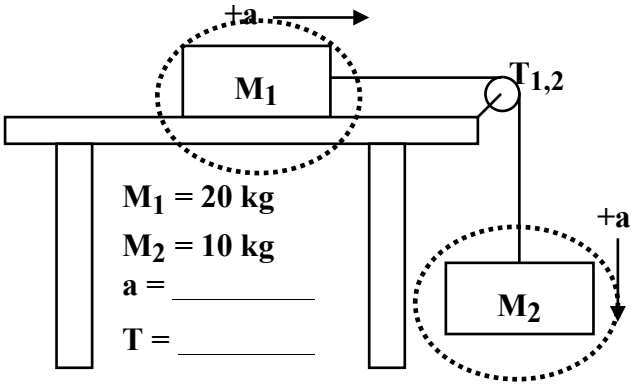
Single Body Analysis Worksheet Help

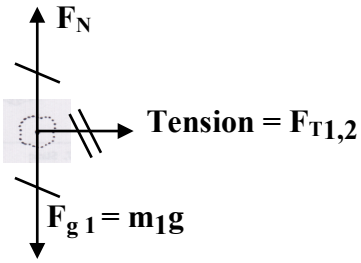
Use $F_{T1,2}$ for the force between box 1 and box 2 instead of $F_{rope,\ box}$ or $F_{box1,\ box2}$.

Step 1 – Circle system for each object.
Step 2 – Define direction of acceleration for each box. Notice how it changes when it hits the pulley.



M_1 = 20 kg
M_2 = 10 kg
a = _____
T = _____

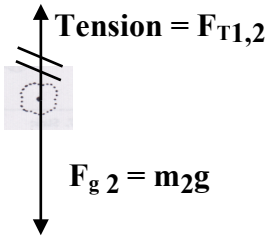
Step 3 - Force diagram for mass 1



Step 4 - Force equation for box 1 in acceleration direction

$\Sigma F_X = m_1 a_X$ $\quad$ **$F_{T1,2} = m_1 a$**

Step 5 - Force diagram for mass 2



Step 6 - Force equation for box 2

$\Sigma F_y = m_2 a_y$ $\quad$ **$m_2 g - F_{T1,2} = m_2 a$**

Step 7 - Combine both force equations so you can find the acceleration of the system.

Rewrite Force equations from above.

$F_{T1,2} = m_1 a$
$+ m_2 g - F_{T1,2} = m_2 a$

$m_2 g = m_1 a + m_2 a$	**Pull out the acceleration**
$m_2 g = (m_1 + m_2) a$	**Divide both sides by $(m_1 + m_2)$**
$m_2 g / (m_1 + m_2) = a$	**Now plug the numbers in for the masses and g.**

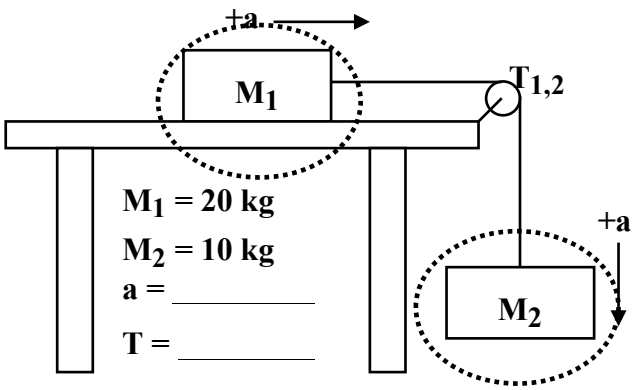
Step 8 – Plug thy numbers in to find acceleration.

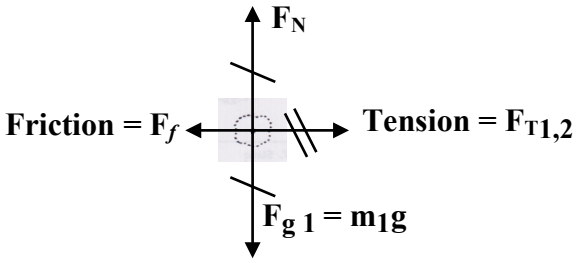
$m_2 g / (m_1 + m_2) = a$ $\qquad$ **$a = (10\ kg * 10\ m/s^2) / (20\ kg + 10\ kg)$** $\qquad$ **$a = 3.33\ m/s^2$**

Step 9 - Now plug the value you found for acceleration into one of the F = ma equations and solve for $F_{T1,2}$.

$F_{T1,2} = m_1 a$ $\qquad$ **$F_{T1,2} = 20\ kg * 3.33\ m/s^2$** $\qquad$ **$F_{T1,2} = 66.6\ N$**

2. Friction is present. (μ = **0.15**)





Force equation for box 1 in Y-direction

$\Sigma F_y = m_1 a_y$ 0

$F_N - F_g = m_1 a_y$

$F_{N\,1\perp} = m_1 g$

Friction equation

$F_f = \mu * F_{N\,1}$

μ = coefficient of friction (how rough a surface is)

SO if Normal Force equals Weight then

$F_f = \mu * m_1 g$

Force equation for box 1 in Acceleration direction

$\Sigma F_1 = m_1 a$ $\quad F_{T1,2} - F_f = m_1 a$

Substitute what friction is equal to in to the ΣF=ma equation.

$F_{T1,2} - \mu * m_1 g = m_1 a$

Now repeat steps 5 thru 9 from the front of the page.