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

MATE-INFO UBB 2026 Contest
Written exam in MATHEMATICS

1. If $z = \dfrac{7+24i}{4+3i}$, then

A $\mathrm{Re}(z) = \dfrac{7}{4}$; B $\mathrm{Re}(z) = 4$; C $\mathrm{Im}(z) = 3$; D $|z| = 5$.

2. The value of $p > 0$ for which $\displaystyle\int_0^1 x^p \mathrm{d}x = \frac{p+2}{6p}$ can be

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

3. If $x \in \mathbb{R}$ satisfies the equality $2^{x+1} - 2^{x-2} = 21$, then

A $x \leq 2$; B $x \in (2,3]$; C $x \in (3,4]$; D $x > 4$.

4. In the cartesian system xOy, consider the points $A(1,-1)$ and $B(2,3)$. Given that $x + ay + b = 0$ is the equation of the line AB, then the value of $a - b$ can be

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

5. Let $\vec{i}$ and $\vec{j}$ be the versors of a cartesian system. If the vectors $\vec{u} = a\vec{i} + 8\vec{j}$ and $\vec{v} = 3\vec{i} - (a-10)\vec{j}$ are colinear, then which of the following statements can be true?

A $a = -4$; B $a = 4$; C $a = -6$; D $a = 6$.

6. The value of the area of the planar region bounded by the Ox axis, the lines $x = 0$ and $x = \dfrac{\pi}{2}$ respectively, and the graph of the function $f : \left[0, \dfrac{\pi}{2}\right] \to \mathbb{R}, f(x) = \sin^2 x, \ \forall x \in \left[0, \dfrac{\pi}{2}\right]$, is

A 1; B $\dfrac{\pi}{4}$; C π; D $\dfrac{\pi}{2}$.

7. Let $f : \mathbb{R} \to \mathbb{R}$ be the function defined by $f(x) = \dfrac{x}{\sqrt{1+x^2}}$, $\forall x \in \mathbb{R}$. The line d tangent to the graph of f at the point with abscissa 0 has equation

A $d : y = 0$; B $d : y = x$; C $d : y = -x$; D $d : x = 0$.

8. The value of the limit $\displaystyle\lim_{n\to\infty} \left(\sqrt{n^2+2n} - n\right)$ is

A 0; B $\dfrac{1}{2}$; C 1; D ∞.

9. Let $f : (0, +\infty) \to \mathbb{R}$ be the function defined by

$$f(x) = \ln(1 + x) - \ln(x) + x, \quad \forall\, x > 0.$$

The graph of f

A has an oblique asymptote as $x \to +\infty$.
B has a horizontal asymptote as $x \to +\infty$.
C has the vertical asymptote $x = 0$ to the right.
D has no asymptotes.

10. For every $n \in \mathbb{N}, n \geq 2$, the sum $C_2^2 + C_3^2 + \ldots + C_n^2$ is equal to

A C_{n+1}^3; B C_{n+1}^2; C 4^{n-2}; D C_{n+1}^{n-1}.

11. The equation $\dfrac{mx - 4}{x - 2} = 2$, $x \in \mathbb{R} \setminus \{2\}$, has:

A infinitely many solutions for $m \in \mathbb{R} \setminus \{2\}$;
B infinitely many solutions for $m = 2$;
C a unique solution for $m \in \mathbb{R} \setminus \{2\}$;
D a unique solution for $m = 2$.

12. The length of the radius of the circle inscribed in the triangle with side lengths $4, 5, 7$ is

A $4\sqrt{6}$; B $2\sqrt{6}$; C $\sqrt{6}$; D $\dfrac{\sqrt{6}}{2}$.

13. Consider a triangle ABC, with $AB = 4$, $AC = 6$, $BC = 8$. Then the value of the scalar product $\overrightarrow{AB} \cdot \overrightarrow{AC}$ is

A -6; B 0; C 6; D 24.

14. Consider the rhombus $ABCD$, where O is the point of intersection of the diagonals. Which of the following statements are true?

A $\overrightarrow{AB} = \overrightarrow{AD}$; B $\overrightarrow{AB} = \overrightarrow{DC}$; C $\overrightarrow{BO} = \dfrac{1}{2}(\overrightarrow{BC} + \overrightarrow{BA})$; D $\overrightarrow{BO} = \dfrac{1}{2}(\overrightarrow{BC} - \overrightarrow{BA})$.

15. Let $f : \mathbb{R} \to \mathbb{R}$ be the function defined by $f(x) = \dfrac{x^2 - 1}{\mathrm{e}^{x-1}}$, $\forall x \in \mathbb{R}$. The tangent to the graph of the function f at the point with abscissa 1

A is perpendicular to the line with equation $x + 2y = 1$.
B is parallel to the line with equation $x + 2y = 2$.
C passes through the point $(3, 4)$.
D intersects the Ox axis at $(0, -2)$.

16. For every $n \in \mathbb{N}^*$ denote by a_n the coefficient of x^n in the expansion of the binomial $\left(x^2 + \dfrac{1}{2x}\right)^{2n}$.

The value of the limit $\lim\limits_{n\to\infty} \dfrac{a_{n+1}}{a_n}$ is

A 0; B $\dfrac{1}{2}$; C 1; D 2.

17. Let $(a_n)_{n\in\mathbb{N}^*}$ be a sequence whose terms are in arithmetic progression. If $a_5 + a_9 + a_{13} + a_{17} = 24$, then the sum of the first 21 consecutive terms of the sequence is:

A 216; B 162; C 261; D 126.

18. Let $m \in \mathbb{R}$ and consider the system of equations

$$\begin{cases} x + 2y + \quad 4z & = m + 2 \\ x + 3y + \quad 9z & = m + 3 \\ x + my + m^2 z & = 2m. \end{cases}$$

Which of the following statements are true?

A For $m = 2$ the system is incompatible.
B For $m = 3$ the system is incompatible.
C For every $m \in \mathbb{R} \setminus \{2, 3\}$ the system is compatible determined.
D For every $m \in \mathbb{R}$ the system is compatible.

19. If $x \in \left(0, \frac{\pi}{2}\right)$, $y \in \left(\frac{\pi}{2}, \pi\right)$ and $\sin x = \frac{\sqrt{5}}{3}$, $\cos y = -\frac{\sqrt{5}}{5}$, then $\sin(x - y)$ is equal to

A $\frac{-5 - 4\sqrt{5}}{15}$; B $\frac{-5 + 4\sqrt{5}}{15}$; C $\frac{5 + 4\sqrt{5}}{15}$; D $\frac{5 - 4\sqrt{5}}{15}$.

20. Consider the equation $2\cos(2x) - 4\sin x + 1 = 0$. Which of the following statements are true?

A $\frac{\pi}{6}$ is a solution of the equation.
B In the interval $[0, \pi]$ the equation has a unique solution.
C In the interval $[0, \pi]$ the equation has two solutions.
D In the interval $[0, 2\pi]$ the equation has four solutions.

21. On the set $(0, \infty)$ the binary operation „$\circ$" is defined by $x \circ y = x^{\ln y}$. Which of the following statements are true?

A The set $(0, \infty) \setminus \{1\}$ is closed with respect to the given binary operation.
B The binary operation „$\circ$" is commutative on $(0, \infty)$.
C The binary operation „$\circ$" determines a group structure on the set $(0, \infty)$.
D $e^0 \circ e^1 \circ \ldots \circ e^n = 1, \forall n \in \mathbb{N}^*$.

22. Two sides of a square lie on the lines with equations $2x - 3y + 1 = 0$ and $3x + 2y - 5 = 0$. On which of the following lines can a diagonal of the square lie?

A $x + 5y - 6 = 0$; B $5x - y - 4 = 0$; C $x - y = 0$; D $x - 2y + 2 = 0$.

23. Let $S = \left\{(x, y) \in \mathbb{N} \times \mathbb{N} \mid y^2 = x^2 + 91\right\}$. Which of the following statements are true?

A $xy \leq 20, \forall (x, y) \in S$. B x is an even number and y is an odd number, $\forall (x, y) \in S$.
C x is an odd number and y is an even number, $\forall (x, y) \in S$. D The set S has two elements.

24. The value of the integral $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\cos x}{1 + \mathrm{e}^x} \mathrm{d}x$ is

A e; B $\frac{\mathrm{e}\pi}{2}$; C 1; D π.

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Correct Answers

BBU Math-CS Contest 2026

Written test in MATHEMATICS

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