BABEŞ-BOLYAI UNIVERSITY CLUJ-NAPOCA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

ADMISSION 2026
Written exam in MATHEMATICS

IMPORTANT NOTE: The problems may have one or more correct answers, which must be indicated by the candidate on the special form on the contest sheet. The grading of the multiple-choice items is carried out according to the partial scoring system specified in the contest regulations.

1. The second degree function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^2 - 2(a+1)x + 2a + 4$ is given. For which values of $a \in \mathbb{R}$ does the parabola associated with f have the ordinate of its vertex strictly greater than the abscissa of its vertex?

A $a \in (-2, 1)$; B $a \in \mathbb{R} \setminus (-2, 1)$; C $a \in [-2, 1]$; D $a \in \mathbb{R} \setminus [-2, 1]$.

2. For which value of the parameter p are the lines $d_1 : (1+\sqrt{3})y = px + 5$ and $d_2 : y = (2-\sqrt{3})x + 8$ parallel?

A $-1-\sqrt{3}$; B $-1+\sqrt{3}$; C $1-\sqrt{3}$; D $1+\sqrt{3}$.

3. If $f : \mathbb{R} \to \mathbb{R}$, $f(x) = |x+1| - 2$, then the value of $f(f(-4))$ is equal to:

A -1; B 0; C 1; D 2.

4. If $z = \dfrac{\sqrt{3}+i}{\sqrt{3}-i}$, then

A $|z| = 1$; B $\mathrm{Re}(z) = \dfrac{1}{2}$; C $\mathrm{Im}(z) = \dfrac{1}{2}$; D $\mathrm{Re}(z) = \mathrm{Im}(z)$.

5. What is the value of the expression $E(a) = \sin\left(a + \dfrac{\pi}{2}\right) - \sin\left(a - \dfrac{\pi}{2}\right)$, where a is an arbitrary real number?

A $2\sin a$; B $-2\cos a$; C $2\cos a$; D 0.

6. In the Cartesian coordinate system xOy, three points are given: $A(1,2)$, $B(7,-1)$, and $C(m,5)$. The real number m for which the vectors $\overrightarrow{AB}$ and $\overrightarrow{AC}$ are perpendicular is

A $-\dfrac{1}{2}$; B $\dfrac{2}{3}$; C $\dfrac{4}{5}$; D $\dfrac{5}{2}$.

7. Let $f : (0, \infty) \to \mathbb{R}$ be the function $f(x) = x \ln x$. The tangent to the graph of f at the point with abscissa 1 intersects the Oy axis at the point with ordinate

A -2; B -1; C 1; D 2.

8. The value of $a \in \mathbb{R}$ for which the function $f : \mathbb{R} \setminus \{-1\} \to \mathbb{R}$, $f(x) = \dfrac{x^2 + ax + 1}{x+1}$, has, as $x \to \infty$, the oblique asymptote with equation $y = x + 3$, can be

A 1; B 2; C 3; D 4.

9. The point $(11, a)$ lies on the perpendicular bisector of the segment joining the points $(3, -5)$ and $(1, 1)$. The value of a is

A $\frac{2}{3}$; B 1; C $\frac{3}{2}$; D 3.

10. Let the numbers $a = \cos(-20^\circ)$, $b = \cos 10^\circ$, $c = \cos 375^\circ$ and $d = \sin 75^\circ$ be given. Which of the following statements are true?

A Among these numbers, a is the smallest.
B Among these numbers, b is the largest.
C Among these numbers, c is the largest.
D Two of these numbers are equal.

11. The value of $a \in \mathbb{R}$ for which the function $f : \mathbb{R} \to \mathbb{R}$,

$$f(x) = \begin{cases} \mathrm{e}^{x-2}, & x \leq 2 \\ \dfrac{a}{x+1} + 2\cos(x-2), & x > 2 \end{cases}$$

is continuous can be

A $a = -3$; B $a = -2$; C $a = 0$; D $a = 1$.

12. If x_0 is a point of local extremum of the function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = x^3 - 3x + 3 - 45\operatorname{arctg} x$, then the value of x_0 can be

A -2; B -1; C 1; D 2.

13. The value of the integral $\displaystyle\int_1^{\mathrm{e}} \frac{\ln x}{\sqrt{x}}\,\mathrm{d}x$ is

A $1 + \sqrt{\mathrm{e}}$; B $4 - 2\sqrt{\mathrm{e}}$; C $2 + \sqrt{\mathrm{e}}$; D $4 - \sqrt{\mathrm{e}}$.

14. On the set $\mathbb{R}^*$, the composition law $x * y = \frac{x}{y} + \frac{y}{x}$ is defined. Which of the following statements are true?

A $x * x = 2$, $\forall x \in \mathbb{R}^*$;
B $2 * x = 2$, $\forall x \in \mathbb{R}^*$;
C $(1 * 1) * 2 = 1 * (1 * 2)$;
D $x * y = y * x$, $\forall x, y \in \mathbb{R}^*$.

15. Let $A = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$ and $M = \{X \in \mathcal{M}_2(\mathbb{R}) \mid AX + XA = O_2\}$. Which of the following statements are true?

A $I_2 \in M$;
B $AX = O_2$, for all $X \in M$;
C $AX = XA$, for all $X \in M$;
D $M = \left\{ \begin{pmatrix} a & a \\ a & a \end{pmatrix} \mid a \in \mathbb{R} \right\}$.

16. Let $(\mathbb{Z}_7, +, \cdot)$ be the field of residue classes modulo 7. Then

A the equation $\hat{3}x^2 + \hat{6} = \hat{0}$ has a unique solution in $\mathbb{Z}_7$;
B $\hat{5}^6 = \hat{1}$;
C the equation $\hat{3}x^2 + \hat{6} = \hat{0}$ does not have solutions in $\mathbb{Z}_7$;
D $\hat{5}^3 = \hat{1}$.

17. The equation $(m+1)x^2 - (2m-1)x + m - 2 = 0$ is given, where $m \in \mathbb{R}$. Which of the following statements are true?

A The equation has two distinct real solutions for every $m \in \mathbb{R}$.
B The equation has two strictly positive real solutions for every $m \in (-\infty, -1) \cup (2, \infty)$.
C The equation has two strictly negative real solutions for every $m \in (-1, 2)$.
D The equation has two distinct real solutions for every $m \in \mathbb{R} \setminus \{-1\}$.

18. If $s = 1 + \frac{1}{2} + \frac{1}{2^2} + \ldots + \frac{1}{2^{2026}}$, then:

A $s = 2$; B $s = 2 - \frac{1}{2^{2026}}$; C $s = 2 - \frac{1}{2^{2027}}$; D $s \in (1, 2)$.

19. Let $ABCD$ be a rectangle with vertices $A(0, -1)$, $B(8, 5)$ and area equal to 50. Which of the following statements can be true?

A The length of the side AD is 5;
B The equation of the line CD can be $3x - 4y + 21 = 0$;
C The equation of the line CD can be $3x - 4y - 29 = 0$;
D The equation of the line CD can be $3x + 4y + 8 = 0$.

20. If x_0 is a point of inflection of the function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = \mathrm{e}^x(x^2 - 4x + 5)$, then the value of x_0 can be

A -1; B 0; C 1; D 3.

21. In the plane of the triangle ABC, we consider the points M, N and P such that $\overrightarrow{BM} = \frac{1}{4}\overrightarrow{BC}$, N is the midpoint of the side AB, and $\overrightarrow{AP} = \frac{4}{7}\overrightarrow{AM}$. Which of the following statements are true?

A $\overrightarrow{AM} = \frac{3\overrightarrow{AB} + \overrightarrow{AC}}{4}$; B $\overrightarrow{CN} = \frac{1}{2}\overrightarrow{AB} - \overrightarrow{AC}$; C $\overrightarrow{CP} = \frac{6}{7}\overrightarrow{CN}$; D $\overrightarrow{CP} = \frac{4}{5}\overrightarrow{CN}$.

22. The value of the integral $\int_0^1 \mathrm{e}^{x^2+2x}(x+1)\mathrm{d}x$ is

A $\frac{\mathrm{e}^2 - 1}{2}$; B $\frac{\mathrm{e}^3 - 1}{2}$; C $\frac{\mathrm{e}^2 + 1}{2}$; D $\frac{\mathrm{e}^3 + 1}{2}$.

23. The value of the limit $\lim\limits_{x \to \infty} \left(\frac{x^2 - x}{x^2 + 1}\right)^{x-1}$ is

A e^{-1}; B e; C 1; D e^{-2}.

24. Consider the triangle ABC with $AB = 10$ cm and $\widehat{BAC} = 30°$. If D is the midpoint of the side AC and $BC = BD = k$ cm, then the value of k is

A $\frac{10\sqrt{3}}{3}$; B $\frac{10}{3}$; C $10\sqrt{3}$; D $\sqrt{3}$.

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Correct Answers

ADMISSIONS EXAM, July 2026

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1. **A**
2. **B**
3. **B**
4. **A**, **B**
5. **C**
6. **D**
7. **B**
8. **D**
9. **B**
10. **A**, **B**, **D**
11. **A**
12. **A**, **D**
13. **B**
14. **A**, **D**
15. **B**, **C**
16. **B**, **C**
17. **B**, **D**
18. **B**, **D**
19. **A**, **B**, **C**
20. **A**, **C**
21. **A**, **B**, **C**
22. **B**
23. **A**
24. **A**