Connected Masses

Strategies to solve problems

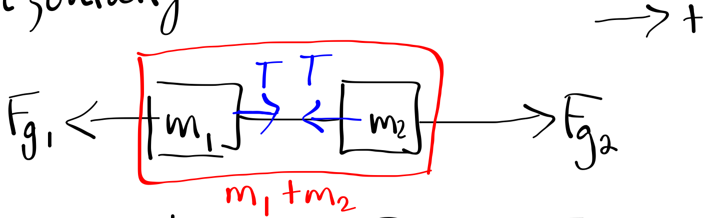
(A) Draw a FBD for each mass.

Assign + to the direction each mass moves

Set up $F_{net} = ma$

Usually you end up solving for a and T

(B) "Stretch" out the masses so the system lies horizontally



Tug-o-war between F_{g2} and F_{g1}

$F_{net} = F_{g2} - F_{g1}$

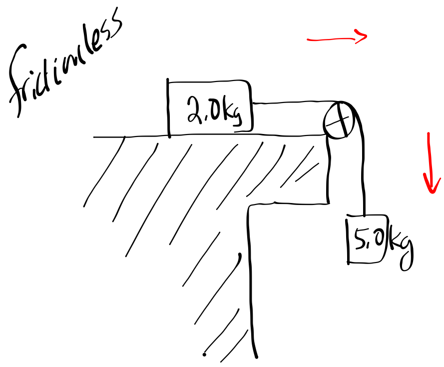
↑ this F_{net} acts on $m_1 + m_2$

find acceleration

Draw a FBD for either m_1 or m_2 in order to find the tension

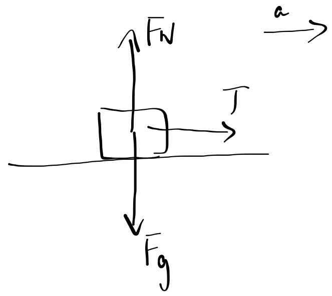
NOTE: Max acceleration is 9.81 m/s^2

Example (FOP/159)



What is the acceleration and the tension in the string?

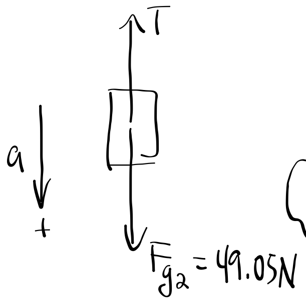
Consider the 2.0kg mass:



$\vec{F}_{net} = m\vec{a}$

$T = (2.0kg)a$

Consider the 5.0kg mass:



$\vec{F}_{net} = m\vec{a}$

$F_{g_2} - T = m_2 a$

$49.05N - T = (5.0kg)a$

$49.05 - 2.0a = 5.0a$

$49.05 = 7.0a$

$a = 7.0\,m/s^2$

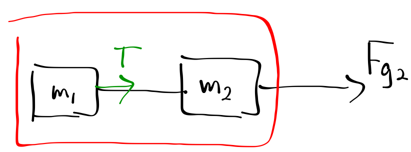
Sub $a = 7.0\,m/s^2$ into:

$T = (2.0kg)a$

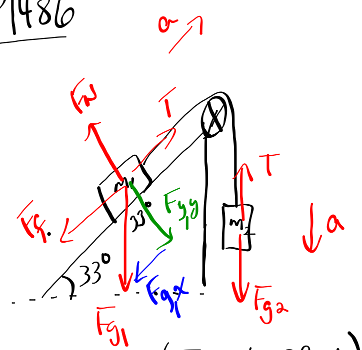
$T = (2.0kg)(7.0\,m/s^2)$

$T = 14\,N$

OR the other way



MP|486



$m_1 = 615\,g$ $(F_{g1} = 6.033\,N)$

$m_2 = 525\,g$ $(F_{g2} = 5.150\,N)$

$\mu_k = 0.19$

Find acc + tension

The biggest value that T can be is F_{g2} (5.150 N) if the block m_1 goes uphill and m_2 goes down.

So we need to see if (F_{g2}) $T_{max} > F_f + F_{g1x}$. If it is, then m_1 will go uphill and m_2 will go straight down.

$T_{max} = F_{g2} = 5.150\,N$

$F_{gx} = F_{g1}\sin\theta = (6.033\,N)\sin 33° = 3.286\,N$

$F_f = \mu F_N = \mu F_{gy} = \mu F_g \cos\theta = (0.19)(6.033\,N)\cos 33$

$= 0.961\,N$

4.247 N

Since the maximum tension $(= F_{g2})$ is greater than $F_{gx} + F_f$, then m_1 will go uphill and m_2 will go down.

Consider m_1 only

$\vec{F}_{net} = m\vec{a}$

$T - (F_{gx} + F_f) = m_1 a$

$T - 4.247\,N = (0.615\,kg)a$

Consider m_2 only

$\vec{F}_{net} = m\vec{a}$

$F_{g2} - T = m_2 a$

$5.150\,N - T = (0.525\,kg)a$

finish → find a and T

TO DO

1. PP|478 (elevator)
2. PP|485 (Atwood's) ← HW probs
3. PP|488-489 (horizontal + inclines)