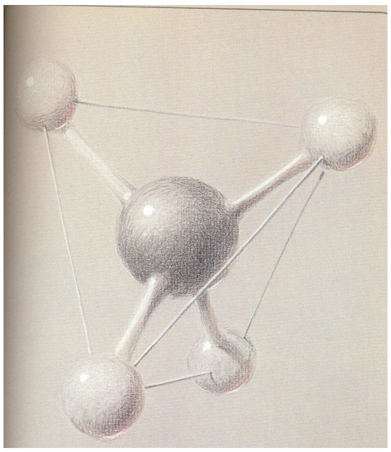
MAT115 Exam 2 (Fall 2016)

Name:

Directions: Show your work! Answers without justification will likely result in few points. Your written work also allows me the option of giving you partial credit in the event of an incorrect final answer (but good reasoning). Indicate clearly your answer to each problem (e.g., put a box around it). **Good luck!**

Problem 1: (10 pts)

a. At left is methane, a potent greenhouse gas increasingly responsible for global warming. What do you notice about it? (2 pts)



b. Fully complete the following table with the Platonic solids:

Name	Faces	Edges	Vertices	Faces at each vertex	Edges per face

c. (3 pts) Each Platonic solid has a "dual" solid.

i. What are the dual pairs?

ii. How do we know that these are the correct pairs?

Problem 2: (10 pts) Symmetry:

a. I've provided space below the figure for your answers: please put them there.

All these shapes are hexagons.

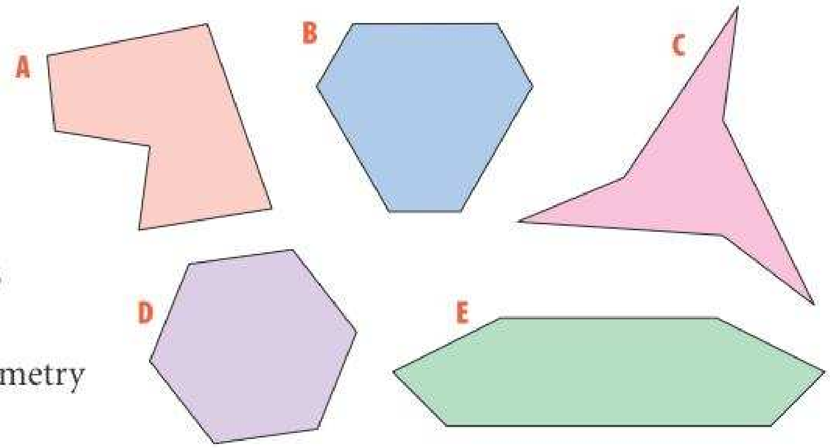
Which hexagon has

(a) only one line of symmetry

(b) rotation symmetry but no reflection symmetry

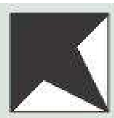
(c) rotation symmetry of order 3 and 3 lines of symmetry

(d) no reflection or rotation symmetry



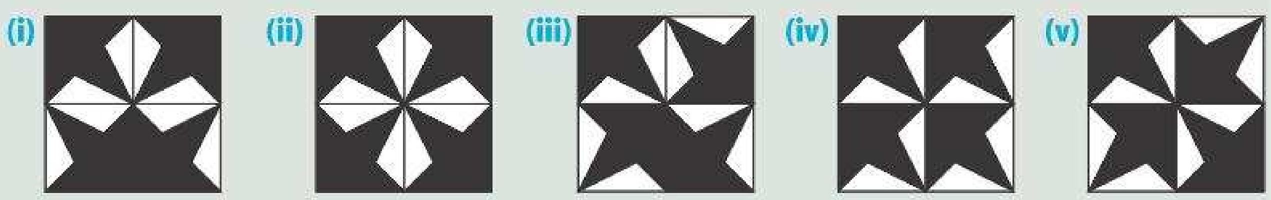
- (a)
- (b)
- (c)
- (d)

b. For Judith's problem, write your answer directly under each pattern in part (a); for (b), just fill in the proper pattern. If you mess up, draw another elsewhere on the paper.

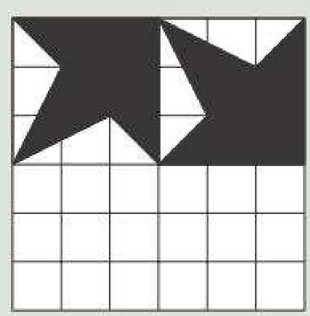
Judith has lots of tiles, all like this one. 

(a) Judith makes these patterns.

For each pattern, write down the number of lines of symmetry it has.
If the pattern does not have reflection symmetry, write 0.



(b) Copy and complete this tiling pattern so that it has rotation symmetry of order 4.



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Problem 3: (10 pts) Short answer:

a. While we did not focus on the Egyptians' method of writing numbers, we did notice something about their method in one of our readings, which I commented on in class. What was it? (or demonstrate some familiarity with their number system in some other way).

b. In your readings you discovered the importance of Arabic mathematicians. Demonstrate some familiarity with their contributions to mathematics. You might say something about Omar Khayyam, for example. What did he do that was related to our course?

c. What was interesting about Leibniz's harmonic triangle, and how did we use it in class?

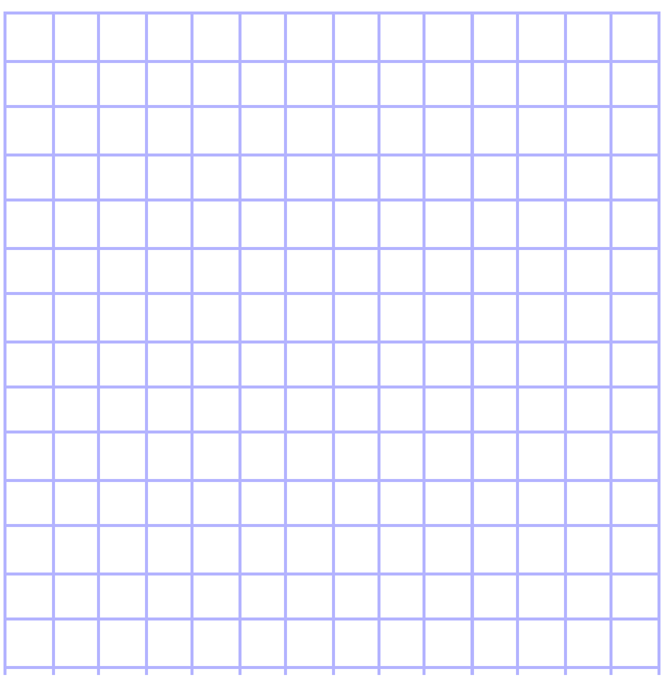
d. Harold Jacobs observes in his book chapter on Symmetry that playing cards are often symmetrical. What kind of symmetry would they have, and why would they be symmetrical?

Problem 4: (10 pts) The golden ratio ϕ was discovered in class in two different ways.

a. (2 pts) What is the true value of ϕ? What is its four digit approximate value?

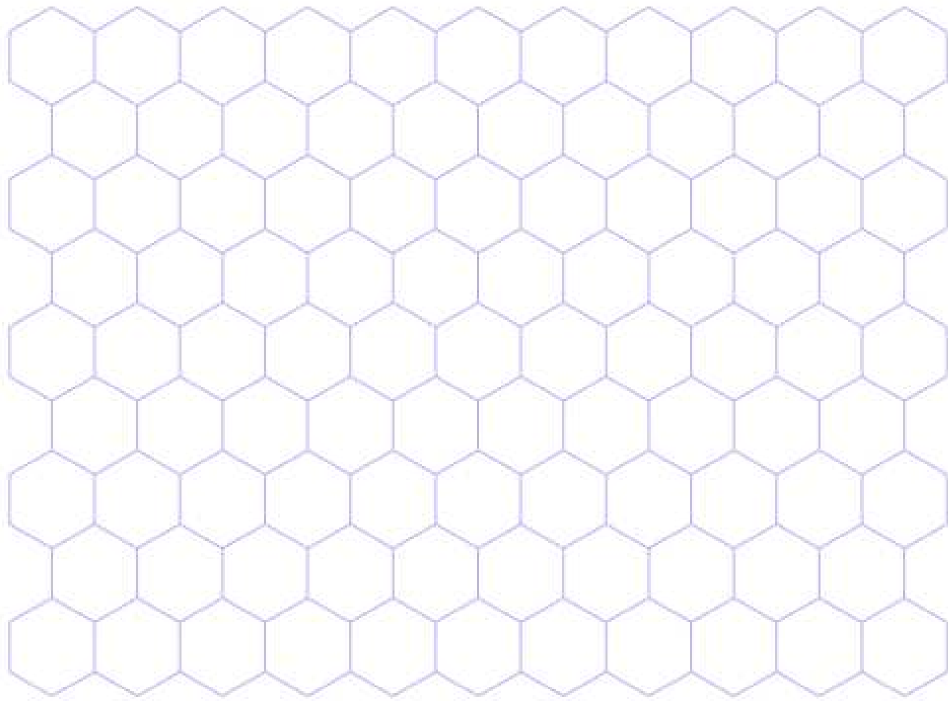
b. (4 pts) What was the Greek's definition of a golden rectangle, and how does it relate to ϕ? **Note:** you do not need to **derive** ϕ: just explain how the Greek's went about defining it (perhaps with a diagram).

c. (4 pts) In the grid provided, make the largest Fibonacci spiral you can. At right, describe the connection between this spiral process and the golden ratio and rectangle.



Problem 5: (10 pts) Pascal's triangle

a. (4 pts) Use this hexagonal grid to create Pascal's triangle, starting down from a "1" in the top row, center: Describe every system of numbers appearing in the triangle that you can think of – including



in particular the Fibonacci numbers.

b. You have seven different cans of soda in your cooler. You reach in and pull out three at random. How many different soda combinations are possible? Justify your answer!

Problem 6: (10 pts) Demonstrate Egyptian Multiplication by multiplying

a. 39*63

b. 81*115

Problem 7: (10 pts) Demonstrate Egyptian division (give your answer as Egyptians would) for the following. You may use either of our two methods (the unit fraction table – there's a table at the end of the test – or the doubling/halving table).

a. Compute $\dfrac{21}{32}$.

b. Divide 9 loaves among 11 people.

A short 2/n table from the Rhind Mathematical Papyrus

2/3 = 1/2 + 1/6	2/5 = 1/3 + 1/15	2/7 = 1/4 + 1/28
2/9 = 1/6 + 1/18	2/11 = 1/6 + 1/66	2/13 = 1/8 + 1/52 + 1/104
2/15 = 1/10 + 1/30	2/17 = 1/12 + 1/51 + 1/68	2/19 = 1/12 + 1/76 + 1/114
2/21 = 1/14 + 1/42	2/23 = 1/12 + 1/276	2/25 = 1/15 + 1/75
2/27 = 1/18 + 1/54	2/29 = 1/24 + 1/58 + 1/174 + 1/232	2/31 = 1/20 + 1/124 + 1/155
2/33 = 1/22 + 1/66	2/35 = 1/30 + 1/42	2/37 = 1/24 + 1/111 + 1/296
2/39 = 1/26 + 1/78	2/41 = 1/24 + 1/246 + 1/328	2/43 = 1/42 + 1/86 + 1/129 + 1/301
2/45 = 1/30 + 1/90	2/47 = 1/30 + 1/141 + 1/470	2/49 = 1/28 + 1/196
2/51 = 1/34 + 1/102	2/53 = 1/30 + 1/318 + 1/795	2/55 = 1/30 + 1/330