ÉRETTSÉGI VIZSGA • 2025. október 14.

MATEMATIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ

OKTATÁSI HIVATAL

Instructions to examiners

Formal requirements:

1. Mark the paper **legibly, in ink, different in colour** from that used by the candidate.
2. The first of the rectangles next to each problem shows the maximum attainable score on that problem. The **score** given by the examiner is to be entered **into the rectangle** next to this.
3. **If the solution is perfect,** enter maximum score and, with a checkmark, indicate that you have seen each item leading to the solution and consider them correct.
4. If the solution is incomplete or incorrect, please **mark the error** and also indicate the individual **partial scores**. It is also acceptable to indicate the points lost by the candidate if it makes grading the paper easier. After correcting the paper, it must be clear about every part of the solution whether that part is correct, incorrect or unnecessary.
5. Please, **use the following symbols** when correcting the paper:
   - correct calculation: *checkmark*
   - conceptual error: *double underline*
   - calculation error or other, not principal, error: *single underline*
   - correct calculation with erroneous initial data: *dashed checkmark or crossed checkmark*
   - incomplete reasoning, incomplete list, or other missing part: *missing part symbol*
   - unintelligible part: *question mark* and/or *wave*
6. Do not assess anything written **in pencil**, except for diagrams

Assessment of content:

1. The answer key may contain more than one solution for some of the problems. If the **solution given by the candidate is different**, allocate the points by identifying parts of the solution equivalent to those given in the answer key.
2. Subtotals may be **further divided, unless otherwise stated in the answer key**. However, scores awarded must always be whole numbers.
3. In the event of a **calculation error** or inaccuracy in the solution, take points off only for the part where the error occurs. If the reasoning remains correct and the error is carried forward while the nature of the problem remains unchanged, points for the rest of the solution must be awarded.
4. **In case of a conceptual error,** no points should be awarded at all for that section of the solution, not even for steps that are formally correct. (These logical sections of the solutions are separated by double lines in the answer key.) However, if the erroneous information obtained through a conceptual error is carried forward to the next section or the next part of the problem, and it is used there correctly, the maximum score is due for that part, provided that the error has not changed the nature of the task to be completed.
5. Where the answer key shows a **remark** in brackets, the solution should be considered complete without the remark as well.

6. Deduct points for **missing units of measurement** only if the missing unit of measurement is part of the answer or a unit exchange (without parentheses).
7. If there is more than one different approach to a problem, **assess only the one indicated by the candidate**. Please, mark clearly which attempt was assessed.
8. **Do not give extra points** (i.e. more than the score due for the problem or part of problem).
9. The score given for the solution of a problem, or part of a problem, **may never be negative**.
10. **Do not take points off** for steps or calculations that contain errors but are not actually used by the candidate in the solution of the problem.
11. **The use of calculators** in the course of the elaboration of a particular solution **is acceptable without further mathematical explanation in case of the following operations**:

    addition, subtraction, multiplication, division, calculating powers and roots, $n!$, $\binom{n}{k}$,

    substitution of values provided in the tables of *Négyjegyű függvénytáblázat* (Formula Booklet) (sin, cos, tan, log, and their inverse functions), approximate values of the numbers π and e, and finding the solutions of the standard quadratic equation. No further explanation is needed when the calculator is used to find the mean and the standard deviation, as long as the text of the question does not explicitly require the candidate to show detailed work. **In any other cases, results obtained through the use of a calculator are considered as unexplained and points for such results will not be awarded.**
12. Using **diagrams** to justify a solution (e.g. reading data off diagrams by way of direct measurement) is unacceptable.
13. **Probabilities** may also be given in percentage form (unless otherwise stated in the text of the problem).
14. If the text of the problem does not instruct the candidate to round their solution in a particular way, any solution **rounded reasonably and correctly** is acceptable even if it is different from the one given in the answer key.
15. **Assess only two out of the three problems in part B of Paper II.** The candidate was requested to indicate in the appropriate square the number of the problem not to be assessed and counted towards their total score. Should there be a solution to that problem, it does not need to be marked. However, if the candidate did not make a selection and neither is their choice clear from the paper, assume automatically that it is the last problem in the examination paper that is not to be assessed.

I.

1.		
$x = 2$ or $x = 3$	2 points	
Total:	**2 points**	

2.		
$t = \left(\frac{11-5}{2} =\right) 3$	2 points	
Total:	**2 points**	

3.		
I. false II. true III. false	2 points	*Award 1 point for two correct answers, 0 points for one correct answer.*
Total:	**2 points**	

4.		
$\left(\frac{7 \cdot 4}{2} =\right) 14$	2 points	
Total:	**2 points**	

5.		
C	2 points	*Not to be divided.*
Total:	**2 points**	

6.		
There are $(2 \cdot 3! =)$ 12 ways.	2 points	
Total:	**2 points**	

7.		
$A \cup B = \{1; 2; 3; 5; 7; 9\}$	1 point	
$(A \cap B) \setminus C = \{3; 5; 7\}$	2 points	
Total:	**3 points**	

8.		
$\tan\alpha = \frac{5}{12}$,	1 point	
then $\alpha \approx 22.6°$.	1 point	
$\beta = (90° - 22.6° =)\ 67.4°$	1 point	
Total:	**3 points**	

9.		
$(2 \cdot 7 + 3 =)$ 17	2 points	
Total:	**2 points**	

10.		
The slant height of the cone is $\sqrt{3^2 + 4^2} = 5$ cm long.	1 point	
The surface area is $3^2 \cdot \pi + 3 \cdot 5 \cdot \pi =$	1 point	
$= 24\pi \approx 75.4$ cm^2.	1 point	
Total:	**3 points**	

11.		
The mean is $\left(\dfrac{0+1+1+2+3+5}{6} =\right) 2$.	1 point	
The standard deviation is $\left(\sqrt{\dfrac{2^2+1^2+1^2+0^2+1^2+3^2}{6}} =\right) \sqrt{\dfrac{8}{3}} \approx 1.63$.	2 points	
Total:	**3 points**	

12. **Solution 1**		
When two dice are rolled the number of possible outcomes is 36 (all cases).	1 point	*Favourable cases are shown in grey.*
The sum of the numbers shown will be 6 or 12 in the following cases: 1-5, 2-4, 3-3, 4-2, 5-1, 6-6. The number of favourable cases is, therefore, 6.	2 points	
The probability: $\dfrac{6}{36} \approx 0.167$.	1 point	
Total:	**4 points**	

	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

12. **Solution 2**		
Whatever the number shown on one die, there is only one number shown on the other that completes it to 6 or 12: 1-5, 2-4, 3-3, 4-2, 5-1, 6-6.	3 points	
The probability is therefore $\left(1 \cdot \dfrac{1}{6} =\right) \dfrac{1}{6} \approx 0.167$.	1 point	
Total:	**4 points**	

II. A

13. a)		
Let d be the common difference of the sequence. In this case $a_4 - a_2 = 2d = 6$,	1 point	
so $d = 3$.	1 point	
The first term of the sequence is (7 – 3 =) 4,	1 point	
the tenth term is 4 + 9·3 = 31.	1 point	
The sum of the first 10 terms is $\frac{4+31}{2}\cdot 10 =$	1 point	4 + 7 + … + 31 =
= 175.	1 point	
Total:	**6 points**	

13. b)		
Let q be the common ratio of the sequence. In this case $\frac{b_5}{b_2} = q^3 = -27$,	1 point	
so $q = -3$.	1 point	
The first term of the sequence is $\left(\frac{6}{-3} =\right) -2$,	1 point	
the tenth term is $(-2)\cdot(-3)^9 = 39\ 366$.	1 point	
The sum of the first 10 terms is $(-2)\cdot\frac{(-3)^{10}-1}{(-3)-1} =$	1 point	(–2) + 6 + (–18) + … + + 39 366 =
= 29 524.	1 point	
Total:	**6 points**	

14. a)		
Let h be the length of the chord. Apply the Cosine-Rule: $h^2 = 5^2 + 5^2 - 2\cdot 5\cdot 5\cdot\cos 100°$ (≈ 58.68),	1 point	*With the isosceles triangle OAB split into two right triangles:* $\frac{h}{2} = 5\cdot\sin 50°$.
then $h \approx 7.66$ cm.	1 point	
Total:	**2 points**	

14. b)		
The area of the triangle: $\frac{5\cdot 5\cdot\sin 100°}{2} \approx$	1 point	*The height that corresponds to base AB is* $5\cdot\cos 50° \approx 3.21$ cm.
≈ 12.3 cm^2.	1 point	$A = \frac{7.66\cdot 3.21}{2} \approx$ ≈12.3 cm^2
Total:	**2 points**	

14. c)		
The length of the arc subtended by the central angle measuring 100° is $\frac{100}{360}\cdot 2\cdot 5\cdot \pi \approx$	1 point	
$\approx$ 8.73 cm.	1 point	
Total:	**2 points**	

Note: If the candidate gives one or more of their answers without a unit of measurement, a total of 1 point should be deducted for this item.

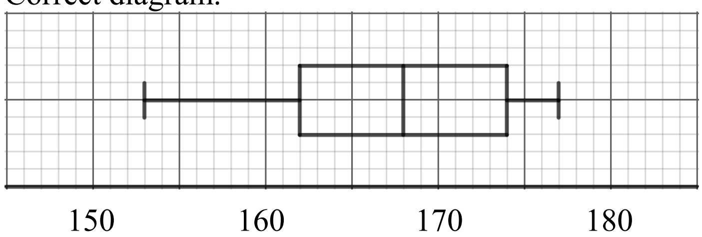
14. d) Solution 1		
There are (3! =) 6 different colourings using three colours.	1 point	
There are 3 different ways to choose the colours in case we use two colours only (r-y, y-g, r-g).	1 point*	
Assuming we use, for example, red and yellow, the possible colourings will be r-r-y, r-y-r, y-r-r, y-y-r, y-r-y, r-y-y, so there will be 6 different cases.	1 point*	*Colouring all three regions either red or yellow would provide 2^3 different ways to colour. However, two of these would be single-colour solutions, so the number of different ways is* $8 - 2 = 6$.
There are ($3\cdot 6$ =) 18 different possibilities using two colours.	1 point*	
The total number of different possibilities is therefore (6 + 18 =) 24.	1 point	
Total:	**5 points**	

*Note: The 3 points marked * may also be given for the following reasoning:*

When two colours are used, there are 3 different ways to select the single colour for two regions,	1 point	
there are also 3 different ways to select which two regions will be of the same colour and 2 different ways to select the colour for the third region.	1 point	
This gives a total of ($3\cdot 3\cdot 2$ =) 18 different possibilities.	1 point	

14. d) Solution 2		
Use complementary counting.	1 point	*Award this point also if this is not explicitly stated but apparent from the solution.*
There are a total $3^3 = 27$ different ways to colour three regions in three colours.	2 points	
The three single-colour cases do not comply.	1 point	
There are a total $(27 - 3 =)$ 24 different possibilities that meet the given conditions.	1 point	
Total:	**5 points**	

Note: Award full marks if the candidate gives the correct answer by providing an organised list of all possible colourings.

15. a)		
minimum: 153 cm lower quartile: 162 cm median: 168 cm upper quartile: 174 cm maximum: 177 cm	3 points	*Award 2 points for 3 or 4 correct answers, 1 point for 1 or 2 correct answers.*
Correct diagram. 	2 points	
Total:	**5 points**	

15. b) Solution 1		
There are 5 girls taller and 9 shorter than 170 cm.	1 point	
There are 5 different ways to select one of the five girls taller than 170 cm, and 9 different ways to select one of the 9 girls shorter than that. The number of favourable cases is thus $5 \cdot 9 = 45$.	1 point	*Considering the order of selection (the girl first selected may be taller or shorter) the number of favourable cases is* $2 \cdot 5 \cdot 9 = 90$.
There are $\binom{14}{2} = 91$ different ways to select two girls out of 14 (total number of cases).	1 point	*The total number of cases is* $14 \cdot 13 = 182$.
The probability is $\frac{45}{91} \approx 0.495$.	1 point	
Total:	**4 points**	

15. b) **Solution 2**		
There are 5 girls taller and 9 shorter than 170 cm.	1 point	
The probability that the girl first selected is taller and the second is shorter than 170 cm is $\frac{5}{14}\cdot\frac{9}{13}$.	1 point	
The probability that the girl first selected is shorter and the second is taller than 170 cm is $\frac{9}{14}\cdot\frac{5}{13}$.	1 point	
The probability at issue is the sum of the above, approximately 0.495.	1 point	
Total:	**4 points**	

15. c) **Solution 1**		
The sum of the heights of the 28 students is $28\cdot172.75 = 4837$ cm.	2 points	
With the new student it is (4837 + 180 =) 5017 cm,	1 point	
giving a new mean of $\frac{5017}{29}=173$ (cm).	1 point	
Total:	**4 points**	

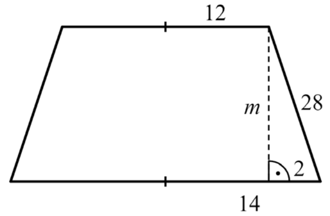
15. c) **Solution 2**		
(If the height of the new student had happened to coincide with the previous mean, the mean would have remained the same.) The height of the new student is (180 – 172.75 =) 7.25 cm more than the old mean.	1 point	
The properties of the mean require to distribute this “extra” over 29 students evenly, giving (7.25 : 29 =) 0.25 cm.	2 points	
Adding this to the old mean, the new mean will be (172.75 + 0.25 =) 173 (cm).	1 point	
Total:	**4 points**	

II. B

16. a)

With the capsules lined up, the chain would be $56 \cdot 10^9 \cdot 40 = 2.24 \cdot 10^{12}$ mm,	1 point	
that is 2 240 000 km long.	1 point	
The length of the Equator is $2 \cdot 6370 \cdot \pi \approx 40\,024$ km.	1 point	
2 240 000 : 40 024 ≈ 56, so the statement is correct within reasonable approximation.	1 point	
Total:	**4 points**	

16. b)

The radius of the base circle is 14 mm, the radius of the top is 12 mm.	1 point	
The height m of the truncated cone is one leg of a right triangle whose other leg is (14 – 12 =) 2 mm and whose hypotenuse is 28 mm long.	1 point	
According to the Pythagorean Theorem: $m = \sqrt{28^2 - 2^2} \approx$ 27.9 mm.	1 point	
The volume of the truncated cone is $\dfrac{(14^2 + 14 \cdot 12 + 12^2) \cdot \pi \cdot 27.9}{3} \approx$	1 point	
$\approx 14\,842$ mm^3.	1 point	
So, one capsule holds about 15 cm^3 of coffee (with the required rounding).	1 point	*Do not award this point if the solution is not rounded or rounded incorrectly.*
Total:	**6 points**	

16. c)

10 ml = 10 cm^3	1 point	
Let r be the radius of the hemisphere. Then $\frac{1}{2} \cdot \frac{4}{3} r^3 \pi = 10$.	1 point	
$r^3 \approx 4.775$,	1 point	
$r \approx 1.7$ cm.	1 point	
Total:	**4 points**	

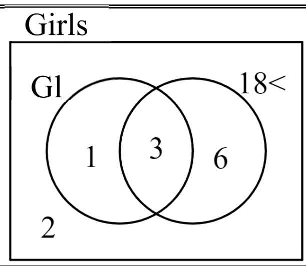
16. d)

The probability that a capsule is not defective is (1 – 0.001 =) 0.999.	1 point	*Award this point also if this is not explicitly stated but apparent from the solution.*
The probability that none of the 100 capsules is defective is $0.999^{100} \approx 0.905$.	2 points	
Total:	**3 points**	

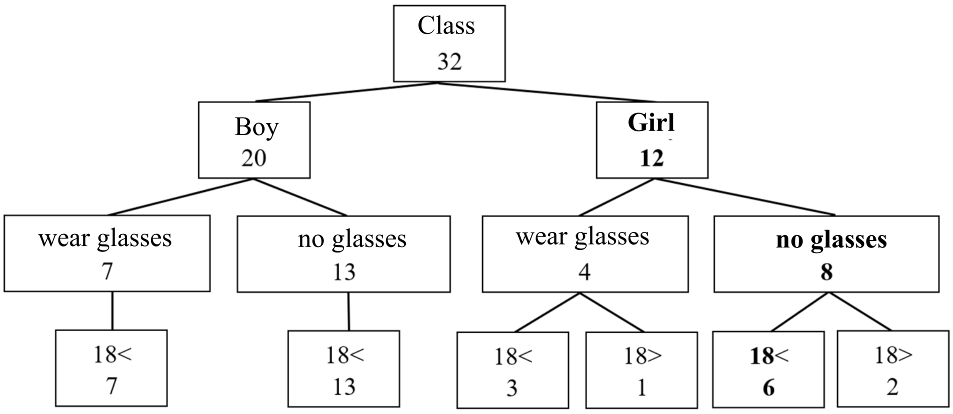
17. a)		
A 37-year-old customer will pay 63% of the original price of the frame.	1 point	$30\,000 \cdot 0.37 = 11\,100$
The discount price is therefore $30\,000 \cdot 0{,}63 = 18\,900$ Ft.	1 point	$30\,000 - 11\,100 =$ $= 18\,900$ Ft
Total:	**2 points**	

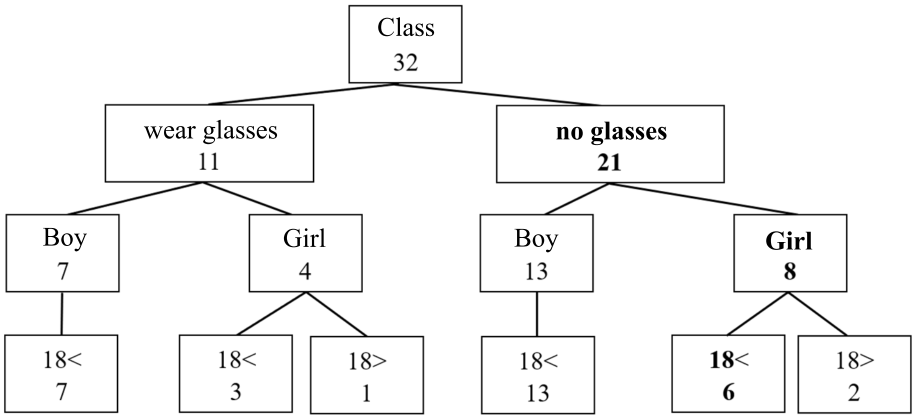
17. b)		
Of 30 000, 16 500 is $\frac{16\,500}{30\,000} \cdot 100 =$	1 point	*There is a discount of* $30\,000 - 16\,500 =$ $= 13\,5000$ Ft.
= 55 percent.	1 point	$\frac{13\,500}{30\,000} \cdot 100 =$
The customer is (100 – 55 =) 45 years old.	1 point	*= the age of the customer is 45 years.*
Total:	**3 points**	

17. c)		
Let p be Péter's age in years. Then $30\,000 \cdot \left(1 - \frac{p}{100}\right) = 3 \cdot 30\,000 \cdot \left(1 - \frac{3p}{100}\right)$.	2 points	*Let r be one hundredth of Péter's age. Then* $30\,000 \cdot (1 - r) =$ $= 3 \cdot 30\,000 \cdot (1 - 3r)$.
$100 - p = 300 - 9p$,	2 points	$1 - r = 3 - 9r$
so $p = 25$, therefore Péter is 25 years old.	1 point	$r = 0.25$*, therefore Péter is 25 years old.*
Péter's grandmother is $(3 \cdot 25 =)$ 75 years old.	1 point	
Check: Péter pays $30\,000 \cdot 0.75 = 22\,500$ Ft, while his grandmother pays $30\,000 \cdot 0.25 = 7500$ Ft, which is one third of what Péter pays, indeed.	1 point	
Total:	**7 points**	

17. d)		
$32 : (5 + 3) = 4$,	1 point	
so there are $(3 \cdot 4 =)$ 12 girls in this class (and 20 boys),	1 point	
(11 – 7 =) 4 of whom wear glasses.	1 point*	
Among the girls, there are (3 – 1 =) 2, who do not wear glasses and have not yet had their 18th birthday,	1 point*	
so there are (12 – 4 – 2 =) 6 girls who do not wear glasses and are over 18.	1 point	
Total:	**5 points**	

*Note: The 2 points marked * may also be awarded if the candidate proves their answer with the help of a diagram similar to the ones shown.*





18. a)		
$x = 13$	1 point	
$y = 7.67 \cdot 1.27^{13} \approx 171{,}5$ GW	1 point	
The difference is 171.5 – 146 = 25.5 (GW).	1 point	
Total:	**3 points**	

18. b)		
(The annual growth factor is 1.27, which means a) 27% increase from one year to the next.	2 points	
Total:	**2 points**	

18. c)		
The equation $3000 = 7.67 \cdot 1.27^{x}$ is to be solved.	1 point	
$x = \log_{1.27} \frac{3000}{7.67} \approx \log_{1.27} 391.1 \approx$	1 point	$x = \frac{\log \frac{3000}{7.67}}{\log 1.27}$
≈ 24.97.	1 point	
This model predicts that the total capacity would reach 3000 GW in the year (2007 + 25 =) 2032.	1 point	
Total:	**4 points**	

18. d)		
$x = 9$	1 point	
The linear model gives the 2016 value as $y = 7.7 \cdot 9 - 5 = 64.3$ GW.	1 point	
$\frac{64.3}{77} \approx 0.835$,	1 point	
therefore the value calculated from the linear model is about 16.5% less than the actual value given in the diagram.	1 point	
Total:	**4 points**	

18. e) Solution 1		
With the equation of the line stated in the form of $y = mx + b$ the gradient of the line is $m = \frac{77-7}{9-1} =$	1 point	
$= 8.75$.	1 point	
Using the coordinates of one of the points: $7 = 8.75 \cdot 1 + b$.	1 point	$77 = 8.75 \cdot 9 + b$
$b = -1.75$. The equation of the line is $y = 8.75x - 1.75$.	1 point	
Total:	**4 points**	

18. e) Solution 2		
Stating the equation of the line in the form of $y = mx + b$ gives rise to the system: $\left.\begin{array}{r} 7 = m \cdot 1 + b \\ 77 = m \cdot 9 + b \end{array}\right\}.$	1 point	
From the first equation $b = 7 - m$. Substituting this into the second equation: $77 = 8m + 7$.	1 point	*Subtracting the first equation from the second:* $70 = 8m$.
$m = 8.75$,	1 point	
and $b = -1.75$. The equation of the line is $y = 8.75x - 1.75$.	1 point	
Total:	**4 points**	

18. e) Solution 3		
One direction vector of the line is (8; 70).	2 points	*One normal vector of the line is* (70; –8).
The equation of the line is $70x - 8y = 14$.	2 points	
Total:	**4 points**	

Note: Award maximum score if the candidate provides the correct answer by properly substituting into the formula for the equation of the line through two given points.