

MATHEMATICS COMPETITION FOR THE SEVENTH
GRADERS OF HELSINKI, 5–9 MARCH, 2018

- The time allotted is 50 minutes.
- The allowed tools are writing and drawing instruments, i.e. pencil, eraser, ruler and compass. Calculators and mathematical tables are not allowed.
- Each problem is worth one point. Wrong answers are not punished.
- The problems are not ordered in increasing difficulty, but the first problems are likely to be easier than the last ones.

1. Compute $(10 - 1)(10 + 1)$.

- a) 10 b) 20 c) 49 d) 99 e) 100

2. Compute $56 \cdot 28$.

- a) 1445 b) 1556 c) 1568 d) 1602 e) 1604

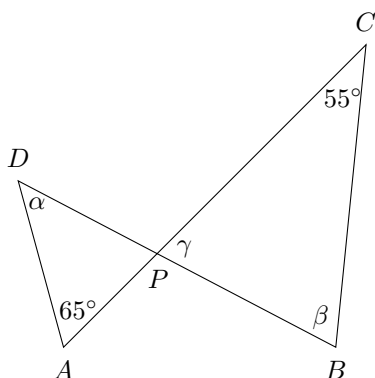
3. When baking 18 large muffins, 300g of chocolate chips is required. How much chocolate chips is required to bake 24 large muffins?

- a) 200g b) 375g c) 400g d) 450g e) 600g

4. Compute $1 \cdot (-2) \cdot 3 \cdot (-4) \cdot \dots \cdot 9 \cdot (-10)$.

- a) 0 b) 1374865 c) -1374862 d) 3628800 e) -3628800

5. Compute $\alpha + \beta + 2\gamma$. The points A , P and C lie on the same line, as do the points D , P and B .



- a) 60° b) 120° c) 180° d) 240° e) 300°

6. We define a new operation \star for numbers by

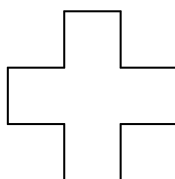
$$a \star b = a + 2b.$$

Is it true for some a and b that

$$a \star b = b \star a?$$

- a) Yes, if and only if $a = b$ b) Never. c) Only if $a = 1 = b$.
d) Only if $a = 0$ and $b = 1$. e) Yes, for all numbers a and b .

7. Below is a plus sign with height and width 8. All angles in the picture are right angles. Determine the length of the circumference of the figure.

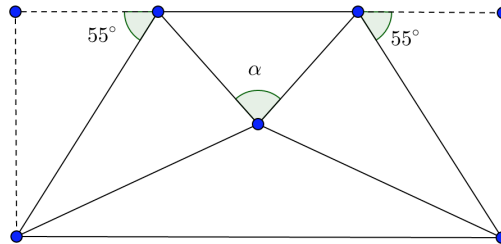


- a) 20 b) 24 c) 28 d) 32 e) Cannot be determined with the given data.

8. A trip of 120 kilometers is driven with two different cars. One car is driven at a speed of 100km/h, and the other at a speed of 80km/h. Both cars leave at the same time, but the faster car has a stop mid-journey while the slower one doesn't. How long is the stop, when both cars arrive at the same time?

- a) 5 min b) 10 min c) 12 min d) 15 min e) 18 min

9. Below is a picture of a rectangular sheet of paper, with two corners folded over the paper meeting each other. Determine the angle α .

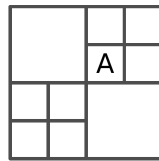


- a) 90° b) 70° c) 55° d) 40° e) Cannot be determined with the given data.

10. Using numbers $-1, 0, 1, 2$, all possible pairs are formed where the two numbers are different. For each such pair of numbers, their product is computed. How large is the proportion of pairs for which the product is zero?

- a) $\frac{1}{6}$ b) $\frac{1}{5}$ c) $\frac{1}{4}$ d) $\frac{1}{3}$ e) $\frac{1}{2}$

11. Pictured are multiple squares, the largest of which has an area of 4096cm^2 . What is the side length of the square A ?



- a) 2cm b) 4cm c) 8cm d) 16cm e) 32cm

12. A 3×3 grid of squares has an integer in each square. For every row and column in the grid, the numbers in the squares sum up to 30. In addition, for every diagonal of the grid (from the lower left corner to the upper right corner or from the upper left corner to the lower right corner), the numbers in the squares also sum up to 30. What is the number in the middle square of the grid?

- a) 1 b) 5 c) 10 d) 15
e) There are multiple options for the number in the middle square.

13. How many ways are there to write the numbers $1, 2, \dots, 9$ in a row so that the sum of every consecutive pair of numbers is at least 10 and the sum of the outermost (leftmost and rightmost) numbers is at least 11?

- a) 0 b) 1 c) 5 d) 10 e) 100

14. Minna has eight white and five colored cube-shaped blocks. All of the colored blocks have different colors. She wants to build a thirteen blocks high tower by placing the blocks on top of each other so that no two colored blocks are in contact with each other. How many such towers are there?

- a) 52 b) 152 c) 10557 d) 15120 e) 20010

15. Compute

$$\frac{1}{1 \cdot 6} + \frac{1}{6 \cdot 11} + \frac{1}{11 \cdot 16} + \dots + \frac{1}{2016 \cdot 2021}.$$

- a) $\frac{1}{2021}$ b) $\frac{1}{7}$ c) 2021 d) $\frac{2016}{2021}$ e) $\frac{2020}{5 \cdot 2021}$