Modeling the Human Arm as a Lever– Prelab Quiz

Answer these questions after reading the "Engineering an Arm" assignment. Submit your answers via Blackboard as either a MS Word (.docx) or MS Excel spreadsheet file (.xlsx). Be sure to show all of your work so that partial credit can be given.

1. **[5 points]** A meter-long, massless rod is fixed so that it can rotate freely around one end as shown in Figure 0.1. A mass is hung from the free end of the rod to produce a downward force of $\vec{F}_o$. A wire supports the rod at 20cm from the pivot point.
   - What force, $\vec{F}_i$, does the wire exert to keep the rod horizontal?
   - How large, and in which direction, is the force at the pivot?

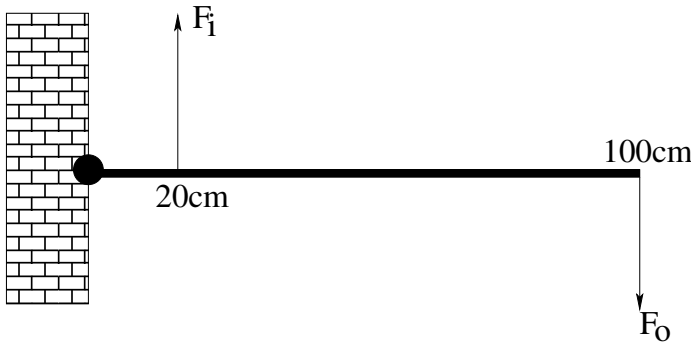

Figure 0.1

2. **[5 points]** The mechanical advantage is given in the assignment by Equation 3.4:

$$\text{MA} = \frac{|\vec{F_{out}}|}{|\vec{F_{in}}|}. \tag{3.4}$$

   For a system in rotational equilibrium, derive an alternative expression for the mechanical advantage.

   Hints: Use the expression for torque in Equation 3.2 to replace $\vec{F}$:

$$\vec{\tau} = \vec{r} \times \vec{F}. \tag{3.2}$$

For a system in equilibrium, what does Equation 3.5 indicate for $\vec{\tau_{in}}$ and $\vec{\tau_{out}}$?

$$\sum_i \vec{\tau}_i = 0 \tag{3.5}$$