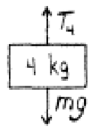
1.

a. $\Sigma F_{external} = m_{total}a$; $m_4g - m_1g - m_2g = (m_4 + m_2 + m_1)a$ gives $a = 1.4$ m/s^2

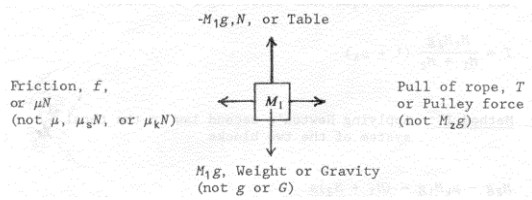
b. For the 4 kg block:
$\Sigma F = ma$
$mg - T_4 = ma$ gives
$T_4 = 33.6$ N



c. Similarly for the 1 kg block: $T_1 - mg = ma$ gives $T_1 = 11.2$ N

2.

a.

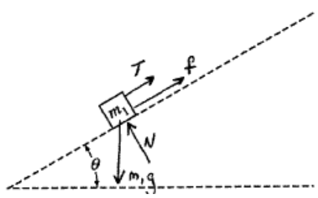


b. $\Sigma F_{ext} = m_{tot}a$; Where the maximum force of static friction on mass M_1 is $\mu_s N$ and $N = M_1g$; $M2g - \mu_s M_1 g = 0$ gives $\mu_s = M_2/M_1$

c/d. $\Sigma F_{ext} = m_{tot}a$ where we now have kinetic friction acting gives $M_2g - \mu_k M_1 g = (M_1 + M_2)a$
so $a = (M_2g - \mu_k M_1 g)/(M_1 + M_2)$
$\Sigma F = ma$ for the hanging block gives $M_2g - T = M_2a$ and substituting a from above gives $T = \frac{M_1 M_2 g}{M_1 + M_2}(1 + \mu_k)$

3.

a.



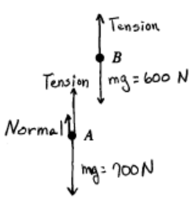
b. $f = \mu N$ where $N = m_1 g \cos\theta$ gives $\mu = \frac{f}{m_1 g \cos\theta}$

c. constant velocity means $\Sigma F = 0$ where $\Sigma F_{external} = m_1 g \sin\theta + m_2 g \sin\theta - f - 2f - Mg = 0$
solving for M gives $M = (m_1 + m_2)\sin\theta - (3f)/g$

d. Applying Newton's second law to block 1 gives $\Sigma F = m_1 g \sin\theta - f = m_1 a$ which gives $a = g\sin\theta - f/m_1$

4.

a.



b. The tension in the rope is equal to the weight of student B: $T = m_B g = 600$ N
$\Sigma F_A = T + N - m_A g = 0$ gives $N = 100$ N

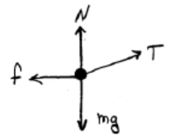
c. For the climbing student $\Sigma F = ma$; $T - m_B g = m_B a$ gives $T = 615$ N

d. For student A to be pulled off the floor, the tension must exceed the weight of the student, 700 N. No, the student is not pulled off the floor.

e. Applying Newton's second law to student B with a tension of 700 N gives $\Sigma F = T - m_B g = m_B a$ and solving gives $a = 1.67$ m/s^2

5.

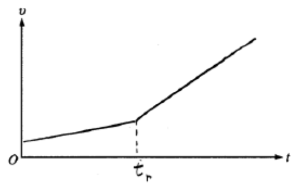
a.



b. $\Sigma F_y = 0$; $N + T \sin\theta - mg = 0$ gives $N = mg - T \sin\theta = 177$ N

c. $f = \mu N = 38.9$ N and $\Sigma F_x = ma$; $T \cos\theta - f = ma$ yields $a = 0.64$ m/s^2

d.



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6.

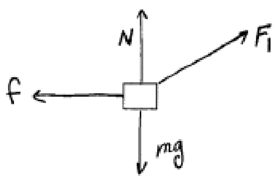
a. Combining the person and the platform into one object, held up by two sides of the rope we have $\Sigma F = ma$; $2T = (80 \text{ kg} + 20 \text{ kg})g$ giving $T = 500$ N

b. Similarly, $\Sigma F = ma$; $2T - 1000 \text{ N} = (100 \text{ kg})(2 \text{ m/s}^2)$ giving $T = 600$ N

c. For the person only: $\Sigma F = ma$; $N + 600 \text{ N} - mg = ma$ gives $N = 360$ N

7.

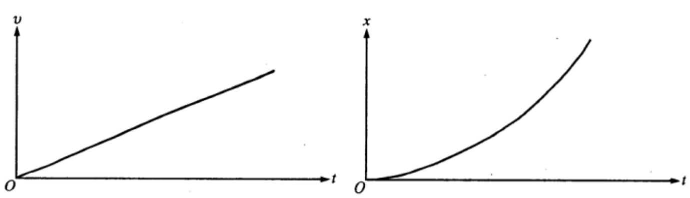
a.



b. $\Sigma F_y = 0$; $N + F_1 \sin\theta - mg = 0$ gives $N = mg - F_1 \sin\theta$

c. $\Sigma F_x = ma$; $F_1 \cos\theta - \mu N = ma_1$. Substituting N from above gives $\mu = (F_1 \cos\theta - ma_1)/(mg - F_1 \sin\theta)$

d.



e. The condition for the block losing contact is when the normal force goes to zero, which means friction is zero as well. $\Sigma F_x = F_{max} \cos\theta = ma_{max}$ and $\Sigma F_y = F_{max} \sin\theta - mg = 0$ giving $F_{max} = mg/(\sin\theta)$ and $a_{max} = (F_{max} \cos\theta)/m$ which results in $a_{max} = g \cot\theta$