1. The limit

$$\lim_{x\to 0} \frac{\cos x - \sec x}{x^2(x+1)}$$

is equal to

(A) 0. (B) -1. (C) $\frac{1}{2}$. (D) 1.

2. The locus of a point having equal distances from

$$3x - 2y = 5 \text{ and } 3x + 2y = 5, \text{ is}$$

(A) one circle.
(B) only one straight line.
(C) two possible straight lines.
(D) none of the above.

3. The bounded area formed by $|x| + |y| = 2018$ is

(A) 4×2018^2. (B) 3×2018^2. (C) 2×2018^2. (D) 2018^2.

4. The point on the curve $4y + 2x^2 = 0$ nearest to $(0, -\frac{1}{2})$ is

(A) $(0,0)$. (B) $\left(\frac{1}{2}, -\frac{1}{8}\right)$. (C) $\left(1, -\frac{1}{2}\right)$. (D) none of these.

5. If $Z_n = \cos\frac{\pi}{2^n} + i\sin\frac{\pi}{2^n}$, then the product $Z_1 Z_2 Z_3 \cdots$ to ∞ is equal to

(A) -1. (B) 0. (C) 1. (D) e.

6. The values of x which satisfy the inequality

$$|x^2 - 9x + 14| > x^2 - 9x + 14$$

are

(A) $x > 2$. (B) $2 < x < 7$. (C) $x < 7$. (D) none of these.

7. The sum ${}^nC_0 + 2 \times {}^nC_1 + 3 \times {}^nC_2 + \cdots + (n+1) \times {}^nC_n$ is

(A) 2^n. (B) $2^{n+1} - 1$. (C) 2×2^n. (D) none of these.

8. If $3p^2 = 5p + 2$ and $3q^2 = 5q + 2$, for $p \neq q$, then the quadratic equation whose roots are p^2 and q^2 is

   (A) $9x^2 + 13x + 4 = 0$. (B) $9x^2 - 13x + 4 = 0$.

   (C) $9x^2 - 37x + 4 = 0$. (D) $9x^2 + 37x + 4 = 0$.

9. If z is a complex number such that

$$iz^3 + z^2 - z + i = 0, \quad \text{where } i = \sqrt{-1},$$

   then the value of $|z|$ is

   (A) $\frac{1}{2}$. (B) $\sqrt{2}$. (C) 2. (D) 1.

10. The function $f(x) = x^3 - 6x^2 + 24x, \quad x \in R$, attains

    (A) neither a maximum nor a minimum value.

    (B) both a maximum and a minimum value.

    (C) only a maximum value.

    (D) only a minimum value.

11. The area of the bounded region enclosed by the curve $y = 6 + x - x^2$ and the line $y = 4$ is

    (A) $\frac{31}{6}$. (B) $\frac{3}{2}$. (C) $\frac{9}{2}$. (D) $\frac{33}{2}$.

12. The value of the integral

$$\int_0^2 \sqrt{y^2 + 1 - 2y}\, dy$$

    is

    (A) 0. (B) $\frac{1}{2}$. (C) 1. (D) -1.

13. The sum of the sequence $\frac{1}{2}, \frac{3}{4}, \frac{7}{8}, \frac{15}{16}, \cdots$ up to the n^{th} term is

    (A) $n + 1 + 2^{-n}$. (B) $n - 1 + 2^{-n}$.

    (C) $n + 1 - 2^{-n}$. (D) $n - 1 - 2^{-n}$.

14. The area (in square unit) of the region in the first quadrant bounded by the curves $y^2 = x$ and $y = |x|$ is

    (A) $\frac{1}{6}$. (B) $\frac{1}{3}$. (C) $\frac{2}{3}$. (D) 1.

15. Let $1, 4, 7, ...$ and $9, 14, 19, ...$ be two arithmetic progressions. Then the number of distinct integers in the collection of first 500 terms from each of the progressions is

(A) 903. (B) 902. (C) 901. (D) 900.

16. Let $f : \mathbb{Z} \to \mathbb{Z}$ be the function defined by

$$f(n) = \begin{cases} \frac{n}{2}, & \text{if } n \text{ is even} \\ \frac{n-1}{2}, & \text{if } n \text{ is odd.} \end{cases}$$

Then

(A) f is bijective.
(B) f is surjective, but not injective.
(C) f is injective, but not surjective.
(D) none of the above.

17. Let $S = \{(x, y) : x, y \in N\}$. Consider all points $P \in S$ having the property that sum of distances from the point P to the points $(8, 0)$ and $(0, 12)$ is the minimum among the sums of distances from all other elements of S. The number of such points P in the set S is

(A) 8. (B) 5. (C) 3. (D) 1.

18. The value of $1 - \cos 20°$ is approximately equal to

(A) $\frac{\pi^2}{2 \times 9^2}$.
(B) $\frac{\pi^3}{6 \times 9^3}$.
(C) $\frac{20^2}{2!} - \frac{20^4}{4!}$.
(D) $\frac{\pi}{9} - \frac{\pi^3}{6 \times 9^3}$.

19. Let

$$f(x) = \begin{cases} x \sin \frac{\pi}{x}, & \text{if } x > 0 \\ 0, & \text{if } x = 0. \end{cases}$$

Then $f'(x)$ vanishes

(A) at no point in $(0, 1)$.
(B) exactly at one point in $(0, 1)$.
(C) at finitely many points in $(0, 1)$.
(D) at infinitely many points in $(0, 1)$.

20. The system of equations

$$\begin{array}{rcrcrcr} 2x & + & 4ky & - & z & = & 1 \\ x & - & 8y & - & 3z & = & -2 \\ 2x & & & - & z & = & 1 \end{array}$$

has a unique solution for all values of k lying in

(A) $(-1, 1)$. (B) $(-1, 0]$. (C) $(1, \infty)$. (D) $[0, 1)$.

21. The value of the determinant

$$\begin{vmatrix} a-3b & a+b & a+5b & e \\ a-2b & a+2b & a+6b & f \\ a-b & a+3b & a+7b & g \\ a & a+4b & a+8b & h \end{vmatrix}$$

is

(A) abc. (B) $efgh$. (C) 1. (D) 0.

22. Let A and B be two non-empty sets and $f : A \longrightarrow B$ be a function. Further, let U and V be two non-empty subsets of B. Then, which of the following statements is true?

(A) $f^{-1}(U \cap V) = f^{-1}(U) \cap f^{-1}(V)$.
(B) $f^{-1}(U \cup V)$ is a proper subset of $f^{-1}(U) \cup f^{-1}(V)$.
(C) $f^{-1}(U \cap V)$ is a proper subset of $f^{-1}(U) \cap f^{-1}(V)$.
(D) None of the above.

23. The greatest value of the term independent of x in the expansion of $(x \sin\theta + \frac{\cos\theta}{x})^{12}$ is

(A) ${}^{12}C_6$. (B) $\frac{{}^{12}C_6}{2}$. (C) $\frac{{}^{12}C_6}{32}$. (D) $\frac{{}^{12}C_6}{64}$.

24. Let h and r be the height and radius, respectively, of a closed cylinder of fixed volume. Then its surface area will be minimum if $h : r$ is equal to

(A) $1 : 1$. (B) $2 : 1$. (C) $3 : 1$. (D) $8 : 1$.

25. Consider a chess board of 8×8 squares. Then the number of ways 8 pawns can be arranged so that no two pawns are in the same line (row as well as column) is

(A) 1. (B) 8. (C) $8 \times 8!$. (D) none of these.

26. Let X and Y be two symmetric matrices of the same order. Then, the matrix XY is also symmetric

(A) if the inverses of both X and Y exist.
(B) if and only if X and Y are similar to each other.
(C) if X and Y are orthogonal.
(D) if and only if X and Y commute.

27. There are 25 books of which there are two pairs of books. They are placed at random on a shelf satisfying the following conditions: books from each pair remain together, but no two books from different pairs are together. The number of such arrangements is

(A) $21! \times 24$. (B) $22! \times 44$.

(C) $22! \times 88$. (D) $23! \times 84$.

28. Let x, y, z be three distinct positive real numbers such that $x+y+z=1$. Which one of the following statements necessarily hold?

(A) $xyz > \frac{1}{27}$.
(B) $xy + yz + zx > \frac{1}{3}$.
(C) $(1-x)(1-y)(1-z) > \frac{8}{27}$.
(D) None of the above.

29. Let A be an $m \times n$ $(m \leq n)$ matrix and B be an $n \times n$ matrix with non-zero determinant. Which one of the following statements necessarily hold?

(A) rank of $AB =$ rank of A.
(B) rank of $AB <$ rank of A.
(C) rank of $AB < m$.
(D) None of the above.

30. In a competition, a school awarded medals to students in different categories: 36 medals in dance, 12 medals in drama, and 18 medals in music. If these medals went to a total of 45 students and only 4 students got medals in all three categories, the number of students who received medals in exactly two categories is

(A) 25. (B) 13. (C) 12. (D) 10.