LAB 5: Atwood's Machine*

Equipment List:

pulley
rod
2-meter stick
stop watch
pan balance
masses and hangers
string
tape

Purpose: To find the acceleration of the Atwood machine experimentally by using the kinematic equations of motion and to compare to the expected value obtained from applying Newtons 2nd Law to the Atwood machine. You will also make measurements of g.

Theory Exercise: You will find an expression predicting the acceleration of the masses in the Atwood machine and another expression giving the (constant) acceleration of a mass that starts from rest and moves a distance H in a time t. Do this as follows:

1. Draw free-body diagrams for mass M_1 and mass M_2, selecting appropriate axes for each mass.

2. Apply Newtons 2nd Law to each mass by using the corresponding axes to get equations of motion for each in terms of tension and acceleration.

3. Solve these equations together to obtain an expression for the acceleration of the blocks in terms of M_1, M_2, and g. That is $a_{\text{th}} = a(M1, M2, g)$. This expression will give the theoretical (predicted) value for the acceleration.

4. Using one of the kinematic equations derive and expression for the acceleration of the blocks when they have moved a distance H starting from rest in a time t. Your expression will be in terms of H and t. That is $a_{\text{exp}} = a(H, t)$. This expression will give the experimentally measured acceleration.

Procedure:

1. Setup apparatus as shown in Figure 1.

*Based on the lab by Prof. Luna.

2. Choose $M_1 \approx 180$ g and $M_2 \approx 150$ g, measuring on the balance to check that your masses plus hangers are close to these values. Record the exact values in your lab book.

3. Adjust M_1 and M_2 so that M_1 falls through a height $H = 130$ cm.

4. Release M_1 from rest and measure the time of fall t for a total of 5 runs. Construct a data table similar to the one shown below to record your values in your lab book.

5. Repeat steps (3) and (4) for $M_1 \approx 230$ g and $M_2 \approx 200$ g.

6. Calculate a_{exp} and a_{th} for each set of data and find the percentage error.

7. Rearrange the expression a_{th} to give an expression for g. Using your experimentally measured values of the acceleration, determine the *experimentally determined* value of the acceleration due to gravity g for each pair of masses.

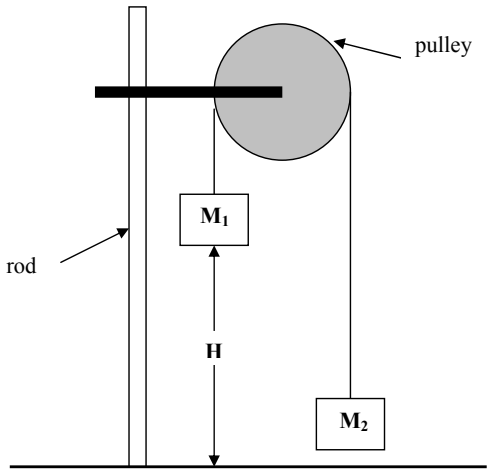

Figure 1: Experimental setup.

$H =$____, $M_1 =$ ____g, $M_2 =$ ____g

Trial number	time, t (s)	accel, a (sec)
1		
2		
3		
4		
5		
average acceleration a_{exp}		
predicted acceleration a_{th}		

Table 1: Example data table.