

# Geometric Structures

3 Hour Exams & Final

Fall 2003

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Oklahoma State University  
Terry Williams, Instructor

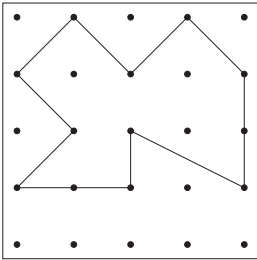
# Geometric Structures – Exam I – Fall 2004

Name: \_\_\_\_\_

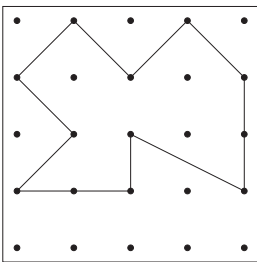
1. (11 points) One way to find Geoboard areas is *Pick's Formula*.

(a) Write down *Pick's Formula*.

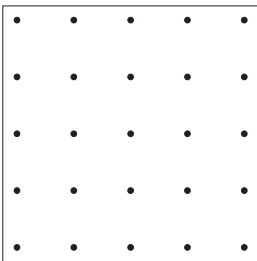
(b) Use Pick's Formula to find the area of this figure. *Show your calculations.*



(c) Use another method to check the area of the figure in part (b). *Show how you find the area.*



(d) Draw a figure on the geoboard below for which Pick's law does not work.

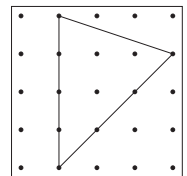


2. (12 points) Here are some ways we have used to find the areas of Geoboard figures:

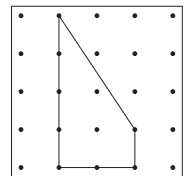
- |   |                |
|---|----------------|
| Take-away   | Cut-up         |
| Julie's way (triangles)   | Base x height  |
| $\frac{1}{2}(\text{base} \times \text{height})$                 | Pick's Formula |
| $\frac{1}{2}(\text{base1} + \text{base2}) \times \text{height}$ |                |

Use a different method on each figure below to find the area of the figure. State which method you are using and show clearly how you found the area. *Note: Be sure to use 4 different methods.*

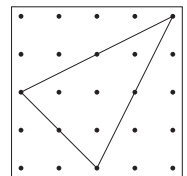
(a) Method 1:



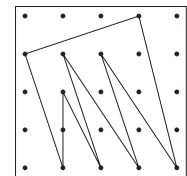
(b) Method 2:



(c) Method 3:

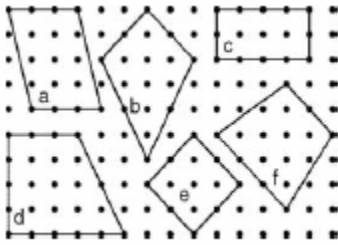


(d) Method 4:

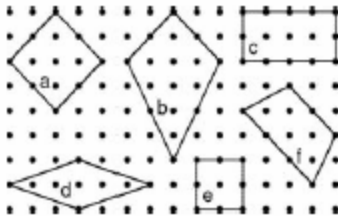


3. (9 points) Several properties are given below followed by a Geoboard on which several quadrilaterals are drawn. Draw a circle around the quadrilaterals for which the property holds.

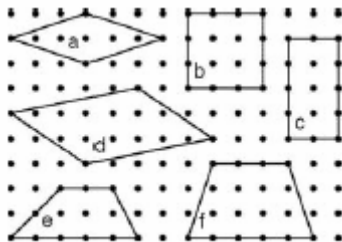
(a) **Property:** Opposite angles are congruent.



(b) **Property:** The diagonals bisect the vertex angles.



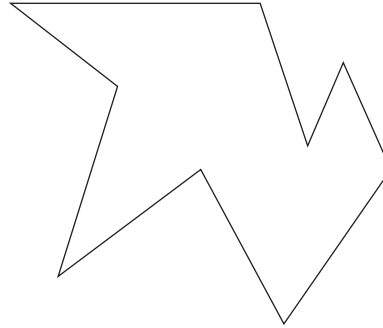
(c) **Property:** The diagonals are congruent.



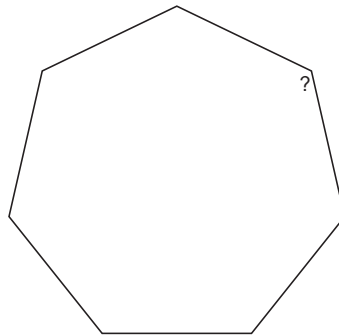
4. (5 points) Use the figure below to explain why the adjacent angles of a parallelogram are supplementary.

5. (9 points)

(a) Find the sum of the interior angles for this polygon:



(b) What is the measure of the angle marked ? in this regular polygon?



(c) The interior angle sum of a polygon is  $540^\circ$ . If this polygon is regular, what is the measure of each interior angle of the polygon?

6. (16 points) A rhombus is a special case of a kite.

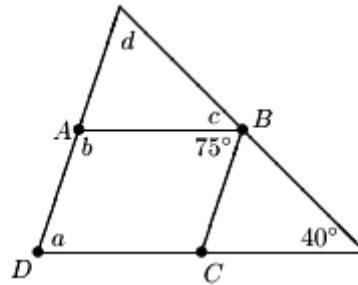
(a) (6 points) Properties that a kite and rhombus share.  
List 3 properties that a kite and a rhombus share for 6 points. List additional properties that a kite and a rhombus share for 1 bonus point each.

(b) (4 points) Properties that a rhombus has and a kite does not. List 2 properties that a rhombus has and a kite does not for 4 points. List additional properties for 1 point each.

(c) (3 points) Write a defining property of a kite that includes a rhombus as a kite.

(d) (3 points) Write a defining property of a rhombus.

7. (12 points) In the diagram below ABCD is a parallelogram. Find the measures of angles a, b, c, and d. Be sure to show your work in determining the angles.



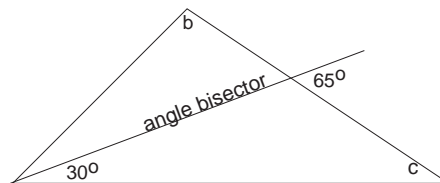
What is angle a?

What is angle b?

What is angle c?

What is angle d?

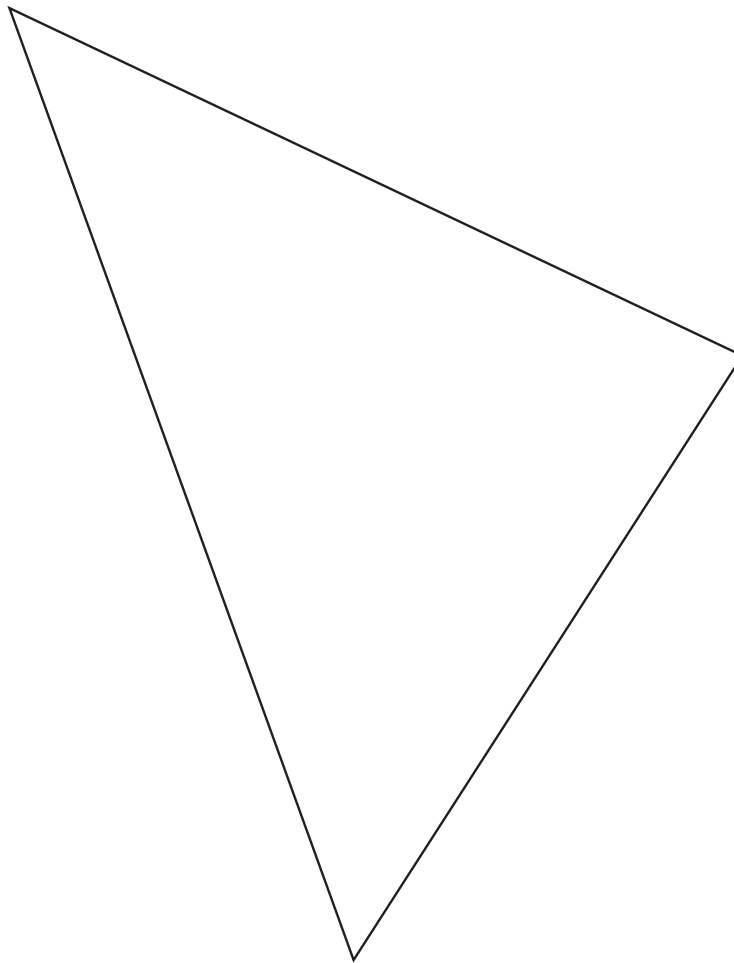
8. (6 points) Find the values of angles b and c. *Show your reasoning.*



**CD Problem – Paper Folding**

Name: \_\_\_\_\_

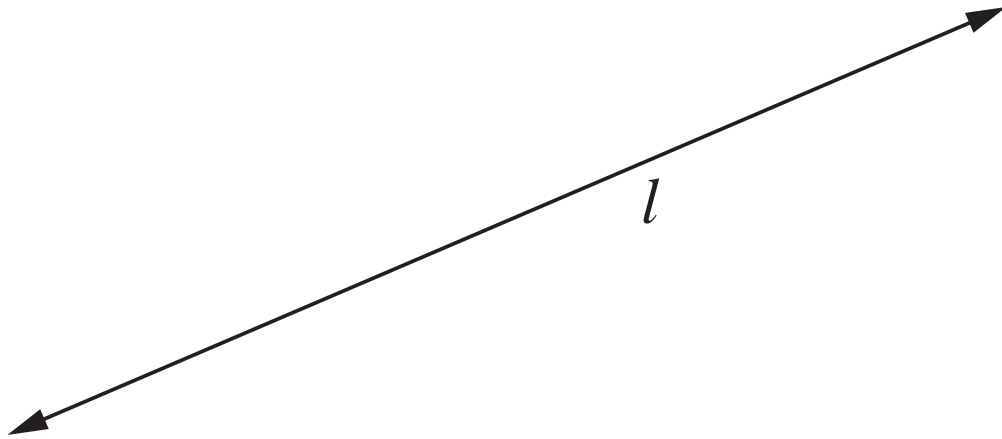
9. (10 points) Using paper folding, find the center of balance of the triangle given below.  
*Note: Do the construction and then clearly describe the process that you used.*



**CD Problem – Paper Folding**

Name: \_\_\_\_\_

10. (10 points) Fold a line through point P that is parallel to line  $l$ . *Note: Do the construction and then clearly describe the process that you used.*

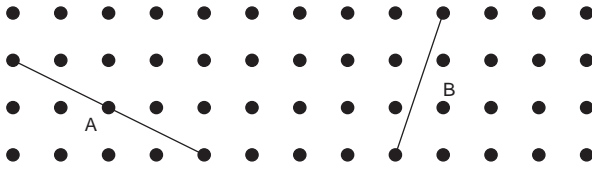


# MATH 3403 – Geometric Structures – Exam II

## October 2003

Name: \_\_\_\_\_

1. (14 points) Consider the two lines pictured:



First figure the slopes for the two lines:

**Line A:** Slope as ratio: \_\_\_\_\_ **Line B:** Slope as ratio \_\_\_\_\_

Slope as decimal: \_\_\_\_\_ Slope as decimal \_\_\_\_\_

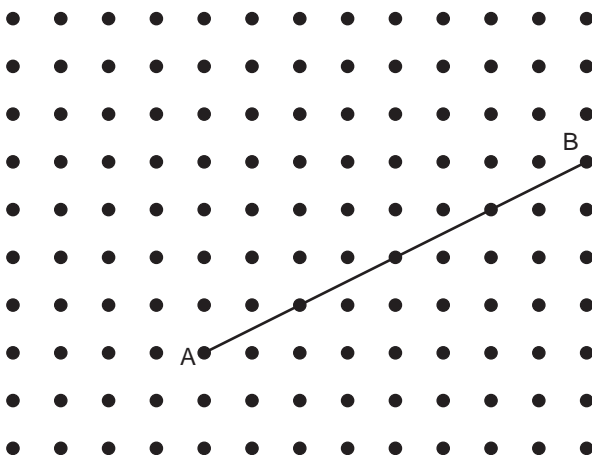
Slope as percent: \_\_\_\_\_ Slope as percent \_\_\_\_\_

Next figure the lengths for the two lines:

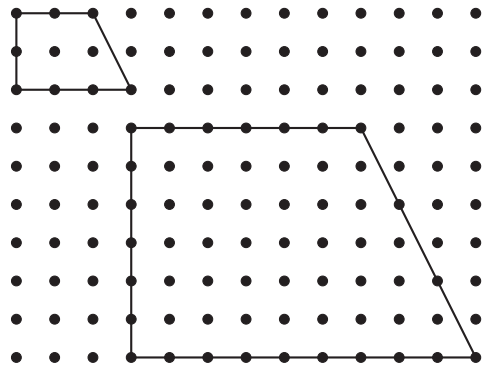
**Line A:** Length as a square root: \_\_\_\_\_ **Line B:** Length as a square root: \_\_\_\_\_

Length as a decimal: \_\_\_\_\_ Length as a decimal: \_\_\_\_\_

2. (6 points) A line segment AB is given below. Circle two points and mark them C and D to make a square with AB a diagonal.



3. (6 points) The two figures drawn below are similar. Inside of each figure write the area.



(a) What is the *scale factor* going from the smaller figure to the larger?

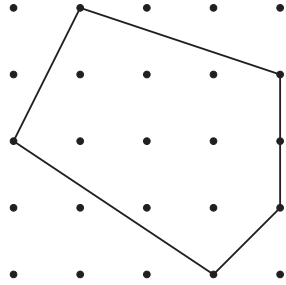
(b) What is the *area factor* going from the smaller figure to the larger?

(c) Describe how the area factor and the scale factor are related. Your description:

4. (6 points) When Marilyn cooks at home, one box of brownie mix makes brownies of just the right height. If she uses her mother's pan, which has dimensions twice the dimensions of her pan, how many boxes of brownie mix will she have to buy to make the same thick chewy brownies?

5. (6 points) Last year Robert bought his girlfriend Louise a heart-shaped box of chocolates for Valentine Day. Since they both like chocolates they finished it off in 1 day. If he wants to make the chocolate last all weekend (2 days) how much larger should the dimensions of the box be? (Think about twice as much candy in the same number of layers.)

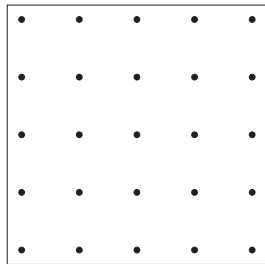
6. (6 points) Figure out the perimeter of the following figure. Write your answer two ways: (a) as a sum of square roots and (b) as a decimal.



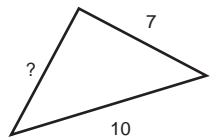
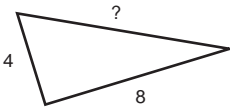
(a) As a sum of square roots:

(b) As a decimal:

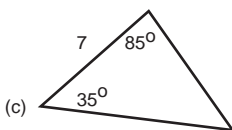
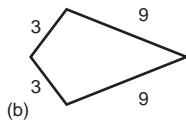
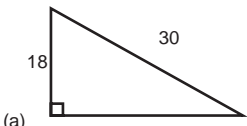
7. (6 points) Make a line which has a length of  $\sqrt{18}$  joining two points of this Geoboard.



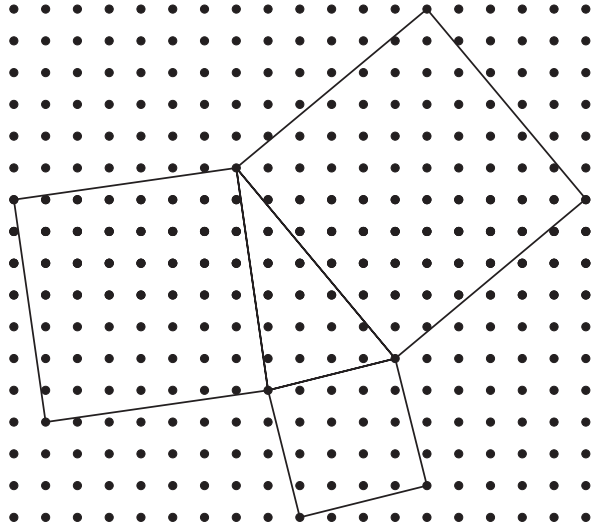
8. (6 points) Figure out the length of the sides of these right triangles which are marked with a “?”. Show your work.



9. (6 points) By each of the three figures given below write CC for congruence condition if enough information is given to determine the figure. If not enough information is given write NOT CC.



10. (8 points) Consider this figure.



(a) (2 points) Is this triangle of squares a right triangle of squares (Yes or No)?

(b) (6 points) give two different reasons for your answer. Show calculations to support your reasons.

**Reason 1:**

**Reason 2:**

11. (6 points) The base of an 8-foot ladder is placed 2 feet away from a wall. How far up the wall does the ladder reach? Show all work and include a diagram in your work.



## Four Step Problem

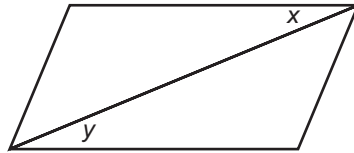
Name: \_\_\_\_\_

12. (12 points)

**Official Definition:** A parallelogram is a quadrilateral in which opposite sides are equal.

**Property:** For official parallelograms, alternate interior angles for a diagonal are congruent.

*Note:* You only need to show for one diagonal. the same presentation will apply to the other diagonal as well. Alternate interior angles for the diagonal are labeled  $x$  and  $y$  in the figure below.



Step 1

Step 2

Step 3

Step 4

### Four Step Model

Step 1: Mark given information on figure: official definition, constructions, related definitions, earlier results

Step 2: Draw and identify apparently congruent triangles.

Step 3: Cite and fully apply CC to triangles.

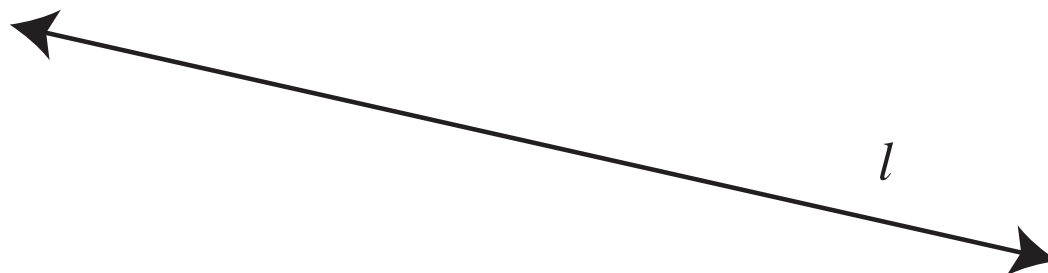
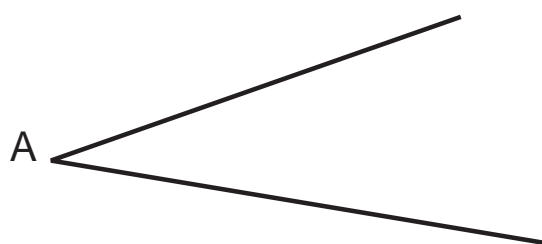
Step 4: Apply CPCT for results needed for the property.

### CD Problem – Straight Edge and Compass

Name: \_\_\_\_\_

13. (12 points) Two sides and the included angle are given below. Using a straight edge and compass, make a triangle out of the given information. Begin by copying segment AB onto line  $l$  below.

First carry out your construction. Then write out a step by step description of the process that you use.

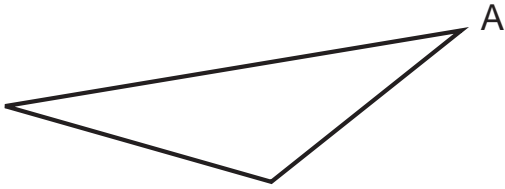


# MATH 3403 – Geometric Structures – Exam III

November 2003

Name: \_\_\_\_\_

1. (5 points) In the triangle given below, use a Mira to carefully draw and identify the altitude that goes through the vertex labeled A.

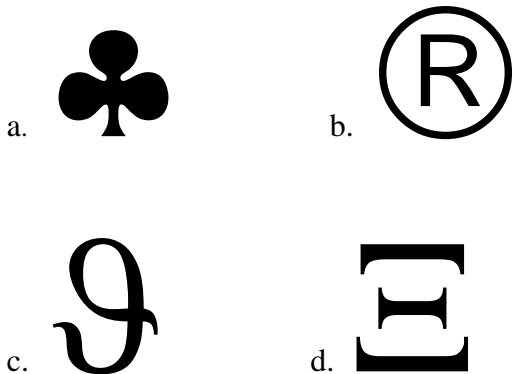


2. (5 points) Sketch an example of a triangle that has an altitude that coincides with a side of the triangle.

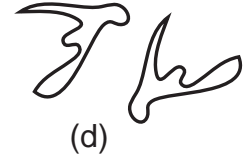
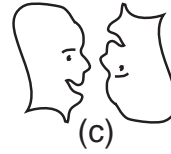
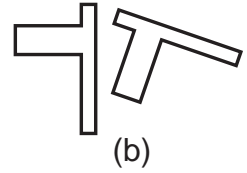
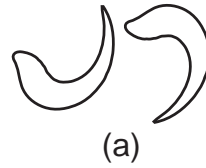
What kind of triangle is this?

How many altitudes of the triangle coincide with sides of the triangle? Give a brief reason for your answer to this part.

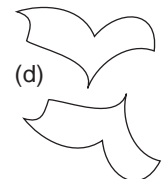
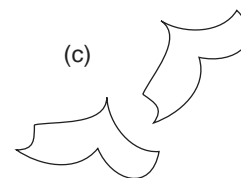
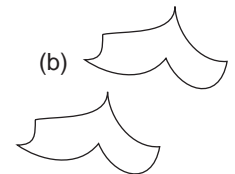
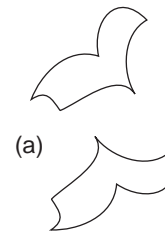
3. (4 points) For each of the following figures, write “1” if it is one-sided and write “2” if it is two-sided.



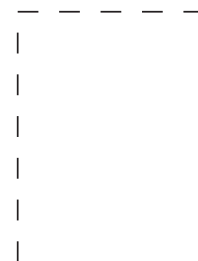
4. (4 points) For the following pairs of figures, write the letter **S** or **O** underneath to indicate if the orientation is the Same or Opposite.



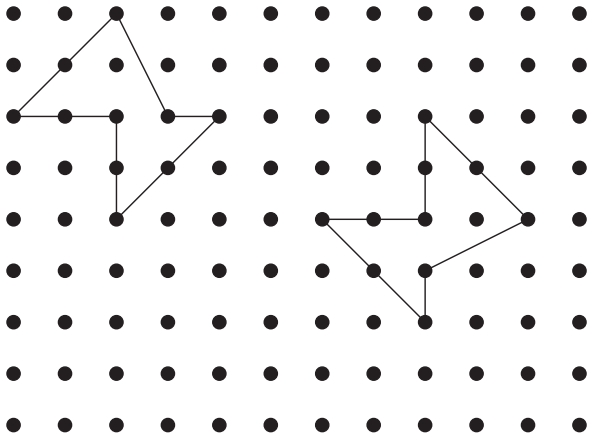
5. (8 points) Pairs of congruent figures are given below. For each pair, indicate by which of the four types of transformations the two copies are related (translation, reflection, rotation or glide reflection).



6. (5 pts) A rectangle is given below which can be used to generate a border by repeated translation both left and right. Draw a figure in this rectangle so that the resulting border would be of type **m1**.



7. (4 points) The two figures below are related by a rotation. Find the center of rotation for the two figures.



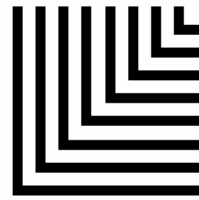
8. (15 points) Using the code table below, identify the symmetry type of these borders.



Code for Border Patterns

First	Second
m crossline sym.	m centerline sym.
1 no crossline sym.	g glide reflectional sym.
	2 half-turn symmetry
	1 no additional sym.

9. (18 points) Using the code table below, identify the symmetry type of the following mandalas.



Code for Mandalas

$C_n$	n-fold rotational symmetry (no reflectional symmetry)
$D_n$	Reflectional symmetry and n-fold rotational symmetry
D or $D_1$	Bilateral symmetry only
N or $C_1$	No symmetry

10. (10 points) Give your best answer to these questions.

a) How do you know when a shape is one-sided?

b) What happens to the slope of a line segment that is reflected across a horizontal line?

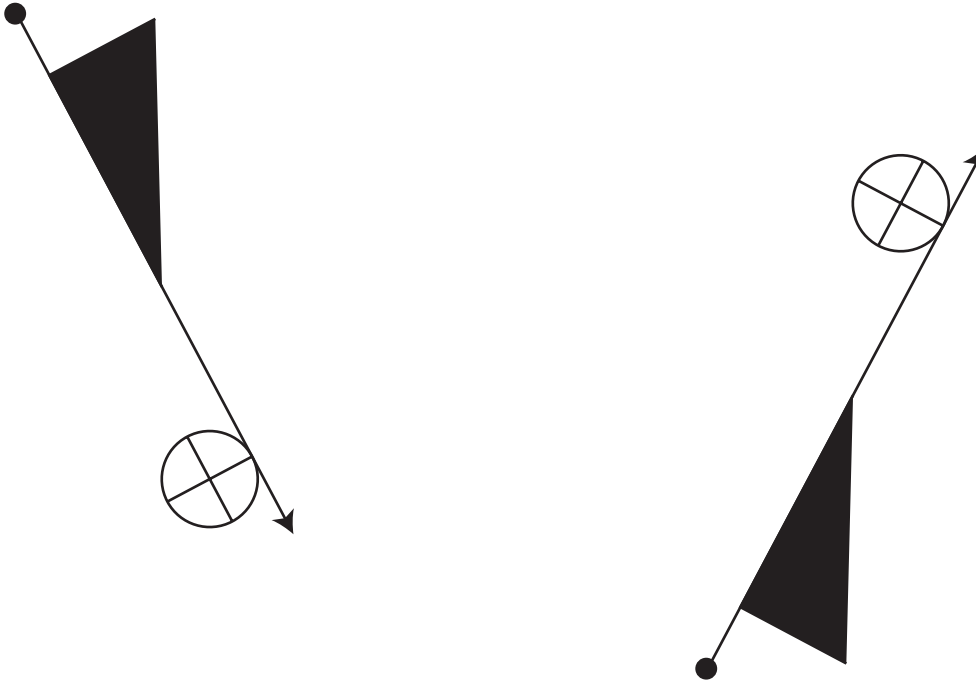
c) If a mandala has two lines of symmetry, what is the relationship between the two lines of symmetry?

**CD Problem –MIRA**

Name: \_\_\_\_\_

11. (11 points) The two figures given below are related by a glide reflection. Using a Mira, construct the glide reflection line.

*Note: Do the construction and then clearly describe the process that you used.*

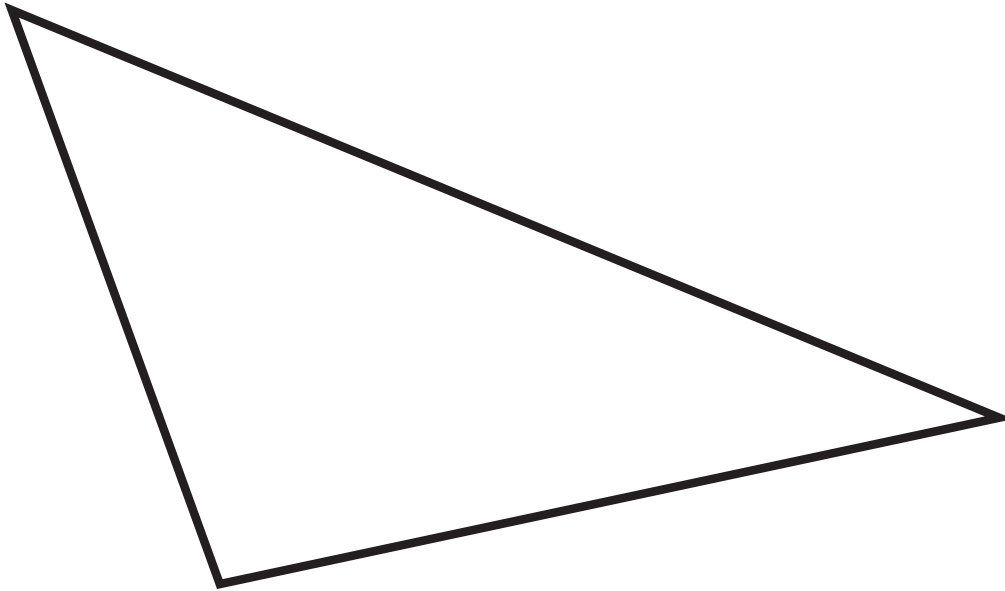


**Describe:**

**CD Problem –MIRA**

Name: \_\_\_\_\_

11. (11 points) Using a Mira, bisect all three angles of this triangle.



**Describe how you bisect an angle with a Mira:**

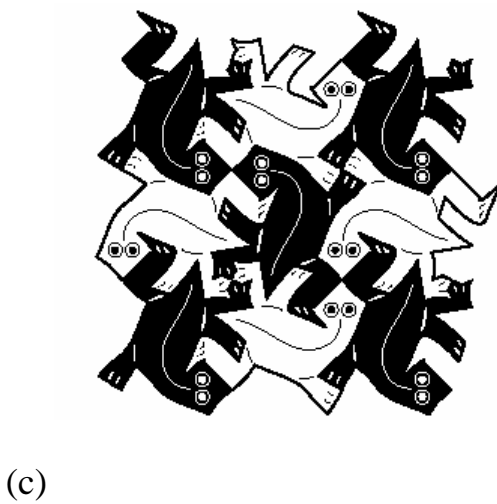
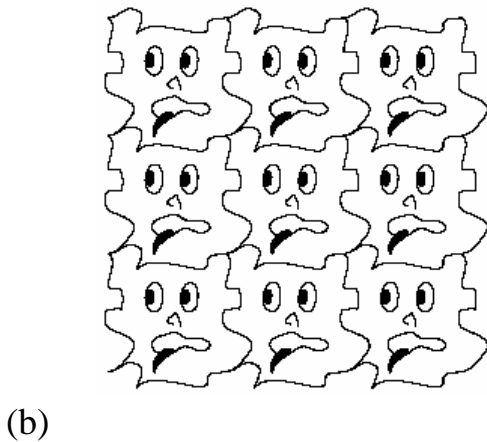
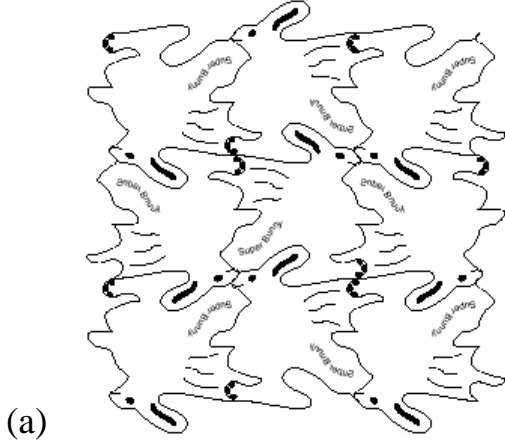
**What is the name of the point where the 3 angle bisectors intersect?**

# MATH 3403 – Geometric Structures – Final Exam

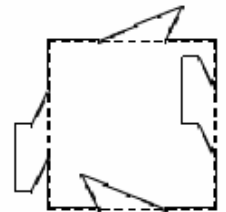
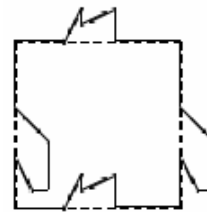
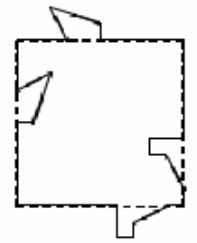
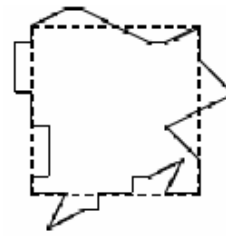
December 2003

Name: \_\_\_\_\_

1. (9 points) Analyze each of the Escher style tessellations given below. For each design, indicate the Heesch type.



2. (8 points) For each of the tessellation prototiles given below, identify the Heesch type.



3. (8 points) Several figures are given below.



- Which figures are symmetric?(list letters)
- Which figures have bilateral symmetry?
- Which figures are fold and cut?
- Which figures are double fold and cut?

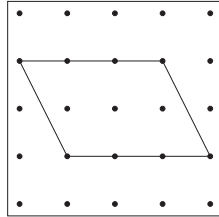
4. (12 points) Here are some ways we have used to find the areas of Geoboard figures:

Take-away  
 Julie's way (triangles)  
 $\frac{1}{2}(\text{base} \times \text{height})$   
 Pick's Formula

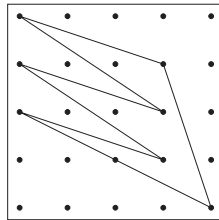
Cut-up  
 Base  $\times$  height  
 Internal pegs + 1

Use a different method on each figure below to find the area of the figure. State which method you are using and show clearly how you found the area. *Note: Be sure to use 4 different methods.*

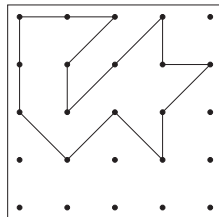
(a) Method 1:



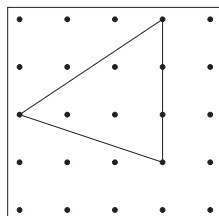
(b) Method 2:



(c) Method 3:

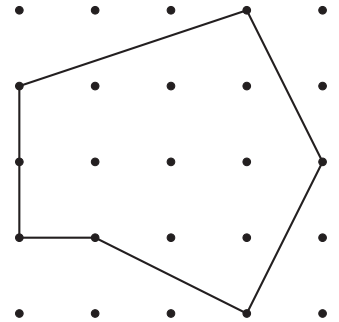


(d) Method 4:



5. (5 points) Max is planning to enlarge his square cattle pasture so that the new fence encloses two times the area of the present pasture. He wants the pasture to remain square. The original fence is 200 feet long on each side. How long should one side of the new fence be?

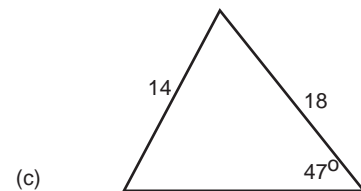
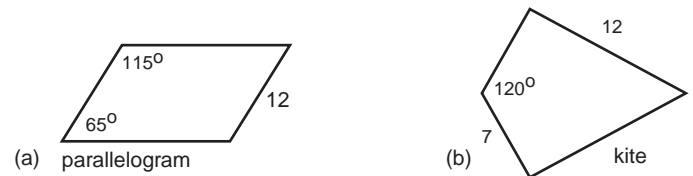
6. (6 points) Figure out the perimeter of the following figure. Write your answer two ways: (a) as a sum of square roots and (b) as a decimal.



(a) As a sum of square roots:

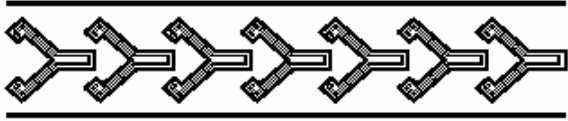
(b) As a decimal:

7. (9 points) By each of the three figures given below write CC for congruence condition if enough information is given to determine the figure. If not enough information is given write NOT CC.





8. (12 points) Using the code table below, identify the symmetry type of these borders.



**Code for Border Patterns**

First	Second
m crossline sym.	m centerline sym.
1 no crossline sym.	g glide reflectional sym.
	2 half-turn symmetry
	1 no additional sym.

9. (4 pts) Draw a mandala that has symmetry type  $D_3$ . If the mandala has lines of reflectional symmetry, sketch them also, or state no lines of symmetry.

10. (9 points) Three statements are given below. After each statement either

- circle definition if the statement is a definition, or
- circle property if the statement is a property but not a definition. Also give an example to show the property is not a definition.

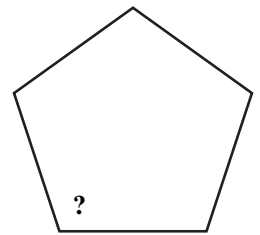
(a) An isosceles trapezoid is a quadrilateral that has a line of symmetry. Property or Definition?

(b) A parallelogram is a quadrilateral that has equal opposite sides. Property or Definition?

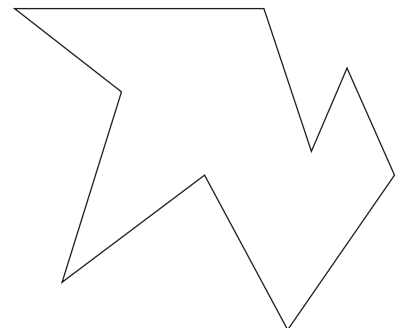
(c) An isosceles trapezoid is a trapezoid that has a line of symmetry. Property or Definition?

11. (8 points) Find the sum of the interior angles for this polygon. *Show your work.*

(a) What is the measure of the angle marked ? in this regular polygon?



(b) Find the sum of the interior angles for this polygon.

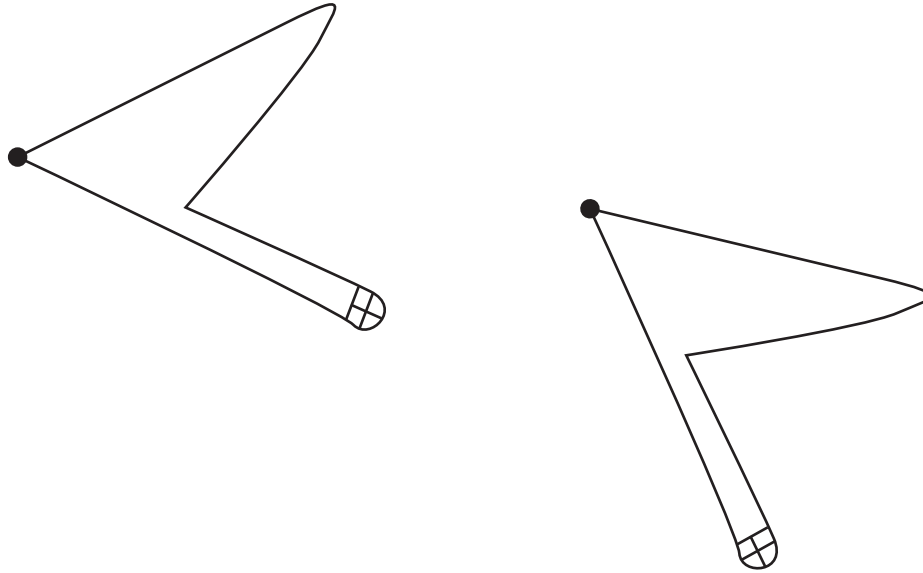


**CD Problem –MIRA**

Name: \_\_\_\_\_

13. (10 points) The two figures given below are related by a rotation. Using a mira, construct the center of this rotation.

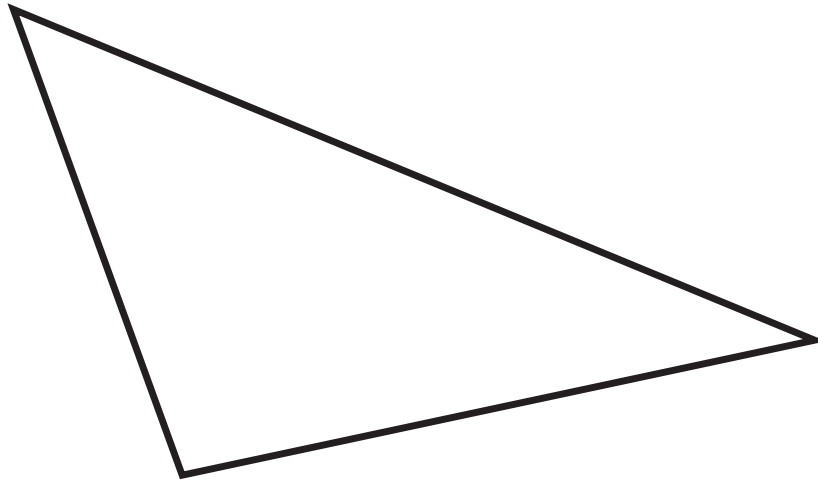
*Note: Do the construction and then clearly describe the process that you used.*



**CD Problem –MIRA**

Name: \_\_\_\_\_

14. (10 points) Using a Mira, find the circumcenter of this triangle. Then with a compass draw the circumscribing circle for the triangle. Finally, describe fully the process you used to construct the circumcenter and circumscribing circle.



## Definitions to Properties – Four Step Model

Name: \_\_\_\_\_

12. (10 pts)

*Official Definition:* A kite is a quadrilateral in which one of the diagonals bisects the angles at both ends.

*Property:* For an official kite, there are two pairs of adjacent congruent sides (ASA).

Step 1

Step 2

Step 3

Step 4

### Four Step Model

Step 1: Mark given information on figure: official definition, constructions, related definitions, earlier results

Step 2: Draw and identify apparently congruent triangles.

Step 3: Cite and fully apply CC to triangles.

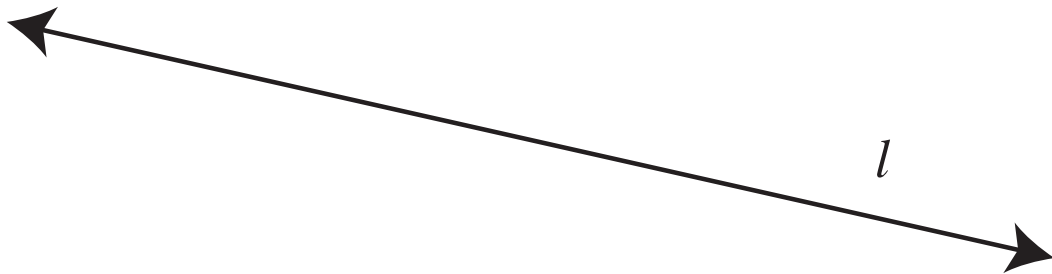
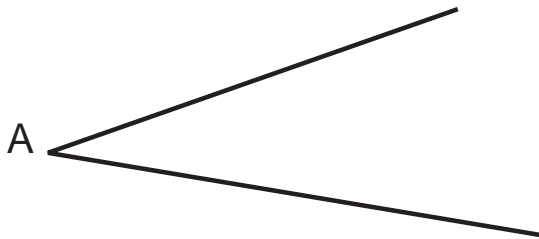
Step 4: Apply CPCT for results needed for the property.

**CD Problem – Straight Edge and Compass**

Name: \_\_\_\_\_

15. (10 points) Two sides and the included angle are given below. Using a straight edge and compass, make a triangle out of the given information. Begin by copying segment AB onto line  $l$  below.

First carry out your construction. Then write out a step by step description of the process that you use.



### CD Problem – Folding

Name: \_\_\_\_\_

16. (10 points) Using folding construct a line parallel to line segment AB through point P.

First carry out your construction. Then write out a step by step description of the process that you use.

