Name:___________________________ Date:____________________________

Mr. Croom's Physics Static Equilibrium Lab 04-5

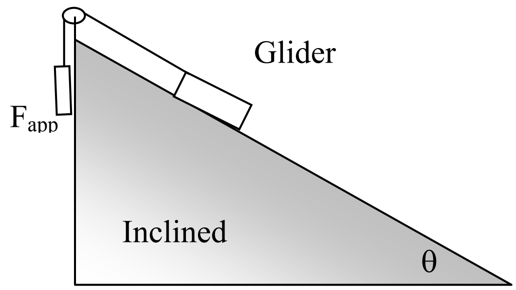
Static Equilibrium

Objective: Using the techniques discussed in class, the student will analyze 2 systems in static equilibrium and in doing so experimentally proving Newton's Second Law.

Apparatus: mass hangers, air track planes, support rods, gliders, slotted masses.

Background Information:

In any statics problem, we know that the sum of all forces is zero. In equation form, $\sum F = 0$. This includes all spatial directions as well ($\sum F_x = 0$ and $\sum F_y = 0$). In this experiment, two different systems in static equilibrium will be analyzed.



System 1: Mass on a Frictionless Inclined Plane.

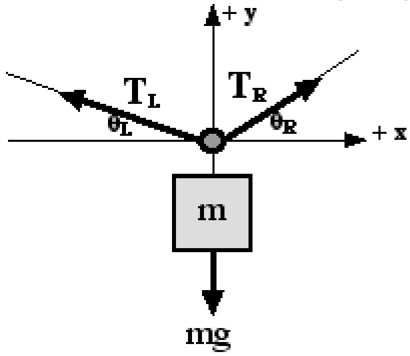
In this first system, a lab cart will be placed in equilibrium on an inclined plane. The amount of tension needed for equilibrium will be experimentally measured from a spring scale. The tension will then be computed from a free-body diagram of the first system. These values will then be compared via a percent of error approach.

n	m_{cart} (kg)	extra mass (kg)	TOTAL mass m (kg)	θ (°)	$F_{applied}$ Weight hanging mass (N)	$F_{parallel}$ (N)	% error
1		0.000		≈15→			
2		0.050		≈15→			
3		0.100		≈15→			
4		0.150		≈15→			
5		0.100		5			
6		0.100		10			
7		0.100		15			
8		0.100		20			

Calculation 1: **a) Draw a free body diagram of system 1 in the space provided below.**
b) Using the techniques discussed in class, derive an algebraic expression to calculate the tension force T as a function of m, θ, and g. This tension force is needed to hold the mass in system 1 in static equilibrium.

Calculation 2: **Using the expression you derived in Calculation 1, complete Table 1.**

System 2: Mass Suspended by two strings, angles unequal.



In the second system, a known mass will be suspended between 2 strings at unequal angles. The other ends of the strings will be attached to spring scales. Experimental tension values for each string will be measured from the spring scales. Accepted tension values of each string will be calculated from statics equations you will develop with your team.

These statics equations will be similar in structure to the various statics problems that have been worked on in class. These values (accepted and experimental) will then be compared in a percent of error approach.

n	Given mass (kg)	θ_L (°)	θ_R (°)	measured T_L (N)	measured T_R (N)	calculated T_L (N)	calculated T_R (N)	% error in T_L	% error in T_R
1	0.500								
2	0.500								
3	0.500								
4	1.00								
5	1.00								
6	1.00								

Calculation 3: **a) Draw a free body diagram of system 2 in the space provided below.**
b) Using the techniques discussed in class, derive 2 algebraic expressions, 1 each to calculate the right-sided tension T_R and the left-sided tension T_L. T_R and T_L are both functions of m, θ_R, θ_L, and g.

Calculation 4: **Using the expressions derived in Calculation 3, complete Table 2**

Calculation 5: **Calculate the percent of error between the experimental values (spring scale) and the accepted values (your values from your algebraic expressions).**

$$\%\,\text{Error} = \frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}}$$

RUBRIC (Total Points = 30)

Table 1 (10 points)
Table 2 (10 points)
Page 2 Equations (10 Points)