Physics 12 Name:_____

Block: _____

Equilibrium Lab

Purpose: To calculate the **mass** of an object using equilibrium methods.

Materials:

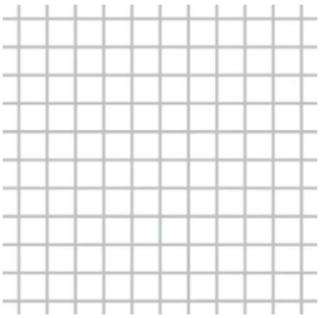
- Clinometer app downloaded to phone (or protractor)
- Spring scale
- String
- Mass (with actual mass written on it)

Procedure/Data/Observations:

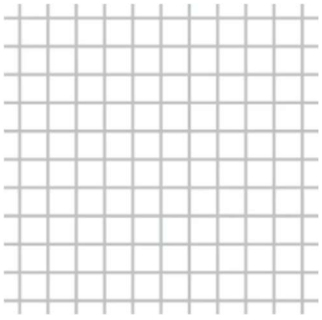
1. Hang a mass from a string on a nail in the classroom
2. Pull the mass horizontally out from the wall using a spring scale. (**Hold scale horizontal**.)
   - Draw a diagram of the situation and label the forces and angle involved.
   - Create a table of θ and resulting F_{spring}.

   Diagram: Table:

3. Repeat procedure #2 for 5 different angles between 10^o and 60^o. (Only one drawing though.) Enter data into table above – there will be 6 angles in total.
4. Plot a graph of F_{spring} vs θ.



5. The graph above is not linear. Draw an equilibrium triangle and explain why using tan θ, instead of θ, should yield a straight line. Add a tan θ column to your table in procedure #2 and plot a graph of F_{spring} vs tan θ.



6. Calculate the slope of the straight-line graph in procedure #5 and determine what physical quantity it represents.

7. Calculate the **mass** from your experimental results to 3 sig figs.

8. Calculate the percent difference between your measured mass and the actual mass (as written on the mass itself):

$$percent\ difference = \frac{|\ measured - actual\ |}{actual} \times 100\%$$

Analysis/Conclusions: (own words, not your partner's)

Write-up hints for Analysis and Conclusions:

- Did you accomplish the purpose of the lab? Explain, don't just say "yes".
- Discuss what your results mean in terms of the physics concept being studied. Connection to formula/theory. What was learned through the lab? Did it prove a physics concept? Explain.
- Did the procedure lead to good results? Is there a better way to do the lab? Explain.
- List any inherent errors that affected, or could have affected, the results like: equipment issues ___, friction of ___ , etc (NOT "human error", NOT "I measured wrong"). Be specific, detailed.

Marking guide:

- Discussion of how to get: straight line graph, calculated mass, % difference — 5 marks
- Two graphs — 4 marks
- Analysis and conclusion — 6 marks

Total: /15 marks

Due date:_____

Labs must be handed in on the due date. Labs will not be accepted after they have been marked and returned. (*Personal Awareness and Responsibility Core Competency*)
If a student was away on the day of the lab, he/she can come to make up the lab, before it is handed back, immediately when he/she returns to school.