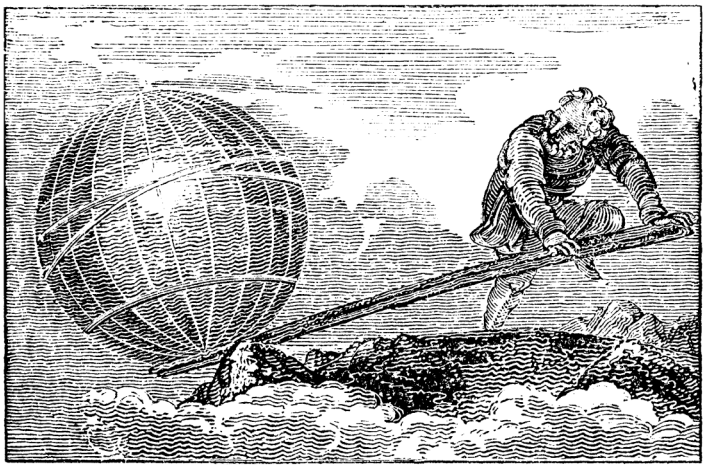
Name: _____

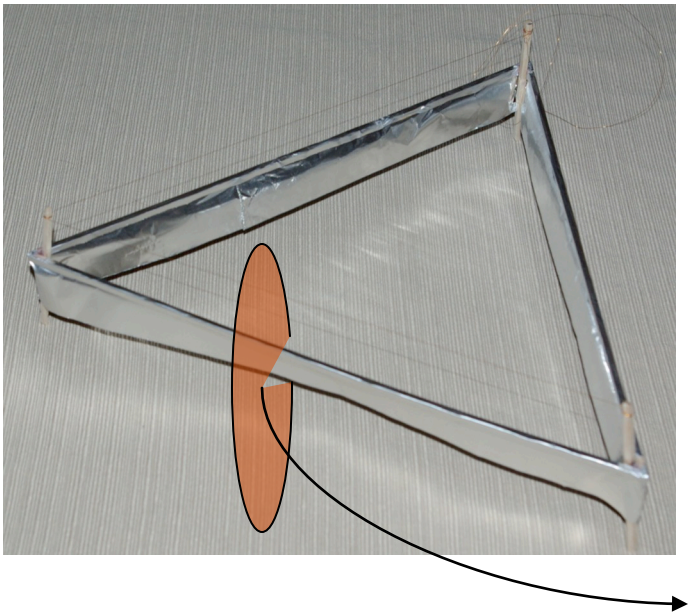
Date: _____

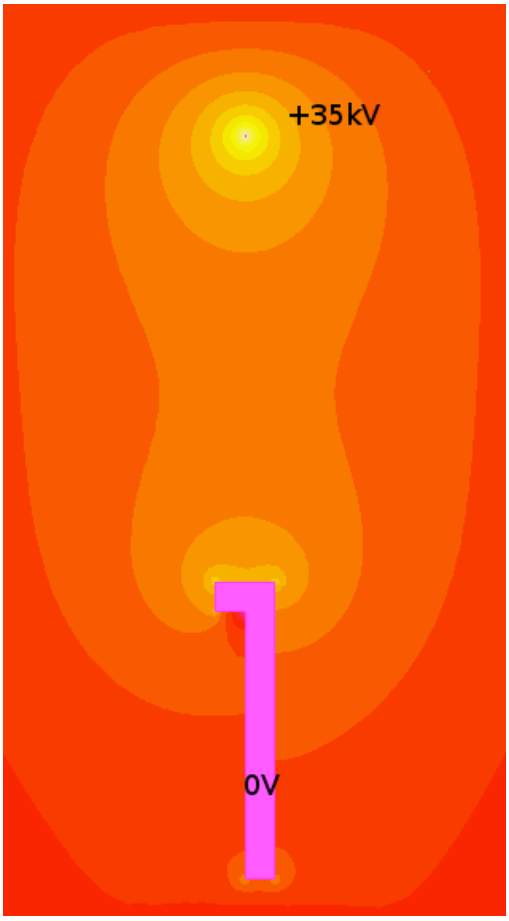
Teacher: _____ Period: _____

Lifter - Worksheet



"GIVE ME A PLACE TO STAND AND I WILL MOVE THE EARTH" - *Archimedes*





Electrostatic Cross Section

This worksheet will act as an introduction to a lifter and present a method for measure the force produced by this propulsion system.

Goals:

- Introductions to some aspects of high voltage electronics
- Problem identification
- Systematic measuring techniques

Archimedes Figure from: http://www.math.nyu.edu/~crorres/Archimedes/Lever/LeverIntro.html, acquired on 4/4/2010

Initial Calculations - Torque

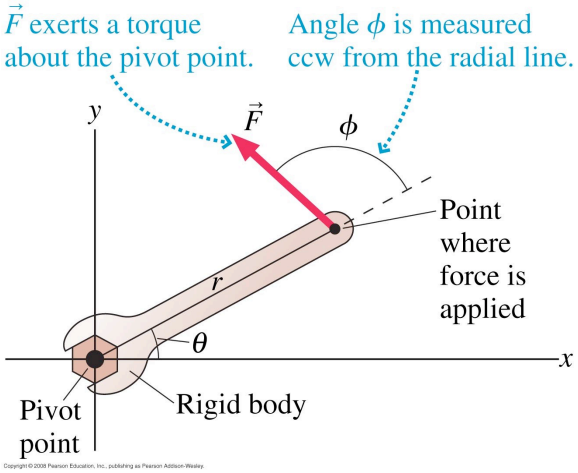
Torque is a measure of a force about some fixed point and is used when talking about a rotation. If the torques applied an object sum to zero then no rotation will occur.

This page is meant to serve as a brief introduction to torque and some basics of statics. To that end the follow items are presented as an introduction.

1. Define torque
2. Example of a static calculation using toque
3. Problems to solidify static calculation knowledge

Torque

- Vector definition: $\vec{\tau} = \vec{r} \times \vec{F}$
- Definition using trigonometry: $\tau = rF\sin(\theta)$
- You are all familiar with torque and use it all the time from trying to open a lid to tightening or loosening a bolt. Torque is a measure of a force applied to a pivot point given a lever arm with a length r. We can use torque to measure the force that is exerted by a lifter wing. ***To do this we need recognize that the sum of the toques applied to an object that is not rotating must be zero.***

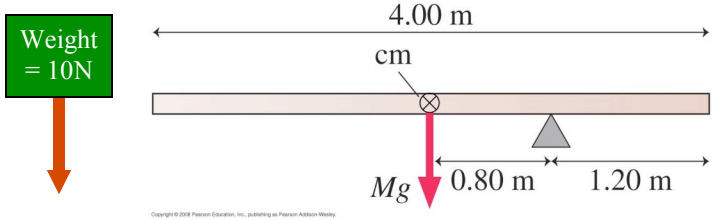


Force applied to a wrench exerts a torque about the pivot point

Example 1

- Given the Mg = 10N calculate where the green weight should be placed so that the torques sum to zero.
- Once the location has been calculated draw the weight in the location that you calculated.
- Don't forget to define the coordinate system and where x = 0.

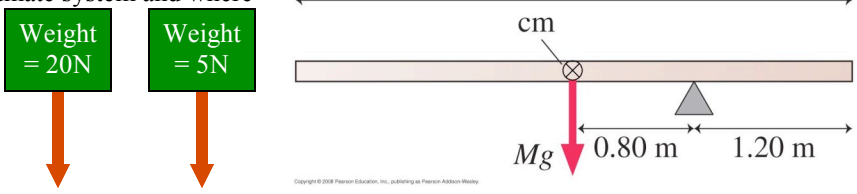
x = _____ (m)



Example 2

- Given the Mg = 10N calculate where the two weights should be placed so that the torques sum to zero.
- Once the locations have been calculated draw each weight in the location that you calculated.
- Don't forget to define the coordinate system and where x = 0.

x (5N) =_____ (m)
x (20N) = _____ (m)



Experimental Setup

- Each group is going to build a wing and then determine the exerted force as a function of the separation between the high voltage wire and the grounded aluminum foil.
- A fulcrum will be used to balance the wing portion of the lifter. A weight will be provided to for balancing purposes.
- ***Make sketch of the experiment*** *(Look at the examples on the previous page and think about how the liter should work)*

- Determine the data that needs to be collected in order to calculate the force. Explain your reasoning for the choices in data collection.
- ***Make and label a template table to collect data*** *(A discussion will occur after the template table had been made, any modifications should be seen here and used on the next page with the table will be used to collect data)*

Build and Measure

Build the lifter portion along with the lever arm to be used on the fulcrum

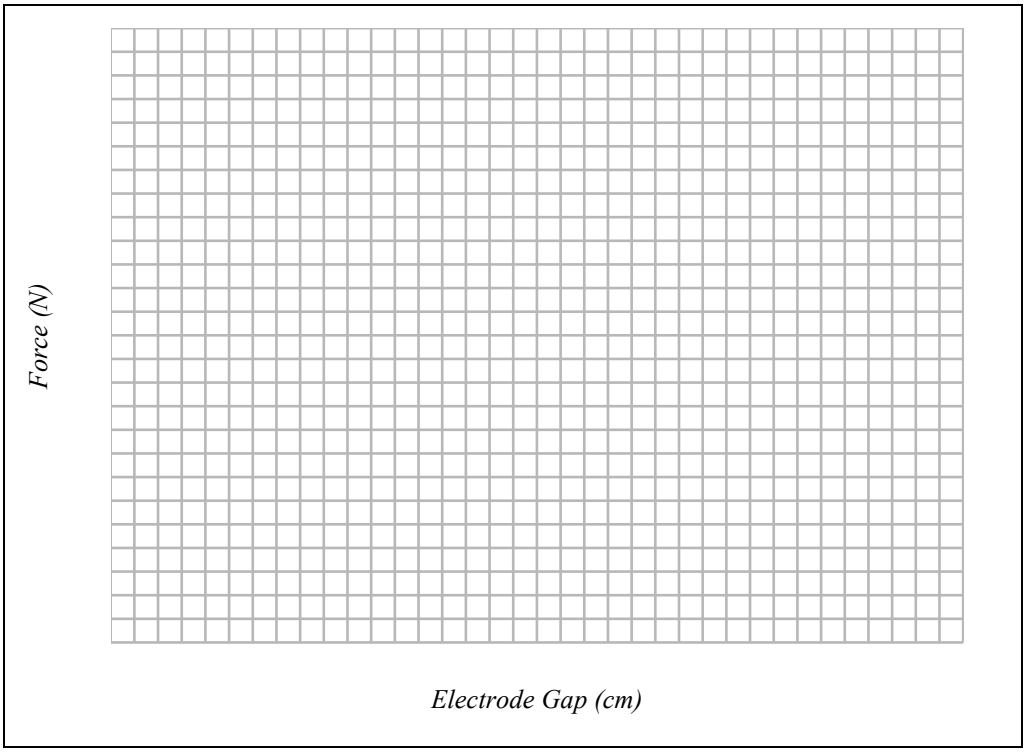
Make a table to collect data that reflects the table on the previous page and can be used to measure 3 different separation distances.

Having collected the data calculate the force and fill in the table below

	Force	Separation Distance
Measurement 1		
Measurement 2		
Measurement 3		

Analyze Results

Start by plotting the force distance data from the previous page



In your group discuss the following questions

- If you draw a line through the points (best fit line) what kind of line does it make?
- What trends do you notice from the data?
- What would you expect to happen at the extreme ends of the line?
- What could the type of technology be used for?

Please write done response to the following questions:

- Do you have any suggestions on improving this lesson?

- Were the CREAM projects helpful or interesting?

- Are you interested in science and if so which field interests you the most?