

Math 3403: Geometric Structures

Exams I, II and Final

(Exam III not included for technical reasons)

Summer 2003

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Geometric Structures – Exam I – Summer 2003

Name: _____

- 1) (20 points) These are some of the ways we have been finding areas of geoboard figures:

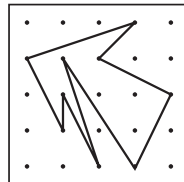
| | |
|--------------------------------------|----------------------|
| Take-away | Cut-up |
| Julie's way (triangles) | Base \times height |
| $\frac{1}{2}$ (base \times height) | Internal pegs + 1 |
| Pick's Formula | |

Two copies of a figure are given below. You are to do this figure by two *different* methods in the space shown. Also mention two methods that do *not* work and explain why they do not work.

- (a) Show a method that works.

Method Name:

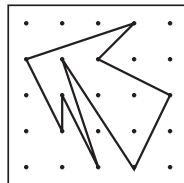
Show method:



- (b) Show another method that works.

Method name:

Show method:



- (c) Name a method that does not work.

Method name:

Explain why it does not work:

- (d) Name another method that does not work.

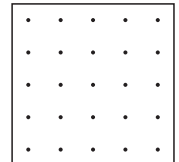
Method name:

Explain why it does not work:

- 2) (6 points) For this problem we will consider the following procedure for finding area:

$$\text{Internal dots} + 1$$

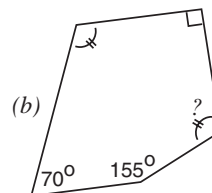
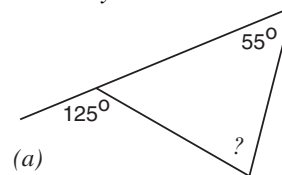
- a) Give an example here where this procedure works:



- b) Clearly state conditions under which this procedure will always work:

Your conditions:

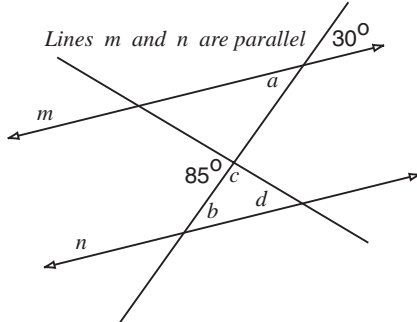
- 3) (10 points) In the two figures below, give the value of the angles marked with a question mark "?." *Be sure to show your work!*



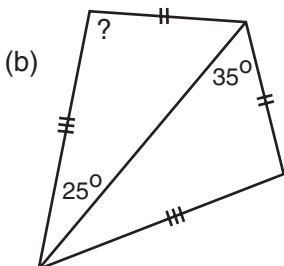
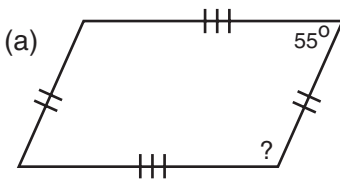
- 4) (8 points) In the figure below for each of the angles marked with a letter, (i) give the value of the angle and (ii) give a reason.

Acceptable reasons include:

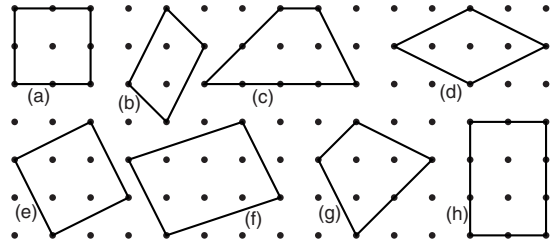
- “alternate interior angle to something”
- “corresponding angle to something”
- “vertical angle to something”
- “supplementary angle to something” or
- “the angle sum is something.”



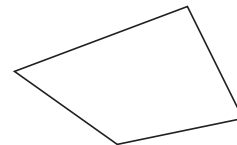
- (a) The value of a is:
The reason is:
- (b) The value of b is:
The reason is:
- (c) The value of c is:
The reason is:
- (d) The value of d is:
The reason is:
- 5) (10 points) In the two figures given below give the value of the angles marked with a question mark. Show your thinking!



- 6) (12 points) After each of the properties listed below, write the letters of all of the quadrilaterals from the sampling below which satisfy the statement.



- A) Quadrilaterals where the diagonals are perpendicular.
- B) Quadrilaterals with 4 lines of symmetry.
- C) Quadrilaterals with equal diagonals.
- D) Quadrilaterals where there is at least one pair of opposite parallel sides.
- 7) (7 points) The class was discussing angle sums. Most of the students knew that a quadrilateral had an angle sum of 360° . However, Annie said, “*Something bothers me! When I divided the quadrilateral up into triangles I got an angle sum of $4 \times 180^\circ = 720^\circ$.*”
- a) In the quadrilateral below indicate how you suspect that Annie must have been dividing up the quadrilateral.



- b) How would you explain to Annie the way that a polygon needed to be divided up in order to get the correct angle sum?

Your Explanation:

8) (7 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) A square is a quadrilateral with 4 right angles.

Circle one: Definition

Property (give example)

(b) A rhombus is a quadrilateral with 4 equal sides.

Circle one: Definition

Property (give example)

(c) A parallelogram is a quadrilateral in which opposite angles are the same.

Circle one: Definition

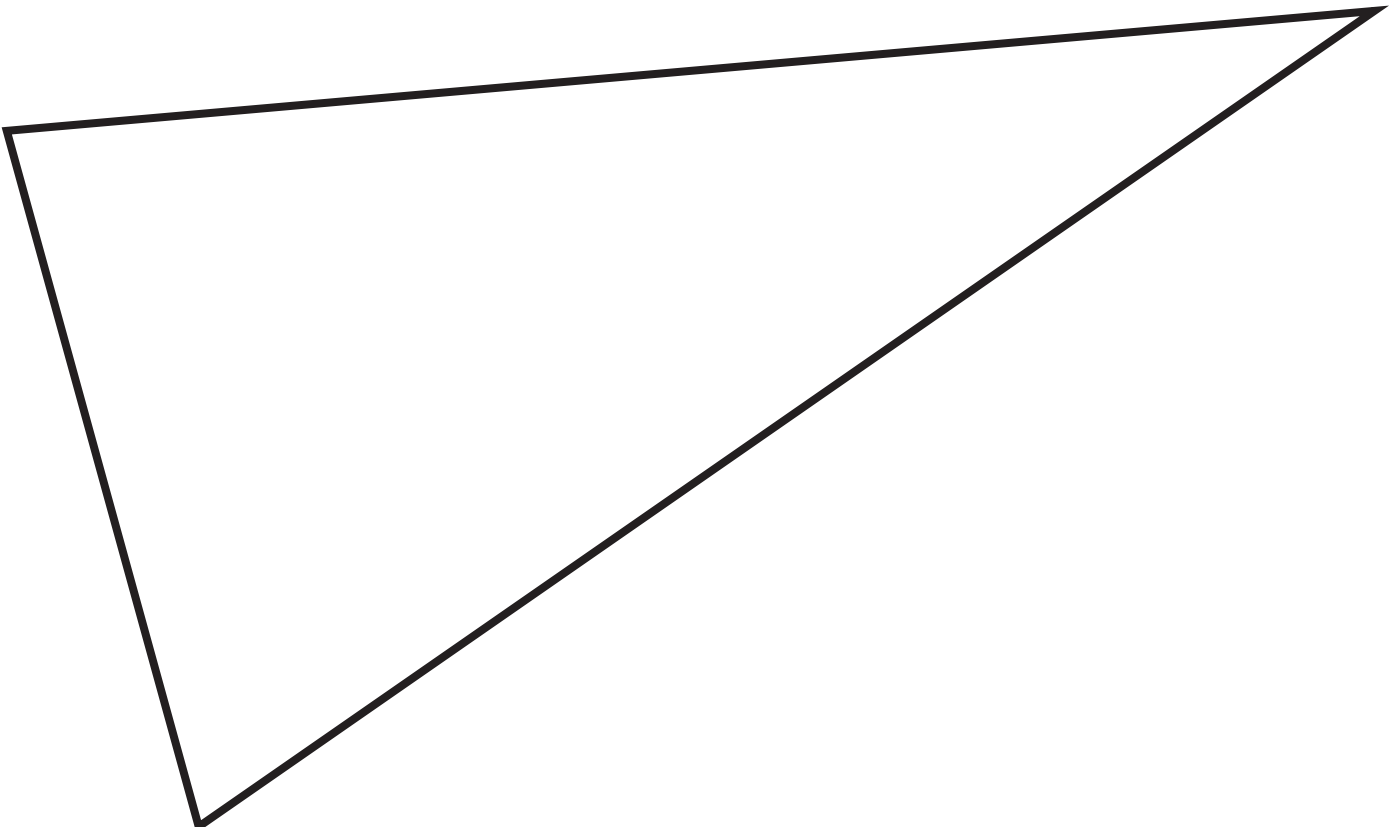
Property (give example)

CD Problem – Paper Folding

Name: _____

- 9) (10 points) Using paper folding, find the circumcenter of the triangle given below. Use a compass to check your procedure by drawing the circumscribing circle.

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

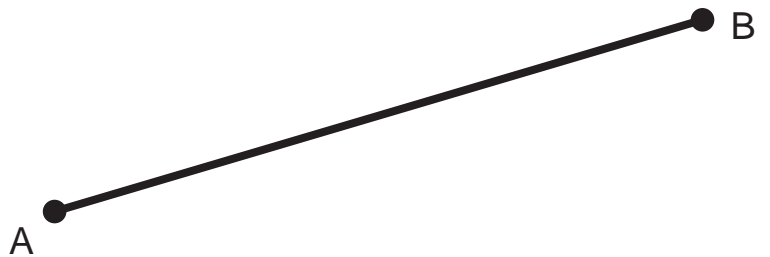


CD – Problem – Paper Folding

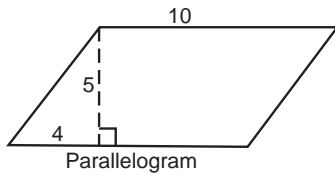
Name: _____

10) (10 points) Fold an isosceles right triangle so that segment AB given below is a leg of the triangle.

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

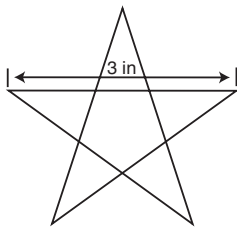


5. (8 points) What is the perimeter of the parallelogram shown below where one side is 10 meters, the altitude is 5 meters and the foot of the altitude is 4 meters from one end?



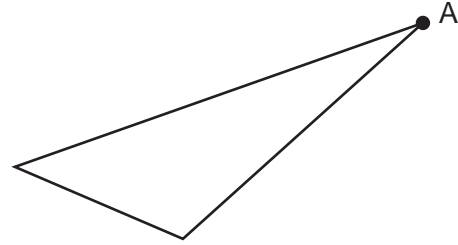
6. (7 Points) A 2 by 3 foot cage is just right for 12 gerbils. What dimensions would be needed for a cage that would be just right for 108 gerbils? *Show your reasoning!*

7. (7 points) Julie made silver stars for decorations. The design for her stars is shown below. The “point to point” width of her stars was 3 in.

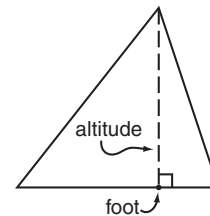


It took 11 square inches of silver foil to cover each of her stars front and back. If she enlarged the stars so that the “point to point” width was 12 inches, how many square inches of silver foil would be needed to cover each star front and back?

8. (5 points) In the triangle given below, carefully draw and identify the altitude that goes through the vertex labeled A.



9. (5 points) An altitude of a triangle starts at a vertex and goes to the opposite side. The point where the altitude touches the side is called the foot of the altitude.



It sometimes happens that the altitude touches the side at the midpoint of the side (in this case, the altitude and the perpendicular bisector are the same). Describe under what circumstances (for what type of triangles) this occurs.

Your Description:

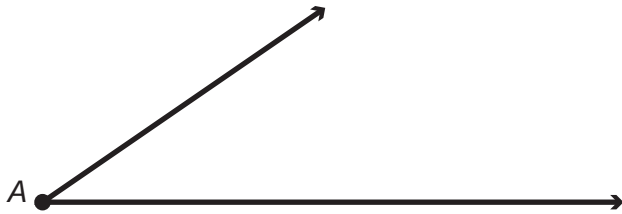
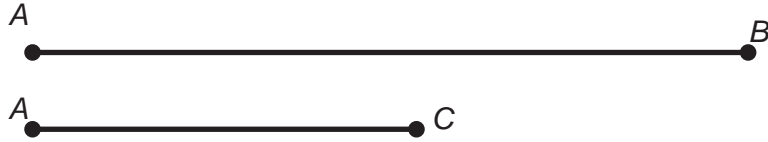
10. (6 points) What is a congruence condition for a parallelogram? Clearly describe the information needed to specify a parallelogram.

CD Problem – Straight Edge and Compass

Name: _____

11. (10 points) Begin by copying line segment AB onto line m below. Then finish making a triangle which has sides of length AB and AC and also angle A as given below.

Carefully do this construction and then describe the process that you used.



Describe:

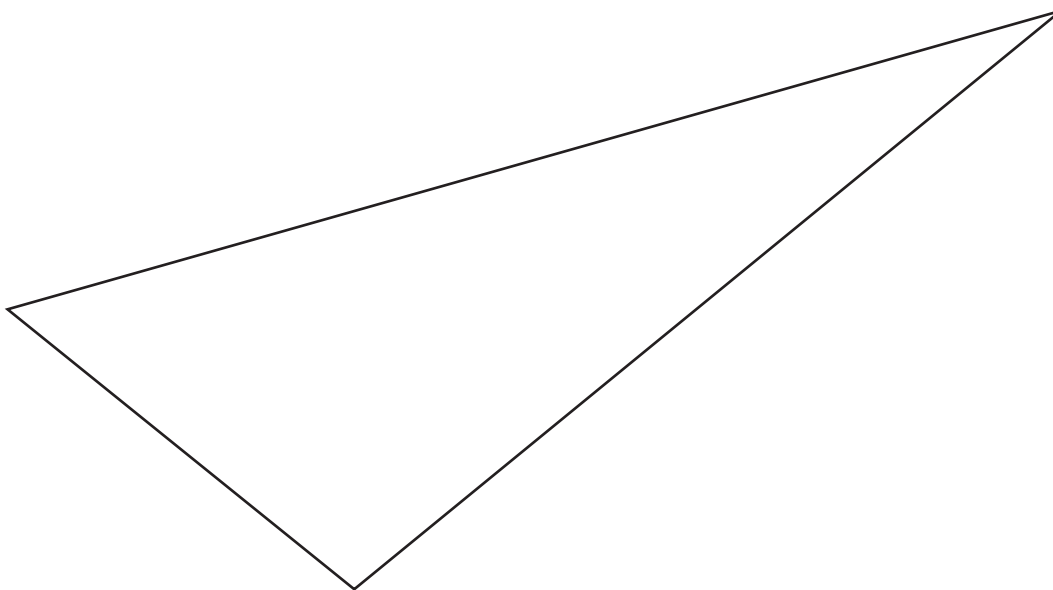
CD Problem – Mira

Name: _____

12. (10 points) On the triangle below, use a mira to find the center of the inscribed circle. Use a compass to draw this circle.

Describe the process that you used to find the inscribed circle.

Describe:



Four Step Problem

Name: _____

13. (12 points)

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

Property: For an official parallelogram, opposite angles are equal.

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.

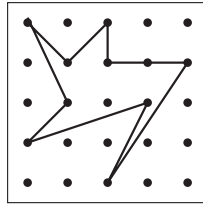
Step 3: Cite and fully apply CC to triangles.

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

Geometric Structures – Final Exam – Summer 2003

Name: _____

1. (6 points) Calculate the area of the following figure. Be sure to show your reasoning!

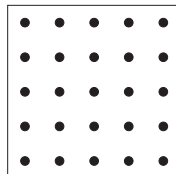


2. (11 points) Here are three of the ways we have discussed for calculating areas on a geoboard.
- count the interior pegs and add one,
 - count the edge pegs and divide by two, then add the number of interior pegs and subtract one, and
 - base times height.

Choose one of these methods, then (a) illustrate the method with an example, (b) describe the circumstances where the method works, and, finally, (c) give an example where the method does not work.

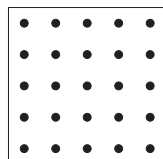
The method chosen (circle one): i) ii) iii)

- a) Make up an example on the geoboard below and show how the method works.



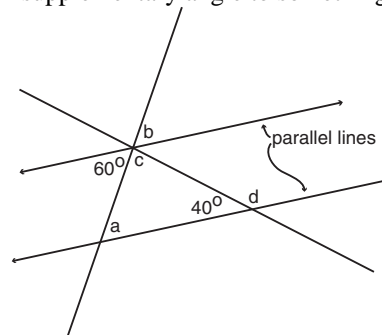
- b) For what kinds of geoboard figures does this method work? Describe:

- c) Give an example below where the method does not work. Your example:



3. (12 points) For each of the angles marked with a letter below, give the value of the angle and give a reason.

Acceptable reasons include:
 “alternate interior angle to something,”
 “corresponding angle to something,”
 “vertical angle to something,” or
 “supplementary angle to something.”



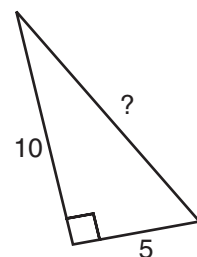
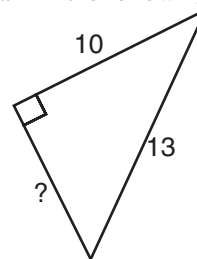
- a) The value of **a** is:
The reason is:

- b) The value of **b** is:
The reason is:

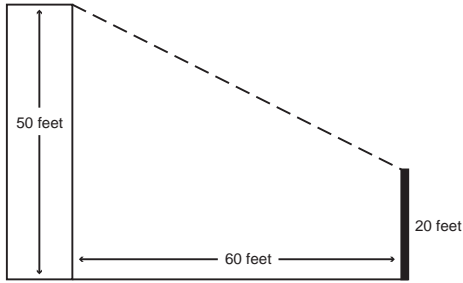
- c) The value of **c** is:
The reason is:

- d) The value of **d** is:
The reason is:

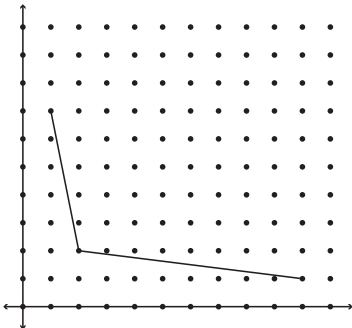
4. (10 points) Figure out the sides marked with a question mark in the following right triangles.



5. (9 points) If a rope goes from the top of a building which is 50 feet tall to the top of a 20 foot pole which is located 60 feet from the building, how long does the rope need to be?



6. (9 points) Two sides of a kite are drawn below. Draw a circle around the point which will make the fourth corner of the kite.



Give the coordinates of this fourth point.

Coordinates:

7. (9 points) Three statements about quadrilaterals are given below. After each statement is a list of the types of quadrilaterals we have been studying. Circle the figures representing quadrilaterals for which the statement is true.

- (a) Opposite angles are congruent.



- (b) Diagonals are congruent.



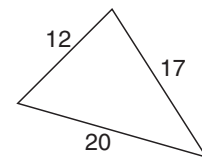
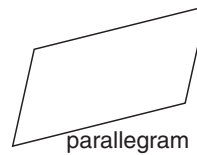
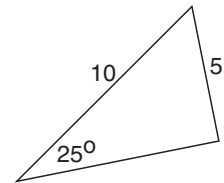
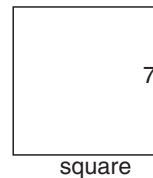
- (c) Diagonals are perpendicular.



8. (7 points) Jenny's flower garden is now just the right size for 20 plants. However, she wants to increase the size so that it will hold 60 plants. By what factor must she increase the dimensions to get the right sized flower garden?

9. (7 points) Grandma Betty is crocheting a blanket. She has used 5 balls of yarn so far. When she is done the blanket will be twice as long and twice as wide as what she has done so far. How many additional balls of yarn will she need to finish the blanket?

10. (8 points) By each of the figures below write "CC" (congruence condition) if there is enough information given to determine the figure. Write "not CC" if there is not enough information.



11. (10 points) **True or Not** For each of the following statements
- if it is true, then circle “TRUE,”
 - if it is false, then circle “FALSE” and draw an example which shows it is false.
- a) If opposite angles of a quadrilateral are equal then the quadrilateral must be a parallelogram.
TRUE FALSE (show example)
- b) If the diagonals of a quadrilateral are perpendicular, then the quadrilateral must be a kite.
TRUE FALSE (show example)
- c) If two triangles have the same angles then they must be congruent.
TRUE FALSE (show example)

Four Step Problem

Name: _____

12. (10 points)

Official Definition: A rectangle is a quadrilateral with opposite sides the same length and all four angles right angles.

Property: For a rectangle the two diagonals are the same length (SAS).

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.

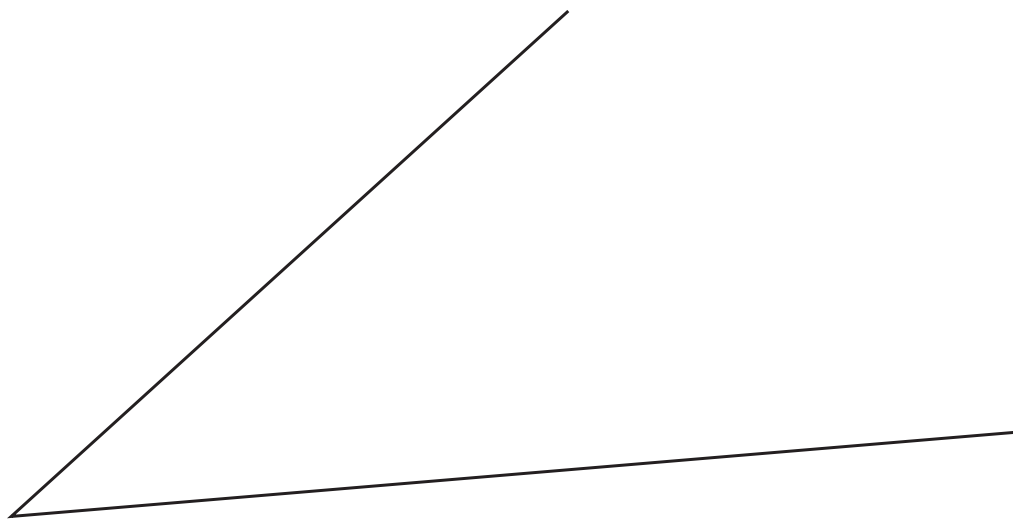
CD Problem – Straightedge and Compass

Name: _____

13. (10 points) Using a straightedge and compass, construct the angle bisector of the angle given below.

After doing the construction clearly describe the process that you used.

Describe:



CD Problem – Paper Folding

Name: _____

14. (10 points) On the triangle below, use paper folding to find the balance point.

After doing the construction clearly describe the process that you used.

Describe:

