Polly Gone

Level A

Polly works in a zoo and needs to build pens where animals can live and be safe.

The walls of the pens are made out of cubes that are connected together. Each section of fencing has a length of 1 cube.

Polly has 40 cubes and wants to make the largest rectangular pen possible, so the animals can move around freely but not get loose.

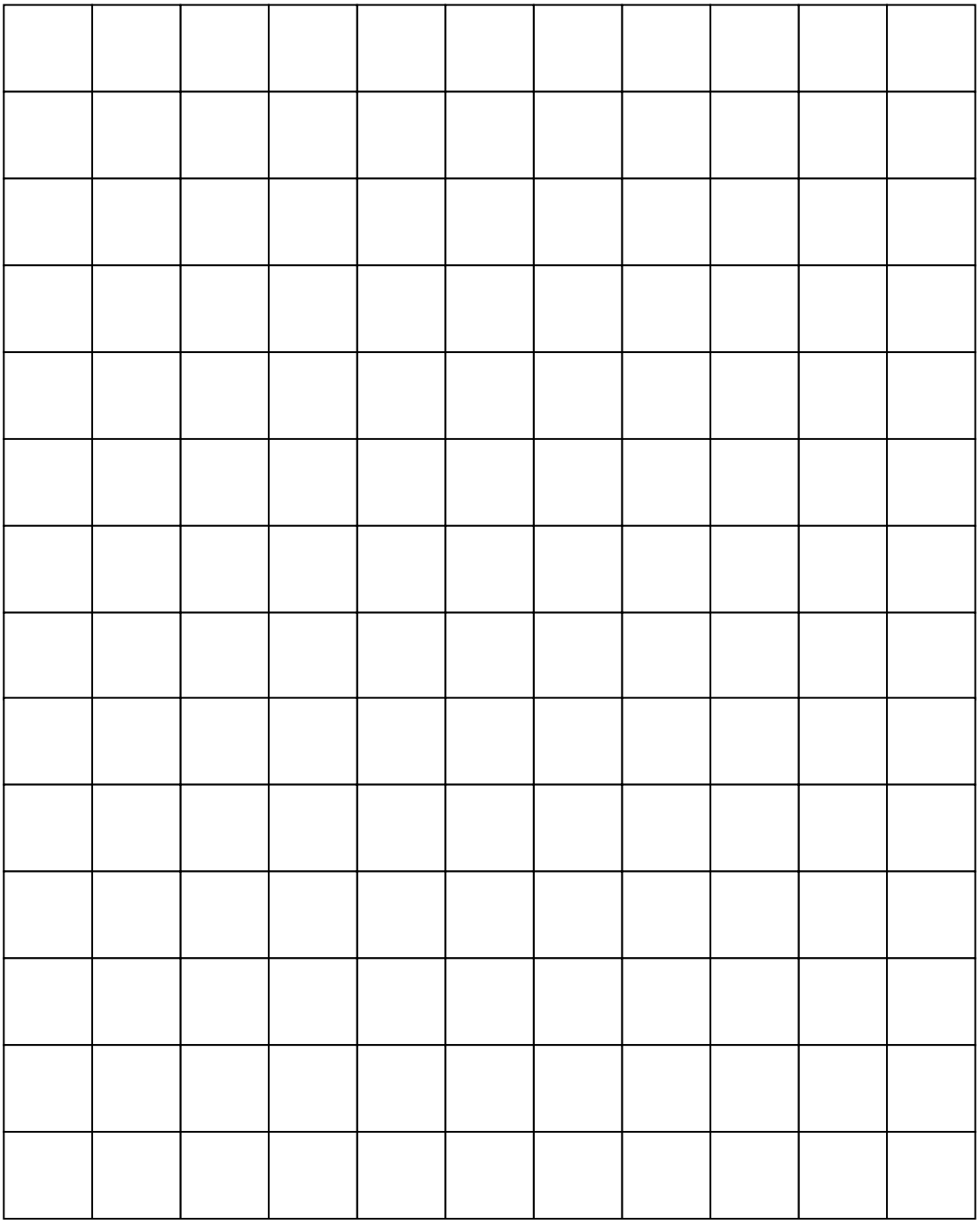
How can she use all 40 cubes to make the walls of the pen so that it has the greatest area for the animals? The walls must:

- Be fully enclosed, with no doors or windows, so Polly's animals can't get out (no gaps).
- Not overlap each other.

Help Polly by making several different-shaped pens and determine what pen provides the largest area for the animals. You might want to build the pen on the grid paper, so that it will be easier to determine the area.

Use the grid paper to show the shape of the pen. Explain to Polly why you believe your pen is the largest one that can be made.

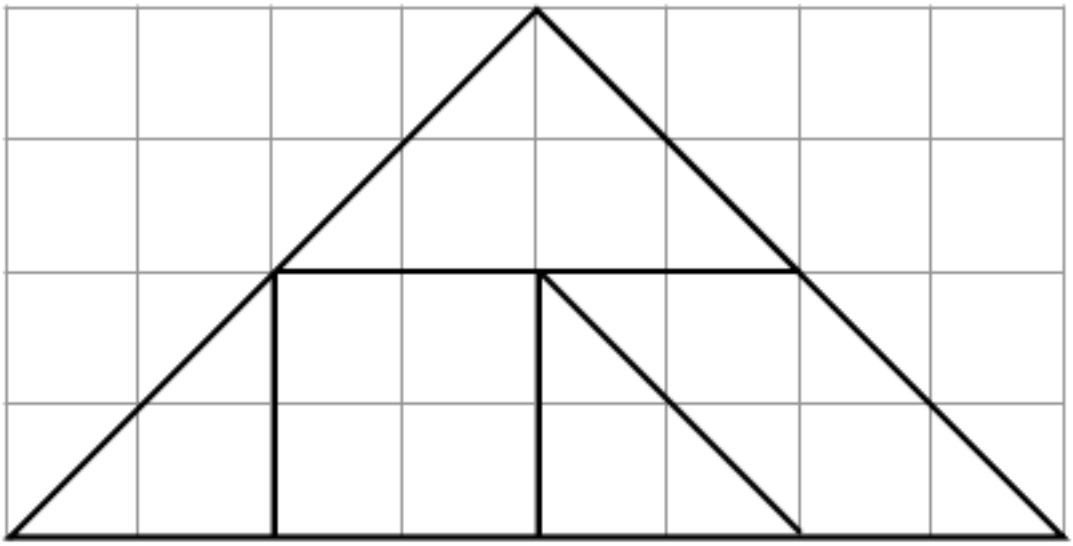
Manipulative for Level A—Grid paper



Polly Gone

Level B

The diagram shows a large triangle that is made up of five shapes. Name each of the five shapes that make up the larger triangle and determine the area of each of them.



Rearrange the shapes to find all possible parallelograms of any size. Note: rectangles and squares are special types of parallelograms.

Draw a picture of each parallelogram that you have found, and then determine its area.

How did you find all of the parallelograms? How do you know you found them all?

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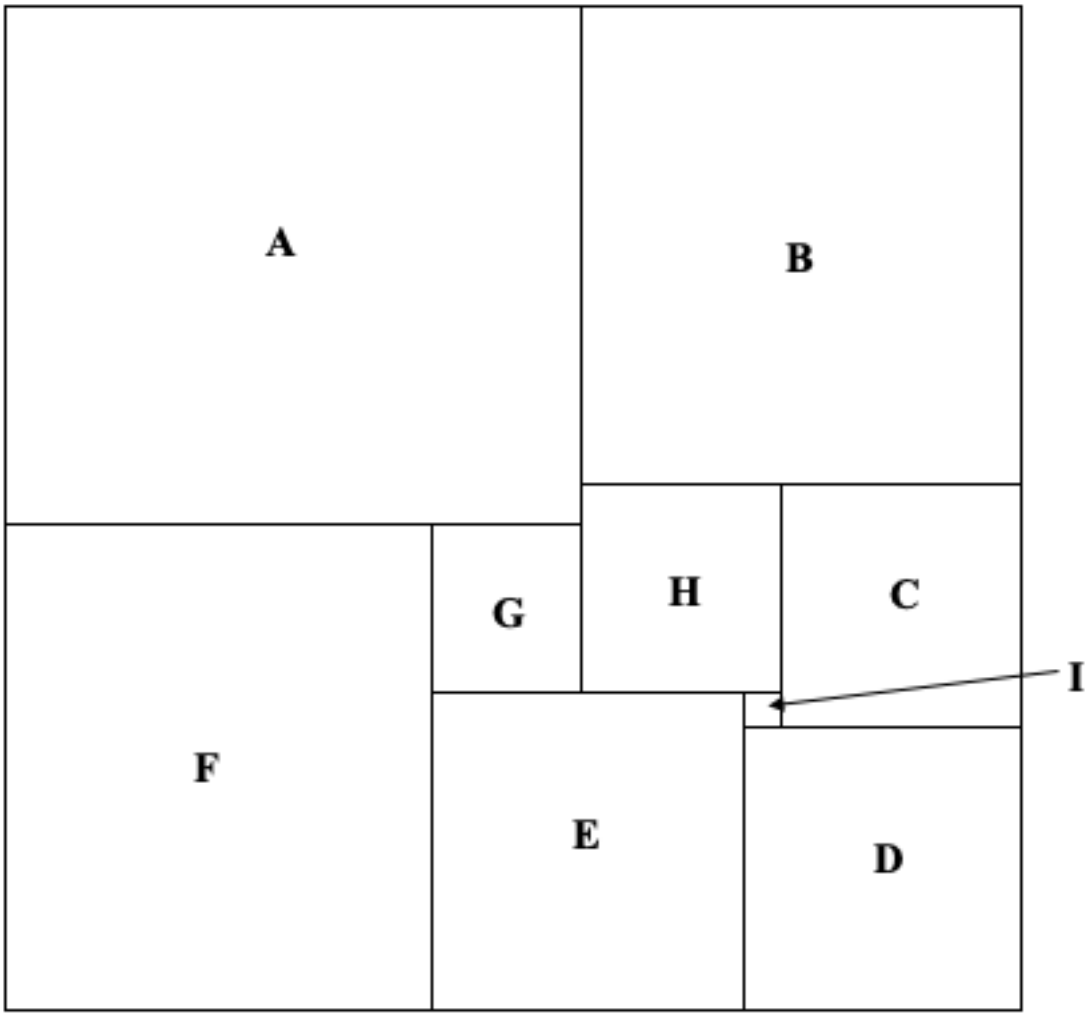
Level C

In November 1958, the magazine *Scientific American* showed this diagram on its cover.



Each of the interior rectangles is a square.

If square D is 81 square units and square C is 64 square units, what is the area of the other seven squares? What is the area of the entire figure? What is the perimeter of the entire figure? Explain your solutions.

Polly Gone

Level D

A new arena is going to be constructed at a local university.

A study is being done to find the best design for the performance or playing area. Since the arena will be used for many different sports, as well as shows and concerts, the designers want a seating arrangement that allows spectators to be as close as possible to the action.

They also want to seat as many front-row spectators as possible around the performance area. They have also decided that the boundary of the performance area needs to have straight sides—no curves due to the building materials they are using. The goal is to have front-row seats no more than 20 meters from the center of the performance or playing area.

They want to hire you as a consultant to investigate this matter and explain to them which design would best suit their needs. They need to see several examples of possible performance-area designs that fit their constraints. The final recommendation must explain the advantages of the design in terms of the size of the playing area and the number of people they can seat in the front row.

Polly Gone

Level E

Catherine said to Rebecca, “I need to draw an octagon, and I want it to be accurate.”

Rebecca replied, “I have an easy way to draw an octagon. Start with a large square. Find the midpoint of each side. Now draw a line segment from each midpoint to the two opposite vertices. In the center of the drawing, an octagon will be formed.”

“That’s a great method, Rebecca, but I want to make my octagon a certain size. How big do I need to make the original square in terms of area to get an octagon of a certain area?” Catherine asked.

Please help Catherine and Rebecca determine the relationship between the area of the square and the area of the octagon that can be created from it. Explain your reasoning.

“After you have drawn your octagon, you will see that it comes out as a beautiful regular octagon,” Rebecca exclaimed. “Well, it may be beautiful, but I don’t think it is regular,” challenged Catherine.

Who is right? Determine your answer using mathematics.