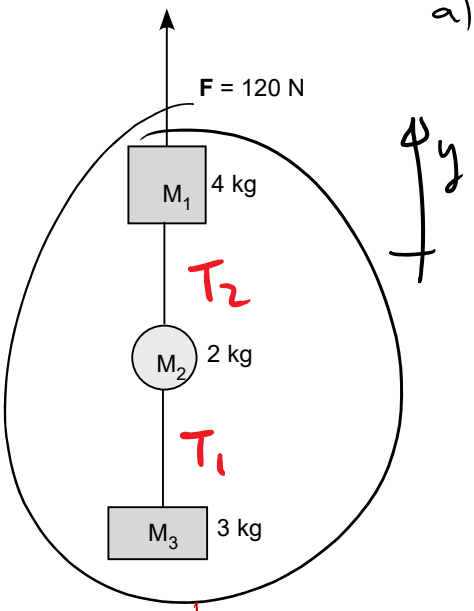
DO NOT TURN THIS PAGE!!!!!

Name: KEY

Physics 50
Fall 2014
Exam 3

MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL. NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN. EXPRESS ALL ANSWERS IN SI UNITS.

1. A force of magnitude 120 N is exerted on the 4 kg mass as shown below. (10 pts)
    a) Calculate the acceleration of the masses.
    b) Calculate the tension in each string.



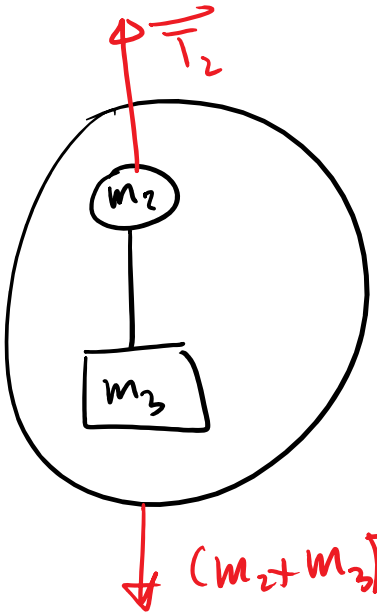
a) system $= m_1+m_2+m_3$

$\Sigma F_y = F-(m_1+m_2+m_3)g$

$=(m_1+m_2+m_3)a$

$120-9(9.8)=9a$

$a = 3.5 \frac{m}{s^2}$



$\Sigma F_y = T_2-(m_2+m_3)g=(m_2+m_3)a$

$T_2 = 66.5\ N$

b)

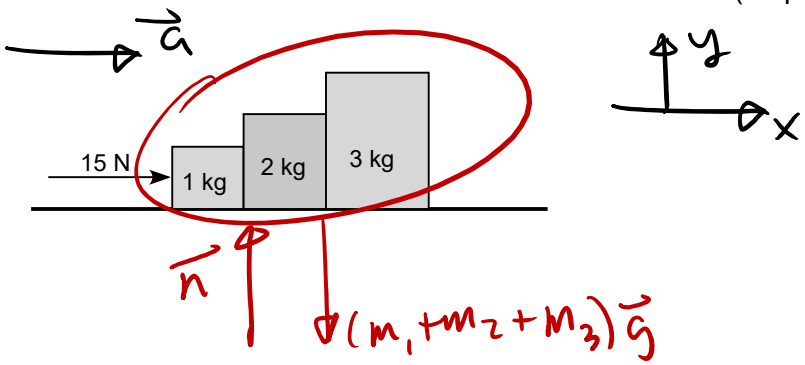
$\Sigma F_y = T_1 - m_3g = m_3a$

$T_1 = m_3g+m_3a$

$T_1 = 39.9\ N$

$(m_1+m_2+m_3)\vec{g}$

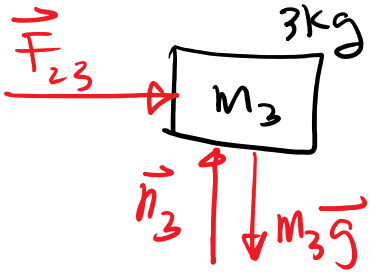
2. For the system shown below, calculate the force the 3-kg block exerts on the 2-kg block. Assume masses move on a frictionless surface. (10 pts)



system = $m_1+m_2+m_3$

$\Sigma F_x = 15N = (m_1+m_2+m_3)a$

$a = 2.5\ m/s^2$



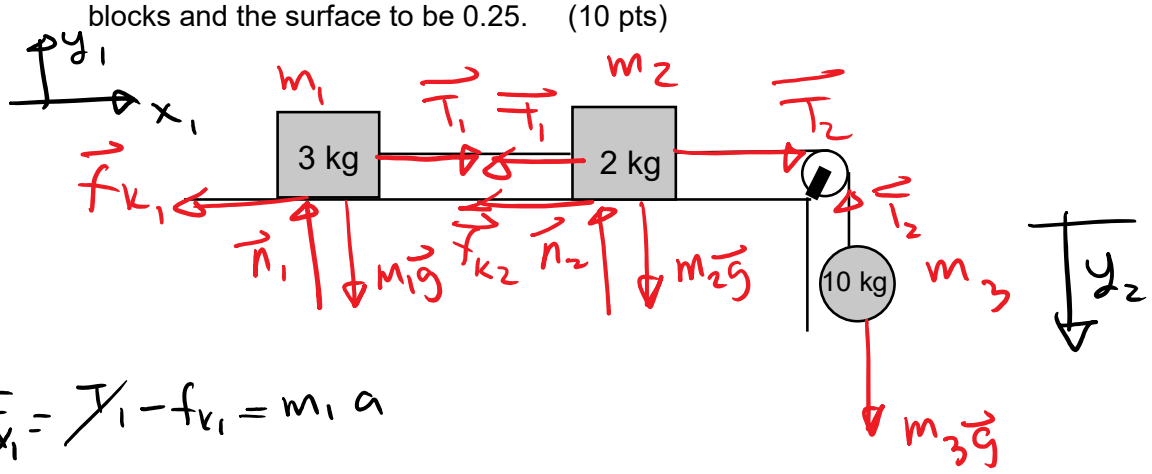
M_3

$\Sigma F_x = F_{23} = m_3 a$

$F_{23} = (3)(2.5) = 7.5N$

but $F_{32} = F_{23} = \boxed{7.5N}$

3. If the blocks are released from rest, find the tension in each rope and the acceleration of the blocks. Take the coefficient of kinetic friction between the blocks and the surface to be 0.25. (10 pts)



m_1: $\Sigma F_{x_1} = T_1 - f_{k_1} = m_1 a$

m_2: $\Sigma F_{x_1} = T_2 - T_1 - f_{k_2} = m_2 a$

m_3: $\Sigma F_{y_2} = m_3 g - T_2 = m_3 a$ +

$m_3 g - f_{k_1} - f_{k_2} = (m_1 + m_2 + m_3) a$

$m_3 g - \mu_k n_1 - \mu_k n_2 = (m_1 + m_2 + m_3) a$

$m_3 g - \mu_k m_1 g - \mu_k m_2 g = (m_1 + m_2 + m_3) a$

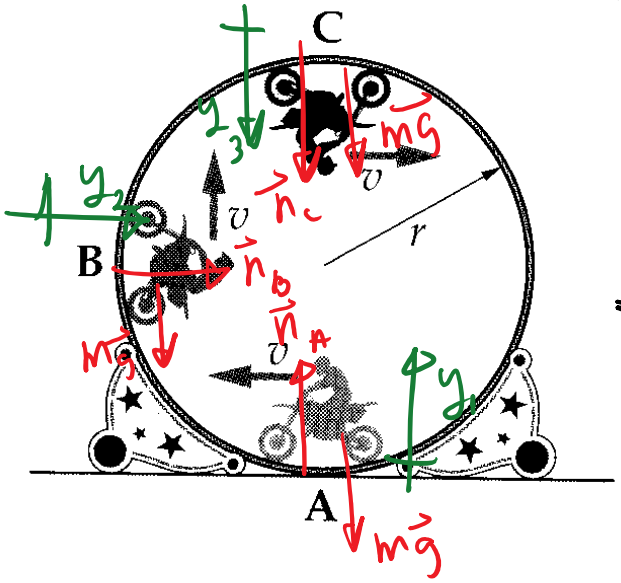
$m_3 = 10\ kg$
$m_2 = 2\ kg$
$m_1 = 3\ kg$
$\mu_k = 0.25$

$$a = \frac{m_3 g - \mu_k g (m_1 + m_2)}{m_1 + m_2 + m_3} = 5.7\ \frac{m}{s^2}$$

$T_1 = 24.5\ N$

$T_2 = 41\ N$

4. The motorcyclist is moving at a constant speed of 28.5 m/s in a track as shown below. (10 pts)
   a) Calculate the normal force exerted on the motorcycle at point A, B, and C if r = 8 m and the combined mass of the motorcycle and person is 150 kg.
   b) Calculate the minimum speed the motorcycle should have at the top of the track in order to make a complete loop.



a)

$$\Sigma F_{y_1} = n_A - mg = m\frac{v^2}{R}$$

$$\Sigma F_{y_2} = n_B = m\frac{v^2}{R}$$

$$\Sigma F_{y_3} = n_c + mg = m\frac{v^2}{R}$$

b) set $n_c = 0$

$$0 + mg = m\frac{v_{min}^2}{R}$$

$$v_{min} = \sqrt{Rg}$$