AP Physics: Short Lab 4-C
Atwood Machines

Name ______________________ Hour ______

Lab Partners ____________________________________

Purpose:

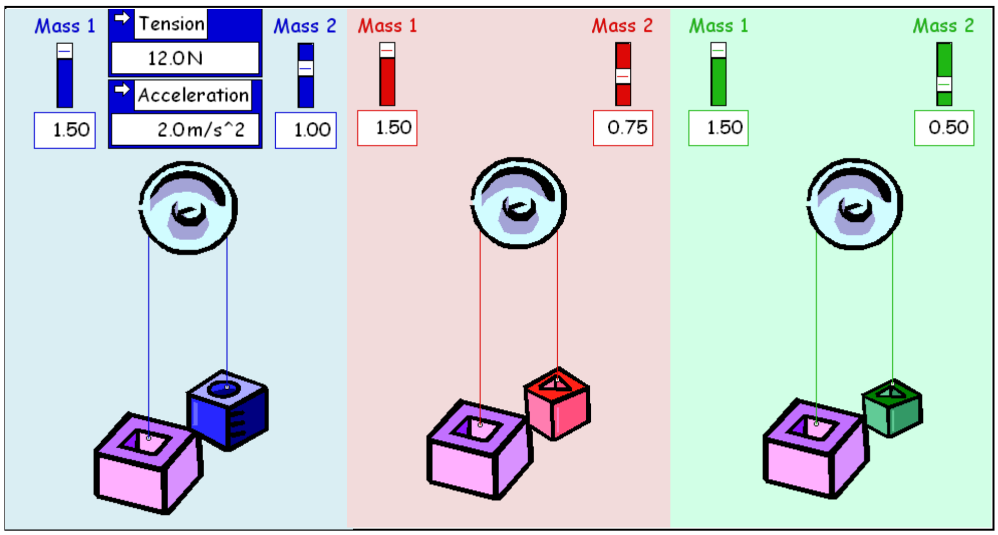
Analyze how tension and acceleration values in an Atwood machine change as the masses change.
Analyze Atwood machines on an incline.

Equipment:

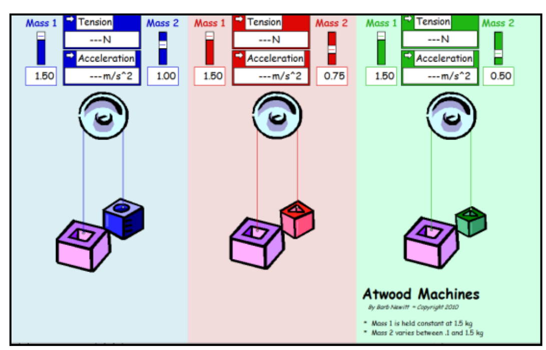
- Interactive Physics computer software

Procedures (Part I):

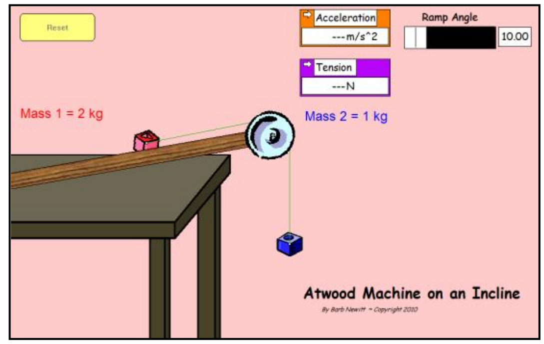
1. Study the 3 Atwood machine situations shown at right. The 1st situation uses masses of 1.5 kg and 1.0 kg and produces a tension of 12 N and an acceleration of 2 m/s^2. The larger mass remains at 1.5 kg in the other two Atwood machines, but the smaller mass changes to .75 kg and .50 kg as shown. Make a prediction regarding the acceleration and tension of the other 2 Atwood machines. Will the tension change from 12 N as the masses change? If so, how? Will the acceleration change from 2 m/s^2 as the masses change? If so, how?



2. Open the Interactive Physics file "*Atwood Machines (I)*". Run the simulation and study the tension and acceleration of the three Atwood Machine situations. Was your prediction correct? Change the values of Mass 2 and observe the results for several different situations. If the larger mass is held constant, what general pattern describes the changes in tension as the smaller mass decreases? If the larger mass is held constant, what general pattern describes the changes in acceleration as the smaller mass decreases? *(NOTE: The Interactive Physics files "Atwood Machines (II) and Atwood Machines (III) provide the opportunity to vary both masses or add greater precision to the masses if needed.)*

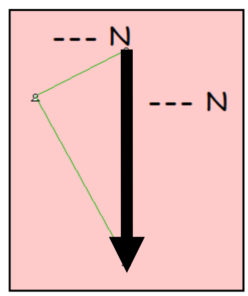


Procedures (Part II):

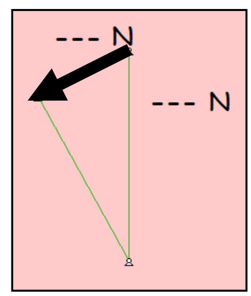


1. It is easy to determine the direction of motion in a vertical Atwood Machine, since the lighter mass always moves up and the heavier mass always moves down. However, this process is more complex when one of the masses is on an incline. Open the Interactive Physics file "*Atwood Machine on an Incline*". This simulation shows an Atwood Machine with a 1 kg mass hanging vertically and a 2 kg mass on a ramp with an adjustable angle. Run the simulation at a very low angle of incline and again at a very high angle of incline and observe the results. *(NOTE: If an error message is given at very extreme angles, simply click "Yes" and continue.)* How can you predict the direction of motion of the masses when the Atwood Machine is at extreme angles?

2. The results from Question #1 indicate that there must be an angle at which the masses on this particular Atwood Machine remain at rest. Try a variety of angles of incline until you find this angle and record it in the space below. Why do you think this particular angle causes the masses to remain at rest in this Atwood Machine?



Resultant Vector (Weight)



Vector Component (Force Pulling Down Ramp)

3. Open the Interactive Physics file "*Atwood Machine on an Incline (II)*". This simulation shows the same Atwood Machine, but also includes an important vector diagram. This vector diagram is similar to the diagram used to analyze the acceleration on a ramp in *Lab #3 – Galileo's Incline Plane*. However, rather than represent the *acceleration* of the object with vectors, this diagram represents the *forces* acting on an object with vectors. The hypotenuse of the triangle represents the resultant, or the weight of the object directed straight downwards. The vector component pointed in the same direction as the ramp represents the component of weight that actually pulls the object down the ramp. Set the simulation to use the same angle that you found in Question #2 and run the simulation. How does the vector diagram help explain why this particular angle used with the 2 kg and 1 kg masses allows them to remain at rest? *(NOTE: The Interactive Physics simulations use 10 m/s^2 for the acceleration of gravity.)*

4. Open the Interactive Physics file "*Atwood Machine on an Incline (III)*". This simulation allows you to change the value of both masses. Experiment with different mass combinations and angles of incline. Explain how you could use the vector diagram to predict which direction the masses will move in each situation.