
MATHEMATICS EXPLORATION PROBLEMS

Name : _____

Participant ID : _____

Country : _____



21st International Mathematics and Science Olympiad
Wenzhou, China
04 October 2024

Instructions:

1. Write your name, country, and Participant ID on every page of the Answer Sheet.
2. Write your answers only on the Answer Sheet.
3. Answer all questions in Arabic Numerals or English.
4. There are 6 questions in this paper.
5. Each question is worth 6 marks and partial credit may be awarded.
6. You have 120 minutes to complete this paper.
7. You are provided with some manipulatives for exploration on some questions.
8. Use black pen or blue pen or pencil to write your answer.

Do not turn over this page until you are told to do so.

21st International Mathematics and Science Olympiad

EXPLORATION PROBLEMS

1. Fill in the 4×16 grid by using the sixteen 2×2 tiles given below. Each tile can be used only once. Furthermore, the sum of numbers in each column of the grid must match the number at the bottom of that column and the sums of the numbers in each row are given at the right end of corresponding rows. What are the numbers of the tiles that represent [C], [H], [I], [N], [A]?

1	2	3	4	5	6	7	8
9 8 1 3	5 4 2 1	3 6 1 3	5 8 5 6	6 7 2 5	4 6 9 7	3 9 4 5	4 3 8 7

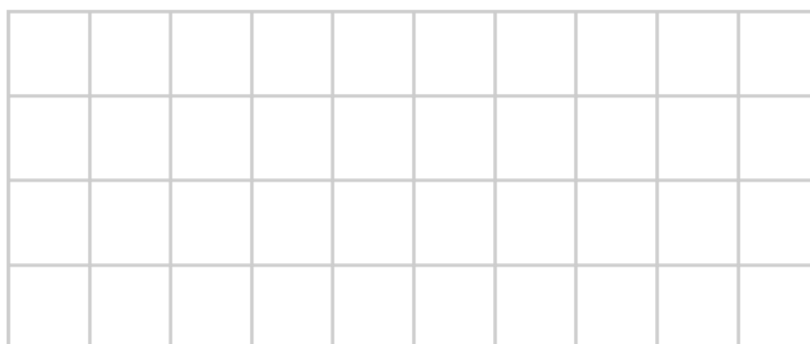
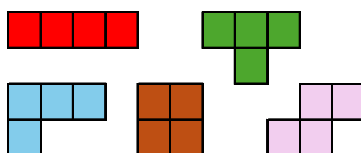
9	10	11	12	13	14	15	16
4 9 1 1	1 5 2 9	1 3 7 2	1 8 7 8	7 1 1 3	5 9 2 3	2 1 2 9	6 8 3 7

C				H								N			
								I						A	

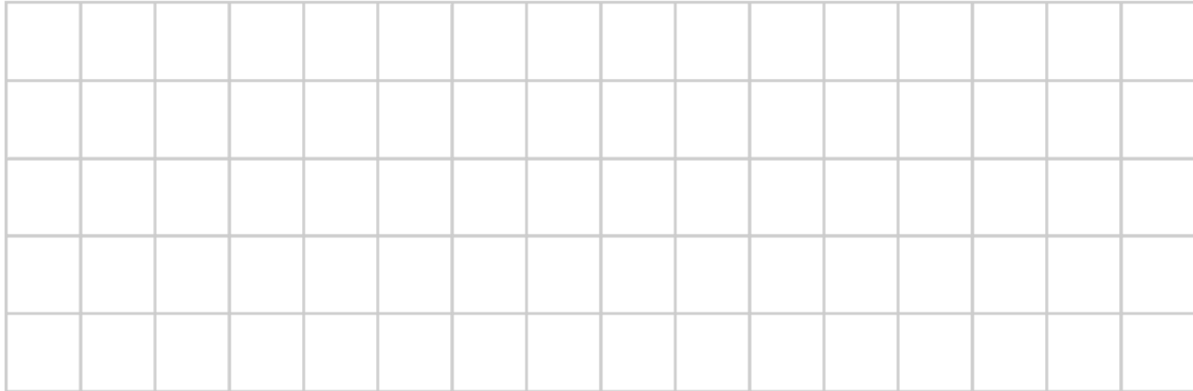
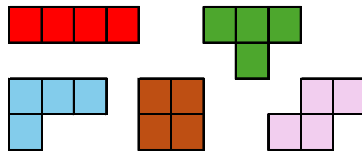
96
66
65
70

12131215162825231517172512291424

2. a. Use exactly 2 pieces for each of the following tetrominoes to cover the 4×10 grid without overlapping.



- b. Use exactly 4 pieces for each of the following tetrominoes to cover the 5×16 grid without overlapping.



3. A standard set of dominoes consists of 28 pieces, marked respectively 6-6, 6-5, 6-4, 6-3, 6-2, 6-1, 6-0, 5-5, 5-4, 5-3, 5-2, 5-1, 5-0, 4-4, 4-3, 4-2, 4-1, 4-0, 3-3, 3-2, 3-1, 3-0, 2-2, 2-1, 2-0, 1-1, 1-0, 0-0.

- a. In the left diagram below, one standard set of dominoes is laid out in an 8×8 grid.

Use a pencil to mark the position of the dominoes. You may find a check box in the right diagram below helpful; cross out each domino you have found.

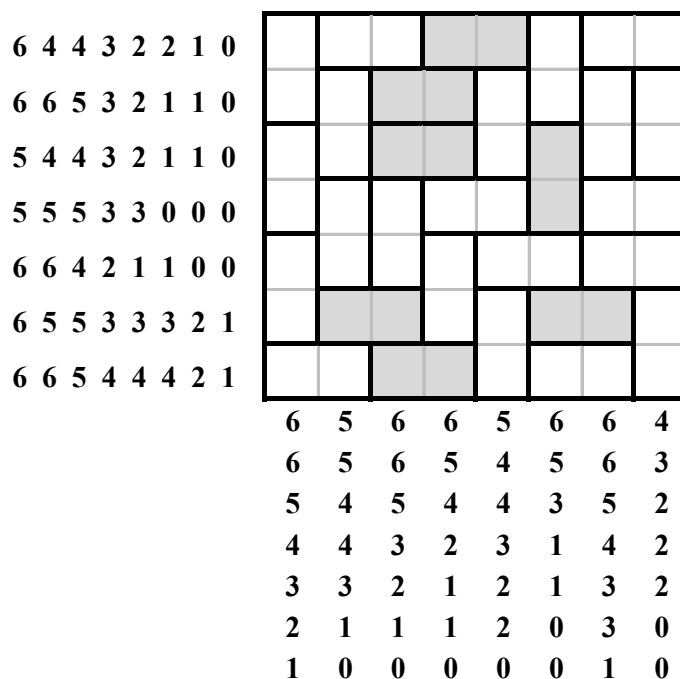
To start off, the 0-0 domino has already been marked.

3	6	0	4	0	1	6	3
2	1	1	6	3	5	2	0
1	3	5	2	5	5	4	0
4	6	4	0	6	3	3	5
5	4	2	0	2	1	4	1
5	3	2	4	4	5	2	0
5	6	2	1	0	1	5	3

0	x						
1							
2							
3							
4							
5							
6							
	0	1	2	3	4	5	6

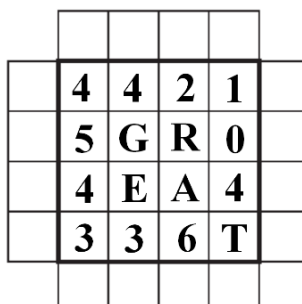
- b. The bold lines indicate the position of each domino. The numbers which are located at the side of each row and at the bottom of each column are the numbers that must be placed in the corresponding row and column (not necessarily in the given order). In each horizontal domino, the smaller number is always on the right. In each vertical domino, the smaller number is always on the top. Given that each of the dominoes in the coloured tiles has two equal numbers.

Complete the 8×8 grid with the suitable dominoes.

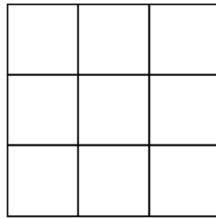


4. In the diagram, an arrow must be placed in each of the 16 outer squares, vertically, horizontally or 45 degrees diagonally pointing inside to the bold-bordered grid. The numbers in each square inside the bold-bordered grid represent the number of arrows pointing to such square. Write down all the arrows correctly and find the five-digit

number if G, R, E, A and T are 5 missing numbers inside the bold border as shown in the figure.



5. In the diagram, a 3×3 grid is shown.



Andy wants to shade some cells so that no two shaded cells share an edge.

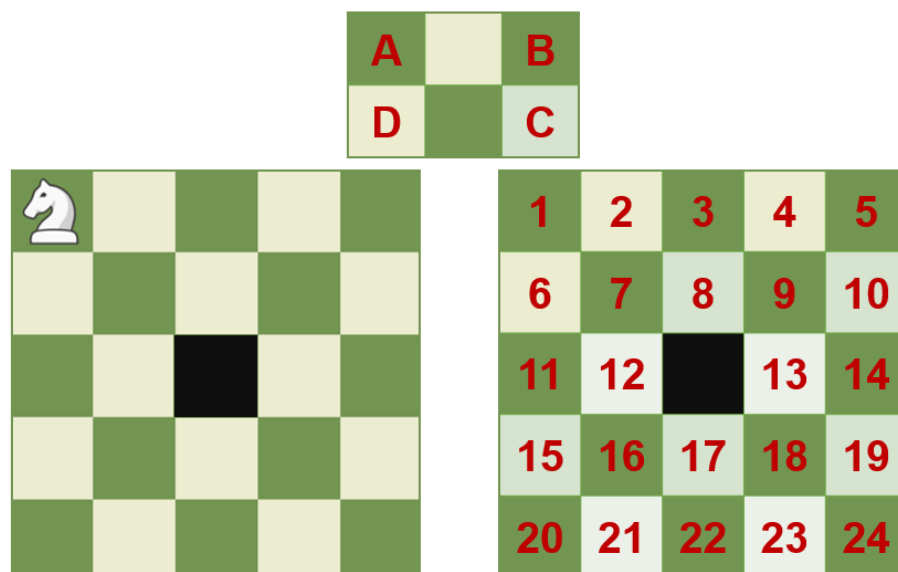
How many ways to shade:

- a. fewer than 3 cells
- b. 3 or 4 cells
- c. more than 4 cells

are there?

6. Given a 5×5 square board with a missing center square (marked black in the diagram below). The white knight moves in an *L-shape*. (In the given 3×2 rectangle, a knight can move from *A* to *C*, *C* to *A*, *B* to *D* or *D* to *B*). Starting from the top left square of the board (Square 1), list every possible route by writing the numbers on the squares that the white knight passes through in order.

(A route is a sequence of moves that passes through every square, each of them exactly once).



End of the Exploration Problems