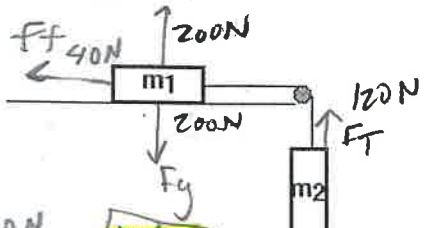
Key

Tension Practice Problems – Mass on Surface with Friction

1. A 20.0 kg weight that is on a ledge (m_1) is attached with a string, to another 20.0 kg weight that is hanging over the edge of the perfectly flat ledge (m_2). Assuming that the coefficient of friction is 0.200:



a. What is the acceleration?

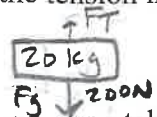
$F_F = \mu_K F_N$
$= (0.200)(200N) = 40N$

$\Sigma F = Ma \rightarrow a = \frac{\Sigma F}{M}$

$a = \frac{(200N - 40N)}{(20kg + 20kg)} = \frac{160N}{40kg} = 4\ m/s^2$

b. What is the tension in the string?

Tunnel Vision



$\Sigma F = Ma \rightarrow a = \frac{\Sigma F}{M}$ $\quad 4\ m/s^2 = \frac{200N - F_T}{20\ kg}$ $\quad F_T = 120N$

2. A 10.0 kg mass, m_1, on a table with a coefficient of friction of 0.40 is accelerated by a 5.0 kg mass, m_2, hanging over the edge of the table (refer to the diagram in #1).

a. What is the acceleration of the mass along the table?

$\Sigma F = Ma$ $\quad a = \frac{\Sigma F}{M} \rightarrow \frac{(50N - 40N)}{(10kg + 5kg)}$

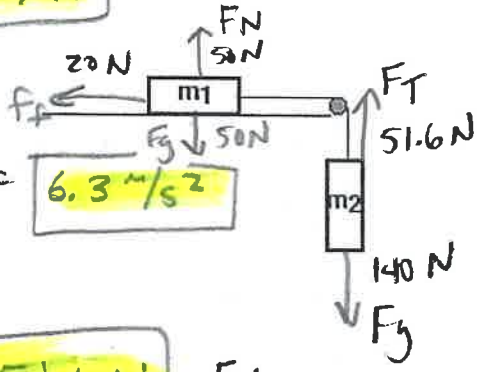
$F_F = \mu_K F_N \rightarrow (0.40)(100N) = 40N$

$a = 0.67\ m/s^2$

b. What is the tension in the string?

5 kg $\quad 0.67\ m/s^2 = \frac{50N - F_T}{5\ kg}$ $\quad F_T = 46.7\ N$

3. A 5.0 kg weight that is on a ledge (m_1) is attached with a string, to a 14 kg weight that is hanging over the edge of the perfectly flat ledge (m_2). Assuming that the coefficient of friction is 0.40:



a. What is the acceleration?

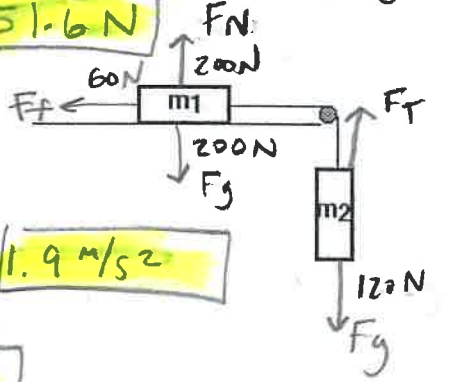
$a = \frac{(140N - 20N)}{(5.0kg + 14kg)} = 6.3\ m/s^2$

$F_F = \mu_K F_N$
$= (0.40)(50N) = 20N$

b. What is the tension in the string?

14 kg $\quad 6.3\ m/s^2 = \frac{140N - F_T}{14\ kg}$ $\quad F_T = 51.6N$

4. A 20.0 kg mass, m_1, on a table with a coefficient of friction of 0.300 is accelerated by a 12.0 kg mass, m_2, hanging over the edge of the table (refer to the diagram).



a. What is the acceleration of the mass along the table?

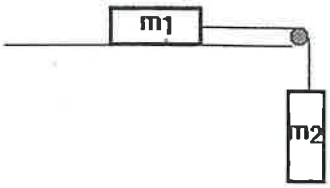
$F_F = \mu_K F_N$
$= (0.300)(200N) = 60N$

$a = \frac{(120N - 60N)}{(20kg + 12kg)} = 1.9\ m/s^2$

b. What is the tension in the string?

$1.9\ m/s^2 = \frac{120N - F_T}{12\ kg}$ $\quad F_T = 116N$

5. A box of mass m_1 sits on a table. It is connected, by a rope drawn through a pulley, to a box $m_2 = 2.10$ kg that is hanging off the side of the table. (Note that box m_2 does not touch the table in any way.) The coefficient of friction between mass m_1 and the table is 0.295. If the acceleration is 2.00 m/s^2:



a. What is the tension in the rope?

b. What is the mass of m_1?