

136.102 Math in Art
Midterm Exam
February 25 2003
(70 minutes)

Important: The phrase “unmarked ruler” stands for any ruler that may be used only as a straight edge to draw straight line segments. When you use a compass, show the (intermediate) circular arcs you draw in your constructions (do not erase them – they justify the steps you have used in the constructions and I consider them when marking).

1. (a) Use an unmarked ruler and a compass to find the golden cut C of the line segment AB .
(b) Use an unmarked ruler and a compass to construct a golden triangle with basis equal to the length of the segment CB and the lengths of the other two sides equal to the length of the line segment AC (make a separate picture for (b)).

A ————— B

2. List all of the symmetries of the objects **A** and **B** below.

[If you list a rotation as a symmetry then say “a rotation centered at O and for an angle of x many degrees”, where O is a point you should identify in the picture, and x is a specific angle measure you should find.

If you list a reflection as a symmetry then say “a rotation with respect to the line l (or however you call it), where l is a line you should sketch.

You do not have to justify or precisely construct anything in this question]

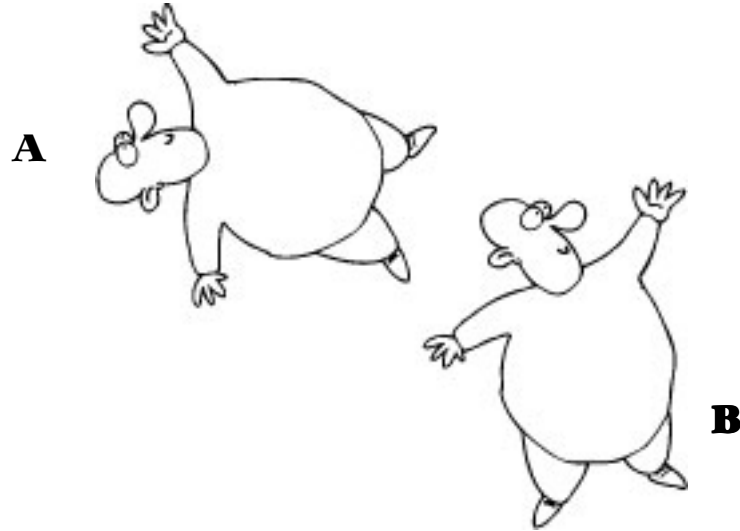


Object A

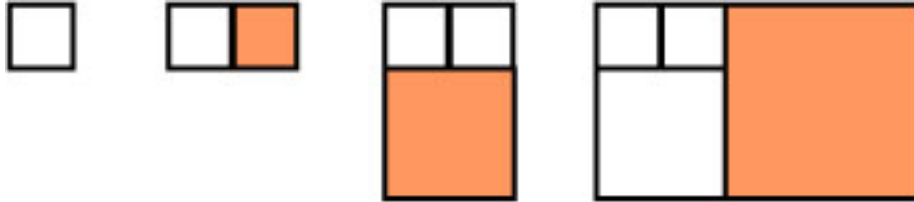


Object B

3. (a) The object B is obtained from the object A by rotation. Use an unmarked ruler and a compass to construct the center of the rotation.
- (b) The object D is obtained from the object C by reflection. Use an unmarked ruler and a compass to construct the line of reflection.



4. We construct a sequence of rectangles by adding squares over the larger sides of the rectangles (see the picture; assume that the length of the side of the initial square is 1 unit). Draw the next rectangle in this sequence and explain (in not more than 2 sentences) how are the shorter sides of the rectangles in this sequence related to the Fibonacci numbers.



5. The first two stages of a construction of a fractal are given in the picture below. Notice what has been done with each of the line segments of Figure 1 in order to get the shape in Figure 2, and draw the shape obtained after applying this procedure one more step.

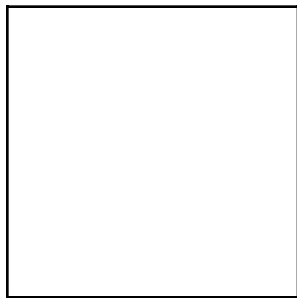


Figure 1.

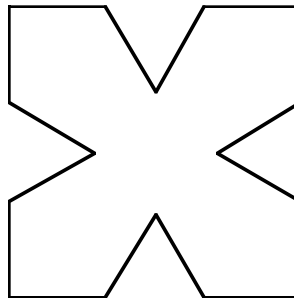


Figure 2.

