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Belur Math, Howrah - 711202

B. Sc ADMISSION TEST - 2023

MATHEMATICS

Date : 17/07/2023 **Full Marks : 50** Time : 11:00am - 12 noon

Instructions for the candidates

- Answer all questions.
- Each question has 4 options out of which only one is correct.
- Tick (✓) the correct option on OMR SHEET.
- The tick (✓) must be very clear − if it is smudgy or not clear, no marks will be awarded.
- Each correct answer carries **2 marks** and for each incorrect answer **1 mark** will be deducted.
- Unanswered questions will not be awarded.
- Multiple answers will be considered as wrong answer.
- Calculator is **not** allowed.

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1. $\int \frac{dx}{x(x^4+1)}$ is equal to (c is arbitrary constant)

   (a) $\frac{1}{4}\ln(\frac{x^4+1}{x^4})+c$ **(b)** $\frac{1}{4}\ln(\frac{x^4}{x^4+1})+c$ **(c)** $\frac{1}{4}\ln(x^4+1)+c$ **(d)** $\frac{1}{4}\ln(x^4)+c$.

2. The coefficient of the middle term in the binomial expansion of $(1+\alpha x)^4$ and $(1-\alpha x)^6$ is the same if α equals to

   (a) $\frac{-3}{10}$ **(b)** $\frac{10}{3}$ **(c)** $\frac{-5}{3}$ **(d)** $\frac{3}{5}$

3. If $\omega(\neq 1)$ is a complex cube root of unity and $(1+\omega^4)^n = (1+\omega^8)^n$, then the least positive integral value of n is

   (a) 2 **(b)** 3 **(c)** 6 **(d)** 12

4. Suppose $a_1, a_2, \ldots$ are in A. P. If $a_8 : a_5 = 3 : 2$ then $a_{17} : a_{23}$ is

   (a) 1:2 **(b)** 3:4 **(c)** 4:11 **(d)** 8:11

5. If the sum of the coefficients in the expansion of $(x+y)^n$ is 2048, then the greatest coefficient in the expansion is

   (a) ${}^{10}C_6$ **(b)** ${}^{11}C_6$ **(c)** ${}^{10}C_7$ **(d)** ${}^{12}C_6$

6. Which of the following is true for $f(x) = |\sin x + 1|$ in the interval $(-\pi, 0)$

   (a) f attains both its maxima and minima,

   (b) f does not attain its maxima,

   (c) f does not attain its minima,

   (d) f has neither maxima nor minima.

7. If $\tan(1+y) = x - 1$ for $x \in \mathbb{R}$, then $\frac{dy}{dx} =$

$$(a)\frac{1}{(x-1)^2-1}, \qquad (b)\frac{1}{(x+2)^2-2(3x+1)}, \qquad (c)\frac{1}{x^2+2x+2}, \qquad (d)-\frac{(x-1)^2}{1+(x-1)^2}$$

8. Let $f(x) \neq g(x)$ for all positive real number x. If f and g are differentiable everywhere and $f'(1) = g'(1)$ then which of the following statements are true for the curves $y = f(x)$ and $y = g(x)$.
   (a) Both the curves have same tangent at $x = 1$.
   (b) The tangents of the above curves intersect at $x = 1$.
   (c) The tangents of the above curves at $x = 1$ may be different but parallel to each other.
   (d) Either one or both the curves may not have any tangents at $x = 1$.

9. Three people each speak the truth three out of four times. There is a fair coin flip that they all see. They all say it's a Tail. What's the probability that it is actually a Tail?
   (a) $\frac{1}{28}$ **(b)** $\frac{3}{64}$ **(c)** $\frac{27}{64}$ **(d)** $\frac{27}{28}$

10. Three dice are rolled together. What is the probability of getting at least one '4'?
    (a) $\frac{1}{36}$ **(b)** $\frac{11}{36}$ **(c)** $\frac{125}{216}$ (d) $\frac{91}{216}$

11. How many numbers are there between 99 and 1000, having at least one of their digits '8'?
    (a) 642 **(b)** 201 **(c)** 991 **(d)** 252

12. $\binom{50}{0}.\binom{50}{1} + \binom{50}{1}.\binom{50}{2} + \ldots + \binom{50}{49}.\binom{50}{50} =$? (where $\binom{m}{n} = {}^mC_n$)
    (a) $\binom{50}{25}$ (b) $\binom{100}{50}$ **(c)** $\binom{50}{24}$ **(d)** $\binom{100}{49}$

13. The locus of the mid-points of the focal chords of the parabola $y^2 = 4px$ $(p > 0)$ is
    (a) $y^2 = 2p(x+p)$ **(b)** $y^2 = 4p(x+p)$ **(c)** $y^2 = 2p(x-p)$ **(d)** $y^2 = 4p(x-p)$

14. The distance of the point (7, 1) from the line $3x + y = 4$ measured parallel to the line $3x–5y + 2 = 0$ is
    (a) $\sqrt{17}$ **(b)** $2\sqrt{17}$ **(c)** $\sqrt{34}$ **(d)** $2\sqrt{34}$

15. Let a given line L_1 intersects the x and y axes at P and Q respectively. Let another line L_2 , perpendicular to L_1 , cuts the x and y axes at R and S respectively . Then the locus of the point of intersection of the lines PS and QR is
    (a) a circle **(b)** an ellipse **(c)** a parabola **(d)** a hyperbola

16. The length of the shortest distance between the lines $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$ and $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ is
    (a) $\sqrt{29}$ **(b)** $2\sqrt{29}$ **(c)** $\sqrt{58}$ **(d)** $2\sqrt{58}$

17. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero vectors, no two of which are collinear. If the vector $\vec{a}+2\vec{b}$ is collinear with $\vec{c}$, and $\vec{b}+3\vec{c}$ is collinear with $\vec{a}$, then $\vec{a}+2\vec{b}+6\vec{c}$ is equal to (λ being some non-zero scalar)

(a) $\lambda\vec{a}$ **(b)** $\lambda\vec{b}$ **(c)** $\lambda\vec{c}$ **(d)** $\vec{0}$

18. Suppose n is the number of elements in $P(X)$, power set of X. If $60 \leq n < 102$, then the number of elements in $X \times X$ is

(a) 24 **(b)** 36 **(c)** 64 **(d)** 96

19. Let $\mathbb{N} = \{1, 2, 3, ...\}$ and $A = \mathbb{N} - \{1, 2, 3\}$. Then

(a) there is no bijection from $\mathbb{N}$ to A.
(b) there is a bijection from $\mathbb{N}$ to A.
(c) there are exactly three bijections from $\mathbb{N}$ to A.
(d) any injective map from $\mathbb{N}$ to A is a bijection.

20. Let $A = \{1, 2, 3, 4\}$, $B = \{5, 6, 7, 8\}$. The number of surjective maps from A to B is

(a) 8 **(b)** 16 **(c)** 24 **(d)** 32

21. Suppose $X = \{1, 2, 3\}$, $\rho = \{(1, 1), (2, 2)\}$. Then

(a) ρ is reflexive.
(b) ρ is reflexive but not symmetric.
(c) ρ is symmetric but not reflexive.
(d) ρ is symmetric but not transitive.

22. Suppose $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = |x| + |x - 1|$, for each $x \in \mathbb{R}$. Then f is

(a) continuous.
(b) continuous everywhere except '0'.
(c) continuous everywhere except '0' and '1'.
(d) continuous only at '0' and '1'.

23. If tan A $= \frac{2}{3}$ and tan B $= \frac{3}{2}$, then A + B is

(a) $\frac{\pi}{3}$ **(b)** $\frac{\pi}{6}$ **(c)** $\frac{\pi}{4}$ **(d)** $\frac{\pi}{2}$

24. $\det(c \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix})$ is

(a) $2c$ **(b)** $2c^2$ **(c)** $-2c$ **(d)** $-2c^2$.

25. $\begin{bmatrix} 1 & 2 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}$ is

(a) symmetric **(b)** nilpotent **(c)** singular **(d)** invertible.

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