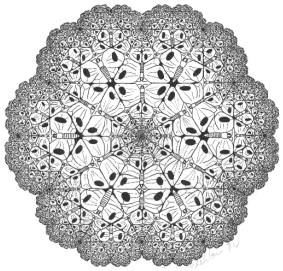
MATH 101 TEST 2 **Name:** _____

GEOMETRY AND NUMBER THEORY **Spring 2012**

DIRECTIONS: Be sure to show your work. You may use a calculator, but if work is not shown, you will not receive credit; write out the formula you are using, etc. Once the test is returned, the key will be posted outside my office. Use the key to check and correct your work. Keep this test to study from for the final exam.



1. As part of our geometry unit we studies fractal geometry, a relatively new branch of mathematics which is well-termed "The Geometry of Nature." In the lecture, through a NOVA video, and through a recent newspaper article we've seen many applications of fractal geometry. List two *specific* applications here:

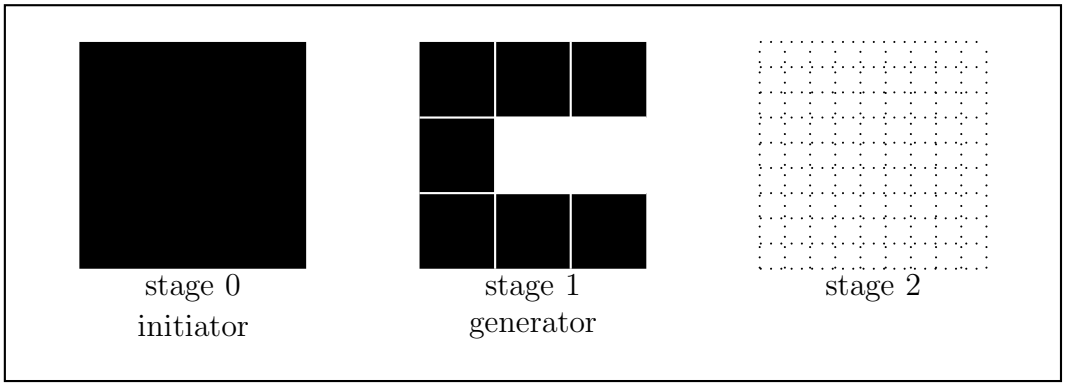
- _____
- _____

List the five characteristics of all fractals:

- _____
- _____
- _____
- _____
- _____

In our study of fractal geometry we considered a third way of looking at dimension. It's called self-similarity dimension. What does self-similarity dimension tell us?

2. The fractal whose initiator and generator are given below is called the "C Fractal." Given this initiator (stage 0) and generator (stage 1), draw stage 2 of this fractal. A grid has been provided to help you.



3. As we find fractal dimension and area our concern is about number and size.

How many pieces is the **edge** cut into as you move from stage 0 to stage 1? ____

What size are the smaller squares in stage 1 compared to the large square in stage 0? ____

What size are the smaller squares in stage 2 compared to the large square in stage 0? ____

How many smaller squares have we kept in stage 1? ____

How many smaller squares have we kept in stage 2? ____

4. Find the self-similarity dimension of the C Fractal. (Remember to show work.)

5. Assuming that the area of the original square (the initiator) is 1 square unit, find the area of the C Fractal. Be sure to show your work, which should include a geometric series in some way. No credit will be given for an answer not supported by work.

6. Count to twenty-five using Mayan numerals. Use the chart to record your numbers.

one	two	three	four	five
six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen
sixteen	seventeen	eighteen	nineteen	twenty
twenty-one	twenty-two	twenty-three	twenty-four	twenty-five

7. Beginning with the number one, count to twenty-five in base three. Put your numbers in the blanks starting in the upper left-hand corner and going left to right:

one	two			

8. Answer the following questions about positional systems.

a) What is the value of the base 5 number 234_{five} in base 10? _____

b) How do you write twenty-three in base 2? _____

c) How do you write two in base 2? _____

d) How do your write five in base 5 _____

e) Given the answers to parts c and d of this question, how do you think you write ANY number in *its own* base?

_____

9. Add or subtract as requested below:

a) Add 234_{five} to 413_{five}

a) Subtract 234_{five} from 413_{five}

10. NUMBER TYPES:

a) Fill in the blanks with the next 6 Fibonacci Numbers:

1, 1, 2, 3, _____, _____, _____, _____, _____, _____

b) List all of the terms below that apply to the number 63:

prime, Mersenne prime, composite, deficient, perfect, abundant

c) In 1963 the 23^{rd} Mersenne Prime was found. This so excited people that a cancellation mark was created to celebrate it. This mark is shown in the picture below. Given the relationship between Mersenne Primes and perfect numbers, what is the other factor you would have to multiply this prime by in order to get a perfect number?

EXTRA CREDIT

Use your calculator and the Binet's Formula (given below) find the 42^{nd} Fibonacci Number.

$$F = \frac{1}{\sqrt{5}}\left[\left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n\right]$$