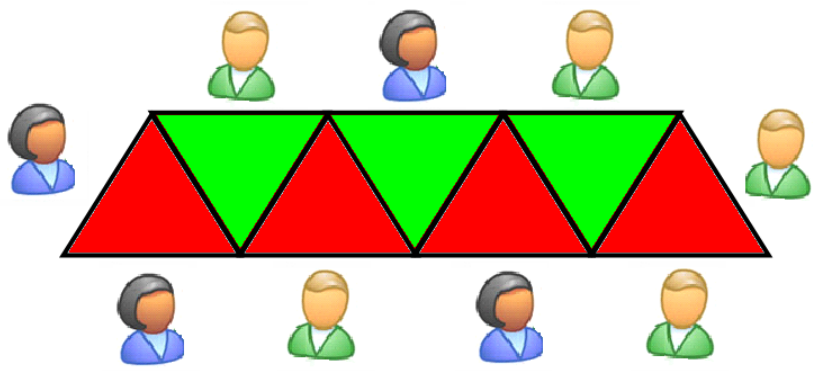
International Mathematics and Science Olympiad (IMSO) for Primary School 2006

Jakarta, November 12-18, 2006

Instructions:

* Write down your name and country on answer sheet.
* Answer all 6 questions in English.
* You have 120 minutes to work on this test.
* Write down your answer on the provided answer sheets.
* Use pen to write your answer.
* Use pencil only to draw figures.

1. For a meeting, equilateral triangular tables are arranged in a row as shown. Only one person can sit at each open edge of a table.



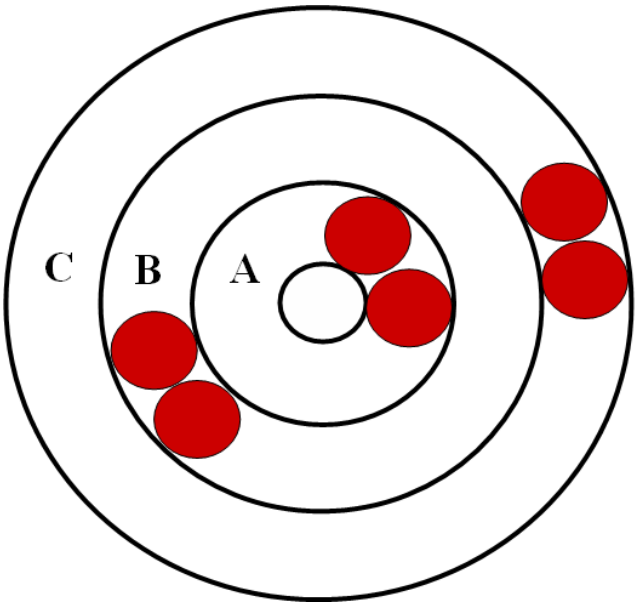
Questions:

(a) How many people can be seated when 20 tables are assembled in this manner?

(b) What is the minimum number of tables needed to seat 99 people in one row?

(c) What is the minimum number of tables needed to seat 100 people if there are five rows?

2. Three concentric circular tracks, denoted by A, B and C are shown in the following figure. The diameter of the innermost circle is 1 unit, and the width of each track is also 1 unit. Circles with 1 unit length in diameter are put to fill the tracks so that in each track no circles are overlapping each other (an example is shown in the figure below, where two non-overlapping circles are placed in each track).



Questions:

(a) What is the total number of circles, at most, that can fill the three tracks A, B, and C?

(b) Suppose there are 6 concentric circular tracks, what is the number of circles, at most, that can fill the outermost track?

3. Positive numbers are written in order beginning with 1 as shown in the following table. The number 15 appears in row R_1, column C_5.

		Column									
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
Row	R_1	1	2	6	7	15	16				
	R_2	3	5	8	14	17					
	R_3	4	9	13	18						
	R_4	10	12	19							
	R_5	11	20								
	R_6	21									
	R_7										
	R_8										
	R_9										
	R_{10}										

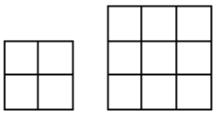
Questions:

(a) If the pattern continues, what number is in row R_7, column C_7?

(b) In which position is the number 100?

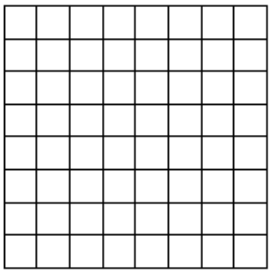
(c) What number appears directly below the number 150?

4. In the figure below there are 5 squares in a 2x2 grid and 14 squares in a 3x3 grid.

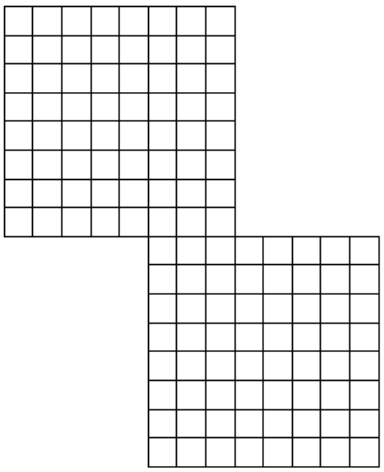


Questions:
For questions (a)-(c) you may do your working in the work-sheets provided.

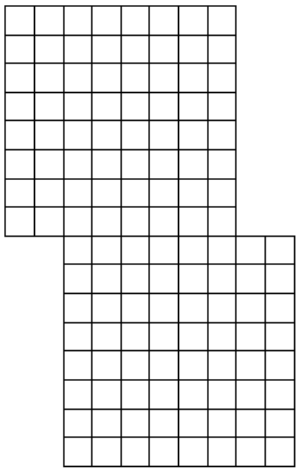
(a) How many squares are in the 8x8 grid?



(b) How many squares are in the two 8x8 grids with 3 coinciding units as shown in the figure below?



(c) How many squares are in the two 8x8 grids with 6 coinciding units as shown in the figure below?



5. There are some adults and children with only one boat on one side of the river. All people can row the boat. However, the boat can only carry *not more than*:

   * 2 adults,
   * or 2 children when accompanied by an adult,
   * or 4 children.

   (Note: Crossing from one side of the river to the other side is counted as one trip.)

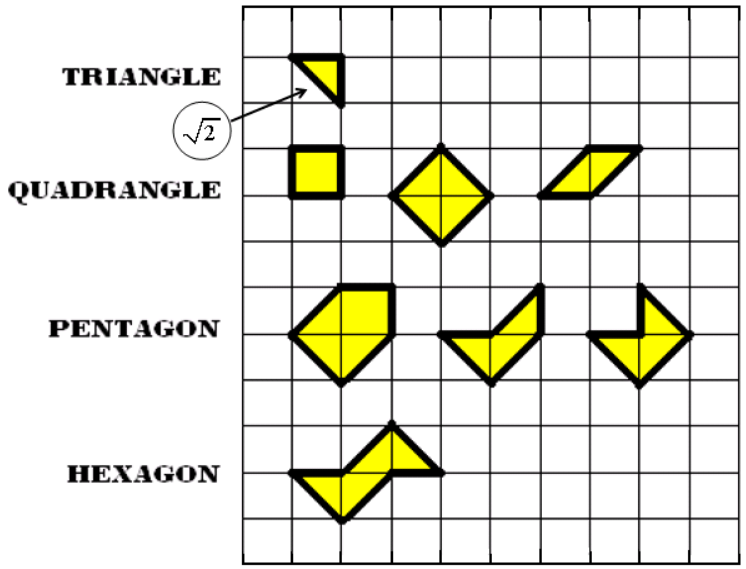
   Questions:

   (a) At least how many trips are needed to get five adults and ten children across the river?

   (b) At least how many trips are needed to get ten adults and ten children across the river?

   (c) At least how many trips are needed to get twenty adults and twenty children across the river?

6. On a grid paper, polygons can be drawn by connecting nearest neighboring grid points horizontally, vertically or diagonally. The length of the edge of the polygon is not more than $\sqrt{2}$ unit length. The figure below shows triangle, quadrangles (quadrilaterals), pentagons, and hexagon, drawn in such a way.



Questions:

Using the same method, then

(a) draw as many non-congruent hexagons (6-gons) as possible other than the given example.

(b) draw as many non-congruent heptagons (7-gons) as possible.

(c) what are the maximum and minimum possible areas of the heptagons?