I. Washers

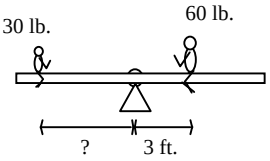
A. Suppose you had an object that you suspected had a mass of one half of one of the washer+paperclip units you used in tutorial. (In the rest of this problem we'll call that a "washerclip.") Describe how you could use the balance you used in tutorial and a single washerclip to check this.

B. How could you use the balance to check that an object had a mass of one-fifth of one of your washerclips?

C. Suppose you had a single washerclip and an object that you suspected had a mass of 5 washerclips. How could you use your balance to check this?

II. See-saw

A. A 60-pound girl sits on a see-saw, 3 feet to the right of the pivot. How far to the left of the pivot should her 30-pound little brother sit in order to balance the see-saw? Answer using any kind of reasoning you want.



B. Now a 54-pound boy sits 2.7 feet to the right of the pivot. Where should his 45-pound friend sit in order to balance the see-saw? Answer using any kind of reasoning you want.

C. Here's how two different students approached part A.

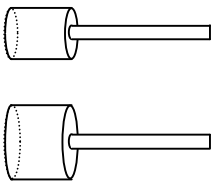
Elizabeth: Since the little brother is half as heavy as her sister, he must sit twice as far from the pivot in order to "compensate" for his lower weight—6 feet instead of 3 feet.

Jill: I used the formula for torque, $\tau = Fr$, where F is force and r is distance from the pivot. Here, the relevant forces acting on the see-saw are gravitational, the weights of the children: F_1 = 60 pounds and F_2 = 30 pounds. The big sister sits r_1 = 3 feet from the pivot, and we're solving for r_2. The torques must balance: $F_1r_1 = F_2r_2$. I plugged in the numbers to get (60 pounds)×(3 feet) = (30 pounds)×r_2, and solved for r_2 to get 6 feet.

1. The two students got the same answer. Did one (or both) of them get lucky, or are both kinds of reasoning valid? Explain.

2. Are Jill and Elizabeth's reasoning fundamentally the same, fundamentally different, or a mix of those two extremes? Explain.

III. Screwdriver



You need to loosen a really stuck screw. You have a choice between two screwdrivers, both of which you can grip very well. The only difference is that one of them, the bottom one of these drawings, has a thicker handle than the other. Which screwdriver, if either, will be more effective at loosening the stuck screw (or will they be the same)? Why?

