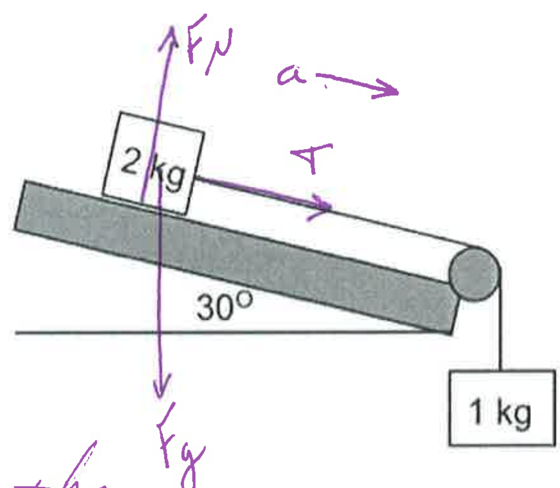
Big Exam #5, *Pito*

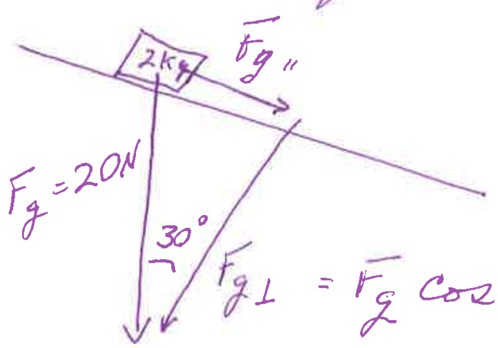
#1 The system at right is started from rest. The coefficient of friction is 0.3. The strings and pulleys are massless and frictionless. I let the system go from rest. $V_0 = 0$

a) Find the force of friction on the 2 kg mass.

b) Find the tension in the string…. Will you need to find something else along the way?



a) This is a dynamics Problem because $F_f = \mu F_N$ so I need the normal Force. $\Sigma \vec{F} = m\vec{a}$, so $\Sigma F_\perp = ma_\perp = 0$ we are in equilibrium in the $\perp$ direction



so $F_N + F_{g\perp} = 0$ $\quad F_N \approx 17.4N$

$F_f = \mu F_N \approx .3 \times 17.4N$

$= 5.22N \approx 5.2N$

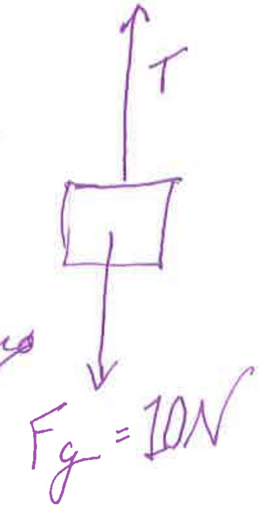
$F_{g\perp} = F_g \cos 30 \approx 17.4N$

b) To find Tension, I see this is a dynamics Problem because T is a force acting between each block. I choose to look at the 1 kg Block

$\Sigma F_y = ma_y = ?$ $\quad T - F_g = ma$; $T = ma + F_g$

so if the system is at equilibrium, $T = F_g$.

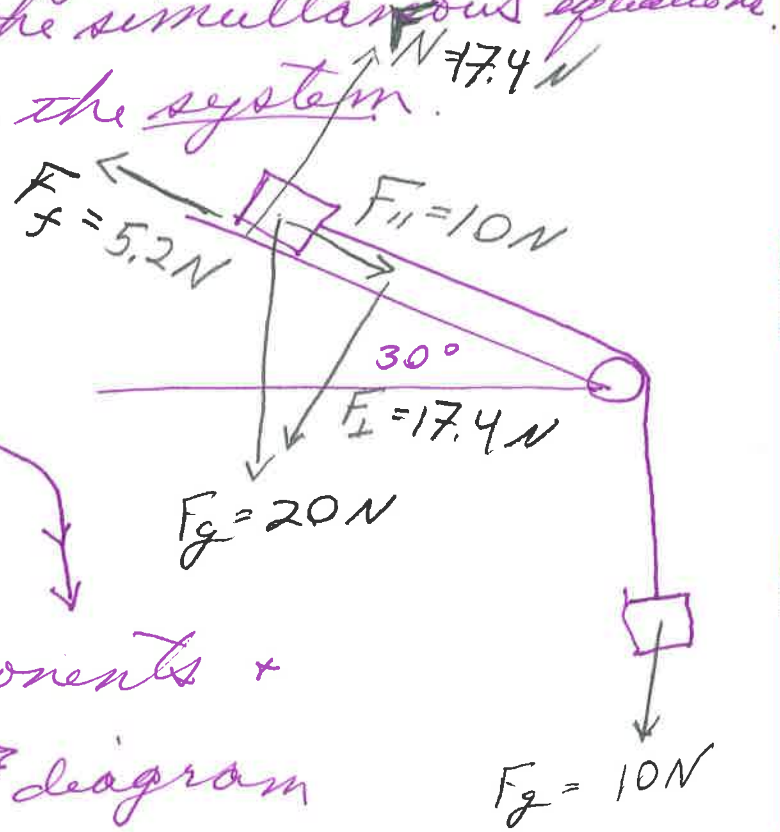
This could happen if F_f is really big, but I think the system is accelerating downward, so $\underline{T < 10N}$.



$\Rightarrow$ I must find acceleration.

I can find $\vec{a}$ 3 ways:

1) using conservation of energy $\rightarrow V_f \rightarrow V_a \rightarrow \Delta t \rightarrow a$
2) using dynamics using $\Sigma \vec{F} = m\vec{a}$ for each mass and solving the simultaneous equations.
3) using dynamics on the system.



$\Sigma F_s = M_s a_s$

I choose #3

Dynamics. The system is accelerating in this direction

So I take all the // components + I don't really need a $\Sigma \vec{F}$ diagram to see F_f & the other forces.

$\Sigma F_s = M_s a_s$

$\ominus F_f + F_{\parallel (2kg)} + F_{g(1kg)} = (2kg + 1kg)\, a_s$

$-5.2N + 10N + 10N = 3kg\, a_s$

$14.8N = 3kg\, a_s$

$a_s \approx 4.9 \, m/s^2$ so ΣF on the 10kg mass $= ma$ $= 4.9N \Downarrow$

So Tension must be 5.1N upward.