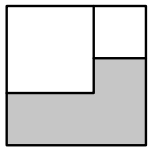
MT Classes Math Olympiad

Ages 13–14 • 90 minutes • October 2026 • English

Multiple-choice problems

Each problem has several answer choices. Choose the one correct answer and write it on the answer sheet.

Problem 1 (3 points).



In the figure, a large square is divided into two smaller squares, whose perimeters are 20 cm and 12 cm, and a shaded figure. Find the perimeter of the shaded figure.

(a) 24 **(b)** 26 **(c)** 28 **(d)** 30 **(e)** 32

Answer: 26

Solution. The sides of the two smaller squares are, respectively,

$$20 : 4 = 5 \qquad \text{and} \qquad 12 : 4 = 3.$$

Therefore the side of the large square is $5 + 3 = 8$.

The boundary of the shaded figure consists of segments of lengths

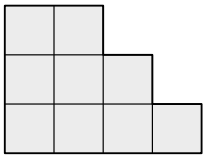
$$8,\ 5,\ 3,\ 2,\ 5,\ 3.$$

Consequently, its perimeter is

$$8 + 5 + 3 + 2 + 5 + 3 = 26.$$

□

Problem 2 (3 points).



The figure is made of identical cells, as shown in the picture. How many rectangles with sides along the grid lines are there in the picture in total? Squares are also considered rectangles.

(a) 25 **(b)** 27 **(c)** 29 **(d)** 31 **(e)** 33

Answer: 31

Solution. Let us count the rectangles by the number of rows of cells.

In the bottom row we can choose any run of consecutive cells out of four. The number of such rectangles is

$$4 + 3 + 2 + 1 = 10.$$

In the middle row we get

$$3 + 2 + 1 = 6$$

rectangles, and in the top row,

$$2 + 1 = 3.$$

In total, the number of rectangles of height one cell is

$$10 + 6 + 3 = 19.$$

Now let us count the rectangles of height two cells. In the two bottom rows there are

$$3 + 2 + 1 = 6,$$

and in the two top rows,

$$2 + 1 = 3.$$

So there are $6 + 3 = 9$ such rectangles.

Finally, three rectangles pass through all three rows: two of width one cell and one of width two cells.

Therefore the picture contains in total

$$19 + 9 + 3 = 31$$

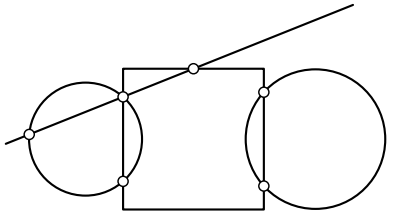
rectangles. □

Short-answer problems

Write only the final answer (a number, an expression, an example, a short statement — as required in the problem). No solution is needed: only the answer is checked.

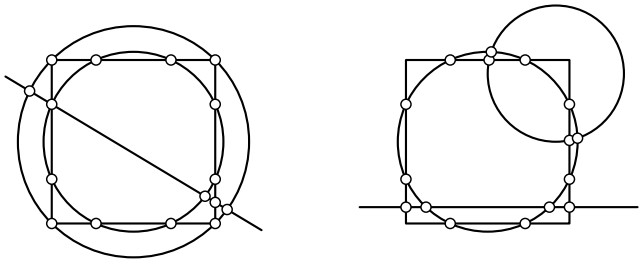
Problem 3 (5 points).

In the figure, two circles, a square and a line have 6 marked intersection points in total.



Give an example of an arrangement of these same geometric figures in the plane that gives exactly 16 distinct intersection points. The positions and sizes of the figures may be changed.

Answer: For example, these constructions:



Problem 4 (5 points). A three-digit number is called *self-enamored* if it equals the sum of the cubes of its digits. For example, the number 123 is not self-enamored, because the sum of the cubes of its digits is not equal to 123: $1^3 + 2^3 + 3^3 = 36 \neq 123$. Find any one self-enamored number.

Answer: For example, the numbers 153, 370, 371, 407.

Solution. Consider the cubes of the digits from 0 to 9:

$$0^3 = 0,\ 1^3 = 1,\ 2^3 = 8,\ 3^3 = 27,\ 4^3 = 64,$$

$$5^3 = 125,\ 6^3 = 216,\ 7^3 = 343,\ 8^3 = 512,\ 9^3 = 729.$$

Using these values we get, for example:

$$1^3 + 5^3 + 3^3 = 1 + 125 + 27 = 153,$$

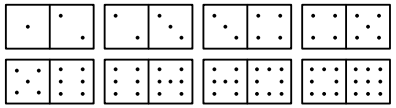
so the number 153 works. Other suitable examples:

$$3^3 + 7^3 + 0^3 = 370, \qquad 3^3 + 7^3 + 1^3 = 371, \qquad 4^3 + 0^3 + 7^3 = 407.$$

□

Problem 5 (5 points).

You are given the eight dominoes shown on the right. Use them to tile a 4×4 grid without overlaps so that the sums of the dots in all rows and columns are equal.

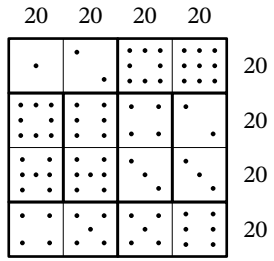


Answer: See the figure in the solution.

Solution. In total, the dominoes have

$$(1 + 2) + (2 + 3) + \ldots + (8 + 9) = 80$$

dots, so the sum in each row and each column must be $80 : 4 = 20$. Place the domino 8–9 horizontally. Then in the two remaining cells of this row there must be the numbers 1 and 2. One suitable tiling is shown below; the numbers on the right and on top confirm the sums over rows and columns.



□

Full-solution problems

Write a complete solution: your reasoning, justifications and proof (where required). Both the answer and the reasoning are assessed.

Problem 6 (7 points). A 2026-digit number was formed by the following rule: its first digit is 2, the second is 7, and each subsequent digit is the units digit of the product of the two previous ones. How many times does the digit 8 occur in this number?

Answer: 338

Solution. Let us write out the beginning of the number:

$$2,\ 7,\ 4,\ 8,\ 2,\ 6,\ 2,\ 2,\ 4,\ 8,\ \ldots$$

The pair of digits 4, 8 in the third and fourth places appears again in the ninth and tenth. Each digit is determined by the two previous ones, so from then on the sequence repeats: starting from the third digit, it consists of periods 4, 8, 2, 6, 2, 2 of length 6.

Starting from the third digit there are $2026 - 2 = 2024 = 6 \cdot 337 + 2$ digits. Each period contains exactly one digit 8, so the 337 full periods contain 337 of them. The two remaining digits are 4, 8 — they add one more eight. In total, $337 + 1 = 338$. □

Problem 7 (7 points).

Is it possible to place the natural numbers $1, 2, 3, \ldots, 25$ in the cells of a 5×5 square so that for every number greater than 1, **in at least one of the cells sharing a side with it** there is a number that is 1 or 2 less than it, and the numbers $10, 12, 14$ are placed as in the picture?

10				12
14				

Answer: No.

Solution. Suppose the numbers can be placed. By the condition, for every number greater than 1 there must be, in a cell adjacent by side, at least one number that is 1 or 2 less. Consider the number 14. Next to it there must be either 13 or 12. But 12 is already in the top-right corner and is not adjacent to 14. So next to 14 there must necessarily be the number 13.

Now consider the number 13. Next to it there must be either 12 or 11. The number 13 is in a cell adjacent to 14, so it can only be directly above 14 or directly to the right of it. In both cases the number 13 cannot be adjacent to the number 12. So next to 13 there must necessarily be the number 11. But then the number 11 is also near the bottom-left corner of the square and cannot be adjacent to the number 12, which is in the top-right corner.

Finally, consider the number 12. Next to it there must be either 11 or 10. As we found, it cannot be adjacent to the number 11. So 12 must be adjacent to 10. But according to the picture, the numbers 10 and 12 are not adjacent.

We have reached a contradiction. Therefore such an arrangement cannot be made. □