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. Consider the quadratic function $f:\mathbb{R}\to\mathbb{R}$, $f(x)=x^2+2(m-3)x+m-3$. For which values of $m\in\mathbb{R}$ does the parabola associated with f have its vertex below the Ox-axis?

A $m\in\mathbb{R}\setminus[3,4]$; B $m\in\mathbb{R}\setminus(3,4)$; C $m\in(3,4)$; D $m\in[3,4]$.

2. The equation of the diagonal AC of a square $ABCD$ is $2x-3y-4=0$, and the coordinates of the vertex B are $(-1,2)$. The equation of the diagonal BD is

A $2x-3y+8=0$; B $3x+2y+3=0$; C $3x-2y+7=0$; D $3x+2y-1=0$.

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

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

4. If $z=\dfrac{1+2i}{1-3i}$, then

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

5. Let $\vec{i}$ and $\vec{j}$ be the unit versors of a Cartesian coordinate system, and consider the vectors $\vec{u}=3\vec{i}+4\vec{j}$ and $\vec{v}=5\vec{i}+12\vec{j}$. Which of the following numbers is the length of the vector $2\vec{u}-\vec{v}$?

A $\sqrt{5}$; B $\sqrt{15}$; C $\sqrt{17}$; D $\sqrt{19}$.

6. If $A=\cos\dfrac{3\pi}{4}-\cos\dfrac{5\pi}{4}$, then:

A $A<0$; B $A>0$; C $A=0$; D $A=-\sqrt{2}$.

7. Let $f:\mathbb{R}\to\mathbb{R}$ be the function $f(x)=x\cos x$. The tangent to the graph of f at the point with abscissa π intersects the Oy-axis at a point whose ordinate is

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

8. A possible value of $a\in\mathbb{R}$ for which the function $f:(0,\infty)\to\mathbb{R}$, $f(x)=\sqrt{x^2+ax+2}$, has the oblique asymptote $y=x+1$ as $x\to\infty$ is

A 0; B 1; C 2; D 3.

9. Let ABC be an equilateral triangle, let M be the midpoint of the segment BC, and let N be the midpoint of the segment BM. Which of the following relations are true?

$\boxed{\text{A}}$ $\overrightarrow{AB} = \overrightarrow{AC}$; $\boxed{\text{B}}$ $\overrightarrow{AN} = \dfrac{\overrightarrow{AB} + \overrightarrow{AC}}{4}$; $\boxed{\text{C}}$ $\overrightarrow{AN} = \dfrac{3\overrightarrow{AB} + \overrightarrow{AC}}{4}$; $\boxed{\text{D}}$ $\overrightarrow{AN} = \dfrac{\overrightarrow{AB} + 3\overrightarrow{AC}}{4}$.

10. Consider the trigonometric equation $2\sin\left(2x - \dfrac{\pi}{3}\right) - 1 = 0$. Which of the following statements are true?

$\boxed{\text{A}}$ $x = \dfrac{\pi}{3}$ is a solution of the equation.

$\boxed{\text{B}}$ In the interval $(0, 2\pi)$, the equation has exactly 4 solutions.

$\boxed{\text{C}}$ The sum of the solutions in the interval $(0, 2\pi)$ is $\dfrac{5\pi}{6}$.

$\boxed{\text{D}}$ The sum of the solutions in the interval $(0, 2\pi)$ is $\dfrac{11\pi}{3}$.

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

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

is continuous can be

$\boxed{\text{A}}$ $a = 1$; $\boxed{\text{B}}$ $a = 2$; $\boxed{\text{C}}$ $a = 3$; $\boxed{\text{D}}$ $a = 4$.

12. If x_0 is a local extremum point of the function $f : (-1, \infty) \to \mathbb{R}$, $f(x) = \ln(1 + x + x^2) - x$, then a possible value of x_0 is

$\boxed{\text{A}}$ 0; $\boxed{\text{B}}$ 1; $\boxed{\text{C}}$ 2; $\boxed{\text{D}}$ 3.

13. The value of the integral $\displaystyle\int_0^1 \sqrt{x}\,\mathrm{d}x$ is

$\boxed{\text{A}}$ $\dfrac{2}{3}$; $\boxed{\text{B}}$ $\dfrac{1}{2}$; $\boxed{\text{C}}$ $\dfrac{5}{6}$; $\boxed{\text{D}}$ $\dfrac{3}{4}$.

14. If $a = \log_2(7 + 4\sqrt{3}) + 2\log_2(2 - \sqrt{3})$, then

$\boxed{\text{A}}$ $a = 0$; $\boxed{\text{B}}$ $a = 1$; $\boxed{\text{C}}$ $a = \log_2 3$; $\boxed{\text{D}}$ $a = 2$.

15. Let $A = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ and $M = \{X \in \mathcal{M}_2(\mathbb{R}) \mid AX + XA = O_2\}$. Which of the following statements are true?

$\boxed{\text{A}}$ $O_2 \in M$;

$\boxed{\text{B}}$ there exists $X \in M$ for which $AX = I_2$;

$\boxed{\text{C}}$ there exists $X \in M$ for which $AX = XA$;

$\boxed{\text{D}}$ $M = \left\{ \begin{pmatrix} a & 0 \\ 0 & d \end{pmatrix} \mid a, d \in \mathbb{R} \right\}$.

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

$\boxed{\text{A}}$ the equation $\hat{2}x^2 + \hat{3} = \hat{0}$ has two distinct solutions in $\mathbb{Z}_7$;

$\boxed{\text{B}}$ $\hat{4}^6 = \hat{1}$;

$\boxed{\text{C}}$ the equation $\hat{2}x^2 + \hat{3} = \hat{0}$ has no solution in $\mathbb{Z}_7$;

$\boxed{\text{D}}$ $\hat{4}^3 = \hat{1}$.

17. Let $(a_n)_{n \in \mathbb{N}^*}$, with $a_n \geq 0, \forall n \in \mathbb{N}^*$, be an arithmetic progression with common difference r. We denote $S_n = a_1^2 + a_2^2 + \ldots + a_n^2$. If $a_1 = 1$ and $S_5 = 165$, then:

$\boxed{\text{A}}$ $r = 2$; $\boxed{\text{B}}$ $r = 4$; $\boxed{\text{C}}$ $r = 6$; $\boxed{\text{D}}$ $r = 8$.

18. Consider the polynomial $f = X^4 - X^3 - X^2 - 2X$. If g is the quotient obtained by dividing f by $X^2 + X + 1$ and $n \in \mathbb{N}^*$ is an arbitrary number, then $g(1) + g(2) + \ldots + g(n)$ is

A $\dfrac{n(n+1)(2n-5)}{6}$; B $\dfrac{n(n+1)(n^2+n-2)}{4}$; C $\dfrac{(n-1)n(n+1)}{3}$; D $\dfrac{n(n+1)(2n+1)}{6}$.

19. A line d passes through the point $A(-2, 4)$ and makes an angle of 45° with the Ox-axis. If the line d intersects the Ox-axis at a point with negative abscissa, then the area of the triangle formed by the axes Ox, Oy, and the line d may be:

A 2; B 4; C 16; D 18.

20. Let $f : [-\pi, \pi] \to \mathbb{R}$, $f(x) = \mathrm{e}^{\sin x}$. The product of the maximum and minimum values of the function f is

A 0; B 1; C e; D $-$e.

21. In the nondegenerate triangle ABC, the lengths of the sides BC, AC, and AB are $s+1$, s, and $s\sqrt{3}$, respectively. The set of values of s for which the angle $\widehat{ACB}$ is obtuse is:

A $\left(\dfrac{\sqrt{3}}{3}, \infty\right)$; B $(0, \infty)$; C $(1+\sqrt{2}, \infty)$; D $(0, 1+\sqrt{2})$.

22. The value of the limit $\lim\limits_{n\to\infty} \left(\dfrac{1}{1\cdot 2} + \dfrac{1}{2\cdot 3} + \ldots + \dfrac{1}{(n-1)\cdot n}\right)^n$ is

A $\sqrt{\mathrm{e}}$; B $\dfrac{1}{2}$; C 1; D $\dfrac{1}{\mathrm{e}}$.

23. Let $f : D \to \mathbb{R}$, $f(x) = \dfrac{\sin x}{x^3 - x}$, where $D \subset \mathbb{R}$ is the maximal domain of definition of the function f. The number of vertical asymptotes of the graph of the function f is

A 0; B 1; C 2; D 3.

24. Consider the nine lines $y = 3x + 1, y = 3x + 2, \ldots, y = 3x + 9$ and the seven lines $y = -x + 1, y = -x + 2, \ldots, y = -x + 7$. We mark the points of intersection of the line $d : y = 1 - 9x$ with the 16 lines under consideration. How many distinct points will be marked?

A 13; B 14; C 15; D 16.

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Correct Answers

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1. $\boxed{\textbf{A}}$

2. $\boxed{\textbf{D}}$

3. $\boxed{\textbf{D}}$

4. $\boxed{\textbf{A}}$, $\boxed{\textbf{C}}$, $\boxed{\textbf{D}}$

5. $\boxed{\textbf{C}}$

6. $\boxed{\textbf{C}}$

7. $\boxed{\textbf{C}}$

8. $\boxed{\textbf{C}}$

9. $\boxed{\textbf{C}}$

10. $\boxed{\textbf{B}}$, $\boxed{\textbf{D}}$

11. $\boxed{\textbf{D}}$

12. $\boxed{\textbf{A}}$, $\boxed{\textbf{B}}$

13. $\boxed{\textbf{A}}$

14. $\boxed{\textbf{A}}$

15. $\boxed{\textbf{A}}$, $\boxed{\textbf{C}}$

16. $\boxed{\textbf{A}}$, $\boxed{\textbf{B}}$, $\boxed{\textbf{D}}$

17. $\boxed{\textbf{A}}$

18. $\boxed{\textbf{A}}$

19. $\boxed{\textbf{D}}$

20. $\boxed{\textbf{B}}$

21. $\boxed{\textbf{C}}$

22. $\boxed{\textbf{D}}$

23. $\boxed{\textbf{C}}$

24. $\boxed{\textbf{A}}$