1. If the expression

$$\frac{\left[\sin\left(\frac{x}{2}\right)+\cos\left(\frac{x}{2}\right)-i\tan(x)\right]}{\left[1+2i\sin\left(\frac{x}{2}\right)\right]}$$ is real

the set of all possible value of x is

(a) $n\pi+\alpha$

(b) $2n\pi$

(c) $\frac{n\pi}{2}+\alpha$

(d) None of these

2. If t_1, t_2 and t_3 are distinct, points $(t_1, 2at_1+at_1^3)$, $(t_2, 2at_2+at_2^3)$ and $(t_3, 2at_3+at_3^3)$ are collinear, if

(a) $t_1t_2t_3=1$

(b) $t_1+t_2+t_3=t_1t_2t_3$

(c) $t_1+t_2+t_3=0$

(d) $t_1+t_2+t_3=-1$

3. If the pair of straight lines $ax^2 + 2hxy - ay^2 = 0$ and $bx^2 + 2gxy - by^2 = 0$ be such that each bisect the angle between the other, then

(a) $hg + ab = 0$ (b) $ah + bg = 0$
(c) $h^2 - ab = 0$ (d) $ag + bh = 0$

4. The locus of a points which moves such that the sum of the squares of its distance from three vertices of the triangle is constant is a/an

(a) circle (b) straight line
(c) ellipse (d) None of these

5. AB is a chord of the parabola $y^2 = 4ax$ with vertex at A. BC is drawn perpendicular to AB meeting the axis at C. The projection of BC on the axis of the parabola is

(a) 2 (b) $2a$
(c) $4a$ (d) $8a$

6. If $\tan\theta_1, \tan\theta_2 = -\frac{a^2}{b^2}$, then the chord joining two points θ_1 and θ_2 on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ will subtend a right angle at

(a) focus
(b) centre
(c) end of the major axis
(d) end of the minor axis

7. The largest interval for which $x^{12} - x^9 + x^4 - x + 1 > 0$ is

(a) $-4 < x < 0$ (b) $0 < x < 1$
(c) $-100 < x < 100$ (d) $-\infty < x < \infty$

8. The eccentricity of the conic represented by $x^2 - y^2 - 4x + 4y + 16 = 0$ is

(a) 1 (b) $\sqrt{2}$
(c) 2 (d) 1/2

9. Let f be a twice differentiable function such that $f''(x) = -f(x)$ and $f'(x) = g(x)$. If $h'(x) = [f(x)^2 + g(x)^2]$ $h(1) = 8$ and $h(0) = 2$, then $h(2)$ is equal to

(a) 1 (b) 2
(c) 3 (d) None of these

10. The equation of those tangents to $4x^2 - 9y^2 = 36$ which are perpendicular to the straight line $5x + 2y - 10 = 0$ are

(a) $5(y-3) = 2\left(x - \frac{\sqrt{117}}{2}\right)$
(b) $2x - 5y + 10 - 2\sqrt{18} = 0$
(c) $2x - 5y - 10 - 2\sqrt{18} = 0$
(d) None of the above

11. If $f(x) = a\log|x| + bx^2 + x$ has its extremum value at $x = -1$ and $x = 2$, then

(a) $a = 2, b = -1$ (b) $a = 2, b = \frac{-1}{2}$
(c) $a = -2, b = \frac{1}{2}$ (d) None of these

12. If $\int \frac{1}{(\sin x + 4)(\sin x - 1)}\,dx$

$= A\frac{1}{\tan\frac{x}{2} - 1} + B\tan^{-1}(f(x)) + C_1$.

Then

(a) $A = \frac{1}{5}, B = \frac{-2}{5\sqrt{15}}, f(x) = \frac{4\tan x + 3}{\sqrt{15}}$
(b) $A = -\frac{1}{5}, B = \frac{1}{\sqrt{15}}, f(x) = \frac{4\tan\left(\frac{x}{2}\right) + 1}{\sqrt{15}}$
(c) $A = \frac{2}{5}, B = \frac{-2}{5}, f(x) = \frac{4\tan x + 1}{5}$
(d) $A = \frac{2}{5}, B = \frac{-2}{5\sqrt{15}}, f(x) = \frac{4\tan\frac{x}{2} + 1}{\sqrt{15}}$

13. If $a_1, a_2, \ldots, a_n$ are in arithmetic progression, where $a_i > 0$ for all i. Then

$\frac{1}{\sqrt{a_1} + \sqrt{a_2}} + \frac{1}{\sqrt{a_2} + \sqrt{a_3}} + \ldots + \frac{1}{\sqrt{a_{n-1}} + \sqrt{a_n}}$

is equal to

(a) $\frac{n^2(n+1)}{2}$ (b) $\frac{n-1}{\sqrt{a_1} + \sqrt{a_n}}$
(c) $\frac{n(n-1)}{2}$ (d) None of these

14. Let f be a positive function. Let

$I_1 = \int_{1-k}^{k} x\, f\{x(1-x)\}dx$,

$I_2 = \int_{1-k}^{k} f\{x(1-x)\}\,dx$

where $2k - 1 > 0$. Then, $\frac{I_1}{I_2}$ is

(a) 2 (b) k
(c) $\frac{1}{2}$ (d) 1

15. The area bounded by the curve $y = x|x|$, x-axis and the ordinates $x = 1$, $x = -1$ is given by

(a) 0 (b) $\frac{1}{3}$
(c) $\frac{2}{3}$ (d) None of these

16. The degree of the differential equation satisfying $\sqrt{1-x^2} + \sqrt{1-y^2} = a(x - y)$ is

(a) 1 (b) 2
(c) 3 (d) None of these

17. 7 relatives of a man comprises 4 ladies and 3 gentlemen his wife has also 7 relatives, 3 of them are ladies and 4 gentlemen. In how many ways can they invite a dinner party of 3 ladies and 3 gentlemen so that there are 3 of man's relative and 3 of the wife's relative ?

(a) 485 (b) 500
(c) 486 (d) 102

18. If $\vec{\alpha} = x(\vec{\mathbf{a}} \times \vec{\mathbf{b}}) + y(\vec{\mathbf{b}} \times \vec{\mathbf{c}}) + z(\vec{\mathbf{c}} \times \vec{\mathbf{a}})$ and $[\vec{\mathbf{a}}\,\vec{\mathbf{b}}\,\vec{\mathbf{c}}] = \frac{1}{8}$, then $x + y + z$ is equal to

(a) $8\vec{\alpha} \cdot (\vec{\mathbf{a}} + \vec{\mathbf{b}} + \vec{\mathbf{c}})$ (b) $\vec{\alpha} \cdot (\vec{\mathbf{a}} + \vec{\mathbf{b}} + \vec{\mathbf{c}})$
(c) $8(\vec{\mathbf{a}} + \vec{\mathbf{b}} + \vec{\mathbf{c}})$ (d) None of these

19. The xy-plane divides the line joining the points $(-1, 3, 4)$ and $(2, -5, 6)$

(a) internally in the ratio 2 : 3
(b) externally in the ratio 2 : 3
(c) internally in the ratio 3 : 2
(d) externally in the ratio 3 : 2

20. The plane $2x - (1 + \lambda)y + 3\lambda z = 0$ passes through the intersection of the plane

(a) $2x - y = 0$ and $y + 3z = 0$
(b) $2x - y = 0$ and $y - 3z = 0$
(c) $2x + 3z = 0$ and $y = 0$
(d) None of the above

21. In a triangle ABC, $\sin A - \cos B = \cos C$, then angle B is

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

22. Eight chair are numbered 1 to 8. Two women and three men wish to occupy one chair each. First the women choose the chairs from amongst the chair marked 1 to 4; and then the men select the chairs from amongst the remaining. The number of possible arrangements is

(a) ${}^6C_3 \times {}^4C_2$ (b) ${}^4P_2 \times {}^6P_3$
(c) ${}^4C_2 + {}^4P_3$ (d) None of these

23. In a ΔABC, $\tan\frac{A}{2} = \frac{5}{6}$, $\tan\frac{C}{2} = \frac{2}{5}$, then

(a) a, c, b are in AP (b) a, b, c are in AP
(c) b, a, c are in AP (d) a, b, c are in GP

24. $\Sigma a^3 \cos(B - C)$ is equal to

(a) $3abc$ (b) $3(a + b + c)$
(c) $abc(a + b + c)$ (d) 0

25. If $\alpha, \beta, \gamma \in \left[0, \frac{\pi}{2}\right]$, then the value of $\frac{\sin(\alpha + \beta + \gamma)}{\sin\alpha + \sin\beta + \sin\gamma}$ is

(a) < 1 (b) $= -1$
(c) < 0 (d) None of these

26. If $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$

then $f(100)$ is equal to

(a) 0 (b) 1
(c) 100 (d) -100

27. The general value of θ satisfying the equation $2\sin^2\theta - 3\sin\theta - 2 = 0$ is

(a) $n\pi + (-1)^{n+1}\frac{\pi}{6}$ (b) $n\pi + (-1)^n\frac{\pi}{2}$
(c) $n\pi + (-1)^n\frac{5\pi}{6}$ (d) $n\pi + (-1)^n\frac{7\pi}{6}$

28. In a right angled triangle the hypotenuse is $2\sqrt{2}$ times the length of perpendicular drawn from the opposite vertex on the hypotenuse, then the other two angles are

(a) $\frac{\pi}{3}, \frac{\pi}{6}$ (b) $\frac{\pi}{4}, \frac{\pi}{4}$
(c) $\frac{\pi}{8}, \frac{3\pi}{8}$ (d) $\frac{\pi}{12}, \frac{5\pi}{12}$

29. If $x + y + z = xyz$, then $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z$ is equal to

(a) π (b) $\frac{\pi}{2}$
(c) 1 (d) None of these

30. If two events A and B are such $P(A^c) = 0.3$, $P(B) = 0.4$ and $P(A \cap B^c) = 0.5$, then $P[B / (A \cup B)^c]$ is equal to

(a) 1/2 (b) 1/4
(c) 0 (d) None of these

31. If x_1, x_2, x_3, x_4 are roots of the equation $x^4 - x^3\sin 2\beta + x^2\cos 2\beta - x\cos\beta - \sin\beta = 0$, then $\tan^{-1}x_1 + \tan^{-1}x_2 + \tan^{-1}x_3 + \tan^{-1}x_4$ is equal to

(a) β (b) $\frac{\pi}{2} - \beta$
(c) $\pi - \beta$ (d) $-\beta$

32. The value of $\cos(2\cos^{-1} 0.8)$ is

(a) 0.48 (b) 0.96

(c) 0.6 (d) None of these

33. ABC is a triangular park with $AB = AC = 100$ m. A clock tower is situated at the mid point of BC. The angle of elevation if the top of the tower at A and B are $\cot^{-1} 3.2$ and $\operatorname{cosec}^{-1} 2.6$ respectively. The height of the tower is

(a) 16 m (b) 25 m

(c) 50 m (d) None of these

34. The equation $\frac{3}{4}(\log_2 x)^2 + \log_2 x - \frac{5}{4} = \log_x \sqrt{2}$ has

(a) at least one real solutions

(b) exactly three real solutions

(c) exactly one irrational solution

(d) complex roots

35. If G is the GM of the product of r set of observation with geometric means $G_1, G_2, \ldots, G_r$ respectively, then G is equal to

(a) $\log G_1 + \log G_2 + \ldots + \log G_n$

(b) $G_1 \, G_2 \ldots . G_n$

(c) $\log G_1, \log G_2, \ldots, \log G_n$

(d) None of the above

36. If $Z = aX + bY$ and r the correlation coefficient between X and Y, then σ_z^2 is equal to

(a) $a^2 \sigma_X^2 + b^2 \sigma_Y^2 + 2abr \, \sigma_X \, \sigma_Y$

(b) $a^2 \sigma_X^2 + b^2 \sigma_Y^2 - 2abr \, \sigma_X \, \sigma_Y$

(c) $2abr \, \sigma_X \, \sigma_Y$

(d) None of the above

37. If $\log_2(5 \cdot 2^x + 1)$, $\log_4(2^{1-x} + 1)$ and 1 are in AP, then x equals

(a) $\log_2 5$ (b) $1 - \log_2 5$

(c) $\log_5 2$ (d) None of these

38. If $A = \begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix}$, then value of α for which $A^2 = B$ is

(a) 1 (b) -1

(c) 4 (d) no real value

39. The maximum value of $|z|$ when z satisfies the condition $\left| 2 + \frac{2}{z} \right| = 2$ is

(a) $\sqrt{3} - 1$ (b) $\sqrt{3}$

(c) $\sqrt{3} + 1$ (d) $\sqrt{2} + \sqrt{3}$

40. The value

$$1 + \sum_{k=0}^{14} \left\{ \cos \frac{(2k+1)\pi}{15} + i \sin \frac{(2k+1)\pi}{15} \right\} \text{is}$$

(a) 0 (b) -1

(c) 1 (d) i

41. The sum to n terms of the infinite series $1 \cdot 3^2 + 2 \cdot 5^2 + 3 \cdot 7^2 + \ldots \infty$ is

(a) $\frac{n}{6}(n+1)(6n^2 + 14n + 7)$

(b) $\frac{n}{6}(n+1)(2n+1)(3n+1)$

(c) $4n^3 + 4n^2 + n$

(d) None of the above

42. If $f(x) = \sin^2 x + \sin^2 \left(x + \frac{\pi}{3} \right) + \cos x \cos \left(x + \frac{\pi}{3} \right)$ and $g\left(\frac{5}{4}\right) = 1$, then $(g \circ f)(x)$ is equal to

(a) 0 (b) 2

(c) 1 (d) 3

43. If the roots of the quadratic equation $x^2 - 4x - \log_3 a = 0$ are real, then the least value of a is

(a) 81 (b) 1/81

(c) 1/64 (d) None of these

44. The exponent of 12 in 100! is

(a) 48 (b) 49

(c) 96 (d) None of these

45. The value of $1 \cdot 1! + 2 \cdot 2! + 3 \cdot 3! + \ldots + n \cdot n!$ is

(a) $(n+1)!$ (b) $(n+1)! + 1$

(c) $(n+1)! - 1$ (d) None of these

46. $\lim_{n \to \infty} \frac{1}{n} \sum_{r=1}^{2n} \frac{r}{\sqrt{n^2 + r^2}}$ equals

(a) $1 + \sqrt{5}$ (b) $-1 + \sqrt{5}$

(c) $-1 + \sqrt{2}$ (d) $1 + \sqrt{2}$

47. If $(1 + 2x + 3x^2)^{10} = a_0 + a_1 x + a_2 x^2 + \ldots + a_{20} x^{20}$, then a_1 equals

(a) 10 (b) 20

(c) 210 (d) None of these

48. The sum of series $\sum_{n=1}^{\infty} \frac{2n}{(2n+1)!}$ is

(a) e (b) e^{-1}

(c) $2e$ (d) None of these

49. If the value of the determinants $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix}$ is positive, then

(a) $abc > 1$ (b) $abc > -8$
(c) $abc < -8$ (d) $abc > -2$

50. The function $f(x) = \frac{\ln(1+ax) - \ln(1-bx)}{x}$ is not defined at $x = 0$. The value which should be assigned to f at $x = 0$ so that it is continuous at $x = 0$, is

(a) $a - b$ (b) $a + b$
(c) $\ln a + \ln b$ (d) None of these

51. If $f(x + 2y, x, x - 2y) = xy$, then $f(x, y)$ equals

(a) $\frac{x^2 - y^2}{8}$ (b) $\frac{x^2 - y^2}{4}$
(c) $\frac{x^2 + y^2}{4}$ (d) $\frac{x^2 - y^2}{2}$

52. If $\lim_{x \to \infty} \left[\frac{x^3 + 1}{x^2 + 1} - (ax + b) \right] = 2$, then

(a) $a = 1, b = -2$ (b) $a = -1, b = 2$
(c) $a = -1, b = -2$ (d) None of these

53. $\lim_{x \to \infty} \frac{\sqrt{x^2+1} - \sqrt[3]{x^3+1}}{\sqrt[4]{x^4+1} - \sqrt[5]{x^4+1}}$ equals

(a) 1 (b) 0
(c) –1 (d) None of these

54. The tangent at (1, 7) to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ at

(a) (6, 7) (b) (– 6, 7)
(c) (6, – 7) (d) (– 6, – 7)

55. The set of points where the function $f(x) = x|x|$ is differentiable is

(a) $(-\infty, \infty)$ (b) $(-\infty, 0) \cup (0, \infty)$
(c) $(0, \infty)$ (d) $[0, \infty)$

56. If $f(x) = |\log_e |x||$, then $f_0'(x)$ equals

(a) $\frac{1}{|x|}, x \neq 0$
(b) $\frac{1}{x}$ for $|x| > 1$ and $\frac{-1}{x}$ for $|x| < 1$
(c) $\frac{-1}{x}$ for $|x| > 1$ and $\frac{1}{x}$ for $|x| < 1$
(d) $\frac{1}{x}$ for $x > 0$ and $-\frac{1}{x}$ for $x < 0$

57. The equation of the tangent to the curve $y = (2x - 1)e^{2(1-x)}$ at the points its maximum, is

(a) $y - 1 = 0$ (b) $x - 1 = 0$
(c) $x + y - 1 = 0$ (d) $x - y + 1 = 0$

58. A function $f(x) = \begin{cases} 1 + x, & x \leq 2 \\ 5 - x, & x > 2 \end{cases}$ is

(a) not continuous at $x = 2$
(b) differentiable at $x = 2$
(c) continuous but not differentiable at $x = 2$
(d) None of the above

59. The interval of increase of the function $F(x) = x - e^x + \tan(2\pi/7)$ is

(a) $(0, \infty)$ (b) $(-\infty, 0)$
(c) $(1, \infty)$ (d) $(-\infty, -1)$

60. Let $P(x) = a_0 + a_1 x^2 + a_2 x^4 + \ldots + a_n x^{2n}$ be a polynomial in a real variable x with $0 < a_0 < a_1 < a_2 < \ldots < a_n$. The function $P(x)$ has

(a) neither a maximum nor a minimum
(b) only one maximum
(c) only one minimum
(d) only one maximum and only one minimum

Answer – Key

1. b	2. c	3. a	4. a	5. c	6. b	7. d	8. b	9. d	10. d
11. b	12. d	13. b	14. c	15. c	16. a	17. a	18. a	19. b	20. b
21. a	22. b	23. b	24. a	25. a	26. a	27. a	28. c	29. a	30. b
31. b	32. d	33. b	34. b	35. b	36. a	37. b	38. d	39. c	40. c
41. a	42. c	43. b	44. a	45. c	46. b	47. b	48. b	49. b	50. b
51. a	52. a	53. b	54. d	55. a	56. b	57. a	58. c	59. b	60. c