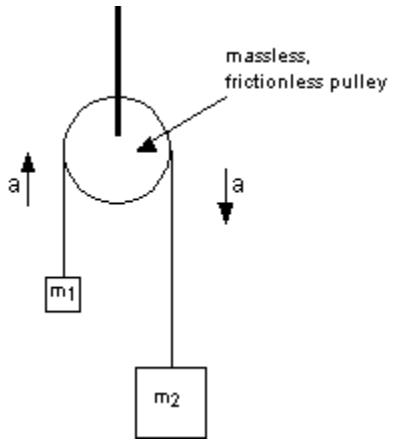
Atwood and Modified Atwood Machines
Unit V Prelab Worksheet

Purpose:
To determine mathematical models for the relationship between net force (total force or $\mathbf{F_{net}}$) and acceleration (**a**) of a system and between total mass ($\mathbf{m_{tot}}$) and the acceleration (**a**) of a system.

Part 1: Atwood Machine



a and F_{net} are both vectors acting in the same direction.

m_{tot} is a scalar.

$m_2 > m_1$

If you are doing this experiment with actual equipment instead of a simulation, you can use cups to hold masses or hooks with slotted masses for m_2 and m_1. Acceleration can be measured with a photogate and a smart pulley

1. Draw a freebody diagram for $\mathbf{m_1}$ and $\mathbf{m_2}$.

$\mathbf{m_1}$ $\mathbf{m_2}$

2. On the two freebody diagrams above, rank the forces from largest to smallest.

3. If you know the mass, how do you calculate the weights of $\mathbf{m_1}$ and $\mathbf{m_2}$? (formula?)

4. All a pulley does is change the direction of the force (not its magnitude). What is the net force (total force) acting on the whole system ($\mathbf{m_1}$ and $\mathbf{m_2}$ together) that causes the acceleration? Explain. Think of $\mathbf{m_1}$ and $\mathbf{m_2}$ as having a tug-of-war.

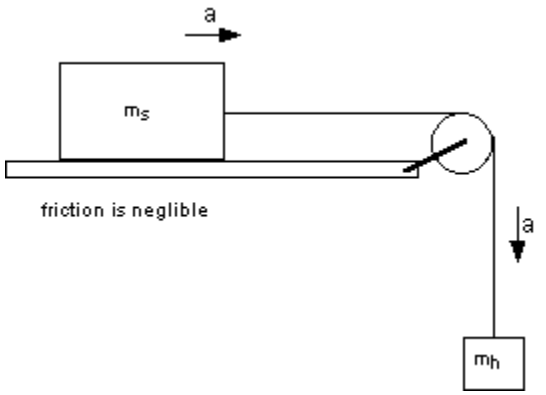
5. What would be the acceleration of the system if $\mathbf{m_1} = \mathbf{m_2}$? Describe the possible motions of the system.

6. Write an equation for the net force ($\mathbf{F_{net}}$) on the whole system in terms of $\mathbf{m_1}$, $\mathbf{m_2}$ and $\mathbf{g}$ (9.8 N/kg).

7. If $\mathbf{m_{tot}} = \mathbf{m_1} + \mathbf{m_2}$, how can you hold the total mass constant, but change $\mathbf{F_{net}}$?

8. How can you hold $\mathbf{F_{net}}$ constant but change $\mathbf{m_{tot}}$?

Part 2: Modified Atwood machine



If you are doing this experiment with actual equipment instead of a simulation, you can use a cup or a hook with slotted masses for m_h. Acceleration can be measured with a photogate and a smart pulley or with a motion detector.

1. If you were to do this experiment, what are two ways to reduce the friction between the surface and the sliding block?

2. Draw a freebody diagram for the sliding block and for the hanging block (assume friction is negligible).

sliding block hanging block

3. Which forces in the freebody diagrams above do not affect the acceleration in the direction whown? Explain.

4. Write an equation for $\mathbf{F}_{net}$ on the whole system (sliding and hanging block together).

5. What is the total mass ($\mathbf{m}_{tot}$) of the system? How can you hold $\mathbf{m}_{tot}$ constant and change $\mathbf{F}_{net}$?

6. How can you hold $\mathbf{F}_{net}$ constant and change $\mathbf{m}_{tot}$?