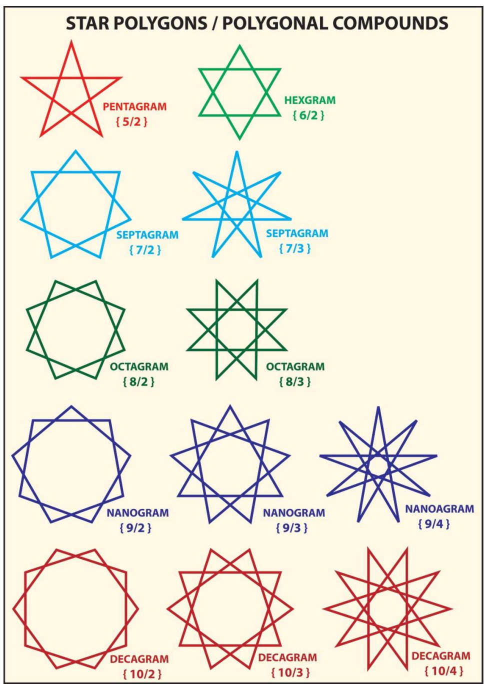
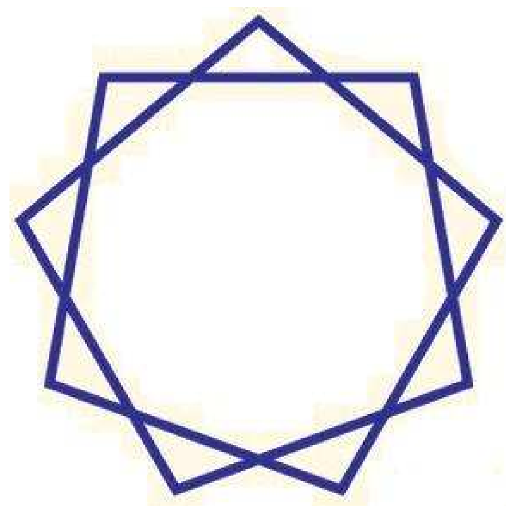
MATH 101 TEST 1 A **Name:** ______________________________

GRAPH THEORY AND GEOMETRY UNITS **SPRING 2012**

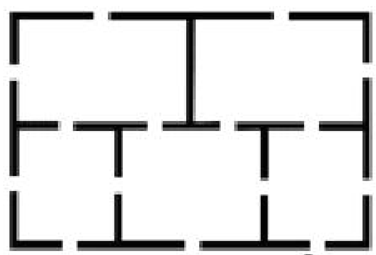
DIRECTIONS: Be sure to show your work. You may use a calculator, but if work is not shown, you will not receive credit; write out the formula you are using, etc. Keep this test to study from for the final exam. Each problem is worth 10 points.



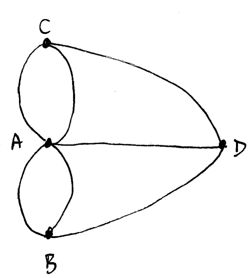
1. To the left is a partial table of stellated polygons. Find the angle measure of the tip of the figure labeled "nanogram {9/2}." It has been enlarged for you and reprinted directly below. Note that the interior is a regular nonagon.



2. The image below represents a building with five rooms. The openings are doors. Is it possible to go through each door *exactly* once without missing a door and without going through the same door more than once? Use the space to the right of the image to **draw** a graph that represents the situation. Use the space below the diagram and your drawing to **explain** in a few sentences whether this is possible and **why or why not**. **IF** it is possible be sure to explain whether or not it matters where you start. Your explanation should include supportive mathematical background information why the rule you are appealing to works. (NOTE: This is not exactly the same image you saw in the extended syllabus, so look carefully.)



3. In our first class session we explored the famous Königsberg Bridge Problem. You also had a number of exercises in section 9.1 of your text relating to this situation. We figured out that the bridges are not traversable. Can you blow up one of the bridges in order to create an **Euler CIRCUIT**? If so, which bridge should you blow up, and why does that give you an Euler Circuit? If not, why not? In either case, explain fully yet concisely.



4. Part of your exploration of the fourth dimension was to watch Dr. Edward Burger's Cherry Award Lecture on that topic. We also talked a bit about it in class, and you had further explanation in your Extended Syllabus. Though we, as three-dimensional creatures, cannot directly experience the fourth dimension we can figure out quite a lot about it through the use of mathematics and analogy.

QUESTION: If we could create a four-dimensional analog of a cube (a hypercube), how many ***faces*** (i.e. squares) would it contain? Give your answer as a number **and** support it using either a chart & pattern or a diagram or by expressing your mathematical reasoning logically in a few sentences.

Answer: ____________________

Support:

5. In our third week of class (before we got to fractals) we discussed TWO ways of defining dimension. State the name of each AND describe each very briefly and casually. Don't use pictures. Just tell me in words what each one means.

A) Name: ____________________________________

Description:

B) Name: ____________________________________

Description:

6. a) Circle the polygons in the list below that tessellate:

triangle square pentagon hexagon heptagon octagon nonagon decagon

b) Explain in one or two sentences why (mathematically) the polygons you've circled above tessellate and the others do not.

7. ***Hamiltonian Circuits***:

a) Does using the Cheapest Edge Algorithm guarantee that you will find the cheapest route possible, ***yes or no? Why or why not?*** (HINT: what do we call this type of method.) ***IF*** it doesn't, what would you have to do to find the cheapest route ***for sure***?

b) If a businessman lives in Los Angeles but must make a business trip that includes stops in San Francisco, Seattle, Denver, Las Vegas, Pheonix, Houston, Boston, Chicago and New York City how many different routes (i.e. Hamiltonian Circuits) are possible for this trip?

8. Given the flight costs in the chart below, use the Nearest Neighbor Algorithm to approximate the cheapest route if a businessman begins in San Francisco (SFO) and must travel to Atlanta (ATL), Boston (BOS) and Phoenix (PHX).

		From:						
		ATL	BOS	DEN	PHX	PORT	SFO	WASH
	ATL		\$104	\$144	\$357	\$467	\$154	\$74
	BOS	\$104		\$312	\$446	\$179	\$134	\$54
To:	DEN	\$144	\$310		\$156	\$122	\$192	\$175
	PHX	\$447	\$444	\$156		\$104	\$136	\$182
	PORT	\$216	\$177	\$122	\$104		\$84	\$492
	SFO	\$154	\$132	\$192	\$136	\$84		\$124
	WASH	\$74	\$52	\$175	\$182	\$492	\$144	

A) Fill in the blanks to give the route:

San Francisco $\longrightarrow$ ____________ $\longrightarrow$ ____________ $\longrightarrow$ ____________ $\longrightarrow$ San Francisco

B) What is the cost of this trip?

9. What is the length of the shortest network that can be formed in a rectangle that is 300 feet by 700 feet? Draw a picture of the network using the vertices given, show your work, and put your final answer in the blank.

Answer: ______________________ feet

10. Being sure to show your work, use the formulas we developed in class to find the following information about a regular ***dodecagon***:

a) What is its angle sum (all angles)?

b) What is its angle measure (one angle) ?

EXTRA CREDIT

Fill in the blanks. Each blank is worth one point. These come from the videos we watched. Even though I'm not testing you on fractal concepts yet, I'm anticipating that you can better recall the movie now than you will be able to by the time of the next test - and this serves as a bonus to those who were paying close attention.

In the video on the fourth dimension, Dr. Ed Burger had a mantra he kept repeating while creating shapes going from one dimension to the next. Over and over he said, "When life gets you down, ____________________________________." (Hint: it was a 4-word phrase.) In helping us understand the fourth dimension intuitively he shared many seemingly miraculous things we could do if we could harness the freedom of the fourth dimension. One of these was that we could perform surgery without ____________ ________________________. Of course I hope you realize he was being sarcastic when he told you what to write down as your answer for test problems in order to be sure to get full credit. His advice was to write, in bold letters: ________________________. He also told you what mathematicians do when they encounter hard problems. He said that "____________________________________."

In the NOVA presentation *Hunting the Hidden Dimension* we saw MANY applications of fractal geometry. Three of them were (specifically):

____

____

____

Some mathematicians were negative towards fractal geometry at first because they were too focused on shapes that were ____________________________________ instead. Because they require thousands of iterations (repetitions), it was not possible to fully develop fractal geometry until the invention of ________________________. One of the things that may have contributed to Benoit Mandelbrot becoming such a maverick mathematician was that, as a child, he grew up in ________________________ ____.

(For that last blank I'm looking for: when? where? and under what conditions?)