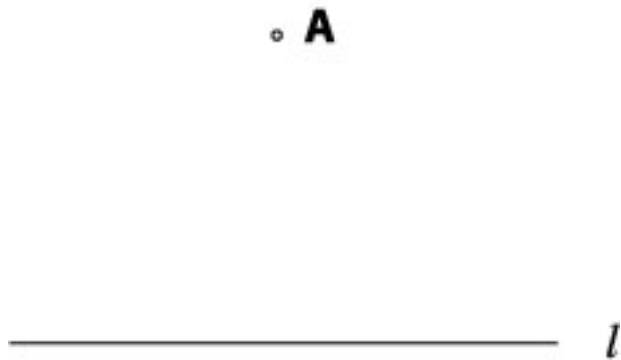


136.102 (056.102)

Final Exam

Show your work. Leave clear sketches of the intermediate steps you make in the construction. Clarity in your pictures will be appreciated and may affect the marking. Accompany your constructions with short descriptions of the steps you make.

1. (a) Use a ruler and a compass to construct a line through A perpendicular to l .



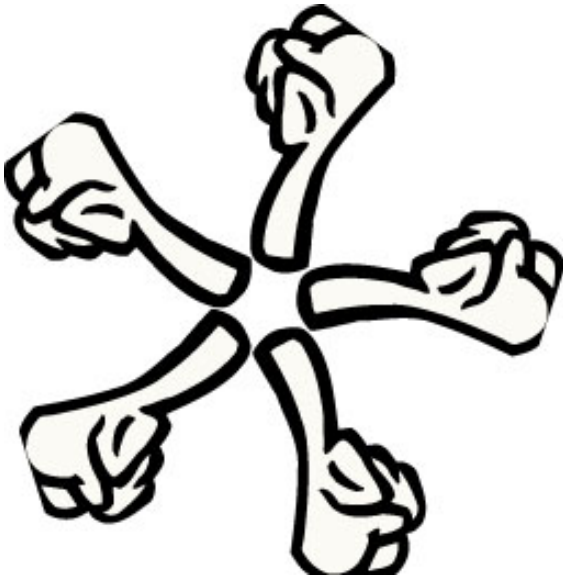
- (b) Use a ruler and a compass to construct a line through A parallel to l .



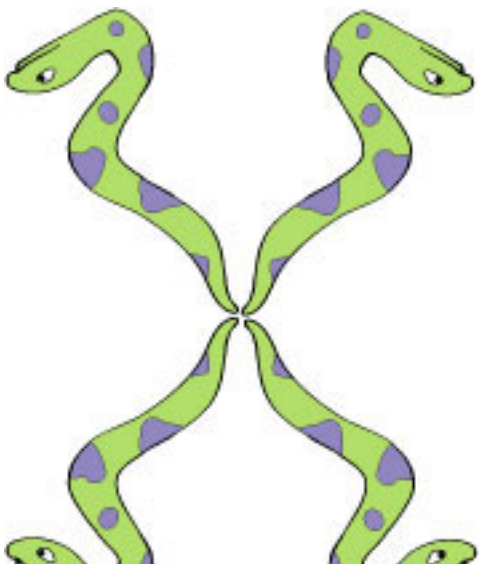
2. Find the symmetries of the following objects.

[If you list a rotation as a symmetry then identify the center and the angle of rotation. If you list a reflection as a symmetry then identify the line of reflection.]

(a)



(b)



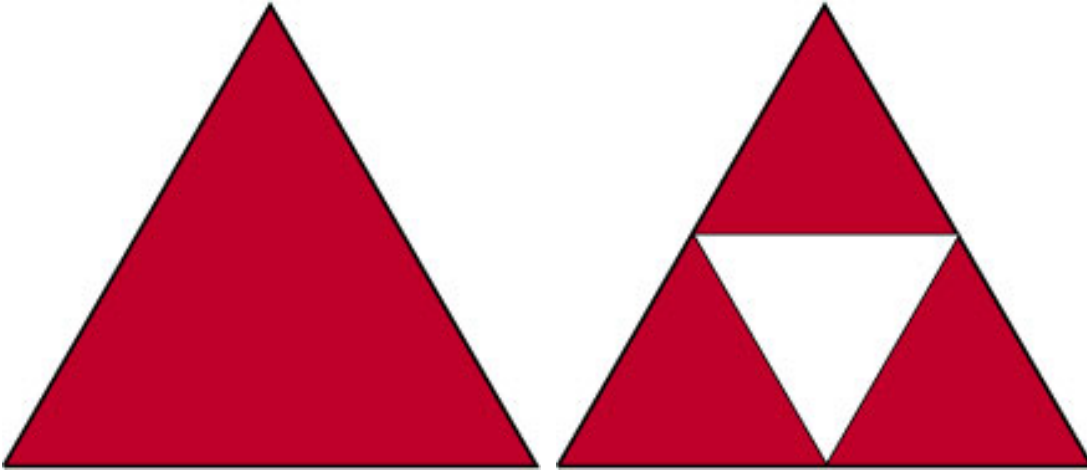
3.

(a) Construct (using a ruler and a compass) an acute golden triangle.

(b) Copy the triangle constructed in (a) and use a ruler and a compass to subdivide it into one acute and one obtuse golden triangle.

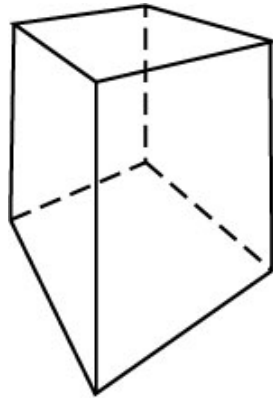
(c) Copy the triangle constructed in (a) again and use it to construct (using a ruler and a compass) a regular pentagon.

4. (a) The first two stages of a construction of a fractal are given in the picture below. Notice that the object in the second picture is made of three new smaller triangles (the middle small triangle has been removed). Draw the shape obtained after applying this procedure one more step.



(b) Suppose the area of the first large triangle is 4 units. Find the area of the object obtained (after correctly solving) in part (a).

5. The following is a perspective drawing of a cube. Find (construct) the vanishing points and the horizon line.



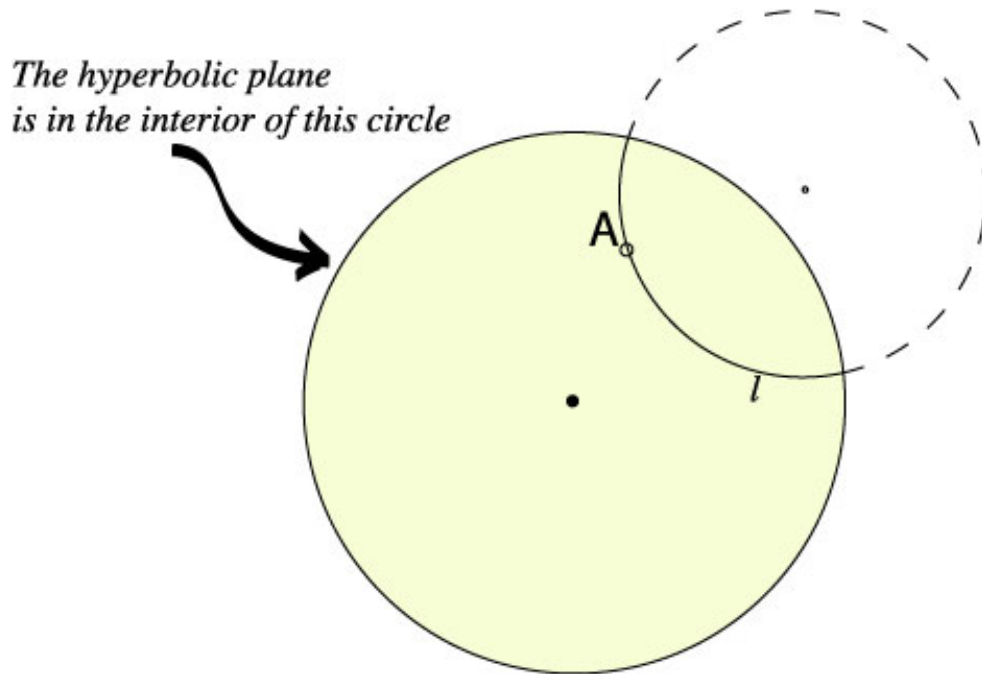
6.

(a) Construct (using a ruler and a compass) a golden rectangle (Do not make a miniature rectangle – you will need to draw something in it in the next question).

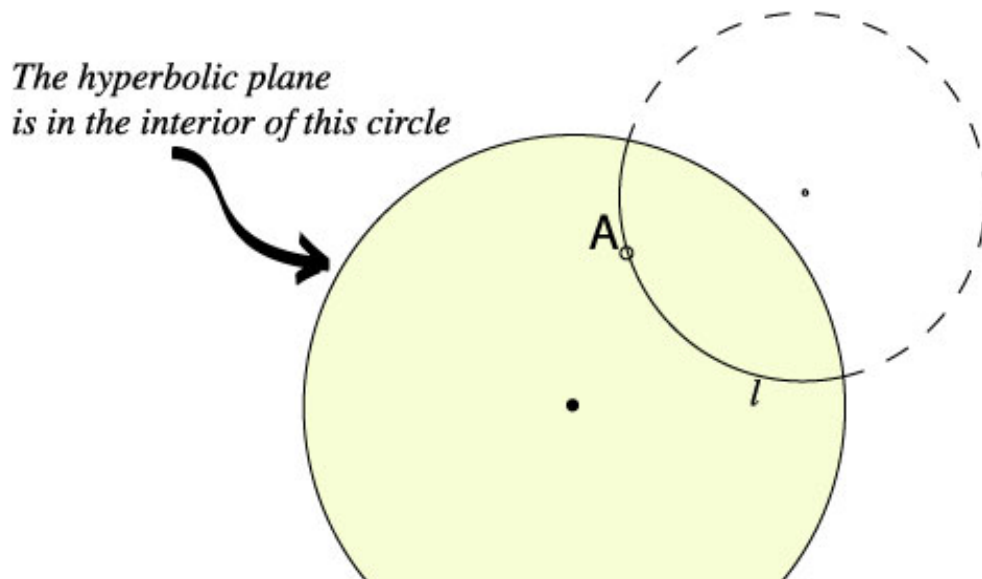
(b) Copy the rectangle constructed in (a) in a separate picture and use strings (tangents) to inscribe an (approximation of an) ellipse in it.

7.

(a) Construct a hyperbolic line through the point A and perpendicular to the given hyperbolic line l .



(b) Construct one (any) hyperbolic line that is parallel to the given hyperbolic line l .



8. Show that the scissors in the picture are homotopically (topologically) equivalent to the eyeglasses-frame by drawing at least 3 in-between sketches showing how the scissors can be continuously deformed into the frame.

