2022-I

NDA/NA Solved Paper

Paper I: Mathematics

1. If $\Delta_1 = \begin{vmatrix} 1 & p & q \\ 1 & q & r \\ 1 & r & p \end{vmatrix}$ *and* $\Delta_2 = \begin{vmatrix} 1 & 1 & 1 \\ q & r & p \\ r & p & q \end{vmatrix}$

where $p \neq q \neq r$, then $\Delta_1 + \Delta_2$ is

(*a*) 0

(*b*) always positive

(*c*) always negative

(*d*) positive if p, q, r, are positive else negative

2. If $(a-b)(b-c)(c-a) = 2$ and $abc = 6$, then what is the value of $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$?

(*a*) 3 (*b*) 12 (*c*) 14 (*d*) 15

3. Under which of the following conditions does the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ vanish?

1. $a + b + c = 0$
2. $a^3 + b^3 + c^3 = 3abc$
3. $a^2 + b^2 + c^2 - ab - bc - ca = 0$

Select the correct answer using the code given below:

(*a*) 1 and 2 only (*b*) 2 and 3 only

(*c*) 1 and 3 only (*d*) 1, 2, and 3

4. Consider the following in respect of the matrices:

$A = \begin{bmatrix} m & n \end{bmatrix}$, $B = \begin{bmatrix} -n & -m \end{bmatrix}$ and $C = \begin{bmatrix} m \\ -m \end{bmatrix}$

1. $CA = CB$
2. $AC = BC$
3. $C(A + B) = CA + CB$

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only (*c*) 2 and 3 (*d*) 1 and 2

5. If $A = \begin{bmatrix} 2\sin\theta & \cos\theta & 0 \\ -2\cos\theta & \sin\theta & 0 \\ -1 & 1 & 1 \end{bmatrix}$, then what is $A(\text{adj}A)$ equal to?

(*a*) Null matrix (*b*) $-I$

(*c*) I (*d*) $2I$

where I is the identity matrix.

6. For what value of k is the matrix $\begin{bmatrix} 2\cos 2\theta & 2\cos 2\theta & 6 \\ 1-2\sin^2\theta & 2\cos^2\theta - 1 & 3 \\ k & 2k & 1 \end{bmatrix}$ singular?

(*a*) 0 only (*b*) 1 only

(*c*) 2 only (*d*) Any real value

7. Let A be a non-singular matrix and $B = adjA$. Which of the following statements is/are correct?

1. $AB = BA$
2. AB is a scalar matrix
3. AB can be a null matrix

Select the correct answer using the code given below:

(*a*) 1 only (*b*) 1 and 2 only

(*c*) 2 only (*d*) 1, 2 and 3

8. Consider the following statements in respect of square matrices A and B of same order:

1. If AB is a null matrix, then at least one of A and B is a null matrix.
2. If AB is an identity matrix, then $BA = AB$.

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1

9. If A is the identity matrix of order 3 and B is its transpose, then what is the value of the determinant of the matrix $C = A + B$?

(*a*) 1 (*b*) 2 (*c*) 4 (*d*) 8

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10. Let A and B be non-singular matrices of the same order such that $AB = A$ and $BA = B$. Which of the following statements is/are correct?

1. $A^2 = A$
2. $AB^2 = A^2B$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

11. How many terms are there in the expansion of

$$\left(1+\frac{2}{x}\right)^9\left(1-\frac{2}{x}\right)^9 ?$$

(a) 9 (b) 10 (c) 19 (d) 20

12. Consider the following statements in respect of the expansion of $(x + y)^{10}$:

1. Among all the coefficients of the terms, the coefficient of the 6th term has the highest value
2. the coefficient of the 3rd term is equal to coefficient of the 9th term

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

13. If $C(3n, 2n) = C(3n, 2n - 7)$, then what is the value of $C(n, n - 5)$?

(a) 42 (b) 35 (c) 28 (d) 21

14. What is the value of

$C(51, 21) - C(51, 22) + C(51, 23) - C(51, 24) + C(51, 25) - C(51, 26) + C(51, 27) - C(51, 28) + C(51, 29) - C(51, 30)$?

(a) $C(51, 25)$ (b) $C(51, 27)$
(c) $C(51, 51) - C(51, 0)$ (d) $C(51, 25) - C(51, 27)$

15. How many odd numbers between 300 and 400 are there in which none of the digits is repeated?

(a) 32 (b) 36 (c) 40 (d) 45

16. How many permutations are there of the letters of the word 'TIGER' in which the vowels should not occupy the even positions?

(a) 72 (b) 36 (c) 18 (d) 12

17. Let α and β be the roots of the equation $x^2 + px + q = 0$. If a^3 and b^3 are the roots of the equation $x^2 + mx + n = 0$, then what is the value of $m + n$?

(a) $p^3 + q^3 + pq$ (b) $p^3 + q^3 - pq$
(c) $p^3 + q^3 + 3pq$ (d) $p^3 + q^3 - 3pq$

18. Let α and β be the roots of the equation

$x^2 - ax - bx + ab - c = 0$. What is the quadratic equation whose roots are a and b?

(a) $x^2 - \alpha x - \beta x + \alpha\beta + c = 0$ (b) $x^2 - \alpha x - \beta x + \alpha\beta - c = 0$
(c) $x^2 + \alpha x + \beta x + \alpha\beta + c = 0$ (d) $x^2 + \alpha x + \beta x + \alpha\beta - c = 0$

19. If the roots of the equation $x^2 - ax - bx - cx + bc + ca = 0$ are equal, then which one of the following is correct ?

(a) $a + b + c = 0$ (b) $a - b + c = 0$
(c) $a + b - c = 0$ (d) $-a + b + c = 0$

20. Let α and $\beta(\alpha > \beta)$ be the roots of the equation $x^2 - 8x + q = 0$. If $\alpha^2 - \beta^2 = 16$, then what is the value of q?

(a) –15 (b) –10 (c) 10 (d) 15

21. What is the maximum value of n such that 5^n divides $(30! + 35!)$, where n is a natural number?

(a) 4 (b) 6 (c) 7 (d) 8

22. What is the value of

$2(2 \times 1) + 3(3 \times 2 \times 1) + 4(4 \times 3 \times 2 \times 1) + 5(5 \times 4 \times 3 \times 2 \times 1) + ... + 9(9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 2$?

(a) 11! (b) 10! (c) 10 + 10! (d) 11 + 10!

23. If $A = \{\{1, 2, 3\}\}$, then how many elements are there in the power set of A?

(a) 1 (b) 2 (c) 4 (d) 8

24. If a, b, c are in GP where $a > 0$, $b > 0$, $c > 0$, then which of the following are correct ?

1. a^2, b^2, c^2 are in GP
2. $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in GP
3. $\sqrt{a}, \sqrt{b}, \sqrt{c}$ are in GP

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

25. If $\frac{a+b}{2}, b, \frac{b+c}{2}$ are in HP, then which one of the following is correct?

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

26. What is value of $\cot^2 15° + \tan^2 15°$?

(a) 12 (b) 14 (c) $8\sqrt{3}$ (d) 4

27. In a triangle ABC, $\sin A - \cos B - \cos C = 0$.

What is angle B equal to?

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

28. If $\alpha + \beta = \frac{\pi}{4}$ and $2\tan\alpha = 1$, then what is $\tan 2\beta$ equal to?

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{3}{5}$

29. If $\tan(45° + \theta) = 1 + \sin 2\theta$, where $-\frac{\pi}{4} < \theta < \frac{\pi}{4}$, then what is the value of $\cos 2\theta$?

(a) 0 (b) $\frac{1}{2}$ (c) 1 (d) 2

30. Let $\sin 2\theta = \cos 3\theta$, where θ is acute angle. What is the vlaue of $1 + 4\sin\theta$?

(given that $\sin 18° = \frac{\sqrt{5}-1}{4}$)

(a) $\sqrt{3}$ (b) 2 (c) $\sqrt{5}$ (d) 3

31. If $\tan\theta = -\frac{5}{12}$, then what can be the value of $\sin\theta$?

(a) $\frac{5}{13}$ but cannot be $-\frac{5}{13}$ (b) $-\frac{5}{13}$ but cannot be $\frac{5}{13}$
(c) $\frac{5}{13}$ or $-\frac{5}{13}$ (d) None of the above

32. What is the value of $\cos^4\frac{7\pi}{8}+\cos^4\frac{5\pi}{8}$?

(*a*) $\frac{3}{2}$ (*b*) $\frac{3}{4}$ (*c*) $\frac{3}{8}$ (*d*) $\frac{3}{16}$

33. What is $\sin^2\left(\frac{\pi}{4}+\theta\right)-\sin^2\left(\frac{\pi}{4}-\theta\right)$ equal to?

(*a*) $\sin2\theta$ (*b*) $\cos2\theta$ (*c*) $2\sin\theta$ (*d*) $2\cos\theta$

34. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height *h*. At a point on the plane the angles of elevation of the bottom and top of the flagstaff are θ and 2θ respectively. What is the height of the tower ?

(*a*) $h\cos\theta$ (*b*) $h\sin\theta$ (*c*) $h\cos2\theta$ (*d*) $h\sin2\theta$

35. The shadow of a tower becomes *x* metre longer, when the angle of elevation of sun changes from 60° to θ. If the height of the tower is $\sqrt{3}x$ metre, then which one of the following is correct?

(*a*) $0<\theta<30°$ (*b*) $30°<\theta<45°$

(*c*) $45°<\theta<60°$ (*d*) $60°<\theta<90°$

36. If $\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{x}{3}\right)=\frac{\pi}{4}$, where $0 < x < 6$, then what is *x* equal to?

(*a*) 1 (*b*) 2 (*c*) 3 (*d*) 5

37. If $3\sin^{-1}x+\cos^{-1}x=\pi$, then what is *x* equal to?

(*a*) 0 (*b*) $\frac{1}{2}$ (*c*) $\frac{1}{\sqrt{2}}$ (*d*) $\frac{1}{\sqrt{3}}$

38. If $\tan\alpha+\tan\beta=1-\tan\alpha.\tan\beta$, where $\tan\alpha.\tan\beta\neq1$, then which of the following is one of the values of $(\alpha+\beta)$?

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

39. If $(1+\tan\theta)(1+\tan9\theta)=2$, then what is the value of $\tan(10\,\theta)$?

(*a*) 0 (*b*) 1 (*c*) 2 (*d*) Infinite

40. What is the value of $\sin0°+\sin10°+\sin20°+...+\sin360°$?

(*a*) –1 (*b*) 0 (*c*) 1 (*d*) 2

41. Consider all the subsets of the set $A = \{1, 2, 3, 4\}$. How many of them are supersets of the set {4}?

(*a*) 6 (*b*) 7 (*c*) 8 (*d*) 9

42. Consider the following statements in respect of two non-empty sets *A* and *B*.

1. $x\notin(A\cup B)\Rightarrow x\notin A$ or $x\notin B$
2. $x\notin(A\cap B)\Rightarrow x\notin A$ and $x\notin B$

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

43. Consider the following statements in respect of two non-empty sets A and B.

1. $A\cup B=A\cap B$ iff $A=B$ 2. $A\Delta B=\varphi$ iff $A=B$

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

44. Consider the following statements in respect of the relation *R* in the set IN of natural numbers defined by xRy if $x^2-5xy+4y^2=0$:

1. *R* is reflexive
2. *R* is symmetric
3. *R* is transitive

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) 1 and 2 only (*d*) 1, 2, and 3

45. Consider the following statements in respect of any relation *R* on a set *A*:

1. If *R* is reflexive, then R^{-1} is also reflexive
2. If *R* is symmetric, then R^{-1} is also symmetric
3. If *R* is transitive, then R^{-1} is also transitive

Which of the above statements are correct?

(*a*) 1 and 2 only (*b*) 2 and 3 only

(*c*) 1 and 3 only (*d*) 1, 2 and 3

46. What is the principal argument of $\frac{1}{1+i}$ where $i=\sqrt{-1}$?

(*a*) $-\frac{3\pi}{4}$ (*b*) $-\frac{\pi}{4}$ (*c*) $\frac{\pi}{4}$ (*d*) $\frac{3\pi}{4}$

47. What is the modulus of $\left(\frac{\sqrt{-3}}{2}-\frac{1}{2}\right)^{200}$?

(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{2}$ (*c*) 1 (*d*) 2^{200}

48. Consider the following statements:

1. $\frac{n!}{3!}$ is divisible by 6, where $n > 3$
2. $\frac{n!}{3!}+3$ is divisible by 7, where $n > 3$

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) both 1 and 2 (*d*) Neither 1 nor 2

49. In how many ways can a team of 5 players be selected out of 9 players so as to exclude two particular players?

(*a*) 14 (*b*) 21 (*c*) 35 (*d*) 42

50. In the expansion of $\left(x+\frac{1}{x}\right)^{2n}$, what is the $(n+1)^{th}$ term from the end (when arranged in descending powers of *x*)

(*a*) $C(2n, n)x$ (*b*) $C(2n, n-1)x$

(*c*) $C(2n, n)$ (*d*) $C(2n, n-1)$

51. If the sum of the first 9 terms of an AP is equal to sum of the first 11 terms, then what is the sum of the first 20 terms?

(*a*) 20 (*b*) 10 (*c*) 2 (*d*) 0

52. If the 5th term of an AP is $\frac{1}{10}$ and its 10th term is $\frac{1}{5}$, then what is the sum of first 50 terms?

(*a*) 25 (*b*) 25.5 (*c*) 26 (*d*) 6.5

53. What is $(1110011)_2\div(10111)_2$ equal to ?

(*a*) $(101)_2$ (*b*) $(1001)_2$ (*c*) $(111)_2$ (*d*) $(1011)_2$

54. If $x^3+y^3=(100010111)_2$ and $x+y=(11111)_2$, then what is $(x-y)^2+xy$ equal to?

(*a*) $(1101)_2$ (*b*) $(1001)_2$

(*c*) $(1011)_2$ (*d*) $(1111)_2$

55. Consider the inequations $5x-4y+12<0$, $x+y<2$, $x<0$ and $y>0$. Which one of the following points lies in the common region?

(*a*) (0, 0) (*b*) (–2, 4) (*c*) (–1, 4) (*d*) (–1, 2)

56. Consider the following statements in respect of the function $y = [x], x \in (-1, 1)$ where [.] is the greatest integer function:

1. Its derivative is 0 at $x = 0.5$
2. It is continuous at $x = 0$

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

57. What is the degree of the differential equation

$$1+\left(\frac{dy}{dx}\right)^2=\left(\frac{d^2y}{dx^2}\right)^{\frac{4}{3}}?$$

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

58. A raidoactive substance decays at a rate proportional to the amount of substance present. If half of the substance decays in 100 years, then what is the decay constant (proportionality constant)?

(*a*) $\frac{ln2}{100}$ (*b*) $\frac{ln5}{100}$ (*c*) $\frac{ln10}{100}$ (*d*) $\frac{2ln2}{100}$

59. What is the domain of the function $f(x)=\sqrt{1-(x-1)^2}$?

(*a*) (0, 1) (*b*) [–1, 1] (*c*) (0, 2) (*d*) [0, 2]

60. The area of the region bounded by the parabola $y^2 = 4kx$, where $k > 0$ and its latus rectum is 24 square units. What is the value of k?

(*a*) 1 (*b*) 2 (*c*) 3 (*d*) 4

61. What is $\int_0^{\pi/4}\frac{dx}{(\sin x+\cos x)^2}$ equal to?

(*a*) $-\frac{1}{2}$ (*b*) $\frac{1}{2}$ (*c*) 1 (*d*) $\frac{3}{2}$

62. What is $\int(\sin x)^{-1/2}(\cos x)^{-3/2}\,dx$ equal to?

(*a*) $\sqrt{\tan x}+c$ (*b*) $2\sqrt{\tan x}+c$

(*c*) $\sqrt{\cot x}+c$ (*d*) $\sqrt{2\tan x}+c$

63. If $I_1=\int\frac{e^x dx}{e^x+e^{-x}}$ and $I_2=\int\frac{dx}{e^{2x}+1}$, then what is $I_1 + I_2$ equal to?

(*a*) $\frac{x}{2}+c$ (*b*) $x + c$

(*c*) $ln(e^x + e^{-x}) + c$ (*d*) $ln(e^x - e^{-x}) + c$

64. What is $\int_{-2}^{-1}\frac{x}{|x|}dx$ equal to?

(*a*) –2 (*b*) –1 (*c*) 1 (*d*) 2

65. How many extreme values does $\sin 4x + 2x$, where $0<x<\frac{\pi}{2}$ have?

(*a*) 1 (*b*) 2 (*c*) 4 (*d*) 8

66. What is the maximum value of the function

$f(x)=\frac{1}{\tan x+\cot x}$, where $0<x<\frac{\pi}{2}$?

(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{2}$ (*c*) 1 (*d*) 2

67. If $4f(x)-f\left(\frac{1}{x}\right)=\left(2x+\frac{1}{x}\right)\left(2x-\frac{1}{x}\right)$, then what is $f(2)$ equal to?

(*a*) 0 (*b*) 1 (*c*) 2 (*d*) 4

68. If $f(x) = 4x + 3$, then what is $fofof(-1)$ equal to?

(*a*) –1 (*b*) 0 (*c*) 1 (*d*) 2

69. If $x^y y^x = 1$, then what is $\frac{dy}{dx}$ at (1, 1) equal to?

(*a*) –1 (*b*) 0 (*c*) 1 (*d*) 4

70. If $y = (x^x)^x$, then what is the value of $\frac{dy}{dx}$ at $x = 1$?

(*a*) $\frac{1}{2}$ (*b*) 1 (*c*) 2 (*d*) 4

71. Let $y = [x + 1], -4 < x < -3$ where [.] is the greatest integer function. What is the derivative of y with respect to x at $x = –3.5$?

(*a*) –4 (*b*) –3.5 (*c*) –3 (*d*) 0

72. If $\frac{dy}{dx}=(ln5)\,y$ with $y(0) = ln5$, then what is $y(1)$ equal to?

(*a*) 0 (*b*) 5 (*c*) $2ln5$ (*d*) $5ln5$

73. Consider the following in respect of the function $f(x) = 10^x$.

1. Its domain is $(-\infty, \infty)$
2. It is continuous function
3. It is differentiable at $x = 0$

Which of the above statements are correct?

(*a*) 1 and 2 only (*b*) 2 and 3 only

(*c*) 1 and 3 only (*d*) 1, 2 and 3

74. What is $\lim_{x\to 0} x^3\,(\text{cosec}\,x)^2$ equal to?

(*a*) 0 (*b*) $\frac{1}{2}$

(*c*) 1 (*d*) Limit does not exist

75. What is $\lim_{x\to 1}\frac{x^3-1}{\sqrt{x}-1}$ equal to?

(*a*) 0 (*b*) 3

(*c*) 6 (*d*) Limit does not exist

76. In which one of the following intervals is the function $f(x)=\frac{x^3}{3}-\frac{7x^2}{2}+6x+5$ decreasing?

(*a*) $(-\infty, 1)$ only (*b*) (1, 6)

(*c*) $(6, \infty)$ only (*d*) $(-\infty, 1) \cup (5, \infty)$

77. If the derivative of the function $f(x)=\frac{m}{x}+2nx+1$ vanishes at $x = 2$, then what is the value of $m + 8n$?

(*a*) –2

(*b*) 0

(*c*) 2

(*d*) Cannot be determined due to insufficient data

78. What is the area included in the first quadrant between the curves $y = x$ and $y = x^3$?

(*a*) $\frac{1}{8}$ square unit (*b*) $\frac{1}{4}$ square unit

(*c*) $\frac{1}{2}$ square unit (*d*) 1 square unit

79. If $xy = 4225$ where x, y are natural numbers, then what is the minimum value of $x + y$?

(*a*) 130 (*b*) 260 (*c*) 2113 (*d*) 4226

80. What does the equation $x\frac{dy}{dx} - 2y = 0$ represent?

(*a*) A family of straight lines (*b*) A family of circles

(*c*) A family of parabolas (*d*) A family of ellipses

81. If the points with coordinates $(-5, 0)$, $(5p^2, 10p)$ and $(5q^2, 10q)$ are collinear, then what is the value of pq where $p \neq q$?

(*a*) –2 (*b*) –1 (*c*) 1 (*d*) 3

82. What is the equation of the straight line which passes through the point (1, –2) and cuts off equal intercepts from the axes?

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

(*c*) $x + y + 1 = 0$ (*d*) $x - y - 2 = 0$

83. What is the equation of the circle which touches both the axes in the first quadrant and the line $y - 2 = 0$?

(*a*) $x^2 + y^2 - 2x - 2y - 1 = 0$ (*b*) $x^2 + y^2 + 2x + 2y + 1 = 0$

(*c*) $x^2 + y^2 - 2x - 2y + 1 = 0$ (*d*) $x^2 + y^2 - 4x - 4y + 4 = 0$

84. What is the equation of the parabola with focus (–3, 0) and directrix $x - 3 = 0$?

(*a*) $y^2 = 3x$ (*b*) $x^2 = 12y$

(*c*) $y^2 = 12x$ (*d*) $y^2 = -12x$

85. What is the distance between the foci of the ellipse $x^2 + 2y^2 = 1$?

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

86. Let a, b, c be the lengths of sides BC, CA, AB respectively of a triangle ABC. If p is the perimeter and q is the area of the triangle, then what is $p(p-2a)\tan\left(\frac{A}{2}\right)$ equal to?

(*a*) q (*b*) $2q$ (*c*) $3q$ (*d*) $4q$

87. A straight line passes through the point of intersection of $x + 2y + 2 = 0$ and $2x - 3y - 3 = 0$. It cuts equal intercepts in the fourth quadrant. What is the sum of the absolute values of the intercepts?

(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 6

88. Under which one of the following conditions are the lines $ax + by + c = 0$ and $bx + ay + c = 0$ parallel ($a \neq 0$, $b \neq 0$)?

(*a*) $a - b = 0$ only (*b*) $a + b = 0$ only

(*c*) $a^2 - b^2 = 0$ (*d*) $ab + 1 = 0$

89. What is the equation of the locus of the mid-point of the line segement obtained by cutting the line $x + y = p$, (where p is a real number) by the coordiante axes?

(*a*) $x - y = 0$ (*b*) $x + y = 0$

(*c*) $x - y = p$ (*d*) $x + y = p$

90. If the point (x, y) is equidistant from the points $(2a, 0)$ and $(0, 3a)$ where $a > 0$ then which one of the following is correct?

(*a*) $2x - 3y = 0$ (*b*) $3x - 2y = 0$

(*c*) $4x - 6y + 5a = 0$ (*d*) $4x - 6y - 5a = 0$

Consider the following for the next three (03) items that follow:

The plane $6x + ky + 3z - 12 = 0$ where $k \neq 0$ meets the coordinate axes at A, B and C respectively. The equation of the sphere passing through the origin and A, B, C is $x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$.

91. What is the value of k?

(*a*) 3 (*b*) 4 (*c*) 6 (*d*) 12

92. If p is the perpendicular distance from the centre of the sphere to the plane, then which one of the following is correct?

(*a*) $0 < p < 0.5$ (*b*) $0.5 < p < 1$

(*c*) $1 < p < 1.5$ (*d*) $p > 1.5$

93. What is the equation of the line through the origin and the centre of the sphere?

(*a*) $x = y = z$ (*b*) $2x = 3y = 4z$

(*c*) $6x = 3y = 4z$ (*d*) $6x = 4y = 3z$

Consider the following for the next two (02) items that follow:

Let the plane $\frac{2x}{k} + \frac{2y}{3} + \frac{z}{3} = 2$ pass through the point (2, 3, –6).

94. What are the direction ratios of a normal to the palne?

(*a*) <3, 2, 1> (*b*) <2, 3, 6>

(*c*) <6, 3, 2> (*d*) <1, 2, 3>

95. If p, q and r are the intercepts made by the plane on the coordinate axes respectively, then what is $(p + q + r)$ equal to ?

(*a*) 10 (*b*) 11 (*c*) 12 (*d*) 13

96. If $4\hat{i} + \hat{j} - 3\hat{k}$ and $p\hat{i} + q\hat{j} - 2\hat{k}$ are collinear vectors, then what are the possible values of p and q respectively?

(*a*) 4, 1 (*b*) 1, 4 (*c*) $\frac{8}{3}, \frac{2}{3}$ (*d*) $\frac{2}{3}, \frac{8}{3}$

97. If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of the vertices A, B, C respectively of a triangle ABC and G is the centroid of the triangle, then what is $\overrightarrow{AG}$ equal to?

(*a*) $\frac{\vec{a} + \vec{b} + \vec{c}}{3}$ (*b*) $\frac{2\vec{a} - \vec{b} - \vec{c}}{3}$

(*c*) $\frac{\vec{b} + \vec{c} - 2\vec{a}}{3}$ (*d*) $\frac{\vec{a} - 2\vec{b} - 2\vec{c}}{3}$

98. Consider the following statements:

1. Dot product over vector addition is distributive
2. Cross product over vector addition is distributive
3. Cross product of vectors is associative

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) 1 and 2 only (*d*) 1, 2, and 3

99. $\vec{a}, \vec{b}, \vec{c}$ be three non-zero vectors such that $\vec{a} \times \vec{b} = \vec{c}$. Consider the following statements:

1. $\vec{a}$ is unique if $\vec{b}$ and $\vec{c}$ are given
2. $\vec{c}$ is unique if $\vec{a}$ and $\vec{b}$ are given

Which of the above statements is/are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

100. Let $\vec{a}$ and $\vec{b}$ be two unit vectors such that $|\vec{a} - \vec{b}| < 2$. If 2θ is the angle between $\vec{a}$ and $\vec{b}$, then which one of the following is correct?

(*a*) $0 < \sin\theta < 1$ only (*b*) $-\frac{1}{2} < \sin\theta < \frac{1}{2}$ only

(*c*) $-1 < \sin\theta < 0$ only (*d*) $-1 < \sin\theta < 1$

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101. Two digits out of 1, 2, 3, 4, 5 are chosen at random and multiplied together. What is the probability that the last digit in the product appears as 0?

(*a*) $\frac{1}{10}$ (*b*) $\frac{1}{5}$ (*c*) $\frac{2}{5}$ (*d*) $\frac{4}{5}$

102. The frequency curve (assuming unimodal) corresponding to the data obtained in an experiment is skewed to the left. What conclusion can be drawn from the curve?

(*a*) Mean > Median > Mode (*b*) Mean > Mode > Median
(*c*) Median > Mean > Mode (*d*) Mode > Median > Mean

103. The variance of five positive observations is 3.6. If four of the observations are 2, 2, 4, 5 then what is the remaining observation?

(*a*) 4 (*b*) 5 (*c*) 7 (*d*) 9

104. What is the arithmetic mean of 50 terms of an AP with first term 4 and common difference 4?

(*a*) 50 (*b*) 51 (*c*) 100 (*d*) 102

105. What is the coefficient of mean deviation of 21, 34, 23, 39, 26, 37, 40, 20, 33, 27 (taken from mean)?

(*a*) 0.11 (*b*) 0.22 (*c*) 0.33 (*d*) 0.44

Consider the following for the next three (03) items that follow:

The algebraic sum of the deviations of a set of values $x_1, x_2, x_3, \ldots x_n$ measured from 100 is –20 and the algebraic sum of the deviations of the same set of values measured from 92 is 140.

106. What is the mean of the values?

(*a*) 91 (*b*) 96 (*c*) 98 (*d*) 99

107. What is the algebraic sum of the deviations of the same set of values measured from 99?

(*a*) 0 (*b*) 10 (*c*) 20 (*d*) 40

108. If the algebraic sum of the deviations of the same set of values measured from y is 180, then what is the value of y?

(*a*) 80 (*b*) 85 (*c*) 90 (*d*) 95

Consider the following data for the next three (03) items that follow:

The marks obtained by 51 students in a class are in AP with its first term 4 and common difference 3.

109. What is the mean of the marks?

(*a*) 67 (*b*) 71 (*c*) 75 (*d*) 79

110. What is the median of the marks?

(*a*) 79.5 (*b*) 79 (*c*) 78.5 (*d*) 77

111. What is the sum of the deviations measured from the median?

(*a*) –1 (*b*) 0 (*c*) 1 (*d*) 2

Consider the following data for the next three (03) items that follow:

There are 90 applicants for a job. Some of them are graduates. Some of them have less than three years experience.

	Number of graduates	Number of non-graduates
At least 3 years experience	18	9
Less than 3 years experience	36	27

Let G be the event that the first applicant interviewed is a graduate and T be the event that first applicant interviewed has at least 3 year experience.

112. What is $P(G \cap \overline{T})$ equal to?

(*a*) $\frac{1}{5}$ (*b*) $\frac{2}{5}$ (*c*) $\frac{3}{5}$ (*d*) $\frac{4}{5}$

113. What is $P(G|\overline{T})$

(*a*) $\frac{2}{7}$ (*b*) $\frac{3}{7}$ (*c*) $\frac{4}{7}$ (*d*) $\frac{5}{7}$

114. What is $P(\overline{T}|\overline{G})$ equal to?

(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{3}$ (*c*) $\frac{3}{5}$ (*d*) $\frac{3}{4}$

Consider the following data for the next three (03) items that follow:

The incidence of suffering from a diseases among workers in an industry has a chance of $33\frac{1}{3}\%$.

115. What is the probability that exactly 3 out of 6 workers suffer from a disease?

(*a*) $\frac{80}{729}$ (*b*) $\frac{10}{81}$ (*c*) $\frac{10}{243}$ (*d*) $\frac{160}{729}$

116. What is the probability that no one out of 6 workers suffers from a disease?

(*a*) $\frac{665}{729}$ (*b*) $\frac{64}{729}$ (*c*) $\frac{4}{243}$ (*d*) $\frac{1}{729}$

117. What is the probability that at least one out of 6 workders suffer from a disease?

(*a*) $\frac{728}{729}$ (*b*) $\frac{665}{729}$ (*c*) $\frac{653}{729}$ (*d*) $\frac{596}{729}$

Consider the following frequency distribution for the next three (03) items that follow:

Class	0-20	20-40	40-60	60-80	80-100
Frequency	17	$p+q$	32	$p-3q$	19

The total frequency is 120. the mean is 50.

118. What is the value of p?

(*a*) 25 (*b*) 26 (*c*) 27 (*d*) 28

119. What is the value of q?

(*a*) 1 (*b*) 2 (*c*) 3 (*d*) 4

120. If the frequency of each class is doubled, then what would be the mean?

(*a*) 25 (*b*) 50 (*c*) 75 (*d*) 100

Paper II: General Ability

PART-A

Spotting Errors

Directions (1-10): Each item in this section has a sentence with three underlined parts labelled (*a*), (*b*) and (*c*). Read each sentence to determine whether there is any error in any underline part and indicate your response in the Answer sheet with the corresponding letter, i.e., (*a*) or (*b*) or (*c*). If you find no error, your response should be indicated as (*d*).

1. (*a*) A company of five thousand soldiers
(*b*) having marched tirelessly for over five days
(*c*) have just moved into their cantonment
(*d*) No error

2. (*a*) Every person who believes in principles
(*b*) must stand up to fight
(*c*) for their convictions
(*d*) No error

3. (*a*) The Olympic Games reflects
(*b*) the highest spirit of
(*c*) human endeavour and achievement
(*d*) No error

4. (*a*) The principal of the school
(*b*) stressed the need for discipline
(*c*) amongst the students
(*d*) No error

5. (*a*) Failure is the stepping stone to success;
(*b*) however, successive failures are not
(*c*) successive stepping stones to success
(*d*) No error

6. (*a*) India's strengths are
(*b*) its diversity of culture and
(*c*) the spirit of tolerance in it's people
(*d*) No error

7. (*a*) Once considered ninth planet of the solar system
(*b*) Pluto is today listed as the
(*c*) largest dwarf planet of the solar system
(*d*) No error

8. (*a*) The greatest glory in life
(*b*) is to be able to realize ones dreams and ambitions
(*c*) without trampling on those of others
(*d*) No error

9. (*a*) To be able to manage one's
(*b*) anger is a reflection of an individual's
(*c*) psychological maturity
(*d*) No error

10. (*a*) A honest mistake
(*b*) is no more than that;
(*c*) just an honest mistake.
(*d*) No error

Idioms and Phrases

Directions (11-20): Given below are some idioms/phrases followed by four alternative meanings to each. Choose the most appropriate answer from the options (*a*), (*b*), (*c*) and (*d*).

11. Counting your chickens
(*a*) confident of success
(*b*) being careful about spending money
(*c*) getting scared because of danger
(*d*) greedily accumulating wealth

12. The icing on the cake
(*a*) baked food that is delicate and delicious with a topping
(*b*) extra benefit over and above an already good deal
(*c*) more than what is needed
(*d*) getting what you asked for

13. A stitch in time
(*a*) making an effort to succeed
(*b*) tailoring one's efforts efficiently
(*c*) inability to take timely decision
(*d*) timely action that prevents a negative outcome

14. At sixes and sevens
(*a*) on top of the situation (*b*) state of denial
(*c*) state of total confusion. (*d*) well-planned and prepared

15. Talking twenty to the dozen
(*a*) talking hurriedly and rapidly
(*b*) talking too much
(*c*) talking without making sense
(*d*) talking out of turn

16. Under the weather
(*a*) walking in the rain (*b*) controlled by the elements.
(*c*) browbeaten by the heat (*d*) unwell

17. To sit on the fence
(*a*) to act promptly (*b*) to be lazy
(*c*) to be undecided (*d*) to sit without doing anything

18. Once in a blue moon
(*a*) romantic moment (*b*) occasionally
(*c*) rarely (*d*) often

19. Through thick and thin
(*a*) in genuine friendship
(*b*) through the best of everything
(*c*) among people both fat and slim
(*d*) through difficult times

20. Like chalk and cheese
(*a*) very different from each other
(*b*) without any blemish
(*c*) pure white in colour
(*d*) very like each other

Ordering of Words in a Sentence

Directions (21-30): Each of the following items in this section consists of a sentence, the parts of which have been jumbled. These parts have been labelled P, Q, R and S. Given below each sentence are four sequences namely (*a*), (*b*), (*c*) and (*d*). You are required to rearrange the jumbled parts of the sentence and mark your response accordingly.

21. P: but perhaps the best way is to agree
Q: there are many ways of dealing
R: with them without excessive argumentation
S: with intransigent customers
The correct sequence should be
(*a*) QPRS (*b*) QSPR (*c*) PSQR (*d*) RSQP

22. P: in the years following
Q: India achieved remarkable economic development
R: liberalization in the year 1991
S: the landmark reforms inaugurated via
The correct sequence should be
(*a*) PQRS (*b*) PRSQ (*c*) SPRQ (*d*) QPSR

23. P: was the victory secured by the women's hockey team
Q: in the arena of sport, perhaps
R: against Australia in the Tokyo Olympics
S: the greatest moment in Indian Olympic history
The correct sequence should be
(*a*) SPQR (*b*) QSPR (*c*) RPQS (*d*) QRPS

24. P: in terms of GDP and GNP
Q: for gauging the success of a nation
R: which are the two major determinants
S: economic progress is determined
The correct sequence should be
(*a*) SQRP (*b*) RPQS (*c*) SPRQ (*d*) QRPS

25. P: with the aplomb of a stage artist
Q: that they are not men of straw
R: they can twist and shake their wobbly heads
S: mesmerizing the gullible into believing
The correct sequence should be
(*a*) PRQS (*b*) RPSQ (*c*) SPQR (*d*) QRPS

26. P: of its rain-soaked verdure
Q: and on the other there are
R: on the one hand there is the immense beauty
S: the artifacts of its visible modernity
The correct sequence should be
(*a*) PRQS (*b*) QRSP (*c*) SPQR (*d*) RPQS

27. P: are often rooted
Q: the causes
R: of extreme poverty
S: in the inequalities of social systems
The correct sequence should be
(*a*) QRPS (*b*) QRSP (*c*) SRQP (*d*) SRPQ

28. P: a person by the way
Q: he behaves and
R: you must judge
S: not by the way he looks
The correct sequence should be
(*a*) RPQS (*b*) QRSP (*c*) RSQP (*d*) QPSR

29. P: to the greatest number of people
Q: that causes the least discomfort
R: whenever in doubt
S: always opt for the option
The correct sequence should be
(*a*) RQPS (*b*) QRSP (*c*) RSQP (*d*) QPSR

30. P: brought by bad times
Q: against the despondency
R: our greatest defence
S: faith and belief are
The correct sequence should be
(*a*) RQPS (*b*) SRQP (*c*) RSQP (*d*) QPRS

Antonyms

Directions (31-40): Each item in this section consists of a sentence with an underlined word followed by four words (*a*), (*b*), (*c*) and (*d*). Select the option that is opposite in meaning to the underlined word and mark your response in your Answer Sheet accordingly.

31. He is essentially a **crude** person.
(*a*) coarse (*b*) refined
(*c*) eager (*d*) balanced

32. His **confidence** is high.
(*a*) diffidence (*b*) eagerness
(*c*) steadfastness (*d*) endurance

33. His **integrity** is noticed.
(*a*) skillfulness (*b*) ability
(*c*) dependability (*d*) dishonesty

34. She is a **benevolent** individual.
(*a*) clever (*b*) muddled
(*c*) malevolent (*d*) ambivalent

35. His **sartorial** manner is judged.
(*a*) unstylish (*b*) uncompromising
(*c*) common (*d*) crude

36. This piece of art is **authentic**.
(*a*) genuine (*b*) expensive
(*c*) rare (*d*) fake

37. The **deluge** affected the population.
(*a*) cloudburst (*b*) drought
(*c*) deforestation (*d*) drizzle

38. His **dedication** is known to all.
(*a*) clarity (*b*) hostility
(*c*) apathy (*d*) anger

39. His **perspicacity** was remarkable.
(*a*) smartness (*b*) dullness
(*c*) dedication (*d*) deviousness

40. He has a **penchant** for spicy food.
(*a*) tendency (*b*) affinity
(*c*) fear (*d*) dislike

Synonyms

Directions (41-50): Each item in this section consists of a sentence with an underlined word followed by four words (*a*), (*b*), (*c*) and (*d*). Select the option that is nearest in meaning to the underlined word and mark your response in your Answer Sheet accordingly.

41. After a good meal, it is important to pay a **compliment** to the chef.
(*a*) tip (*b*) praise (*c*) admonish (*d*) revile

42. His work is **laudable**.
(*a*) praiseworthy (*b*) laughable
(*c*) bold (*d*) loud

43. Raj is a **competent** carpenter.
(*a*) capable (*b*) exceptional
(*c*) inadept (*d*) clumsy

44. He is **diligent** in submitting assignments.
(*a*) dilly-dallying (*b*) procrastinating
(*c*) intelligent (*d*) conscientious

45. He appears to be **reticent**.
(*a*) expansive (*b*) jolly
(*c*) silent (*d*) withdrawn

46. He is always **jovial**.
(*a*) cheerful (*b*) callous
(*c*) garrulous (*d*) credulous

47. Mohan remains **morose** these days.
(*a*) introspective (*b*) generous
(*c*) chirpy (*d*) sullen

48. He was a **reluctant** learner.
(*a*) enthusiastic (*b*) eager
(*c*) unwilling (*d*) fearful

49. Amit is **optimistic** about the prospects of his investments.
(*a*) pessimistic (*b*) uncaring
(*c*) carefree (*d*) sanguine

50. Sachin is very **cooperative** by nature.
(*a*) complaisant (*b*) covert
(*c*) complacent (*d*) conniving

PART-B

51. What is the mass of a material, whose specific heat capacity is 400 J/(kg °C) for a rise in temperature from 15 °C to 25 °C, when heat received is 20 kJ?
(*a*) 0.1 kg (*b*) 1 kg (*c*) 10 kg (*d*) 5 kg

52. The specific latent heat of vaporization of a substance is the quantity of heat needed to change unit mass from
(*a*) liquid to vapour with a change of temperature
(*b*) liquid to vapour without a change of temperature
(*c*) vapour to liquid without a change of temperature
(*d*) vapour to liquid with a change of temperature

53. Evaporation from the surface of a given liquid takes place more rapidly when
(*a*) the temperature is high and the surface area of the liquid is large
(*b*) the temperature is low and the surface area of the liquid is large
(*c*) the temperature is low and the surface area of the liquid is small
(*d*) the temperature is high and the surface area of the liquid is small

54. Which of the following statements correctly explains/explain the existence of a positive force between two electric charges?
1. Both the charges are positive.
2. Both the charges are negative.
3. Both the charges are oppositely charged.

Select the correct answer using the code given below.
(*a*) 1 only (*b*) 2 only
(*c*) 1 and 2 only (*d*) 1, 2 and 3

55. An electric wire of resistance 50 ohm is cut into five equal wires. These wires are then connected in parallel. What is the equivalent resistance of this combination?
(*a*) 2 ohm (*b*) 10 ohm (*c*) 0.5 ohm (*d*) 5 ohm

56. The electric field lines from an isolated positively charged conducting sphere are
(*a*) tangential to surface the conducting
(*b*) at right angles to the conducting surface and towards the centre of the sphere
(*c*) at any angle to the conducting surface
(*d*) at right angles to the conducting surface and outwards from the centre of the sphere

57. Which one of the following is not a solution?
(*a*) Alloy (*b*) Milk (*c*) Air (*d*) Sugar

58. Refining of petroleum is carried out using which one of the following techniques?
(*a*) Evaporation
(*b*) Fractional distillation
(*c*) Separating funnel
(*d*) Sublimation

59. Which one of the following is a chemical change?
(*a*) Dissolving sugar in water
(*b*) Melting of ice
(*c*) Crystallization
(*d*) Milk turning sour

60. Which one of the following is the correct molecular formula of ammonium carbonate if the valency of ammonium ion is (+1) and carbonate anion is (–2)?
(*a*) $(NH_4)_2CO_3$ (*b*) $NH_4(CO_3)_2$
(*c*) $(NH_3)_2CO_3$ (*d*) NH_4CO_3

61. Which one of the following is a covalent compound?
(*a*) Calcium oxide (*b*) Sodium nitride
(*c*) Silicon carbide (*d*) Zinc sulphide

62. The mass number of argon is 40. Which one of the following statements is correct?
(*a*) The number of protons in argon is 22.
(*b*) The number of neutrons in argon is 18.
(*c*) The number of electrons in argon is 18.
(*d*) The sum of numbers of protons and electrons in argon is 40.

63. Which one of the following is the correct order of the valencies of elements Ne, Si, N and Mg?
(*a*) Ne < Mg <N < Si (*b*) Si <N< Mg < Ne
(*c*) Ne <N <Si < Mg (*d*) Mg < Ne <N <Si

64. The frequency of an alternating current is 3 Hz. It implies that
(*a*) there are 6 cycles/s (*b*) there are 3 cycles/s
(*c*) there are 2 cycles/s (*d*) there is only 1 cycle/s

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65. Which one of the following correctly represents the SI unit of resistivity?
(*a*) Ω (*b*) Ω/m (*c*) Ω cm (*d*) Ω m

66. What is the current required to light a 60 W incandescent bulb in a domestic supply of 240 V?
(*a*) 0.5 A (*b*) 0.25 A (*c*) 1 A (*d*) 5 A

67. The magnetic field produced by a current-carrying straight wire at a point outside the wire depends
(*a*) inversely on the distance from it
(*b*) directly on the distance from it
(*c*) inversely at short distances and directly at large distances from it
(*d*) directly on the distance (at short distances) and inversely on the distance (at long distances) from it

68. What is the dimension of gravitational constant?
(*a*) $[ML^3T^{-2}]$ (*b*) $[M^{-1}L^3T^{-2}]$
(*c*) $[M^2L^{-2}T^{-2}]$ (*d*) $[M^2L^{-1}T^{-2}]$

69. A ball is thrown vertically upward with a speed of 40 m/s. The time taken by the ball to reach the maximum height would be approximately
(*a*) 2 s (*b*) 3 s
(*c*) 4 s (*d*) 5 s

70. The time period of a 1 m long pendulum approximates to
(*a*) 6 s (*b*) 4 s (*c*) 2 s (*d*) 1 s

71. Which of the following statements about living and non-living being is/are correct?
1. While living being can demonstrate growth and repair, non-living being cannot.
2. While living being demonstrates metabolic processes, non-living being does not.

Select the correct answer using the code given below.
(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

72. Which one of the following plant plastids stores starch, oil and protein granules?
(*a*) Chloroplast (*b*) Leucoplast
(*c*) Chromoplast (*d*) Xanthoplast

73. Which one of the following statements about 'vacuoles' is not correct?
(*a*) In plants, there is a large central vacuole that may occupy 90% of total cell volume.
(*b*) In plant cells, vacuoles provide turgidity and rigidity.
(*c*) In *Amoeba*, vacuoles have role in nutrition.
(*d*) Vacuoles are absent in animal cells.

74. In aquatic plants, large air sacs give them buoyancy effects. These sacs surrounded by which one of the following types of tissues?
(*a*) Parenchyma (*b*) Collenchyma
(*c*) Sclerenchyma (*d*) Complex tissue

75. Which one of the following belongs to 'Pisces'?
(*a*) Dogfish (*b*) Jellyfish
(*c*) Silverfish (*d*) Starfish

76. Which one of the following groups is called 'amphibians of plant kingdom' ?
(*a*) Bryophytes (*b*) Thallophytes
(*c*) Pteridophytes (*d*) Gymnosperms

77. Which one of the following is caused by a bacterial pathogen?
(*a*) AIDS (*b*) Dengue fever
(*c*) COVID-19 (*d*) Typhoid fever

78. The twinkling of a star is due to the atmospheric
(*a*) diffraction of starlight (*b*) reflection of starlight
(*c*) refraction of starlight (*d*) dispersion of starlight

79. A mass M is dragged by a pulley on a horizontal plane by a force anti-parallel to its displacement. The work done in pulling the mass M is
(*a*) zero (*b*) positive (*c*) infinite (*d*) negative

80. A 5 N force is defined when a mass of 10 kg is accelerated with
(*a*) 5.0 cm/s² (*b*) 0.5 m/s² (*c*) 0.5 cm/s² (*d*) 5.0 m/s²

81. A boy of mass 52 kg jumps with a horizontal velocity of 2 m/s onto a stationary cart of mass 3 kg. The cart is fixed with frictionless wheels. Which one of the following would be the speed of the cart?
(*a*) 2·15 m/s (*b*) 1·89 m/s (*c*) 1.51 m/s (*d*) 2.51 m/s

82. The energy possessed by a body due to its change in position or shape is called
(*a*) thermal energy (*b*) potential energy
(*c*) kinetic energy (*d*) electric energy

83. A sound wave has a frequency of 1 kHz and wavelength 50 cm. How long will it take to travel 1 km?
(*a*) 5 s (*b*) 4 s
(*c*) 3 s (*d*) 2 s

84. For an element with atomic number 35, which one of the following will be the correct number of electrons in its valence shell based on Bohr's model of an atom?
(*a*) 1 (*b*) 3
(*c*) 5 (*d*) 7

85. Which one of the following is not an example of a redox reaction?
(*a*) $AlCl_3 + 3H_2O \rightarrow Al(OH)_3 + 3HC1$
(*b*) $2NaH \rightarrow 2Na + H_2$
(*c*) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$
(*d*) $CuSO_4 + Zn \rightarrow Cu + ZnSO_4$

86. Which one of the following allotropes of carbon is isomorphous with crystalline silicon?
(*a*) Coke (*b*) Diamond
(*c*) Graphite (*d*) Coal

87. Which one of the following is the colour of hydrogen gas?
(*a*) Light yellow (*b*) Orange
(*c*) Black (*d*) Colourless

88. Which one of the following is not a pigment?
(*a*) Zinc oxide (*b*) Chalk
(*c*) White lead (*d*) Silica

89. Which one of the following statements about fertilizers is not correct?
(*a*) Urea is a phosphorus-containing fertilizer.
(*b*) Application of fertilizer to the soil increases fertility of the soil.
(*c*) Urea can be prepared by action of ammonia and carbon dioxide under high pressure and at high temperature.
(*d*) Urea contains more nitrogen than other fertilizers.

90. Which one of the following statements is not correct?

(*a*) Most carbon compounds are good conductors of electricity.

(*b*) Bonding in organic compounds is covalent.

(*c*) Graphite is used as a lubricant.

(*d*) Diamond is an allotrope of carbon.

91. Which one of the following reactions is an example of decomposition reaction?

(*a*) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

(*b*) $2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$

(*c*) $CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O$

(*d*) $Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

92. Which one of the following is the mechanism of action of oral contraceptive pills?

(*a*) They kill the egg.

(*b*) They kill the sperm.

(*c*) They kill the zygote.

(*d*) They inhibit the release of egg.

93. Which one of the following plants has unisexual flowers?

(*a*) Papaya (*b*) Hibiscus

(*c*) Mustard (*d*) Sunflower

94. A cell is unable to synthesize lipids. Which of its cell organelles might be defective?

(*a*) Smooth endoplasmic reticulum

(*b*) Golgi bodies

(*c*) Lysosomes

(*d*) Mitochondria

95. All objects experience a buoyancy when they are immersed in a fluid. Buoyancy is

(*a*) a downward force (*b*) a downward pressure

(*c*) an upward force (*d*) an upward pressure

96. According to Fleming's right-hand rule, if the forefinger indicates the direction of magnetic field and thumb shows the direction of motion of conductor, then the stretched middle finger will predict the direction of

(*a*) force acting on the conductor

(*b*) electric field

(*c*) induced current

(*d*) current

97. Two resistors R_1 and R_2 arranged in parallel combination in an electrical closed circuit are made of the same material and of same thickness. If the length of R_2 is twice the length of R_1, then the total resistance R satisfies

(*a*) $3R = 2R_1$ (*b*) $3R = 2R_2$ (*c*) $2R = 3R_1$ (*d*) $2R = 3R_2$

98. What is the magnification produced by a concave lens of focal length 10 cm, when an image is formed at a distance of 5 cm from the lens?

(*a*) 2.0 (*b*) 1.0 (*c*) 0.5 (*d*) 0.33

99. A wooden box of mass 2 kg and dimensions (30 cm × 15 cm × 10 cm) is placed on a table with sides 30 cm and 10 cm touching the tabletop. Which one of the following is the approximate pressure exerted on the table?

(*a*) 111.1 N/m^2 (*b*) 222.2 N/m^2

(*c*) 333.3 N/m^2 (*d*) 666.6 N/m^2

100. Why are the tyres of aircrafts made of conducting rubber?

1. So that the charge accumulated on the aircraft in flight, by rubbing the air, can easily be transferred to ground on landing.
2. So that the charge accumulated due to the operation of various electronic equipments in the aircraft in flight can easily be transferred to ground on landing.

Select the correct answer using the code given below.

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

101. Arthashastra, the classical work of Indian political thought, focuses primarily on

(*a*) economy (*b*) culture (*c*) statecraft (*d*) monarchy

102. When did Charaka Samhita originate?

(*a*) 6th Century BCE (*b*) 3rd to 2nd Century BCE

(*c*) 4th Century BCE (*d*) 5th Century BCE

103. Early Buddhist sculptors did not show Buddha in human form. Through which of the following symbols was Buddha's presence shown by the early sculptors?

(*a*) Empty Seat and Stupa only

(*b*) Wheel and Tree only

(*c*) Wheel, Tree and Stupa only

(*d*) Empty Seat, Wheel, Tree and Stupa

104. The Parliament of India is primarily based on the model of

(*a*) German Parliament (*b*) British Parliament

(*c*) American Congress (*d*) French Parliament

105. Who among the following had the shortest span in office as the Prime Minister of India?

(*a*) Lal Bahadur Shastri (*b*) Chaudhary Charan Singh

(*c*) Chandra Shekhar (*d*) H. D. Deve Gowda

106. Which one of the following does not fall under the jurisdiction of the apex court of India?

(*a*) Original Jurisdiction

(*b*) Appellate Jurisdiction

(*c*) Collegiate Jurisdiction

(*d*) Advisory Jurisdiction

107. According to the Indian Meteorological Department, which of the following is/are the feature/features of cloudburst?

1. Heavy precipitation in short period of time in a limited geographical area
2. It occurs generally during monsoon period and triggers flash flood and landslides

Select the correct answer using the code given below.

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

108. In a group discussion on shape and size of the Earth, three students stated the following points:

1. Student 1: The shape of the Earth is basically an oblate spheroid.
2. Student 2: The polar diameter of the Earth is more than the equatorial diameter.
3. Student 3 Bulge along the equatorial region is due to revolution of the Earth.

Who among the above students is/are correct?

(*a*) Student 1 only

(*b*) Student 1 and Student 2 only

(*c*) Student 2 and Student 3 only

(*d*) Student 1, Student 2 and Student 3

109. While watching news, you hear about a place, of which you had never heard earlier. You want to know more about the place and you want to locate it on the map. Which of the following is/are required for you to be able to locate the place on the map?
(*a*) Only latitude of the place
(*b*) Only longitude of the place
(*c*) Both longitude and latitude of the place
(*d*) Latitude, longitude and altitude of the place

110. Which one of the following statements with respect to Global Positioning System (GPS) is not correct?
(*a*) It is based on network of satellites, orbiting above the Earth.
(*b*) It is based on the system of triangulation.
(*c*) GPS receivers provide location in terms of latitude, longitude and altitude.
(*d*) It provides information exclusively for military operations.

111. Which one of the following is not Constitutional Commission of India?
(*a*) The National Commission for Scheduled Castes
(*b*) The National Commission for Scheduled Tribes
(*c*) The National Commission for Backward Classes
(*d*) The National Commission for Women

112. Which Chinese traveller in ancient India wrote the diary called 'Records of the Travels to Middle India"?
(*a*) Wang Xuance (*b*) Xuanzang
(*c*) Yijing (*d*) Li Yibiao

113. The elections to the Lower House of the Parliament of India, held in 2019, constituted the
(*a*) 14th Lok Sabha (*b*) 15th Lok Sabha
(*c*) 16th Lok Sabha (*d*) 17th Lok Sabha.

114. Panchayati Raj Institutions are primarily the institutions of
(*a*) Popular Government (*b*) Self-Government
(*c*) Federal Government (*d*) Quasi-Government

115. Which of the following is/are the right/ rights mentioned in the 'American Declaration of Independence'?
1. Life 2. Liberty
3. Pursuit of Happiness 4. Fraternity
Select the correct answer using the code given below.
(*a*) 1 only (*b*) 1 and 2 only
(*c*) 1, 2 and 3 (*d*) 2, 3 and 4

116. Who among the following American Presidents described democracy as "Government of the People, for the People and by the People"?
(*a*) Abraham Lincoln (*b*) Thomas Jefferson
(*c*) George Washington (*d*) John F. Kennedy

117. Inhabitants are unaware of the speed of rotation of the planet Earth because
1. The angular velocity is constant for each place on the Earth's surface
2. The atmosphere rotates with the Earth
3. There are no nearby objects, either stationary or moving at a rate different from that of the Earth
Which of the above is/are the correct explanation(s)?
(*a*) 1 only (*b*) 1 and 2 only
(*c*) 2 and 3 only (*d*) 1, 2 and 3

118. While travelling to a hilly region, you notice a massive boulder, which was loosened by heavy rains and moved downhill. This has resulted due to which of the following processes?
1. Mass wasting 2. Erosion
3. Weathering
Select the correct answer using the code given below.
(*a*) 1 only (*b*) 1 and 2 only
(*c*) 2 and 3 only (*d*) 1, 2 and 3

119. Which of the following statements in respect of landslides are correct?
1. These occur only on gentle slopes during rain.
2. They generally occur in clay-rich soil.
3. Earthquakes trigger landslides.
Select the correct answer using the code given below.
(*a*) 1 and 2 only (*b*) 1 and 3 only
(*c*) 2 and 3 only (*d*) 1, 2 and 3

120. Consider the following features about a geographical phenomenon:
1. Torrents of snow and ice roaring down a steep mountain side
2. It is hazardous to skiers and mountaineers
3. Itinvolves a mix of falling, rolling, sliding and flowing of materials
Which of the following phenomena can be identified with the above features?
(*a*) Slump and earthflow (*b*) Avalanche
(*c*) Landslide (*d*) Rockslide

121. The real beginning of western education in India can be dated from.
(*a*) the Charter Act of 1813
(*b*) the Charter Act of 1793
(*c*) the Sarda Act of 1929
(*d*) the Macaulay's Minute on Indian Education, 1835

122. The term 'Industrial Revolution' was first used by
(*a*) J. A. Blanqui (*b*) T. S. Ashton
(*c*) Arnold Toynbee (*d*) R. H. Tawney

123. The Khudai Khidmatgar (Servants of the God) was organized by
(*a*) Mahatma Gandhi (*b*) Khan Abdul Ghaffar Khan
(*c*) M. A. Jinnah (*d*) M. M. Malaviya

124. The Mahad Satyagraha of 1927 was organized by
(*a*) B. R. Ambedkar (*b*) Mahatma Gandhi
(*c*) S. C. Bose (*d*) Lokmanya Tilak

125. The Satyashodhak Samaj (Truth-Seeking Society) was set up by
(*a*) Vinoba Bhave (*b*) Jyotiba Phule
(*c*) B. R. Ambedkar (*d*) C. Rajagopalachari

126. The 13th Century text Lekhapaddhati gives us information on which one of the following topics?
(*a*) Art of writing (*b*) Essay writing
(*c*) Legal document (*d*) Epigraphic style

127. Nkrumah was one of the five leaders, who comprised the core of the Non-Aligned Movement (NAM). He was the leader of which country in Africa?
(*a*) Nigeria (*b*) Kenya (*c*) Uganda (*d*) Ghana

128. The idea of Planning in Independent India was drawn from
(*a*) the Bombay Plan
(*b*) the demand made by peasants
(*c*) the demand made by workers' unions
(*d*) the Gandhian vision of India's future

129. Nisarga, Gati, Nivar, Tauktae and Yaas are names of
(*a*) new fighter aircrafts (*b*) tourist places
(*c*) weather stations (*d*) cyclones

130. Which one of the following States/UTS was connected with the Indian Railways network in the year 2021?
(*a*) Mizoram (*b*) Ladakh (*c*) Manipur (*d*) Sikkim

131. The forests of Uttarakhand, Kullu Valley in Himachal Pradesh and Dzukou Valley in Nagaland and Manipur were in the news on account of which one of the following reasons?
(*a*) Deforestation (*b*) Forest fire
(*c*) Poaching of wild animals (*d*) Illegal mining

132. Which one of the following is correct in respect of total number of States and Union Territories in India?
(*a*) 28 States and 8 Union Territories
(*b*) 27 States and 9 Union Territories
(*c*) 30 States and 6 Union Territories
(*d*) 29 States and 7 Union Territories

133. Snow, sleet and hail are the forms of
(*a*) precipitation (*b*) condensation
(*c*) transpiration (*d*) evaporation

134. Which one of the following is likely to be the most prevalent form of weathering in hot-tropical desert areas?
(*a*) Mechanical (*b*) Chemical
(*c*) Biological (*d*) Leaching

135. Which one of the following cities was the first to attain the status of a 'megacity"?
(*a*) London (*b*) Paris (*c*) New York (*d*) Washington

136. In India, rigid and stable elevated lands, denuded rocks and series of scarps are the features of which of the following?
(*a*) Northern mountains (*b*) Peninsular plateau
(*c*) Northern plains (*d*) Coastal plains

137. A person had visited a region in India and found trees, such as Khair, Neem, Khejri and Palas. Which one of the following regions is she/he expected to have visited?
(*a*) Malabar Coast (*b*) Garo Hills
(*c*) Sunderban Delta (*d*) Desert Region

138. Consider the following statements:
1. Rocks do not remain in their original form for long and undergo transformation.
2. Transformation of rocks is caused by weathering, erosion and metamorphic action.

Which of the statements given above is/are correct?
(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

139. Weathering, mass wasting, erosion and transportation are indicators of which one of the following processes?
(*a*) Denudation (*b*) Endogenetic process
(*c*) Diastrophism (*d*) Mountain building

140. If you want to observe moraines, eskers and outwash plains, which one of the following Union Territories you may have to visit?
(*a*) Andaman and Nicobar Islands
(*b*) Lakshadweep
(*c*) Puducherry
(*d*) Ladakh

141. Legendary Kathak dancer Pandit Birju Maharaj died recently. He was the doyen of which one of the following Gharanas of Kathak?
(*a*) Jaipur (*b*) Raigarh
(*c*) Lucknow (*d*) Banaras

142. In a first, India is to export BrahMos missile to
(*a*) Bhutan (*b*) Philippines
(*c*) Maldives (*d*) Nepal

143. Who among the following is the Head of the Committee appointed by the Supreme Court of India to enquire into the circumstances that led to the Prime Minister of India's convoy being stuck for several minutes on a flyover in Punjab recently?
(*a*) Justice Indu Malhotra (*b*) Justice Ashok Bhushan
(*c*) Justice Navin Sinha (*d*) Justice Rohinton Fali Nariman

144. Who among the following retired from test cricket by bagging a wicket on the last ball of his career?
(*a*) AB de Villiers (*b*) Michael Hussey
(*c*) Quinton de Kock (*d*) Ross Taylor

145. Who among the following is appointed as the tenth Chairman of the Indian Space Research Organization (ISRO) recently?
(*a*) A. S. Kiran Kumar (*b*) K. Sivan
(*c*) K. Radhakrishnan (*d*) S. Somanath

146. According to the Forest Survey Report, 2021, area-wise which one of the following States has the largest forest cover in India?
(*a*) Odisha (*b*) Madhya Pradesh.
(*c*) Arunachal Pradesh (*d*) Chhattisgarh

147. Who among the following is the Chairperson of the Goods and Services Tax Council?
(*a*) The Prime Minister of India
(*b*) The Union Finance Minister
(*c*) The Speaker of the Lok Sabha
(*d*) The President of India

148. The International Union for Conservation of Nature categorized (IUCN) has recently the Red Sanders (Red) Sandalwood) into
(*a*) deficient category (*b*) endangered category
(*c*) near-threatened category (*d*) critically endangered category

149. The Government of India has decided to observe Veer Baal Diwas' on
(*a*) 6th October (*b*) 26th November
(*c*) 26th December (*d*) 6th December

150. On 14th January, 2022, which one of the following ministries has organized a global Surya Namaskar Demonstration programme?
(*a*) The Ministry of Culture
(*b*) The Ministry of AYUSH
(*c*) The Ministry of Health and Family Welfare
(*d*) The Ministry of Tourism

ANSWER KEY

Paper I: Mathematics

1. (*c*)	**2.** (*b*)	**3.** (*d*)	**4.** (*c*)	**5.** (*d*)	**6.** (*d*)	**7.** (*b*)	**8.** (*b*)	**9.** (*d*)	**10.** (*c*)
11. (*b*)	**12.** (*c*)	**13.** (*d*)	**14.** (*c*)	**15.** (*a*)	**16.** (*b*)	**17.** (*d*)	**18.** (*a*)	**19.** (*c*)	**20.** (*d*)
21. (*c*)	**22.** (*b*)	**23.** (*b*)	**24.** (*d*)	**25.** (*b*)	**26.** (*b*)	**27.** (*d*)	**28.** (*c*)	**29.** (*c*)	**30.** (*c*)
31. (*c*)	**32.** (*b*)	**33.** (*a*)	**34.** (*c*)	**35.** (*b*)	**36.** (*a*)	**37.** (*c*)	**38.** (*b*)	**39.** (*b*)	**40.** (*b*)
41. (*c*)	**42.** (*d*)	**43.** (*c*)	**44.** (*a*)	**45.** (*d*)	**46.** (*b*)	**47.** (*c*)	**48.** (*d*)	**49.** (*b*)	**50.** (*c*)
51. (*d*)	**52.** (*b*)	**53.** (*a*)	**54.** (*b*)	**55.** (*d*)	**56.** (*a*)	**57.** (*d*)	**58.** (*a*)	**59.** (*d*)	**60.** (*c*)
61. (*b*)	**62.** (*b*)	**63.** (*b*)	**64.** (*b*)	**65.** (*b*)	**66.** (*b*)	**67.** (*d*)	**68.** (*a*)	**69.** (*a*)	**70.** (*b*)
71. (*d*)	**72.** (*d*)	**73.** (*d*)	**74.** (*a*)	**75.** (*c*)	**76.** (*b*)	**77.** (*d*)	**78.** (*b*)	**79.** (*a*)	**80.** (*c*)
81. (*c*)	**82.** (*c*)	**83.** (*c*)	**84.** (*d*)	**85.** (*b*)	**86.** (*d*)	**87.** (*a*)	**88.** (*c*)	**89.** (*a*)	**90.** (*c*)
91. (*b*)	**92.** (*b*)	**93.** (*d*)	**94.** (*a*)	**95.** (*b*)	**96.** (*c*)	**97.** (*c*)	**98.** (*c*)	**99.** (*b*)	**100.** (*d*)
101. (*b*)	**102.** (*d*)	**103.** (*c*)	**104.** (*d*)	**105.** (*b*)	**106.** (*d*)	**107.** (*a*)	**108.** (*c*)	**109.** (*d*)	**110.** (*b*)
111. (*b*)	**112.** (*b*)	**113.** (*c*)	**114.** (*d*)	**115** (*d*)	**116.** (*b*)	**117.** (*b*)	**118.** (*c*)	**119.** (*a*)	**120.** (*b*)

Paper II: General Ability

1. (*c*)	**2.** (*c*)	**3.** (*a*)	**4.** (*c*)	**5.** (*c*)	**6.** (*c*)	**7.** (*a*)	**8.** (*b*)	**9.** (*b*)	**10.** (*a*)
11. (*a*)	**12.** (*b*)	**13.** (*d*)	**14.** (*c*)	**15.** (*a*)	**16.** (*d*)	**17.** (*c*)	**18.** (*c*)	**19.** (*d*)	**20.** (*a*)
21. (*b*)	**22.** (*d*)	**23.** (*b*)	**24.** (*c*)	**25.** (*b*)	**26.** (*d*)	**27.** (*a*)	**28.** (*a*)	**29.** (*c*)	**30.** (*b*)
31. (*b*)	**32.** (*a*)	**33.** (*d*)	**34.** (*c*)	**35.** (*a*)	**36.** (*d*)	**37.** (*b*)	**38.** (*c*)	**39.** (*b*)	**40.** (*d*)
41. (*b*)	**42.** (*a*)	**43.** (*a*)	**44.** (*d*)	**45.** (*d*)	**46.** (*a*)	**47.** (*d*)	**48.** (*c*)	**49.** (*d*)	**50.** (*a*)
51. (*d*)	**52.** (*b*)	**53.** (*a*)	**54.** (*c*)	**55.** (*a*)	**56.** (*d*)	**57.** (*d*)	**58.** (*b*)	**59.** (*d*)	**60.** (*a*)
61. (*c*)	**62.** (*c*)	**63.** (*a*)	**64.** (*b*)	**65.** (*d*)	**66.** (*b*)	**67.** (*a*)	**68.** (*b*)	**69.** (*c*)	**70.** (*c*)
71. (*c*)	**72.** (*b*)	**73.** (*d*)	**74.** (*a*)	**75.** (*a*)	**76.** (*a*)	**77.** (*d*)	**78.** (*c*)	**79.** (*d*)	**80.** (*b*)
81. (*b*)	**82.** (*b*)	**83.** (*d*)	**84.** (*d*)	**85.** (*a*)	**86.** (*b*)	**87.** (*d*)	**88.** (*d*)	**89.** (*a*)	**90.** (*a*)
91. (*b*)	**92.** (*d*)	**93.** (*a*)	**94.** (*a*)	**95.** (*c*)	**96.** (*c*)	**97.** (*a*)	**98.** (*c*)	**99.** (*d*)	**100.** (*a*)
101. (*a*)	**102.** (*b*)	**103.** (*d*)	**104.** (*b*)	**105.** (*b*)	**106.** (*c*)	**107.** (*c*)	**108.** (*a*)	**109.** (*c*)	**110.** (*d*)
111. (*d*)	**112.** (*b*)	**113.** (*d*)	**114.** (*b*)	**115.** (*c*)	**116.** (*a*)	**117.** (*d*)	**118.** (*d*)	**119.** (*c*)	**120.** (*b*)
121. (*d*)	**122.** (*c*)	**123.** (*b*)	**124.** (*a*)	**125.** (*b*)	**126.** (*c*)	**127.** (*d*)	**128.** (*a*)	**129.** (*d*)	**130.** (*c*)
131. (*b*)	**132.** (*a*)	**133.** (*a*)	**134.** (*a*)	**135.** (*c*)	**136.** (*b*)	**137.** (*d*)	**138.** (*c*)	**139.** (*a*)	**140.** (*d*)
141. (*c*)	**142.** (*b*)	**143.** (*a*)	**144.** (*d*)	**145.** (*d*)	**146.** (*b*)	**147.** (*b*)	**148.** (*b*)	**149.** (*c*)	**150.** (*b*)

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EXPLANATION

Paper I: Mathematics

1. (*c*) $\Delta_1 = -p^2 - q^2 - r^2 + qr + pr + pq$ ...(i)

$\Delta_2 = -q^2 - r^2 - p^2 + pq + pr + qr$ ...(ii)

Adding (i) and (ii)

$\Delta_1 + \Delta_2 = -[(p-q)^2 + (q-r)^2 + (r-p)^2]$ which is negative.

2. (*b*) $\Delta = \begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$

$= abc(a-b)(b-c)(c-a)$

$= 6 \times 2 = 12$

3. (*d*) Let $A = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$.

After solving and expanding, we get

$A = -(a+b+c)[a^2 + b^2 + c^2 - ab - bc - ac]$

Value of A can be zero if

$a + b + c = 0$ or

$a^2 + b^2 + c^2 - ab - bc - ac = 0$

$\because$ We know that $a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$

$\Rightarrow a^3 + b^3 + c^3 = 3abc$

4. (*c*) **Statement 1:** $CA = CB$,

Now $CA = \begin{bmatrix} m^2 & mn \\ -m^2 & -mn \end{bmatrix}$,

$CB = \begin{bmatrix} -mn & -m^2 \\ mn & m^2 \end{bmatrix}$

$\therefore CA \neq CB$

Statement 1 is incorrect.

Statement 2: $AC = BC$

$AC = m^2 - mn$, $BC = m^2 - mn$

$\therefore$ Statement 2 is correct.

Statement 3: $C(A+B) = CA + CB$

Now, $C(A+B) =$

$$\begin{bmatrix} m^2 - mn & mn - m^2 \\ -m^2 + mn & -mn + m^2 \end{bmatrix}$$

$CA + CB =$

$$\begin{bmatrix} m^2 - mn & mn - m^2 \\ -m^2 + mn & -mn + m^2 \end{bmatrix}$$

Statement 3 is correct.

5. (*d*) $A = \begin{bmatrix} 2\sin\theta & \cos\theta & 0 \\ -2\cos\theta & \sin\theta & 0 \\ -1 & 1 & 1 \end{bmatrix} \Rightarrow |A| = 2$

$\therefore A(\text{adj } A) = |A| I = 2I$

6. (*d*) $A = \begin{bmatrix} 2\cos 2\theta & 2\cos 2\theta & 6 \\ 1 - 2\sin^2\theta & 2\cos^2\theta - 1 & 3 \\ k & 2k & 1 \end{bmatrix}$

$\Rightarrow |A| = 0$

$\therefore$ Matrix A is singular for any real value of k.

7. (*b*) $\because A^{-1} = \dfrac{adjA}{|A|}$

Statement 1: $AB = BA$

Now $AA^{-1} = \dfrac{A.\,adjA}{|A|}$

$\Rightarrow I = \dfrac{A.\,adjA}{|A|}$

$\Rightarrow I|A| = AB$ ...(i)

Now $A^{-1}A = \dfrac{A.\,adjA}{|A|}$

$\Rightarrow I = \dfrac{adjA.A}{|A|}$

$\Rightarrow I|A| = BA$ ...(ii)

From (i) and (ii), $AB = BA$

Statement 1 is correct.

Statement 2: AB is a scalar matrix.

From equation (i), $AB = |A|I \Rightarrow AB$ is a scalar matrix.

Statement 2 is correct.

Statement 3: AB can be a null matrix.

$\because A$ is a non-singular matrix $\Rightarrow |A| \neq 0$

$A(adjA) = |A|I \neq 0 \Rightarrow AB \neq 0$

Statement 3 is incorrect.

8. (*b*) **Statement 1:** If AB is a null matrix, then at least one of A and B is a null matrix.

Let $A = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$ then

$AB = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

Here both A & B are non zero matrices but AB is null matrix.

$\Rightarrow$ Statement 1 is incorrect.

Statement 2: If AB is an identity matrix, then $BA = AB$

$\because AB = I \Rightarrow A^{-1}AB = A^{-1}I$

$\Rightarrow B = A^{-1}$

Again $BA = A^{-1}A \Rightarrow BA = I$

$\Rightarrow$ Statement 2 is correct.

9. (*d*) Given $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$,

$B = A^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$C = A + B = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

$\therefore |C| = 2(4 - 0) = 8$

10. (*c*) Given $AB = A$, $BA = B$

Statement 1: $A^2 = A$

$\because A = AB \Rightarrow A^2 = (AB)^2$

$\Rightarrow A^2 = A(BA)B \Rightarrow A^2 = A(B)B$

$\Rightarrow A^2 = (AB)B \Rightarrow A^2 = (A)B$

$\Rightarrow A^2 = A$

Statement 1 is correct.

Statement 2: $AB^2 = A^2B$

$\because B = BA \Rightarrow B^2 = (BA)^2$

$\Rightarrow B^2 = BABA$

$\Rightarrow AB^2 = ABABA \Rightarrow AB^2 = ABA(BA)$

$\Rightarrow AB^2 = ABA(B) \Rightarrow AB^2 = (AB)AB$

$\Rightarrow AB^2 = (A)AB \Rightarrow AB^2 = (AA)B = A^2B$

Statement 2 is correct.

11. (*b*) $\left(1 + \dfrac{2}{x}\right)^9 \left(1 - \dfrac{2}{x}\right)^9 = \left[1 - \left(\dfrac{2}{x}\right)^2\right]^9$

$\therefore$ Total number of terms $= 9 + 1 = 10$

12. (*c*) **Statement 1:** Term having highest coefficient

$= \dfrac{n+2}{2} = \dfrac{10+2}{2} = 6 \quad [\because n = 10]$

$\therefore$ Coefficient of 6th term has highest value. Statement 1 is correct.

Statement 2: Coefficient of 3rd term, $T_3 = {}^{10}C_2 = \dfrac{10!}{8!2!}$

Coefficient of 9th term,

$T_9 = {}^{10}C_8 = \dfrac{10!}{8!2!}$

$\therefore$ Coefficient of 3rd term = Coefficient of 9th term. Statement 2 is correct.

13. (*d*) $C(3n, 2n) = C(3n, 2n-7)$

$\Rightarrow {}^{3n}C_{2n} = {}^{3n}C_{2n-7} \Rightarrow n = 7$

$\therefore C(n, n-5) = {}^{n}C_{n-5} = {}^{7}C_{2} = 21$

14. (*c*) $\because {}^{n}C_{r} = {}^{n}C_{n-r}$

So we can write,

$C(51, 21) = C(51, 30)$,

$C(51, 22) = C(51, 29)$,

$C(51, 23) = C(51, 28)$,

$C(51, 24) = C(51, 27)$

and $C(51, 25) = C(51, 26)$

$\therefore$ Value of given expression after solving is 0.

Now checking option(*c*) $C(51, 51) - C(51, 0) = 0$

15. (*a*) Total odd numbers between 300 and 400 $= 4p_1 \times 8p_1$

$= 4 \times 8 = 32$

16. (*b*) Selection of any two consonants out of three $= {}^{3}C_{2}$

The arrangement of these two consonants = 2!

$\therefore$ No. of ways to fill even places $= {}^{3}C_{2} \times 2! = 6$

No. of ways to fill odd places = 3! = 6

$\therefore$ Total number of ways

$= {}^{3}C_{2} \times 2! \times 3! = 6 \times 6 = 36$

17. (*d*) $\because \alpha + \beta = -p$ and $\alpha\beta = q$

$\alpha^3 + \beta^3 = -m$ and $\alpha^3\beta^3 = n$

$\alpha^3 + \beta^3 = (\alpha+\beta)(\alpha+\beta)^2 - 3\alpha\beta) = -m$

$\Rightarrow -p(p^2 - 3q) = -m$

$\therefore m + n = p(p^2 - 3q) + q^3$

$= p^3 + q^3 - 3pq$

18. (*a*) $\alpha + \beta = a + b$ ...(*i*)

$\alpha\beta = ab - c$

$\Rightarrow ab = \alpha\beta + c$ ...(*ii*)

$\therefore$ Quadratic equation with roots *a* and *b* is,

$x^2 - (a + b)x + ab = 0$

From (i) and (ii),

$\Rightarrow x^2 - (\alpha + \beta)x + \alpha\beta + c = 0$

$\Rightarrow x^2 - \alpha x - \beta x + \alpha\beta + c = 0$

19. (*c*) $x^2 - ax - bx - cx + bc + ca = 0$

$\Rightarrow x^2 - (a + b + c)x + bc + ca = 0$

For equal roots, $D = 0$

$\Rightarrow [-(a + b + c)]^2 - 4(bc + ca) = 0$

$\Rightarrow a^2 + b^2 + c^2 + 2ab - 2bc - 2ca = 0$

$\Rightarrow (a + b - c)^2 = 0$

$\therefore a + b - c = 0$

20. (*d*) $\because \alpha + \beta = 9$, $\alpha\beta = q$

$\therefore \alpha^2 - \beta^2 = 16 \Rightarrow (\alpha - \beta) = 2$

$\because (\alpha - \beta)^2 + 4\alpha\beta = (\alpha + \beta)^2$

$\Rightarrow 4 + 4q = 64 \Rightarrow q = 15$

21. (*c*) $\because (30! + 35!)$

$= 30!(1 + 7 \times 5 \times 17 \times 2 \times 3 \times 11 \times 2^5 \times 31)$

No. of 5's in 30!

$= \frac{30}{5} + \frac{30}{5^2} + \frac{30}{5^3} = 6 + 1 + 0 = 7$

$\therefore$ The maximum nubmer of 5's = 7

22. (*b*) $x = 2.2! + 3.3! + 4.4! + \ldots.. 9.9! + 2$

$= 10! - 2! + 2 = 10!$

23. (*b*) $n(A) = 1$

So, no. of elements in power set $= 2^1 = 2$

24. (*d*) *a*, *b*, *c* are in G.P $\Rightarrow b^2 = ac$ ...(*i*)

Statement 1: $b^4 = (ac)^2$ yes it satisfy equation (i) i.e., a^2, b^2, c^2 are in G.P

Statement 2: $\left(\frac{1}{b}\right)^2 = \frac{1}{a} \times \frac{1}{c} \Rightarrow b^2$

$= ac$ again satisfy equation (i) i.e., $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in G.P.

Statement 3: $(\sqrt{b})^2 = \sqrt{a} \times \sqrt{c}$

$\Rightarrow b = \sqrt{ac}$

$\Rightarrow$ satisfy G.P given condition

25. (*b*) It is given that, $\frac{a+b}{2}, b, \frac{b+c}{2}$ are in H.P

$\Rightarrow \frac{2}{a+b}, \frac{1}{b}, \frac{2}{b+c}$ are in A.P

$\Rightarrow \frac{1}{b} - \frac{2}{a+b} = \frac{2}{b+c} - \frac{1}{b}$

$\Rightarrow ab + ac + bc + b^2 = ab + 2b^2 + bc$

$\Rightarrow b^2 = ac$

$\therefore a, b, c$ are in G.P.

26. (*b*) $\cot^2 15^\circ + \tan^2 15^\circ$

$= (2 + \sqrt{3})^2 + (2 - \sqrt{3})^2 = 8 + 6 = 14$

27. (*d*) $\sin A = \cos B + \cos C$

$\Rightarrow 2\sin\frac{A}{2}\cos\frac{A}{2}$

$= 2\sin\left(\frac{B+C}{2}\right)\cos\left(\frac{B-C}{2}\right)$

$\Rightarrow 2\sin\frac{A}{2}\cos\frac{A}{2}$

$= 2\sin\frac{A}{2}\cos\left(\frac{B-C}{2}\right)$

$\Rightarrow \cos\frac{A}{2} = \cos\left(\frac{B-C}{2}\right)$

$\Rightarrow \frac{A}{2} = \frac{B-C}{2} \Rightarrow A = B - C$

$\because A + B + C = \pi \Rightarrow B = \frac{\pi}{2}$

28. (*c*) $\tan\beta = \tan\left(\frac{\pi}{4} - \alpha\right) = \frac{1 - \tan\alpha}{1 + \tan\alpha}$

$= \frac{1 - \frac{1}{2}}{1 + \frac{1}{2}} = \frac{1}{3}$

$\therefore \tan 2\beta = \frac{2\tan\beta}{1 - \tan^2\beta} = \frac{\frac{2}{3}}{1 - \frac{1}{9}} = \frac{3}{4}$

29. (*c*) $\frac{1 + \tan\theta}{1 - \tan\theta} = 1 + \frac{2\tan\theta}{1 + \tan^2\theta} = \frac{(1 + \tan\theta)^2}{1 + \tan^2\theta}$

$\Rightarrow \frac{1 - \tan^2\theta}{1 + \tan^2\theta} = 1 \Rightarrow \cos 2\theta = 1$

30. (*c*) $\sin 2\theta = \cos 3\theta \Rightarrow 2\theta + 3\theta = 90^\circ$

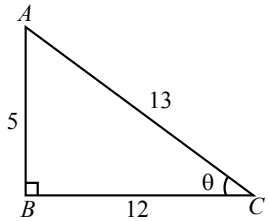
$\Rightarrow \theta = 18^\circ$

$\therefore 1 + 4\sin\theta = 1 + 4\sin 18^\circ$

$= 1 + \sqrt{5} - 1 = \sqrt{5}$

31. (*c*) $\tan\theta = \frac{-5}{12}$, in II and IV quadrants

$\tan\theta$ is negative



$\therefore \sin\theta$ in II quadrant $= \frac{5}{13}$

$\sin\theta$ in IV quadrant $= \frac{-5}{13}$

$\therefore \sin\theta = \pm\frac{5}{13}$

32. (*b*) $\cos^4\frac{7\pi}{8} + \cos^4\frac{5\pi}{8}$

$= \left(\cos^2\frac{7\pi}{8}\right)^2 + \left(\cos^2\frac{5\pi}{8}\right)^2$

$= \left(\frac{1 + \cos\frac{7\pi}{4}}{2}\right)^2 + \left(\frac{1 + \cos\frac{5\pi}{4}}{2}\right)^2$

$= \left(\frac{1 + \frac{1}{\sqrt{2}}}{2}\right)^2 + \left(\frac{1 - \frac{1}{\sqrt{2}}}{2}\right)^2 = \frac{3}{4}$

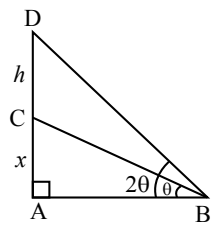
33. (*a*) $\sin^2\left(\frac{\pi}{4} + \theta\right) - \sin^2\left(\frac{\pi}{4} - \theta\right)$

$= \sin\left[\frac{\pi}{4} + \theta + \frac{\pi}{4} - \theta\right]$

$= \sin\left[\frac{\pi}{4} + \theta - \frac{\pi}{4} + \theta\right]$

$= \sin\frac{\pi}{2}\sin 2\theta = \sin 2\theta$

34. (*c*) Let the height of the tower be *x*.



In right ΔABC, $\tan\theta = AC/AB = x/AB$

$\Rightarrow AB = x/\tan\theta$ ...(i)

In right triangle ABD

$\tan 2\theta = AD/AB = (x + h)/AB$

$$\Rightarrow \frac{2\tan\theta}{1-\tan^2\theta} = (x+h)/AB$$

$$\Rightarrow \frac{2\tan\theta}{1-\tan^2\theta} = \frac{(x+h)\tan\theta}{x}$$

[From equation (*i*)]

$$\Rightarrow \frac{2}{1-\tan^2\theta} = 1+\frac{h}{x}$$

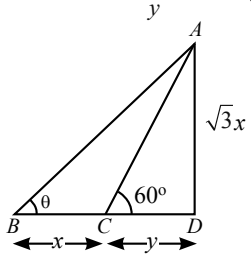
$$\Rightarrow \frac{h}{x} = \frac{2}{1-\tan^2\theta} - 1$$

$$\Rightarrow \frac{h}{x} = \frac{1+\tan^2\theta}{1-\tan^2\theta}$$

$$\Rightarrow \frac{x}{h} = \frac{1-\tan^2\theta}{1+\tan^2\theta} = \cos 2\theta$$

$\Rightarrow x = h\cos 2\theta$

35. (*b*) $\because \tan 60° = \dfrac{\sqrt{3}x}{y} \Rightarrow x = y$



$$\Rightarrow \tan\theta = \frac{\sqrt{3}x}{BC + x}$$

$$\Rightarrow \tan\theta = \frac{\sqrt{3}x}{2x} \approx 0.86$$

$\because 0.57 < 0.86 < 1$

$\therefore 30° < \theta < 45°$

36. (*a*) $\tan^{-1}\left(\dfrac{1}{2}\right) + \tan^{-1}\left(\dfrac{x}{3}\right) = \dfrac{\pi}{4}$

$$\Rightarrow \frac{\frac{1}{2}+\frac{x}{3}}{1-\frac{x}{6}} = \tan\frac{\pi}{4} = 1$$

$\Rightarrow 3 + 2x = 6 - x \Rightarrow 3x = 3$

$\therefore x = 1$

37. (*c*) $3\sin^{-1}x + \cos^{-1}x = \pi$

$$\Rightarrow 3\sin^{-1}x + \frac{\pi}{2} - \sin^{-1}x = \pi$$

$$\Rightarrow 2\sin^{-1}x = \frac{\pi}{2} \Rightarrow \sin^{-1}x = \frac{\pi}{4}$$

$$\Rightarrow x = \frac{1}{\sqrt{2}}$$

38. (*b*) $\tan\alpha + \tan\beta = 1 - \tan\alpha \cdot \tan\beta$

$$\Rightarrow \frac{\tan\alpha + \tan\beta}{1-\tan\alpha\cdot\tan\beta} = 1$$

$$\Rightarrow \tan(\alpha+\beta) = \tan\frac{\pi}{4} \Rightarrow \alpha+\beta = \frac{\pi}{4}$$

39. (*b*) $\because$ Given, $1 + \tan\theta + \tan 9\theta + \tan 9\theta \tan\theta = 2$

$$\Rightarrow \frac{\tan\theta + \tan 9\theta}{1-\tan\theta\tan 9\theta} = 1$$

$\Rightarrow \tan 10\theta = 1$

40. (*b*) $\sin 0° + \sin 10° + \sin 20° + \sin 30° + ... + \sin 360°$

$\Rightarrow \sin 0° + \sin 10° + \sin 360° + \sin 20° + \sin 340° + ...$

$= 0 + \sin 10° - \sin 10° + \sin 20° - \sin 20° ... = 0$

41. (*c*) {1, 2, 3, 4} is a proper subset. Supersets of set {4} = {4},{1, 4}, {2, 4}, {3, 4}, {1, 2, 4}, {2, 3, 4}, {1, 3, 4}, {1, 2, 3, 4}

$\therefore$ The required number of set = 8

42. (*d*) **Statement 1:** $x \notin (A \cup B) \Rightarrow x \notin A$ or $x \notin B$

As $x \notin (A \cup B) \Rightarrow x \in (A \cup B)' \Rightarrow x \in A'$ and $x \in B'$

$\Rightarrow x \notin A$ and $x \notin B$

Statement 1 is incorrect.

Statement 2: $x \notin (A \cap B) \Rightarrow x \notin A$ and $x \notin B$

As $x \notin (A \cap B) \Rightarrow x \in A' \cup B' \Rightarrow x \in A'$ or $x \in B'$

Statement 2 is incorrect.

43. (*c*) **Statement 1:** $A \cup B = A \cap B$ iff $A = B$

Let $x \in A \Rightarrow x \in A \cup B$, $[\because A \subseteq A \cup B]$

$\Rightarrow x \in A \cap B$, $[\because A \cup B = A \cap B]$

$\Rightarrow x \in A$ and $x \in B \Rightarrow x \in A, B \subseteq A$

Now, $A \subseteq B, B \subseteq A \Rightarrow A = B$

Statement 1 is correct.

Statement 2: $A\Delta B = \phi$ iff $A = B$

$\Rightarrow A\Delta B = (A \cup B) - (A \cap B)$

$\Rightarrow (A \cup B) - (A \cap B) = \phi$

$\Rightarrow (A \cup B) = (A \cap B) \Rightarrow A = B$

Statement 2 is correct.

44. (*a*) **Statement 1:** Reflexive

If $y = x$, then $x^2 - 5x^2 + 4x^2 = 0$

$\Rightarrow (x, x) \in R$.

$\Rightarrow R$ is reflexive

Statement 2: Symmetric

Take (4, 1) i.e. $x = 4$ and $y = 1$

We have $(4)^2 - 5(4)(1) + 4(1)^2$

$= 16 - 20 + 4 = 0$

$\Rightarrow (4, 1) \in R$.

Also, $(1)^2 - 5(1)(4) + 4(4)^2$

$= 1 - 20 + 64 = 45 \neq 0$

$\Rightarrow (1, 4) \notin R$

$\Rightarrow R$ is not symmetric.

Statement 3: Transitive

$(16, 4) \in R$ because

$(16)^2 - 5(16)(4) + 4(4)^2$

$= 256 - 320 + 64 = 0$

Also $(4, 1) \in R$ because

$\Rightarrow (4)^2 - 5(4)(1) + 4(1)^2$

$= 16 - 20 + 4 = 0$

Now, $(16, 1) \in R$

if $(16)^2 - 5(16)(1) + 4(1)^2 = 0$

$\Rightarrow 256 - 80 + 4 = 180 \neq 0$, which is not so.

$\Rightarrow (16, 4), (4, 1) \in R$ and $(16, 1) \notin R$

$\Rightarrow R$ is not transitive.

$\therefore R$ is only Reflexive.

45. (*d*) If R is reflexive, symmetric and transitive then R^{-1} is also reflexive, symmetric and transitive.

46. (*b*) $\dfrac{1}{1+i} = \dfrac{1}{1+i}\times\dfrac{1-i}{1-i} = \dfrac{1-i}{2}$

$$\text{Argument of } \left(\frac{1-i}{2}\right) = \tan^{-1}\left(\frac{-\frac{1}{2}}{\frac{1}{2}}\right)$$

$$= -\frac{\pi}{4}$$

47. (*c*) $\left(\dfrac{\sqrt{-3}}{2} - \dfrac{1}{2}\right)^{200} = \left(\dfrac{\sqrt{3}i}{2} - \dfrac{1}{2}\right)^{200}$

$$\left|\frac{\sqrt{3}}{2}i - \frac{1}{2}\right|^{200}$$

$$= \left[\sqrt{\left(\frac{\sqrt{3}}{2}\right)^2 + \left(\frac{-1}{2}\right)^2}\right]^{200}$$

$= (1)^{200} = 1$

48. (*d*) **Statement 1:** $\dfrac{n!}{3!}$ is divisible by 6, where $n > 3$

Let $n = 4 \Rightarrow \dfrac{n!}{3!} = \dfrac{4!}{3!} = 4$

4 is not divisible by 6.

Statement 1 is incorrect.

Statement 2: $\dfrac{n!}{3!} + 3$ is divisible by 7, where $n > 3$

Let $n = 5$

$$\Rightarrow \frac{n!}{3!} + 3 = \frac{5!}{3!} + 3$$

$$= \frac{5\times 4\times 3!}{3!} + 3 = 20 + 3 = 23$$

23 is not divisible by 7.

Statement 2 is incorrect.

$\therefore$ Neither statement 1 nor 2 is correct.

49. (*b*) Required number of ways $= {}^7C_5 = \dfrac{7!}{5!\times 2!} = \dfrac{7\times 6}{2} = 21$

50. (*c*) $T_{n+1} = {}^{2n}C_n (x)^{2n-n}\left(\dfrac{1}{x}\right)^n$

$= {}^{2n}C_n\, x^n \times \dfrac{1}{x^n}$

$= {}^{2n}C_n = C(2n, n)$

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51. (*d*) $\frac{9}{2}[2a+(9-1)d]$

$=\frac{11}{2}[2a+(11-1)d]$

$\Rightarrow 18a+72d=22a+110d$

$\Rightarrow a=-\frac{19d}{2}$

$\therefore S_{20}=10\left[2\left(-\frac{19d}{2}\right)+19d\right]$

$=10\,[-19d+19d]=0$

52. (*b*) $a+4d=\frac{1}{10}$ ...(i)

$a+9d=\frac{1}{5}$ ...(ii)

On solving (i) and (ii),

$a=\frac{1}{50}, d=\frac{1}{50}$

$\therefore S_{50}=25\left[2\times\frac{1}{50}+49\times\frac{1}{50}\right]=25.5$

53. (*a*) $(1110011)_2=(115)_{10}$

$(10111)_2=(23)_{10}$

$(1110011)_2\div(10111)_2$

$=(115)_{10}\div(23)_{10}=(5)_{10}=(101)_2$

54. (*b*) $x^3+y^3=(100010111)_2$

$x^3+y^3=(279)_{10}$ ... (i)

$x+y=(11111)_2=(31)_{10}$ ...(ii)

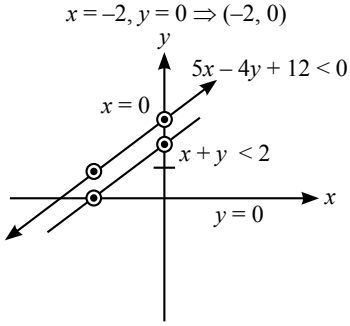
$x^3+y^3=(x+y)(x^2-xy+y^2)$

$\Rightarrow 279=(31)[(x-y)^2+xy]$

$\therefore (x-y)^2+xy=9=(1001)_2$

55. (*d*) $x=0, y=2\Rightarrow(0,2)$

$x=-2, y=0\Rightarrow(-2,0)$



$5x-4y+12<0$

$\Rightarrow 4y=5x+12$

$x=0, y=3\Rightarrow(0,3)$

$x=-2, y=\frac{1}{2}\Rightarrow\left(-2,\frac{1}{2}\right)$

Only (–1, 2) satisfying given sets of equations

56. (*a*) $y=[x], x\in(-1,1)$

Greatest integer function is non-continuous therefore statement 2 is not correct.

Statement 1 is correct, its derivative is 0 at $x=0.5$

57. (*d*) $1+\left(\frac{dy}{dx}\right)^2=\left(\frac{d^2y}{dx^2}\right)^{\frac{4}{3}}$

$\Rightarrow\left[1+\left(\frac{dy}{dx}\right)^2\right]^3=\left(\frac{d^2y}{dx^2}\right)^4$

$\therefore$ The degree of the given differential equation is 4.

58. (*a*) Half-life: $t_{\frac{1}{2}}=\frac{\log_e 2}{k}$

Where k is the decay constant.

On putting the value of $t_{1/2}=100$ years,

$\Rightarrow 100=\frac{\log_e 2}{k}$

$\Rightarrow k=\frac{\log_e 2}{100}$

59. (*d*) $f(x)=\sqrt{1-(x-1)^2}$

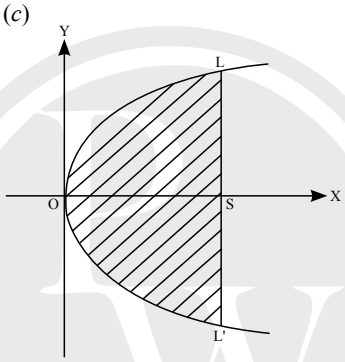
$\Rightarrow 1-(x-1)^2\geq 0$

$\Rightarrow -x^2+2x\geq 0$

$\Rightarrow x(x-2)\leq 0$

$\therefore x\in[0,2]$

60. (*c*)



$\Rightarrow$ Required area, $A=2\int_0^k y\,dx$

$\Rightarrow A=2\int_0^k 2\sqrt{k}\sqrt{x}\,dx$

$\Rightarrow A=4\sqrt{k}\int_0^k x^{\frac{1}{2}}dx$

$\Rightarrow A=4\sqrt{k}\left[\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\right]_0^k$

$\Rightarrow A=\frac{8}{3}\sqrt{k}\left(k^{\frac{3}{2}}\right)\Rightarrow A=\frac{8}{3}k^2$

Since the area of the given parabola is 24.

$\Rightarrow 24=\frac{8}{3}k^2\Rightarrow k=\pm 3$

As the value of $k>0$, $k=3$.

$\therefore$ The value of $k=3$

61. (*b*) $I=\int_0^{\pi/4}\frac{dx}{(\sin x+\cos x)^2}$

$=\int_0^{\pi/4}\frac{\sec^2 x\,dx}{(\tan x+1)^2}$

Let, $\tan x=t\Rightarrow\sec^2 x\,dx=dt$

and on solving, we get, $I=\frac{1}{2}$

62. (*b*) $I=\int(\sin x)^{-1/2}(\cos x)^{-3/2}dx$

$=\int\frac{\text{cosec}^2 x\,dx}{\cot x\cdot\sqrt{\cot x}}$

Let, $\cot x=t\Rightarrow -\text{cosec}^2 x\,dx=dt$

$\therefore I=\int\frac{-dt}{t^{3/2}}=-\frac{-t^{-\frac{1}{2}}}{\left(-\frac{1}{2}\right)}$

$=\frac{2}{\sqrt{t}}+c=\frac{2}{\sqrt{\cot x}}+c$

$=2\sqrt{\tan x}+c$

63. (*b*) $I_1+I_2=\int\frac{e^x dx}{e^x+e^{-x}}+\int\frac{dx}{e^{2x}+1}$

$=\int\frac{e^{2x}dx}{e^{2x}+1}+\int\frac{dx}{e^{2x}+1}$

$=\int\left(\frac{1+e^{2x}}{1+e^{2x}}\right)dx=x+c$

64. (*b*) $I=\int_{-2}^{-1}\frac{x}{(-x)}dx=\int_{-2}^{-1}(-1)dx$

$=[-x]_{-2}^{-1}=1-2=-1$

65. (*b*) Let $f(x)=\sin 4x+2x,\ 0<x<\frac{\pi}{2}$

$\Rightarrow f'(x)=4\cos 4x+2$

$\Rightarrow f'(x)=0\ \Rightarrow\cos 4x=\frac{-1}{2}$

$\Rightarrow 4x=\frac{2\pi}{3},\frac{4\pi}{3}\ \Rightarrow x=\frac{\pi}{6},\frac{\pi}{3}$

$\therefore$ $f(x)$ have 2 extreme values in interval $0<x<\frac{\pi}{2}$.

66. (*b*) $f(x)=\frac{1}{\frac{\sin x}{\cos x}+\frac{\cos x}{\sin x}}$

$=\frac{\sin x\cdot\cos x}{\sin^2 x+\cos^2 x}$

$=\sin x\cdot\cos x=\frac{\sin 2x}{2}$

$\because -1\leq\sin 2x\leq 1$

$\therefore -\frac{1}{2}\leq f(x)\leq\frac{1}{2}$

Hence, the maximum value of function $f(x)$ is $\frac{1}{2}$.

67. (*d*) $4f(x)-f\left(\frac{1}{x}\right)$

$=\left(2x+\frac{1}{x}\right)\left(2x-\frac{1}{x}\right)$

$\Rightarrow 4f(x)-f\left(\frac{1}{x}\right)=4x^2-\frac{1}{x^2}$ ...(i)

Multiply by 4 on both sides

$$16f(x)-4f\left(\frac{1}{x}\right)=16x^2-\frac{4}{x^2} \quad ...(ii)$$

Replace x with $\frac{1}{x}$ in equation (i)

$$\Rightarrow 4f\left(\frac{1}{x}\right)-f(x)=4\left(\frac{1}{x}\right)^2-x^2 \quad ...(iii)$$

On adding equation (ii) and (iii), we get

$\Rightarrow 16f(x) - f(x)$

$= (16x^2 - 4/x^2) + (4/x^2 - x^2)$

$\Rightarrow 15\,f(x) = 15x^2$

$\Rightarrow f(x) = x^2$

$\therefore f(2) = 4$

68. (*a*) $fof(x) = 4(4x + 3) + 3 = 16x + 15$

$fofof(x) = 16(4x + 3) + 15 = 64x + 63$

$\therefore fofof(-1) = 64(-1) + 63 = -1$

69. (*a*) $x^y y^x = 1$

Taking log on both sides $\log x^y + \log y^x = \log 1$

$\Rightarrow y\log x + x \log y = 0$ [$\because$ log 1 = 0]

Differentiating above equation with respect to x.

$$\Rightarrow y\times\frac{1}{x}+\log x\frac{dy}{dx}+x\times\frac{1}{y}\frac{dy}{dx}+\log y=0$$

$$\Rightarrow \frac{y}{x}+\log x\frac{dy}{dx}+\frac{x}{y}\frac{dy}{dx}+\log y=0$$

$$\Rightarrow\left(\log x+\frac{x}{y}\right)\frac{dy}{dx}=-\log y-\frac{y}{x}$$

$$\Rightarrow\frac{(y\log x+x)}{y}\frac{dy}{dx}=-\frac{-x\log y-y}{x}$$

$$\Rightarrow\frac{dy}{dx}=-\frac{(x\log y+y)}{x}\times\frac{y}{(y\log x+x)}$$

$$\frac{dy}{dx}(1,1)=-\frac{(1\log 1+1)}{1}\times\frac{1}{(1\log 1+1)}$$

$= -1$

70. (*b*) $y = (x^x)^x \Rightarrow \log y = x \log x^x$

Differentiating w.r.t x

$$\frac{1}{y}\frac{dy}{dx}=\log x^x+\frac{x\times x^{x-1}}{x^x}$$

$= \log x^x + 1$

$$\Rightarrow \frac{dy}{dx}=(x^x)^x(1+\log x^x)$$

$$\Rightarrow\left(\frac{dy}{dx}\right)_{x=1}=1(1+\log 1)=1$$

71. (*d*) $y = [x + 1]$

At $x = -3.5$

$\Rightarrow y = [-3.5 + 1] = [-2.5] = -3$

Hence, $\frac{dy}{dx}=0$

72. (*d*) $\int\frac{dy}{y}=\int ln5\,dx$

$\Rightarrow ln\,y = (ln\,5)x + c$

Taking antilog

$y = e^{(ln\,5)x + c} = e^c . e^{(ln\,5)x}$

$y(1) = e^c.e^{ln\,5} = 5e^c = 5ln\,5$

($\because e^c = ln\,5$)

73. (*d*) **Statement 1:** Its domain is $(-\infty, \infty)$

Since 10 is a positive real constant, it can be raised to any real power, so the domain is not limited. It is R.

So, its domain is $(-\infty, \infty)$

Statement 2: It is a continuous function

We know that $f(x) = 10^x$ and

$f'(x) = 10^x \log 10$

$f'(x) = 0 \Rightarrow 10^x \log 10 = 0$

As, we know that this can't happen.

So, 10^x is a continuous function for all real numbers.

Statement 3: It is differentiable at $x = 0$

At $x = 0, f'(0) = 10^0 \log 10 \Rightarrow \log 10$

So, It is differentiable at $x = 0$.

$\therefore$ Statement 1, 2 and 3 are correct.

74. (*a*) $\lim\limits_{x\to 0} x^3(\operatorname{cosec} x)^2=\lim\limits_{x\to 0}\frac{x^3}{\sin^2 x}$

$$=\lim_{x\to 0}\frac{x^2}{\sin^2 x}\cdot x=1\times 0=0$$

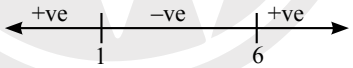
75. (*c*) $\lim\limits_{x\to 1}\frac{x^3-1}{\sqrt{x}-1}=\lim\limits_{x\to 1}\frac{3x^2}{\frac{1}{2\sqrt{x}}}$

[Using L' Hospital's rule]

$= 3 \times 2 = 6$

76. (*b*) $f(x)=\frac{x^3}{3}-\frac{7x^2}{2}+6x+5$

$f'(x) = x^2 - 7x + 6 = (x - 1)(x - 6)$



$\therefore$ The function $f(x)$ is decreasing in the interval (1, 6)

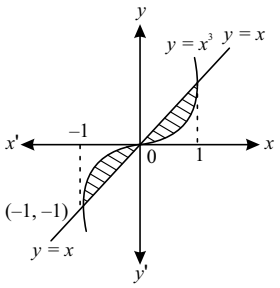
77. (*d*) $f(x)=\frac{m}{x}+2nx+1$

$$f'(x)=\frac{-m}{x^2}+2n,\ f'(x=2)$$

$$=\frac{-m}{4}+2n=0$$

$\Rightarrow -m + 8n = 0 \Rightarrow m = 8n \Rightarrow m + 8n = 2m$ or $16n$

78. (*b*)



Required area in the first quadrant

$$A=\int_0^1(x-x^3)dx$$

$$\Rightarrow A=\int_0^1 xdx-\int_0^1 x^3dx$$

$$\Rightarrow A=\left[\frac{x^2}{2}-\frac{x^4}{4}\right]_0^1=\frac{1}{4}$$

79. (*a*) $y=\frac{4225}{x}$

Sum, $S = x + y = x + \frac{4225}{x}$

$$\frac{dS}{dx}=1-\frac{4225}{x^2}$$

$$\frac{d^2S}{dx^2}=\frac{8450}{x^3}$$

$$\because \frac{dS}{ax}=0\Rightarrow x^2=4225\Rightarrow x=\pm 65$$

$\frac{d^2S}{dx^2}$ is (+ve) at $x = 65$.

Hence, it has minimum value at $x = 65$.

$\therefore$ Minimum value of S

$$=65+\frac{4225}{65}=130$$

80. (*c*) $\frac{dy}{dx}=\frac{2y}{x}\Rightarrow\frac{dy}{y}=\frac{2dx}{x}$

$\Rightarrow ln\,y = 2ln\,x + ln\,c$

$\Rightarrow ln\,y = ln(x^2 \times c) \Rightarrow y = cx^2$

81. (*c*) $\begin{vmatrix}-5 & 0 & 1\\ 5p^2 & 10p & 1\\ 5q^2 & 10q & 1\end{vmatrix}=0$

$\Rightarrow (p - q) = pq\,(p - q)$

$\Rightarrow pq = 1, p = q$ but $p \neq q$

82. (*c*) $x + y = a$ ...(i)

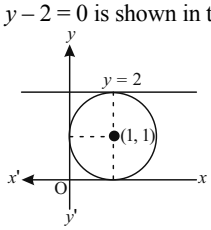
Putting (1, –2) in (i)

$1 - 2 = a \Rightarrow a = -1$

$\therefore$ The equation is, $x + y = -1$

$\Rightarrow x + y + 1 = 0$

83. (*c*) The circle which touches both the axes in the first quadrant and the line $y - 2 = 0$ is shown in the figure.



From the above figure, we can say that the diameter of the circle is 2.

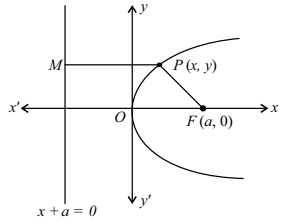
$\Rightarrow r = 1$ and the center of the circle is (1, 1).

We know that the equation of the circle is $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) is the center and r is the radius.

$\Rightarrow (x - 1)^2 + (y - 1)^2 = 1^2$

$\Rightarrow x^2 + y^2 - 2x - 2y + 1 = 0$

84. (*d*)



Distance PF = Distance PM

$\Rightarrow \sqrt{(x-a)^2+(y-0)^2} = \frac{|x+a|}{1}$

$\Rightarrow (x-a)^2 + y^2 = (x+a)^2 \Rightarrow y^2 = 4ax$

$\therefore y^2 = 4(-3)x = -12x \quad [\because a = -3]$

85. (*b*) $\frac{x^2}{(1)} + \frac{y^2}{\left(\frac{1}{2}\right)} = 1$

$\Rightarrow a = 1, b = \frac{1}{\sqrt{2}}$

$\Rightarrow e = \sqrt{1-\frac{b^2}{a^2}} = \sqrt{1-\frac{1}{2}} = \frac{1}{\sqrt{2}}$

$\Rightarrow$ Distance between foci $= 2ae$

$= 2 \times 1 \times \frac{1}{\sqrt{2}} = \sqrt{2}$

86. (*d*) $2s = p = a + b + c$ ...(i) &

$q = \sqrt{s(s-a)(s-b)(s-c)}$ ...(ii)

$\therefore p(p - 2a) \tan\left(\frac{A}{2}\right)$

$= (a+b+c)(a+b+c-2a) \tan\left(\frac{A}{2}\right)$

$= (a + b + c)(a + b + c - 2a)$

$= \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$

$(a+b+c)(a+b+c-2a)$

$= \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s(s-a)}$

From equation (i) and (ii)

$\Rightarrow 2s \times 2(s-a) \times \frac{q}{s(s-a)} = 4q$

87. (*a*) We have,

$x + 2y + 2 = 0$ ...(i)

$2x - 3y - 3 = 0$ ...(ii)

On solving (i) and (ii), we get $x = 0$ and $y = -1$

$\because$ The line makes equal intercepts with axes.

$\therefore$ Slope, $m = 1$

The equation of the given line is

$y - y_1 = m(x - x_1)$

$\Rightarrow y - (-1) = 1(x - 0)$

$\Rightarrow y + 1 = x \Rightarrow x - y = 1$

$\therefore$ Sum of absolute values of intercepts = 1 + 1 = 2

88. (*c*) Given, $by = -ax - c$

$\Rightarrow y = \frac{-a}{b}x - \frac{c}{b}$ ...(i)

And, $bx + ay + c = 0$

$\Rightarrow ay = -bx - c$

$\Rightarrow y = -\frac{b}{a}x - \frac{c}{a}$ ...(ii)

Since, both the lines are parallel.

$\therefore$ Slope of first line = Slope of second line

$\Rightarrow -\frac{a}{b} = -\frac{b}{a} \Rightarrow a^2 = b^2$

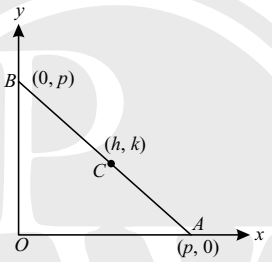
$\Rightarrow a^2 - b^2 = 0$

89. (*a*) Given, the equation of the line is $x + y = p$.

Let the line cut the coordinate axes at A and B and if $C(h, k)$ be the midpoints of AB, then

Now, the intercept made by the line on the coordinate axes is p.

Point $C(h, k)$ is equidistant from the points $A(p, 0)$ and $B(0, p)$ i.e., $AC = BC$



$\Rightarrow \sqrt{(h-p)^2 + (k-0)^2}$

$= \sqrt{(h-0)^2 + (k-p)^2}$

Squaring both sides, we get,

$\Rightarrow (h-p)^2 + k^2 = h^2 + (k-p)^2$

$\Rightarrow h = k$

Now, to obtain the locus of the mid-point replace (h, k) with (x, y),

$\Rightarrow x = y \Rightarrow x - y = 0$ is correct.

90. (*c*) Point (x, y) is equivalent from the points $(2a, 0)$ and $(0, 3a)$

$\therefore \sqrt{(2a-x)^2 + (0-y)^2}$

$= \sqrt{(0-x)^2 + (3a-y)^2}$

Squaring both sides, we get,

$\Rightarrow (2a - x)^2 + y^2 = x^2 + (3a - y)^2$

$\Rightarrow 4x - 6y + 5a = 0$

91. (*b*) Given sphere

$x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$ ...(i)

and plane is $6x + ky + 3z = 12$

$\Rightarrow \frac{x}{2} + \frac{y}{\frac{12}{k}} + \frac{z}{4} = 1$

$\therefore$ So co-ordinate of A, B, C are

$(2, 0, 0)\ \left(0, \frac{12}{k}, 0\right)\ (0, 0, 4)$

We know equation of shpere is

$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0$ ...(ii)

and it passes through origin (0,0,0), A, B and C then

$\therefore d = 0, u = -1, v = \frac{-6}{k}, w = -2$

Putting these value in eq. (ii)

$x^2 + y^2 + z^2 - 2x - \frac{12}{k}y - 4z = 0$ ...(iii)

Comparing eq. (i) & (iii), we get

$\frac{-12}{k} = -3 \Rightarrow k = 4$

92. (*b*) Given equation of the sphere is

$x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$

$\therefore$ Centre of sphere is $\left(1, \frac{3}{2}, 2\right)$

Equation of plane is

$6x + 4y + 3z - 12 = 0$

$\therefore p = \left|\frac{6 \times 1 + 4 \times \frac{3}{2} + 3 \times 2 - 12}{\sqrt{6^2 + 4^2 + 3^2}}\right|$

$= \left|\frac{6}{\sqrt{61}}\right| = 0.768$

$\therefore 0.5 < p < 1$

93. (*d*) Equation of sphere is

$x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$

Centre $(-u, -v, -w) = \left(1, \frac{3}{2}, 2\right)$

Here, two points are (0, 0, 0) and $\left(1, \frac{3}{2}, 2\right)$

$\therefore$ Equation of the line passing through (0, 0, 0) and $\left(1, \frac{3}{2}, 2\right)$

$\frac{x-0}{1-0} = \frac{y-0}{\frac{3}{2}-0} = \frac{z-0}{2-0}$

$\Rightarrow 6x = 4y = 3z$

94. (*a*) Equation of plane is $\frac{2x}{k} + \frac{2y}{3} + \frac{z}{3} = 2$

$\because$ It passes through (2, 3, –6)

So, $\frac{4}{k} + 2 - 2 = 2 \Rightarrow k = 2$

So, eq. of plane is $x + \frac{2y}{3} + \frac{z}{3} = 2$

$\Rightarrow 3x + 2y + z = 6$

$\Rightarrow (x\hat{i} + y\hat{j} + z\hat{k})(3\hat{i} + 2\hat{j} + \hat{k}) = 6$

Where, $(3\hat{i} + 2\hat{j} + \hat{k})$ is normal to plane.

So, required direction ratio is <3,2,1>

95. (*b*) Given plane is $\frac{2x}{2}+\frac{2y}{3}+\frac{z}{3}=2$ ...(i)

$\frac{2x}{2}+\frac{2y}{3}+\frac{z}{3}=2 \Rightarrow \frac{x}{2}+\frac{y}{3}+\frac{z}{6}=1$

$\therefore p=2, q=3, r=6$

$p+q+r=2+3+6=11$

96. (*c*) Let

$\vec{a}=4\hat{i}+\hat{j}-3\hat{k},\ \vec{b}=p\hat{i}+q\hat{j}-2\hat{k}$

given $\vec{a}$ and $\vec{b}$ are collinear

$\therefore \vec{b}=m\vec{a}$

$\Rightarrow p\hat{i}+q\hat{j}-2\hat{k}=m\cdot(4\hat{i}+\hat{j}-3\hat{k})$

$\Rightarrow -2=-3m \Rightarrow m=\frac{2}{3}$

Hence, $p=m\times 4=\frac{8}{3}$ and

$q=m\times 1=\frac{2}{3}$

97. (*c*) $\vec{a},\vec{b},\vec{c}$ are position vectors of verticles *A, B, C*

and *G* is centroid of ΔABC

$\therefore G=\frac{\vec{a}+\vec{b}+\vec{c}}{3}$

$\Rightarrow \overrightarrow{AG}=\frac{\vec{a}+\vec{b}+\vec{c}}{3}-\vec{a}=\frac{\vec{b}+\vec{c}-2\vec{a}}{3}$

98. (*c*) In vectors

1. $\vec{A}.(\vec{B}+\vec{C})=\vec{A}.\vec{B}+\vec{A}.\vec{C}$
   Distributive law of dot product.
2. $\vec{A}\times(\vec{B}+\vec{C})=\vec{A}\times\vec{B}+\vec{A}\times\vec{C}$
   Distributive law of cross product.
3. $\vec{A}\times(\vec{B}+\vec{C})=(\vec{A}\times\vec{B})\times\vec{C}$
   Not follows.

99. (*b*) Given that $\vec{a}\times\vec{b}=\vec{c} \Rightarrow \vec{a}\perp\vec{c}$ and $\vec{b}\perp\vec{c}$

If $\vec{b}$ and $\vec{c}$ are given then any vector $\vec{a}$ coplanar with $\vec{b}$ is also perpendicular to $\vec{c}$. So $\vec{a}$ is not unique.

If $\vec{a}$ and $\vec{b}$ is given then $\vec{a}\times\vec{b}$ is unique so, $\vec{c}$ is unique.

100. (*d*) $\vec{a}$ and $\vec{b}$ are unit vector i.e $|\vec{a}|=|\vec{b}|=1$

Given $|\vec{a}-\vec{b}|<2 \Rightarrow |\vec{a}-\vec{b}|^2<2^2$

$\Rightarrow |\vec{a}|^2+|\vec{b}|^2-2\vec{a}.\vec{b}<4$ ...(i)

$\because 2\theta$ is angle between $\vec{a}$ and $\vec{b}$

$\Rightarrow \vec{a}\cdot\vec{b}=|\vec{a}||\vec{b}|\cos 2\theta$

From eqn. (i), $1+1-2|\vec{a}|\cdot|\vec{b}|\cos 2\theta<4$

$\Rightarrow 1-\cos 2\theta<2 \Rightarrow 2\sin^2\theta<2$

$\Rightarrow \sin^2\theta<1$

$\therefore -1<\sin\theta<1$

101. (*b*) $n(s)={}^5C_2=\frac{5!}{2!\times 3!}=10$

$E=\{(2,5),(4,5)\} \Rightarrow n(E)=2$

$P(E)=\frac{n(E)}{n(S)}=\frac{2}{10}=\frac{1}{5}$

102. (*d*) Since, frequency curve has left skewed so, in this case Mode > Median > Mean.

103. (*c*) $N=5$ and $\sigma^2=3.6$

Let *a* is fifth observation

Mean $=\bar{x}=\frac{2+2+4+5+a}{5}$

$\Rightarrow 5\bar{x}=13+a$

$\Rightarrow a=5\bar{x}-13$ ...(*i*)

We know, $\sigma^2=\frac{\sum_{i=1}^{5}(x_i-\bar{x})^2}{N}=3.6$

$\Rightarrow (2-\bar{x})^2+(2-\bar{x})^2+(4-\bar{x})^2+(5-\bar{x})^2+(a-\bar{x})^2=18$

$\Rightarrow \bar{x}=4,\frac{5}{2}$

From eq. (i), $a=7,\ \frac{-1}{2}\ \therefore a=7$

104. (*d*) $a=4, d=4, n=50$

$S_{50}=\frac{50}{2}[2\times 4+49+4]=25\times 204$

Arithmetic mean of 50 terms is

$A=\frac{25\times 204}{50}=102$

105. (*b*) Mean $=\bar{x}=\frac{[21+34+23+39+26+37+40+20+33+27]}{10}=30$

Mean deviation from mean

$=\frac{\sum|x_i-\bar{x}|}{10}=\frac{66}{10}=6.6$

Coefficient of mean deviation

$=\frac{6.6}{30}=0.22$

106. (*d*) $\therefore (x_1-100)+(x_2-100)+(x_3-100)+...+(x_n-100)=-20$

$=x_1+x_2+x_3+...+x_n-100n=-20$

$=x_1+x_2+x_3+...+x_n=100n-20$ ...(i)

and $(x_1-92)+(x_2-92)+(x_3-92)+...+(x_n-92)=140$

$\Rightarrow x_1+x_2+x_3+...+x_n=92n+140$ ...(ii)

From (i) and (ii) $100n-20=92n+140 \Rightarrow n=20$

Put $n=20$ in eq. (i)

$=x_1+x_2+x_3+...+x_n=100\times 20-20=1980$

$\therefore$ Mean $=\frac{1980}{20}=99$

107. (*a*) $\Sigma x-99n=1980-99n=1980-99\times 20=1980-1980=0$

108. (*c*) $\Sigma x-ny=180$

$\Rightarrow 1980-20y=180 \Rightarrow y=90$

109. (*d*) $n=51, a=4, d=3$

$S_{51}=\frac{51}{2}[2\times 4+50\times 3]=51\times 79$

$\therefore$ Mean $=\frac{51\times 79}{51}=79$

110. (*b*) $n=51$ (odd)

$\Rightarrow \frac{51+1}{2}=26$ terms

Median $=T_{26}=4+25\times 3=79$

111. (*b*) $\Sigma x-79=(4-79)+(7-79)+(10-79)+...+(151-79)+(154-79)=0$

112. (*b*) $P(G\cap\overline{T})=\frac{n(G\cap\overline{T})}{n(s)}=\frac{36}{90}=\frac{2}{5}$

113. (*c*) $P(\overline{T})=\frac{36+27}{90}=\frac{7}{10}$

$P\left(\frac{G}{\overline{T}}\right)=\frac{P(G\cap\overline{T})}{P(\overline{T})}=\frac{\frac{2}{5}}{\frac{7}{10}}=\frac{4}{7}$

114. (*d*) $P(\overline{T}/\overline{G})=\frac{P(\overline{T}\cap\overline{G})}{P(\overline{G})}=\frac{27}{36}=\frac{3}{4}$

115. (*d*) $p=\frac{1}{3}$ and $q=1-p=1-\frac{1}{3}=\frac{2}{3}$

Probability, where out of 6, exactly 3 suffer from the disease is $P(X=3)$

$\Rightarrow P(X=3)={}^6C_3\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^{6-3}$

$=\frac{160}{729}$

116. (*b*) $P(X=0)={}^6C_0\left(\frac{1}{3}\right)^0\left(\frac{2}{3}\right)^{6-0}$

$=\frac{64}{729}$

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117. (*b*) $P(X \geq 0) = 1 - P(X = 0) = 1 - \frac{64}{729}$
$= \frac{665}{729}$

118. (*c*) Total frequency $= 120$

$\sum f_i = 17 + p + q + 32 + p - 3q + 19 = 120$

$\Rightarrow p - q = 26$ ...(i)

We know mean

$\bar{x} = \sum \frac{f_i x_i}{N} = 50$

$= \sum f_i x_i = 6000$

$\Rightarrow 6000 = 170 + 30p + 30q + 1600 + 70p - 210q + 1710$

$\Rightarrow 252 = 10p - 18q$ ...(ii)

Solving (i) and (ii), we get

$\Rightarrow p = 27$

119. (*a*) $\because q = p - 26 \Rightarrow q = 1$

120. (*b*) If the frequency of each class is doubled

$\therefore$ New mean

$$= \frac{\sum_{i=1}^{n} x_i \, 2f_i}{\sum_{i=1}^{n} 2f_i} = \frac{2\sum_{i=1}^{n} x_i f_i}{2\sum_{i=1}^{n} f_i} = \frac{\sum_{i=1}^{n} x_i f_i}{\sum_{i=1}^{n} f_i} = 50$$

Paper II: General Ability

1. (*c*) Along with countable noun 'company', a helping verb or singular verb should be used. Use of 'have' in part (*c*) of the sentence should be replaced by 'has' to make it grammatically correct.

2. (*c*) The use of 'every' with subject should be followed by singular verb or singular pronoun. Hence, replace 'their' in part (*c*) by 'his' to make the sentence grammatically correct.

3. (*a*) With plural subject 'Olympic Games', a plural verb should be used .Replace 'reflects' with 'reflect'.

4. (*c*) Here, 'amongst' is replaced by 'among' as it is followed by a consonant.

5. (*c*) Here, in part (*c*) 'stones' should be replaced by 'stone'.

6. (*c*) 'It's' is a contraction of 'it is 'or 'it has' whereas 'its' is possessive determiner used to say something belongs to or refer to something. Replace 'it's' in part (*c*) by 'its'.

7. (*a*) 'Ninth' is an ordinal number. So 'the' should be used before the ordinal number.

8. (*b*) The possessive pronoun requires an apostrophe before 's'. Replace ones with 'one's' in part (*b*).

9. (*b*) The possessive pronoun requires an apostrophe before 's' in 'ones'. Also the sentence has use of 'ones' in first part so, there is no need to introduce another pronoun in second part. Therefore, replace 'an individuals' with 'ones' in part (*b*) to make the sentence grammatically correct.

10. (*a*) 'An' should be used in place of article 'a' as pronunciation of 'h' in honest is silent. Thus, 'an' should be used before vowels, sounds.

11. (*a*) It is usually used in negative statements to mean that someone should hope for something until he or she knows for certain that it will happen.

12. (*b*) The meaning of "icing on the cake" is something extra that makes a good thing even better.

13. (*d*) It is used to say that it is better to fix a problem when it is small than to wait and let it become bigger.

14. (*c*) If you say that someone or something is at 'sixes and sevens', you mean that they are confused or disorganized.

15. (*a*) When someone talks 'twenty to the dozen' they are taking very quickly and incessantly without stopping.

16. (*d*) If you say that 'you are under the weather', you mean that you feel slightly ill.

17. (*c*) If you 'sit on the fence', you avoid supporting a particular side in a discussion or argument.

18. (*c*) When we say that something happens 'once in a bluemoon', what we mean is that it happens very rarely.

19. (*d*) If you do something 'through thick and thin', you do it even though the conditions or circumstances are very bad.

20. (*a*) It is used to express difference between two people or things.

21. (*b*) QSPR

22. (*d*) QPSR

23. (*b*) QSPR

24. (*c*) SPRQ

25. (*b*) RPSQ

26. (*d*) RPQS

27. (*a*) QRPS

28. (*a*) RPQS

29. (*c*) RSQP

30. (*b*) SRQP

31. (*b*) 'Crude' means simple and not skillfully done or made whereas 'refined' is developed or improved so as to be precise or subtle.

32. (*a*) 'Confidence' means having strong belief or full assurance whereas 'diffidence' is hesitant in acting or speaking due to lack of self-confidence.

33. (*d*) 'Integrity' means the quality of being honest and having strong moral principles whereas 'dishonesty' is the quality or an act of not being honest.

34. (*c*) 'Benevolent' means kind and helpful whereas 'malevolent' is causing or wanting to cause harm or evil.

35. (*a*) 'Sartorial' means relating to clothes and to the way they are made or worn whereas 'unstylish' is lacking in style or elegance.

36. (*d*) 'Authentic' means undisputed origin and not a copy; genuine hence, 'fake' is its correct antonym.

37. (*b*) 'Deluge' means lot of rain or water whereas 'drought' is very long period when there is little or no rain.

38. (*c*) 'Dedication' means the willingness to give a lot of time and energy to something, whereas 'apathy' is lack of interest, enthusiasm, or concern.

39. (*b*) 'Perspicacity' means the ability to understand things quickly and make accurate judgements, whereas 'dullness' is lack of interest or excitement.

40. (*d*) 'Penchant' means a strong or habitual liking for something or tendency to do something hence, 'dislike' is its correct antonym.

41. (*b*) 'Compliment' is an expression of esteem, respect, affection, or admiration hence, 'praise' is its correct synonym.

42. (*a*) 'Laudable' means describe something that deserves praise or admiration hence, 'praiseworthy' is its correct synonym.

43. (*a*) 'Competent' means having requisite or adequate ability or qualities hence, 'capable' is its correct synonym.

44. (*d*) 'Diligent' means having or showing care and constant effort to accomplish in one's work or duties hence, 'conscientious' is its correct synonym.

45. (*d*) 'Reticent' means not revealing one's thoughts or feelings readily hence, 'withdrawn' is its correct synonym.

46. (*a*) 'Jovial' means friendly and in a good mood hence, 'cheerful' is its correct synonym.

47. (*d*) 'Morose' means unhappy or annoyed and unwilling to speak, smile, or be pleasant to people hence, 'sullen' is its correct synonym.

48. (*c*) 'Reluctant' means hesitating before doing something because you do not want to do it or because you are not sure that it is the right thing to do hence, 'unwilling' is its correct synonym.

49. (*d*) Someone who is 'optimistic' is hopeful about the future or the success of something in particular hence, 'sanguine' is its correct synonym.

50. (*a*) 'Cooperative' means involving mutual assistance in working towards a common goal hence, 'complaisant' is its correct synonym.

51. (*d*) $Q = mc\Delta T$

$$\Rightarrow m = \frac{Q}{c(T_f - T_i)}$$

$$= \frac{20 \times 10^3}{400 \times (25-15)} = 5kg$$

52. (*b*) The latent heat of vaporization is the heat energy required to change 1 kg of the material in its liquid state at its boiling point to 1 kg of the material in its gaseous state.

53. (*a*) From the formula $Q = mc\Delta T$, it is clear that heat transfer will be more if the temperature difference between the water and the atmosphere is more.

Also, if the surface area of liquid is large, the number of atoms in contact with the atmosphere per unit volume will also be large.

54. (*c*) Force $(F) = K\frac{q_1 q_2}{r^2}$ is positive when

(*i*) either both q_1 and q_2 are positive.

(*ii*) or, both q_1 and q_2 are negative.

55. (*a*) $$\frac{1}{R_{eq}} = \frac{1}{\frac{R}{5}} + \frac{1}{\frac{R}{5}} + ...(5 \text{ times})$$

$$\Rightarrow \frac{1}{R_{eq}} = \frac{5 \times 5}{R} = \frac{25}{50} = \frac{1}{2}$$

$$\Rightarrow R_{eq} = 2\Omega$$

56. (*d*)

57. (*d*) A solution is a homogeneous mixture of solute and solvent. Sugar is a solute. Hence, not a solution.

58. (*b*) Fractional Distillation.

Refining of petroleum involves fractional distillation. Through it, the crude oil gets separated into different hydrocarbon products.

59. (*d*) Milk turning sour

Milk souring is a chemical change because it ends up forming a new product that is the lactic acid, hence leaving the milk sour.

60. (*a*) $(NH_4)_2CO_3$

Molecular formula can be found using criss-cross method

Ions	NH_4	CO_3	Formula
Valency	+1	−2	$(NH_4)_2CO_3$

61. (*c*) Silicon carbide

In silion carbide (SiC), bond is formed between Si and C by sharing of e^- s. Therefore it is a covalent compound.

62. (*c*) Mass number = No. of protons + No. of neutrons

40 = 18 + No. of neutrons

No. of neutrons = 22

No. of electrons = No of protons = 18.

63. (*a*) Valency

Ne 0

Mg 2

N 3

Si 4

Thus, correct order is Ne < Mg < N < Si

64. (*b*) Frequency is number of cycles completed in one second. So, 3Hz means 3 cycles/s.

65. (*d*) $R = \rho\frac{l}{A}$

Unit of R, l and A are Ω, m and m^2 respectively. So, unit of

$$\rho = \frac{\Omega \times m^2}{m} = \Omega m$$

66. (*b*) $P = VI \Rightarrow I = \frac{P}{V} = \frac{60}{240} = 0.25A$

67. (*a*) $B = \frac{\mu_0 I}{2\pi R} \Rightarrow B \propto \frac{1}{R}$

68. (*b*) $F = (GmM) \times r^{-2}$

$\Rightarrow G = F \times r^2 \times (Mm)^{-1}$

Dimension of $G = [M^1L^1T^{-2}] \times [L]^2 \times [M]^{-2} = [M^{-1}L^3T^{-2}]$

69. (*c*) $t = \frac{u}{g} = \frac{40}{10} = 4s$

70. (*c*) $T = 2\pi\sqrt{\frac{\ell}{g}} = 2\pi\sqrt{\frac{1}{10}}$

$= 2\sqrt{10} \times \frac{1}{\sqrt{10}} = 2s$

71. (*c*) Living things refer to any organism or a living form that possesses a characteristic of life or being alive. Living things are made up of microscopic units called cells. They experience metabolism, they can exhibit movement, they show growth and repair, reproduction, etc. While non-living things do not eat, grow, breathe, move and reproduce. They do not have senses. Hence, they don't show any similar characteristics like living beings.

72. (*b*) Leucoplasts are a group of plastids that include many differentiated colourless organelles with very different functions, e.g., the amyloplasts (act as a storage site for starch in non-green tissues such as roots, tubers, or seeds), elaioplasts (specialised in oil synthesis and storage) and the aleuroplast (responsible for storage of proteins).

73. (*d*) Vacuoles are also present in animal cells. In animal cells, vacuoles generally smaller and help sequester waste products. In the plant cells, it mainly helps in maintaining the water balance.

74. (*a*) The parenchyma forms the major part of the plant organs. In aquatic plants, large air sacs give them buoyancy effects. These sacs are surrounded by parenchyma tissues, also known as aerenchyma. Aerenchyma cells form a network with large air spaces or air cavities for gaseous exchange.

75. (*a*) Dogfish belongs to the class Chondrichthyes of Pisces. Jellyfish, silverfish and starfish belongs to the phylum Coelenterata, Arthropoda and Echinodermata respectively.

76. (*a*) Bryophytes are non-vascular embryophytes, that are characterized by the presence of an independent gametophyte and parasitic sporophyte. These are called amphibians of the plant kingdom because these can live in soil but are dependent on the water for the sexual reproduction.

77. (*d*) AIDS, dengue fever and COVID-19, all three are viral diseases but typhoid fever caused by *Salmonella typhi* is a bacterial disease.

78. (*c*) The star-light reaching our eyes increases and decreases continuously due to atmospheric refraction.

79. (*d*) Force (F) is anti-parallel to displacement (*d*). So the angle (θ) between them is 180°.

So, work done = Fd cosθ = Fd cos180° = –Fd.

80. (*b*) $F = ma \Rightarrow a = \frac{F}{m} = \frac{5}{10} = 0.5 m/s^2$

81. (*b*) $(m_1 + m_2)V = m_1 u$

$\Rightarrow (52 + 3)V = 52 \times 2$

$\Rightarrow v = \frac{52 \times 2}{55} = 1.89 m/s$

82. (*b*) Potential energy is the energy possessed by a body by virtue of its position or shape.

83. (*d*) Velocity (V) = Frequency (ν) × wave length (λ)

$= 1000 \times \frac{50}{100} = 500\ m/s$

$\text{Time} = \frac{\text{distance}}{\text{velocity}} = \frac{1000}{500} = 2s$

84. (*d*) Bohr's model is only applicable for monoelectronic species. A monoelectronic species is one which has tendency to gain one e^- to complete its octet or has only one e^- in its valence shell

An element with atomic number 35 will have electronic configuration as $[Ar]3d^{10}4s^24p^5$. Hence, no. of valence electrons = 7.

It will readily gain one e^- to complete its valence shell to attain stability.

85. (*a*) In the reaction, $AlCl_3 + 3H_2O \rightarrow Al(OH)_3 + 3HCl$, there is no change in the oxidation state of any atom i.e. no atom is undergoing simultaneous oxidation and reduction. Therefore, not a redox reaction.

86. (*b*) Diamond and crystalline silicon are isomorphous because they both have three dimensional tetrahedral structure.

87. (*d*) Colourless.

88. (*d*) Silica

A pigment is a coloured substance that is completely or nearly insoluble in water. Silica occurs as crystalline Quartz in its purest form Silica is not commonly used as a pigment.

89. (*a*) Urea is rich in nitrogen content. It has approximately 46% of nitrogen in it.

90. (*a*) Carbon compounds don't have the presence of free electrons. Therefore, they are bad conductors.

91. (*b*) In $2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(s)$, AgCl is getting decomposed in the presence of sunlight to produce Ag and Cl_2. Since one reactant (AgCl) is broken into more than one product, therefore, it is an example of decomposition reaction.

92. (*d*) Mechanism of action of oral contraceptive pills:
- Prevents ovulation by inhibition of LH surge
- Induce atrophic changes in endometrium, preventing implantation.
- Thickening of cervical mucus preventing entry of sperms

93. (*a*) Papaya has unisexual flowers i.e. male flowers and female flowers are located on separate plants.

94. (*a*) The smooth ER is important in the synthesis of lipids, such as cholesterol and phospholipids, which form the membranes of the organism. In addition it is also important for the synthesis and secretion of steroid hormones.

95. (*c*) Buoyancy is an upward force/thrust which is opposite to the weight of the immersed body.

96. (*c*) According to Fleming's Right-hand rule, if the thumb is pointing towards the conductor's motion and the fore finger pointing towards the magnetic field direction, then the middle finger gives the direction of induced current.

97. (*a*) $\frac{R_1}{R_2} = \frac{\rho \ell_1}{A} \times \frac{A}{\rho \ell_2} = \frac{\ell_1}{\ell_2} = \frac{\ell_1}{2\ell_1} = \frac{1}{2}$

$\Rightarrow R_2 = 2R_1$

Now, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{2R_1} = \frac{3}{2R_1}$

$\Rightarrow 3R = 2R_1$

98. (*c*) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{-10} = \frac{1}{-5} - \frac{1}{u} \Rightarrow u = -10cm$

$m = \frac{v}{u} = \frac{-5}{-10} = \frac{1}{2} = 0.5$

99. (*d*) $P = \frac{F}{A} = \frac{mg}{A}$, A = area of table.

$\Rightarrow P = \frac{2 \times 10}{0.3 \times 0.1} = 666.67 \frac{N}{m^2}$

100. (*a*)

101. (*a*) Arthashastra, the classical work of Indian political thought, focuses primarily on economy. It includes books on the nature of government, law, civil and criminal court systems, ethics, economics, markets and trade and nature of peace.

102. (*b*) Charaka Samhita originated between 3rd to 2nd Century BCE. It is a detailed text on ancient Indian medicine attributed to Charaka and it is also called Charaka-Samhita.

103. (*d*) Empty seat, Wheel, Tree and Stupa are the symbols that shows the presence of Buddhist. Great thinkers like Buddha, Mahavira, Heraclitus, Zoroaster, Confucius and Lao Tse lived and preached their ideas in this century.

104. (*b*) The Parliament of India is primarily based on the model of British Parliament. Article 74 and 75 provide parliamentary system for the centre and Article 163 and 164 provides parliamentary system for the states.

105. (*b*) Chaudhary Charan Singh had the shortest span in office as the Prime Minister of India. He was the Prime Minister of India only for 170 days and he was the only Prime Minister who never faced the Parliament.

106. (*c*) Collegiate Jurisdiction does not fall under the jurisdiction of the apex court of India. According to Article 32, Supreme court is the guardian/ protector of fundamental rights.

107. (*c*) Both 1 and 2. Cloudbursts are short-duration, intense rainfall events over a small area.

108. (*a*) Earth is not a perfect sphere. Its shape is an oblate spheroid. This just means that it flattens at the poles and widens out at the equator.

109. (*c*) Both latitude and longitude of the place are required to locate the place on the map. Latitude lines run east-west around the globe and longitude run north-south, from pole to pole.

110. (*d*) Among the given options, (*d*) is not correct. GPS is a satellite navigation system, used to determine the ground position of an object.

111. (*d*) The National Commission for Women is not a Constitutional Commission of India. A Constitutional body is a body or institute established by the Constitution of India.

112. (*b*) Xuanzang wrote the diary called 'Records of the Travels to Middle India. He was also known as Hiuen Tsang. He was a 7th century Chinese Buddhist monk, scholar, traveller and translator.

113. (*d*) The elections to the Lower House of the Parliament of India, held in 2019, constituted the 17th Lok Sabha. The Lok Sabha elections held after every five years. The minimum age to cast the vote is 18 years.

114. (*b*) Panchayati Raj Institutions are primarily the institutions of Self-Government. Local Self Government is the management of local affairs by such local bodies that have been elected by the people.

115. (*c*) Life, Liberty and Pursuit of Happiness are the rights mentioned in the American Declaration of Independence. It was adopted by the second continental congress meeting in Philadelphia, Pennsylvania in 1776.

116. (*a*) Abraham Lincoln described democracy as "Government of the People, for the People and by the People. He served as the 16th President of the United States.

117. (*d*) In a rotational motion, the external Torque is zero then the angular momentum and hence angular velocity of the rotating body becomes constant.

118. (*d*) Mass movements are part of a continuum of erosional processes between weathering and stream transport. Mass wasting is associated with a variety of serious landslide hazards that are often associated with heavy precipitation.

119. (*c*) Landslides generally occur in clay-rich soil and earthquakes trigger landslides. Land slides are type of mass wasting and it is defined as the movement of a mass of rock, debris.

120. (*b*) When a mass of snow moves rapidly down a slope of a mountain is known as Avalanche. There are various kinds of avalanche-Rock avalanche, ice avalanche and debris avalanche.

121. (*d*) The real beginning of western education in India can be dated from the Macaulay's Minute on Indian Education, 1835. Macaulay was a law member of the Governor General's Executive Council and was appointed as President of the Committee of Public Instruction.

122. (*c*) The term 'Industrial Revolution' was first used by Arnold Toynbee. Industrial Revolution began in Great Britain and was largely confined in the period of 1760 to 1830.

123. (*b*) The Khudai Khidmatgar (Servants of the God) was organized by Khan Abdul Ghaffar Khan. He is popularly called as the "Frontier Gandhi". He was the first non-Indian to receive the Bharat Ratna award.

124. (*a*) The Mahad Satyagraha of 1927 was organized by B.R Ambedkar. He was appointed as the first Law minister of India. He is popularly known as Babasaheb and he was also the chairman of drafting committee.

125. (*b*) The Satyashodhak Samaj (Truth-Seeking Society) was set up by Jyotiba Phule. It was founded in Pune, Maharashtra in 1873. It was a social reform society focused specially on women, shudras and Dalits.

126. (*c*) The 13th Century text Lekhapaddhati gives us information on Legal document. It belongs to Chalukaya kingdom of Gujarat.

127. (*d*) Nkrumah was the leader of Ghana in Africa. There are 17 countries and 10 international organisations that are observers at NAM. Jawaharlal Nehru was the leader of India.

128. (*a*) The idea of Planning in Independent India was drawn from the Bombay Plan. The Bombay Plan was the economic plan for India proposed by a group of industrialists and technocrats in January 1944.

129. (*d*) Nisarga, Gati, Nivar, Tauktae and Yaas are names of cyclones. Cyclones name in past Gati in India, Nivar in Iran, Burevi in Maldives, Tauktae in Myanmar, Yaas in Oman and Nisarga in Bangladesh.

130. (*c*) Manipur was connected with the Indian Railways network in the year 2021. It is a north eastern state of India. Its capital is Imphal.

131. (*b*) The total forest and tree cover in 24.62% of the geographical area of the country.

132. (*a*) There are 28 states and 8 union territories in India. India is a union of states. It is the seventh-largest country by area and the second most populous country of the world.

133. (*a*) Snow, sleet and hail are the forms of precipitation. Precipitation is the falling of water from the sky in various forms and it occurs when water particles of any size fall from the upper atmosphere to the earth's surface.

134. (*a*) Mechanical weathering is likely to be the most prevalent form of weathering in hot-tropical desert areas. It is also called physical weathering.

135. (*c*) New York was the first city to attain the status of a 'megacity". The term megacity refers to metropolitan areas with a population of more than 10 million people.

136. (*b*) Peninsular plateau is rigid and stable. It has seen recurring periods of uplift and submergence, which have been accompanied by crustal faulting and fractures.

137. (*d*) The given species are found in Desert region. Acacias, palms and euphorbias and cacti are the main plant species. Important species found are babool, ber, wild date palm, Khair, neem, khejri and palm.

138. (*c*) Both 1 and 2. Rocks changes their original form by undergoing process like weathering, erosion and metamorphic actions.

139. (*a*) Weathering, mass wasting, erosion and transportation are indicators of Denudation. Denudation refers to the weathering of Earth's materials that cause a certain levelling of the surface.

140. (*d*) Moraines, eskers and outwash plains terms are related to the glacier. Most glaciers in India are found in Himachal Pradesh, Sikkim, Uttarakhand and the Union Territory of Ladakh.

141. (*c*) Legendary Kathak dancer Pandit Birju Maharaj was the doyen of Lucknow Gharanas of Kathak. Kathak has its origin in Uttar Pradesh and is thought to be the one of the important dances in 8th form of classical dance.

142. (*b*) In a first, India is to export BrahMos missile to Philippines. BrahMos is a joint venture of DRDO, India and NPOM Russia. It is named after the rivers Brahmaputra and Moskva.

143. (*a*) Justice Indu Malhotra is the Head of the Committee appointed by the Supreme Court of India to enquire into the circumstances that led to the Prime Minister of India's convoy being stuck for several minutes on a flyover in Punjab recently.

144. (*d*) Ross Taylor bagged a wicket on the last ball of his career. He was a New Zealand cricket team fast bowler.

145. (*d*) S. Somnath is appointed as the tenth Chairman of the Indian Space Research Organization (ISRO) recently. He has been appointed as the tenth ISRO chief. ISRO headquarters are located at Bengaluru.

146. (*b*) Madhya Pradesh has the largest forest cover in the country followed by Arunachal Pradesh, Chhattisgarh, Odisha and Maharashtra.

147. (*b*) Union Finance Minister serves as the chairperson of the GST council in India. Other members are Union State Minister of Revenue of Finance and Ministers.

148. (*b*) The International Union for Conservation of Nature categorized (IUCN) has recently the Red Sanders (Red) Sandalwood) into endangered category. IUCN Red list was established in 1964 and it is a critical indicator of the health of the world's biodiversity.

149. (*c*) The Government of India has decided to observe Veer Baal Diwas' on 26th December. Veer Baal Diwas is celebrated to pay homage to the courage of the Sahibzades, four sons of Guru Gobind Singh, the last Sikh guru.

150. (*b*) On 14th January, 2022, Ministry of AYUSH has organized a global Surya Namaskar Demonstration programme.

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