1 Consider $y = \frac{2x}{1+x^2}$, then the range of expression, $y^2 + y - 2$ is:

(A) $[-1, 1]$ (B) $[0, 1]$ (C) $[-9/4, 0]$ (D) $[-9/4, 1]$

2 Expressed in the form $r(\cos\theta + i\sin\theta)$, $-2 + 2i$ becomes :

(A) $2\sqrt{2}\left[\cos\left(-\frac{\pi}{4}\right) + i\sin\left(-\frac{\pi}{4}\right)\right]$ (B) $2\sqrt{2}\left[\cos\left(\frac{3\pi}{4}\right) + i\sin\left(\frac{3\pi}{4}\right)\right]$

(C) $2\sqrt{2}\left[\cos\left(-\frac{3\pi}{4}\right) + i\sin\left(-\frac{3\pi}{4}\right)\right]$ (D) $\sqrt{2}\left[\cos\left(-\frac{\pi}{4}\right) + i\sin\left(-\frac{\pi}{4}\right)\right]$

3 $\{a_1, a_2, \ldots, a_4, \ldots\}$ is a progression where $a_n = \frac{n^2}{n^3+200}$. The largest term of this progression is:

(A) a_6 (B) a_7 (C) a_8 (D) none

4 The value of λ for which the system of equations $2x - y - z = 12$, $x - 2y + z = -4$, $x + y + \lambda z = 4$ has no solution is

(A) 3 (B) –3 (C) 2 (D) –2

5 The sum to 10 terms of the series $\sqrt{2} + \sqrt{6} + \sqrt{18} + \sqrt{54} + \ldots$ is

(A) $121(\sqrt{6} + \sqrt{2})$ (B) $\frac{121}{2}(\sqrt{3} + 1)$ (C) $243(\sqrt{3} + 1)$ (D) $243(\sqrt{3} - 1)$

Space for rough work

6 If one root of the equation $x^2 + px + q = 0$ is the square of the other, then

(A) $p^3 + q^2 - q(3p + 1) = 0$ (B) $p^3 + q^2 + q(1 + 3p) = 0$

(C) $p^3 + q^2 + q(3p - 1) = 0$ (D) $p^3 + q^2 + q(1 - 3p) = 0$

7 If $x^2 + 2ax + 10 - 3a > 0$ for all $x \in R$, then

(A) $-5 < a < 2$ (B) $a < -5$ (C) $a > 5$ (D) $2 < a < 5$

8 If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x + iy$, then :

(A) $x = 3, y = 1$ (B) $x = 1, y = 3$ (C) $x = 0, y = 3$ (D) $x = 0, y = 0$

9 The sum of the series $\frac{1}{\log_2 4} + \frac{1}{\log_4 4} + \frac{1}{\log_8 4} + \ldots\ldots + \frac{1}{\log_{2^n} 4}$ is

(A) $\frac{1}{2} n(n+1)$ (B) $\frac{1}{12} n(n+1)(2n+1)$ (C) $\frac{1}{n(n+1)}$ (D) $\frac{1}{4} n(n+1)$

10 If hyperbola $\frac{x^2}{b^2} - \frac{y^2}{a^2} = 1$ passes through the focus of ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ then eccentricity of hyperbola is

(A) $\sqrt{2}$ (B) $\frac{2}{\sqrt{3}}$ (C) $\sqrt{3}$ (D) None of these

Space for rough work

11 If $(\sqrt{3}+i)^{100} = 2^{99}(a+ib)$, then b is equal to

(A) $\sqrt{3}$ (B) $\sqrt{2}$ (C) 1 (D) none of these

12 If $\omega(\neq 1)$ is a cube root of unity, then $\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2-1 \\ -i & -i+\omega-1 & -1 \end{vmatrix}$ equals :

(A) 0 (B) 1 (C) i (D) ω [IIT '95 ,

13 If P(1, 2), Q(4, 6), R(5, 7) & S(a, b) are the vertices of a parallelogram PQRS, then :

(A) a = 2, b = 4 (B) a = 3, b = 4 (C) a = 2, b = 3 (D) a = 3, b = 5

14 The diagonals of a parallelogram PQRS are along the lines $x + 3y = 4$ and $6x - 2y = 7$. Then PQRS must be a :

(A) rectangle (B) square (C) cyclic quadrilateral (D) rhombus

15 The length of a longest interval in which the function $3\sin x - 4\sin^3 x$ is increasing, is

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{2}$ (C) $\frac{3\pi}{2}$ (D) π

Space for rough work

16 The equation of a hyperbola with co-ordinate axes as principal axes, if the distances of one of its vertices from the foci are 3 & 1 can be :

(A) $3x^2 - y^2 = 3$ (B) $x^2 + 3y^2 + 3 = 0$ (C) $x^2 - 3y^2 - 3 = 0$ (D) none

17 If $x^2y + y^3 = 2$ then the value of $\frac{d^2y}{dx^2}$ at the point (1, 1) is :

(A) $-\frac{3}{4}$ (B) $-\frac{3}{8}$ (C) $-\frac{5}{12}$ (D) none

18 Let $f(\theta) = \begin{vmatrix} \cos^2\theta & \cos\theta\sin\theta & -\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta & \cos\theta \\ \sin\theta & -\cos\theta & 0 \end{vmatrix}$ then $f\left(\frac{\pi}{6}\right) =$

(A) 0 (B) 1 (C) 2 (D) none

19 The interval in which $f(x) = x^3 - 3x^2 - 9x + 20$ is strictly decreasing

(A) $(-1, 3)$ (B) $(3, \infty)$ (C) $(-\infty, -1)$ (D) $(5, 9)$

20 The equation of the tangent to the curve $y = x + \frac{4}{x^2}$, that is parallel to the x-axis is

(A) $y = 1$ (B) $y = 2$ (C) $y = 3$ (D) $y = 0$

Space for rough work

21 The angle between the curves $y = x^3$ and $y = e^{3(x-1)}$ at (1, 1) is

(A) 0 (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{2}$

22 The number of ways of arranging the letters of the word DEVIL so that neither D is the first letter nor L is the last letter is

(A) 36 (B) 114 (C) 42 (D) 78

23 The function $f(x) = \frac{x}{2} + \frac{2}{x}$ has a local minimum at

(A) $x = -2$ (B) $x = 0$ (C) $x = 1$ (D) $x = 2$

24 Angle between the tangents to the curve $y = x^2 - 5x + 6$ at the points (2, 0) and (3, 0) is

(A) $\pi/2$ (B) $\pi/6$ (C) $\pi/4$ (D) $\pi/3$

25 A function is matched below against an interval where it is supposed to be increasing, Which of the following pairs is incorrectly matched?

Interval	Function
(A) $(-\infty, -4]$	$x^3 + 6x^2 + 6$
(B) $\left(-\infty, \frac{1}{3}\right)$	$3x^2 - 2x + 1$
(C) $(2, \infty)$	$2x^3 - 3x^2 - 12x + 6$
(D) $(-\infty, \infty)$	$x^3 - 3x^2 + 3x + 3$

Space for rough work

26 The line 5x + 12y = 9 touches the hyperbola $x^2 - 9y^2 = 9$ at the point

(A) (– 5, 4/3) (B) (5, – 4/3) (C) (3, – 1/2) (D) none of these

27 If the foci of the ellipse $\frac{x^2}{25}+\frac{y^2}{b^2}=1$ & the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ coincide then the value of b^2 is :

(A) 4 (B) 9 (C) 16 (D) none

28 A particle moves along a line by $S = t^3 - 9t^2 + 24t$ the time when its velocity decreases.

(A) $t > 3$ (B) $t = 5$ (C) $t < 3$ (D) $t > 5$

29 Total number of four digit odd numbers that can be formed using 0, 1, 2, 3, 4, 5, 7 are

(A) 216 (B) 375 (C) 1176 (D) 720

30 A box contains 5 different red and 6 different white balls. In how many ways can 6 balls be selected so that there are at least two balls of each colour

(A) 425 (B) 426 (C) 452 (D) 526

Space for rough work

31 $\dfrac{\cos 20° + 8\sin 70° \sin 50° \sin 10°}{\sin^2 80°}$ is equal to:

(A) 1 (B) 2 (C) 3/4 (D) none

32 If cos A = 3/4, then the value of $16\cos^2(A/2) - 32\sin(A/2)\sin(5A/2)$ is

(A) – 4 (B) – 3 (C) 3 (D) 4

33 If $y = \cos^2(45° + x) + (\sin x - \cos x)^2$ then the maximum & minimum values of y are:

(A) 2 & 0 (B) 3 & 0 (C) 3 & 1 (D) none

34 If the curves $ay + x^2 = 7$ and $x^3 = y$ cut orthogonally at (1, 1) then a =

(A) 1 (B) -6 (C) 6 (D) 1/6

35 A polygon has 35 diagonals. The number of its sides are

(A) 8 (B) 9 (C) 10 (D) 11

Space for rough work

36 When the origin is shifted to a point P, the point (2, 0) is transformed to (0, 4) then the coordinates of P are

(A) $(2,-4)$ (B) $(-2,4)$ (C) $(-2,-4)$ (D) $(2,4)$

37 If α and β are the roots of $x^2-2x+4=0$ then the value of $\alpha^6+\beta^6$ is

(1) 32 (2) 64 (3) 128 (4) 256

38 If $\begin{vmatrix} x & x+y & x+y+z \\ 2x & 3x+2y & 4x+3y+2z \\ 3x & 6x+3y & 10x+6y+3z \end{vmatrix}=64$, then the real value of x is

(A) 2 (B) 3 (C) 4 (d) 6

39 A ray of light passing through the point (8,3) and is reflected at (14,0) on x axis. Then the equation of the reflected ray

(A) x+y=14 (B) x-y=14 (C) 2y=x-14 (D) 3y=x-14

40 If repetitions are not allowed, the number of numbers consisting of 4 digits and divisible by 5 and formed out of 0, 1, 2, 3, 4, 5, 6 is

(A) 220 (B) 240 (C) 370 (D) 588

Space for rough work

Directions to Questions 41 to 45:

Derivatives can be used (i) to determine rate of change of quantities, (ii) to find the equations of tangent and normal to a curve at a point, (iii) to find turning points on the graph of a function which in turn will help us to locate points at which largest or smallest value (locally) of a function occurs. Derivatives can also be used to find intervals on which a function is increasing or decreasing and to find approximate value of certain quantities.

41 The approximate value of $\sqrt{1.02}$ is

(A) 1.01 (B) 1.001 (C) 1.0001 (D) 1.1001

42 The approximate value of $\sqrt[5]{33}$ is

(A) 2.0125 (B) 2.1 (C) 2.01 (D) 3.258

43 If the percentage error in the surface area of sphere is k, then the percentage error in its volume is

(A) $\frac{3k}{2}$ (B) $\frac{2k}{3}$ (C) $\frac{k}{3}$ (D) $\frac{4k}{3}$

44 If an error of $\left(\frac{1}{10}\right)\%$ is made in measuring the radius of a sphere then percentage error in its volume is

(A) 0.3 (B) 0.03 (C) 0.003 (D) 0.0003

45 The height of a cylinder is equal to its radius. If an error of 1 % is made in its height. Then the percentage error in its volume is

(A) 1 (B) 2 (C) 3 (D) 4

Space for rough work

Learn At Quest

46 The number of words that can be formed from the letters of the word "INTERMEDIATE" in which no two vowels are together is

(A) $6!\ {}^{7}P_{6}$ (B) $\frac{6!}{2!}\frac{{}^{7}P_{6}}{2!3!}$ (C) $\frac{6!\ {}^{7}P_{6}}{2!3!}$ (D) $\frac{(7!)\ {}^{7}P_{6}}{2!3!}$

47 The number of more words can be found by rearranging the letters of the word 'CHEESE' are

(A) 119 (B) 120 (C) 720 (D) 6

48 If the product of the roots of the equation $x^2 - 5kx + 2e^{4\ln k} - 1 = 0$ is 31, then sum of the root is

(A) –10 (B) 5 (C) –8 (D) 10

49 The solutions of the equation $4\cos^2 x + 6\sin^2 x = 5$ are

(A) $x = n\pi \pm \frac{\pi}{4}$ (B) $x = n\pi \pm \frac{\pi}{3}$ (C) $x = n\pi \pm \frac{\pi}{2}$ (D) $x = n\pi \pm \frac{2\pi}{3}$

50 ${}^{23}C_0 + {}^{23}C_2 + {}^{23}C_4 + .. + {}^{23}C_{22}$ equals

(A) $2^{23} - 2$ (B) 2^{22} (C) 2^{11} (D) $\frac{2^{10} - 4^{10}}{2}$

Space for rough work

51 A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa, is

(A) (2, 4) (B) (2, -4) (C) $\left(-\frac{9}{8}, \frac{9}{2}\right)$ (D) $\left(\frac{9}{8}, \frac{9}{2}\right)$

52 The term independent of x in $\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$ is

(A) 5 (B) 6 (C) 7 (D) 8

53 The value of the greatest term in the expansion of $\sqrt{3}\left(1+\frac{1}{\sqrt{3}}\right)^{20}$ is

(A) 2871.11 (B) 2871 (C) 2872 (D) 2873

54 Let $\Delta = \begin{vmatrix} 1 & \sin\theta & 1 \\ -\sin\theta & 1 & \sin\theta \\ -1 & -\sin\theta & 1 \end{vmatrix}, 0 \le \theta \le 2\pi$. The

(A) $\Delta = 0$ (B) $\Delta \in (2, \infty)$ (C) $\Delta \in (2, 4)$ (D) $\Delta \in [2, 4]$

55 A particle is moving along a line such that $s = 3t^3 - 8t + 1$. Find the time ‘t’ when the distance ‘S’ travelled by the particle increases.

(A) $t > \frac{2\sqrt{2}}{3}$ (B) $t < \frac{2\sqrt{2}}{3}$ (C) $t < \frac{-2\sqrt{3}}{\sqrt{2}}$ (D) $t = 0$

Space for rough work

56 If $(1 + ax)^n = 1 + 8x + 24x^2 + \ldots$.., then the values of a and n are equal to

(A) 2, 4 (B) 2, 3 (C) 3, 6 (D) 1, 2

57 The product of middle terms in the expansion of $\left(x+\frac{1}{x}\right)^{11}$ is equal to

(A) ${}^{11}C_6 {}^{11}C_6$ (B) ${}^{11}C_5 {}^{11}C_6\left(\frac{1}{x}\right)$ (C) ${}^{11}C_5 {}^{11}C_6(x)$ (D) $\left({}^{11}C_6\right)^2 x^2$

58 If $\Delta = \begin{vmatrix} 1+y & 1-y & 1-y \\ 1-y & 1+y & 1-y \\ 1-y & 1-y & 1+y \end{vmatrix} = 0$, then value of y are

(A) 0, 3 (B) 2, -1 (C) -1, 3 (D) 0, 2

59 The real number x ($x > 0$) when added to its reciprocal gives the minimum sum at x equals

(A) 2 `(B) 1 (C) -1 (D) -2

60 The normal to the curve $x^2 + 2xy - 3y^2 = 0$ at $(1,1)$

(A) does not meet the curve again

(B) meet the curve again in second quadrant

(C) meet the curve again in the third quadrant

(D) meet the curve again in forth quadrant

Space for rough work