Advanced Level Practice Set - 2025 (December 2025)

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From 2005, the Hungarian school-leaving exam (érettségi) in mathematics can be taken at two levels: standard level and advanced level. The advanced-level exam also serves as the university entrance exam in mathematics.
The written part of the advanced-level exam takes 240 minutes. Part I consists of 4 problems worth 51 points in all. Part II consists of 5 problems worth 16 points each, of which students choose and solve 4, for 64 points. So there is a total of 115 points possible.
This problem set is similar to such an exam. We advise the reader to work through the problem set while measuring the time. There are 240 minutes to solve and present the problems.

Part I

1. Solve the following equation over the set of real numbers.

$$\sqrt{x^2-5x-14}\cdot|5-x|\cdot\sin\left(2x+\frac{\pi}{6}\right)\cdot\lg(9-x)=0$$

(lg denotes the base 10 logarithm.)

(13 points)

2. a) How many digits does 5^{29} have in base ten? *(3 points)*

b) The first term of a geometric sequence is 5^{-29} and its common ratio is 5. At least how many terms, starting with the first one, do we have to multiply so that the product reaches 5^{29}? *(8 points)*

c) János Apáczai Csere was born exactly 400 years ago. Write the year of birth of the scholar in base five. *(2 points)*

3. Nobody in a class of 34 students was born in February.

a) Prove that there is a month in which at least four students of the class were born. *(3 points)*

b) What is the probability that there are two students in this class who were born on the same day of the year? *(6 points)*

c) The sorbet shop near the school sells ten flavors of fruit sorbet. At least how many times did the whole class have to go to the sorbet shop, if we can be sure that during these visits there were two exactly identical orders, if everyone can buy at most two scoops? (Two orders are different if the flavor of the lower or the upper scoop in the cone is different.) *(5 points)*

4. At a summer party of a class, some of the students buy food and drinks at the snack bar of the beach. Lujzi buys only one lángos (fried flatbread) for herself, but she also pays for the tea and fries menus of Sanyi, Szöszi, Kati, and Béla (four teas and four fries), so she pays 7130 Ft in all. Jani collected a few orders too: he buys eight teas, five lángos, and two fries, and pays 12 790 Ft. Armand invites only Zsuzsi and Amanda this time; he plans to buy a tea, a fries, and a lángos for each of the three of them, but he realizes that he would stay hungry, so he adds two more fries to the order. He pays with a 10 000 Ft bill and gets 230 Ft change.

a) How much does a tea, a lángos, and a fries cost at this snack bar? *(8 points)*

b) In how many different orders can all the food and drinks paid for above be handed out at the counter, if we do not distinguish between identical items? *(3 points)*

Part II

5. The vectors $\mathbf{a}$ and $\mathbf{b}$ satisfy $|\mathbf{a}| = |\mathbf{b}| = |\mathbf{a} + \mathbf{b}| = 1$.

   a) Find the dot product of the vectors $\mathbf{a}$ and $\mathbf{b}$. *(4 points)*

   b) Find the length of the vector $2\mathbf{a} + \mathbf{b}$. *(4 points)*

   Consider the vector $\mathbf{a}\,(3, 4)$. A tangent line of the circle of radius 6 centered at the origin that is parallel to the vector $\mathbf{a}$ meets the y-axis at the point $(0, p)$.

   c) Find the possible values of p. *(8 points)*

6. Mr. Zsigri, a teacher, takes part in a private pension savings plan: on the first banking day of 2001, and since then on the first banking day of every month, he paid in $40\,000$ Ft. The pension fund pays 0.4% interest per month all the time. To support saving for retirement, the state pays 5% of the amount paid in during the year, but at most $25\,000$ Ft per year, into the member's account on the first banking day of the next year.

   a) How much money will be in the teacher's account on the first banking day of 2026? (In 2026 the teacher no longer pays in, and the bank no longer computes interest; only the state credit for 2025 arrives.) *(7 points)*

   From part of the money collected by 2026, Mr. Zsigri goes on a trip around the world, but he leaves 12 million Ft in the account, so that he gets a constant monthly supplementary pension from it for exactly 20 years. (The fund credits the interest on the first day of every month, and then transfers the supplementary pension to the teacher's regular bank account free of charge.)

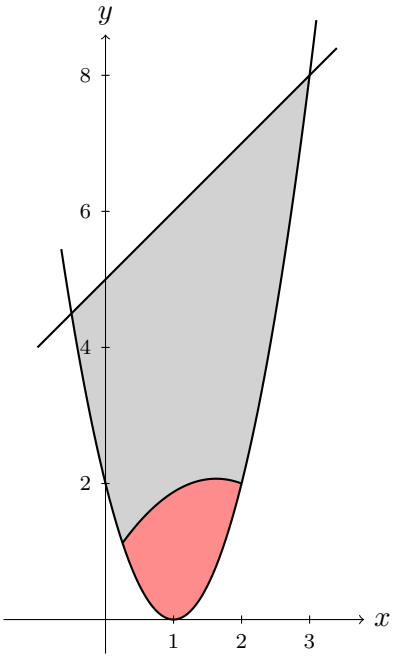
   b) What monthly supplementary pension can the teacher count on, if the fund continues to pay a fixed 0.4% monthly interest on the money in the account? *(6 points)*

   Each year, the probability that this pension fund lowers its interest rate is 0.002.

   c) What is the probability that the fund never lowers its interest rate during the whole 45 years of the process? *(3 points)*

7. A ghost train is making a sign in the shape of a monster's mouth. In the coordinate plane, the boundary lines of its design are given by the line $y = x + 5$ and the graphs of the functions

$$f\,(x) = 2x^2 - 4x + 2 \qquad \text{and} \qquad g\,(x) = -\frac{1}{2}x^2 + \frac{13}{8}x + \frac{3}{4}$$



How many deciliters of red paint are needed for the tongue, and how many deciliters of gray paint for the inside of the mouth, if 7 dl of paint is needed per square meter of both colors, and one unit on the coordinate axes of the design

corresponds to 50 cm in reality? (The teeth will be a white LED lamp, but the area under it is also painted gray.) Round your answers to whole numbers.

(16 points)

8. The base of an isosceles triangle is 10 units and its legs are 13 units long. We inscribe rectangles in the triangle with one side on the base of the triangle and the other two vertices on the two legs.

   a) Find the area of the rectangle whose side on the base of the triangle is 8 units long. *(5 points)*

   b) Find the sides of the inscribed rectangle of maximal area. *(5 points)*

   We rotate the triangle in two ways: A) about its base, B) about one of its legs.

   c) Find the exact value of the ratio of the surface areas of the solids we get in cases A) and B). *(6 points)*

9. In an inspection, they examined how much the mass of rice in 1 kg packages really differs from 1000 grams. They made two series of 8 measurements each; the results are in the table below.

measured differences in grams								
series 1	1	3	5.5	2.5	3	6	5	0
series 2	3	6	6	3	3	3		6

   a) Find the mean and the standard deviation of the first series in grams, to one decimal place. *(3 points)*

   b) Draw a box plot of the data of the first series. *(5 points)*

   The standard deviation of the second series is 1.5 grams.

   c) What could the missing data value in the table be? *(8 points)*

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