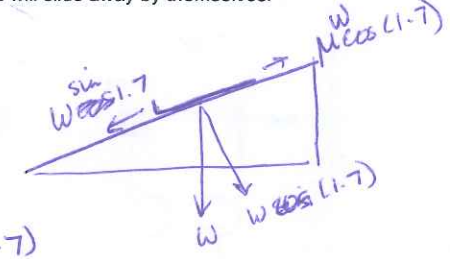
Easier Ramp Problem: Skis will slide

A skier places a pair of skis on a snow slope that is at an angle of 1.7 to the horizontal. The coefficient of static friction between the skis and the snow is 0.025. Determine whether the skis will slide away by themselves.

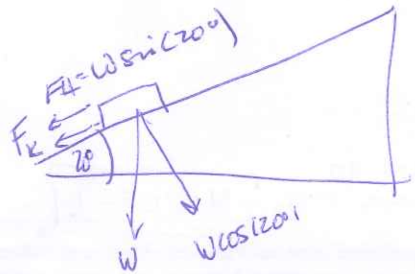


$W\sin(1.7)$ $\mu W\cos(1.7)$

$.0297 > .0249$

Harder Ramp Problem: a = 5.2 m/s² and s = 0.38 m

A box is sliding up an incline that makes an angle of 20 degrees with respect to the horizontal. The coefficient of kinetic friction between the box and the surface of the incline is 0.2. The initial speed of the box at the bottom of the incline is 2 m/s. How far does the box travel along the incline before coming to rest?



$\Sigma F = W\sin(20°) + \mu W\cos(20°) = ma$

$a = g\sin(20°) + \mu g\cos(20°) = 3.355 + 1.844 = 5.2 \text{ m/s}^2$

$u = 2 \text{ m/s}$

$v = 0$

$a = -5.2 \text{ m/s}^2$

$s = ?$

$v^2 = u^2 + 2as$

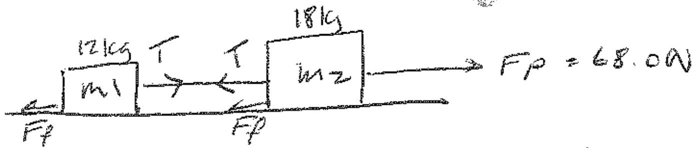
$s = \frac{-u^2}{2a} = \frac{-(2)^2}{2(-5.2)} = 0.38 \text{ m}$

HINT Easier Ramp Problem:

1. Don't know the mass or weight of skis? Just call them "W" or you can just make up a mass. (1 kg).
2. Find component of the ski weight (mg) that is directed down (parallel to) the slope.
3. Find the component of the weight that is perpendicular to the surface. This is always the normal force F_N so it can be used to find the friction.
4. Compare the force up the slope (friction) to the force down the slope.

HINT Harder Ramp Problem:

1. Find the net force UP the ramp. It is equal (and opposite) to the TWO forces down the ramp (friction and the parallel component of the weight).
2. Use the perpendicular force (equal to FN) to calculate friction.
3. Calculate the acceleration.
4. Use suvat to find the distance traveled before coming to rest (decelerating).



$m_2 T = m_1 F_p - m_1 T$ $18T = (12)(68) - (12)T$

$30T = 816$

Tension Problem 1: 27.3 N

Two blocks (m1 = 12.0 kg and m2 = 18.0 kg) on a flat table are connected by a rope of negligible mass. They are being dragged by a horizontal force of 68.0 N, and the coefficient of kinetic friction between each block and the surface is 0.100. Determine the tension T.

$T = 27.2\,N$ The same regardless of order of blocks

m_1: $T - \mu m_1 g = m_1 a$ m_2: $F_p - T - \mu m_2 g = m_2 a$

$a = \frac{T - \mu m_1 g}{m_1}$ $a = \frac{F_p - T - \mu m_2 g}{m_2}$

$= m_2 T - \mu m_1 m_2 g = m_1 F_p - m_1 T - \mu m_1 m_2 g$

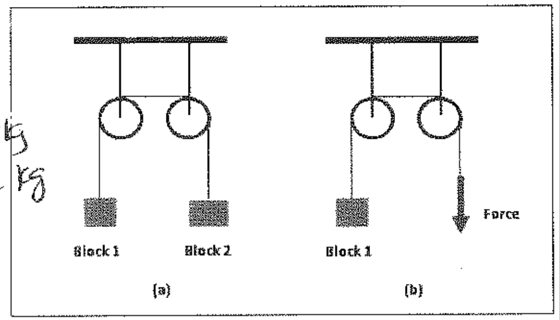
HINT Tension Problem 1:

1. Write F=ma expressions for each block separately. "T" and "a" will be the same for both blocks.
2. T will be the force in one direction and Force of friction will be the other.
3. What is the normal force F_N on a flat surface?
4. Isolate "a" for acceleration in each equation and set them equal to each other.
5. Solve for T.

Tension Problem 2 (Pulley): a = 1.96 m/s^2 and a = 4.9 m/s^2

As part a of the drawing shows, two blocks are connected by a rope that passes over a set of pulleys. The block 1 has a weight of 400 N, and the block 2 has a weight of 600 N. The rope and the pulleys are massless and there is no friction.

$m_1 = 40.8\,kg$
$m_2 = 61.2\,kg$



(a) What is the acceleration of the lighter block?

(b) Suppose that the heavier block is removed, and a downward force of T = 600 N is provided by someone pulling on the rope, as part b of the drawing shows. Find the acceleration of the remaining block.

for block 1 only

$T - 400 = (40.8)a$

$600 - 400 = (40.8)a$

$200 = 40.8 \cdot a$

$a = 4.9\,m/s^2$

HINT Tension Problem 2 (Pulley):

1. Acceleration for both blocks is the same. So is T.
2. Figure out what direction block will accelerate and make that direction +.
3. Write F=ma expressions for each block separately.
4. Isolate T in each equation and set them equal.
5. Solve for "a".

1: $T - m_1 g = m_1 a$ 2: $m_2 g - T = m_2 a$

$T = m_1 a + m_1 g$ $T = m_2 g - m_2 a$

$(40.8)a + 400N = 600N - (61.2)a$

$102 \cdot a = 200$

$a = 1.96\,m/s^2$

Elevator Problem 1: 861 N

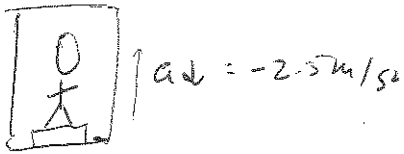
Tom with mass of 70 kg is in an elevator descending at 10 m/s. The elevator takes 4.0 s to brake to a stop at the first floor. What is Tom's apparent weight while the elevator is braking?

$a = \frac{v-u}{t} = \frac{0-{}^{-}10}{4} = +2.5\ m/s^2$

$\Sigma F = F_N + mg = ma \qquad F_N = ma - mg$

$F_N = 70(2.5 - {}^{-}9.8) = 861\,N$

Elevator Problem 2: 511 N



Jim with mass of 70 kg is in an elevator that is moving up at the speed of 10 m/s. The elevator takes 4.0 s to brake to a stop at the fifth floor. What is Jim's apparent weight while the elevator is braking?

$\Sigma F = F_N + mg \qquad F_N = ma - mg$

$F_N = (70)(-2.5 - {}^{-}9.8) = 511\,N$

HINT Elevator Problem 1:

1. Scale reading = apparent weight = FN
2. Elevator is slowing in the DOWN direction, so the acceleration is opposite to the direction of motion (UP). Calculate "a".
3. Think about whether Tom will feel lighter or heavier.
4. Write an expression for the net force that includes Tom's weight an the normal force. The net force = ma.
5. Solve for the F_N which will be his apparent weight.

HINTElevator Problem 2:

6. Scale reading = apparent weight = FN
7. Elevator is slowing in the UP direction, so the acceleration is opposite to the direction of motion (DOWN). Calculate "a".
8. Think about whether Jim will feel lighter or heavier.
9. Write an expression for the net force that includes Jim's weight an the normal force. The net force = ma.
10. Solve for the F_N which will be his apparent weight.