# Mathematics Competition for the Seventh Graders of Helsinki, 2–6 March, 2020

- 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 $-5 + 4 \cdot 7$.

    a) 23   **b)** -23 **c)** 7   **d)** -7 **e)** -140

2. In the picture below one (larger) square has side length 1. Compute the area of the shaded figure.
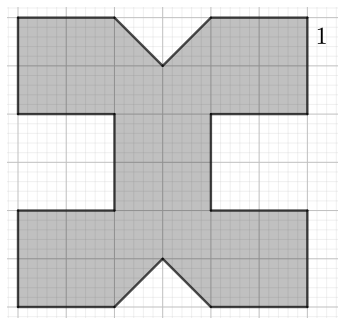
    a) 8   **b)** 10   **c)** 13   **d)** 24   **e)** 26

3. An animation requires showing 25 frames in a second. Drawing one frame takes 90 minutes. How many artists are needed to make an animation 10 minutes long given that one artist does five hours of efficient work in a day and the animation needs to be completed in 30 days?

    a) 50   **b)** 75   **c)** 100   **d)** 125   **e)** 150

4. Compute $1 \cdot \dfrac{2}{3 \cdot \dfrac{4}{5 \cdot \dfrac{6}{7 \cdot \dfrac{8}{9}}}}$.

    a) $\dfrac{23}{34}$ **b)** $\dfrac{34}{45}$ **c)** $\dfrac{45}{56}$ **d)** $\dfrac{56}{67}$ **e)** $\dfrac{67}{78}$

5. How many times does the number 10^9 (one billion) need to be halved before the result is less than 1?

    a) ca. 10   **b)** ca. 30   **c)** ca. 200   **d)** ca. 5000   **e)** ca. 5000000

6. A chocolate bar is rectangular and has more than one row of chocolate pieces, and more than one column of pieces as well. In total, it has n pieces. Which of the following is a possible value of n?
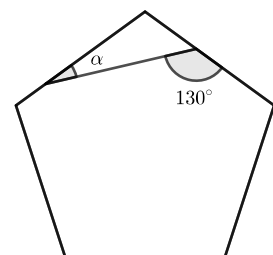
    a) 2   **b)** 23   **c)** 59   **d)** 87   **e)** All of the previous

7. Compute $73.5 - 22.25$.

    a) -149 **b)** 51.25   **c)** 512.5   **d)** 5125   **e)** 93.75

8. The picture shows a regular pentagon. One of its vertices is also a vertex of a triangle. Compute the angle α marked in the picture.

    a) 3°   **b)** 17°   **c)** 22°   **d)** 30°   **e)** 65°

9. Viljami has invented a new unit of length he calls a *stump*. The corresponding unit of area is called a square stump. Viljami measured the area of a certain rectangle to be 24 square stumps. Riina measured the same area to be 54 square centimeters. How many centimeters is one stump?

a) $\dfrac{4}{9}$ cm **b)** $\dfrac{2}{3}$ cm **c)** $\dfrac{3}{2}$ cm **d)** $\dfrac{9}{4}$ cm

e) The question cannot be answered with the given data.

10. A house of cards in the shape of an equilateral triangle is built as follows: the lowest floor is made by placing next to each other pairs of cards so that each pair forms an equilateral triangle. The following floors are constructed by first connecting the tops of the card triangles of the previous floor with horizontal cards and then placing new card triangles on these. How many cards to we need to build a house of cards with 10 floors?
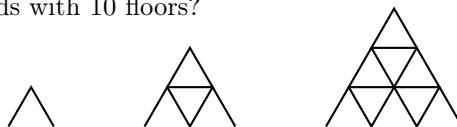
**a)** 155 **b)** 30 **c)** 145 **d)** 65 **e)** 175

11. A triangle has the perimeter 12 and a side of length 2. Which of the following is a possible length of a side of the triangle?

**a)** 1 **b)** $\dfrac{3}{2}$ **c)** 3 **d)** All of the previous **e)** None of the previous

12. We know that a red basket and a blue basket together contain 13 balls, that the blue basket and a yellow basket together contain 15 balls, and that the yellow and red baskets together contain 7 balls. How many balls does the red basket contain?

a) 0 **b)** 2 **c)** 4 **d)** This situation is impossible.

e) The problem cannot be solved with the given data.

13. A point X has been chosen from the side AD of a parallelogram $ABCD$, and a point Y has been chosen from the side BC. The segments AY and BX intersect at a point P, and the segments XC and YD intersect at a point Q. If the triangle ABP has the area 5, and the triangle QCD has the area 3, then what is the area of the quadrilateral $PYQX$?
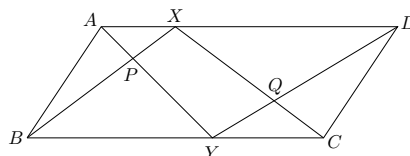
a) 4 **b)** 5 **c)** 6 **d)** 7 **e)** 8

14. Maija has a grid of hexagons as in the picture below, and she would like to color its cells using four colors 1, 2, 3 and 4 so that a single tile of the shape always covers exactly one cell of each color, when the tile is placed on the grid oriented in an arbitary way but so that it covers exactly four cells. What must be the color of the lower right corner of the grid, when the uppermost three cells have already been colored as in the picture?
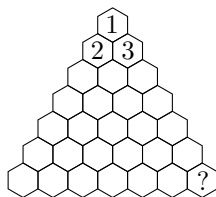
a) 1 **b)** 2 **c)** 3 **d)** 4 **e)** There are several possible colors.

15. In how many ways can one choose four positive integers a, b, c and d, when it is required that $a^3 + b^3 + c^3 = d^4$?

a) 0 **b)** 15 **c)** 150 **d)** 1500 **e)** In infinitely many ways.