# Geometric Structures

# 3 Hour Exams & Final
# Fall 2004

Oklahoma State University
John Wolfe, Instructor
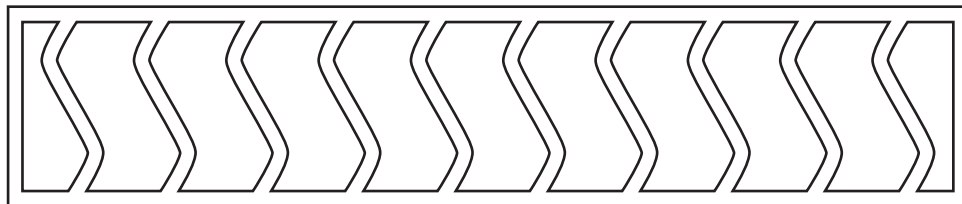
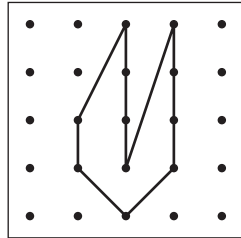# Geometric Structures – Exam I – Fall 2004

Name:_____

1. (15 points) Three copies of a geoboard figure with area 4 ½ are shown below. For each of these a method for figuring the area is given. You are to use the figure to illustrate the method named. Be sure to fully show the method so that it will be clear how you are doing it.
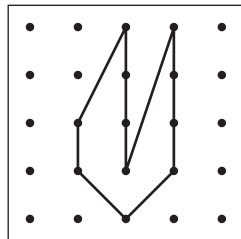
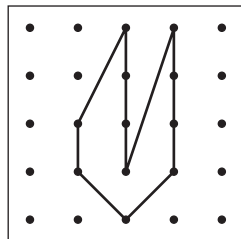   a) Method: Cut-Up

      Show method:
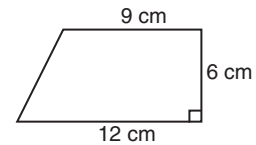
   b) Method: Take-away

      Show method:

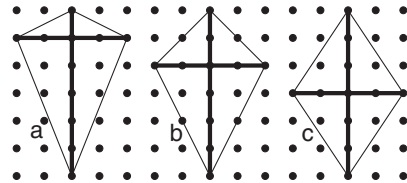   c) Method: Julie's Way

      Show method:

2. (6 points) What is the area of the trapezoid shown below? Show your work!

   9 cm
   6 cm
   12 cm

3. (6 points) Three kite-shaped figures are shown below. Each of these kites is made of a 4 unit stick and a 6 unit stick.

   a
   b
   c

   a) Carefully work out the area of each of these kites and write the value by each of them.

   b) Make a guess or conjecture about an easy way to figure the area of a kite. Clearly and carefully write out your conjecture.
      **Your Conjecture:**

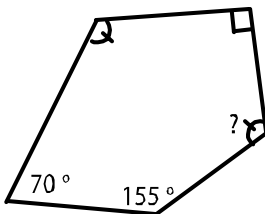4. (5 points) Based on the information given, are lines *m* and *n* parallel? Clearly express your reasoning.

64$^{\circ}$

44$^{\circ}$

71$^{\circ}$

*n*

*m*
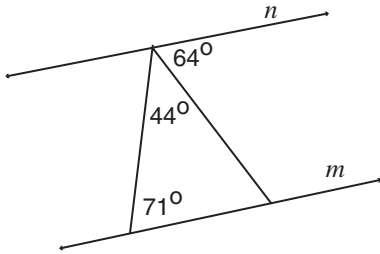
Parallel? (Circle one)  YES  or  NO
Reasoning:

5. (5 points) Figure out the value of the angle marked with an **a**. *Show your work!*

95$^{\circ}$

95$^{\circ}$

75$^{\circ}$

a
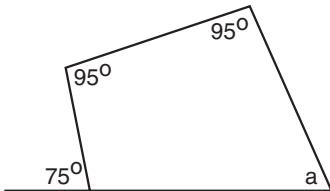
6. (5 points) What is the value of the angle marked with a question mark? *Be sure to show your work!*

?

70$^{\circ}$

155$^{\circ}$

7. (12 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."

rectangle

60$^{\circ}$   80$^{\circ}$

b  a       d

c
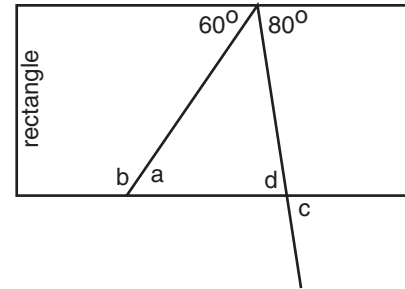
(a) The value of  *a*  is:
The reason is:

(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:

8. (5 points)  Types of quadrilaterals are listed below. Circle the names of the quadrilaterals which are special cases of a trapezoid.

Squares                    Parallelograms

Rectangles                 Kites

Rhombuses                  Isosceles Trapezoids

9. (12 points) Five figures are given on the geoboard below. For each of the properties below list the letters of the figures which satisfy the property.
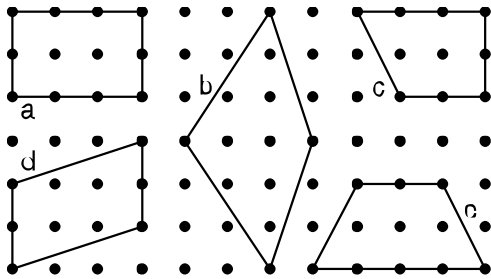


a) Property: The diagonals are congruent.

Letters:

b) Property: Opposite angles are the same.

Letters:

c) Property: The diagonals bisect each other.

Letters:

10. (9 points) **Possible?** For each of the following statements, decide if it is possible or not.

- If it is possible, write POSSIBLE <u>and</u> draw a picture.
- If it is not possible, write NOT <u>and</u> give a reason.

a) A parallelogram with one angle of 70$^o$ and another of 100$^o$.

b) A trapezoid with just one pair of equal sides.

c) An equilateral right triangle.

Name:_____

11) (10 points)  Using paper folding, construct an isosceles right triangle with the line segment AB as a <u>leg</u>.

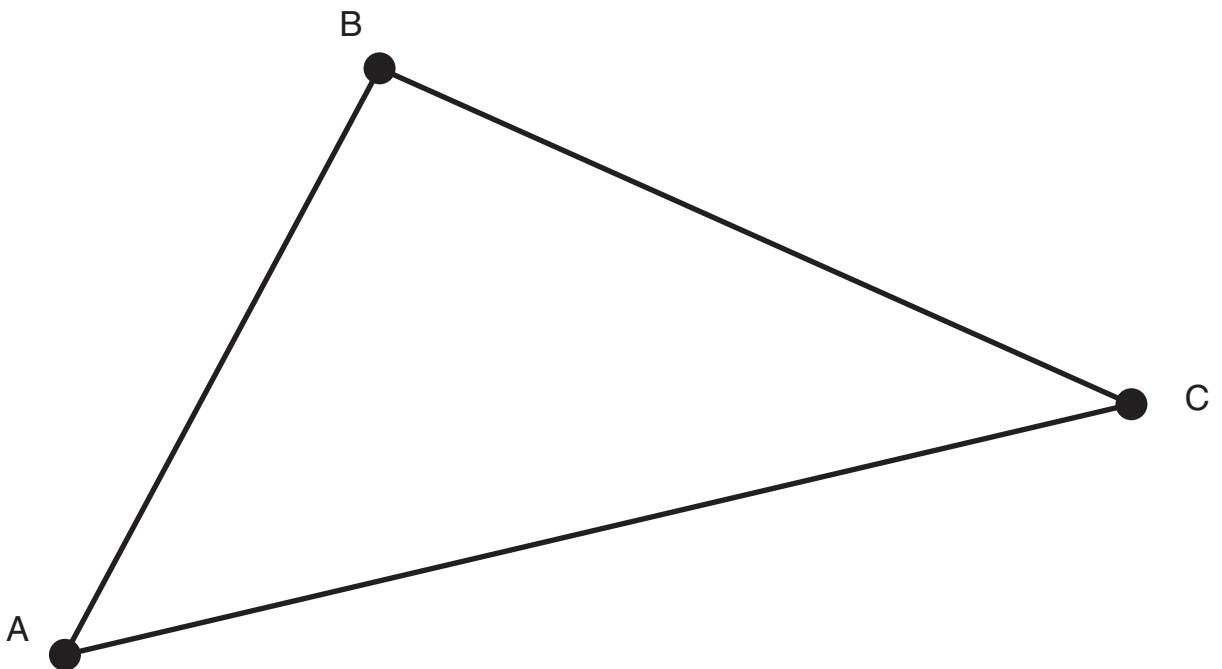*Note:  Do the construction and then clearly describe the process that you used.*

A ●━━━━━━━━━━━━━━━━● B
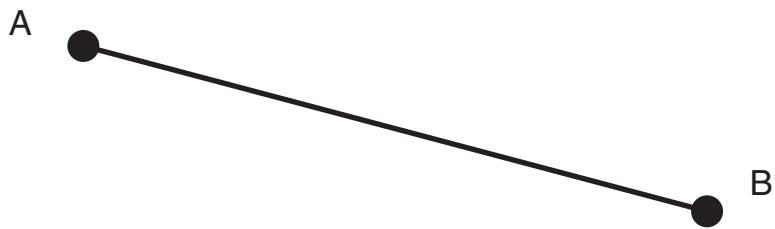
Name:_____

12) (10 points)  Using paper folding, construct the circumcenter of the triangle given below.  Use a compass to check your procedure by drawing the circumscribed circle.
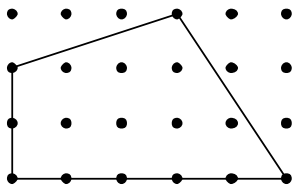
*Note:  Do the construction and then clearly describe the process that you used.*

B

C

A

# Geometric Structures – Exam II – Fall 2004

Name:_____

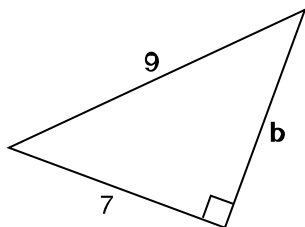1. (7 points) What is the perimeter of the quadrilateral pictured below?
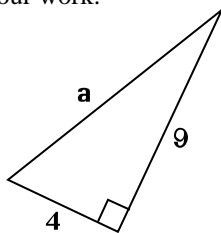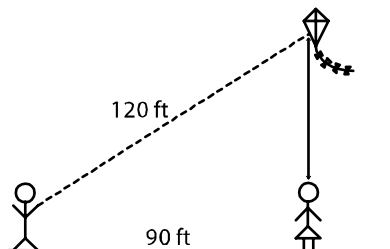


Express your answer

(a) as a sum of square roots:

(b) as a decimal:

2. (9 points) In the right triangles below, work out the lengths of the sides labeled **a** and **b**. Be sure to show your work.



3. (8 points) Mark and Mary are flying a kite. Mark has let out 120 feet of string and the kite is directly above Mary's head. Mary is 90 feet away from Mark. How far above Mary's head is the kite?
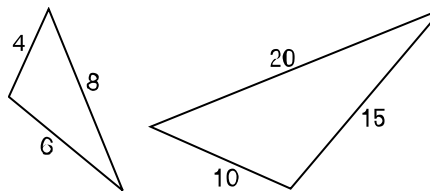


4. (5 Points) Clearly mark two additional points C and D on the dotpaper given below so that ABCD is a square.
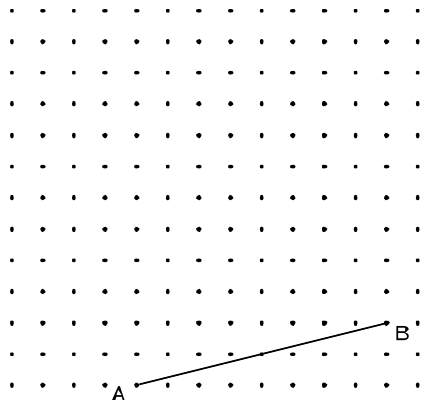


5. (5 points) If the two figures below are similar then, based on the information given, what is the length of the side marked with an *x*?
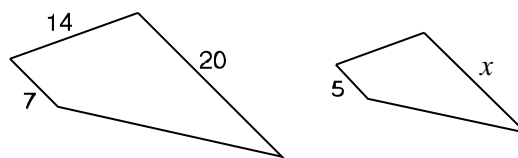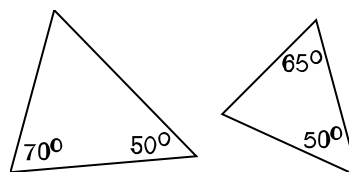


6. (8 points) Based on the information given, decide if the pairs of triangles below are similar or not. *Be sure to give your reasoning!*
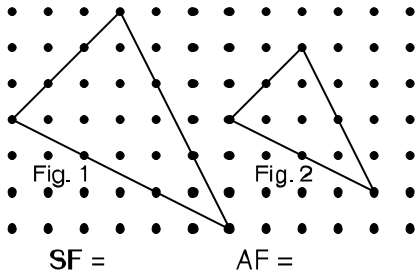


a) Similar triangles?: YES or NO
   **Reason:**



b) Similar triangles? YES or NO
   **Reason:**

7. (6 points) Going from Figure 1 to Figure 2 below, what are the scale factor and the area factor. Write the values in the spaces provided.



SF = _____    AF = _____

8. (7 points) A fence encloses 125 square yards. If the length of the fence is made three times as long (but the shape is the same) how much area will be enclosed?

9. (6 points) **Riddles with Solids:** Two descriptions of three dimensional solid figures are given below. After each of these descriptions write a descriptive name of a solid which matches the description.

a) This solid has two faces which is are pentagons and 7 faces in total.

b) This solid is a pyramid which has 7 vertices.

10. (7 points) A tent is pictured below along with a diagram of the floor of the tent. Figure out the volume of this tent. (*Show your work!*)



Pole = 10 feet

little square is 5 ft x 5 ft
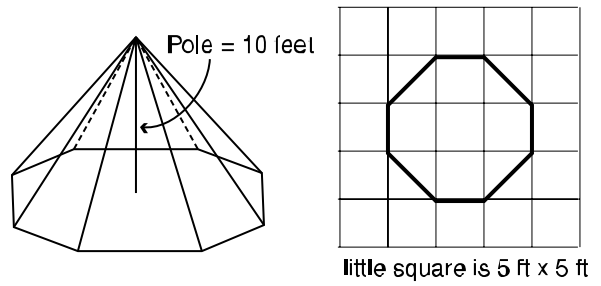
11. (8 points) A cathedral-like structure has a square-shaped base which is 40 feet on a side, a height of 90 feet and has a hemispherical dome just fitting on the top. A drawing is shown below. What is the volume of this building? (Be sure to show your work.)
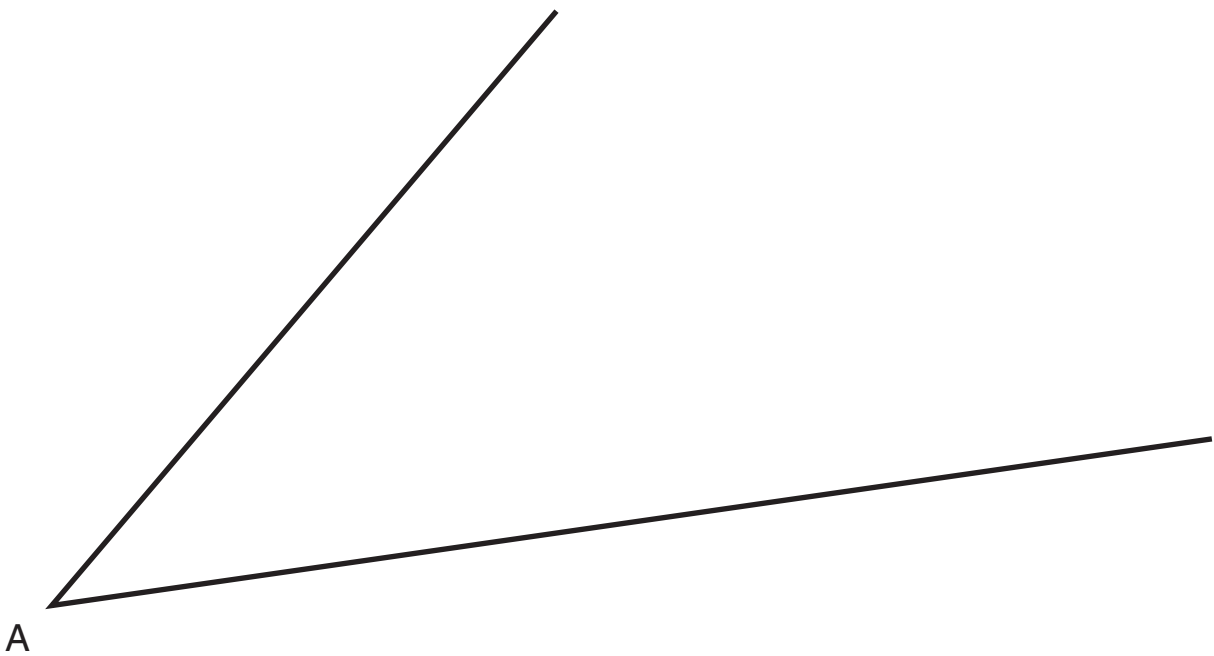


90 ft

40 ft

40 ft
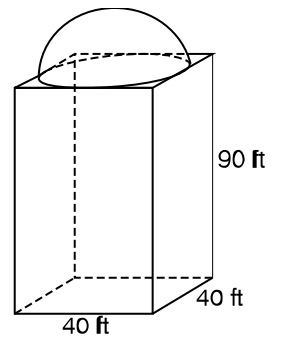
Name:_____

12. (12 points)  Using *a straightedge and compass*, construct the angle bisector of the angle given below.

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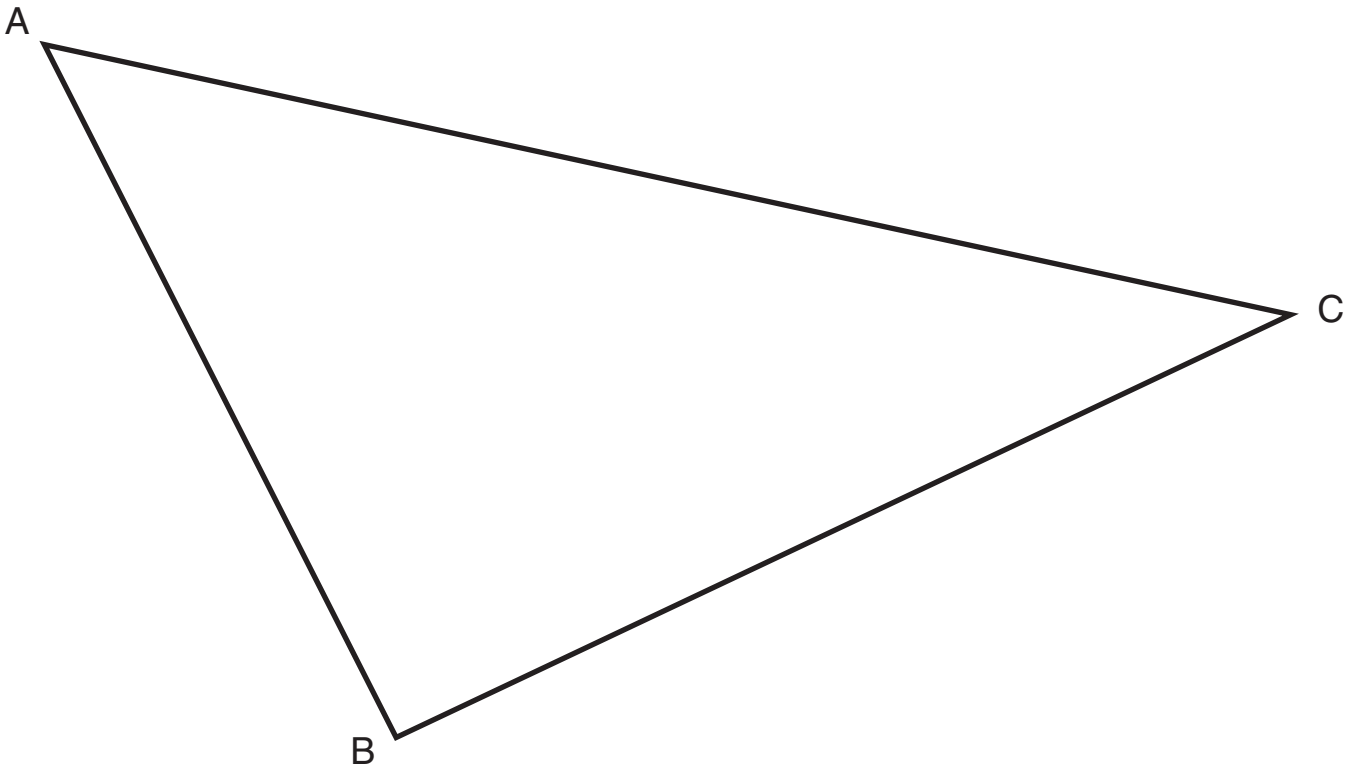
**Describe:**

A

Name:_____

13. (12 points) *Using a straightedge and compass*, construct the center of the circumscribing circle for the triangle ABC given below. Also, use the compass to draw the circumscribing circle.
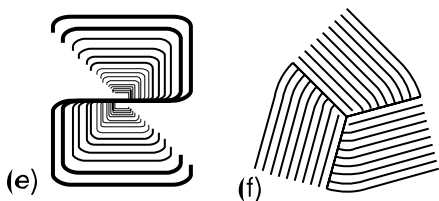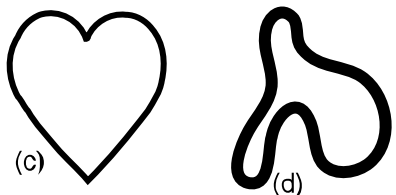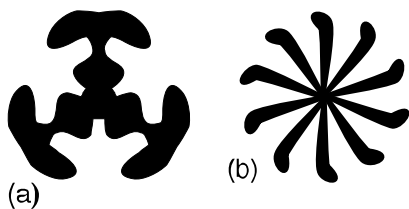
*Describe the process that you used.*

**Describe:**

A

C

B

# Geometric Structures – Exam III – Fall 2004

Name:_____

1.  (15 points)  Using the codetable below, identify the symmetry type of the following mandalas.

(a)

(b)

(c)

(d)

(e)

(f)

### 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 |

2.  (4 Points)  Using the code table for mandalas given above,  figure out the symmetry type of a kite shape when considered as a mandala.  (Consider kites which are not special cases of other quadrilaterals.)

   Symmetry type:

3.  (6 points)  Notice that, when considered as a mandala, the capitol letter  "Z" has type  **C₂**.

## Z

 Give two more capitol letters which are of type **C₂**. Draw these letters below:

4.  (15 points) Using the codetable below, identify the symmetry type of these borders.
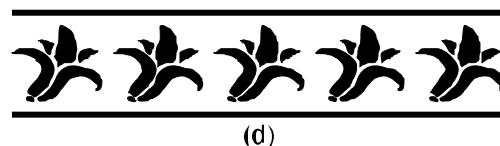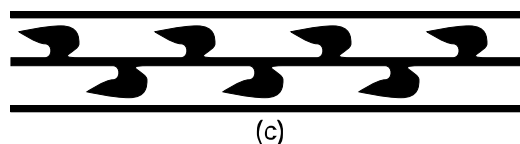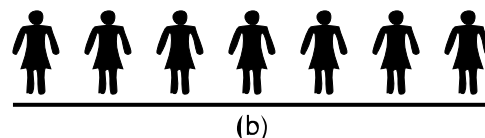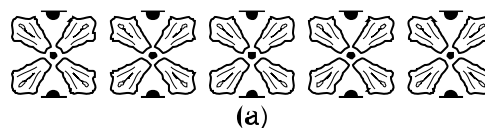
(a)

(b)

(c)

(d)

(e)

### 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. | |

5.  (12 points) Pairs of congruent figures are given below. For each pair, indicate by which of the four types of transformations the copies are related (translation, reflection, rotation  or glide reflection).

(a)

(b)

(c)

(d)
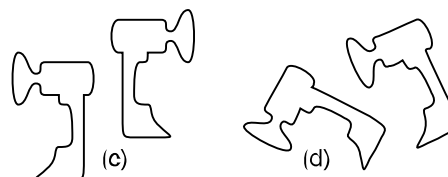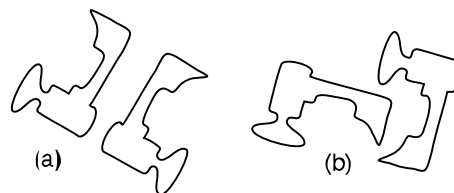
6. (6 points) The figure below shows a regular pentagon inscribed in a circle. Then a quadrilateral is formed from three sides of the pentagon and a diagonal. Work out the values of the four angles marked a, b, c, and d of the quadrilateral.



Regular pentagon
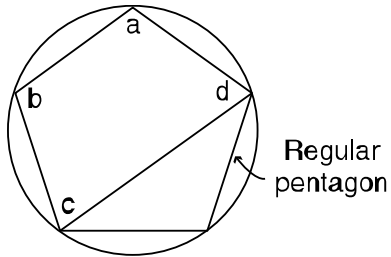
7. (6 points) What is the area of the shaded sector of the circle of radius 3 which is shown below?



70°

r = 3
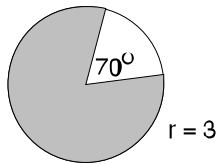
8. (7 Points) If Jenna Rae runs at a speed of 1225 feet per minute, how long will it take her to run 10 times around the track shown below which is made up of two semicircles at the ends of a rectangle with dimension as shown?



100 feet

200 feet
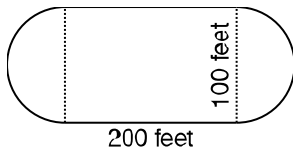
9. (7 points)
(a) Draw the altitude that goes through point A in the triangle given below.

A
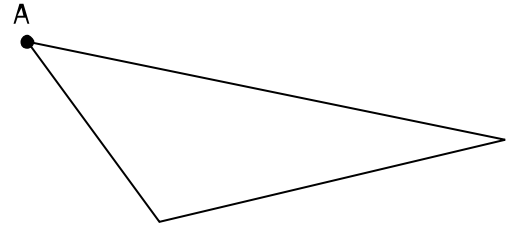


(b) In the case above, it is necessary to extend one of the sides in order to draw the altitude. For what kinds of triangles is it necessary to extend one of the sides to draw one of the altitudes? Describe, giving a complete sentence.

10. (11 points)  The two figures given below are related by a rotation.  Using a mira, find the center of this rotation.

   *Note:  Do the construction and then clearly describe the process that you used.*
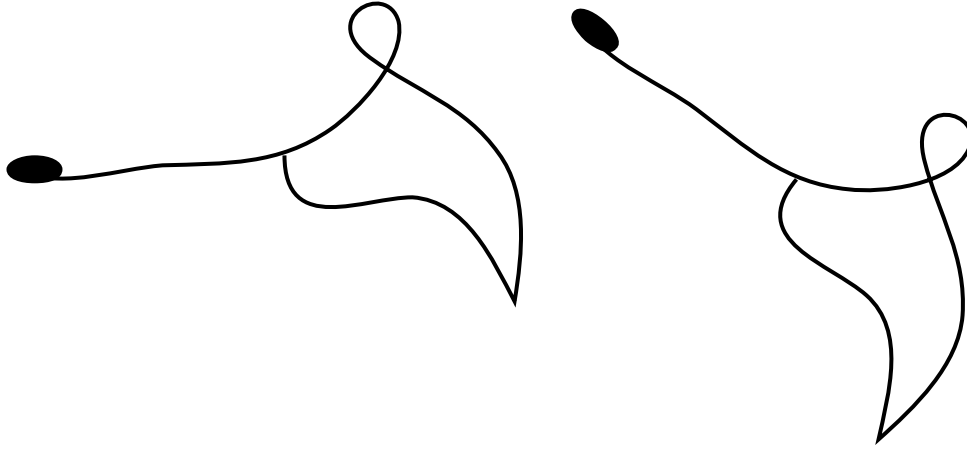
11. (11 points) Using a mira, construct a line which is parallel to the line given below and which goes through the point **A**.
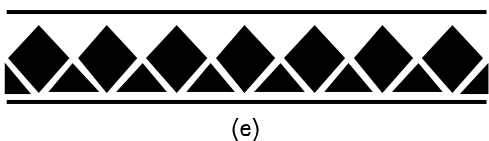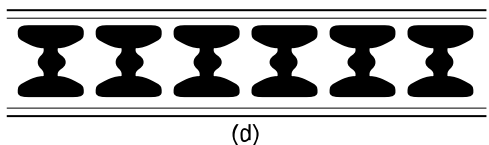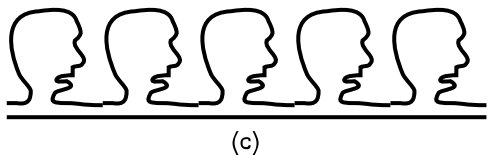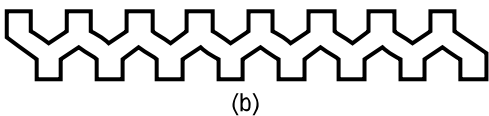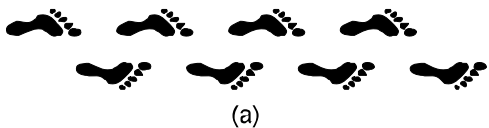
Note: Do the construction and then clearly describe the process that you used.

A

●
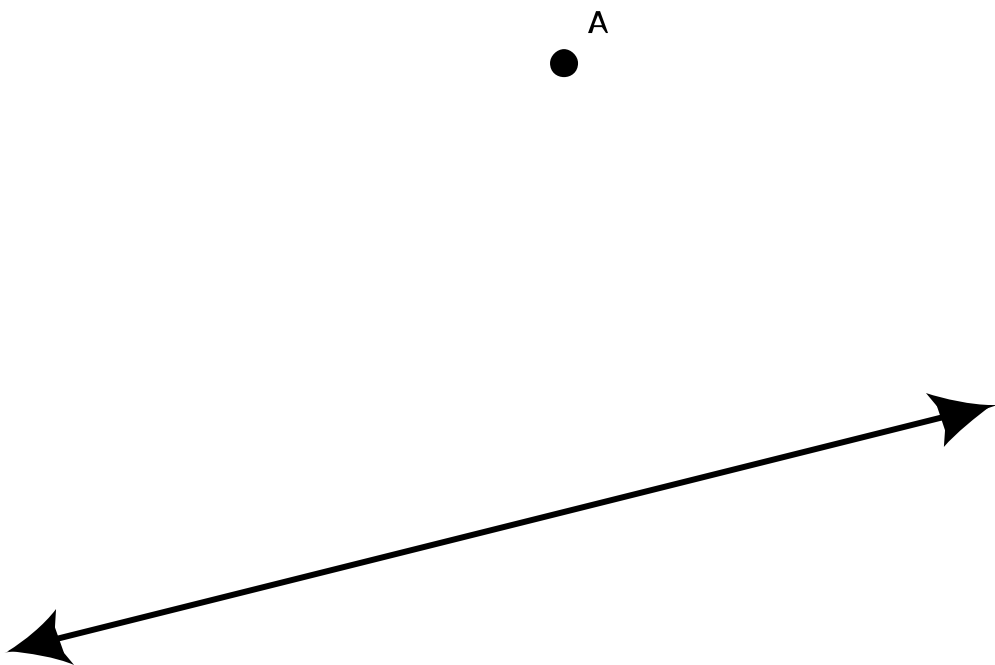
# Geometric Structures – Final – Fall 2004

Name:_____

1.  (12 points) Using the code table below, identify the symmetry type of these borders.

(a)

(b)

(c)

(d)

(e)

**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. |

2.  (6 points) Four pairs of congruent figures are given below.  Indicate which of the four types of actions relate the two copies by writing translation, rotation, reflection or glide reflection.

a)

b)

c)

d)
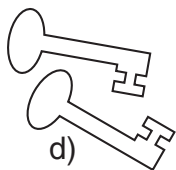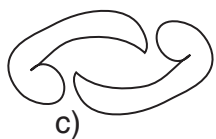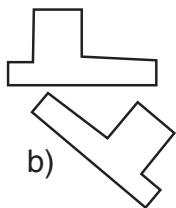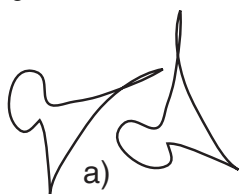
3.  (8 points)  For the two geoboards shown below you are to figure the areas and describe the method you used.  Two different methods need to be used.
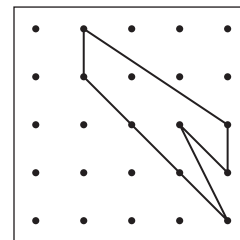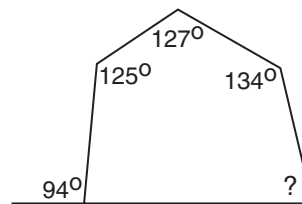
(a)  Name Method Used:
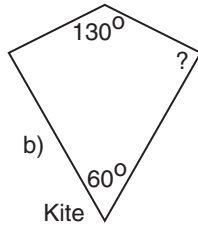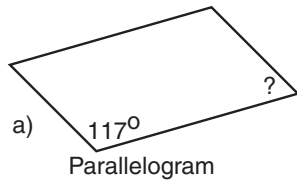
Describe the method:
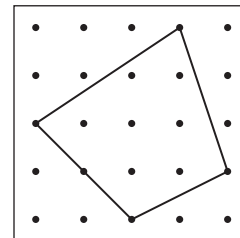
(b)  Name Different Method Used:

Describe the method:

4.  (4 points) What is the measure of the angle marked with a question mark?  *Show your work!*

127°

125°    134°

94°    ?

5. (8 points) Figure out the value of the angles marked with a question mark given below.



a) $117^O$
Parallelogram

b) $130^O$ ? $60^O$
Kite

6. (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.
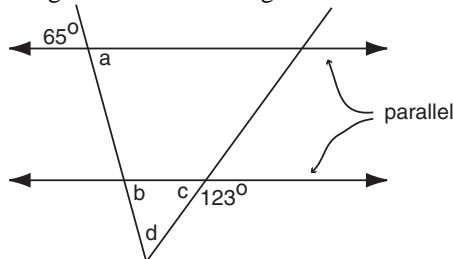
Acceptable reasons include:
  "alternate interior angle to something"
  "corresponding angle to something"
  "vertical angle to something"
  "supplementary angle to something" or
  "the angle sum is something."



$65^O$
a
parallel
b c $123^O$
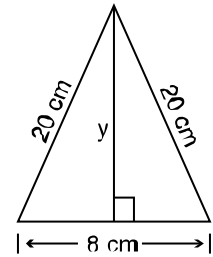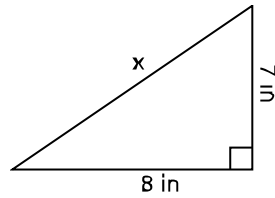d

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

(b) The value of **b** is:
    The reason is:
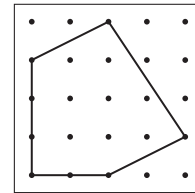
(c) The value of **c** is:
    The reason is:

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

7. (8 points) Figure out the lengths of the sides marked x and y in the two figures below. *Be sure to show your calculations!*



x
7 in
8 in

20 cm   y   20 cm
|← 8 cm →|

8. (6 points) Find the perimeter of the geoboard figure given below. Express your answer in the two ways asked for.



(a) The perimeter expressed as a sum of square roots.

(b) The perimeter expressed as a decimal.

9. (6 points) What is the volume of the barn shown below which is 24 feet long and whose ends are shaped like an isosceles trapezoid with dimensions as shown?
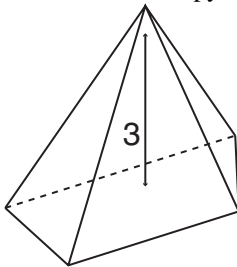


10 feet
10 ft
24 feet
14 feet
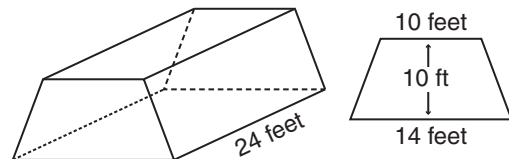
10. (7 points)  There are two related parts to this problem

   (a)  What is the area of the trapezoidal shaped region on the geoboard given below?
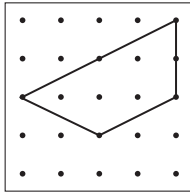
   (b)  If the trapezoid shape from part (a) is the base of a pyramid which is 3 units tall (see figure below), what will the volume of this pyramid be?

11.  (6 points) Five geoboard figures are given below.  For each of the properties below list the letters of the figures which satisfy the property.
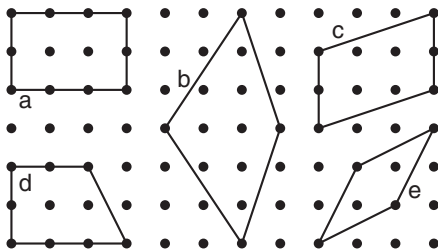
   a)  Property: The diagonals are perpendicular.
       Letters:

   b)  Property: Opposite angles are the same.
       Letters:

   c)  Property: The diagonals bisect the corner angles.
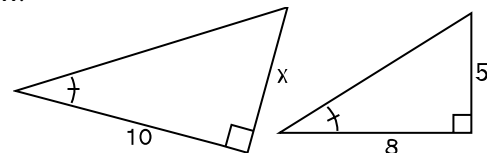       Letters:

12. (6 points)  What is the area of the dark portion of  the following figure where the larger circle has radius 12 centimeters and the seven smaller and equal circles just fit inside?
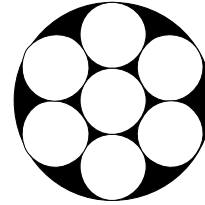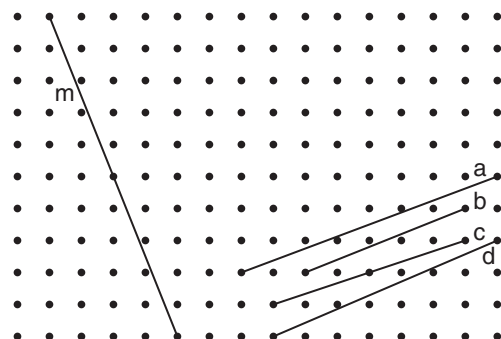
13. (4 points)  What is the scale factor going from Triangle 1 to Triangle 2 as shown below?

   Triangle 1
   2
   4
   3

   Triangle 2
   3
   3
   4.5
   6
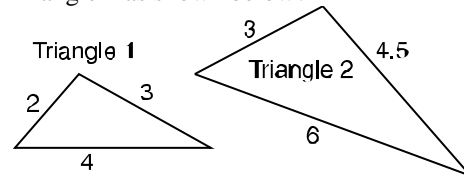
14. (4 points)    What is the length of the side marked with an x?

   10
   x

   8
   5

15. (3 points)  Which of the lines a, b, c, or d is perpendicular to line  m?
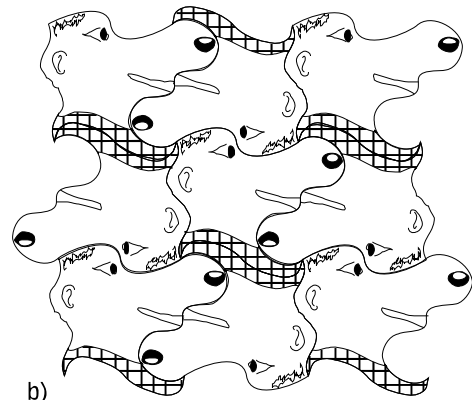
   m
   a
   b
   c
   d

16. (6 points) One application of fertilizer to a certain field requires 500 pounts of fertilizer. If the dimensions of the field are doubled, how many pounds of fertilizer would be needed for an application at the same rate to the enlarged field?
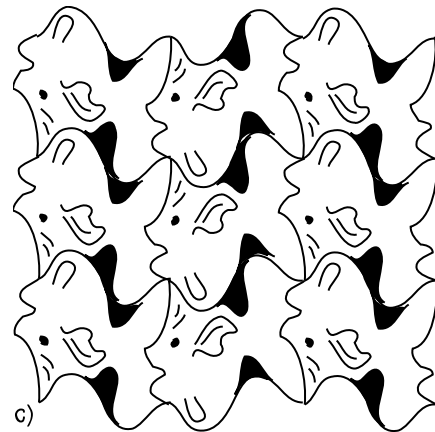
17. (12 points) Analyze each of the Escher style tessellations given below. For each design, indicate the Heesch type.
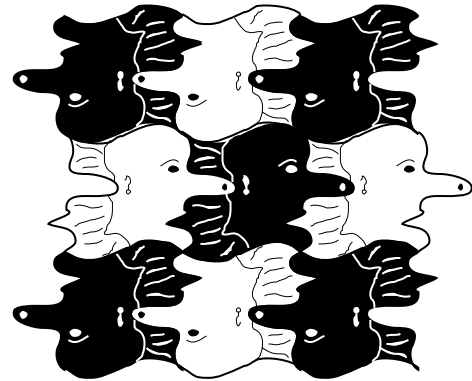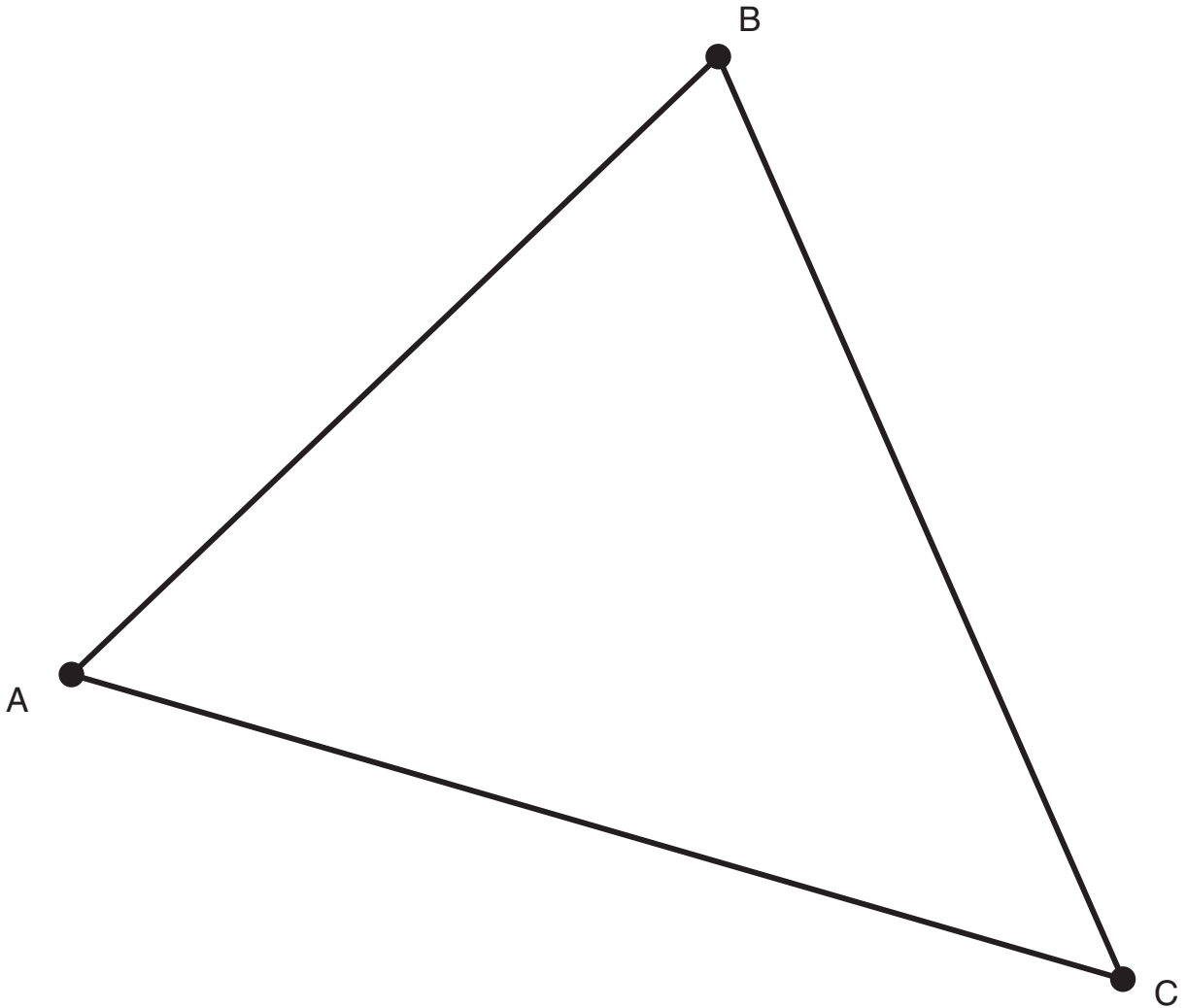


a)



b)



c)

## CD Problem – Mira

Name:_____

18. (9 points)  <u>Using a mira</u>, construct the incenter of the triangle given below.  To check your construction, use a compass to draw the inscribed circle.

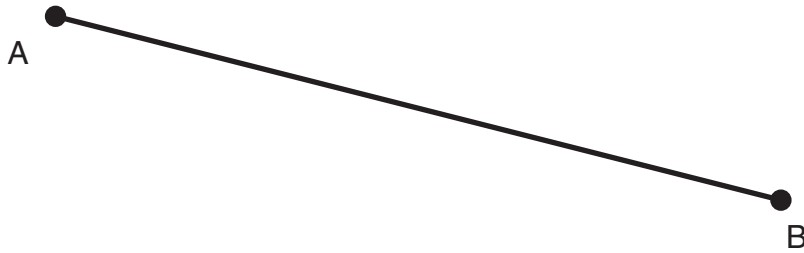   *Note:  Do the construction and then clearly describe the process that you used.*

**Describe:**

B

A

C

19. (9 points) <u>Using paper folding,</u> fold an equilateral triangle so that segment AB below is one side.

*First do the construction and then describe your steps.*

A

B

**Describe:**

# CD Problem – Straight Edge and Compass

20. (9 points)  <u>Using a straight edge and compass</u>, construct a triangle so that the three lengths given below are congruent to the three sides of the triangle and the side corresponding to **AB** is on line m.

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

A————————————————B

——————————————

——————————

m
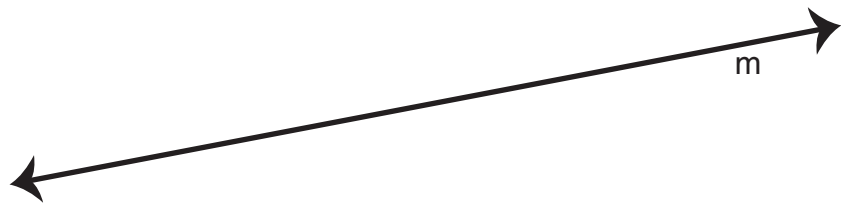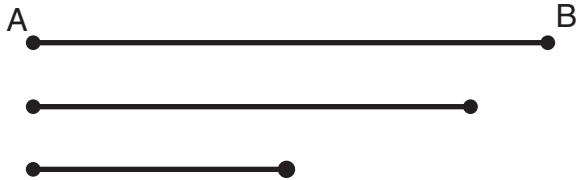
**Describe:**

# CD Problem – Straightedge and Compass

21. (9 points)  Using a straightedge and compass, locate a fourth point  D  so that  ABCD forms a kite.

*Describe the process that you used.*

**Describe:**

C

A

B