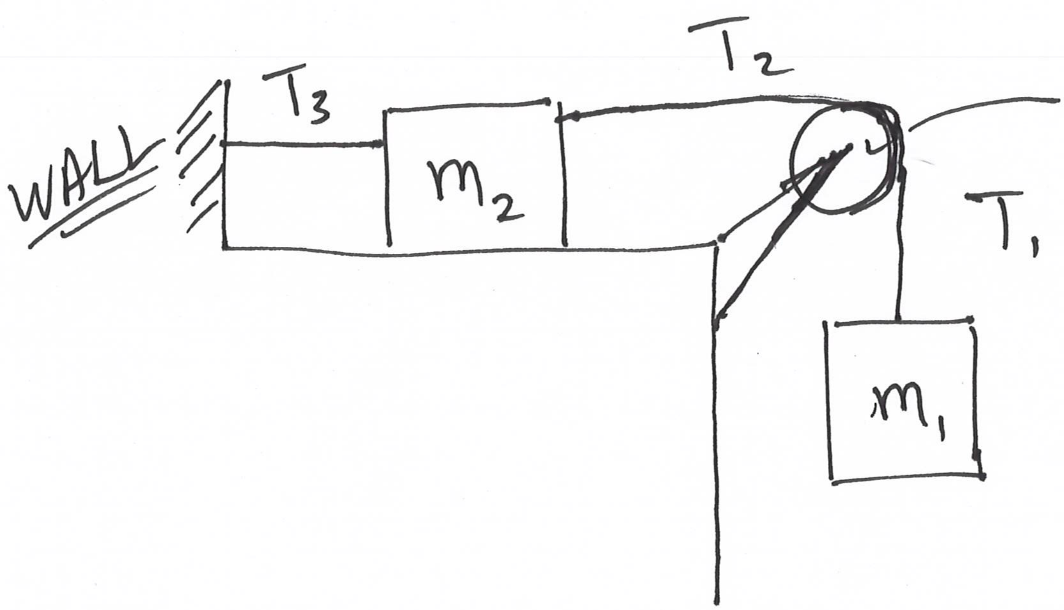
Question # 5 :

$m_1 = 2.00$ kg

$m_2 = 10.0$ kg.



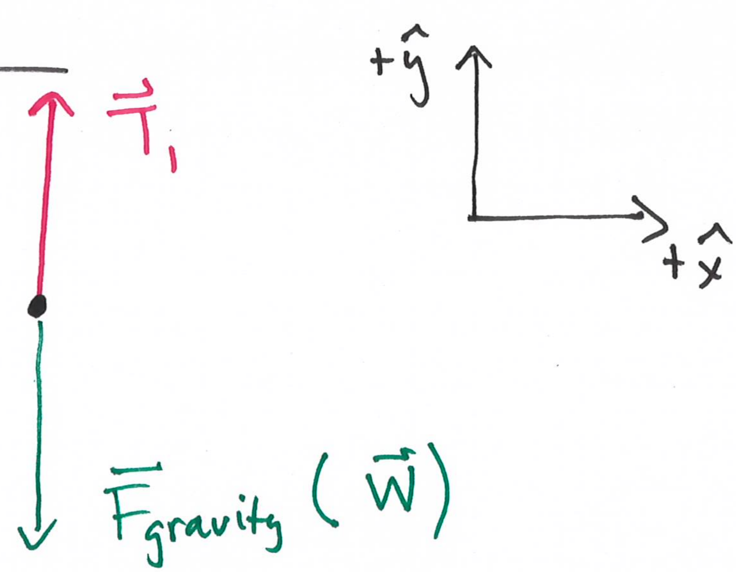
Part a) Solve for T_1

- system doesn't move ⇒ connected to the wall.

  $\vec{v} = 0$ AND $\vec{a} = 0$

- gravity

FBD for mass #1 :



$$\vec{T}_1 = \underbrace{T_1}_{\text{magnitude}} \underbrace{(+\hat{y})}_{\text{direction}}$$

$$\vec{F}_{gravity} = m_1 g \, (-\hat{y})$$

$$= -m_1 g \, (\hat{y})$$

Newton's 2^{nd} law:

$$m_1 \vec{a}_1 = \vec{T}_1 + \vec{F}_{gravity}$$

look at $\hat{y}$:

$$m_1 \cancel{a_{1y}}^{\,0} = T_1 + (-m_1 g)$$

$$0 = T_1 - m_1 g$$

$$T_1 = m_1 g = (2.00\ \text{kg})(9.8\ \text{m/s}^2)$$

$$\boxed{T_1 = 19.6\ \text{N}}$$

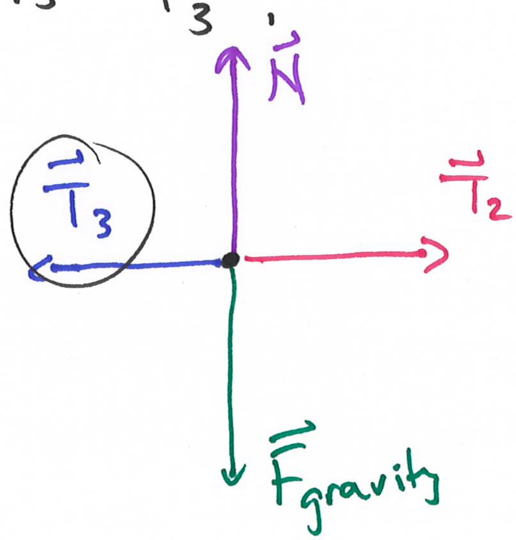
b) What is T_2?

- We were told that the pulley is frictionless.
  - $\Rightarrow$ don't lose any force to friction.
- pulley is stationary. (massless)

$$\Rightarrow \boxed{T_2 = T_1 = 19.6 \text{ N}}$$

c) What is T_3?

FBD for mass #2 :



Newton's 2nd Law:

$$m_2 \vec{a}_2 = \vec{T}_2 + \vec{T}_3 + \vec{N} + \vec{F}_{gravity}$$

$\hat{x}$: $m_2 \cancel{a_{2x}}^{\,0} = T_2 + (-T_3)$

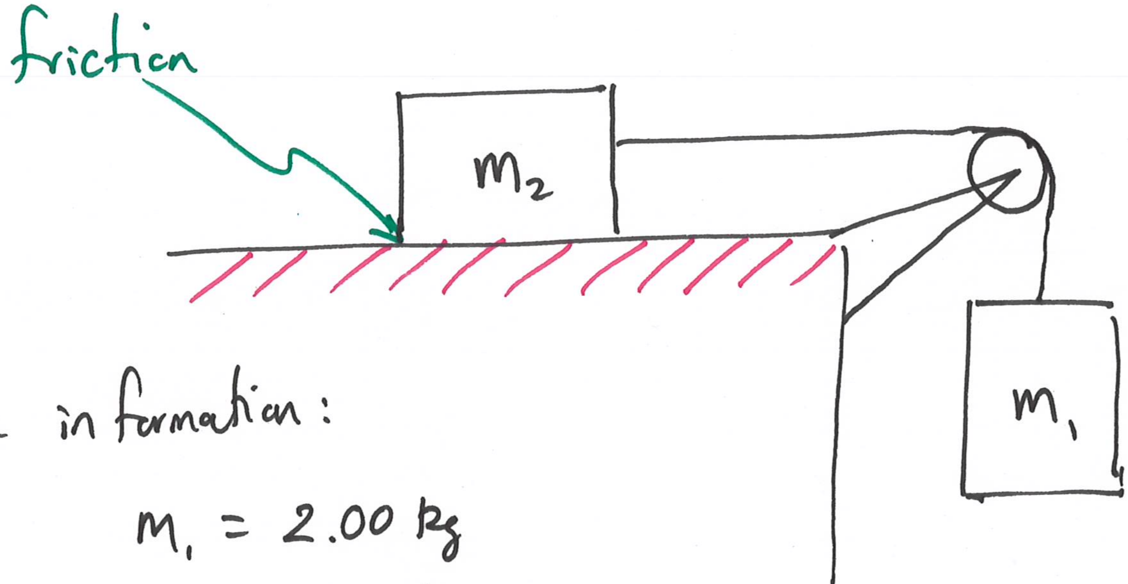
$$\vec{T}_2 = T_2\,(+\hat{x})$$

$$\vec{T}_3 = T_3\,(-\hat{x}) = -T_3\,(\hat{x})$$

$$0 = T_2 - T_3$$

$$\boxed{T_3 = T_2 = 19.6\ \text{N}}$$

Question #6 :



Given information :

$m_1 = 2.00 \text{ kg}$

$m_2 = 10.0 \text{ kg}$

$\mu_s = 0.60$

$\mu_k = 0.25$

System is initially at rest.

Question : What is the accelration of the system? Does it start moving?

Answer: It depends on whether we have static or kinetic friction.

Which one is it?

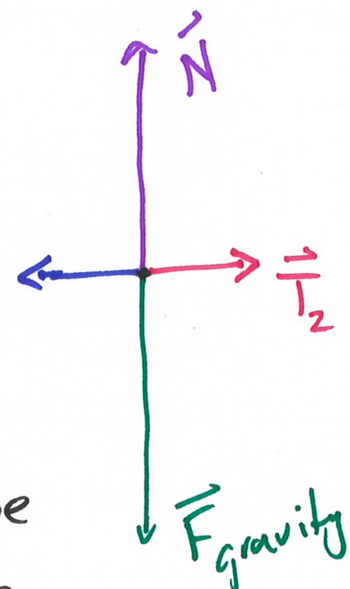
We don't know, initially. We need to consider both.

Let's start by assuming that the system is stationary so that static friction is acting.

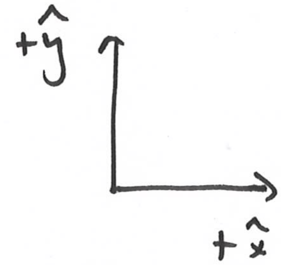
What do we know about static friction?

- It has a maximum value of $\mu_s N$
- It's direction will be whatever is needed to maintain equilibrium.

Consider the forces on mass #2 :



Note that the static friction force must be in this direction in order to balance the tension force to maintain equilibrium.



What is the magnitude of $\vec{T}_2$?

$\Rightarrow$ We found this in the previous problem!

$T_2 = 19.6\ N$

(because both systems are not accelerating)

Let's do the force analysis.

$$m_2\vec{a}_2 = \vec{F}_{gravity} + \vec{N} + \vec{T}_2 + \vec{F}_f$$

$$\vec{F}_{gravity} = mg\,(-\hat{y}) = -mg\,(\hat{y})$$

$$\vec{N} = N\,(+\hat{y})$$

$$\vec{T}_2 = T_2\,(+\hat{x})$$

$$\vec{F}_f = F_f\,(-\hat{x}) = -F_f\,(+\hat{x})$$

Note: this vale is not necessarily $\mu_s N$, which is the maximum possible value.

Component analysis

$$\hat{y}:\quad m_2 \cancel{a_{2y}} = N + (-m_2 g)$$

$$0 = N - m_2 g \quad \Rightarrow \quad \boxed{N = m_2 g}$$

$$\hat{x}:\quad m_2 \cancel{a_{2x}} = T_2 + (-F_f)$$

$$0 = T_2 - F_f \quad \Rightarrow \quad \boxed{F_f = T_2 = 19.6\ N}$$

Now, compare F_f to $\mu_s N = \mu_s m_2 g = (0.6)(10.0\ kg)(9.8\ m/s^2)$
$= \underline{58.8\ N}$

$F_f < F_{f,max}$ so the system is stable and $\boxed{a = 0\ m/s^2}$
$(19.6 < 58.8)$