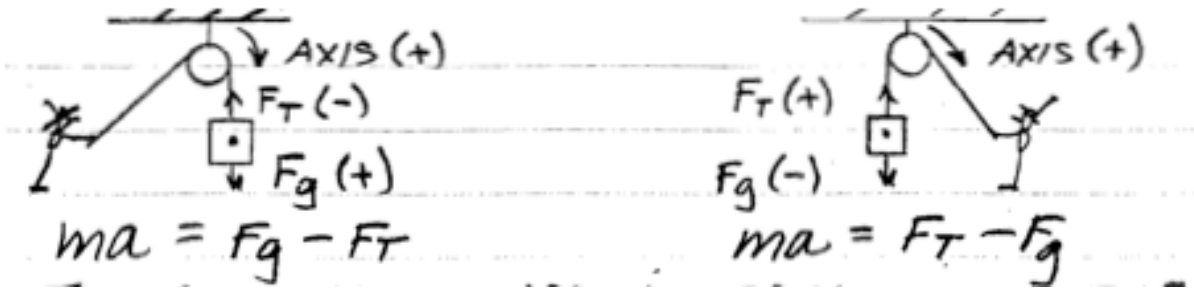
“String Theory”

Pulleys & Many-Body Problems

Pulleys

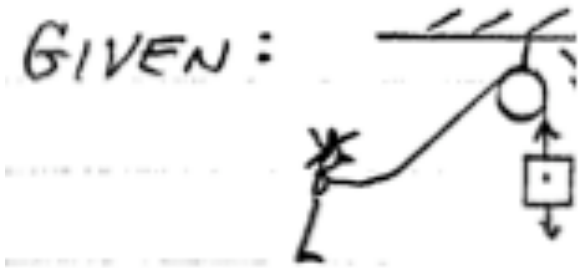
Basics:

- These are 1-dimensional problems. The pulley only serves to bend the x-axis.
- Coordinate system: Clockwise is (+). This is not necessarily the direction of motion
- **Example:**



- These formulas apply regardless of the direction of motion. The force which tries to pull clockwise is (+). We do not assume to know which direction will dominate.

Example: The farmer pulls with a tension 800 N. The mass is 50 kg. Find the acceleration.



- Intuitions:

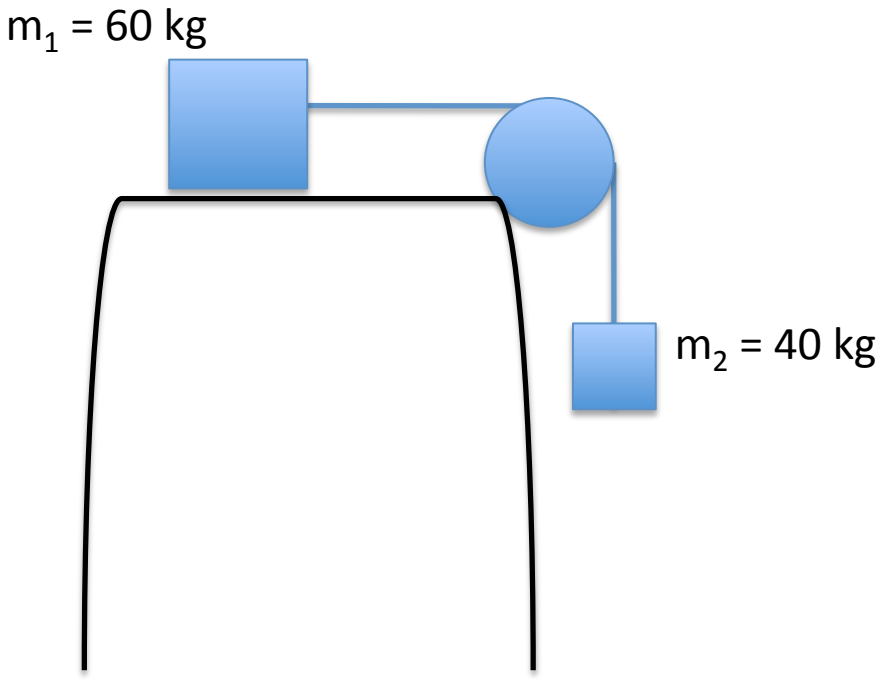
1. If $F_T > F_g$, the mass accelerates upward.
2. If $F_T < F_g$, it accelerates downward and we get rope burn.
3. If $F_T = F_g$, the mass is either stationary or cruising at constant speed.

Many-Body Problems

Recipe:

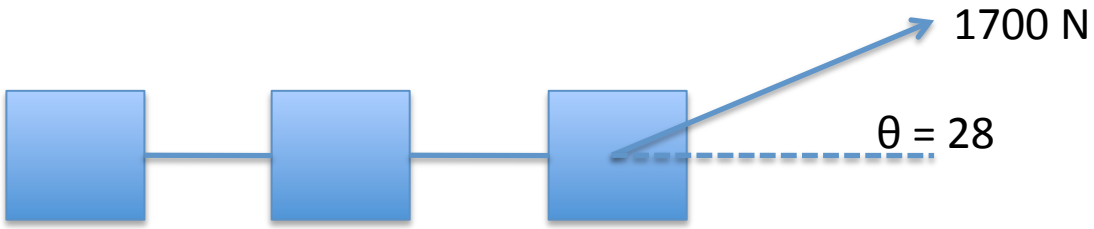
1. Draw a force diagram for **each** object.
   Recall that the objects are local thinkers and only feel forces which directly affect them.
2. Write a Newton's equation for each object using only those local forces.
3. In most cases, the accelerations will be equal. The objects move at the same rates.
4. Each rope has its own tension, which is the same throughout its length.
5. Add all the equations simultaneously. The equal, opposite forces will cancel allowing us to solve for acceleration.
6. Plug back in to solve for the forces.

Example: Given: Surface is frictionless. Find the acceleration and the tension.



Example: Given: No friction. Find the acceleration and tension in the ropes.

$m_1 = 150$ kg $m_2 = 250$ kg $m_3 = 100$ kg



Example: A force of 280 N up is applied to the top hanging mass. What is the tension in the ropes connecting the mass 1 and mass 2? What is the tension in the rope connection the mass 2 and mass 3?