1. The value of $\sum_{k=1}^{6}\left(\sin\frac{2\pi k}{7}-i\cos\frac{2\pi k}{7}\right)$ is

(a) i (b) $-i$

(c) 1 (d) 0

2. If a_n be the nth term of an AP and if $a_7 = 15$, then the value of the common difference that would make $a_2a_7a_{12}$ greatest is

(a) 9 (b) 9/4

(c) 0 (d) 18

3. If $a_1, a_2, a_3, \ldots, a_n$ are in AP, where $a_i > 0$ for all i, then value of the expression

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

(a) $\frac{n-1}{\sqrt{a_n}-\sqrt{a_1}}$ (b) $\frac{n-1}{\sqrt{a_1}-\sqrt{a_n}}$

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

4. If one root of $x^2 - x - k = 0$ is square of the other, then k is equal to

(a) $2\pm\sqrt{3}$ (b) $3\pm\sqrt{2}$

(c) $2\pm\sqrt{5}$ (d) $5\pm\sqrt{2}$

5. The number of ways in which we can select four numbers from 1 to 30 so as to exclude every selection of four consecutive numbers is

(a) 27378 (b) 27405

(c) 27399 (d) None of these

6. The coefficient of x^n in the expansion of $(1-4x)^{-1/2}$ is

(a) $\frac{(2n)!}{(n!)^2}$ (b) $\frac{2n}{(n!)^2}$

(c) $\frac{(2n)!}{n^2}$ (d) None of these

7. Let A and B be symmetric matrices of the same order, then

(a) $A + B$ is symmetric matrix

(b) $AB - BA$ is skew symmetric matrix

(c) $AB + BA$ is symmetric matrix

(d) All of the above

8. If α, β, γ are the roots of $x^3 + ax^2 + b = 0$, then the value of $\begin{vmatrix}\alpha & \beta & \gamma\\ \beta & \gamma & \alpha\\ \gamma & \alpha & \beta\end{vmatrix}$ is

(a) $-a^3$ (b) $a^3 - 3b$

(c) a^3 (d) $a^2 - 3b$

9. If the axes are shifted to the point $(1, -2)$ without rotation the equation $2x^2 + y^2 - 4x + 4y = 0$ becomes

(a) $2X^2 + Y^2 = 6$

(b) $2X^2 + Y^2 + 6 = 0$

(c) $X^2 + 2Y^2 = 6$

(d) $2X^2 + Y^2 = 0$

10. The lines represented by the equation $Ax^2 + 2Bxy + Hy^2 = 0$ are perpendicular, if

(a) $A + B = 0$ (b) $B + H = 0$

(c) $A + H = 0$ (d) $AH = -1$

11. The number of common tangents to the circles $x^2 + (y-1)^2 = 9$ and $(x-1)^2 + y^2 = 25$ is

(a) 0 (b) 1

(c) 2 (d) 3

12. The length of focal chord which makes an angle α with the axis of the parabola $y^2 = 4ax$ is

(a) $2a\cot^2\alpha$ (b) $4a\,\text{cosec}^2\alpha$

(c) $4a\cot\alpha$ (d) None of these

13. The point of intersection of the tangents at two points on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, whose eccentric angles differ by a right angle lies on the ellipse

(a) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=2$ (b) $\frac{x^2}{b^2}+\frac{y^2}{a^2}=1$

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

14. If the normal at $\left(ct, \frac{c}{t}\right)$ on the curve $xy = c^2$ meets the curve again in t, then

(a) $t' = -\frac{1}{t^3}$ (b) $t' = -\frac{1}{t}$

(c) $t' = \frac{1}{t^2}$ (d) $t'^2 = -\frac{1}{t^2}$

15. If $f(x) = \begin{cases} \frac{|x-4|}{x-4}, & x \neq 4 \\ 0, & x = 4 \end{cases}$

then $\lim_{x \to 4} f(x)$ is equal to

(a) 1 (b) -1

(c) 0 (d) does not exist

16. The equation $\begin{vmatrix} x-a & x-b & x-c \\ x-b & x-c & x-a \\ x-c & x-a & x-b \end{vmatrix} = 0$ where a, b, c are different is satisfied by

(a) $x = 0$ (b) $x = a$

(c) $x = \frac{1}{3}(a+b+c)$ (d) $x = a+b+c$

17. The function

$$f(x) = \begin{cases} x & \text{for } x < 1 \\ 2-x & \text{for } 1 \le x \le 2 \\ -2+3x-x^2 & \text{for } x > 2 \end{cases}$$

is differentiable

(a) at $x = 2$ and at $x = 1$

(b) at $x = 2$ but not at $x = 1$

(c) at $x = 1$ but not at $x = 2$

(d) neither at $x = 2$ nor at $x = 1$

18. Find the points on the curve $y = x^3 - 2x^2 - x$ at which the tangent lines are parallel to the line $y = 3x - 2$

(a) $(2, 2), \left(-\frac{2}{3}, -\frac{14}{27}\right)$

(b) $(2, -2)\left(-\frac{2}{3}, -\frac{14}{37}\right)$

(c) $(2, -2)\left(-\frac{2}{3}, -\frac{14}{27}\right)$

(d) None of the above

19. If f and g are two increasing functions such that fog is defined, then

(a) fog is an increasing function

(b) fog is a decreasing function

(c) fog is neither increasing nor decreasing

(d) None of the above

20. The value of the integral $\int \frac{2x\,dx}{(x^2+1)(x^2+2)}$ is

(a) $\log|x^2+1| + \log|x^2+2| + c$

(b) $-[\log|x^2+1| + \log|x^2+2|] + c$

(c) $\log|x^2+1| - \log|x^2+2| + c$

(d) $\log|x^2+2| - \log|x^2+1| + c$

21. The area of the figure bounded by the curves $y = |x-1|$ and $y = 3 - |x|$ is

(a) 1 (b) 2

(c) 3 (d) 4

22. If the unit vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle 2θ such that $|\vec{a} - \vec{b}| < 1$ and $0 \le \theta \le \pi$, then θ lies in the interval

(a) $\left[0, \frac{\pi}{6}\right)$ (b) $\left(\frac{5\pi}{6}, \pi\right]$

(c) Both (a) and (b) (d) Neither (a) nor (b)

23. The plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ meets the coordinate axes at A, B and C respectively. Find the equation of the sphere $OABC$

(a) $x^2 + y^2 + z^2 + ax + by + cz = 0$

(b) $x^2 + y^2 + z^2 - ax - by - cz = 0$

(c) $x^2 + y^2 + z^2 + ax - by + cz = 0$

(d) None of the above

24. A bag contains 16 coins of which two are counterfeit with heads on both sides. The rest are fair coins. One coin is selected at random from the bag and tossed. The probability of getting a head is

(a) $\frac{9}{16}$ (b) $\frac{11}{16}$

(c) $\frac{5}{9}$ (d) None of these

25. The value of $\sqrt{3}\cot 20° - 4\cos 20°$ is equal to

(a) 1 (b) -1

(c) 0 (d) None of these

26. If $\sin x + \operatorname{cosec} x = 2$, then $\sin^n x + \operatorname{cosec}^n x$ is equal to

(a) 2 (b) 2^n

(c) 2^{n-1} (d) 2^{n-2}

27. The number of solutions of the equation $\tan x + \sec x = 2\cos x$, lying in the interval $[0, 2\pi]$ is

(a) 0 (b) 1

(c) 2 (d) 3

28. The arithmetic mean of a set of observations is $\bar{X}$. If each observation is divided by α and then is increased by 10, then the mean of the new series is

(a) $\frac{\bar{X}}{\alpha}$ (b) $\frac{\bar{X}+10}{\alpha}$

(c) $\frac{\bar{X}+10\alpha}{\alpha}$ (d) $\alpha\bar{X}+10$

29. If x and y are two uncorrelated variables and if $u = x + y$, $v = x - y$, then $r(u, v)$ is equal to

(a) $\frac{\sigma_x^2+\sigma_y^2}{\sigma_x^2-\sigma_y^2}$ (b) $\frac{\sigma_x^2-\sigma_y^2}{\sigma_x^2+\sigma_y^2}$

(c) $\frac{\sigma_x^2+\sigma_y^2}{\sigma_x\sigma_y}$ (d) None of these

30. If u and v be the components of the resultant velocity w of a particle such that $u = v = w$, then the angle between the velocities is

(a) 60° (b) 150°

(c) 120° (d) 30°

31. $\left\{\frac{1+\cos\frac{\pi}{8}+i\sin\frac{\pi}{8}}{1+\cos\frac{\pi}{8}-i\sin\frac{\pi}{8}}\right\}^8$ is equal to

(a) $1+i$ (b) $1-i$

(c) 1 (d) -1

32. The arithmetic mean of two positive numbers a and $b(a > b)$ is twice their geometric mean, then $a : b$ is

(a) $2+\sqrt{3} : 2-\sqrt{3}$

(b) $7+4\sqrt{3} : 7-4\sqrt{3}$

(c) $2 : 7+4\sqrt{3}$

(d) $2 : \sqrt{3}$

33. Given that tan A and tan B are the roots of the equation $x^2 - px + q = 0$, the value of $\sin^2(A + B)$ is

(a) $\frac{p^2}{p^2+(1-q)^2}$ (b) $\frac{p^2}{p^2+q^2}$

(c) $\frac{q^2}{p^2+(1-q)^2}$ (d) $\frac{p^2}{(p+q)^2}$

34. How many four letter words can be formed using the letters of the word 'FAILURE', so that F is included in each word?

(a) 400 (b) 420

(c) 460 (d) 480

35. Find the coefficient of x^4 in the expansion of $\left(\frac{1-x}{1+x}\right)^2$

(a) 4 (b) 8

(c) 12 (d) None of these

36. If A is a skew symmetric matrix, then the matrix B^TAB is

(a) symmetric (b) skew symmetric

(c) can't say (d) None of these

37. If the lines $x + 2ay + a = 0$, $x + 3by + b = 0$ and $x + 4cy + c = 0$ are concurrent, then a, b, c are in

(a) AP (b) GP

(c) HP (d) None of these

38. The distance between the parallel lines represented by the equation $x^2 + 6xy + 9y^2 + 4x + 12y - 5 = 0$ is

(a) $\frac{6}{5}$ (b) $\frac{6}{\sqrt{10}}$

(c) $\frac{6}{\sqrt{5}}$ (d) $\frac{3}{2}$

39. If the lengths of the tangents from the point (1, 2) to the circles

$x^2 + y^2 + x + y - 4 = 0$

and $3x^2 + 3y^2 - x - y - \lambda = 0$

are in the ratio 4 : 3, then the value of λ is

(a) $\frac{21}{2}$ (b) $\frac{21}{4}$

(c) $\frac{21}{5}$ (d) $\frac{21}{11}$

40. If M is the foot of the perpendicular from a point P on a parabola to its directrix and SPM is an equilateral triangle, where S is the focus, then PM is equal to

(a) a (b) $2a$

(c) $3a$ (d) $4a$

41. The equations of tangents to the ellipse $9x^2 + 16y^2 = 144$ which pass through the point (2, 3) are

(a) $y = 3$, $y = x + 5$ (b) $y = 3$, $x = 3$

(c) $x = 2$, $y = x + 5$ (d) $y = 3$, $y = -x + 5$

42. Let e and e' be the eccentricities of a hyperbola and its conjugate, then $\frac{1}{e^2}+\frac{1}{e'^2}$ is equal to

(a) 0 (b) 1

(c) 2 (d) None of these

43. If $f(x)$ is an even differentiable function on R, then $f'(x)$ is

(a) an even function
(b) an odd function
(c) can't say
(d) can't be determined

44. The inverse of the function

$$f(x)=\frac{10^x-10^{-x}}{10^x+10^{-x}} \text{ is}$$

(a) $\log_{10}(2-x)$ (b) $\frac{1}{2}\log_{10}\left(\frac{1+x}{1-x}\right)$

(c) $\frac{1}{2}\log_{10}(2x-1)$ (d) $\frac{1}{4}\log_{10}\left(\frac{2x}{2-x}\right)$

45. The value of the $\lim_{x\to\infty} x^{1/x}$ is equal to

(a) 0 (b) 1
(c) e (d) e^{-1}

46. If $f(x)=e^x g(x)$, $g(0)=2$, $g'(0)=1$, then $f'(0)$ is equal to

(a) 1 (b) 3
(c) 2 (d) 0

47. The slope of the tangent to the curve $x=t^2+3t-8$, $y=2t^2-2t-5$ at the point $(2,-1)$ is

(a) $\frac{22}{7}$ (b) $\frac{6}{7}$

(c) $-\frac{6}{7}$ (d) None of these

48. The function $f(x)=\cot^{-1}x+x$ increases in the interval

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

49. The maximum slope of the curve $y=-x^3+3x^2+2x-27$ is

(a) 5 (b) -5
(c) $\frac{1}{5}$ (d) None of these

50. The integral $\int \sin^3 x\cos^3 x\,dx$ is equal to

(a) $\frac{1}{32}\left[-\frac{3}{2}\cos 2x+\frac{1}{6}\cos 6x\right]+c$

(b) $\frac{1}{32}\left[-\frac{3}{2}\sin 2x+\frac{1}{6}\sin 6x\right]+c$

(c) $-\frac{1}{32}\left[-\frac{3}{2}\cos 2x+\frac{1}{6}\sin 6x\right]+c$

(d) None of the above

51. The value of $\int \frac{e^x\,dx}{\sqrt{5-4e^x-e^{2x}}}$ is equal to

(a) $\tan^{-1}\left(\frac{e^x+2}{3}\right)+c$

(b) $\sin^{-1}\left(\frac{e^x+2}{3}\right)+c$

(c) $\cos^{-1}\left(\frac{e^x+2}{3}\right)+c$

(d) None of the above

52. $\int_0^1 \frac{(x^\alpha-1)\,dx}{\log x}$ equals

(a) $\frac{1}{\alpha+1}$ (b) $\frac{1}{\alpha-1}$

(c) $\alpha-1$ (d) None of these

53. Solution of $e^{(dy/dx)}=x+1$; $y(0)=5$ is

(a) $y=x\log(x+1)-x-\log(x+1)+5$
(b) $y=x\log(x+1)+x+\log(x+1)+5$
(c) $y=x\log(x+1)-x+\log(x+1)+5$
(d) None of the above

54. For any vector $\vec{a}$, $|\vec{a}\times\hat{i}|^2+|\vec{a}\times\hat{j}|^2+|\vec{a}\times\hat{k}|^2$ is equal to

(a) $|\vec{a}|^2$ (b) $2|\vec{a}|^2$

(c) $3|\vec{a}|^2$ (d) None of these

55. The shortest distance between the lines

$$\vec{r}=(4\hat{i}-\hat{j})+\lambda(\hat{i}+2\hat{j}-3\hat{k})$$

and $\vec{r}=(\hat{i}-\hat{j}+2\hat{k})+\mu(2\hat{i}+4\hat{j}-5\hat{k})$

is equal to

(a) $\frac{6}{\sqrt{10}}$ (b) $\frac{6}{\sqrt{5}}$

(c) $\frac{6}{5}$ (d) $\frac{3}{5}$

56. If A and B are two independent events such that $P(\bar{A}\cap B)=\frac{2}{15}$ and $P(A\cap\bar{B})=\frac{1}{6}$, then $P(B)$ is

(a) $\frac{1}{5}$ (b) $\frac{5}{6}$

(c) $\frac{4}{5}$ (d) $\frac{7}{6}$

57. Maximum and minimum values of $6\sin x\cos x+4\cos 2x$ are respectively

(a) 5 and -5 (b) $2\sqrt{13}$ and $-2\sqrt{13}$

(c) 10 and -10 (d) $\frac{5}{2}$ and $-\frac{5}{2}$

58. In a ΔABC, if $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$ and the side $a = 2$, then area of the triangle is

(a) 1 (b) 2

(c) $\frac{\sqrt{3}}{2}$ (d) $\sqrt{3}$

59. The equation $\sin^{-1} x - \cos^{-1} x = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ has

(a) no solution
(b) unique solution
(c) infinite number of solutions
(d) None of the above

60. A tower subtends an angle α at a point A in the plane of its base and the angle of depression of the foot of the tower at a point b ft just above A is β. Then, height of the tower is

(a) $b \tan \alpha \cot \beta$ (b) $b \cot \alpha \tan \beta$

(c) $b \tan \alpha \tan \beta$ (d) $b \cot \alpha \cot \beta$

Answer – Key

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