

# The Thirty-Third Annual Eastern Shore High School Mathematics Competition

November 10, 2016

## Team Contest Exam

### Instructions

Answer as many questions as possible in the time provided. To receive full credit for a correct solution, show all work and provide a clearly written explanation. Solutions will be judged based on correctness, completeness and clarity. (Little credit, if any, will be given for a solution consisting of just a number or a single sentence.) Calculators are allowed **only** on the team contest exam.

All work and answers must be written on the provided sheets of plain white paper. Use only one side of each sheet of paper, and start each new problem on a new sheet of paper. Write your team name (that is, the name of the school which you are representing) at the top of each sheet that you turn in for scoring.

**At the start of the team round, your team will receive a copy of only Problem 1. Your team must submit a response to Problem 1 within the first 15 minutes of the team round time interval.**

**When you submit your response for Problem 1, you will receive a copy of Problem 2 and a copy of Problem 3. Your team will then have the time remaining in the team round to complete a response for each problem.**

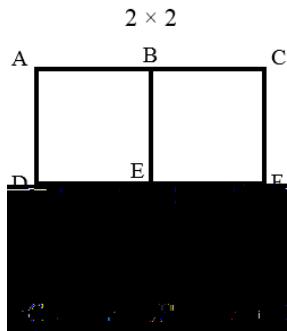
Note: if your team completes Problem 1 before the end of the allotted time, you may submit it and receive copies of Problem 2 and Problem 3 in advance.

PLEASE NOTE THAT QUESTION 1 IS PRINTED ON BOTH SIDES OF THIS PAGE.

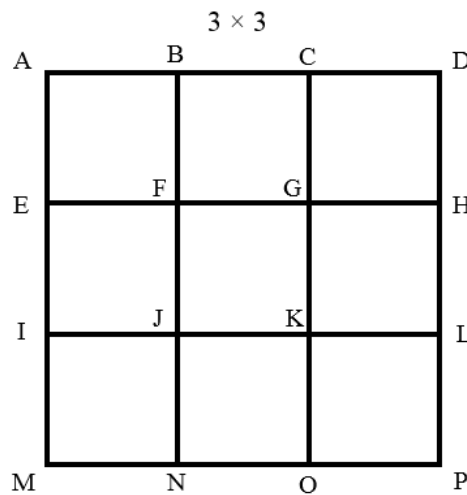
1. **Part 1:** A polyomino is a planar geometric figure formed by joining one or more congruent squares



2. a. A number of squares are made by the grid lines in the following diagram.  
List all of the squares you find in "Alphabetical Vertex Order," with the vertices in alphabetical order. For example "ACGI" for the square with vertices A, C, I and G is "ACGI." Answers that are not in "Alphabetical Vertex Order" will not be considered.



- b. A number of squares are made by the grid lines in the following diagram.  
List all of the squares you find in "Alphabetical Vertex Order," with the vertices in alphabetical order. Answers that are not in "Alphabetical Vertex Order" will not be considered.



- c. Find a formula for the total number of squares in an  $n \times n$  grid where  $n$  is any natural number larger than 1. You may use the grids below to help but your answer must be for a general  $n \times n$  grid.



3. Nine squares with side lengths 1, 4, 7, 8, 9, 10, 14, 15 and 18 (measured in the same units) can be arranged to form a rectangle. After the nine squares are arranged to form the rectangle there are no gaps between any squares and there are no overlapping squares.

What are the dimensions of the rectangle? Provide appropriate justification for your solution.