TANGRAM PERIMETERS

Performance Standard (7A/9A/9C).H

Compare the relative size relationships between pieces in the seven-piece Tangram square and other figures made of Tangram pieces:

- *Mathematical knowledge*: Determine derived measurements; apply the Pythagorean Theorem; and represent, solve and explain numerical relationships using geometric concepts.
- *Strategic knowledge*: Solve problems that involve geometric relationships within a single geometric shape using the Pythagorean Theorem.
- *Explanation*: Explain what was done and why it was done.

Procedures

1. ***In order to measure and compare quantities using appropriate units, instruments and methods (7A), demonstrate and apply geometric concepts involving points, lines and planes (9A), and construct convincing arguments and proofs to solve problems (9C),*** students should experience sufficient learning opportunities to develop the following:
   - Solve pictorial or word problems that involve geometric relationships within a single geometric shape or figure, including the Pythagorean theorem (i.e, the theorem that the sum of the squares of the lengths of the sides of a right triangle is equal to the square of the length of the hypotenuse).
   - Create and critique arguments concerning geometric ideas and relationships, such as congruence, similarity, the Pythagorean relationship, or formulas for surface areas or volume of simple three-dimensional objects.
   - Represent, solve and explain numerical relationships using geometric concepts.
2. Provide each student a copy of the assessment task sheet, tangram pieces, and the rubric. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work. Note: If actual tangram pieces are not available, a template has been provided so you can have them cut their own pieces from card stock. Please note that the template and drawing in the problem may not be the same scale as commercial tangrams. The figure in part B is drawn to the same scale as the tangram template provided.)
3. Have the students work individually to solve the problems on the "Tangram Perimeters" task sheet. (Do not help the students or guide their thinking as they solve the problem.)
4. Evaluate each student's work using the rubric and determine the performance level using the guide on the rubric. Score each part of the problem separately. The criteria listed in Part A below may be used in Parts B and C. Minor errors in computation include making errors in actual addition or multiplication, rounding incorrectly. Major errors include using the wrong operation or formulas, or not using the correct Pythagorean relationship where appropriate.
   - <u>Part A</u>:
     - 4 = completely and clearly describe the relationship between the various pieces, using correct numerical relationships and correct terminology for the names of the pieces. Each of the large isosceles right triangles has a perimeter of $4 + 2\sqrt{2}$ units; the middle-sized isosceles right triangle has a perimeter of $2 + 2\sqrt{2}$ units, and each of the two small isosceles right triangles has a perimeter of $2 + \sqrt{2}$ sq. units. The parallelogram has a perimeter of $2 + 2\sqrt{2}$ units. It is possible that the students do not reduce the $\sqrt{8}$ to $2\sqrt{2}$. They should not be penalized for this in scoring this task.
     - 3 = may have one or two values incorrect due to minor errors, and generally would not have provided a totally complete or clear description of their procedures and processes.
     - 2 = will usually have several incorrect values and incomplete justifications of their work.
     - 1 = would normally not get any of the answers correct due to major errors in their procedures and would not be able to logically explain the reasoning.
   - <u>Part B</u>: Should provide a clearly labeled drawing showing which pieces they used to create the new figure, as well as a detailed description of how they know the new figure has a perimeter of $6 + 6\sqrt{2}$ units. May not reduce the $\sqrt{8}$, this may look like $6 + 2\sqrt{8} + 2\sqrt{2}$ units. A student who does not have a clear understanding of perimeter may try to add the perimeters of all the pieces together and not just consider the distance around the outside.

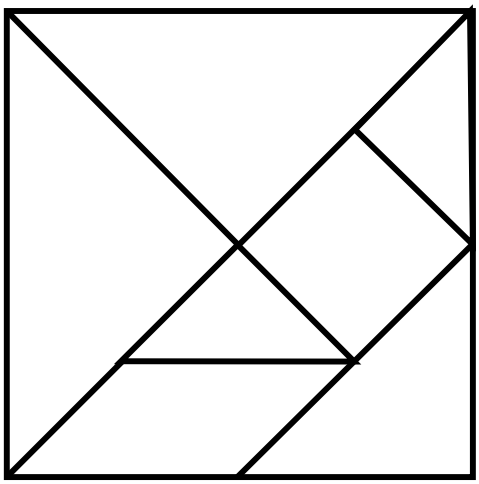
- Part C: Should provide a clearly labeled drawing showing which pieces they used to create the new figure, as well as a detailed description of how they know the perimeter of their figure. Since the pieces they will use can vary, the exact perimeter of their shape will vary also.
  The explanations should include how they found these answers, as well as why these answers are correct.

Examples of Student Work follow

Resources
- Copy of "Tangram Perimeters" task sheet
- Tangram pieces
- Mathematics Rubric

Time Requirements
- One class period

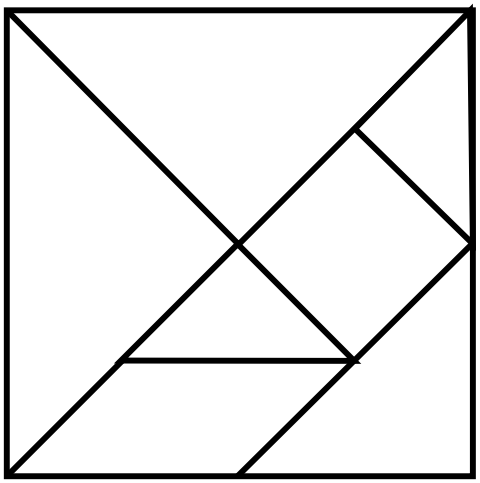
Tangram Template



NAME_____ DATE _____

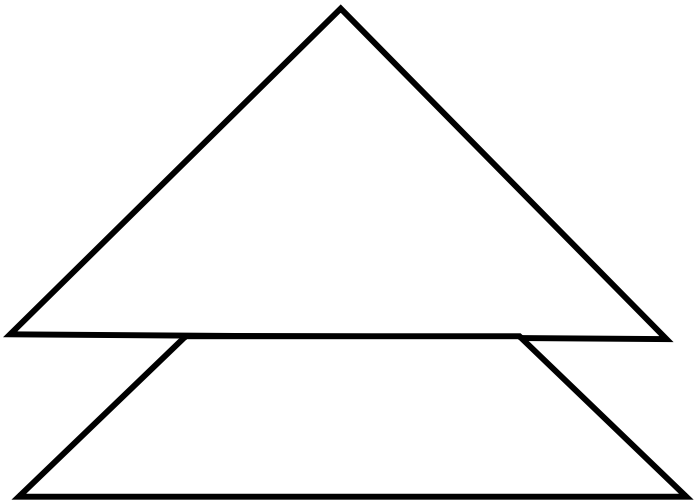
TANGRAM PERIMETERS

The seven-piece tangram puzzle has been around for centuries. The sketch here shows all seven pieces put together to form a square. Use your pieces to explore the relationships between the sizes of the different pieces; then, complete parts A through C.



A. Name the geometric shapes present in the seven pieces and give the perimeter of each given that the small square piece has an area of 1 square unit. Explain your reasoning.

B. Use some of the tangram pieces (You may not need them all.) to build the shape shown here. What is the perimeter of this shape? Explain your reasoning.



C. Construct your own figure using between 3 and 5 of the tangram pieces. Draw and label the shape you made, so others can build it easily. What is the perimeter of your new shape? Justify your reasoning.

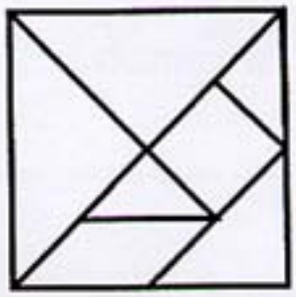
7A9A9C-HW

Name _____ 8X

Date 4-10-01

Tangram Perimeters

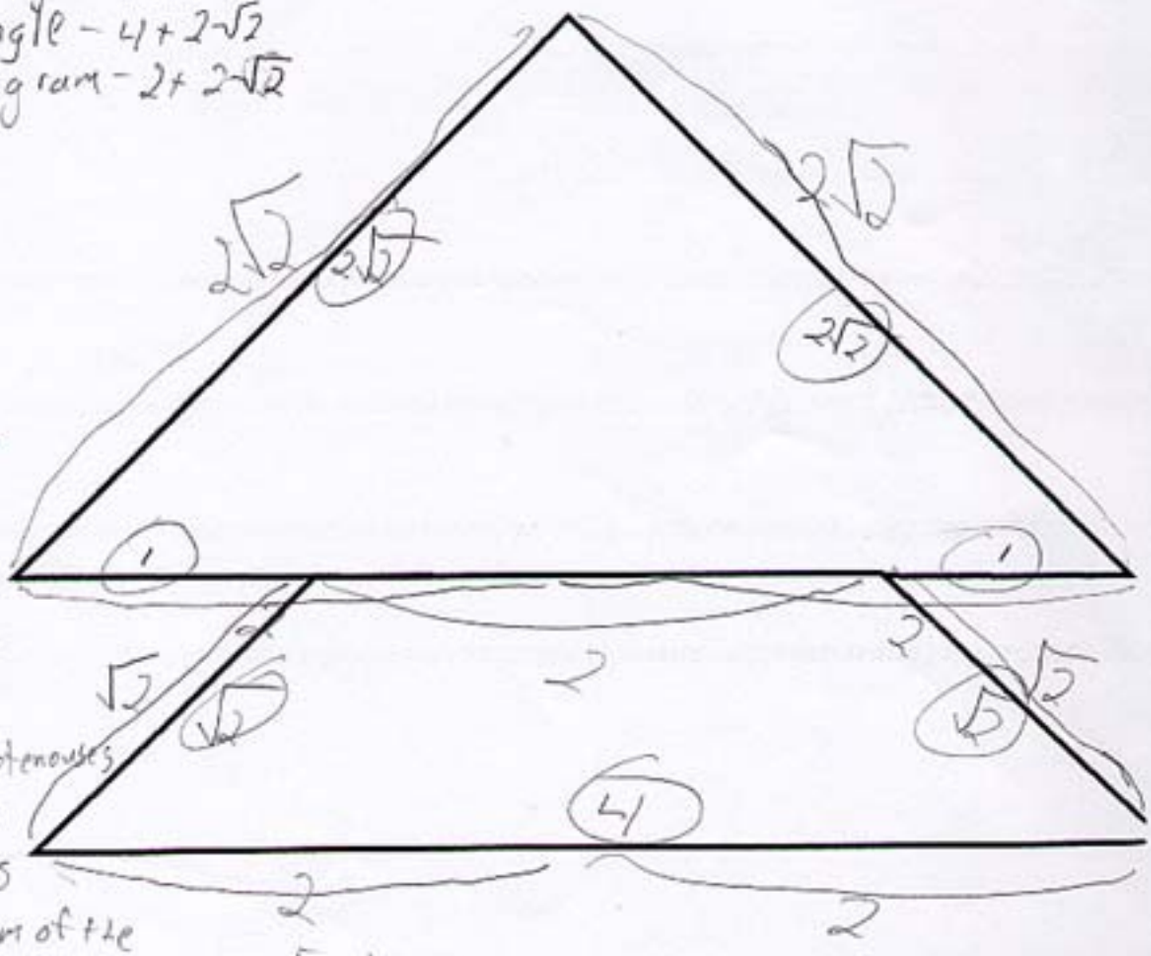
The seven-piece tangram puzzle has been around for centuries. The sketch here shows a reduced picture of all seven pieces put together to form a square. Use your pieces to explore the relationships between the sizes of the different pieces then complete parts A through C.



A. Name the geometric shapes present in the seven pieces and give the perimeter of each given that the small square piece has an area of 1 square unit. Explain your reasoning.

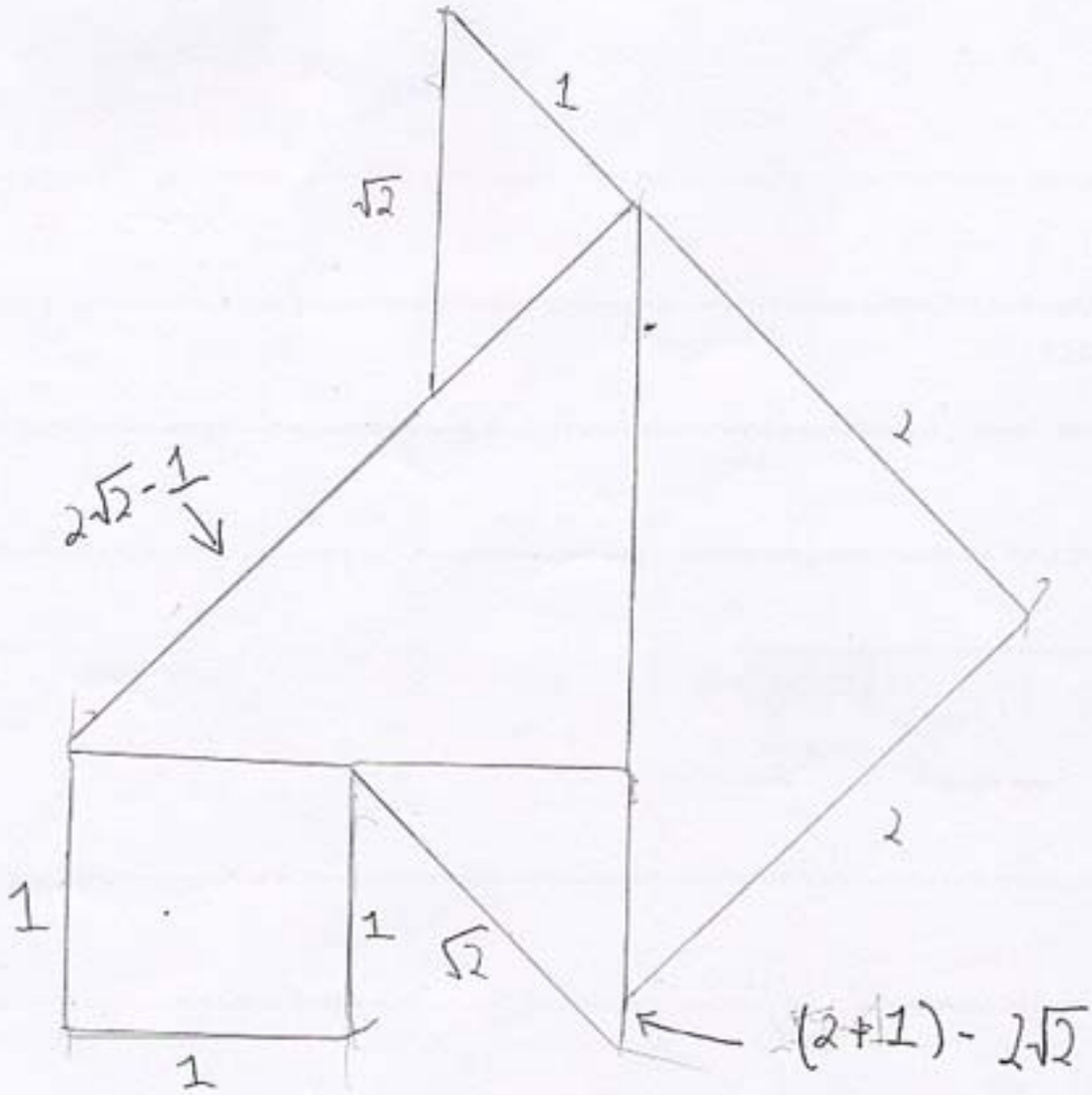
square = 4 units
small triangle - $2+\sqrt{2}$
medium triangle - $2\sqrt{2}+2$
large triangle - $4+2\sqrt{2}$
parrellelogram - $2+2\sqrt{2}$

B. Using some of the tangram pieces (you may not need them all) to build the shape shown here. What is the perimeter of this shape? Explain your reasoning.



Perimeter is the outside of a figure. Perimeter is $6+6\sqrt{2}$. I took the large triangle and fit in the half of the top triangle. I then put the other large triangle in the top triangle. Both of their hypotenouses were on the perimeter, so I added them up (each one is $2\sqrt{2}$.) I found the bottom of the triangle with the large triangle's sides. Each side is 2 units, so the bottom part of the triangle is 4, but some of that is not the perimeter. I fit the large triangle's side in the non-perimeter part, and found it was about 2 units. I fit the medium triangle in the bottom triangle to find each end side is $\sqrt{2}$ units. Then I fit the 2 small triangles in the other side to find the bottom is 4.

C. Construct your own figure using between 3 and 5 of the tangram pieces. Draw and label the shape you made, so others can build it easily. What is the perimeter of your new shape? Justify your reasoning.



$1+2+2+1+1+1+\sqrt{2}+\sqrt{2}+2\sqrt{2}-1+(2+1)-2\sqrt{2}$

$8+2\sqrt{2}+2\sqrt{2}-1+(2+1)-2\sqrt{2}$

$7+3\sqrt{2}+((2+1)-2\sqrt{2})$ ← Perimeter

The perimeter is the length around a figure. I found all of the lengths of the sides, and then added them all up.

7A9A9C-H M2

"Exceeds" (page 1)

Name _____ 8K

Date 4/10/01

Tangram Perimeters

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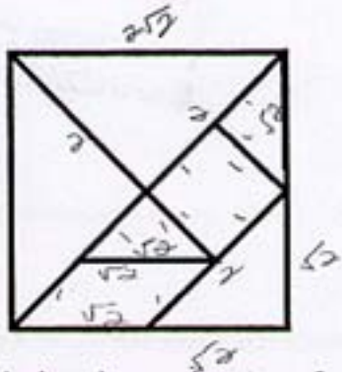
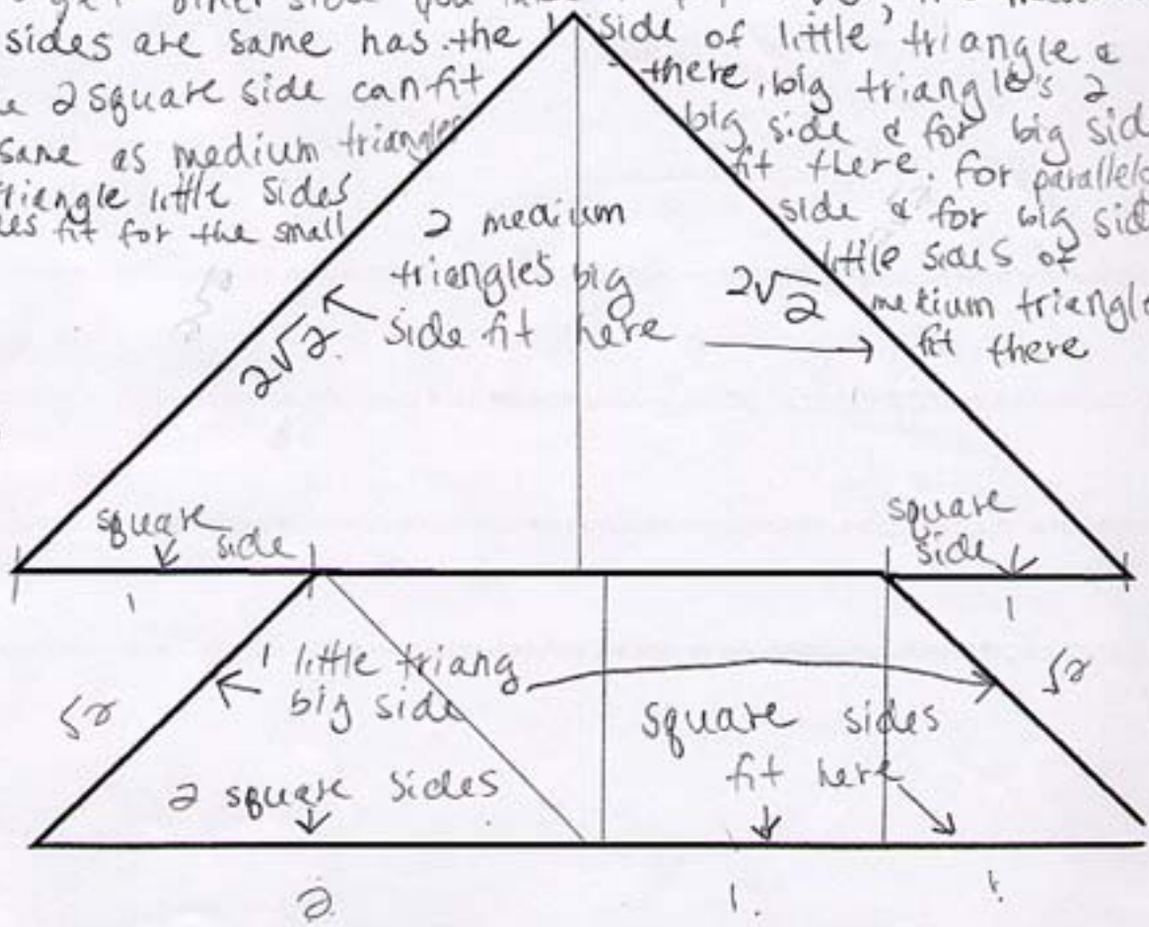


A. Name the geometric shapes present in the seven pieces and give the perimeter of each given that the small square piece has an area of 1 square unit. Explain your reasoning.

Big triangle - 6.8, medium triangle - 4.8, little triangle - 3.4 parallelogram - 4.8, square - 4, little triangle 2 sides are same as square, to get other side you take $1^2 + 1^2 = \sqrt{2}$, the medium triangles 2 sides are same has the big side of little triangle & for big side 2 square side can fit there, big triangle's 2 sides are same as medium triangles big side & for big side 2 medium triangle little sides fit there. for parallelogram 2 square sides fit for the small side & for big sides 2 medium triangles little sides of big triangles fit there

B. Using some of the tangram pieces (you may not need them all) to build the shape shown here. What is the perimeter of this shape? Explain your reasoning.



$2 + 1 + 1 + \sqrt{2} + 1 + 2\sqrt{2} + 2\sqrt{2} + 1 + \sqrt{2}$

$6 + 6\sqrt{2} = 14.4$

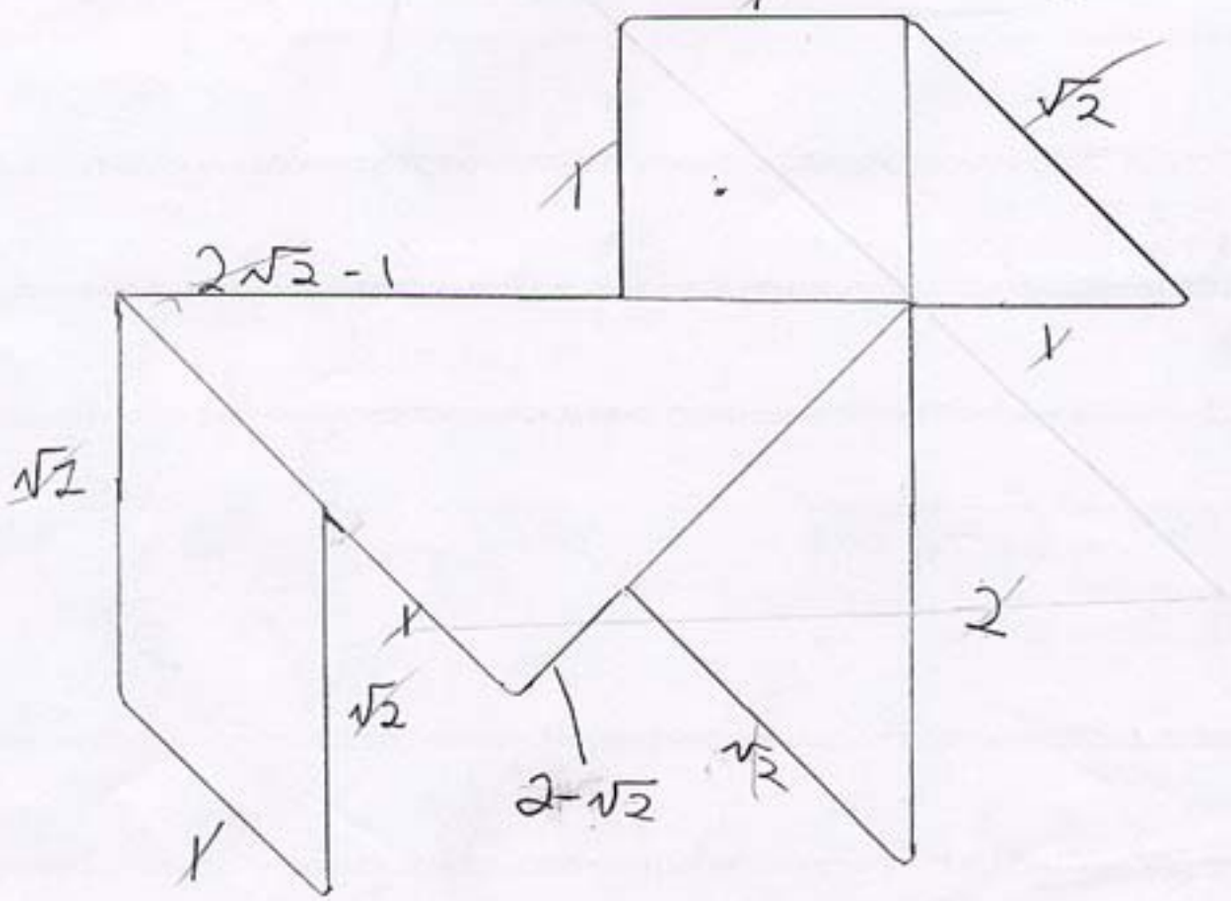
6.4 + 6 = 14.4

21.4 ± 6 = 8.4

7A9A9C-HE1

C. Construct your own figure using between 3 and 5 of the tangram pieces. Draw and label the shape you made, so others can build it easily. What is the perimeter of your new shape? Justify your reasoning.

A Horse made of 5 tangram pieces



perimeter is $5\sqrt{2}+6$. I gathered all the whole numbers which there were 7 and 1 subtracted is 6. Then counted $6\sqrt{2}$. The only thing I had left was $-\sqrt{2}$. So take one of the $6\sqrt{2} = 5\sqrt{2}$. So you get

$5\sqrt{2}+6$