

Stærðfræðikeppni framhaldsskólanema 2025–2026

30th of September 2025

Time limit: 2½ hours.

Full Name:		I	
Kennitala:	Phone number:	II	
Email address:		16	
	17		
		18	
Did you start your high school studies 2024 or earlier?		19	
\square Yes (<i>Upper division</i>) \square No (A	Lower division)	\sum	

Those who started high school 2024 or earlier compete in the *upper division*. Others compete in the *lower division*. The top scoring students in each division are invited to compete in the finals.

Instructions:

- 1. Do not open this booklet before you are told to do so.
- 2. This is **not a test**. Answer the questions you can and do not worry about skipping some questions. Some of the questions are very hard.
- 3. In solutions to the last four problems, those in section 3, you are expected to give a complete explanation for how the answer was found. Write down a finalised solution, drafts belong on scratch paper. When awarding points consideration is given to the accuracy of the reasoning and the clarity of the presentation.
- 4. Pictures that accompany certain problems are only meant for clarification. It is not guaranteed that they are drawn in the correct proportions.
- 5. Permitted items are writing utensils, a compass and a ruler. The use of calculators and phones is prohibited.

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First part (30 points)

In this section there are ten problems. Check at most one answer box. A correct answer is awarded 3 point but one point is deducted for an incorrect answer. There is always exactly one correct answer.

1.	Edda and Atli are jogging a 10km circle. They both keep a constant speed.
	When Atli is halfway done Edda only has a third left. How large a portion
	of the circle will Atli have finished when Edda finishes her jog?

 $\Box 5/8$

 $\Box 2/3$

 $\Box 3/4$

 $\Box 7/8$

2. On a famous math contest there are 100 problems which each give 3,6 or 10 points for being solved. For an unsolved problem 0 points are awarded. Which of the following point totals can not be achieved on the contest? (For example one can not get 4 or 5 points)

 $\Box 15$

 $\Box 17$

 $\square 27$

 $\Box 64$

3. Matthías drives north to Akureyri at the speed 80km/klst on average, but then before he can drive back terrible weather and traffic clogs the roads. He drives the way back at 20km/klst on average. What was his total average speed?

□32 km/klst

□40 km/klst

□48 km/klst

□50 km/klst

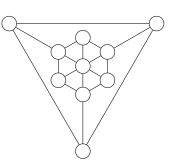
4. Ingfríður colours the circles on the picture to the right. No circles connected by a line segment may have the same colour. What's the minimum number of colours Ingfríður needs to use?

 \square 2

 $\square 3$

 $\Box 4$

 \Box 5



5. The notation ndm denotes that one should throw n dice each with m sides, the sides having numbers $1, 2, \ldots, m$, and then sum up the results showing on the dice. For example 2d6 means that one should throw two normal six sided die and sum their results. Which of the following options gives the highest result on average?

 $\Box 4d4$

 $\square 3d6$

 $\square 2d10$

 $\Box 1d20$

6. You are given that $x + \frac{1}{x} = 45$, what is the value of $x^2 + \frac{1}{x^2}$?

 $\square 2023$

 $\Box 2024$

 $\square 2025$

 $\Box 2026$

You draw two cards from a normal deck of cards with 52 cards. What is the probability that you draw the cards in strictly increasing order? The order goes ace, two, three, ..., ten, jack, queen, king. Strictly increasing order means the second card is strictly greater than the first. The first card is not returned to the deck before the second is drawn.

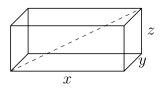
 $\Box 6/13$

 $\Box 24/51$

 $\Box 25/52$

 $\Box 1/2$

8. A box with all right angles has length x, width y and height z. What is the length of the line segment going from one corner to the opposite one?



 $\Box\sqrt{x^2+y^2+z^2}$ $\Box\sqrt{\sqrt{x^2+y^2}+z^2}$ $\Box\sqrt{x^2+y^2}+z^2$ $\Box\sqrt{x^2+y^2}+z$

9. Which of the following values do not end with the digit 0?

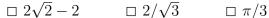
 $\Box 7!$

 $\Box 17^7 - 7^7$

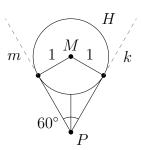
 $\Box 17^7 + 7^7$

 $\Box 11^7 - 1$

A circle H has radius 1 and centre M. The tan-**10.** gents to the circle, m and k, intersect at a point P outside the circle. The angle between the tangents is 60°. What is the shortest distance from P to the circle?



 \square 1



Second part (30 points)

In this section there are 5 problems, each worth 6 points. Write your answer on the line. Do not give reasoning for your answer. For an incorrect, incomplete or ambiguous answer no points are awarded.

Answers in this section are positive integers smaller than 100.000.

11. There exists exactly one three digit number which becomes 4.5 times bigger when the first and third digit are swapped. What number is that?

Answer: _____

12. What is the value of $\sqrt{42 + \sqrt{42 + \sqrt{42 + \sqrt{42 + \dots}}}}$?

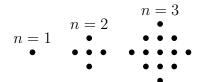
Answer: _____

13. Squares and regular pentagons are arranged into a circle like the section to the right shows. How many squares and pentagons do you need in total to make a full circle?



Answer: _____

14. On the image to the right we see a pattern of points for n = 1, 2, 3. How many points will there be in the pattern for n = 50?



Answer: _____

15. Find the largest number x such that 2^x divides $(2^{2^{2^2}} + 2)!$.

Answer: _____

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Third part (40 points)

In this section there are four problems, each worth 10 point. You must give reasoning for your answers in this section. When awarding points considerations are given to structure, precision and clarity in the presentation of the solution. Note that points are awarded for a partial solution to the problems or for coming up with an idea which is an important part of a solution.

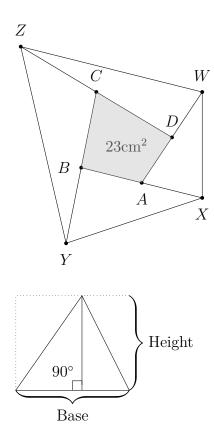
Problem 16

If the number 2025 is split into two two-digit numbers we get 20 and 25. They sum to 45 and $45^2 = 2025$. The next number with this property is 3025, what four digit number with this property is next?

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Problem 17

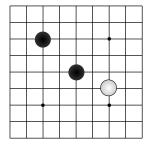
You are given a quadrilateral ABCD with area $23\mathrm{cm}^2$. Its sides are extended to be twice as long, as shown on the picture. This gives us four new points X, Y, Z, W. What is the area of the quadrilateral XYZW? Note that the area of a triangle can be calculated as its base times its height divided by two, see the image below.



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Problem 18

Jörmunrekur has a large $n \times n$ Go board and enough black and white stones to place on it. He wants to place $n \times n$ stones on the board such that each stone has exactly two neighbours in its own colour. Two stones are considered neighbours if they are adjacent (horizontally or vertically) with no gap in between. For which n is this possible? (The image is of a 9×9 board).



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Problem 19

We have a sequence of numbers a_1, a_2, a_3, \ldots

You are given that

$$a_{2n} = a_n$$
, $a_{4n-3} = 2a_{2n-1} - 1$, and $a_{4n-1} = 2a_{2n-1} + 1$

for all $n = 1, 2, \ldots$ Calculate the value of $a_1 + a_2 + \cdots + a_{2025}$.

Partial points are awarded for determining the sequence a_1, a_2, a_3, \ldots