

# Junior Wiskunde Olympiade

## Problems part 2

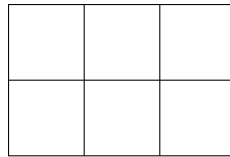


Saturday 24 September 2022  
Vrije Universiteit Amsterdam

- The problems in part 2 are open questions. Write down your answer on the form at the indicated spot. Calculations or explanations are not necessary.
- Each correct and complete answer is awarded 3 points. For a wrong answer no points are deducted.
- You are allowed to use draft paper. The use of compass, ruler or set square is allowed. Calculators and comparable devices are not allowed.
- You have 45 minutes to solve these problems. **Good luck!**

1. Eleonora has a piece of paper in the shape of an equilateral triangle with an area of 1. She folds the piece several times and puts it flat on the table. It turns out that the figure on the table is not more than four layers thick anywhere.  
What is the minimum area of the figure lying on the table?

2. A zoo is reconstructing part of their park. In this part, there will be six areas with six species of animals, one in each area. The six species are tigers, lions, elephants, giraffes, zebras and monkeys. The map is as follows:



The tigers and lions cannot be next to each other (this means not in two areas which share a side as border; two areas bordering in a vertex are allowed). The monkeys cannot be next to the tigers and also not next to the lions. The zebras cannot be next to the tigers.  
In how many ways can the zoo distribute the six species over the six areas?

3. We draw a rectangle in a grid. The four midpoints of the four sides of the rectangle turn out to be the vertices  $(-3, 0)$ ,  $(2, 0)$ ,  $(5, 4)$ , and  $(0, 4)$ .  
What is the area of the rectangle?
4. A whiteboard contains a calculation  $1?2?3?4?5?6$ , where each question mark is either a  $+$  or a  $\times$ . The correct outcome of the calculation is written on the back of the board. Jaap copies the calculation but accidentally turns one of the plus signs into a times sign. The outcome is now 58 more than the number on the back of the board. Jaap now changes a times sign back into a plus sign, but not on the place where he made the mistake before. Now the result differs 1 from the previous result.  
What number is on the back of the board?
5. We construct a sequence of numbers starting with 2022 and 21. Each next number in the sequence is equal to the positive difference of the two previous numbers. So the third and fourth number in the sequence are 2001 and 1980.  
At which place in the sequence do we find the number 0 for the first time?

PLEASE CONTINUE ON THE OTHER SIDE

6. Kjell has a large piece of graph paper of  $100 \times 100$  squares.  
How many squares can Kjell colour at most without there being three coloured squares in a row, all directly next to each other or all directly above each other?
7. In an apartment building with floors 0 up to and including 10, there is one person living on each floor. Each morning, everyone in the building must go to floor 0 to go outside. Everyone is willing to walk the stairs for at most three floors. There can be at most four people in the lift at the same time. The lift starts at floor 0.  
At least how many floors must the lift move to get everyone outside? Movements up and movements down are both counted.
8. A triple of consecutive two-digit positive integers is called *sweet* if the four-digit number formed by the first and the last number is divisible by the middle number. For example, the triple  $(20, 21, 22)$  is *not* sweet, because 2022 is not divisible by 21. Note that a two- or four-digit number cannot start with a 0, so 03 is not a two-digit number, for example.  
How many sweet triples are there?