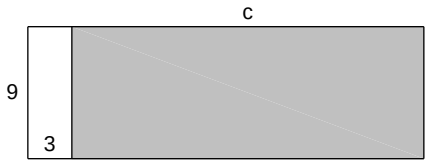
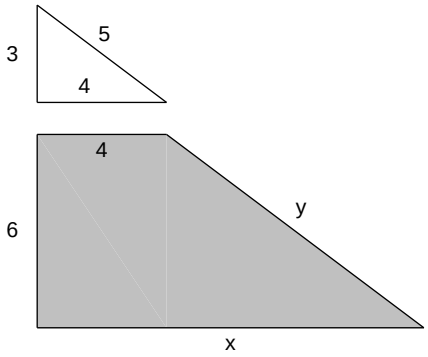
This problem set will not be collected, so that you can use it in your studying. Nonetheless, you should have it completely done by Monday or at the latest, by Tuesday.

1. Find the length of c of the shaded rectangle so that it is a gnomon to the white rectangle with sides 3 and 9.

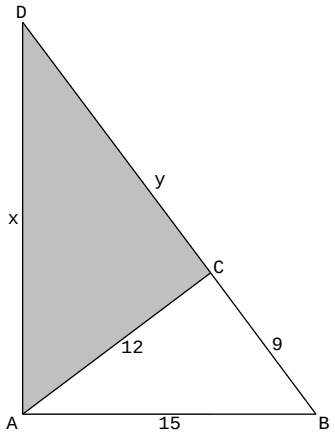


2. Find the values of x and y so that the shaded figure is a gnomon to the white triangle.



3. Rectangle A is 10 by 20. Rectangle B is gnomon to rectangle A. What are the dimensions of rectangle B?

4. Find the values of x and y so that the shaded triangle is a gnomon to the white triangle ABC.

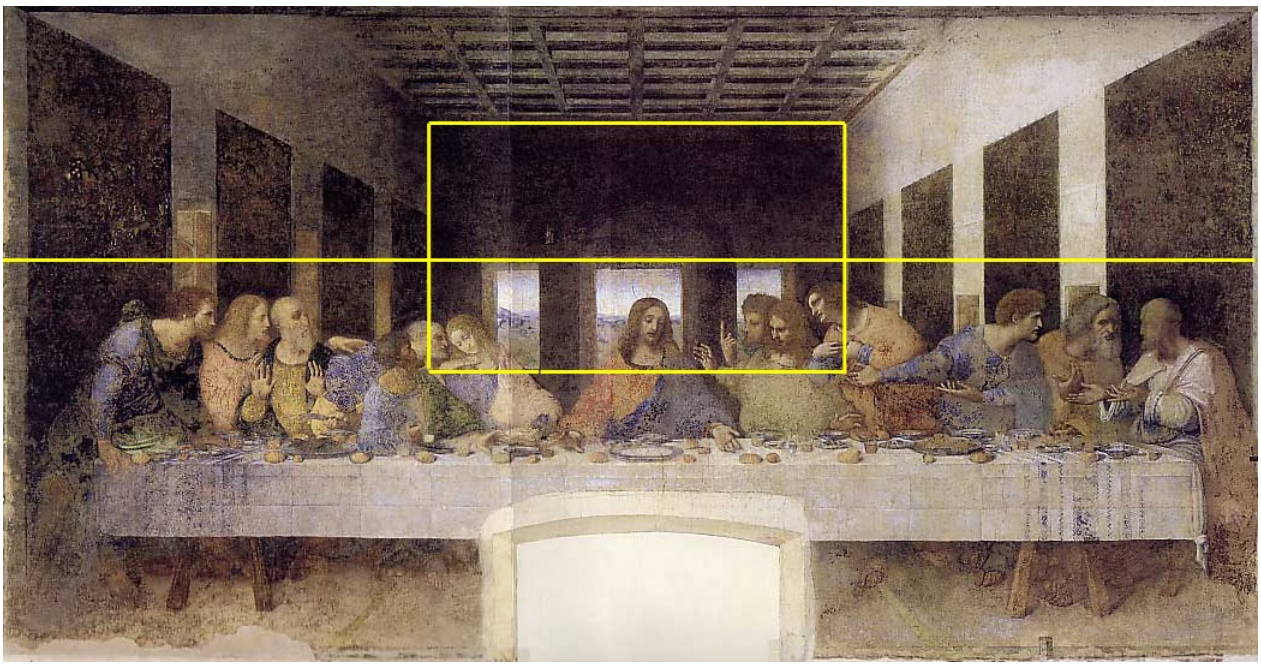


5. A rectangle has a 10 by 10 square gnomon. What are the dimensions of the rectangle?

6. In this problem, you will be studying Leonardo da Vinci's *Last Supper*, and (ultimately) deciding whether you believe he was intentionally trying to incorporate the Golden Ratio. Measure as carefully as you can.

   (a) Find the acceptance range for φ based on a 3% margin of error in measurement (which will allow for a 6% margin of error in your ratios).

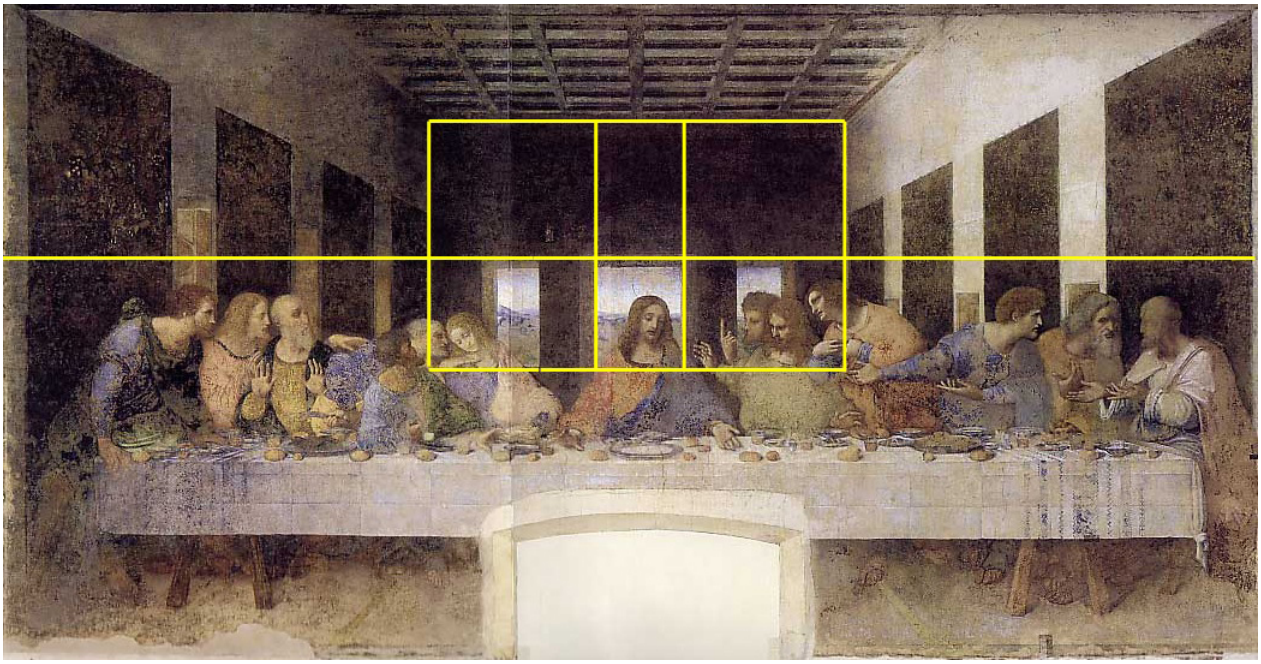
   (b) Below, I have super-imposed a horizontal line that follows the tops of the insides of the windows on the rear wall all the way to the edges of the mural. Does that line cut the height of the painting into Extreme and Mean Ratio?



   (c) In the above figure, I have also outlined the rectangle formed by the rear wall, down to the bottoms of the windows. Is it a Golden Rectangle (within our margin of error)?

   (d) Also in the above figure, does the long horizontal line cut the height of the rear-wall rectangle in Extreme and Mean Ratio?

(e) Below, I have super-imposed two vertical lines that extend upward the vertical lines that separate the light of the outdoors from the interior darkness, thus forming on both the left and right a rectangle that's subdivided into a top part and a smaller rectangle below. Carefully measure the larger rectangles (the ones that go from the top of the wall down to the bottom of the windows, and from the edges of the walls to the window behind Jesus), and determine whether they are Golden (within our acceptance range).



(f) Carefully measure the smaller rectangles (to the left and right of the central window), and determine whether they are Golden (within our margin of error).

7. Below is a list of works of art often said to incorporate the Golden Ratio. Please pick one (or more), and photocopy it from a book. (Avoid printouts from the web, as they can be distorted in shape, and so your results will not mean much.)

   - Dürer's *Adoration of the Magi*
   - Da Vinci's *Mona Lisa*, *St. Jerome*, *A Head of an Old Man*, or *Annunciation*
   - Michelangelo's *David*
   - Seurat's *The Bathers*
   - Mondrian's *Place de la Concorde*
   - Gris' *The Watch* (aka *The Sherry Bottle*)

   Once you've chosen your painting,

   (a) Really look at it, and try to think of as many ways as possible that the Golden Ratio may have been used.

   An artwork may incorporate the Golden Ratio in many ways. One obvious way would be if the painting itself were a Golden Rectangle, but there are lots of other possibilities:

   - a line in the painting may be cut in the Extreme and Mean Ratio
   - a rectangle in the painting may be a Golden Rectangle. Such a rectangle may be explicit, or it may be formed by using four features in the painting as corners.
   - an isosceles triangle in the painting may be a Golden Triangle (that is, the ratio of long side to short side may be the Golden Ratio). Again, such a triangle may be explicit, or three features may form the corners.
   - a rectangle fitting snugly around a figure in the painting may be a Golden Rectangle, and similarly for a Golden Triangle
   - a body might have been drawn so that various parts are in the Golden Ratio
   - the ratio of two distances between items may be the Golden Ratio, etc

Feel free, by the way, to read up on the claims relating to your choices on the web or in books. Just make sure you do the measuring yourself. Draw any lines as thinly as you can, as you're dealing with a much smaller version than the original, so a thin line on a shrunk version would correspond to a very thick line on the original.

(b) Measure all the distances you thought of in the previous part. Clearly label your measurements, and (as indicated in the previous part) draw the lines on the photocopy you're using.

(c) Decide upon an accuracy range for your measurements.

(d) Calculate all the ratios you thought of in the first part, including acceptance ranges for each.

(e) Does the Golden Ratio fall into any of these?

(f) Do you think the artist had the Golden Ratio in mind when creating this artwork? (This may not follow immediately from your previous results if, for instance, you think the Golden Ratio was close enough that it might have been intentional, even if it didn't fall into your ranges. After all, your ranges only reflect your measurement range, not any adjustments or errors the artist might have made.)