Lever Lab: Conceptual Physics **Name_________________________ Date ______**

<u>Purpose</u>: The purpose of this lab is to learn how to calculate the mechanical advantage of levers.

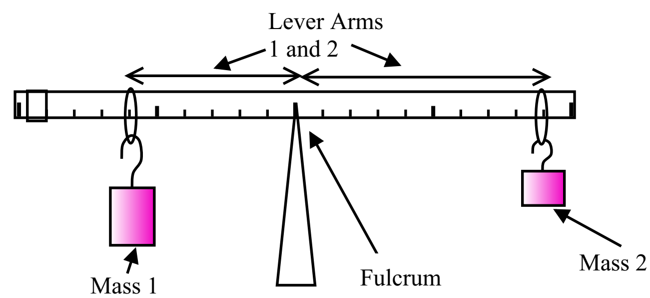

Figure 1

<u>Lever Procedure</u>:

<u>PART 1</u>

1. Choose two <u>different</u> masses to act as your "input" and "output" forces on the lever. The masses should be between 20 and 200 grams. You may use the masses which are already on the lever, or choose different ones.
2. Hang the masses on the lever as shown in Figure 1. Either mass can go on either side. Adjust the positions of the masses until the lever stays in one position. The lever does <u>not</u> have to be perfectly horizontal.
3. Measure the lever arms, the <u>distances</u> from the fulcrum to each mass hanger. (The hanger may be a metal clip, a string, or a rubber band.) Do NOT record the number the mass hangs at and just call that the lever arm. Example, if one mass is hanging at the 18.5cm mark, and the fulcrum is at 50 cm, then Lever Arm 1 = 50 – 18.5 = 31.5cm.
4. Record the masses and the lever arms, in grams and cm.

   Mass 1 = ____________________ Mass 2 = ____________________

   Lever Arm 1 = ____________________ Lever Arm 2 = ____________________

5. Calculate the mass ratios and lever arm ratios:

   $\frac{\text{Large Mass}}{\text{Small Mass}}$ = = $\frac{\text{Long Lever Arm}}{\text{Short Lever Arm}}$ = =

   These numbers should be very close to equal. If they are not, check your measurements and math.

<u>PART 2</u>

6. Choose two new different masses. Calculate the ratio of the large mass to the small one.

   Mass Ratio = $\frac{\text{Large Mass}}{\text{Small Mass}}$ =

7. Choose a location on the left side of the meter stick to hang the small mass. The "location" is the actual reading on the meter stick, <u>not</u> the distance from the fulcrum.
   (Choose a position at least 20 cm away from the fulcrum.) Location = ________ cm
8. Calculate the lever arm for the small mass. Lever arm 1 = _______________ cm
9. To balance, the large mass should be located <u>closer to</u> the fulcrum than the small mass is. The ratio of lever arms should equal the ratio of the masses. Calculate what Lever Arm 2 (for the large mass) should be.
   Lever Arm 2 = Lever Arm 1 ÷ Mass ratio

   = = _____________ cm
10. Calculate the <u>position</u> of the large mass. <u>Predicted</u> Position = _____________ cm.
11. Hang the large mass at the Position that you just calculated. If the lever does not balance, adjust the <u>large mass only</u>, 1 millimeter at a time, until it balances. Record the actual position.

    <u>Actual</u> Position = ____________ cm

Conclusion Questions

1. What is the relationship between the forces and distances on a balanced lever?

2. What is the relationship between the lever arms and how far up and down the masses move?

3. Which mass always ends up on the short end of the lever?

4. If you want to put in a small force and get out a big force on the other end, what do you have to give up?

5. What would be the purpose of using a lever in which you put in a big force and got out a smaller force on the other end?

Challenges:

1. Amy wants to place a 100-gram mass at the 30 cm mark on a meter stick, and a 50-gram mass at the 15 cm mark. Where should she place a 200-gram mass to make the meter stick balance?

2. Get a pair of bolt cutters and measure the lever arms and how far you have to spread the handles to make the jaws move a certain distance. Calculate how much the bolt cutters increase the force you put in.

3. If we place the fulcrum exactly at the center of the meter stick, why might the meter stick itself still tilt to one side instead of being balanced?