

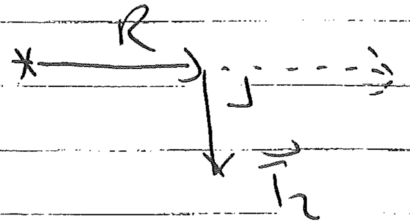
$\boxed{\text{CounterClockwise}}$

(CCW)

$$\vec{\tau}_{T_2} = \vec{R} \times \vec{T}_2 = R T_2 \sin(90)$$

$\boxed{\text{IN}}$

$\boxed{\text{Clockwise}}$ (cw) " + " !!!



2^{nd} law $\quad \sum \vec{\tau} = I \vec{\alpha}$

$\boxed{3}$ $\boxed{+RT_2 - RT_1 = I\alpha}$

$\boxed{2}$ $\boxed{-T_2 + m_3 g = m_3 a_x}$

$\boxed{1}$ $\boxed{T_1 = m_1 a_x}$

TABLE 9.2 $\quad I = \dfrac{M_2 R^2}{2}$ $\quad \Big\|$ "cross talk"

$$a_x = R\alpha$$

$$\therefore \alpha = \frac{a_x}{R}$$

$$\therefore \boxed{3} \Rightarrow RT_2 - RT_1 = \frac{M_2 R^2}{2} \frac{a_x}{R}$$

$$RT_2 - RT_1 = \frac{M_2 R a_x}{2}$$

☺ ★ $T_2 - T_1 = M_2 a_x / 2$

Use $\boxed{2}$ and $\boxed{1}$ in ☆ to get:

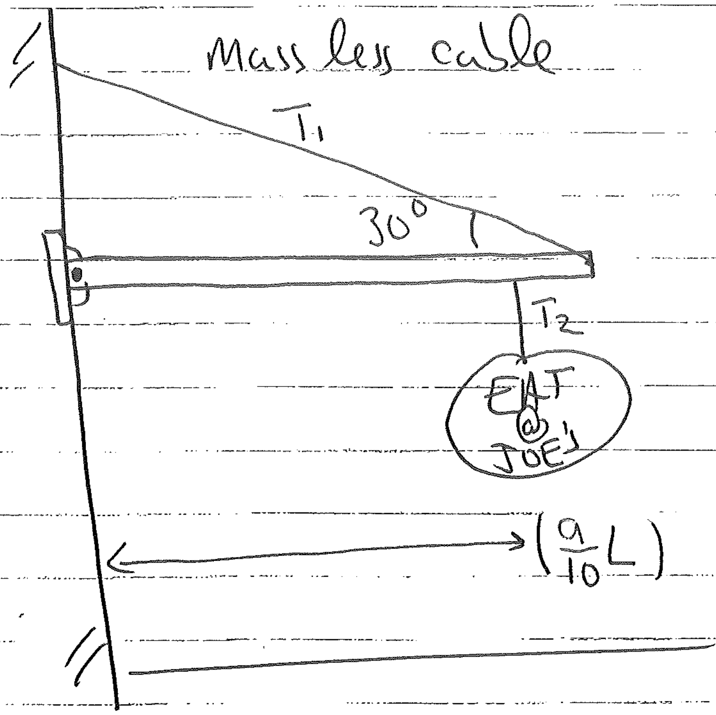
$$m_3 g - m_3 a_x - m_1 a_x = \frac{m_2 a_x}{2}$$

$$m_3 g = a_x\left(\frac{m_2}{2} + m_3 + m_1\right)$$

$$\underline{7.54\ m/s^2} = \frac{m_3 g}{\left(\frac{m_2}{2} + m_3 + m_1\right)} = a_x$$

STATIC EQUIL

EX.



Find tension in the cable.
Find force the bracket exerts on rod.

length 'L' uniform mass 'm'

Let 'M' be mass of sign.

for Sign

$+\hat{j}$

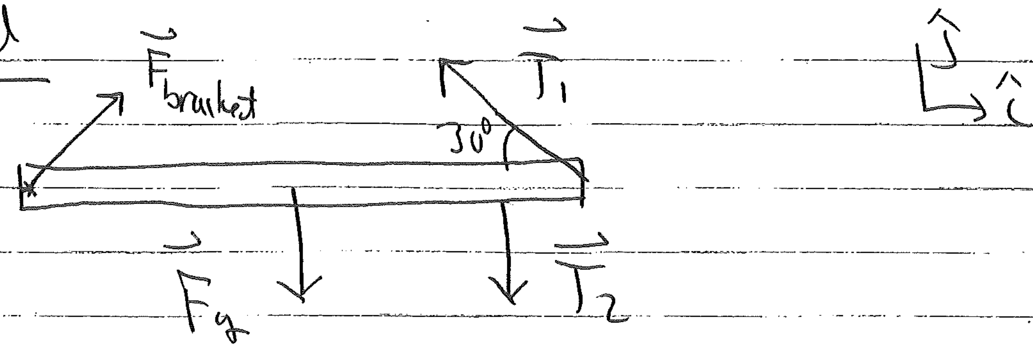
$$\vec{T}_2 = T_2\hat{j}$$

$$\vec{F}_g = -Mg\hat{j}$$

2nd $\boxed{\hat{j}}$ $\sum F_y = 0$

$$\therefore\ T_2 = Mg$$

for rod



$\vec{T}_2 = -\underline{M}g\,\hat{j}$

$\vec{F}_g = -mg\,\hat{j}$

$\vec{F}_{bracket} = F_x\,\hat{i} + F_y\,\hat{j}$

$\vec{T}_1 = -T_1\cos(30)\,\hat{i} + T_1\sin(30)\,\hat{j}$

2nd $\quad \sum\vec{F} = \cancel{m\vec{a}} \to 0$

$(\hat{i})$ $\quad \sum F_x = 0$

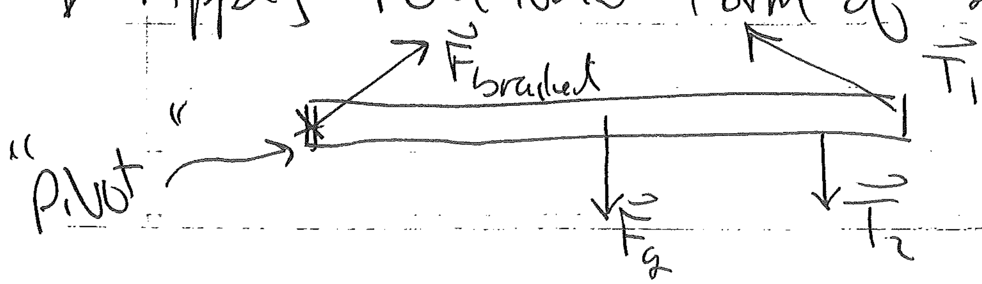
$\boxed{F_x - T_1\cos(30) = 0}$ $\boxed{1}$

$(\hat{j})$ $\quad \sum F_y = 0$

$\boxed{-\underline{M}g - mg + F_y + T_1\sin(30) = 0}$ $\boxed{2}$

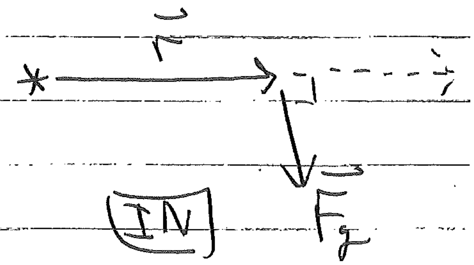
Hmmm.... $\sum\vec{\tau}_c = \cancel{I\vec{\alpha}} \to 0$

Apply rotational form of 2nd Law



$$\vec{\tau}_{\vec{F}_{bracket}} = \underline{\underline{0}}$$

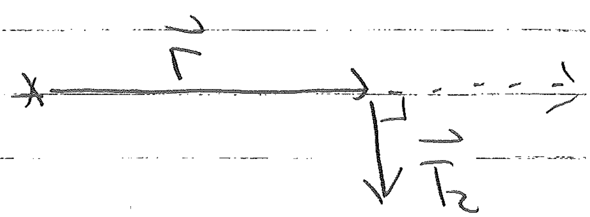
$$\vec{\tau}_{\vec{F}_g} = \vec{r} \times \vec{F}_g = \left(\frac{L}{2}\right)(mg)\sin(90)$$

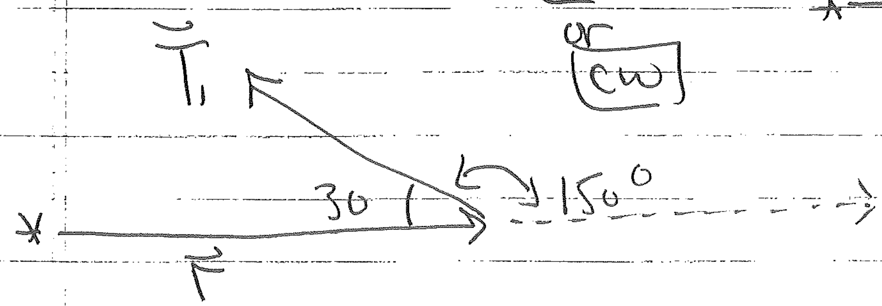


$\boxed{IN}$ or $\boxed{CW}$

$$\vec{\tau}_{\vec{T}_2} = \vec{r} \times \vec{T}_2 = \left(\frac{9L}{10}\right)(Mg)\sin(90)$$

$\boxed{IN}$ or $\boxed{CW}$





$$\vec{\tau}_{\vec{T}_1} = \vec{r} \times \vec{T}_1 = (L)(T_1)\sin(150)$$

$\boxed{OUT}$ $\boxed{CCW}$

τ_{net}: $\sum \vec{\tau} = \cancel{I\alpha} \to 0$