Advanced Level Practice Set - 2026 (January 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) Solve the following equation over the set of integers.

$$(x^2-9)\left(\frac{1}{x-3}-\frac{1}{x+3}-1\right)=9+x$$

(6 points)

b) An angle α of a quadrilateral satisfies $4\sin^2\alpha-3=0$. What can the measure of the angle α be? *(6 points)*

2. The wheels of Zoli's bike have a diameter of 70 cm. The front gear, attached to the pedals, is set to a gear wheel with 56 "teeth" around its circumference, and the rear gear, attached to the rear wheel, is set to a gear wheel with 20 "teeth". (The front gear wheel turns together with the pedals. The bike chain connects the front and rear gear wheels, so the two gear wheels always turn by the same number of "teeth".)

a) How fast does Zoli ride, if the pedals make 10 full turns in 8 seconds, and the rear wheel turns together with the rear gear wheel? *(4 points)*

b) Zoli goes on a bike tour with 34 friends. Each wheel of each bike, independently of the others, gets a flat tire between two whole kilometers with probability 0.0005. For what length of the tour can they say that there will be a flat tire on the tour with probability at least 0.95? *(6 points)*

c) On Tuesday, 48 people rented a bike at a bike rental shop, 4 more women than men. The number of guests younger than 40 was 60% of the number of guests aged at least 40. Among those aged at least 40, five times as many asked for a regular bike as for an electric bike. Exactly one man asked for an electric bike, and there were 2 more women than men aged at least 40. How many women younger than 40 rented a bike on Tuesday? *(4 points)*

3. a) Find the values of the real parameter m for which the quadratic equation $(m-1)x^2+(2m-9)x+1=0$ has two different positive roots whose sum is greater than 5. *(7 points)*

b) I thought of a number, wrote it on a sheet of paper, and wrote its square next to it. Can the number I thought of be even, if the sum of the base 10 logarithms of the numbers written down is less than the base 10 logarithm of the sum of the numbers? *(6 points)*

4. a) The sum of the first three terms of an arithmetic sequence with positive terms is 10.5. The sum of the values of the function $f:\mathbb{R}^+\to\mathbb{R}$, $f(x)=2^x$ at the first three terms of the sequence is $73\sqrt{2}$. Find the common difference of the sequence. *(7 points)*

b) Prove that if the sum of the first n terms of a sequence is $S_n=1.5n^2-n$, then it is an arithmetic sequence with common difference 3. *(5 points)*

Part II

5. In the park of a castle, the tulip bed has the shape of a right trapezoid with parallel sides 8 m and 5 m, and the leg perpendicular to them is 4 m long.

   a) Prove that the tulips planted along the diagonal from the vertex with the acute angle are on the bisector of the acute angle. *(6 points)*

   The gardeners sow grass on an area in the shape of an isosceles trapezoid with bases 6 m and 3 m, whose acute angles are $60°$. Children throw plastic hula hoops of radius 30 cm onto this area. The (imaginary) centers of the hoops fall at random onto the grass area.

   b) What is the probability that a hula hoop does not hang over the edge of the grass area? *(5 points)*

   In the pond in the middle of the park there are water lilies. During the blooming season, every day we can see 30% more open flowers than the day before.

   c) If we counted twelve flowers on June 1, when will there be at least two hundred open flowers on the pond? *(5 points)*

6. The set H consists of the pairs of numbers (a, b) that satisfy the following conditions: a and b are natural numbers, $a \leq b$, and $a \mid 12$, $b \mid 12$.

   a) Prove that H has 21 elements. *(3 points)*

   Consider the graph with 21 vertices, the elements of H. In this graph, we connect two vertices if the corresponding pairs have a number in common. For example, we connect $(4, 6)$ and $(6, 12)$, because both pairs contain 6.

   b) Give a cycle of 5 vertices in this graph by listing its vertices. *(2 points)*

   c) How many edges does this graph have? *(5 points)*

   d) We want to draw a regular 21-gon, corresponding to the 21 vertices of the graph, on a circular disk, so that the longest diagonal of the regular polygon is 18 cm. At least what radius does the disk need? *(6 points)*

7. a) In Szilárd's weather forecast, the daily highs from Monday to Friday are $34°$C, $30°$C, $26°$C, $22°$C, and $28°$C. Szilárd also said that for the whole week the mean of the daily highs is $28°$C, and the mean absolute deviation from the mean is $\frac{18}{7}°$C. Find the daily highs on the weekend, if it is expected to cool down a little on Sunday. *(6 points)*

   b) For the year 2023, Szilárd collected the daily precipitation, and gave the data needed to draw the box plot: $Q_0 = 0$ mm, $Q_1 = 1$ mm, $Q_2 = 5$ mm, $Q_3 = 8$ mm, and $Q_4 = 32$ mm. What can the smallest and the largest possible total precipitation be in 2023? *(5 points)*

   c) The digit 7 on Szilárd's computer broke, so he uses base 7 instead of base 10 to send data. What are the wind speed and the highest and lowest temperatures in base 10, if Szilárd's message was this:

   "The highest wind speed measured today is 50 km/h. The sum of the highest and lowest temperatures is $105°$C, and their difference is $15°$C." *(5 points)*

8. a) We put a regular square pyramid of height 6 cm on top of a square prism, so that the base of the pyramid fits exactly on the square face of the prism. Find the surface area of the solid, if its base edges are 12 cm long and its total height is 30 cm. *(4 points)*

   b) We write positive primes on the edges of the solid above, so that the numbers on the edges meeting at any vertex are different. Is it possible that the sum of the numbers written on the edges is less than 70? Justify your answer. *(4 points)*

   c) We have a square prism of height 22 cm, with a regular square pyramid of height 6 cm attached to one of its square faces. We stand the solid on its square face, pour 500 ml of liquid into it, and mark the liquid level. Then we stand the solid on the apex of the pyramid, and find that the liquid level is now 2 cm higher than the mark, but both levels are in the prism part. How long are the base edges of the prism? *(8 points)*

9. In the oral part of the advanced-level school-leaving exam in mathematics, an important element is presenting practical applications of the given topic. In connection with differential and integral calculus, students often bring examples from physics.

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a) The speed of a car as a function of time is a quadratic function whose two zeros are at 0 seconds and 10 seconds, and whose maximum value, at the 5th second of the motion, is 8 m/s. Prove that the rule of the speed function is $f(x) = -0.32x^2 + 3.2x$. *(4 points)*

b) The distance traveled by the car is the area under the speed–time graph. Find the distance traveled by the car until it stops. *(4 points)*

c) The acceleration of a body can be computed from its speed–time function as the slope of the tangent line at the given time. For a body in simple harmonic motion, the speed is given by $f(x) = 0.3\cos(3x)$. Compute the acceleration at $x = 2$ seconds. *(4 points)*

d) The work done is the product of the force and the displacement in the direction of the force. How much work is done if a constant force of 45 N acts on a body in the positive direction of the x-axis, while the body travels 160 m up the slope along the graph of $f(x) = \frac{1}{2}x$, starting from the origin? *(4 points)*

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