MATHEMATICS
EXPLORATION PROBLEMS

Name : _____ **Participant ID :** _____

Country : _____

IMSO 20
International Mathematics and Science Olympiad
For Primary School

20th International Mathematics and Science Olympiad

Indonesia

19 November 2023

Instructions:

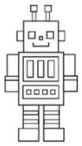
1. Write your name, country, and index number on every page of the Answer Sheet.
2. Write your answers only on the Answer Sheet.
3. Answer all questions in Arabic Numerals or English.
4. There are 6 questions in this paper.
5. Each question is worth 6 marks and partial credit may be awarded.
6. You have 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.

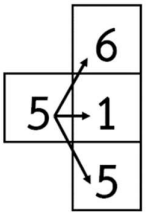
20th International Mathematics and Science Olympiad

EXPLORATION PROBLEMS

1. The robot IMSO–20 moves from left side of the 5×7 board to the right side of the board as shown on the left. It will collect the scores on all cells that it passes. At the beginning, the robot can start at any cells in the first column from the left. Then, it has to move to next column in the same row or one row above or one row below, as shown on the right. Sketch the path for each route that the robot IMSO–20 will get
   a. the lowest score. (2 marks)
   b. the highest score. (4 marks)



5	1	2	0	8	4	1
2	2	9	1	3	6	2
1	4	6	2	5	1	3
8	1	0	7	3	5	4
0	6	3	6	5	2	5



2. Each box in the diagram contains a number multiple of five from 5 to 60. List **ALL** possible arrangements of the number in each box if
   a. The numbers 15, 40 and 55 (*in this order*) are in successive boxes.
   b. The number 5 is in an odd numbered box.
   c. The number in box 6 is larger than the number in box 8.
   d. The difference between the numbers in box 8 and box 7 is 5.
   e. The number in box 2 is 20.
   f. The number in box 5 ends in a zero.
   g. The number in box 4 is twice the number in box 12.
   h. The number 25 is in a box numbered two lower than the box that contains the number 35.

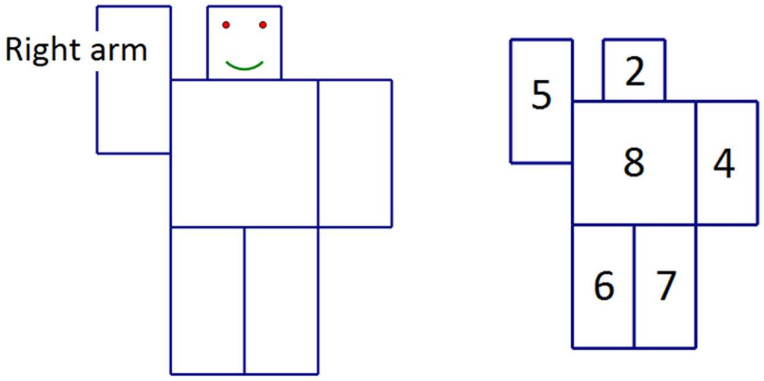
1	2	3	4	5	6	7	8	9	10	11	12

3. A 5×7 board is to be partitioned into some 1×1, 2×2 and 3×3 sub-boards. What is the smallest number of 1×1 sub-boards that can be found? Sketch one possible diagram. (2 marks)

   Now, if we use an 11×11 board and applying the same conditions, what is the smallest number of 1×1 sub-boards that can be found? Sketch one possible diagram. (4 marks)

   (*Correct answers with incorrect drawings will be given 0 marks*)

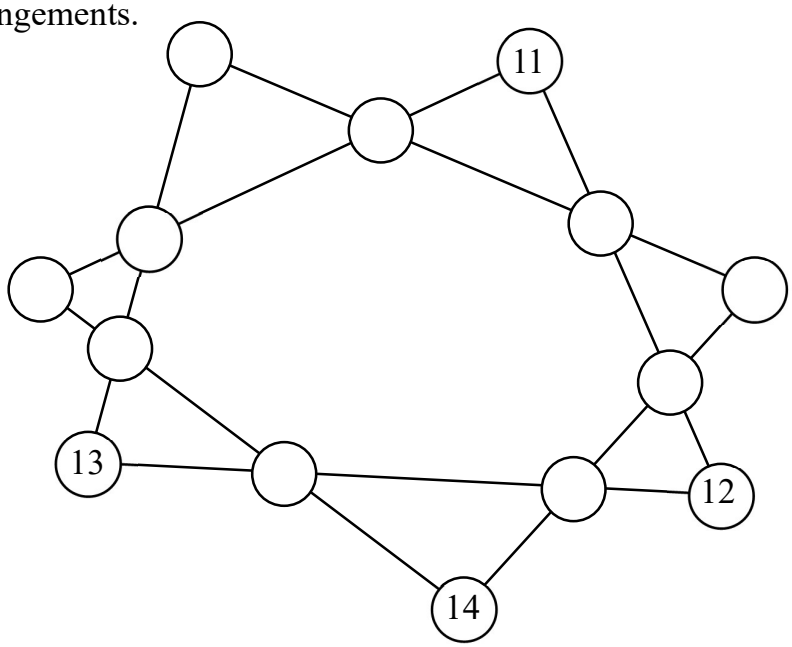
4. Refer to the following for a model robot, which consists of six chambers: a head (***HD***), a right arm (raised) (***RA***) and a left arm (***LA***), a body (***BD***), a right leg (***RL***) and a left leg (***LL***). For each chamber, a control block, chosen from block 1, 2, …, 8 without repetition where the number represent the weight, is to be inserted. The robot is operational only if the control blocks satisfy the following conditions:
   - The body is the heaviest while the head is the lightest among all the control blocks chosen.
   - Balance: the sum of the right arm and right leg is equal to the sum of the left arm and left leg.
   - The right arm is heavier than the left arm.
   - Stability: the right leg is heavier than the right arm, and the left leg is heavier than the left arm and heavier than 5.



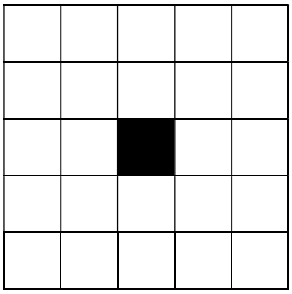
One example is given above on the right diagram. Find **ALL** other arrangements of the control blocks such that the robot is operational.

Head	2																			
Body	8																			
Right Arm	5																			
Left Arm	4																			
Right Leg	6																			
Left Leg	7																			

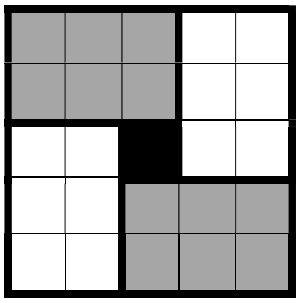
5. Place each of the numbers from 1 to 10 without repetition inside the empty circles so that the sum along any straight line equals 30. Fill in the diagram for **ALL** possible arrangements.



6. A 5×5 square grid with a unit square hole at the center can be cut along the grid lines into 4 congruent pieces (the same shape and size). (*The hole in the center of the square allows each piece to have an area of* 6 *square units.*)



The following is one way to accomplish this. Sketch **ALL** other possible ways except for the example. Two ways are equivalent if one can be obtained from the other by applying a rotation or a reflection.



End of The Problems