

Name: _____

Math 203: Contemporary Mathematics

Chapter 2 test

Thursday, January 29, 2009

60 points

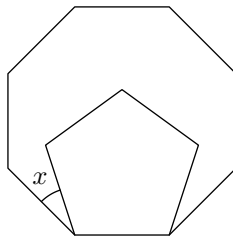
Instructions:

1. Do **TWO** of the following five questions. Each question is worth 30 points. Write your solutions on the scratch paper provided. Be sure to label which problems you're doing, put your name on each page, and staple your pages together when you hand them in.
 2. Read each question carefully. If you have any questions, please ask.
 3. Answer the questions clearly and completely. Justify all of your answers. Most of the points you receive will be based on the accuracy, completeness, and clarity of your responses. Use full sentences, and avoid saying things that are untrue, ambiguous, or nonsensical.
 4. You may use a calculator for this test, but you may not use a book or any notes.
 5. Give your answer to each question completely and clearly.
 6. Erase or cross out work you do not wish to be graded.
 7. You have 25 minutes to complete this test. Good luck!
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Question 1. (Tilings and geometry.) The formula for the degree measure of a vertex angle in a regular n -gon is

$$\frac{(n-2)180^\circ}{n}.$$

- (a) (10 points) What is the measure of a vertex angle in a regular pentagon? in a regular octagon?
- (b) (10 points) The following picture is made from regular polygons. Find the measure of the angle x .



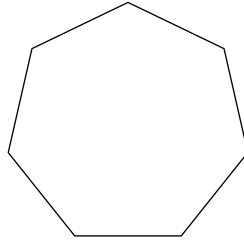
- (c) (10 points) Can an edge-to-edge semiregular tiling be made up of regular pentagons and regular octagons? If so, provide a sketch. If not, provide an explanation.

Question 2. (Polyominoes.)

- (a) (15 points) The handout about polyominoes described three common conventions for distinguishing polyominoes (i.e., deciding whether two polyominoes are different or the same). Describe the differences between these three conventions. (Feel free to draw some pictures as part of your explanation if you think it helps.)
- (b) (15 points) Choose one of these three conventions, and draw all of the pentominoes according to the convention you chose. (Hint: You should get 63, 18, or 12 pentominoes, depending on which convention you choose.)

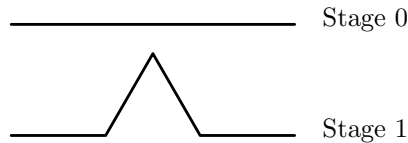
Question 3. (Symmetry.)

- (a) (10 points) Draw all of the lines of reflection symmetry in the following regular heptagon. How many lines of reflection symmetry does it have? In general, how many lines of reflection symmetry does a regular n -gon have?



- (b) (10 points) Draw a shape that has reflection symmetry but not rotation symmetry. Show the line of symmetry.
- (c) (10 points) Draw a shape that has rotation symmetry but not reflection symmetry. Describe the rotation symmetry (how many degrees do you need to rotate the shape to have it look the same?).

Question 4. (Fractals.) The first stage of a fractal called the Koch curve is a single line segment. Each of the following stages is formed by removing the middle third of each line segment and replacing it by an equilateral triangle with no base. The first two stages of the Koch curve are shown below. Assume the original line segment has a length of 27 units.



- (a) (15 points) Construct the next two stages of the Koch curve.
- (b) (15 points) Fill in the following table for the Koch curve at each stage.

Stage	Number of segments	Length of each segment	Total length of curve
0			
1			
2			
3			

Question 5. (Recursion.) The recursion rule, $a_n = 3a_{n-1} - 10$, is used to generate the numbers of a sequence.

- (a) (6 points) What is the rule for finding a_{10} ?
- (b) (10 points) If $a_6 = 85$, what are the values of a_7 and a_8 ?
- (c) (10 points) If $a_3 = 68$, what are the values of a_2 and a_1 ?
- (d) (4 points) If $a_1 = 5$, what is the value of a_{100} ? Explain how you know. (Hint: Start by finding a_2 and a_3 .)