1. In Z, the set of all integers, the inverse of -7 w.r.t. $*$defined by $a * b = a + b + 7$ for all $a, b \in Z$ is :
   (a) -14 (b) 7
   (c) 14 (d) -7

2. $(p \wedge q) \wedge (\sim p \wedge q)$ is :
   (a) a tautology
   (b) a contradiction
   (c) tautology and contradiction
   (d) neither a tautology nor a contradiction

3. The number of words that can be formed out of the letters of the word "ARTICLE" so that the vowels occupy even places is :
   (a) 574 (b) 36
   (c) 754 (d) 144

4. In ΔABC if $\begin{vmatrix} 1 & a & b \\ 1 & c & a \\ 1 & b & c \end{vmatrix} = 0$ then $\sin^2 A + \sin^2 B + \sin^2 C$ is equal to :
   (a) $\frac{4}{9}$ (b) $\frac{9}{4}$
   (c) $3\sqrt{3}$ (d) 1

5. 7th term of an A.P. is 40. Then the sum of first 13 terms is :
   (a) 520 (b) 53
   (c) 2080 (d) 1040

6. The coefficient of x^{32} in the expansion of $\left(x^4 - \frac{1}{x^3}\right)^{15}$ is :
   (a) ${}^{-15}C_3$ (b) ${}^{15}C_4$
   (c) ${}^{-15}C_5$ (d) ${}^{15}C_2$

7. Which of the following is a subgroup of $a = \{0, 1, 2, 3, 4, 5\}$, under addition modulos 6?
   (a) $\{0, 2\}$ (b) $\{0, 1\}$ (c) $\{0, 4\}$ (d) $\{0, 3\}$

8. Assuming that the sums and products given below are defined which of the following is not true for matrices?
(a) $AB = AC$ does not imply $B = C$
(b) $A + B = B + A$
(c) $(AB)' = B'A'$
(d) $AB = 0$ implies $A = 0$ or $B = 0$

9. Inverse of the matrix $\begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$ is :
(a) $\frac{1}{10}\begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$ (b) $\frac{1}{10}\begin{bmatrix} 4 & 2 \\ -3 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} 4 & 2 \\ -3 & 1 \end{bmatrix}$ (d) $\frac{1}{10}\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$

10. If the vectors $4\hat{i} + 11\hat{j} + m\hat{k}$, $7\hat{i} + 2\hat{j} + 6\hat{k}$ and $\mathbf{i} + 5\mathbf{j} + 4\mathbf{k}$ are coplanar then m is equal to :
(a) 0 (b) 38
(c) –10 (d) 10

11. $\begin{vmatrix} b^2c^2 & bc & b+c \\ c^2a^2 & ca & c+a \\ a^2b^2 & ab & a+b \end{vmatrix}$ is equal to :
(a) $\frac{1}{abc}(ab + bc + ca)$ (b) $ab + bc + ca$
(c) 0 (d) $a + b + c$

12. In ΔABC if $\frac{b+c}{11} = \frac{c+a}{12} = \frac{a+b}{13}$ then $\cos C$ is equal to :
(a) $\frac{5}{7}$ (b) $\frac{7}{5}$
(c) $\frac{16}{17}$ (d) $\frac{17}{36}$

13. The value of $\frac{\tan 70^\circ - \tan 20^\circ}{\tan 50^\circ}$ is equal to :
(a) 2 (b) 1 (c) 0 (d) 3

14. $\cos 1^\circ + \cos 2^\circ + \cos 3^\circ + \ldots + \cos 180^\circ$ is equal to :
(a) 1 (b) 0
(c) 2 (d) –1

15. If $|\vec{a} \times \vec{b}| = 4$ and $|\vec{a} \cdot \vec{b}| = 2$ then $|\vec{a}|^2 |\vec{b}|^2$ is equal to :
(a) 6 (b) 2
(c) 20 (d) 8

16. $\lim_{x \to 0} (1 - ax)^{1/x}$ is equal to :
(a) e^{-a} (b) e
(c) e^a (d) 1

17. Which of the following is not a proposition :
(a) 3 is prime
(b) $\sqrt{2}$ is irrational
(c) Mathematics is interesting
(d) 5 is an even integer

18. $\lim_{n \to \infty} (3^n + 4^n)^{1/n}$ is equal to :
(a) 4 (b) 3
(c) e (d) ∞

19. The distance between the directrices of the hyperbola $x = 8 \sec\theta$, $y = 8 \tan\theta$ is :
(a) $8\sqrt{2}$ (b) $16\sqrt{2}$
(c) $4\sqrt{2}$ (d) $6\sqrt{2}$

20. The general solution of the equation $\tan 2\theta \cdot \tan\theta = 1$ for $n \in z$ is, θ is equal to:
(a) $(2n+1)\frac{\pi}{4}$ (b) $(2n+1)\frac{\pi}{6}$
(c) $(2n+1)\frac{\pi}{2}$ (d) $\frac{1}{1}(2n+1)\frac{\pi}{3}$

21. $\sin\left(\frac{1}{2}\cos^{-1}\frac{4}{5}\right)$ is equal to :
(a) $-\frac{1}{\sqrt{10}}$ (b) $\frac{1}{\sqrt{10}}$
(c) $-\frac{1}{10}$ (d) $\frac{1}{10}$

22. The angle between the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ when $\vec{a} = (1, 1, 4)$ and $\vec{b} = (1, -1, 4)$ is :
(a) 45° (b) 90°
(c) 15° (d) 30°

23. The angle between the lines in $x^2 - xy - 6y^2 - 7x + 31y - 18 = 0$ is :
(a) 60° (b) 45° (c) 30° (d) 90°

24. The equation of line bisecting perpendicularly the segment joining the points (–4, 6) and (8, 8) is :
(a) $y = 7$ (b) $6x + y - 19 = 0$
(c) $x + 2y - 7 = 0$ (d) $6x + 2y - 19 = 0$

25. If the distance of any point P from the points $A(a+b, a-b)$ and $B(a-b, a+b)$ are equal then the locus of P is :
(a) $ax+by=0$ (b) $x-y=0$
(c) $x+y=0$ (d) $bx-ay=0$

26. If p is the length of the perpendicular from the origin on the line whose intercepts on the axes are a and b then :
(a) $p^2=a^2+b^2$ (b) $p^2=a^2-b^2$
(c) $\frac{1}{p^2}=\frac{1}{a^2}+\frac{1}{b^2}$ (d) $\frac{1}{p^2}=\frac{1}{a^2}-\frac{1}{b^2}$

27. If the slope of one of the lines given by $ax^2+2hxy+by^2=0$ is 5 times the other then :
(a) $5h^2=9ab$ (b) $5h^2=ab$
(c) $h^2=ab$ (d) $9h^2=5ab$

28. $\int_0^{2\pi}(\sin x+|\sin x|)\,dx$ is equal to :
(a) 4 (b) 0
(c) 1 (d) 8

29. $\int_0^{\pi}\frac{x\,dx}{a^2\cos^2 x+b^2\sin^2 x}$ is equal to :
(a) $\frac{\pi}{2ab}$ (b) $\frac{\pi}{ab}$
(c) $\frac{\pi^2}{2ab}$ (d) $\frac{\pi^2}{ab}$

30. The differential equation for which $\sin^{-1}x+\sin^{-1}y=c$ is given by :
(a) $\sqrt{1-x^2}\,dy+\sqrt{1-y^2}\,dx=0$
(b) $\sqrt{1-x^2}\,dx+\sqrt{1-y^2}\,dy=0$
(c) $\sqrt{1-x^2}\,dx-\sqrt{1-y^2}\,dy=0$
(d) $\sqrt{1-x^2}\,dy-\sqrt{1-y^2}\,dx=0$

31. The derivative of $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ w.r.t. $\cot^{-1}\left(\frac{1-3x^2}{3x-x^3}\right)$ is :
(a) $\frac{3}{2}$ (b) 1
(c) $\frac{1}{2}$ (d) $\frac{2}{3}$

32. If $x=a(\theta-\sin\theta)$, $y=a(1-\cos\theta)$ then $\frac{dy}{dx}$ is equal to :
(a) $\cot\theta/2$
(b) $\tan\theta/2$
(c) $\frac{1}{2}\operatorname{cosec}^2\frac{\theta}{2}$
(d) $-\frac{1}{2}\operatorname{cosec}^2\frac{\theta}{2}$

33. If $y=1-x+\frac{x^2}{2!}-\frac{x^3}{3!}+\frac{x^4}{4!}\ldots$ then $\frac{d^2y}{dx^2}$ is equal to :
(a) $-x$ (b) x
(c) y (d) $-y$

34. If $\sqrt{x}+\frac{1}{\sqrt{x}}=2\cos\theta$ then x^6+x^{-6} is equal to :
(a) $2\cos 12\theta$ (b) $2\cos 6\theta$
(c) $2\sin 3\theta$ (d) $2\cos 3\theta$

35. The slope of the tangent to the curve $x=3t^2+1$, $y=t^3-1$ at $x=1$ is :
(a) $\frac{1}{2}$ (b) 0
(c) -2 (d) ∞

36. Which of the following is a fourth root of $\frac{1}{2}+i\frac{\sqrt{3}}{2}$?
(a) $cis\frac{\pi}{12}$ (b) $cis\frac{\pi}{2}$
(c) $cis\frac{\pi}{6}$ (d) $cis\frac{\pi}{3}$

37. If $f(a)=2f'(a)=1$, $g(a)=3$, $g'(a)=-1$, then $\lim_{x\to a}\frac{f(a)g(x)-f(x)g(a)}{x-a}$ is equal to :
(a) 6 (b) 1
(c) -1 (d) -5

38. The rate of change of the surface area of the sphere of radius r when the radius is increasing at the rate of 2 cm/sec is proportional to :
(a) $\frac{1}{r^2}$ (b) $\frac{1}{r}$
(c) r^2 (d) r

39. The amplitude of $\sin\frac{\pi}{5}+i\left(1-\cos\frac{\pi}{5}\right)$ is :

(a) $\frac{2\pi}{5}$ (b) $\frac{\pi}{5}$

(c) $\frac{\pi}{15}$ (d) $\frac{\pi}{10}$

40. For the curve $xy=c^2$ the subnormal at any point varies as :

(a) x^3 (b) x^2

(c) y^3 (d) ∞

41. The function $f(x)=|x|+\frac{|x|}{x}$ is :

(a) discontinuous at origin because $|x|$ is discontinuous there

(b) continuous at origin

(c) discontinuous at origin because both $|x|$ and $\frac{|x|}{x}$ are discontinuous there

(d) discontinuous at the origin because $\frac{|x|}{x}$ is discontinuous there.

42. $\int e^x\left(\frac{1+\sin x}{1+\cos x}\right)dx$ is equal to :

(a) $e^x\sec^2\frac{x}{2}+C$ (b) $e^x\tan\frac{x}{2}+C$

(c) $e^x\sec\frac{x}{2}+C$ (d) $e^x+\tan x+C$

43. $\int\sqrt{1+\sin\left(\frac{x}{4}\right)}\,dx$ is equal to :

(a) $8\left(\sin\frac{x}{8}+\cos\frac{x}{8}\right)+C$

(b) $8\left(\sin\frac{x}{8}-\cos\frac{x}{8}\right)+C$

(c) $8\left(\cos\frac{x}{8}-\sin\frac{x}{8}\right)+C$

(d) $\frac{1}{8}\left(\sin\frac{x}{8}-\cos\frac{x}{8}\right)+C$

44. $\int_0^\infty\frac{x\,dx}{(1+x)(1+x^2)}$ is equal to :

(a) $\frac{\pi}{2}$ (b) 0

(c) 1 (d) $\frac{\pi}{4}$

45. If $I_n=\int(\log x)^n\,dx$ then $I_n+n\,I_{n-1}$ is equal to :

(a) $(x\log x)^n$ (b) $x(\log x)^n$

(c) $n(\log x)^n$ (d) $(\log x)^{n-1}$

46. The area included between the parabolas $x^2=4y$ and $y^2=4x$ is (in square units) :

(a) $\frac{4}{3}$ (b) $\frac{1}{3}$

(c) $\frac{16}{3}$ (d) $\frac{8}{3}$

47. If $\cos^{-1}x+\cos^{-1}y+\cos^{-1}z=3\pi$ then $xy+yz+zx$ is equal to :

(a) 1 (b) 0

(c) –3 (d) 3

48. Which of the following is a group?

(a) {1, 2, 4, 8} under multiplication

(b) $\{0,\pm2,\pm4,\pm6\ldots\}$ under addition

(c) {1, –1} under addition

(d) {0, 1, 2, 3, 4} under multiplication module 5

49. If the circles $x^2+y^2+2gx+2fy=0$ and $x^2+y^2+2g'x+2f'y=0$ touch each other then :

(a) $ff'=gg'$ (b) $fg=f'g'$

(c) $(fg)^2=(f'g')^2$ (d) $fg'=f'g$

50. The line $3x-2y=k$ meets the circle $x^2+y^2=4r^2$ at only one point if k^2 is equal to :

(a) $52r^2$ (b) $20r^2$

(c) $\frac{20}{9}r^2$ (d) $\frac{52}{9}r^2$

51. In three element group $\{e, a, b\}$ where e is the identity a^5b^4 is equal to :

(a) a (b) e

(c) ab (d) b

52. The locus of a point which moves such that the difference of its distances from two fixed points is always a constant is :

(a) a circle (b) a straight line

(c) a hyperbola (d) an ellipse

53. The directrix of the parabola $x^2 - 4x - 8y + 12 = 0$ is :
(a) $y = 0$ (b) $x = 1$
(c) $y = -1$ (d) $x = -1$

54. Which of the following is a point on the common chord of the circle $x^2 + y^2 + 2x - 3y + 6 = 0$ and $x^2 + y^2 + x - 8y - 13 = 0$
(a) $(1, 4)$ (b) $(1, -2)$
(c) $(1, -4)$ (d) $(1, 2)$

55. The locus of the point of intersection of the perpendicular tangents to ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ is :
(a) $x^2 + y^2 = 4$ (b) $x^2 + y^2 = 9$
(c) $x^2 + y^2 = 5$ (d) $x^2 + y^2 = 13$

56. The sum of the coefficients in the expansion of $(1 + x - 3x^2)^{3148}$ is :
(a) 8 (b) 7
(c) 1 (d) -1

57. The relation $R = \{(1, 1), (2, 2), (3, 3)\}$ on the set $\{1, 2, 3\}$ is :
(a) symmetric only
(b) reflexive only
(c) an equivalence relation
(d) transitive only

58. The least remainder when 17^{30} is divided by 5 is :
(a) 2 (b) 1
(c) 4 (d) 2

59. The limiting points of the co-axial system of circles $x^2 + y^2 + 2\lambda y + 4 = 0$ are :
(a) $(0, \pm 4)$ (b) $(\pm 2, 0)$
(c) $(0, \pm 1)$ (d) $(0, \pm 2)$

60. The maximum of $4 \sin^2 x + 3 \cos^2 x$ is :
(a) 4 (b) 3
(c) 7 (d) 5

Answer – Key

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