Advanced Level Practice Set - 2026 (April 2026)

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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. a) Three consecutive terms of an arithmetic sequence (in this order) are y, x, and $4x-5$. Find these numbers, if their sum is 1500. *(4 points)*

   b) How many geometric sequences are there whose first 5 terms include 2, 8, and 32, if the order of the terms matters? *(5 points)*

   c) Put the cardinalities of the following sets in increasing order. Justify your answer.

   $A = \{\text{the rational solutions of the equation } x^2+2x+1=2\}$

   $B = \{\text{the positive divisors of } 40\}$

   $C = \left\{n : 3^{-n+1} > \frac{1}{27^3}, n \in \mathbb{N}\right\}$ *(5 points)*

2. a) Prove the following statement:

   "If the lengths of all three sides of a right triangle are positive integers, then the length of the height to the hypotenuse is rational." *(4 points)*

   b) State the converse of the statement in part a), and decide whether it is true or false. Justify your answer. *(3 points)*

   c) We added the squares of 27 different primes, and got 155 787. Could 3 be among the primes? *(5 points)*

3. 90 students took part in a camp, and they were housed in wooden cabins. Each cabin had four, eight, or nine beds, and there were exactly five cabins with eight beds. After the students moved into the cabins, there were no empty beds.

   a) On arrival, the host gave the keys to one of the accompanying teachers one by one: first the keys of the four-bed cabins, then those of the eight-bed cabins, and finally those of the nine-bed cabins. In how many different orders could the host do this, if every cabin has one key and the keys are all different? *(4 points)*

   One afternoon the students could choose from several different hikes. The 90 students formed 6 groups in all. We know the following about the sizes of the six groups:

   - the size of every group is divisible by six;
   - there is a group with exactly half as many students as another group;
   - the sizes have two modes, and one of them is equal to the median;
   - the range of the sizes is 30.

   b) How many students were in each group? *(6 points)*

4. a) Consider the following points in the coordinate plane:

$$A\left(\log_3 r, \log_3 5r\right), \qquad B\left(-\log_3 \frac{r}{3}, \log_{\frac{1}{3}} 10\right), \qquad C\left(\log_r 1, \log_r 1\right)$$

Find the value of $r \in \mathbb{R}^+ \setminus \{1\}$, if the centroid of the triangle ABC is the point $S\left(\frac{1}{3}, \frac{1}{3}\right)$. *(5 points)*

b) Consider the function $f : \mathbb{R} \to \mathbb{R}$, $x \mapsto 2x^3 + 6x - 6x^2 - 2$. Give the rule of the function $g(x)$, defined on the real numbers, for which $g(f(x)) = x$. *(4 points)*

c) Find the value of the nonzero real parameter p in the rule of the function $g : \mathbb{R} \to \mathbb{R}$, $x \mapsto x^2 + px + p$, so that the graphs of g and of the linear function $x \mapsto x + 1$ have exactly one intersection point. *(6 points)*

Part II

5. a) The base edges and the lateral edges of a right prism with a regular hexagon base are equally long. If we divide the numerical value of its volume by the numerical value of its surface area (in the same system of units), we get 1.392. How many units long is an edge of the prism? Round your answer to a whole number. *(9 points)*

   b) We choose three edges of a prism with a hexagon base. What is the probability that exactly two of the three edges have a common point? *(7 points)*

6. A marketing company is making a survey of 100 people about a new plant-based chocolate. First the participants decide, without knowing the product, only based on its name, whether they would buy it. Then they taste the product and are asked again whether they would buy it. The answers to the two questions are in the table below.

	based on the name	after tasting
yes	45	72
no	55	28

   a) At most how many people could have changed their minds about buying the product because of the tasting? *(4 points)*

   b) Is it possible that exactly 42 people did not change their minds because of the tasting? *(4 points)*

   The same company organizes the advertising campaign of a board game. One of the accessories of the game is a regular icosahedron. It has 20 faces, and when it is thrown, it lands on each of them with the same probability. The faces show only the numbers 4, 7, and 11 (exactly one number on each face). The rule book says at one place: "two of the three numbers are thrown with the same probability, and the expected value of a throw is 7.35".

   c) How many faces show a 4? *(8 points)*

7. One floor of a lookout tower in the forest has the shape of a regular pentagon with 5 meter sides. Two different "photo points" were marked on the floor, where you can stand to take the best photos of the landscape. Each of the two points is equally far from the center of the circumscribed circle of the pentagon and from two neighboring vertices.

   a) At most how far apart can the two "photo points" be? *(11 points)*

   b) The lookout gives out a free booklet about the plants of the forest. It contains a figure with pictures of ten plants typical of the area; two pictures are connected by a line if the two plants often grow next to each other. Balambér counted that there are two pictures from which only 3 lines start, and from each of the others at least six. His sibling says that this means that you can get from any picture to any other along the lines. Is the sibling right? *(5 points)*

8. a) Rotating a concave kite about its axis of symmetry, we get a solid of volume $\frac{500\pi}{3}$ dm^3. Find the area of the kite, if one of its diagonals is 5 dm long. *(7 points)*

   b) We found the zeros of the function $f(x) = \left(x^2 - 1\right)\left(x^2 - 4\right)$ defined on the real numbers. Then we computed the definite integral of f between the second and third largest zeros, and got a number that is not an integer. What is the smallest positive number we can multiply f by so that this definite integral becomes an integer? *(5 points)*

   c) Write the equation of a tangent line of the function $f(x) = x^4 - 5x^2 + 4$ that is parallel to the x-axis. *(4 points)*

9. a) Prove that for any $x, y \in \left[\frac{\pi}{7}, \frac{3\pi}{7}\right]$, the dot product of the vectors $\mathbf{a}(\tan x, \tan y)$ and $\mathbf{b}\left(\frac{\cos x}{\sin x}, \frac{\cos y}{\sin y}\right)$ is 2. *(4 points)*

b) Solve the following equation over the set of pairs of positive real numbers.

$$\frac{x}{y^2} + \frac{1}{xy} = \frac{4-x}{y} - \frac{1}{x}$$

(5 points)

c) We know that the following infinite sum is convergent and its value is a negative real number. Find the possible values of $p \in \mathbb{R}$.

$$\frac{1}{p+1} + \frac{p^2-1}{p+1} + \frac{\left(p^2-1\right)^2}{p+1} + \frac{\left(p^2-1\right)^3}{p+1} + \cdots < 0$$

(7 points)

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