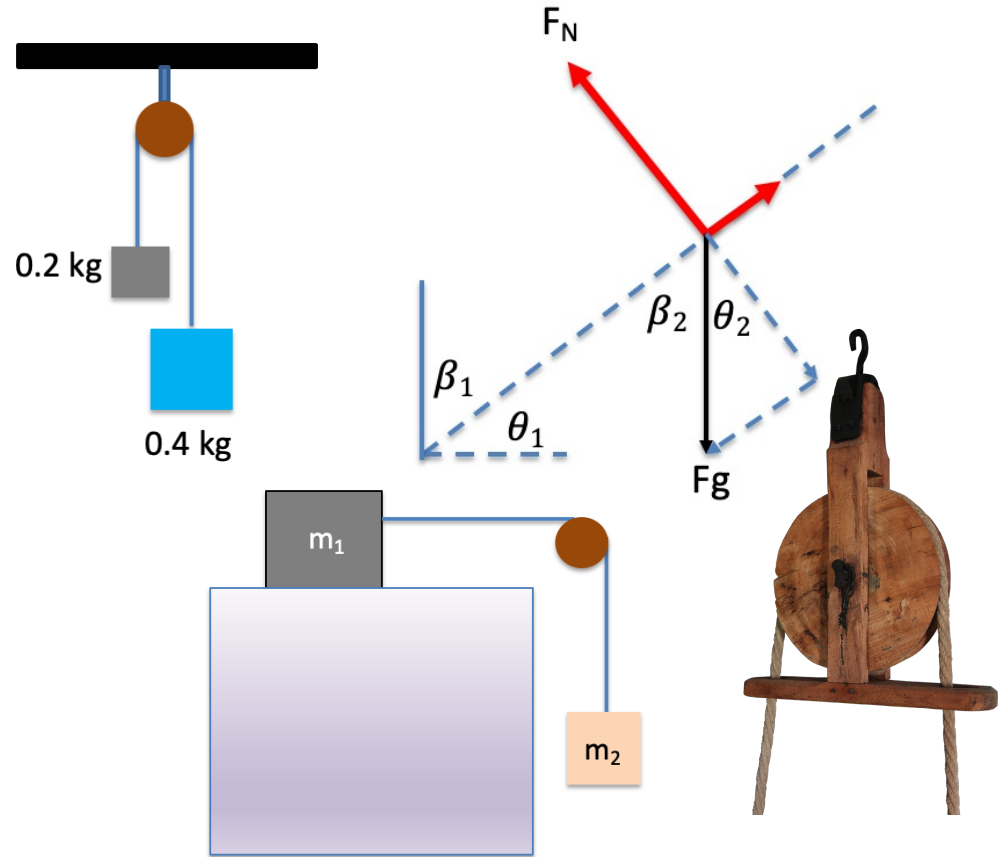


Ramps, Pulleys and Forces

- Tension
- Pulleys
- Atwood Machines
- Solving Atwood Machine Problems
- Ramps
- Angle of Incline
- Ramp Problems



Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

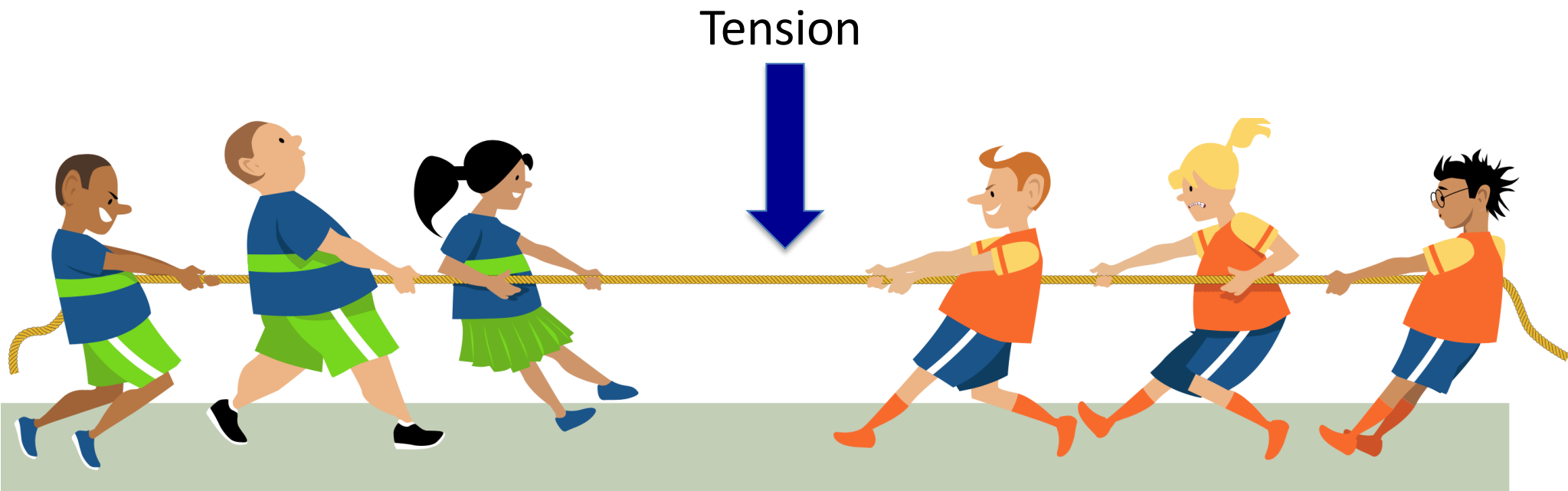
- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

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Tension

- The tension force (T) is the force that is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends
- The tension force is directed along the length of the wire and _____



Tension

- Tension is the same throughout the rope

- _____



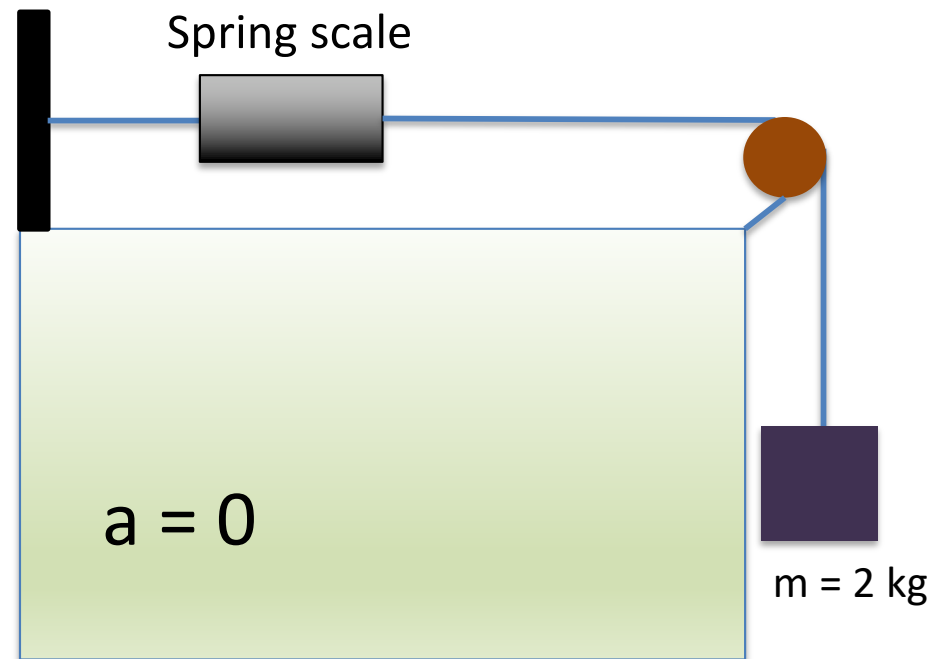
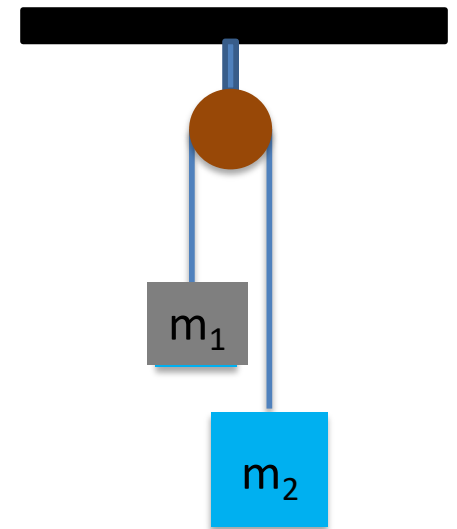
100 N  100 N



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Tension in Pulleys

- Tension is the same along the entire rope in a pulley system
- What would be the tension in the string?

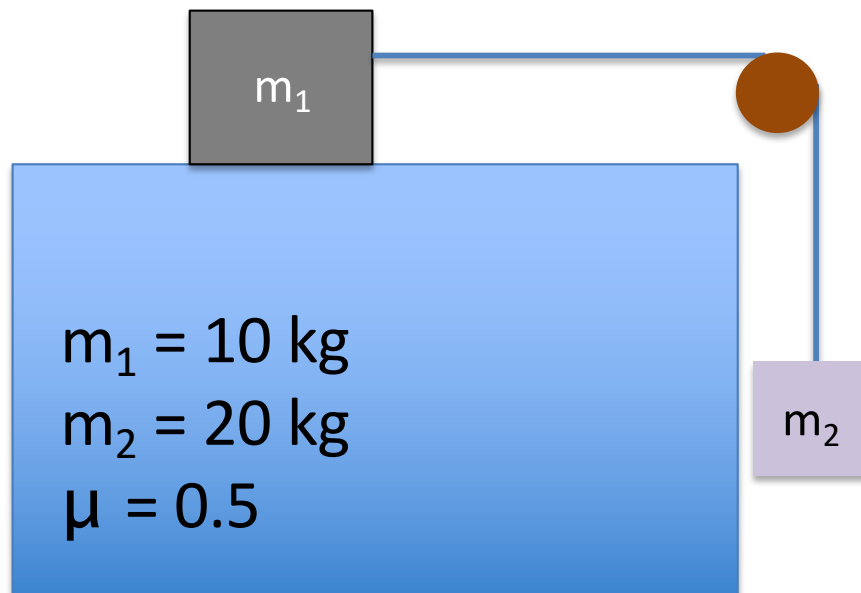


Atwood Machines – Solving Problems with Pulleys

Does the system move?

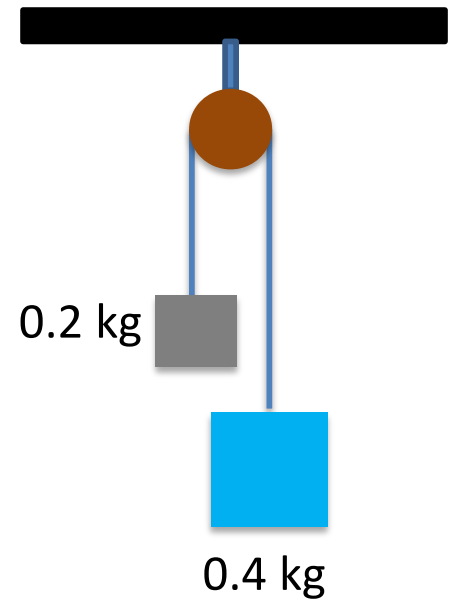
If so, what is its acceleration?

We will come back to this later.



Pulleys

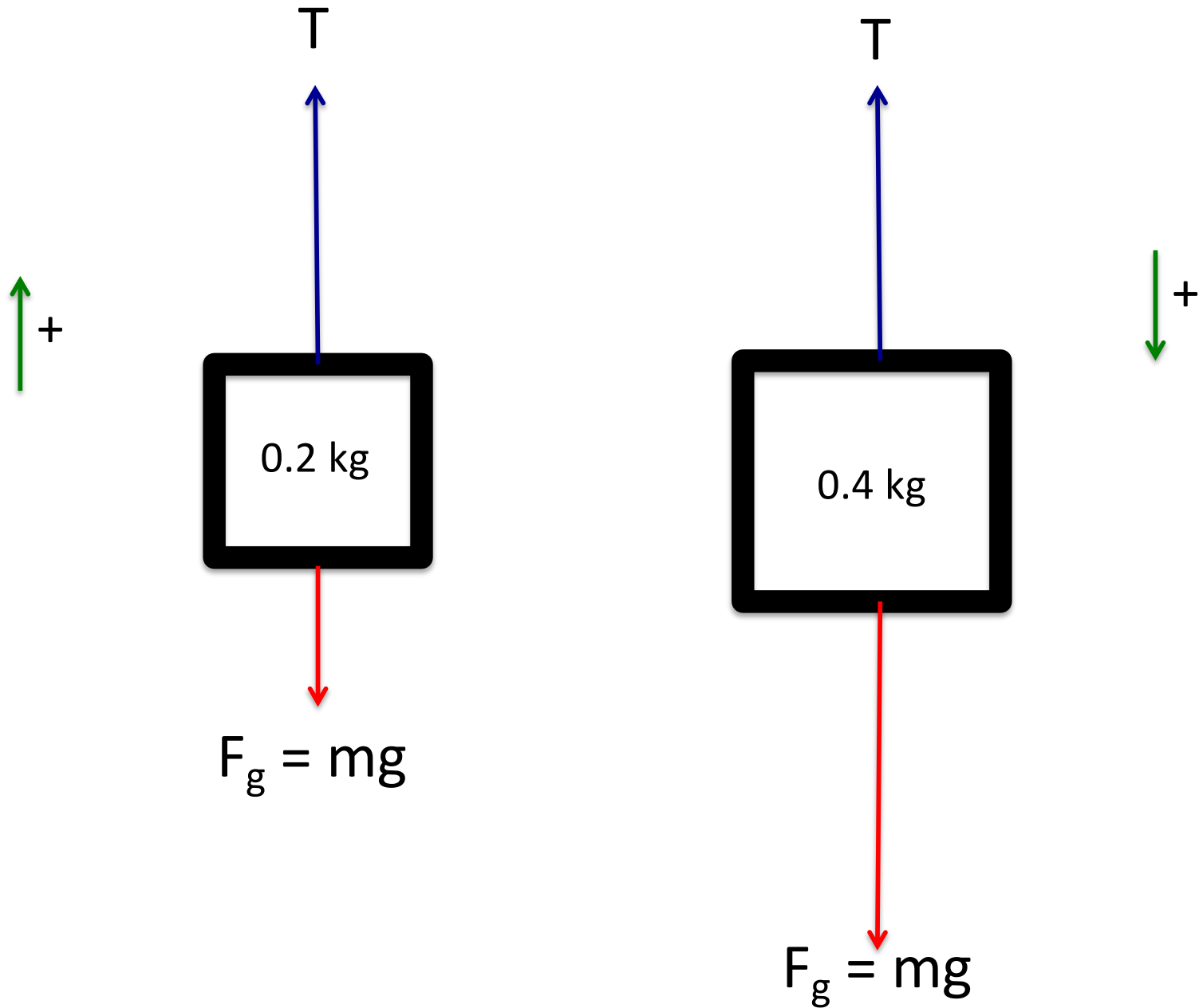
The masses are held stationary then released. What will happen?



- _____
- _____
- _____

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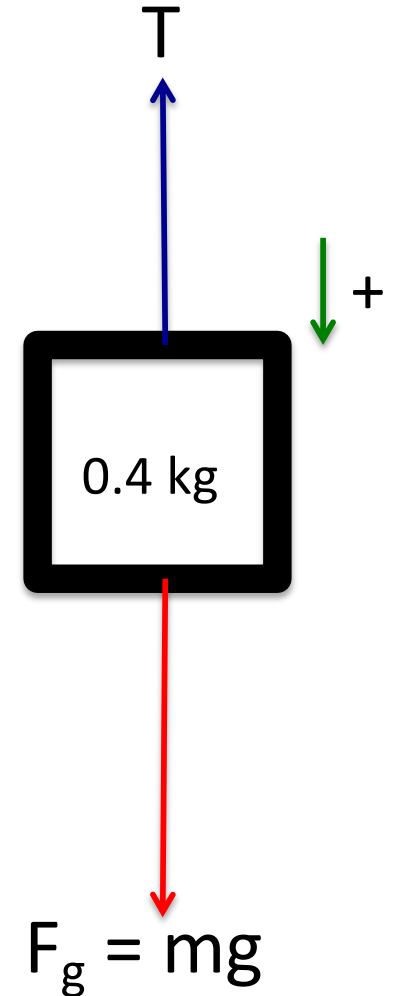
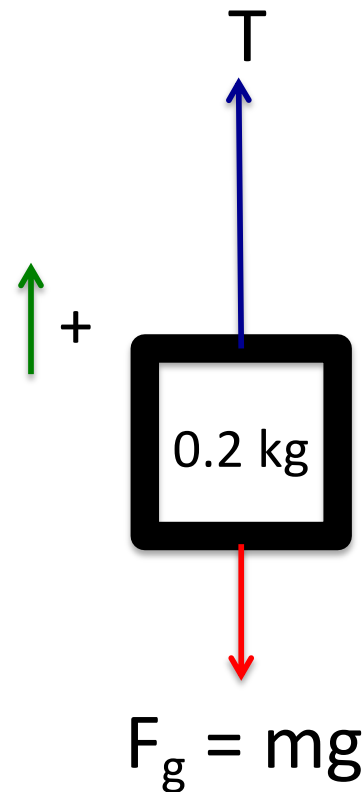
Motion will be clockwise



Solving Atwood Problems

- Find F_{net} for each
$$F_{\text{net}} = T - F_g \quad \text{or}$$
$$F_{\text{net}} = F_g - T$$

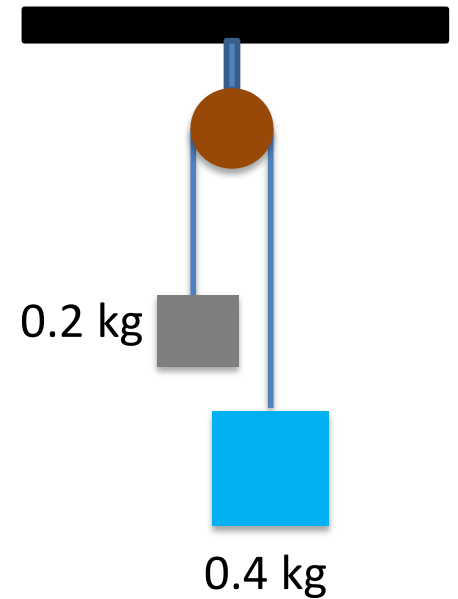
Larger – Smaller force
- Set $F_{\text{net}} = ma$ for each
- Isolate T for the first equation
- Substitute the value of T into the second equation and solve for a
- Substitute a into equation 1 to solve for T



Check Your Understanding

Find the magnitude of the acceleration and tension of an Atwood Machine in which $m_1 = 0.2 \text{ kg}$ and $m_2 = 0.4 \text{ kg}$

- Find F_{net} for each
- Set $F_{\text{net}} = ma$ for each



Check Your Understanding

Find the magnitude of the acceleration and tension of an Atwood Machine in which $m_1 = 0.20$ kg and $m_2 = 0.40$ kg

$$(1) T - 1.96 = 0.2a \quad (2) 3.92 - T = 0.4a$$

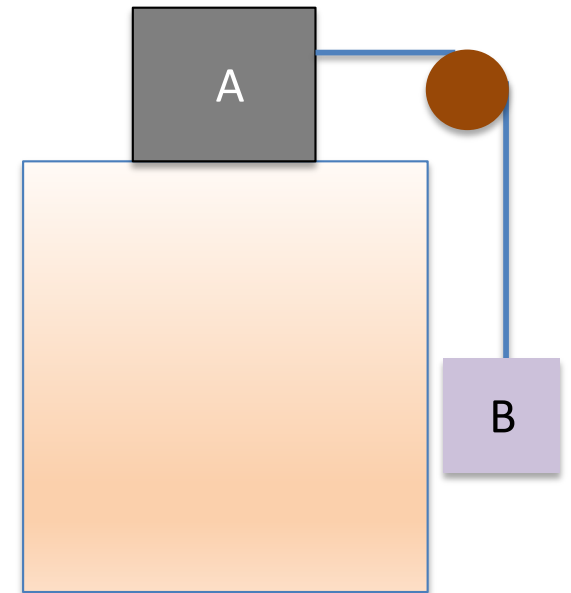
- Isolate T for the first equation
- Substitute the value of T into the second equation and solve for “a”
- Substitute “a” into equation 1 to solve for T

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Check Your Understanding

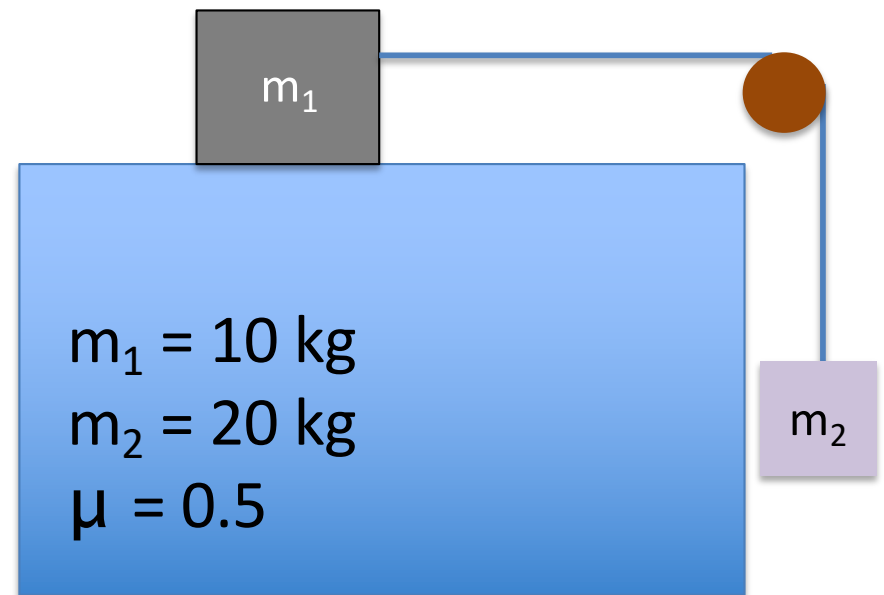
Blocks A and B are connected by a string passing over an essentially frictionless pulley as shown. When the blocks are in motion, Block A experiences a force of kinetic friction of magnitude 5.7 N. If $m_A = 2.7 \text{ kg}$ and $m_B = 3.7 \text{ kg}$, calculate the magnitude of

a) the acceleration of the blocks b) the tension in the string



Check Your Understanding

- a) Does the system move? If so, which direction?
- b) If so, what is its acceleration?
- c) What is the tension in the string?



Homework

A block on the desk is attached to a mass over a pulley (the mass is hanging). If the co-efficient of kinetic friction is 0.4, the mass of the block is 196 g, and the hanging mass is 100 g, calculate a) the acceleration of the system and b) the tension in the string.

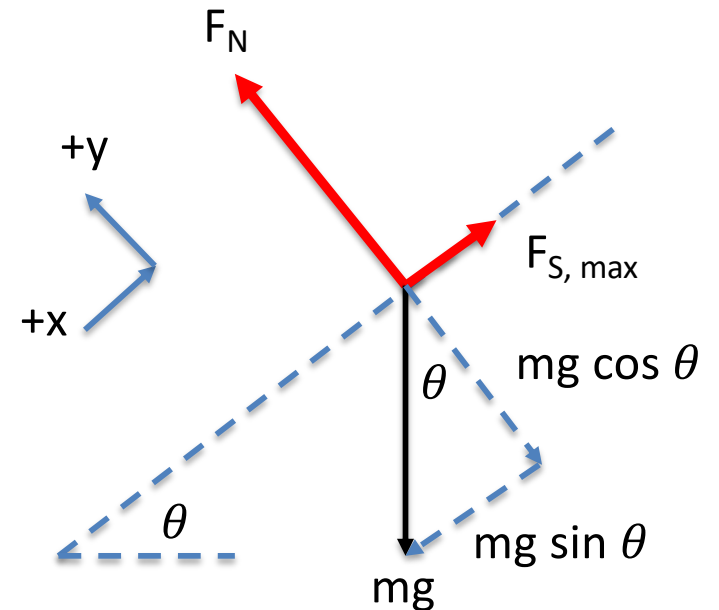
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The Ramp

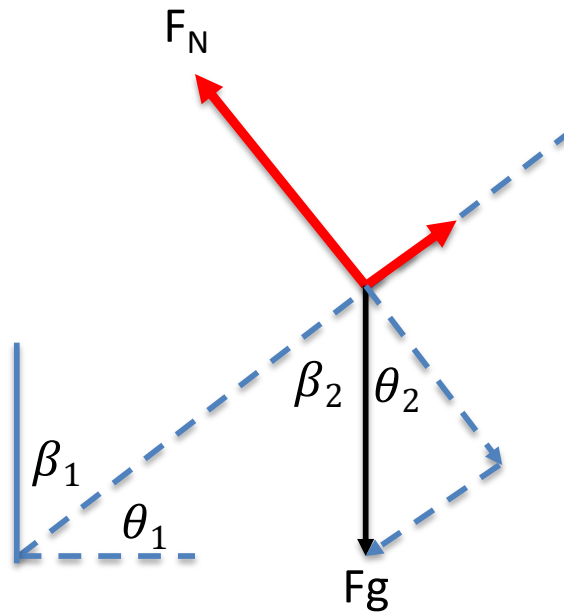
Ramp problems are more difficult as there are many forces acting.

Rules:

- _____
- _____
- _____



Angle of Incline (Θ)



$$\theta_1 + \beta_1 = 90^\circ$$

$$\theta_2 + \beta_2 = 90^\circ$$

$\beta_1 = \beta_2$ from Z pattern

Therefore, $\theta_1 = \theta_2$

Steps to Solving Ramp Problems with Friction

Very similar to Atwood Problems

1. Create your FBD for EACH object separately.
2. Write out your $F_{\text{net}} = ma$ equation for each object.
 - Don't forget F_{net} is the sum of ALL the forces acting.
 - Make one equation 1 and the other equation 2.
3. For equation 1, isolate T and simplify.
4. Substitute the answer for T from equation 1 into T from equation 2.
5. Solve for acceleration in equation 2.
6. Substitute acceleration into equation 1 or 2 and solve for T.

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Check Your Understanding

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Check Your Understanding

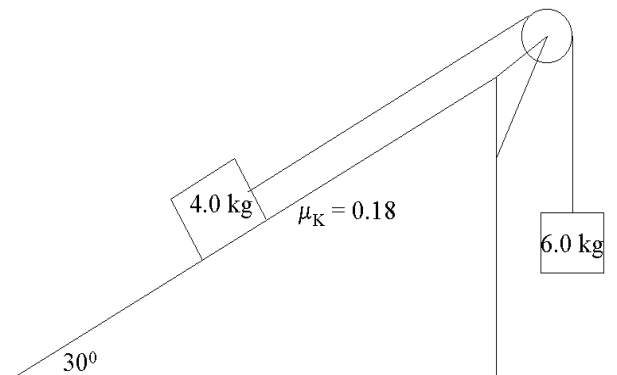
A block on an inclined plane of mass 5.0 kg is attached via a massless rope over a frictionless pulley to a 6.0 kg weight hanging over the side of the incline. The μ_k value is 0.50.

b) Find the Tension in the rope. **[recall: $a = 1.2 \text{ m/s}^2$]**

Check Your Understanding

Two masses, 4.0 kg and 6.0 kg, are connected by a “massless” rope over a “frictionless” pulley as pictured in the diagram. The ramp is inclined at 30.0° and the coefficient of kinetic friction on the ramp is 0.18.

- a) Draw free-body diagrams of both masses.
- b) Determine the magnitude of acceleration for the system once it begins to slide.



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Check Your Understanding

Two masses, 4.0 kg and 6.0 kg, are connected by a “massless” rope over a “frictionless” pulley. The ramp is inclined at 30.0° and the coefficient of kinetic friction on the ramp is 0.18.

d) If the rope breaks when the 4.0 kg mass is 3.0 m from the bottom of the ramp, how long will it take for the mass to slide all the way down? Include a new free-body diagram and assume the sliding mass starts from rest.