1. Consider a single house in Herculaneum, *The House of the Tuscan Colonnade*, also analyzed by the Watts. The floor plan is shown below.

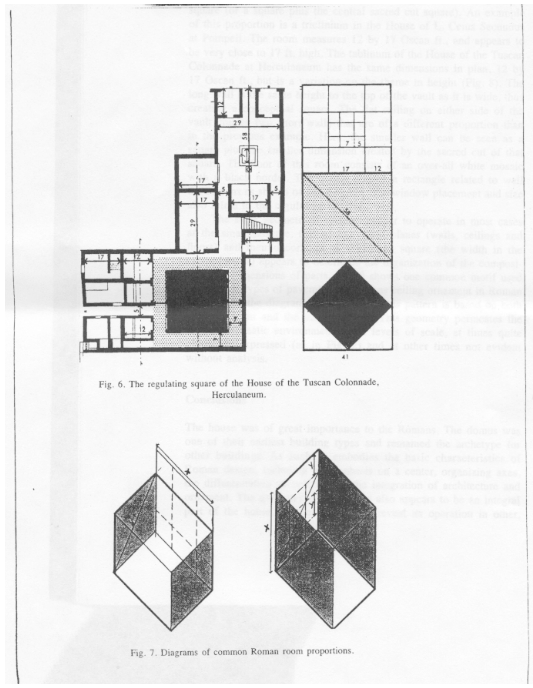

Fig. 6. The regulating square of the House of the Tuscan Colonnade, Herculaneum.

Fig. 7. Diagrams of common Roman room proportions.

The Watts measure the dimensions in Oscan feet – the Oscans were an early Italic people who built the original walls and towers of Pompeii, and may have founded Herculaneum. As you can see in the floor plan, the Watts found the following dimensions:

5   12   17   29   41

Check to see whether ratios of these numbers fall within the acceptance ranges of Sacred Cut ratios. (The acceptance ranges can be found through the link for "In Class Displays and Works", for February 6.)

2. Suppose you are going to be testing several works of art and architecture to see whether your favorite ratio appears. As we did in class, you are assuming that your measurements will be within 1% of the actual lengths, and so you are assuming that the ratios will be off from the

actual ratio of the lengths by no more than 2%. Find the *acceptance range* for your ratio, if your favorite ratio is:

(a) The Golden Ratio, $(1+\sqrt{5})/2$.

(b) $(\sqrt{7}-\sqrt{5})/3$.

3. Suppose a Golden Ratio fanatic measures his box of cereal one morning and finds that the height of the box is 12.2" and the width is 7.8".

   (a) Is the ratio of the height to the width within our acceptance range for the Golden Ratio?

   (b) If the fanatic re-measures and decides he had been off by 1% in each of his measurements, might he be able to claim his cereal box was designed using the Golden Ratio, using our acceptance range?

4. Suppose you measure the length and width of a rectangle, paying attention to how accurately you are measuring. Your results:

$$\text{width } = 3 \text{ feet } \pm .02\% \qquad \text{length } = 6 \text{ feet } \pm .02\%.$$

   (a) Find the value of the ratio of the measured length to the measured width.

   (b) Find the range of values that the *actual* ratio of length to width could fall in. (That is, take into account the errors your measurements could have had.) *Remember:* the errors are percents, so you'll need to calculate what the actual error range is.

   (c) By what percent from the calculated ratio could the actual ratio vary?

5. For each of the following, you'll be drawing a line that is cut in mean and extreme ratio (i.e. the golden ratio).

   (a) Suppose we want to draw a line cut in mean and extreme ratio, and we want the short segment to be 3 units long. How long should the long segment be? Draw such a line as carefully as possible.

(b) Suppose we want to draw a line cut in mean and extreme ratio, and we want the longer segment to have length 3. How long should the shorter segment be? Draw such a line as carefully as possible.

(c) Suppose we want to draw a line cut in mean and extreme ratio, and we want the short segment to be 5 units long. How long would the whole line be? Draw such a line as carefully as possible.

(d) Suppose we want to draw a line of length 6 that is cut in mean and extreme ratio. Where should we place the cut? Draw such a line, as carefully as possible.

Look at all of the lines with cuts that you've drawn. Do they look the same or different? (You don't necessarily have to address this in what you turn in, I just want you to pay attention to the big picture!)

6. Suppose we don't happen to agree with Euclid and all those crazy Greeks about balance between extremes. So we define our own standard of beauty and all that, beginning with the ideal way to cut a line. Here's ours:

   A line is said to be cut in a **very cool** *ratio when the greater segment is to the lesser segment as twice the whole is to the greater.*

   (a) What *is* this very cool ratio?

   (b) Suppose we want to draw a line cut in a very cool ratio, and we want the short segment to be 3 units long. How long should the long segment be? Draw such a line as carefully as possible.

   (c) Suppose we want to draw a line cut in a very cool ratio, and we want the longer segment to have length 6. How long should the short segment be? Draw such a line as carefully as possible.

   (d) Suppose we want to draw a line cut in a very cool ratio, and we want the short segment to be 5 units long. How long would the whole line be? Draw such a line as carefully as possible.

   (e) Suppose we want to draw a line of length 6 that is cut in a very cool ratio. Where should we place the cut? Draw such a line as carefully as possible.

7. Next, suppose a splinter group in the class neither agrees with Euclid nor with the very cool ratio advocates. They feel strongly that the most beautiful way of cutting a line is as follows:

   > *A line is said to be cut in an* **absolutely fabulous** *ratio when the greater segment is to the lesser segment as the whole segment is to twice the greater.*

   (a) What *is* this absolutely fabulous ratio?

   (b) Discuss the issue of the short segment versus the long segment.

8. You want to paint a picture, and you want the canvas to be in the shape of a Golden Rectangle – that is, you want the ratio of the length of the long side to the length of the short side to be φ. If the short side of your canvas is 2' wide, how long should you make it be?

9. *Challenge Problem:* In the regular pentagram shown below, show that the ratio of the length of AC to the length of AH is φ. *Hint:* You may want to use that $\overline{HJ} = \overline{HC}$, and you may want to use similar triangles.