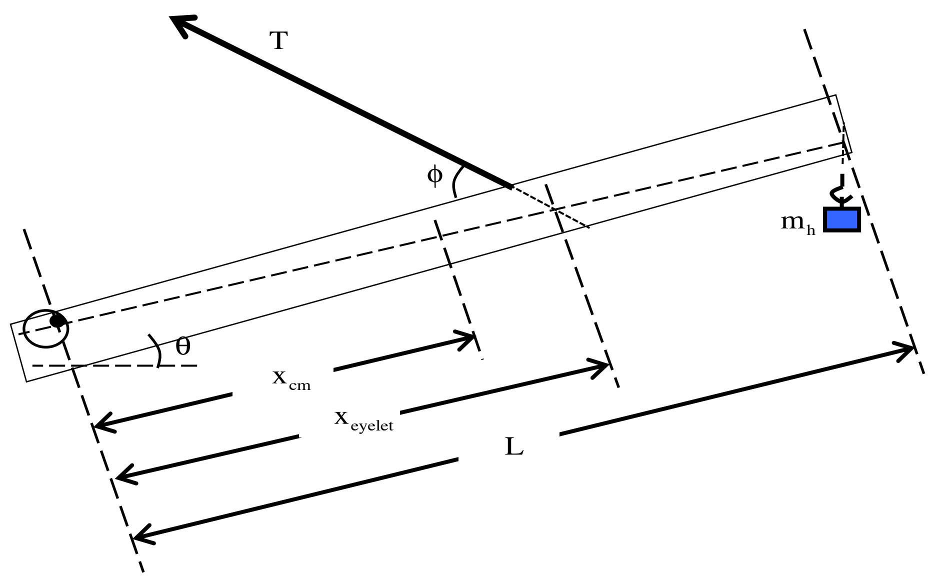
Truncated Rigid Body Lab (L-56c)

The rotational counterpart to force is torque, and just as the translational version of Newton's Second Law states that a *net force* acting on a body will be proportional to the body's *acceleration*, the rotational version states that a *net torque* acting on a body will be proportional to the body's *angular acceleration.*

It stands to reason that the most bare-bones N.S.L. problem possible, then, would be one in which the sum of the force (in any direction) and the sum of the torque (about any point) would sum to zero (leaving the acceleration terms zero and the right-hand side of N.S.L. zero).

That is what rigid body problems are. Situations in which a body, due to the forces being applied, sits in equilibrium. The body you will be dealing with in this lab will be a pinned beam with a cable attached to provide tension support. A sketch of the set-up is shown below.



For data taking:

1.) Turn the computer on and open the Logger Pro program. Connect a Force Transducer and check to see if it is calibrated. If not, calibrate it. Note that once you get it placed in the system, you will have to zero it.

2.) Set up the system. A mock set-up will be shown at the front of the room.

3.) Place a 100 gram mass at the end of the beam (i.e., on the hook at the end) and record the tension in the line using the Force Transducer.

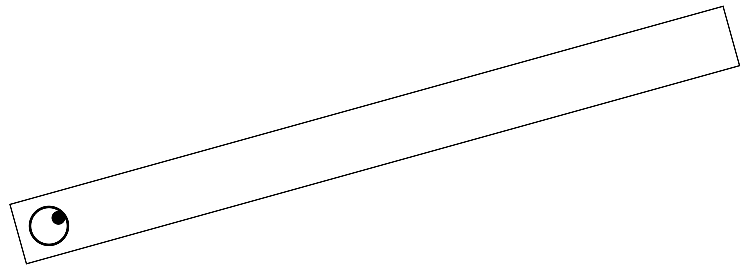
4.) Make the measurements identified in the sketch above (three lengths and two angles). List them below along with the mass of the beam.

m_{beam} = m_h = L = x_{cm} =

x_{eyelet} = θ = ϕ =

For Write-up:

1.) Starting with a f.b.d. on the beam (use the sketch provided to the right). Note that the force components at the pin should be H and V.



2.) Using the parameters defined in the sketch, derive an algebraic expression for the theoretical tension T_{theo} in the cable. (Hint: All you need to do is sum the torques about the pin to do this.) Do not put in any numbers yet!

3.) Using the equation derived in #2 and the values measured during class, determine the theoretical tension required to hold the beam in place.

4.) Do a % deviation between the experimentally observed and theoretically calculated tension in the line. $\% \text{ deviation} = \frac{|\text{theo} - \text{exp}|}{\text{theo}} \text{x}100$. Comment *briefly* on what this tells you.