NDA/NA SOLVED PAPER 2023-I

PAPER -I: MATHEMATICS

1. If ω is a non -real cube root of 1, then what is the value of $\left|\dfrac{1-\omega}{\omega+\omega^2}\right|$?

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

   (c) 1   (d) $\dfrac{4}{\sqrt{3}}$

2. What is the number of 6 -digit numbers that can be formed only by using 0, 1, 2, 3, 4 and 5 (each once); and divisible by 6?

   (a) 96   (b) 120

   (c) 192   (d) 312

3. What is the binary number equivalent to decimal number 1011?

   (a) 1011   (b) 111011

   (c) 11111001   (d) 111110011

4. Let A be a matri x of order 3 $\times$ 3 and $|A|$ = 4. If $\left|2\,\mathrm{adj}(3\,A)\right|=2\,3\,\,^\beta,$ then what is the value of ($\alpha+\beta$)?

   (a) 12   (b) 13

   (c) 17   (d) 24

5. If α and β are the distinct roots of equation $x^2 -x +1 =0$, then wha t is the value of $\left|\dfrac{\alpha^{100}+\beta^{100}}{\alpha^{100}-\beta^{100}}\right|$?

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

   (c) 1   (d) $\dfrac{1}{\sqrt{3}}$

6. Let A and B be symmetric matrices of same order, then which one of the following is correct regarding (AB–BA)?

   1. Its diagonal entries are equal but nonzero

   2. The sum of its non -diagonal entries is zero

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

7. Consider the following stateme nts in respect of square matrices A,B,C each of same order then :

   1. AB = AC $\Rightarrow$ B = C if A is non singular

   2. If BX = CX for every column matrix X having n rows then B = C

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

8. The system of linear equations

   $x+ 2y + z = 4, 2x +4 y +2 z =8$ and

   $3x +6y +3z =10$ has

   (a) a unique solution   (b) infinite many solutions

   (c) no solution   (d) exactly three solutions

9. Let AX = B be a system of 3 linear equations with 3 - unknowns. Let X_1 and X_2 be its two distinct solutions. If the combination $aX_1 +bX_2$ is a solution of AX=B; where a, b are real numbers, then which one of the following is correct?

   (a) a = b   (b) a + b =1

   (c) a + b = 0   (d) a – b =1

10. What is the sum of the roots of the equation

   $\begin{vmatrix} 0 & x-a & x+b \\ 0 & 0 & x-c \\ x+b & x+c & 1 \end{vmatrix} = 0$?

   (a) a + b + c   (b) a – b + c

   (c) a + b – c   (d) a – b – c

11. If $2-i\sqrt{3}$ where $i=\sqrt{-1}$ is a root of the equation $x^2 +ax +b = 0$, then what is the value of (a + b)?

(a) –11   (b) –3

(c) 0   (d) 3

12. If $z = \dfrac{1+i\sqrt{3}}{1-i\sqrt{3}}$ where $i = \sqrt{-1}$, then what is the argument of z?

(a) $\dfrac{\pi}{3}$ (b) $\dfrac{2\pi}{3}$

(c) $\dfrac{4\pi}{3}$ (d) $\dfrac{5\pi}{6}$

13. If a, b, c are in AP, then what is

$$\begin{vmatrix} x+1 & x+2 & x+3 \\ x+2 & x+3 & x+4 \\ x+a & x+b & x+3 \end{vmatrix} \text{ equal to?}$$

(a) –1   (b) 0

(c) 1   (d) 2

14. If $\log_x a, a^x$ and $\log_b x$ are in GP, then what is x equal to?

(a) $\log_a (\log_b a)$ (b) $\log_b (\log_b b)$

(c) $\dfrac{\log_a (\log_b a)}{2}$ (d) $\dfrac{\log_b (\log_a b)}{2}$

15. If $2^{\frac{1}{c}}, 2^{\frac{b}{ac}}, 2^{\frac{1}{a}}$ are in GP, 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, c are in HP   (d) ab, bc, ca are in AP

16. The first and the second terms of an AP are $\dfrac{5}{2}$ and $\dfrac{23}{12}$ respectively. If n^{th} term is the largest negative term, what is the value of n?

(a) 5   (b) 6

(c) 7   (d) n cannot be determined

17. For how many integral values of k, the equation $x^2 - 4x + k = 0$, where k is an integer has real roots and both of them lie in the interval (0, 5)?

(a) 3   (b) 4

(c) 5   (d) 6

18. In an AP, the first term is x and the sum of the first n terms is zero. What is the sum of next m terms?

(a) $\dfrac{mx(m+n)}{n-1}$ (b) $\dfrac{mx(m-n)}{1-n}$

(c) $\dfrac{nx(m+n)}{m-1}$ (d) $\dfrac{nx(m+n)}{1-m}$

19. Consider the following statements:

1. (25)! +1 is divisible by 26
2. (6)! +1 is divisible by 7

Which of the above statements is/are correct?

(a) 1 only   (b) 2 only

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

20. If z is a complex number such that $\dfrac{z-1}{z+1}$ is purely imaginary, then what is $|z|$ equal to?

(a) $\dfrac{1}{2}$ (b) $\dfrac{2}{3}$

(c) 1   (d) 2

21. How many real numbers satisfy the equation $|x-4| + |x-7| = 15$?

(a) Only one   (b) Only two

(c) Only three   (d) Infinitely many

22. A mapping $f : A \to B$ defined as $f(x) = \dfrac{2x+3}{3x+5}$, $x \in A$. If f is to be onto, then what are A and B equal to?

(a) $A = R \setminus \left\{-\dfrac{5}{3}\right\}$ and $B = R \setminus \left\{-\dfrac{2}{3}\right\}$

(b) $A = R$ and $B = R \setminus \left\{-\dfrac{5}{3}\right\}$

(c) $A = R \setminus \left\{-\dfrac{3}{2}\right\}$ and $B = R \setminus \{ \}$

(d) $A = R \setminus \left\{-\dfrac{5}{3}\right\}$ and $B = R \setminus \left\{\dfrac{2}{3.}\right\}$

23. α and β are distinct real roots of the quadratic equation $x^2 + ax + b = 0$. Which of the following statements is/are sufficient to find α?

1. $\alpha + \beta = 0, \alpha^2 + \beta^2 = 2$

2. $\alpha\beta^2 = -1, \alpha = 0$

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

24. If the sixth term in the binomial expansion of $\left(x^{\frac{-8}{3}} + x^2 \log_{10} x\right)^8$ is 5600, then what is the value of x?

(a) 6   (b) 8

(c) 9   (d) 10

25. How many terms are there in the expansion of $(3x-y)^4(x+3y)^4$?
    (a) 9
    (b) 12
    (c) 15
    (d) 17

26. p, q, r and s and in AP such that $p+s=8$ and $qr=15$. What is the difference between largest and smallest numbers?
    (a) 6
    (b) 5
    (c) 4
    (d) 3

27. Consider the following statements for a fixed natural number n;
    1. $C(n, r)$ is greatest if $n=2r$
    2. $C(n, r)$ is greatest if $n=2r-1$ and $n=2r-1$ and $n=2r+1$
    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

28. m parallel lines cut n parallel lines giving rise to 60 parallelograms. What is the value of $(m+n)$?
    (a) 6
    (b) 7
    (c) 8
    (d) 9

29. Let x be the number of permutations of the word 'PERMUTATIONS' and y be the number of permutations of the word 'COMBINATIONS'. Which one of the following is correct?
    (a) $x=y$
    (b) $y=2x$
    (c) $x=4y$
    (d) $y=4x$

30. 5-digit numbers are formed using the digits 0,1,2,4,5 without repetition. What is the percentage of numbers which are greater than 50,000?
    (a) 20%
    (b) 25%
    (c) $\frac{100}{3}\%$
    (d) $\frac{110}{3}\%$

Directions for (31 to 32): Consider the following for the next two (02) items that follow:
Let $\sin\beta$ be the GM of $\sin\alpha$ and $\cos\alpha$; $\tan\gamma$ be the AM of $\sin\alpha$ and $\cos\alpha$.

31. What is $\cos2\alpha$ equal to?
    (a) $(\cos\alpha-\sin\alpha)^2$
    (b) $(\cos\alpha+\sin\alpha)^2$
    (c) $(\cos\alpha+\sin\alpha)^3$
    (d) $\frac{(\cos\alpha-\sin\alpha)^2}{2}$

32. What is the value of $\sec2\gamma$?
    (a) $\frac{3-\sin2\alpha}{5+2\sin2\alpha}$
    (b) $\frac{5-\sin2\alpha}{3-\sin2\alpha}$
    (c) $\frac{3-2\sin2\alpha}{4+\sin2\alpha}$
    (d) $\frac{3-\sin2\alpha}{4+3\sin2\alpha}$

Directions for (33 to 34): Consider the following for the next two (02) items that follow:
A flagstaff 20 m long standing on a pillar 10 m high subtends an angle $\tan^{-1}(0.5)$ at a point P on the ground. Let θ be the angle subtended by the pillar at this point P.

33. If x is the distance of P form bottom of the pillar, then consider the following statements:
    1. x can take two values which are in the ratio 1 : 3
    2. x can be equal to h eight of the flagstaff
    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

34. What is a possible value of $\tan\theta$?
    (a) $\frac{3}{4}$
    (b) $\frac{2}{3}$
    (c) $\frac{1}{3}$
    (d) $\frac{1}{4}$

Directions for (35 to 36): Consider the following for the next two (02) items that follow:
The perimeter of a triangle ABC is 6 times the AM of sine of angles of the triangle.
Further BC $=3$ and CA $=1$.

35. What is the perim eter of the triangle?
    (a) $\sqrt{3}+1$
    (b) $\sqrt{3}+2$
    (c) $\sqrt{3}+3$
    (d) $2\sqrt{3}+1$

36. Consider the following statements:
    1. ABC is right angled triangle
    2. The triangle of the triangle are in AP
    Which of the statements given above is/are correct?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 or 2

Directions for (37 to 38): Consider the following for the next two (02) items that follow:
Let $x=\frac{\sin^2 A+\sin A+1}{\sin A}$ where $0<A\leq\frac{\pi}{2}$

37. What is the minimum value of x?
    (a) 1
    (b) 2
    (c) 3
    (d) 4

38. At what value of A does x attain the minimum value?
    (a) $\frac{\pi}{6}$
    (b) $\frac{\pi}{4}$
    (c) $\frac{\pi}{3}$
    (d) $\frac{\pi}{2}$

Directions for (3 9 to 40): Consider the following for the next two (02) items that follow:

In the triangle ABC $a^2 + b^2 + c^2 = ac + \sqrt{3}bc$

39. What is the nature of the triangle?
    (a) Equilateral
    (b) Isosceles
    (c) Right angled triangle
    (d) Scalene but not right angled

40. If c = 8, what is the area of the triangle?
    (a) $4\sqrt{3}$ (b) $6\sqrt{3}$ (c) $8\sqrt{3}$ (d) $12\sqrt{3}$

Directions for (41 to 42): Conside r the following for the next two (02) items that follow: Consider the function $f(x) = |x - 2| + 3 - |4 - x|$ where $x \in R$

41. At what value x does the function attain minimum value ?
    (a) 2   (b) 3   (c) 4   (d) 0

42. What is the minimum valu e of the function ?
    (a) 2   (b) 3
    (c) 4   (d) 0

Directions for (43 to 44): Consider the following for the next two (02) items that follow: Consider the sum $S = 0! + 1! + 2! + 3! + 4! + ... + 100!$

43. If the sum S is divided by 8, what is the remainder?
    (a) 0   (b) 1
    (c) 2   (d) Cannot be determined

44. If the sum S is divided by 60, what is the remainder?
    (a) 1   (b) 3   (c) 17   (d) 34

Directions for (45 to 46): Consider the following for the next two (02) items that follow:

In a triangle PQR, P is the largest angl e and $\cos p = \dfrac{1}{3}$.

Further the in -circle of the triangle touches the sides PQ, QR and RP at N, L and M respectively such that the lengths PN, QL and RM are n, n + 2, n + 4 respectively where n is an integer.

45. What is the value of n?
    (a) 4   (b) 6   (c) 8   (d) 10

46. What is the length of the smallest side ?
    (a) 12   (b) 14   (c) 16   (d) 18

Directions for (4 7 to 48): Consider the following for the next two (02) items that follow:
Given that $\sin x + \cos x + \tan x + \cot x + \sec x + \csc x = 7$

47. The given equation can be reduced to
    (a) $\sin^2 2x - 44 \sin 2x + 36 = 0$

(b) $\sin^2 2x + 44 \sin 2x - 36 = 0$

(c) $\sin^2 2x - 22 \sin 2x + 18 = 0$

(d) $\sin^2 2x + 22 \sin 2x - 18 = 0$

48. If $\sin 2x = a - b\sqrt{c}$, where a and b are natural number, and c is prime number, then what is the valu e of a – b+2c ?
    (a) 0   (b) 14   (c) 21   (d) 28

Directions for (49 to 50): Consider the following for the next two (02) items that follow:

A quadratic equation is given by
$$\left(3 + 2\sqrt{2}\right)x^2 - \left(4 + 2\sqrt{3}\right)x + \left(4 + 3\sqrt{3}\right) = 0$$

49. What is the HM of the roots of the equation?
    (a) 2   (b) 4
    (c) $2\sqrt{2}$ (d) $2\sqrt{3}$

50. What is the GM of the roots of the equation?
    (a) $\sqrt{2}\left(\sqrt{6} - \sqrt{3} + \sqrt{2} + 1\right)$

    (b) $\sqrt{2}\left(\sqrt{6} + \sqrt{3} - \sqrt{2} + 1\right)$

    (c) $\left(\sqrt{6} - \sqrt{3} + \sqrt{2} - 1\right)$

    (d) $\left(\sqrt{6} + \sqrt{3} + \sqrt{2} - 1\right)$

Directi ons for (51 to 52): Consider the following for the next two (02) items that follow:

Let $\Delta(a,b,c,\alpha) = \begin{vmatrix} a & b & a\alpha + b \\ b & c & b\alpha + c \\ a\alpha + b & b\alpha + c & 0 \end{vmatrix}$

51. if $\Delta(a,b,c,\alpha) = 0$ for every $\alpha > 0$, then which one of the following is correct?
    (a) a, b, c are in AP   (b) a, b, c are in GP
    (c) a, 2b, c are in AP   (d) a, 2b, c are in GP

52. If $\Delta(7,4,2,\alpha) = 0$, then α is a root of which one of the following equations?
    (a) $7x^2 + 4x + 2 = 0$ (b) $7x^2 - 4x + 2 = 0$
    (c) $7x^2 + 8x + 2 = 0$ (d) $7x^2 - 8x + 2 = 0$

Directions for (53 to 54): Consider the following for the next two (02) items that follow:
Given that $m(\theta) = \cot^2\theta + n^2 \tan^2\theta + 2n$, where n is a fixed positive real number.

53. What is the least value of $m(\theta)$?
    (a) n   (b) 2n
    (c) 3n   (d) 4n

54. Under what condition does m attain the least value?
    (a) $n = \tan^2 \theta$
    (b) $n = \cot^2 \theta$
    (c) $n = \sin^2 \theta$
    (d) $n = \cos^2 \theta$

Directions for (55 to 56): Consider the following for the next two (02) items that follow:
A quadrilateral is formed by the lies $x = 0, y = 0, x + y = 1$ and $6x + y = 3$.

55. What is the equation of diagonal through origin?
    (a) $3x + y = 0$
    (b) $2x + 3y = 0$
    (c) $3x - 2y = 0$
    (d) $3x + 2y = 0$

56. What is the equation of other diagonal?
    (a) $x + 2y - 1 = 0$
    (b) $x - 2y - 1 = 0$
    (c) $2x + y + 1 = 0$
    (d) $2x + y - 1 = 0$

Directions for (57 to 58): Consider the following for the next two (02) items that follow:
$P(x, y)$ is any point on the ellipse $x^2 + 4y^2 = 1$. Let E, F be the foci of the ellipse.

57. What is $PE + PF$ equal to?
    (a) 1
    (b) 2
    (c) 3
    (d) 4

58. Consider the following points:
    1. $\left(\frac{\sqrt{3}}{2}, 0\right)$ 2. $\left(\frac{\sqrt{3}}{2}, \frac{1}{4}\right)$ 3. $\left(\frac{\sqrt{3}}{2}, -\frac{1}{4}\right)$

    Which of the above points lie on latus rectum of ellipse?
    (a) 1 and 2 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

Directions for (59 to 60): Consider the following for the next two (02) items that follow:
The line $y = x$ partitions the circle $(x - a)^2 + y^2 = a^2$ in two segments.

59. What is the area of minor segment?
    (a) $\dfrac{(\pi - 2)a^2}{4}$
    (b) $\dfrac{(\pi - 1)a^2}{4}$
    (c) $\dfrac{(\pi - 2)a^2}{2}$
    (d) $\dfrac{(\pi - 1)a^2}{2}$

60. What is the area of major segment?
    (a) $\dfrac{(3\pi - 2)a^2}{4}$
    (b) $\dfrac{(3\pi + 2)a^2}{4}$
    (c) $\dfrac{(3\pi - 2)a^2}{4}$
    (d) $\dfrac{(3\pi + 2)a^2}{2}$

Directions for (61 to 62): Consider the following for the next two (02) items that follow:
Let $A(1, -1, 2)$ and $B(2, 1, -1)$ be the end points of the diameter of the sphere $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz - 1 = 0$.

61. What is $u + v + w$ equal to?
    (a) −2
    (b) −1
    (c) 1
    (d) 2

62. If $P(x, y, z)$ is any point on the sphere, then what is $PA^2 + PB^2$ equal to?
    (a) 15
    (b) 14
    (c) 13
    (d) 6.5

Directions for (63 to 64): Consider the following for the next two (02) items that follow:
Consider two lines whose direction ratios are $(2, -1, 2)$ and $(k, 3, 5)$. They are inclined at an angle $\frac{\pi}{4}$.

63. What is the value of k ?
    (a) 4
    (b) 2
    (c) 1
    (d) −1

64. What are the direction ratios of a line which is perpendicular to both the lines?
    (a) $(1, 2, 10)$
    (b) $(-1, -2, 10)$
    (c) $(11, 12, -10)$
    (d) $(11, 2, -10)$

Directions for (65 to 66): Consider the following for the next two (02) items that follow:
Let $\vec{a} = 3\hat{i} + 3\hat{j} + 3\hat{k}$ and $\vec{c} = \hat{j} - \hat{k}$. Let $\vec{b}$ be such that $\vec{a} \cdot \vec{b} = 27$ and $\vec{a} \times \vec{b} = 9\vec{c}$

65. What is $\vec{b}$ equal to?
    (a) $3\hat{i} + 4\hat{j} + 2\hat{k}$
    (b) $5\hat{i} + 2\hat{j} + 2\hat{k}$
    (c) $5\hat{i} - 2\hat{j} + 6\hat{k}$
    (d) $3\hat{i} + 3\hat{j} + 4\hat{k}$

66. What is the angle between $(\vec{a} + \vec{b})$ and $\vec{c}$?
    (a) $\dfrac{\pi}{2}$
    b. $\dfrac{\pi}{3}$
    c. $\dfrac{\pi}{4}$
    d. $\dfrac{\pi}{6}$

Directions for (67 to 68): Consider the following for the next two (02) items that follow:
Let a vector $\vec{a} = 4\hat{i} - 8\hat{j} + \hat{k}$ make angles α, β, γ with positive directions of x, y, z axes respectively.

67. What is $\cos \alpha$ equal to?
    (a) $\dfrac{1}{3}$
    (b) $\dfrac{4}{9}$
    (c) $\dfrac{5}{9}$
    (d) $\dfrac{2}{3}$

68. What is $\cos 2\beta + \cos 2\gamma$ equal to?

(a) $-\dfrac{32}{81}$ (b) $-\dfrac{16}{81}$ (c) $\dfrac{16}{81}$ (d) $\dfrac{32}{81}$

Directions for (69 to 70): Consider the following for the next two (02) items that follow:

The position vectors of two points A and B are $\hat{i} - \hat{j}$ and $\hat{j} + \hat{k}$ respectively.

69. Consider the following points:
   1. $(-1, -3, 1)$ 2. $(-1, 3, 2)$ 3. $(-2, 5, 3)$
   Which of the above points lie on the line joining A and B?
   (a) 1 and 2 only   (b) 2 and 3 only
   (c) 1 and 3 only   (d) 1, 2 and 3

70. What is the magnitude of $\overrightarrow{AB}$?

   (a) 2   (b) 3   (c) $\sqrt{6}$ (d) $\sqrt{3}$

Directions for (71 to 73): Consider the following f or the nex t three (03) items that follow: Let $f(x) = Pe^{x} + Qe^{2x} + Re^{3x}$, where P, Q, R are real numbers. Further $f(0) = 6$, $f'(\ln 3) = 282$ and $\int_{0}^{\ln 2} f(x)dx = 11$

71. What is the value of Q?
   (a) 1   (b) 2
   (c) 3   (d) 4

72. What is the value of R?
   (a) 1   (b) 2
   (c) 3   (d) 4

73. What is $f'(0)$ equal to?
   (a) 18   (c) 16
   (c) 15   (d) 14

Directions for (74 to 75): Consider the following for the next two (02) items that follow:
Suppose E is the differential equation re   presenting family of curves $y^2 = 2cx + 2c\sqrt{c}$ where c is a positive parameter.

74. What is the order of the differential equation?
   (a) 1   (b) 2
   (c) 3   (d) 4

75. What is the degree of the differential equation?
   (a) 2   (b) 3
   (c) 4   (d) Degree does not exist

Directions for (76 to 78): Consider the following for the next three (03) items that follow:

Let $f(x) = \begin{vmatrix} \cos x & x & 1 \\ 2\sin x & x^{2} & 2x \\ \tan x & x & 1 \end{vmatrix}$

76. What is $f(0)$ equal to?
   (a) -1 (b) 0
   (c) 1   (d) 2

77. What is $\lim\limits_{x \to \infty} \dfrac{f(x)}{x}$ equal to?
   (a) -1 (b) 0
   (c) 1   (d) 2

78. What is $\lim\limits_{x \to \infty} \dfrac{f(x)}{x^{2}}$ equal to?
   (a) -1 (b) 0   (c) 1   (d) 2

Directions for (79 to 80): Consider the following for the next two (02) items that follow:
Let $f(x) = \sin[\pi^3]x + \cos[-\pi^2]x$ where [.] is a greatest integer function.

79. What is $f\left(\dfrac{\pi}{2}\right)$ equal to?
   (a) -1 (b) 0
   (c) 1   (d) 2

80. What is $f\left(\dfrac{\pi}{4}\right)$ equal to?

   (a) $-\dfrac{1}{\sqrt{2}}$ (b) -1

   (c) 1   (d) $\dfrac{1}{\sqrt{2}}$

Directions for (81 to 83): Consider the following for the next three (03) items that follow:

Let $I_1 = \int_{0}^{\pi} \dfrac{x}{1+\cos^{2}x}dx$ and $I_2 = \int_{0}^{\pi} \dfrac{1}{1+\sin^{2}x}dx$

81. What is the value of $\dfrac{I_1 + I_2}{I_1 - I_2}$?
   (a) 1   (b) π
   (c) π^2 (d) $\dfrac{\pi+1}{\pi-1}$

82. What is the valu e of $8I_1^2$?
   (a) π (b) π^2
   (c) π^3 (d) π^4

83. What is the value of I_2?

(a) $\dfrac{\pi}{\sqrt{2}}$ (b) $\dfrac{\pi}{2\sqrt{2}}$

(c) $\dfrac{3\pi}{2\sqrt{2}}$ (d) $\dfrac{\pi}{4\sqrt{2}}$

Directions for (84 to 85): Consider the following for the next two (02) items that follow:

Let $1 = \int_a^b \dfrac{|x|}{x}\,dx,\ a < b$

84. What is 1 equal to when $a < 0 < b$?

(a) $a + b$ (b) $a - b$

(c) $b - a$ (d) $\dfrac{(a+b)}{2}$

85. What is 1 equal to when $a < b < 0$?

(a) $a + b$ (b) $a - b$

(c) $b - a$ (d) $\dfrac{(a+b)}{2}$

Directions for (86 to 88): Consider the following for the next three (03) items that follow:

Let $f(x) = |\ln x|,\ x \ne 1$

86. What is the derivative of $f(x)$ at $x = 0 \cdot 5$?

(a) -2 (b) -1

(c) 1 (d) 2

87. What is the derivative of $f(x)$ at $x = 2$?

(a) $-\dfrac{1}{2}$ (b) -1

(c) $\dfrac{1}{2}$ (d) 2

88. What is the derivative of $f \circ f(x)$, where $1 < x < 2$?

(a) $\dfrac{1}{\ln x}$ (b) $\dfrac{1}{x \ln x}$ (c) $\dfrac{1}{\ln x}$ (d) $-\dfrac{1}{x \ln x}$

Directions for (89 to 90): Consider the following for the next two (02) items that follow:

Let $f(x) = \begin{cases} x + 6, & x \le 1 \\ px + q, & 1 < x < 2 \\ 5x, & x \ge 2 \end{cases}$ and $f(x)$ is continuous

89. What is the value of p?

(a) 2   (b) 3

(c) 4   (d) 5

90. What is the value of q?

(a) 2   (b) 3   (c) 4   (d) 5

91. Consider the following statements:

1. $f(x) = \ln x$ is increasing in $(0, \infty)$

2. $g(x) = e^x + e^{\frac{1}{x}}$ is decreasing in $(0, \infty)$

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

92. What is the derivative of $\sin^2 x$ with respect to $\cos^2 x$?

(a) -1 (b) 1   (c) $\sin 2x$ (d) $\cos 2x$

93. For what value of m with $m < 0$, is the area bounded by the lines $y = x$, $y = mx$ and $x = 2$ equal to 3?

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

94. What is the derivative of $\csc(x^\circ)$?

(a) $-\csc(x^\circ)\cot(x^\circ)$ (b) $-\dfrac{\pi}{180}\csc(x^\circ)\cot(x^\circ)$

(c) $\dfrac{\pi}{180}\csc(x^\circ)\cot(x^\circ)$ (d) $-\dfrac{\pi}{180}\csc(x^\circ)\cot(x^\circ)$

95. A solution of the differential equation $\left(\dfrac{dy}{dx}\right)^2 - x\dfrac{dy}{dx} = 0$ is

(a) $y = 2x$ (b) $y = 2x + 4$

(c) $y = x^2 - 1$ (d) $y = \dfrac{(x^2 - 2)}{2}$

96. If $f(x) = x^2 + 2$ and $g(x) = 2x - 3$, then what is $(fg)(1)$ equal to?

(a) 3   (b) 1

(c) -2 (d) -3

97. What is the range of the function $f(x) = x + |x|$

(a) $(0, \infty)$ (b) $[0, \infty)$

(c) $(-\infty, \infty)$ (d) $[1, \infty)$

98. If $f(x) = x(4x^2 - 3)$, then what is $f(\sin\boldsymbol{\theta})$ equal to?

(a) $-\sin 3\theta$ (b) $-\cos 3\theta$ (c) $\sin 3\theta$ (d) $-\sin 4\theta$

99. What is $\lim\limits_{x \to 5}\dfrac{5 - x}{|x - 5|}$ equal to?

(a) -1 (b) 0

(c) 1   (d) Limit does not exist

100. What is $\lim\limits_{x \to 1}\dfrac{x^9 - 1}{x^3 - 1}$ equal to?

(a) -1 (b) -3

(c) 3   (d) Limit does not exist

101. The mean and variance of five observation are 14 and 13.2 respectively. Three of the five observations are 11, 16 and 29. What are the other two obs ervations?
- (a) 8 and 15
- (b) 9 and 14
- (c) 10 and 13
- (d) 11 and 12

102. Let A and B be two independent events such that $P(\bar{A}) = 0.7, P(\bar{B}) = k, P(A \cup B) = 0.8$
What is the value of k?
- (a) $\dfrac{5}{7}$
- (b) $\dfrac{4}{7}$
- (c) $\dfrac{2}{7}$
- (d) $\dfrac{1}{7}$

103. A biased coin with the probability of getting head equal to $\dfrac{1}{4}$ is tossed five times. What is the probability of getting tail in all the first four tosses followed by head?
- (a) $\dfrac{81}{512}$
- (b) $\dfrac{81}{1024}$
- (c) $\dfrac{81}{256}$
- (d) $\dfrac{27}{1024}$

104. A coin is biased so that heads comes up thrice as likely as tails. In four independent tosses of the coin, what is probabi lity of getting exactly three heads?
- (a) $\dfrac{81}{256}$
- (b) $\dfrac{27}{64}$
- (c) $\dfrac{27}{256}$
- (d) $\dfrac{9}{256}$

105. Let X and Y be two random variables such that $X + Y = 100$. If X follows Binomial distribution with parameters $n = 100$ and $p = \dfrac{4}{5}$, what is the variance of Y?
- (a) 1
- (b) $\dfrac{1}{2}$
- (c) 16
- (d) $\dfrac{1}{16}$

106. If two lines of regression are $x + 4y + 1 = 0$ and $4x + 9y + 7 = 0$, then what is the value of x when $y = -3$?
- (a) -13
- (b) -5
- (c) 5
- (d) 7

107. The central angles p, q, r and s (in degrees) of four sectors in a Pie Chart satisfy the relation $9p = 3q = 2r = 6s$. What is the value of $4p - q$?
- (a) 12
- (b) 24
- (c) 30
- (d) 36

108. The o bservations 4, 1, 4, 3, 6, 2, 1, 3, 4, 5, 1, 6 are outputs of 12 dices thrown simultaneously. If m and M are means of lowest 8 observations and highest 4 observations respectively, then what is (2m + M) equal to?
- (a) 10
- (b) 12
- (c) 17
- (d) 21

109. A bivariate data set contains only two points $(-1,1)$ and $(3, 2)$. What will be the line of regression of y on x ?
- (a) $x - 4y + 5 = 0$
- (b) $3x + 2y - 1 = 0$
- (c) $x + 4y + 1 = 0$
- (d) $5x - 4y + 1 = 0$

110. A die is thrown 10 times and obtained the following outputs: 1, 2, 1, 1, 2, 1, 4, 6, 5, 4
What will be the mode of data so obtained?
- (a) 6
- (b) 4
- (c) 2
- (d) 1

111. Consider the following frequency distribution:

x	1	2	3	6
f	4	6	9	7

What is the value of median of the distribution?
- (a) 1
- (b) 2
- (c) 3
- (d) 3.5

112. For data $-1, 1, 4, 3, 8, 12, 17, 19, 9, 11$; if M is the median of first 5 observations and N is the median of last five observation, then what is the value of $4M - N$?
- (a) 7
- (b) 4
- (c) 1
- (d) 0

113. Let P, Q, R represent mean, median and mode. If for some distribution are $5P = 4Q = \dfrac{R}{2}$, then what is $\dfrac{P + Q}{2P + 0.7R}$ equal to?
- (a) $\dfrac{1}{12}$
- (b) $\dfrac{1}{7}$
- (c) $\dfrac{2}{9}$
- (d) $\dfrac{1}{4}$

114. If G is the geometric mean of numbers $1, 2, 2^2, 2^3, \ldots, 2^{n-1}$, then what is the value of $1 + 2\log_2 G$?
- (a) 1
- (b) 4
- (c) $n - 1$
- (d) n

115. If H is the harmonic mean of numbers $1, 2, 2^2, 2^3, \ldots, 2^{n-1}$, then what is n/H equal to?
- (a) $2 - \dfrac{1}{2^{n+1}}$
- (b) $2 - \dfrac{1}{2^{n-1}}$
- (c) $2 + \dfrac{1}{2^{n-1}}$
- (d) $2 - \dfrac{1}{2^n}$

116. Let P be the median, Q be the mean and R be the mode of observations $x_1, x_2, x_3, \ldots x_n$. Let $S = \sum_{i=1}^{n}(2x_i - a)^2$. S takes minimum value, when a is equal to
- (a) P
- (b) $\dfrac{Q}{2}$
- (c) 2Q
- (d) R

117. One bag contains 3 white and 2 black balls, another bag contains 2 white and 3 black balls. Two balls are drawn from the first bag and put it into the second bag and then a ball is drawn from the second bag. What is the probability that it is white?

(a) $\dfrac{2}{7}$ (b) $\dfrac{33}{70}$ (c) $\dfrac{3}{10}$ (d) $\dfrac{1}{70}$

118. Three dice are thrown. What is the probability that each face shows only multiples of 3?

(a) $\dfrac{1}{9}$ (b) $\dfrac{1}{18}$ (c) $\dfrac{1}{27}$ (d) $\dfrac{1}{3}$

119. What is the probability that the month of December has 5 Sundays?

(a) 1 (b) $\dfrac{1}{4}$ (c) $\dfrac{3}{7}$ (d) $\dfrac{2}{7}$

120. A natural number n is chosen from the first 50 natural numbers. What is the probability that $n + \dfrac{50}{n} < 50$?

(a) $\dfrac{23}{25}$ (b) $\dfrac{47}{50}$ (c) $\dfrac{24}{25}$ (d) $\dfrac{49}{50}$

Answers with Explanations

PAPER -I: MATHEMATICS

1. (a) $\sqrt{3}$

$$\left|\dfrac{1-(-\tfrac{1}{2}+\tfrac{\sqrt{3}}{2}i)}{-1}\right| = \left|\dfrac{\tfrac{3}{2}+\tfrac{\sqrt{3}}{2}i}{1^{-11}}\right| = \dfrac{\sqrt{\tfrac{9}{4}+\tfrac{3}{4}}}{1}$$

$$= \sqrt{\dfrac{12}{4}} = \sqrt{3}$$

2. (d) 120: Divisible by 6 means by 2 and 3 must divisible 6 digit possible number

·	·	·	·		0,2,4

For that last 2 digit must be 0, 2, 4

1 2 3 4 5 3

$\Rightarrow$ $1 \times 2 \times 3 \times 4 \times 5 = 360$

5 digit number must be avoided

0					2,4

1 2 3 4 2 □

$\Rightarrow$ $1 \times 2 \times 3 \times 4 \times 2 = 48$

Therefore $360 - 48 = 312$

3. (d) 111110011

2	1011	1
2	505	1
2	252	0
2	125	0
2	63	1
2	35	1
2	15	1
	7	

2	7	1
2	3	1
	1	

$\Rightarrow$ 111110011

4. (b) We know $|\lambda A| = \lambda^n |A|$

adj $(\lambda A) = \lambda^{n-1}$adj A

$(\text{adj } A) = |A|^{n-1}$

By using above properties

$\left|2 \text{ adj}(3A)\right| = 2^3 \left|\text{adj}(3A)\right|$

$= 2^3 \left|3^2 \left|\text{adj } A\right|\right|$

$= 2^3 9^3 \left|\text{adj } A\right|$

$= 2^3 3^6 \left|\text{adj } A\right|$

$= 2^3 3^6 4^{3-1} = 2^3 3^6 4^2 = 2^3 3^6 2^4$

$= 2^7 3^6 \Rightarrow \alpha = 7, \beta = 6$

$\therefore$ $\alpha + \beta = 7 + 6 = 13$

5. (d) $\dfrac{1}{\sqrt{3}}$

$x^2 - x + 1 = 0$

Equation roots are $\alpha = -\omega$ and $\beta = -\omega^2$

$$\left|\dfrac{\alpha^{100} + \beta^{100}}{\alpha^{100} - \beta^{100}}\right| \Rightarrow \left|\dfrac{(-\omega)^{100} + (-\omega^2)^{100}}{(-\omega)^{100} - (-\omega^2)^{100}}\right|$$

$$\left|\dfrac{\omega^{100} + \omega^{200}}{\omega^{100} - \omega^{200}}\right|$$

$$\left|\dfrac{(\omega^3)^{33}\omega + (\omega)^{66}\omega^2}{(\omega^3)^{33}\omega - (\omega^3)^{66}\omega^2}\right| = \left|\dfrac{\omega + \omega^2}{\omega - \omega^2}\right|$$

We know $1+\omega+\omega^2 = 0$ and $\omega^3 = 1$

$\Rightarrow \left| \dfrac{-1}{\omega-(-1-\omega)} \right| = \left| \dfrac{-1}{1+2\omega} \right| = \dfrac{1}{\sqrt{3}}$

6. **(b)** Given, A and B are symmetric matrices, therefore, we have: $A' = A$ and $B' = B \dots(i)$

Consider $(AB - BA)' = (AB)' - (BA)'$ [$\because (A)B = A'B'$]

$= B'A' - A'B'$, $[\because (AB)' = B'A']$

$= BA - AB$ by (i)

$= -(AB - BA)$

$\therefore (AB - BA)' = (AB - BA)$

Thus, $(AB - BA)$ is a skew-symmetric matrix.

7. **(a)** 1 only

For statement 1,

$AB = AC$

Multiplying by A^{-1} both sides

$A^{-1}AB = A^{-1}AC$

$\Rightarrow B = C$ Invertible

Similarly for statement 2 $\Rightarrow B = C$

$Bx = Cx$ not satisfied for column matrix X.

8. **(c)** no solution

$\Delta = \begin{vmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 3 & 6 & 3 \end{vmatrix} = 0$

Similarly calculate Δ_1 and $\Delta_2 = 0$ we get no solution.

9. **(b)** Let X_1 and X_2 be its two distinct solutions. This implies that 'AX = B' has infinitely many solutions, as any linear combination of X_1 and X_2 (with 'a' and 'b' being real numbers) will also satisfy the system of linear equations. If the combination $aX_1 + bX_2$ is a solution of AX=B; where a, b are real numbers, then $a + b = 1$.

10. **(b)** $a - b + c$

$\begin{vmatrix} 0 & x-a & x-b \\ 0 & 0 & x-c \\ x+b & x+c & 1 \end{vmatrix} = 0$

After expending along C_1, we obtain

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

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

$x^3 - (a+c)x^2 - acx + bx^2 - ab(c+x) + abc = 0$

$x^3 - (a+c-b)x^2 - ac(ba + bc - x) + abc = 0$

11. **(d)** $\alpha = 2 - i\sqrt{3},$ $\beta = 2 + i\sqrt{3}$

$\alpha + \beta = -4 = a$ $\Rightarrow a = -4$

$\alpha\beta = 4 + 3 = b$ $\Rightarrow b = 7$

$a + b = 7 - 4 = 3$

12. **(b)** $\dfrac{2\pi}{3}$ $z = \dfrac{2(\sqrt{3}i - 1)}{4}$

$z = -\dfrac{1}{2} + \dfrac{\sqrt{3}}{2}i$

$\theta = \text{Argument}(z) = \tan^{-1}\left(\dfrac{y}{2}\right)$

$\theta = \tan^{-1}\left(-\sqrt{3}\right)$

$\Rightarrow \theta = \dfrac{2\pi}{3}$

13. **(b)** $\begin{vmatrix} x+1 & x+2 & x+3 \\ x+2 & x+3 & x+4 \\ x+a & x+b & x+c \end{vmatrix} = \begin{vmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ a & b & c \end{vmatrix}$

Applying $c_2 \to c_2 - 2c_1$ and $c_3 \to c_3 - 3c_1$

$= \begin{vmatrix} 1 & 0 & 0 \\ 2 & -1 & -2 \\ a & b-2a & c-3a \end{vmatrix}$

$= -(c - 3a) + 2(b - 2a)$

$= -c + 3a + 2b - 4a$

$= -c - a + 2b$

For AP $b = \dfrac{a+c}{2}$

Therefore the value of determinate must be zero.

14. **(c)** $\dfrac{\log_a (\log_b a)}{2}$

In G. P. $(a^x)^2 = \log x^a \times \log b^x$

$a^{2x} = \log b^a$

$2x = \log a$ $\log b^a$

$x = \dfrac{\log a \quad \log b^a}{2}$

15. **(a)** a, b, c are in AP

In G. P.

$\left(2^{\frac{b}{ac}}\right)^2 = \left(2^{\frac{1}{c}}\right)\left(2^{\frac{1}{a}}\right)$

$2^{\frac{2b}{ac}} = 2^{\frac{1}{c}+\frac{1}{a}}$

$\therefore \qquad \dfrac{2b}{ac} = \dfrac{a+c}{ac} \qquad 2b = a+c$

$b = \dfrac{a+c}{2}$

$\therefore$ a,b and c are in AP .

16. (b) $a = \dfrac{5}{2}, \quad a+d = \dfrac{23}{12}$

$d = \dfrac{23}{12} - \dfrac{5}{2} = \dfrac{23-30}{12} = \dfrac{-7}{12}$

$a+(n-1)d = \dfrac{5}{2} + (n-1)\left(\dfrac{-7}{12}\right) < 0$

$\dfrac{5}{2} = (n-1)\dfrac{7}{12}$

$n-1 = \dfrac{12}{7} \times \dfrac{5}{2} = \dfrac{30}{7}$

$n = \dfrac{30}{7} + 1 = \dfrac{37}{7} \simeq 5\dfrac{2}{7}$

Means n = 6

17. (b) For real roots $b^2 - 4ac \ge 0$

$(4)^2 - 4k \ge 0$

$k = 4$

18. (b) $\dfrac{mx(m+n)}{1-n}$

$a = x$

$Sn = \dfrac{n}{2}\left[2a + (n-1)d\right] = 0$

or $2x + (n-1)d = 0$

$d = -\dfrac{2x}{n-1} = \dfrac{22}{1-n}$

$Sm = \dfrac{m}{2}\left[2a + (m-1)d\right]$

$Sm = \dfrac{m}{2}\left[2x + \left(\dfrac{m-1}{n-1}\right)2x\right]$

$= mx\left[\dfrac{1-n+m-1}{1-n}\right] = \dfrac{mx(m-n)}{1-n}$

19. (b) 2 only

1. $\lfloor 25 + 1$ is divisible by 26

$\lfloor 25$ last digit will be 0 therefore By adding one last digit
will be 1 not be divisible by 26

2. $\lfloor 6 + 1 = 721$ will be divisible by 7.

20. (c) $\dfrac{z+1}{z+1} = \dfrac{x+iy-1}{x+iy+1} = \dfrac{(x-1)+iy}{(x+1)+iy}$

$= \dfrac{\{(x-1)+iy\}\{(x+1)-iy\}}{(x+1)^2 + y^2}$

$= \dfrac{(x^2+1)iy(x-1)+iy(x+1)+y^2}{(x+1)^2 + y^2}$

$= \dfrac{(x^2+y^2-1)+iy(x-1-x-1)}{(x+1)^2 + y^2}$

$= \dfrac{(x^2+y^2-1)+2iy}{(x+1)^2 + y^2}$

For purely imaginary $x^2 = y^2 - 1 = 0 \qquad = x^2 + y^2 = 1$

$\therefore |z| = 1$

21. (b) Only two

$|x-4| + |x-7| = 15$

Critical points are x = 4 and x = 7

Case I $\qquad x<4$

$(4-x) + (7-x) = 15$

$-2x = 4 \Rightarrow x = -2$

x = -2 Satisfying the equation

Case II $\qquad 4 < x < 7$

$x-4+7-2 = 15$ Not possible

Case III $\qquad x \ge 7$

$x-4+x-7 = 15$

$2x = 26$

$x = 13$

$x = -2, 13$ Two solutions.

22. (d) $f(x) = \dfrac{2x+3}{3x+5}$

Domain $A \to x \Rightarrow 3x+5 \ne 0$

$\therefore \qquad x \ne -\dfrac{5}{3}$

In onto function range = co-domain

$\dfrac{2x+3}{3x+5} = y$ or $x = \dfrac{3-5y}{3y-2}$

Means $3y - 2 \ne 0$

$y \ne \dfrac{2}{3}$

Therefore $A = R\left|\left\{-\dfrac{5}{3}\right\}\right.$ and $B = R\left|\left\{\dfrac{2}{3}\right\}\right.$

23. (c) Both 1 and 2

$$x^2 + ax + b = 0$$

$$\alpha + \beta = -a$$

$$\alpha + \beta = 0 \Rightarrow -a = 0$$

$$a = 0$$

$$\alpha^2 + \beta^2 = 2$$

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

$$(-a)^2 - 2b = 2$$

$$a^2 - 2b = 2$$

$$(\alpha\beta)\beta = -1, \alpha = 0$$

$$b\beta = -1$$

$$\beta = -\frac{1}{b}$$

$$\Rightarrow \quad \alpha = -\frac{1}{\beta^2} = -\frac{1}{\left(-\frac{1}{b}\right)^2} = -b^2$$

$$\alpha = -b^2 = 0$$

Individual statements are not sufficient to find α both together needed to get α value.

$$\propto = \pm 1, \beta = \pm 1$$

$$\alpha\beta^2 = -1 \Rightarrow \alpha \text{ must be } -1$$

24. (d) $T_6 = 5600$

$$T_{r+1} = {}^nC_r x^{n-r} a^r$$

$$T_6 = {}^8C_5 (x^{\frac{-8}{3}})^{8-5} (x^2 \log_{10} x)^5 = 5600$$

$$\frac{8 \times 7 \times 6}{1 \times 2 \times 3} x^{-8} x^{10} (\log_{10} x)^5 = 5600$$

$$x^2 (\log_{10} x)^5 = 100 \text{ Satisfied for } x = 10$$

25. (a) $(3x - y)^4 (x + 3y)^4$

$$= \left[(3x - y)(x + 3y)\right]^4$$

$$= \left[3x^2 + 9xy - xy - 3y^2\right]^4$$

$$= \left[3x^2 = 8xy - 3y^2\right]^4$$

In expansion we obtain 9 terms

26. (a) p, q, r and s are in AP.

$$q - p = s - r = r - q = d$$

$$p + s = 8, qr = 15$$

Let four terms

$$p = (a - 3d), q = (a - d), r = (a + d), s = a(+3B)$$

$$p + s \Rightarrow 2a = 8 \Rightarrow a = 4$$

$$qr = (a - d)(a + d) = 15$$

$$a^2 - d^2 = 15$$

$$16 - d^2 = 15 \Rightarrow d = \pm 1$$

First term $p = (4 - 3) = 1,$

Last term $s = 4 + 3 = 7$

$$s - p = 7 - 1 = 6$$

27. (d) Neither 1 nor 2

$${}^nC_r \text{ if n is even} \hspace{2cm} \ldots(i)$$

Maximum value is $\ {}^nC_{n/2} \Rightarrow \frac{n}{2} = r, n = 2r$

If n is odd $\hspace{3cm} \ldots(ii)$

$${}^nC_r \text{ means} = \ {}^nC_{\frac{n-1}{2}} \text{ or } \frac{n+1}{2}$$

$$\text{means } \frac{n-1}{2} = r, \ n = 2r + 1$$

$$\frac{n+1}{2} = r, n = 2r - 1$$

28. (d) $\ {}^mC_2 \times {}^nC_2 = 60$

$${}^5C_2 \times {}^nC_2 = 60$$

$$\Rightarrow \quad m + n = 5 + 4 = 9$$

29. (c) $x = 4y$

PERMUTATIONS in 12 letter t is repeated

$$x = \frac{12!}{2!}$$

Combinations again 12 letters 0, 1, n are repeated

$$y = \frac{12!}{2!2!2!} = \frac{x}{4}$$

$$\Rightarrow \quad x = 4y$$

30. (a) 20%

5 digit number __ __ __ __ __

$$4 \times 4 \times 3 \times 2 \times 1 = 96 \text{ ways}$$

Fixed 5 __ __ __ __

$$4 \times 3 \times 2 \times 1 = 24 \text{ ways}$$

$$\frac{24}{96} \times 100 = 25\%$$

31. (a) $(\cos\alpha - \sin\alpha)^2$

$$\sin^2\beta = \sin\alpha \cos\alpha \hspace{1.5cm} (i)$$

$$\tan\gamma = \frac{\sin\alpha+\cos\alpha}{2} \qquad ...(ii)$$

From (i)

$$2\sin^2\beta = 2\sin\alpha\cos\alpha$$

$$\cos 2\beta = 1 - 2\sin 2\beta$$

$$\Rightarrow \quad 1 - \cos 2\beta = 2\sin\alpha\cos\alpha$$

$$\cos 2\beta = 2 - 2\sin\alpha\cos\alpha$$

$$\cos 2\beta = \sin^2\alpha + \cos^2\alpha - 2\sin\alpha\cos\alpha$$

$$\cos 2\beta = (\cos\alpha - \sin\alpha)^2$$

32. (b) $\dfrac{5-\sin 2\alpha}{3-\sin 2\alpha}$

$$\tan^2\gamma = \frac{\sin 2\alpha + \cos^2\alpha + 2\sin\alpha\cos\alpha}{4}$$

$$\tan^2\gamma = \frac{1+\sin 2\alpha}{4}$$

$$\sec 2\gamma = \frac{-+\tan^2\gamma}{1-\tan^2\gamma}$$

$$\sec 2\gamma = \frac{1+\dfrac{1+\sin 2\alpha}{4}}{1-\dfrac{1+\sin 2\alpha}{4}}$$

$$\sec 2\gamma = \frac{5+\sin 2\alpha}{3-\sin 2\alpha}$$

33. (a) 1 only
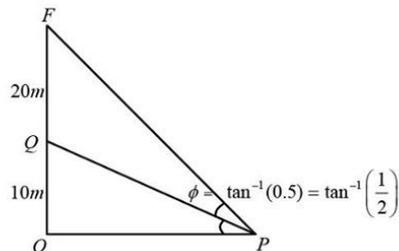
$$\tan\theta = \frac{10}{x} \qquad ...(i)$$

$$\tan(\theta+\phi) = \frac{30}{x} \qquad ...(ii)$$

Where $\phi = \tan^{-1}\left(\dfrac{1}{2}\right) \Rightarrow \tan\phi = \dfrac{1}{2}$

$$\tan(\theta+\phi) = \frac{\tan\theta+\tan\phi}{1-\tan\theta\tan\phi}$$

$$= \frac{\tan\theta+\dfrac{1}{2}}{1-\dfrac{\tan\theta}{2}} = \frac{2\tan\theta+1}{2-\tan\theta}$$

$$\Rightarrow \quad \frac{\tan\theta+1}{2-\tan\theta} = \frac{30}{x} \qquad ...(iii)$$

$$\frac{(iii)}{(i)} = \frac{\dfrac{2\tan\theta+1}{2-\tan\theta}}{\tan\theta} = \frac{\dfrac{30}{x}}{\dfrac{10}{x}}$$

$$\frac{2\tan\theta+1}{(2-\tan\theta)\tan\theta} = 3$$

$$\frac{2\tan\theta+1}{(2-\tan\theta)\tan\theta} = 3$$

$$2\tan\theta+1 = 6\tan\theta - 3\tan^2\theta$$

$$3\tan^2\theta - 4\tan\theta + 1 = 0$$

$$3\tan^2\theta - 3\tan\theta - \tan\theta + 1 = 0$$

$$3\tan\theta(\tan\theta - 1) - 1(\tan\theta - 1) = 0$$

$$(\tan\theta - 1)(3\tan\theta - 1) = 0$$

$$\Rightarrow \quad \tan\theta = 1 \text{ or } \tan\theta = \frac{1}{3} \qquad ...(iv)$$
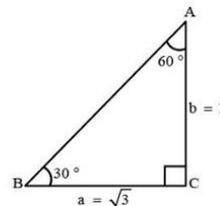
Therefore sum equation (i) and equation (iv)

$$x = \frac{10}{\tan\theta} \Rightarrow x = 10, 30$$

$$x \neq 20$$

34. (c) $\dfrac{1}{3}$

$$\tan\theta = \frac{1}{3}$$

35. (c) $\sqrt{3} + 3$

$$\frac{a}{b} = \frac{\sqrt{3}}{1} = \frac{\dfrac{\sqrt{3}}{2}}{\dfrac{1}{2}} = \frac{\sin 60°}{\sin 30°} = \frac{\sin A}{\sin B}$$

$$AB = \sqrt{(\sqrt{3})^2 + 1} = 2$$

Perimeter of $\triangle ABC = 2 + 1 + \sqrt{3}$

$$= 3 + \sqrt{3}$$

36. (c) Both 1 and 2

As C = < 90° Right angled triangle

Angles are 30°, 60°, 90° are in AP

37. (c) $x = \dfrac{\sin^2 A = \sin A + 1}{\sin A}$

$x = \sin A + \dfrac{1}{\sin A} + 1$

$x = \sin A + \cos ecA + 1$

$\sin A + \cos ecA$ minimum value is 2

⇒ x = 3
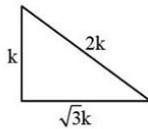
38. (d) $\dfrac{\pi}{2}$; $A = \dfrac{\pi}{2}$ for minimum value

39. (c) $a^2 + b^2 + c^2 = ac + \sqrt{bc}$

Let angles are 30°, 60°, 90°

$\sin \theta \Rightarrow \dfrac{1}{2}, \dfrac{\sqrt{3}}{2}, 1 = 1 : \sqrt{3} : 2$

This satisfied right angle triangle.

40. (c) $8\sqrt{3}$

Area of $\Delta = \dfrac{1}{2} \times \left(\sqrt{3}k\right) \times k = \dfrac{\sqrt{3}}{2}k^2$

$k = 4$

$\Delta = \dfrac{\sqrt{3}}{2} \times 16 = 8\sqrt{3}$

41. (b) f(2)=3

f(3)=2

f(4)=3

f(0)=9

Means minimum value is f(3) = 2

42. (a) f(3)=2

2 is minimum value of function

43. (c) 4! onward multiple of 8 till 100! remainder will be zero.

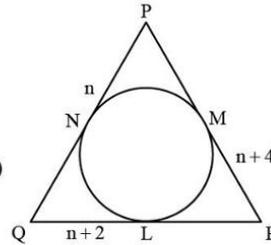⇒ $S = \dfrac{0! + 1! + 2! + 3!}{8} = S = \dfrac{1 + 1 + 2 + 6}{8} = \dfrac{10}{8} = 1\dfrac{2}{8}$

2 is the remainder

44. (d) Now divided by 60

From 5! onward divisible by 60

Therefore $S = \dfrac{1 + 1 + 2 + 6 + 24}{60} = \dfrac{34}{60}$

Remainder is 34

45. (c)

$\cos P = \dfrac{1}{3}$

PN = PM = n

QL = QN = n + 2

RM = RL = n + 4

PQ = 2n + 2, QR = 2n + 6, PR = 2n + 4

$\dfrac{PQ^2 + PR^2 - QR^2}{2(PQ \times PR)} = \dfrac{1}{3}$

$\dfrac{(2n+2)^2 + (2n+4)^2 - (2n+6)^2}{2(2n+2)(2n+4)} = \dfrac{1}{3}$

After so solving we obtain n = 8

46. (d) Smallest side is PQ = 2n + 2

= 2(8) + 2 = 18

47. (a) $\sin^2 2x - 44\sin 2x + 36 = 0$

$\sin x + \cos x + \tan x + \cot x + \sec x + \cos ecx = 7$

$\sin z + \cos x + \dfrac{\sin x}{\cos x} + \dfrac{\cos x}{\sin x} + \dfrac{1}{\cos x} + \dfrac{1}{\sin x} = 7$

$\sin x + \cos x + \left[\dfrac{\sin^2 x + \cos^2 x + \cos x}{\sin^2 x}\right] = 7$

$(\sin x + \cos x) + 2\left[\dfrac{1 + \sin x + \cos x}{\sin 2x}\right] = 7$

$(\sin x + \cos x)\left(1 + \dfrac{2}{\sin 2x}\right) = 7 - \dfrac{2}{\sin 2x}$

⇒ $\sin^2 2x - 44\sin 2x + 36 = 0$

48. (d) Let $x = 7\dfrac{1}{2}$

$\sin 15^0 = a - b\sqrt{c}$

$\dfrac{\sqrt{3} - 1}{2\sqrt{2}} = a - b\sqrt{c}$

The possible value of a − b + 2c = 28

49. (b) H. M. $= \dfrac{2\alpha\beta}{\alpha+\beta} = \dfrac{\frac{2c}{a}}{\frac{-b}{a}} = \dfrac{2c}{-b} = \dfrac{2(8+4\sqrt{3})}{(4+2\sqrt{3})} = 4$

50. (a) $\sqrt{2}\left(\sqrt{6}-\sqrt{3}+\sqrt{2}-1\right)$

G.M $\sqrt{\alpha\beta}$

$= \sqrt{\dfrac{c}{a}} = \sqrt{\dfrac{8+5\sqrt{3}}{3+2\sqrt{2}}}$

$= \sqrt{\dfrac{8+4\sqrt{3}}{3+2\sqrt{2}} \times \dfrac{3-2\sqrt{2}}{3-2\sqrt{2}}}$

$= \sqrt{\dfrac{(8+4\sqrt{3})(3-2\sqrt{2})}{9-8}}$

$= \sqrt{24+12\sqrt{3}-16\sqrt{2}-8\sqrt{6}}$

$\Rightarrow \quad \sqrt{2}(\sqrt{6}-\sqrt{3}+\sqrt{2}-1)$

51. (b) Let $\alpha = 1$

$\begin{vmatrix} a & b & a+b \\ b & c & b+c \\ a+b & b+c & 0 \end{vmatrix} = 0$

$R_3 \to R_3 - (R_1 + R_2)$

$\begin{vmatrix} a & b & a+b \\ b & c & b+c \\ c & 0 & -(a+2b+c) \end{vmatrix} = 0$

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

From $(ac-b^2) = 0$

a, b, c are in G.P.

52. (c) Given $a = 7$, $b = 4$, $c = 2$

$\Delta(7,4,2,\alpha) = \begin{vmatrix} 7 & 4 & 7\alpha+4 \\ 4 & 2 & 4\alpha+2 \\ 7\alpha+4 & 4\alpha+2 & 0 \end{vmatrix}$

$\Rightarrow \quad -7(4\alpha+2)^2 + 8(7\alpha+4)(4\alpha+2) - 2(7\alpha+4)^2 = 0$

$\Rightarrow \quad -7(16\alpha^2+16\alpha+4) + 8(28\alpha^2+14\alpha+16\alpha+8)$

$\qquad -2(49\alpha^2+56\alpha+16) = 0$

$\Rightarrow \quad -112\alpha^2-112\alpha-28 + 224\alpha^2+240\alpha+64$

$\qquad -98\alpha^2-112\alpha-32 = 0$

$\Rightarrow \quad 14\alpha^2+16\alpha+4 = 0$

$\Rightarrow \quad 2(7\alpha^2+8\alpha+2) = 0$

For $\alpha = x$ $7x^2+8x+2 = 0$

53. (d) 4n

$m(\theta) = \cot^2\theta + n^2\tan^2\theta + 2n$

$m'(\theta) = -2\cot\theta(\cos ec^2\theta)$

$2n^2\tan\theta(\sec^2\theta)$

$= 0$

$n^2 = \dfrac{\cot\theta\cos ec^2\theta}{\tan\theta\sec^2\theta}$

$n^2 = \dfrac{\cos\theta}{\sin\theta}\dfrac{\cos\theta}{\sin\theta}\times\dfrac{\cos^2\theta}{\sin^2\theta}$

$n^2 = \cot^4\theta$

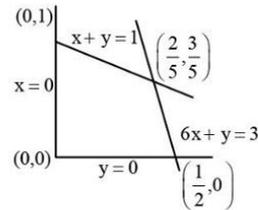$\Rightarrow \quad \cot^2\theta = n$ \qquad ...(i)

therefore $m(\theta) = n + n^2\dfrac{1}{n} + 2n$ Minimum $= 4$

54. (b) $n = \cot^2\theta$

$\cot^2\theta = n$ from equation (i) does m attain the least value.

55. (c) $3x-2y = 0$

$y-0 = \dfrac{\left(\frac{3}{5}-0\right)}{\left(\frac{2}{5}-0\right)}(x-0)$

$y = \dfrac{3}{2}x$

$2y = 3x \Rightarrow 3x-2y = 0$

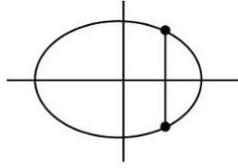56. (d) $x+2y-1 = 0$

$y-1 = \dfrac{0-1}{\frac{1}{2}-0}(x-0)$

$y-1 = -2x$

$2x+y-1 = 0$

57. (b) $\dfrac{x^2}{1} + \dfrac{y^2}{\left(\frac{1}{2}\right)^2} = 1$

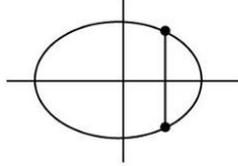$$a = 1, b = \frac{1}{2} \qquad PE + PF = 2a = 2$$

58. (d) 1, 2 and 3

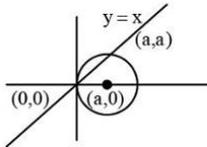Point on latus rectum

$$\left(c, \pm \frac{b^2}{a} \right)$$

$$\frac{b^2}{a} = \frac{1}{4}$$

$$c = \frac{\sqrt{3}}{2},$$

Therefore points are $\left(\frac{\sqrt{3}}{2}, 0 \right)$, $\left(\frac{\sqrt{3}}{2}, \frac{1}{4} \right)$ and $\left(\frac{\sqrt{3}}{2}, -\frac{1}{4} \right)$

59. (a) $\dfrac{(\pi - 2)a^2}{4}$

$$(x - a)^2 + y^2 = a^2$$
$$y^2 = 2ax - x^2$$

Line $y = x$ Area $= \dfrac{1}{4} \int_0^a \sqrt{2ax - x^2}\, dx - \int x\, dx$

Of minor segment $= \dfrac{(\pi - 2)a^2}{4}$

60. (b) $\dfrac{(3\pi + 2)a^2}{4}$

Area of major segment $= \pi a^2 - \dfrac{(\pi - 2)a^2}{4}$

$$\frac{4\pi a^2 - \pi a^2 + 2a^2}{4} = \frac{3\pi a^2 + 2a^2}{4}$$

$$= \frac{(3\pi + 2)a^2}{4}$$

61. (a) Sphere diameter from

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) + (z - z_1)(z - z_2) = 0$$

$$(x - 1)(x - 2) + (y + 1)(y - 1) + (z - 2)(z + 1) = 0$$

$$x^2 + y^2 + z^2 - 3x - z + 2 - 1 - 2 = 0$$

$$x^2 + y^2 + z^2 - 3x - z - 1 = 0 \quad \dots (i)$$

Given $z^2 + y^2 + z^2 + 2ux + 2vy + 2wz - 1 = 0 \qquad \dots (ii)$

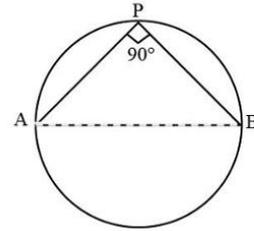Comparing equation (i) and equation (ii)

$$2u = -3 \implies u = -\frac{3}{2}$$

$$2v = 0 \implies v = 0$$

$$2w = -1 \implies w = -\frac{1}{2}$$

$$u + v + w = -\frac{3}{2} + 0 - \frac{1}{2} = \frac{-3 - 1}{2} = -2$$

62. (b) 14

$$PA^2 + PB^2 = AB^2$$
$$AB^2 = (2 - 1)^2 + (1 + 1)^2 + (-1 - 2)^2$$
$$1 + 4 + 9 = 14$$

63. (a) Direction ratios are $(2, -1, 2)$ and $(k, 3, 5)$

$$\cos\theta = \frac{a_1 a_2 + b_1 b_2 + c_1 c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2}\,\sqrt{a_2^2 + b_2^2 + c_2^2}}$$

$$\frac{\pi}{4} = \frac{2k - 3 + 10}{\sqrt{4 + 1 + 4}\,\sqrt{k^2 + 9 + 25}}$$

$$\frac{1}{\sqrt{2}} = \frac{2k + 7}{3\sqrt{k^2 + 34}}$$

$$9(k^2 + 34) = 2(4k^2 + 28k + 49)$$

$$9k^2 + 306 = 8k^2 + 56k + 98$$

$$k^2 - 56k + 208 = 0$$

$$\implies \quad k = 4$$

64. (d) $(11, 2, -10)$

Now direction ratios are $(2, -1, 2)$ and $(4, 3, 5)$

For perpendicular $\perp \implies a_1 a_2 + b_1 b_2 + c_1 c_2 = 0$

$(11, 2, -10)$ satisfied both

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

Let $\vec{a} = 3\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{c} = \hat{j} - \hat{k}$. Let $\vec{b}$ be such that $\vec{a} \cdot \vec{b} = 27$ and $\vec{a} \times \vec{b} = 9\vec{c}$

65. (b) $5\hat{i} + 2\hat{j} + 2\hat{k}$

Let $\vec{b} = x\hat{i} + y\hat{j} + z\hat{k}$

$\vec{a}\cdot\vec{b} = 27$

$\Rightarrow (3\hat{i} + 3\hat{j} + 3\hat{k})\cdot(x\hat{i} + y\hat{i} + z\hat{i}) = 27$

$3x + 3y + 3z = 27$

$\Rightarrow x + y + z = 9$ (i)

$\vec{a} + \vec{b} = 9\vec{c}$

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 3 & 3 \\ x & y & z \end{vmatrix} = 9(\hat{j} - \hat{k})$

$\hat{i}(3z - 3y) - \hat{j}(3z - 3x) + \hat{k}(3y - 3x) = 9\hat{j} - 9\hat{k}$

$\Rightarrow 3z - 3y = 0$ $\Rightarrow y = z$

$3z - 3x = -9$ $\Rightarrow z - x = -3$ or $y - x = 3$

$3y - 3x = -9$ $\Rightarrow y - x = -3$ ...(ii)

Using equation (ii) and equation (i) we get

$x - 2y = 9$ (iii)

Adding equation (ii) and equation (iii) we obtain

$3y = 6 \Rightarrow y = 2$

$\Rightarrow z = 2$ and $x = 5$

Therefore $\vec{b} = 5\hat{i} + 2\hat{j} + 2\hat{k}$

66. (a) $\dfrac{\pi}{2}$

$\vec{a} + \vec{b} = (3\hat{i} + 3\hat{j} + 3\hat{k}) + (5\hat{i} - 2\hat{j} + 2\hat{k})$

$\vec{a} + \vec{b} = 8\hat{i} - 5\hat{j} + 5\hat{k}$ and $\vec{c} = \hat{j} - \hat{k}$.

$(\vec{a} + \vec{b})\cdot\vec{c} = |\vec{a} + \vec{b}||\vec{c}|\cos\theta$

$\cos\theta = \dfrac{(8\hat{i} + 5\hat{j} + 5\hat{k})\cdot(\hat{j} - \hat{k})}{\sqrt{64 + 25 + 25}\sqrt{1 + 1}}$

$\cos\theta = \dfrac{5 - 5}{\sqrt{114}\sqrt{2}} = 0$

$\Rightarrow \theta = 90° = \dfrac{\pi}{2}$

67. (b) $\dfrac{4}{9}$

$\cos\alpha = \dfrac{Q}{\sqrt{a^2 + b^2 + c^2}}$

$\cos\alpha = \dfrac{4}{\sqrt{16 + 64 + 1}} = \dfrac{4}{\sqrt{81}} = \dfrac{4}{9}$

$\cos\alpha = \dfrac{4}{9}$

68. (a) $-\dfrac{32}{81}$

$\cos 2\beta + \cos 2\gamma$

$= 2\cos^2\beta - 1 + 2\cos^2\gamma - 1$

we have $\cos\beta = \dfrac{8}{9}, \cos\gamma = \dfrac{1}{9}$

$= 2\left(\dfrac{8}{9}\right)^2 - 1 + 2\left(\dfrac{1}{9}\right)^2 - 1$

$\dfrac{128 - 81 + 2 - 81}{81} = \dfrac{32}{81}$

69. (b) b. 2 and 3 only

The position vectors of two points A and B are

$\vec{A} = \hat{i} - \hat{j}$; $\vec{B} = \hat{j} + \hat{k}$

The position vectors of A B is

$\overrightarrow{AB} = \hat{i} + 2\hat{j} + \hat{k}$

Equation of line (1,-1,0) ; (0,1,1)

$\dfrac{x - x_1}{x_2 - x_1} = \dfrac{y - y_1}{y_2 - y_1} = \dfrac{z - z_1}{z_2 - z_1}$

$\dfrac{x - 1}{0 - 1} = \dfrac{y + 1}{1 - 1} = \dfrac{z - 0}{1 - 0}$

$\dfrac{x - 1}{-1} = \dfrac{y + 1}{2} = \dfrac{z}{1}$ (i)

Equation (i) will be satisfied by $(-1, 3, 2)$ and $(-2, 5, 3)$

70. (c) $\overrightarrow{AB} = (\hat{j} + \hat{k}) - (\hat{i} - \hat{j})$

$\overrightarrow{AB} = \hat{i} + 2\hat{j} + \hat{k}$

$|\overrightarrow{AB}| = \sqrt{1 + 4 + 1} = \sqrt{6}$

71. (b) $f(x) = Pe^x + Qe^{2x} + Re^{3x}$

$f(0) = 6 \Rightarrow P + Q + R = 6$ (i)

$f'(x) = Pe^x + 2Qe^{2x} + 3Re^{3x}$

$f'(\ell n 3) = 3 \Rightarrow P + 2Qe^{2\ell n 3} + 3Re^{\ell n 3}$

$= 3P + 18Q + 81R = 282$

$= P + 6Q + 27R = 94$ ...(ii)

$\displaystyle\int_0^{\ell n 2}(Pe^x + Qe^{2x} + Re^{3x})dx$

$= \left[Pe^x + \dfrac{Qe^{2x}}{2} + \dfrac{Re^{3x}}{3}\right]_0^{\ell n 2}$

$$= \left[\left(2P + \frac{4}{2}Q + \frac{8}{3}R\right) - \left(P + \frac{Q}{2} + \frac{R}{3}\right) \right]$$

$$= P + \frac{3}{2}Q + \frac{7}{3}R = 11 \qquad ...(iii)$$

Using equation (i) then equation (ii) becomes

$$(6 - Q - R) + 6Q + 27R = 94$$

$$5Q + 26R = 88 \qquad ...(iv)$$

Using equation (i) then equation (iii) becomes

$$6 - Q - R + \frac{3Q}{2} + \frac{7R}{3} = 11$$

$$\frac{Q}{2} + \frac{4}{3}R = 5 \Rightarrow 6Q + 8R = 30 \qquad ...(v)$$

Solving equation (iv) and equation (v) we get
$Q = 2$

72. (c) After solving equation (iv) and equation (v) for R
We get R = 3

73. (d) 14
$$f'(0) = P + 2Q + 3R$$
$$f'(0) = 1 + 4 + 9 = 14$$

74. (a) $y^2 = 2cx + 2c\sqrt{c}$

$$2y\frac{dy}{dx} = 2c + 0$$

$$y\frac{dy}{dx} = c \qquad ...(i)$$

The order of the differential is 1

75. (b) The degree of the differential formed by $y^2 = 2cx + 2c\sqrt{c}$ is 3

76. (b) $f(x) = \begin{vmatrix} \cos x & x & 1 \\ 2\sin x & x^2 & 2x \\ \tan x & x & 1 \end{vmatrix}$ for $x = 0$

$$f(0) = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

$$f(0) = 0$$

77. (b) $f(x) = \cos x(x^2 - 2x^3) - x(2\sin x - 2\tan 2) + 1(2\sin 2 - x^2\tan 2)$

$$\frac{f(x)}{x} = \frac{-x^2\cos x - 2x(\sin x - \tan x) + (2\sin x - x\tan)x}{x}$$

$$\lim_{x \to \infty} \frac{f(x)}{x} = 0$$

78. (a) -1

$$\lim_{x \to \infty} \frac{f(x)}{x^2} = -1$$

79. (b) $f(x) = \sin[\pi^2]x + \cos[-\pi^2]x$

$$f\left(\frac{\pi}{2}\right) = \sin[\pi^2]\frac{\pi}{2} + \cos[-\pi^2]\frac{\pi}{2}$$

$\pi^2 \simeq 9.85$ for greatest integer the values are
$[\pi^2] = 9$ for positive value
$[-9.85] = -10$ for negative value

$$f(x) = \sin 9x + \cos 10x$$

$$f\left(\frac{\pi}{2}\right) = \sin\left(\frac{9\pi}{2}\right) + \cos\left(\frac{10\pi}{2}\right) = 1 - 1 = 0$$

80. (d) $\frac{1}{\sqrt{2}}$

$$f(x) = \sin 9x + \cos 10x$$

$$f\left(\frac{\pi}{4}\right) = \sin\left(\frac{9\pi}{4}\right) + \cos\left(\frac{10\pi}{4}\right)$$

$$f\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}} + 0 = \frac{1}{\sqrt{2}}$$

81. (d) $\frac{\pi+1}{\pi-1}$

$$I_1 = \int_0^\pi \frac{x}{1+cis^2 x}dx = \int_0^\pi \frac{\pi - x}{1 + \{(\cos\pi - x)\}^2}dx$$

$$I_1 = \int_0^\pi \frac{\pi}{1+cis^2 x} - I_1$$

$$2I_1 = \int_0^\pi \frac{\sec^2 x dx}{\sec^2 + 1} = \int_0^\pi \frac{\sec^2 x dx}{\tan^2 x + 2}$$

Let $\tan x = t \sec^2 x dx = dt$
After integrating we obtain

$$I_1 = \frac{\pi^2}{2\sqrt{2}}$$

$$I_2 = \int_0^\pi \frac{1dx}{1+\sin^2 x} = \int_0^\pi \frac{\cos ec^2 x dx}{\cos ec^2 x + 1} = \frac{\pi}{2\sqrt{2}}$$

$$\frac{I_1 + I_2}{I_1 - I_2} = \frac{\frac{\pi^2}{2\sqrt{2}} + \frac{\pi}{2\sqrt{2}}}{\frac{\pi^2}{2\sqrt{2}} - \frac{\pi}{2\sqrt{2}}} = \frac{\pi+1}{\pi-1}$$

82. (d) π^4

We have $I_1 = \frac{\pi^2}{2\sqrt{2}}$

Therefore $8I_1^2 = 8 \times \dfrac{\pi^2}{4 \times 2} = \pi^4$

83. (b) $\dfrac{\pi}{2\sqrt{2}}$

$I_2 = \displaystyle\int_0^\pi \dfrac{1 dx}{1 + \sin^2 x} \quad = \dfrac{\pi}{2\sqrt{2}}$

84. (a) $a + b$

$\ell = \displaystyle\int_a^b \dfrac{|x|}{x} dx,$

$a < b$

$f(x) = |x| \begin{cases} x, x \geq 0 \\ -x, x < 0 \end{cases}$

$\ell = \displaystyle\int_a^0 \dfrac{-x}{x} dx + \int_0^b \dfrac{x}{x} dx$

$= -\displaystyle\int_a^0 dx + \int_0^b dx$

$= -\left[x\right]_a^0 + \left[x\right]_0^b$

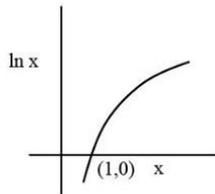$= -(0 - a) + (b - 0)$

$= a + b$

85. (b) $a - b$

$a < b < 0$

Both negative $\ell = -\displaystyle\int_a^b dx = -[x]_a^b = -(b - a) = a - b$

86. (a) -2

$f(x) = |\ln x, x| x \neq 1$

$x = 0.5$

ln x   (1,0)   x

The derivative of $f(x)$

$f'(x) = -\dfrac{1}{x}$ as $x = 0.5 = -\dfrac{1}{0.5} = -2$

87. (a) $\dfrac{1}{2}$

The derivative of $f(x)$

$f(x) = |\ln x, x| x \neq 1$

88. (d) $-\dfrac{1}{x \ln x}$

$f \cdot f(x) \Rightarrow f \cdot (\ln x)$

$1 < x < 2$

$f(x)$ is +ive

Let $y = f \cdot f(x) = \ln \ln x$

$\dfrac{dy}{dx} = -\dfrac{1}{x \ln x}$

89. (b) 3

$f(x) = \begin{cases} x + 6, x \leq 1 \\ Px + q, 1 < x < 2 \\ 5x, x \geq 2 \end{cases}$

for $f(x)$ continuous $f(i) \Rightarrow 1 + 6 = p + q$

$p + q = 7$ ...(i)

$f(ii) \Rightarrow 2p + q = 5(2)$

$2p + q = 10$ ...(ii)

Solving equation (i) and (ii) we get $p = 3$

90. (c) Using (i) $q = 7 - p$

$q = 7 - 3 = 4$

91. (a) 1 only

$f'(x) > 0$

$g'(x) < 0$

1. $f'(x) = \dfrac{1}{x} > 0$ is increasing in $(0, \infty)$

2. $g'(x) = e^x + e^{\frac{1}{x}}$

$g'(x) = e^x + e^{\frac{1}{x}}\left(-\dfrac{1}{x^2}\right)$

$= e^x - \dfrac{e^{\frac{1}{x}}}{x^2} = \dfrac{e^x - e^{\frac{1}{x}}}{x^2}$

It is not the decreasing function.

92. (a) -1

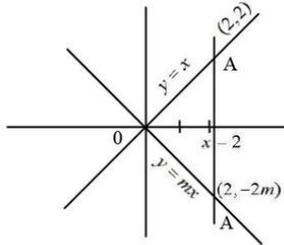$y = \sin^2 x \qquad z = \cos^2 x$

$\dfrac{dy}{dx} = 2\sin x \cos x \qquad \dfrac{dz}{dx} = -2\cos x \sin x$

$$\frac{dy}{dz} = \frac{dy}{dx} \times \frac{dx}{dz} = \frac{2\sin x \cos x}{-2\cos x \sin x} = -1$$

93. (a) $-\dfrac{1}{2}$

Area of $OAB = \dfrac{1}{2} \times 2 \times \sqrt{(2-2)^2 + (2\ M\ -2\ )^2}$

$= 2m + 2 = 3 \quad m = \dfrac{1}{2}$

As slope of line is negative therefore $y = mx \therefore m = -\dfrac{1}{2}$

94. (b) $-\dfrac{\pi}{180}\cos ec(x^\circ)\cot(x^\circ)$

$x = \dfrac{\pi}{180}x^\circ \qquad\qquad y = \cos ec\left(\dfrac{\pi x}{180}\right)$

$\dfrac{dy}{dx} = -\dfrac{\pi}{180}\cos ec x^\circ \cot x^\circ$

95. (d) $y = \dfrac{(x^2 - 2)}{2}$

$\left(\dfrac{dy}{dz}\right)^2 - x\left(\dfrac{dy}{dx}\right) = 0$

$y = 2x \Rightarrow \dfrac{dy}{dx} = 2$

$y = 2x + 4 \Rightarrow \dfrac{dy}{dx} = 2$

$y = 2^2 - 1 \Rightarrow \dfrac{dy}{dx} = \dfrac{1}{2}(2x) = x$

$y = \dfrac{(x^2 - 2)}{2}$ Satisfy the given differential equation.

96. (d) -3

$fg = (x^2 + 2)(2x - 3)$

$fg = 2x^3 - 3x^2 + 4x - 6$

$fg(1) = 2(1)^3 - 3(1)^2 + 4(1) - 6$

$fg(1) = 2 - 3 + 4 - 6 = -3$

97. (b) $[0, \infty)$

$f(x) = x + |x|$

$[0, \infty]$ Satisfied the given function

98. (a) $-\sin 3\theta$

$f(\sin\theta) = \sin\theta\left(4\sin^2\theta - 3\right)$

$= 4\sin\theta - 3\sin\theta$

$= -(3\sin\theta - 4\sin^3\theta)$

$= -\sin 3\theta$

99. (d) Limit does not exist

$\lim\limits_{x\to 5}\dfrac{5-x}{|x-5|}$

For $|x - 5| = \begin{cases} x - 5, & x > 5 \\ 5 - x, & x < 5 \end{cases}$

$LHL = -1; \qquad RHL = +1$

LHL is not equal to RHL therefore limit does not exist.

100. (c) 3

$\lim\limits_{x\to 1}\dfrac{x^9 - 1}{x^3 - 1}$

By applying L hospital Rule

$\lim\limits_{x\to 1}\dfrac{9x^8}{3x^2} = \dfrac{9}{3} = 3$

101. (c) 10 and 13

$14 = \dfrac{x + y + 11 + 16 + 20}{5}$

$70 = x + y + 47$

$x + y = 23 \qquad\qquad ...(i)$

Variance

$\sum\limits_{i=1}^{5}\dfrac{(x_i - \bar{x})^2}{14} = 13.2$

$(x - 14)^2 + (y - 14)^2 + (11 - 14)^2 + (16 - 14)^2$

$+ (20 - 14)^2 = 66$

$x^2 - 28x + 196 + y^2 - 28y + 196 + 9 + 4 + 36 = 66$

$x^2 + y^2 - 28(x + y) + 375 = 0 \qquad\qquad ...(ii)$

use $\quad (i)$

$x^2 + y^2 - 28 \times 23 + 375 = 0$

$x^2 + y^2 = 269 \qquad\qquad ...(iii)$

Square equation (i) we get

$x^2 + y^2 + 2xy = 529$ ...(iv)

Using equation (iii) we obtain

$2xy = 260$

$xy = 130$

using equation (i)

$x(23 - x) = 130$

$x^2 - 23x + 130 = 0$

$(x - 13)(x - 10) = 0$

$x = 10, 13$

102. (c) $\dfrac{2}{7}$

$P(A \cap B) = P(A) P(B)$

$P(A) = 1 - P(\overline{A}) = 1 - 0.7 = 0.3$

$P(B) = 1 - k$

$P(A \cap B) = 0.3(1 - k)$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$0.8 = 0.3 + 1 - k - (1 - k)0.3$

$= 0.5 - k - 0.3 + 0.3 k$

$0 = 0.2 - 0.7 k$

$k = \dfrac{2}{7}$

103. (b) $\dfrac{81}{1024}$

Biased Coin $P(H) = \dfrac{1}{4}, P(T) = \dfrac{3}{4}$

$P = TTTT H$

$P = \dfrac{3}{4} \times \dfrac{3}{4} \times \dfrac{3}{4} \times \dfrac{3}{4} \times \dfrac{1}{4} = \dfrac{8}{1024}$

104. (b) $\dfrac{27}{64}$

$P = {}^4C_3 P^3 Q^1$

Biased coin

$P(H) = \dfrac{3}{4}, P(T) = \dfrac{1}{4}$

$P = \dfrac{4 \times 3 \times 2}{1 \times 2 \times 3}\left(\dfrac{3}{4}\right)^3 \left(\dfrac{1}{4}\right)$

$P = \dfrac{4 \times 27}{64 \times 4} = \dfrac{27}{64}$

105. (c) 16

$X + Y = 100, n = 100, p = \dfrac{4}{5}$

$\Rightarrow \quad q = 1 - \dfrac{4}{5} = \dfrac{1}{5}$

Variance is $= npq$

$= 100 \times \dfrac{4}{5} \times \dfrac{1}{5} = 16$

106. (c) $x + 4y + 1 = 0$ and $4x - 9y - 7 = 0$

x on $y \Rightarrow x = -4 y - 1$

$x = \dfrac{-9y - 7}{4}$

$y = -3$

$x = \dfrac{27 - 7}{4} = 5$

107. (d) Let $9p = 3q = 2r = 6s = x$

$p = \dfrac{x}{9}, q = \dfrac{x}{3}, r = \dfrac{x}{2}, s = \dfrac{x}{6}$

$p + q + r + s = 360°$

$\dfrac{x}{9} + \dfrac{x}{3} + \dfrac{x}{2} + \dfrac{x}{6} = 360°$

$2x + 6x + 9x + 3x = 18 \times 360°$

$20x = 18 \times 360°$

$x = \dfrac{18 \times 360°}{20} = 18 \times 18$

$4p - q = \dfrac{4x}{9} - \dfrac{x}{3} = \dfrac{4x - 3x}{9} = \dfrac{x}{9}$

$\Rightarrow \quad \dfrac{18 \times 18}{9} = 36°$

108. (a) 10, Rearranging in ascending order all the given data

1,1,1,2,3,3,4,4,4,5,6,6

Mean of lowest 8 observations

$m = \dfrac{194}{8}$

Mean of highest 4 observations

$M = \dfrac{29}{4}$

$2m + M = \dfrac{19}{8} \times 2 + \dfrac{21}{4}$

$= \dfrac{19 + 21}{4} = \dfrac{40}{4} = 10$

109. (a) $x - 4y + 5 = 0$

$(-1,1)$ and $(3,2)$

y on $x \Rightarrow y = a + bx$

$b = \dfrac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$

$a = \bar{y} - a\bar{x}$

x	−1	3	$\sum x$	2	
y	1	2	$\sum y$	3	
xy	−1	6	$\sum xy$		5
x^2	1	9	$\sum x^2$	10	

$\bar{x} = \dfrac{2}{2} = 1, \qquad \bar{y} = \dfrac{3}{2}$

$b = \dfrac{2 \times 5 - 2 \times 3}{2 \times 10 - (2)^2} = \dfrac{10 - 6}{20 - 4} = \dfrac{4}{16}$

$b = \dfrac{1}{4}$

$(y - \bar{y}) = b(x - \bar{x})$

$\left(y - \dfrac{3}{2}\right) = \dfrac{1}{4}(x - 1)$

$\dfrac{2y - 3}{2} = \dfrac{x - 1}{4}$

$4y - 6 = x - 1$

$x - 4y + 5 = 0$

110. (d) 1

Mode is maximum happening x

x	1	2	4	5	6
f	4	2	2	1	1

Mode is 1

111. (c) 3

x	f	cf
1	4	4
2	6	10
3	9	19
5	7	26
	$\sum f = 26$	

For even N median $\dfrac{N}{2} = \dfrac{26}{2} = 13$

13 corresponding value of x is 3 therefore median is 3

112. (d) Rearranging in ascending order all the given data
$-1, 1, 3, 4, 8, 9, 11, 12, 17, 19$

Medians are $M = 3$ of first 5 observations and $N = 12$ of last five observation

$\Rightarrow \quad 4M - N = 4(3) - 12 = 0$

113. (d) $5P = 4\theta = \dfrac{R}{2}$

$P = \dfrac{R}{10}$ and $Q = \dfrac{R}{8}$

$\Rightarrow \quad \dfrac{P + Q}{2P + 0.7R} = \dfrac{\dfrac{R}{10} + \dfrac{R}{8}}{\dfrac{2R}{10} + \dfrac{7R}{10}}$

$\Rightarrow \quad \dfrac{8R + 10R}{80} \times \dfrac{10}{9R}$

$\Rightarrow \quad \dfrac{180R}{720R} = \dfrac{1}{4}$

114. (d) n

The Geometric Mean

$GM = \left(1 \times 2 \times 2^2 \times \dots \times 2^{n-1}\right)^{\frac{1}{n}}$

$G = \left(2^{1+2+3\dots+n-1}\right)^{\frac{1}{n}}$

$= \left[2^{\frac{(n-1)n}{2}}\right]^{\frac{1}{n}} = 2^{\frac{n-1}{2}}$

$G = 2\left(\dfrac{n-1}{2}\right)$

$\log_2 G = \dfrac{n-1}{2} \log_2 2$

$\log_2 G = \dfrac{n-1}{2}$

$\Rightarrow \quad 2\log_2 G = n - 1$

$\Rightarrow \quad 1 + 2\log_2 G = n$

115. (b) $2 - \dfrac{1}{2^{n-1}}$

$HM = \dfrac{n}{\dfrac{1}{x_1} + \dfrac{1}{x_2} + \dots + \dfrac{1}{x_n}}$

$H = \dfrac{n}{\dfrac{1}{1} + \dfrac{1}{2} + \dfrac{1}{2^2} \dots + \dfrac{1}{2^{n-1}}}$

$$= \cfrac{n}{1\left(\cfrac{1-\left(\cfrac{1}{2}\right)^n}{1-\cfrac{1}{2}}\right)}$$

$$H = \cfrac{n}{2\left(1-\cfrac{1}{2^n}\right)}$$

$$\Rightarrow \quad \frac{n}{H} = 2\left(1-\frac{1}{2^n}\right) = 2 - \frac{1}{2^{n-1}}$$

116. (c) 2Q

$$S = \sum_{i=1}^{n}(2x_i - a)^2$$

$$S = \sum_{i=1}^{n}(4x_i^2 - 4ax_i + a^2)$$

$$S = 4\sum_{i=1}^{n}x_i^2 - 4a\sum_{i=1}^{n}x_i + a^2$$

As P be the median, Q be the mean and R be the mode of observations are simplifying we get

a = 2Q

117. (a) Let's calculate the probability of drawing a white ball from the second bag after two balls are transferred from the first bag. First, let's calculate the probability of transferring two white balls from the first bag to the second bag. The probability of drawing a white ball from the first bag on the first draw is 3/5 (since there are 3 white balls out of 5 total balls).

After drawing one white ball from the first bag, there are 2 white balls left in the first bag and a total of 4 balls remaining. So the probability of drawing another white ball from the first bag on the second draw is 2/4, or 1/2. Therefore, the probability of transferring two white balls from the first bag to the second bag is $\dfrac{3}{5} \times \dfrac{1}{2} = \dfrac{3}{10}$

The total number of balls in the second bag after transferring two balls from the first bag is 7 (since there were originally 2 white balls + 3 black balls in the second bag, and two white balls were added from the first bag). The probability of drawing a white ball from the second bag is now $\dfrac{2}{7}$ (Since there are 2 white balls out of 7 total balls).

118. (c) Multiple of 3 are 3,6 Probability to get multiple of 3 in one dice $P(3,6) = \dfrac{2}{6} = \dfrac{1}{3}$

For three dice probability is $P = \dfrac{1}{3} \times \dfrac{1}{3} \times \dfrac{1}{3}$

$$P = \frac{1}{27}$$

119. (c) In December we have 31 days means 4 weeks and 3 days extra from these 3 days probability of Sunday is

$$P = \frac{3}{7}$$

120. (b) $\dfrac{47}{50}$

$$n + \frac{50}{n} < 50$$

$$n^2 + 50 < 50n$$

$$n^2 - 50n + 50 < 0$$

$$n = \frac{50 \pm \sqrt{2500 - 100}}{2}$$

$$n = \frac{50 \pm \sqrt{2400}}{2}$$

$$n = \frac{50 \pm \sqrt{(400)6}}{2} = \frac{50 \pm 20\sqrt{6}}{2}$$

$$n = 25 \pm 10\sqrt{6}$$

$$n = 47$$

$$p = \frac{47}{50}$$

PAPER-II: GENERAL ABILITY TEST

PART-A: ENGLISH

Spotting Errors

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

1. Over long periods of time, layers of
   (a)
   sediments builds up to a height of a
   (b)   (c)
   few kilometers. No Error
                    (d)

2. When a gas is cooled down it turns
   (a)   (b)
   into a liquid from a process called
                              (c)
   condensation. No Error
                 (d)

3. If you want to know the news you
   (a)   (b)
   can read a newspaper. No Error
   (c)   (d)

4. Columbus made his first voyage from
   (a)   (b)
   Europe to America on 1492.
                        (c)
   No Error
   (d)

5. Whenever the sky is clear, you can
   (a)   (b)
   see the stars in the night. No Error
   (c)   (d)

6. I'm not working tomorrow, so I don't
   (a)   (b)
   had to get up early. No Error
   (c)   (d)

7. She didn't tell anybody about her
   (a)   (b)   (c)
   plans. No Error
   (c)   (d)

8. She wouldn't have has an accident,
   (a)   (b)
   if she had driven carefully. No Error
   (c)   (d)

9. I will watch film if I finish the work
   (a)   (b)
   in time. No Error
   (c)   (d)

10. In 1989, the government did an
    (a)
    about-face and Iran restored it's
    (b)
    family planning program. No Error
    (c)   (d)

Synonyms

Directions: Each item in this section consists of a sentence with an underlined word followed by four options, (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.

11. **During the pandemic the _indigent_ people had to suffer a lot.**
    (a) very poor
    (b) opulent
    (c) solvent
    (d) prosperous

12. **She had no idea what made him angry in one minute and _jovial_ the next.**
    (a) aggrieved
    (b) melancholic
    (c) doleful
    (d) mirthful

13. **It is sheer _lunacy_ to drive a car in this frosty weather.**
    (a) prudence
    (b) normalcy
    (c) insanity
    (d) sanity

14. **Operating on a child with cancer needs _meticulous_ planning and teamwork.**
    (a) strong
    (b) long
    (c) playful
    (d) scrupulous

15. **The thrill of over-speeding the vehicle can be _exhilarating_, but it is important not to take the consequences lightly.**
    (a) humdrum
    (b) dreary
    (c) exciting
    (d) agitating

16. **The _redemption_ will now depend on his new strategy of inclusiveness.**
    (a) retrieval
    (b) forfeiture
    (c) corporation
    (d) desecration

17. **Only three candidates are now in _contention_ for the title.**
    (a) involved in dispute
    (b) in agreement with each other
    (c) chance of winning
    (d) amiable to each other

18. **All my fishing _paraphernalia_ is in the car.**
    (a) boxes
    (b) accessories
    (c) fuel
    (d) food

19. **The public watched in _astonishment_ as he took a sudden jump from the bridge.**
    (a) anticipation
    (b) hurriedly
    (c) wonderment
    (d) calmness

20. **Drinking _inordinate_ amount of liquor is not good for health.**
    (a) temperate
    (b) exorbitant
    (c) moderate
    (d) regular

Ordering of words in a sentence

Directions: 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 re-arrange the jumbled parts of the sentence correctly and mark your response accordingly.

21. because I feel you remember it better
      P   Q

when you write something,
             R

I make at least three drafts of a song
             S

The correct sequence should be:
(a) SPRQ   (b) RQPS
(c) QRSP   (d) PRSQ

22. for hours in the shop a gunman who
        P   Q

held a hostage demanded ransom of
        R   S

10 lakh

The correct sequence should be:
(a) SPRQ   (b) RQPS
(c) QRPS   (d) PRSQ

23. living in Russia country immediately
      P   Q

Ukraine has urged its citizens to
         R

leave the
    S

The correct sequence should be:
(a) SPRQ   (b) RPSQ
(c) RSQP   (d) PRSQ

24. ripping roofs off houses and raising fears of
    P

coast of Madagascar in the early hours,
    Q

cyclone Emnati crashed into the southeastern
    R

flooding and food shortages in the region.
    S

The correct sequence should be:
(a) SPRQ   (b) RPSQ
(c) RQPS   (d) PRSQ

25. ecology is protected and aquatic
      P

life thrives we need to utilize the
      Q

resources of water for different
      R

purposes while ensuring that its
      S

natural

The correct sequence should be:
(a) SPRQ   (b) RQPS
(c) QRSP   (d) PRSQ

26. very difficult the poor visibility made
    P   Q

the movement of traffic due to fog
      R   S

The correct sequence should be:
(a) SPRQ   (b) RQPS
(c) QRPS   (d) QSRP

27. avenues for the patients to indict
        P

but rarely is it the other way round
there are multiple legal the doctors
Q   R   S

The correct sequence should be:
(a) SPRQ   (b) RPSQ
(c) QRPS   (d) QSRP

28. flight, and each person her own
    P   Q

journey life is a solo makes his or
        R   S

The correct sequence should be:
(a) SPRQ   (b) RPQS
(c) RPSQ   (d) PQRS

29. made it evolve technologies and
      R   Q

equipment has into a rare centre of
           R

excellence adoption of the latest
          S

The correct sequence should be:
(a) PQRS   (c) RPQS
(b) SQPR   (d) QSRP

30. please mark the same be made in
    P   Q

response to this notice if you have any
               R

complaint to the concerned authority
          S

The correct sequence should be:
(a) PQRS   (b) RPQS
(c) SQPR   (d) RQPS

Antonyms

Directions: Each item in this section consists of a sentence with an underlined word followed by four options, (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. The parental support can fortify a child's learning.
(a) weaken   (b) encourage
(c) brace   (d) strengthen

32. Now we can have another dazzling thought, as an outcome of my brilliant research!
(a) splendid   (b) murky
(c) dazing   (d) fulgent

33. The group held some clandestine meetings to resolve the matter.
(a) secret   (b) covert
(c) sneaky   (d) public

34. In the winters, the countryside view is bleak and the house is drafty.
(a) cheerless   (b) verdant
(c) desolate   (d) bare

35. Amid commotion the leader and his supporters remained passive.
(a) quietude   (b) uproar
(c) tempest   (d) stir

36. He had the audacity to blame him.
(a) boldness   (b) vigour
(c) temerity   (d) politeness

37. They are making plans for the abatement of the nuisance within a specified time.
(a) subsidence
(b) ebbing
(c) accumulation
(d) mitigation

38. There is exponential growth in the development of the scientific researches in the recent few decades.
(a) aggressive
(b) rampant
(c) meager
(d) augmented

39. He was known for his sagacity.
(a) prudence   (b) wisdom
(c) ignorance   (d) sapience

40. The river Ganges <u>culminates</u> in the Bay of Bengal.
    (a) concludes   (b) flows
    (c) originates   (d) merges

Idioms and Phrases

Directions: Given below are some idioms/phrases followed by four alternative meanings for each. Choose the most appropriate answer from among the options (a), (b), (c) or (d).

41. The lion's share
    (a) A portion of something
    (b) The largest and the best part of something
    (c) An important decision
    (d) An aggressive statement

42. Spill the beans
    (a) Reveal a secret
    (b) Forced to leave belongings
    (c) Share the news
    (d) Take offence at someone's rude behaviour

43. Cook someone's goose
    (a) To assist others
    (b) Hypnotize other's mind
    (c) To spoil other's plans
    (d) Inviting misfortune

44. Disappear into thin air
    (a) Lost forever
    (b) Become forgetful
    (c) Become uncaring
    (d) Disappear suddenly

45. Put the screws on
    (a) Forcing someone to do what you want
    (b) Never letting go of things
    (c) Keep the past alive
    (d) Using someone's trick for own benefit

46. Sit on the fence
    (a) Avoid meeting someone
    (b) Waiting patiently
    (c) Avoid taking sides
    (d) Hiding from someone

47. Be as sharp as a tack
    (a) A talkative person
    (b) A shrewd person
    (c) A clumsy person
    (d) A clever person

48. From pillar to post
    (a) Upside down
    (b) Keep moving from one place to another
    (c) Constructing a huge building
    (d) Jumping from the top of the mountain

49. Heath Robinson
    (a) Very complicated system or machine for doing a simple task
    (b) Treating everyone as enemy, when they are not
    (c) Sleeping all day, doing nothing
    (d) Very lazy person, slow in action

50. As thick as thieves
    (a) Dumb person
    (b) Good for nothing
    (c) Someone who uses everyone for personal gain
    (d) Very close friends who are looked upon with suspicion

51. Two identical spring balances S_1 and S_2 are connected one after the other and are held vertically as shown in the figure. A mass of 10 kg is hanging from S_2. If the readings on S_1 and S_2 are W_1 and W_2 respectively, then:
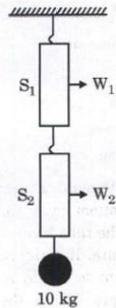

    (a) W_1 = 5 kg and W_2 = 10 kg
    (b) W_1 = 10 kg and W_2 = 5 kg
    (c) W_1 = 5 kg and W_2 = 5 kg
    (d) W_1 = 10 kg and W_2 = 10 kg

52. A stone is thrown horizontally from the top of a 20 m high building with a speed of 12 m/s. It hits the ground at a distance R from the building. Taking g = 10 m/s^2 and neglecting air resistance will give:
    (a) R = 12 m   (b) R = 18 m
    (c) R = 24 m   (d) R = 30 m

53. A sphere of volume V is made of a material with lower density than water. While on Earth, it floats on water with its volume f_1V ($f_1 < 1$) submerged. On the other hand, on a spaceship accelerating with acceleration a < g (g is the acceleration due to gravity on Earth) in outer space, its submerged volume in water is f_2V. Then:
    (a) $f_2 = f_1$
    (b) $f_2 = (1 - \dfrac{a}{g})f_1$
    (c) $f_2 > f_1$
    (d) $f_2 = \dfrac{a}{g}f_1$

54. Two identical containers X and Y are connected at the bottom by a thin tube of negligible volume. The tube has a valve in it, as shown in the figure. Initially container X has a liquid filled up to height h in it and container Y is empty. When the valve is opened, both containers have equal amount of liquid in equilibrium. If the initial (before the valve is opened) potential energy of the liquid is P_1 and the final potential energy is P_2 then:
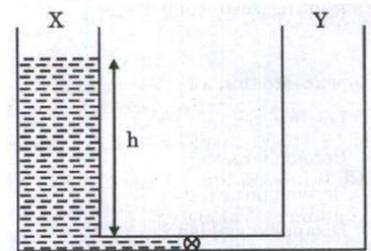
    (a) $P_1 = P_2$
    (b) $P_1 = 4P_2$
    (c) $P_1 = 2P_2$
    (d) $P_1 = 8P_2$

55. A particle is moving in a circle of radius R with a constant speed v. Its average acceleration over the time when it moves over half the circle is:
    (a) $\dfrac{v^2}{R}$ (b) $\dfrac{\pi v^2}{2R}$
    (c) $\dfrac{2v^2}{\pi R}$ (d) 0

56. Two forces of 5.0 N each are acting on a point mass. If the angle between the forces is 60°, then the net force acting on the point mass has magnitude close to:
(a) 8.6 N   (b) 4.3 N
(c) 5.0 N   (d) 6.7 N

57. Which one of the following is not an igneous rock?
(a) Granite   (b) Slate
(c) Basalt   (d) Gabbro

58. Which of the following statements is/are correct?
1. Hypocenter is the point on the surface of the Earth, nearest to the focus.
2. Velocity of earthquake waves is higher in denser materials.
3. P waves move faster and are the first to arrive at the surface of the Earth.
Select the correct answer using the code given below:
(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 3 only

59. In terms of geological time scale, the quaternary period consists of two epochs. They are:
(a) Pleistocene and Pliocene
(b) Holocene and Pleistocene
(c) Pleistocene and Miocene
(d) Holocene and Eocene

60. Which one of the following is the correct sequence of arrangement of the given planets in descending order of their density (in gm/cm3)?
(a) Earth > Jupiter > Venus > Saturn
(b) Jupiter > Earth > Saturn > Venus
(c) Earth > Venus > Jupiter > Saturn
(d) Earth > Venus > Saturn > Jupiter

61. Which one of the following is *not* a cold current ?
(a) Western Australian Current
(b) Eastern Australian Current
(c) Benguela Current
(d) Peru Current

62. The process of Podsolization is predominantly found in:
(a) Equatorial forest
(b) Monsoon forest
(c) Taiga forest
(d) Mediterranean forest

63. Joint Military exercise 'Keen Sword 23' was conducted between:
(a) India and Japan
(b) India and USA
(c) USA and Japan
(d) Japan and Taiwan

64. The Battle of Rezang La, an epic battle in hostile conditions, was fought by the Indian Army in:
(a) 1948   (b) 1956
(c) 1962   (d) 1972

65. Consider the following statements about 'Exercise Sea Vigil-22':
1. Its aim is to assess India's preparedness in the domain of Maritime security and coastal defence.
2. Naval forces of USA and Japan also took part in the exercise.
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

66. Consider the following statements:
1. England is the only country that won the ICC T20 World Cup twice.
2. Virat Kohli is the only player to be adjudged as the Player of the Series in the ICC T20 World Cup twice.
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

67. Who among the following is not a recipient of Nobel Prize in Chemistry in 2022?
(a) Carolyn R. Bertozzi
(b) Benjamin List
(c) Morten Meldal
(d) K. Barry Sharpless

68. Consider the following statements regarding cell wall composition:
1. Bacterial cell wall is made of peptidoglycan.
2. Fungal cell wall is made of cellulose.
3. Animals lack cell wall and have extracellular matrix made up of sugar and proteins.
Select the correct answer using the code given below:
(a) 2 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

69. Which one of the following structures is not present in a prokaryotic cell?
(a) Cell wall
(b) Ribosomes
(c) Nucleus
(d) Plasma membrane

70. In a plant cell, which one of the following contains their own DNA?
(a) Nucleus and Endoplasmic Reticulum
(b) Ribosome and Golgi apparatus
(c) Mitochondria and Chloroplast
(d) Chloroplast and Vacuoles

71. One advantage of sexual reproduction over asexual reproduction is that it helps species to survive over long evolutionary time. This is because sexual reproduction produces:
(a) more offspring in each reproductive cycle.
(b) robust and healthy offspring.
(c) genetically similar offspring.
(d) more variation in offspring.

72. Which one of the following structures or components is *not* always present in living cells?
(a) Cell wall
(b) Plasma membrane
(c) Cytoplasm
(d) Genetic material

73. Browning of the chopped apple can be minimized by:
(a) using table sugar.
(b) preserving in a container.
(c) using lemon juice.
(d) using milk of magnesia.

74. Which of the hydrocarbons are arranged as per the increasing order of their boiling points?
   (a) Methane, Butane, Propane, Heptane
   (b) Propane, Butane, Pentane, Octane
   (c) Propane, Butane, Heptane, Methane
   (d) Octane, Ethane, Methane, Propane

75. Which one of the following apparatus is used for separating benzene and water mixture?
   (a) Round bottom flask
   (b) Conical flask
   (c) Separating funnel
   (d) Dean and Stark apparatus

76. An iron nail dipped in copper sulphate solution turns brown. This is due to which one of the following types of reactions?
   (a) Addition reaction
   (b) Decomposition reaction
   (c) Substitution reaction
   (d) Displacement reaction

77. Among the following, which is *not* the correct method for keeping the curd?
   (a) Keeping in stainless steel vessel
   (b) Keeping in copper vessel
   (c) Keeping in plastic vessel
   (d) Keeping in glass vessel

78. Toothpaste prevents tooth decay by:
   (a) neutralizing the excess acidity.
   (b) means of emulsification.
   (c) the action of fluoride.
   (d) making a coat of calcium over the teeth surface.

79. Freedom fighter Kanaklata Barua martyred in:
   (a) Sepoy Mutiny
   (b) Quit India Movement
   (c) Non-Cooperation Movement
   (d) Peasant Uprising of 1893–1894

80. Which one among the following statements about the Mansabdari system is correct?
   (a) All army troopers were allotted mansabs.
   (b) Mansabs were usually assigned on the basis of ancestry.
   (c) Position and salary of mansabdars were indicated by a numerical designation called zat.
   (d) Mansabdars were never paid in cash.

81. Which Governor General of Bengal underwent impeachment proceedings in the British Parliament?
   (a) Robert Clive
   (b) Henry Vansittart
   (c) Warren Hastings
   (d) Lord Cornwallis

82. Who among the following composed the 'Prayag Prashasti' of Samudragupta?
   (a) Harishena
   (b) Chand Bardai
   (c) Vishakhadatta
   (d) Kalidasa

83. Which one of the following kingdoms was founded by the two brothers Harihar and Bukka?
   (a) Bahmani
   (b) Vijayanagara
   (c) Malwa
   (d) Maratha

84. At which one of the following places did the Danes establish their settlement in India?
   (a) Chinsura
   (b) Karaikal
   (c) Mahe
   (d) Tranquebar

85. A rectangle ABCD is kept in front of a concave mirror of focal length f with its corners A and B being, respectively, at distances 2f and 3f from the mirror with AB along the principal axis as shown in the figure. It forms an image A'B'C'D' in front of the mirror. What is the ratio of B'C' to A'D'?
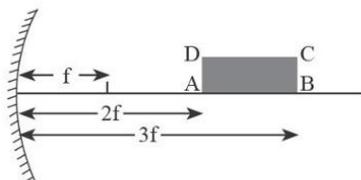
   (a) 1
   (b) 2
   (c) $\frac{1}{2}$
   (d) $\frac{2}{3}$

86. Shown in the figure are two plane mirrors XY and YZ (XY ⊥ YZ) joined at their edge. Also shown is a light ray falling on one of the mirrors and reflected back parallel to its original path as a result of this arrangement. The two mirrors are now rotated by an angle θ to their new position X'YZ', as shown. As a result the new reflected ray is at an angle α from the original reflected ray. Then:

   (a) α = 0
   (b) α = θ
   (c) α = 2θ
   (d) α = 4θ
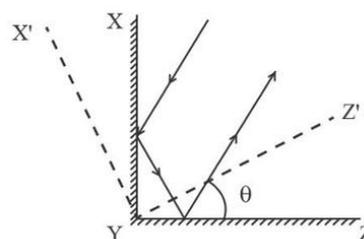
87. A railway wagon (open at the top) of mass M_1 is moving with speed v_1 along a straight track. As a result of rain, after some time it gets partially filled with water so that the mass of the wagon becomes M_2 and speed becomes v_2. Taking the rain to be falling vertically and water stationary inside the wagon, the relation between the two speeds v_1 and v_2 is:
   (a) $v_1 = v_2$
   (b) $\frac{1}{2}M_1v_1^2 < \frac{1}{2}M_2v_2^2$
   (c) $M_1v_1 = M_2v_2$
   (d) $M_1v_1 < M_2v_2$

88. Which one of the following statements is *not* true for *a* flute, a musical instrument?
   (a) Momentum of waves on the blowing jet determines the loudness of the produced note.
   (b) Arrival time of the waves the waves on the blowing jet

determines the pitch of the produced note.

(c) Sound comes from a vibrating column of air inside the flute.

(d) Sound comes from a vibrating column of air inside as well as outside the flute.

89. A positive charge is moving towards south in a space where magnetic field is pointing in the north direction. The moving charge will experience:

(a) a deflecting force towards north direction.

(b) a deflecting force towards east direction.

(c) a deflecting force towards west direction.

(d) no deflecting force.

90. Which one of the following is *not* a main greenhouse gas?

(a) Water vapour

(b) Oxygen

(c) Carbon dioxide

(d) Methane

91. Which one of the following statements about X-rays is not true?

(a) They have wavelengths of about 1Å.

(b) These can be generated by bombarding a metal target by high energy electrons.

(c) Due to their wavelengths being shorter, these can be used for radar systems.

(d) These are also used for the treatment of certain forms of cancer.

92. Which one among the following is the northernmost geographical location?

(a) New Delhi

(b) Kathmandu

(c) Thimphu

(d) Dhaka

93. Consider the following statements:

1. Distance between the longitudes becomes zero on North Pole and South Pole.

2. Distance between the longitudes is maximum on the Equator.

3. Number of longitudes is more than number of latitudes.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

94. Which one among the following states is the leading producer of Manganese in India?

(a) Madhya Pradesh

(b) Jharkhand

(c) Rajasthan

(d) Karnataka

95. Mica is mainly used in:

(a) food and beverage industry.

(b) iron and steel industry.

(c) aluminium industry.

(d) electrical and electronic industries.

96. According to Koppen's climatic classifications, the Great Northern Plains of India have which one of the following climates?

(a) Aw climate

(b) Cwg climate

(c) Amw climate

(d) Dfc climate

97. Which of the following statements about Lachit Borphukan is/are correct?

1. He was a General of the Ahom Force.

2. He is known for his leadership in the Battle of Saraighat.

3. Lachit Borphukan Gold Medal is given to the best cadet at the National Defence Academy.

Select the correct answer using the code given below:

(a) 1, 2 and 3

(b) 2 and 3 only

(c) 1 only

(d) 2 only

98. The 4th edition of joint military exercise 'DUSTLIK' between the Indian Army and the Uzbekistan Army was held in:

(a) Ranikhet

(b) Gangtok

(c) Pithoragarh

(d) Leh

99. Which of the following is India's first privately developed rocket launched by ISRO recently?

(a) Skyroot

(b) Prarambh

(c) Bazoomq

(d) Vikram-S

100. Which one among the following villages was recently declared as India's first 24 × 7 solar-powered village?

(a) Mawlynnong, Meghalaya

(b) Modhera, Gujarat

(c) Ziro village, Arunachal Pradesh

(d) Malana, Himachal Pradesh

101. Tableaux of which one of the following States was adjudged the best in the Republic Day Parade, 2023?

(a) Uttarakhand

(b) Punjab

(c) Gujarat

(d) Uttar Pradesh

102. Organisms capable of using CO_2 as principal carbon source are called:

(a) Autotrophs

(b) Heterotrophs

(c) Parasites

(d) Decomposers

103. When yeast cells are O_2 starved, fermentation serves as the source of energy. This results in the production of:

(a) $ATP + CO_2 + Ethanol$

(b) $ATP + O_2 + Pyruvate$

(c) $ATP + CO_2 + Lactic acid$

(d) $ATP + O_2 + Acetaldehyde$

104. During a laboratory experiment, a student immerses epidermal leaf peel in a hypertonic solution. After some time, the student examined the cells under a microscope and observed that:

(a) the cells swelled.

(b) the cells were plasmolysed.

(c) the cells built up turgor pressure.

(d) the cells size was unaffected.

105. Which one of the of the following is *not* characteristic feature of fungi?

(a) Cell wall is made of chitin

(b) Filamentous mycelium is present

(c) Can carry out photosynthesis

(d) Asexual spores are produced

106. Which one of the following statements about bryophytes is *not* correct?

(a) The plant body is a gametophyte.

(b) They are also called the amphibians of plant kingdom.

(c) The plant body is attached to the substratum by rhizoids.

(d) Specialized water-conducting tissues are present.

107. What is the specific purpose of using potassium hydroxide during the saponification process?

(a) To obtain soaps which are hard on the skin

(b) To obtain soaps which are soft on the skin

(c) To obtain natural fragrance

(d) To make the saponification very economical

108. Which one of the following is the correct arrangement of metals in the decreasing order of their reactivity?

(a) Iron, Sodium, Silver, Copper

(b) Silver, Copper, Iron, Sodium

(c) Sodium, Copper, Silver, Iron

(d) Sodium, Iron, Copper, Silver

109. Which among the following statements is *not* correct with respect to allotropes of Carbon?

(a) Graphite is a good conductor of electricity.

(b) Diamond is the hardest substance known.

(c) Fullerene is one of the allotropes of carbon.

(d) Next to diamond, graphite is the second hardest known substance.

110. Which among the following is the popular method for manufacture of ammonia?

(a) Ostwald's process

(b) Haber-Bosch process

(c) Electric furnace process

(d) Electrolysis process.

111. For manufacturing of glass, which among the following is used as a source of silica?

(a) Fine clay soil

(b) Wood powder

(c) Coconut shell

(d) Sand

112. Which among the following is the correct arrangement of halogens in the increasing order of their oxidizing nature?

(a) F, Cl, Br, I

(b) Cl, Br, F, I

(c) Br, I, Cl, F

(d) I, Br, Cl, F

113. Copper sulphate crystals available in the market are blue coloured crystals. By careful heating, they turn to white colour. Which one of the following is responsible for the blue colour?

(a) Oxygen

(b) Nitrogen

(c) Water

(d) Hydrogen

114. Equal volume of all gases, when measured at the same temperature and pressure, contain an equal number of particles. Who proposed the above law?

(a) Charles

(b) Boyle

(c) Avogadro

(d) Lussac

115. Airbags work on the principle of a chemical reaction triggered by the impact producing a gaseous product that causes a sudden volume change. Which one among the following chemical conversions is responsible for this?

(a) Sodium azide into nitrogen gas

(b) Solid carbon dioxide into gaseous carbon dioxide

(c) Carbon dioxide into carbon monoxide

(d) Sudden conversion of gaseous carbon dioxide into carbon monoxide

116. Which one among the following districts of Eastern India held a referendum in 1947 to decide whether or not to join Pakistan?

(a) Sylhet

(b) Goalpara

(c) Cachar

(d) Jalpaiguri

117. Which one of the following statements about Rabatak inscription is *not* correct?

(a) It throws important light on Kushana genealogy.

(b) It refers to Kanishka as 'a king of kings and a son of God'.

(c) The 23-line inscription is written in Gandhari language.

(d) It mentions names of States which were part of Kanishka's empire.

118. Who among the following was the author of the famous Sanskrit work '*Mrichchhakatika*'?

(a) Kalidasa

(b) Bhasa

(c) Valmiki

(d) Shudraka

119. Yashovarman was ruler of which one of the following kingdoms?

(a) Kannauj

(b) Mewar

(c) Marwar

(d) Kalinga

120. Which one among the following rulers established Pataliputra as the capital of the Magadhan Empire?

(a) Bimbisara

(b) Bindusara

(c) Ajatashatru

(d) Ashoka

121. Which one of the following astronomers proved that the Earth and other planets revolve around the Sun?

(a) Copernicus

(b) Kepler

(c) Galileo

(d) Newton

122. Sand falls vertically on a conveyor belt at a rate of 0.1 kg/s. In order to keep the belt moving at a uniform speed of 2 m/s, the force required to be applied on the belt is:

(a) 0 N

(b) 0.2 N

(c) 1.0 N

(d) 2.0 N

123. The power required to lift a mass of 8.0 kg up a vertical distance of 4 m in 2 s is (taking acceleration due to gravity as 10 m/s^2):
   (a) 80 W   (b) 160 W
   (c) 320 W   (d) 640 W

124. One block of 2.0 kg mass is placed on top of another block of 3.0 kg mass. The coefficient of static friction between the two blocks is 0.2. The bottom block is pulled with a horizontal force F such that both the blocks move together without slipping. Taking acceleration due to gravity as 10 m/s^2, the maximum value of the frictional force is:
   (a) 50 N   (b) 30 N
   (c) 4 N   (d) 10 N

125. A mass is attached to a spring that hangs vertically. The extension produced in the spring is 6 cm on Earth. The acceleration due to gravity on the surface of the Moon is one-sixth of its value on the surface of the Earth. The extension of the spring on the Moon would be:
   (a) 6 cm   (b) 1 cm
   (c) 0 cm   (d) 36 cm

126. Which one of the following is an example of Second Class Lever?
   (a) A pair of scissors
   (b) A bottle opener
   (c) A cricket bat
   (d) A bow and arrow

127. In an electric circuit, a wire of resistance 10 Ω is used. If this wire is stretched to a length double of its original value, the current in the circuit would become:
   (a) half of its original value.
   (b) double of its original value.
   (c) one-fourth of its original value.
   (d) four times of its original value.

128. What is the total resistance in the following circuit element?
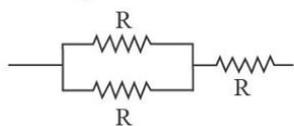
   (a) R/2   (b) 3R
   (c) 3R/2   (d) 2R/3

129. Which of the following scheme(s) is/are included under *Bharatmala Pariyojana*?
   1. Develop the road connectivity to border areas
   2. Development of coastal roads
   3. Improvement in the efficiency of National Corridors
   Select the correct answer using the code given below:
   (a) 1 only
   (b) 3 only
   (c) 2 and 3 only
   (d) 1, 2 and 3

130. Deendayal Port was earlier known as:
   (a) Paradip Port
   (b) Tuticorin Port
   (c) Kandla Port
   (d) Visakhapatnam Port

131. The Counter Insurgency and Jungle Warfare School of Indian Army is situated at:
   (a) Dehradun
   (b) Vairengte
   (c) Gulmarg
   (d) Mhow

132. In the soil-forming regime, which one of the following occurs in a region where evapotranspiration exceeds precipitation significantly?
   (a) Calcification
   (b) Laterization
   (c) Podsolization
   (d) Gleization

133. Which one of the following is found in the innermost part of the Earth?
   (a) Conrad discontinuity
   (b) Moho discontinuity
   (c) Guttenberg discontinuity
   (d) Lehmann discontinuity

134. Which of the following tree species is/are found on Himalayas ?
   1. Oak
   2. Rhododendron
   3. Rosewood
   Select the correct answer using the code given below:
   (a) 1 only   (b) 2 and 3
   (c) 1 and 3   (d) 1 and 2

135. Which one of the the following is the lowermost/innermost intrusive igneous rock?
   (a) Laccolith
   (b) Batholith
   (c) Lopolith
   (d) Phacolith

136. If it is 12 noon in New Delhi, what will be the time in London, UK?
   (a) 6:30 A.M.
   (b) 6:30 P.M.
   (c) 5:30 A.M.
   (d) 5:30 P.M.

137. Which of the following positions of Sun, Earth and Moon is/are suitable for Spring Tide?
   1. SYZYGY Conjunction
   2. SYZYGY Opposition
   3. Quadrature
   Select the correct answer using the code given below:
   (a) 1 only
   (b) 2 only
   (c) 1 and 2
   (d) 1 and 3

138. Which Renaissance artist painted "The Last Supper'?
   (a) Michelangelo
   (b) Donatello
   (c) Botticelli
   (d) Leonardo da Vinci

139. Which one of the following European explorer conquered Mexico?
   (a) Vasco da Gama
   (b) Bartholomew Diaz
   (c) Magellan
   (d) Hernán Cortés

140. Near which one of the following cities in India have large statues of Kushana rulers been discovered?
   (a) Karnal
   (b) Ropar
   (c) Hisar
   (d) Mathura

141. The Treaty of Yandabo was concluded as part of which one of the following wars?
   (a) First Anglo-Burmese War
   (b) Second Anglo-Burmese War
   (c) Anglo-Kuki War
   (d) Anglo-Maratha War

142. Plan allocation in agriculture and irrigation as percentage of total plan outlay was highest in:
(a) Seventh Five-Year Plan
(b) Third Five-Year Plan
(c) First Five-Year Plan
(d) Second Five-Year Plan

143. The UN COP-27 Summit relates to:
(a) Russia-Ukraine war
(b) Terrorism and counter-terrorism
(c) Climate change
(d) Interpol

144. Which one of the following tribes from India's North-East had the earliest known association with cultivation and production of tea?
(a) Khasis
(b) Garos
(c) Singphos
(d) Jayantias

145. By which one of the following amendments, was Article 51A, relating to the Fundamental Duties, inserted into the Constitution of India?
(a) The Constitution (42nd Amendment) Act
(b) The Constitution (44th Amendment) Act
(c) The Constitution (85th Amendment) Act
(d) The Constitution (92nd Amendment) Act

146. Which one of the following statements is true?
(a) The force of gravity of the Earth on the Moon is greater than the force of gravity of the Moon on the Earth.
(b) The force of gravity of the Moon on the Earth is greater than the force of gravity of the Earth on the Moon.
(c) The force of gravity of the Earth on the Moon and of the Moon on the Earth are equal in magnitude and are in the same direction.
(d) The force of gravity of the Earth on the Moon and of the Moon on the Earth are equal in magnitude but are in opposite directions.

147. An electric bulb is rated as 220 V and 80 W. When it is operated on 110 V, the power rating would be:
(a) 80 W   (b) 60 W
(c) 40 W   (d) 20 W

148. In the dispersion of white light by a common glass prism, which one among the following is correct?
(a) Red light deviates the most because red light has highest speed in prism
(b) Blue light deviates the most because blue light has highest speed in prism
(c) Red light deviates the most because red light has lowest speed in prism
(d) Blue light deviates the most because blue light has lowest speed in prism

149. Which one among the following is true for the speed of sound in a given medium?
(a) Speed of sound remains same at all frequencies
(b) Speed of sound is faster at higher frequencies
(c) Speed of sound is slower at higher frequencies
(d) Speed of sound is slower at higher wavelengths

150. Which one of the following telescopes contains only mirrors?
(a) Galilean telescope
(b) Keplerian telescope
(c) Newtonian telescope
(d) Schmidt telescope

Answers with Explanations

PAPER-II:
GENERAL ABILITY TEST

PART-A: ENGLISH

1. (b) The error is in part (b). The correct verb form is "build" instead of "builds" because "layers" is a plural noun. The correct sentence should be:

Over long periods of time, layers of sediments build up to a height of a few kilometers.

Therefore, the correct answer is (b).

2. (d) The sentence is grammatically correct with no errors. Therefore, the correct answer is (d).

3. (d) The sentence is grammatically correct with no errors. Therefore, the correct answer is (d).

4. (c) The error is in part (c). The correct preposition to use with "on" is "in" because "1492" refers to a year. The correct sentence should be: Columbus made his first voyage from Europe to America in 1492.

5. (d) The sentence is grammatically correct with no errors.

6. (b) The error is in part (b). The correct verb form is "have" instead of "had" because "don't" is a contraction of "do not", which is present tense. The correct sentence should be:

I'm not working tomorrow, so I don't have to get up early.

Therefore, the correct answer is (b).

7. (d) The sentence is grammatically correct with no errors.

8. (b) The error is in part (b). The correct verb form is "have" instead of "has" because "wouldn't have" is a conditional perfect construction, which requires the past participle form of the verb "have". The correct sentence should be:

She wouldn't have had an accident, if she had driven carefully.

Therefore, the correct answer is (b).

9. (a) The error is in part (a). The correct article to use with "film" is "a"

because "film" is a countable noun. The correct sentence should be:

I will watch a film if I finish the work in time.

Therefore, the correct answer is (a).

10. (c) The error is in part (c). The correct possessive pronoun to use with "it" is "its" without an apostrophe. The correct sentence should be:

In 1989, the government did an about-face and Iran restored its family planning program.

Therefore, the correct answer is (c).

11. (a) The word "indigent" means very poor or impoverished. Therefore, the correct answer is very poor.

12. (d) The word "jovial" means cheerful and friendly, so the sentence implies that the person's mood changed from angry to cheerful. Therefore, the correct answer is (d) mirthful, which means full of mirth or humor.

13. (c) The word "lunacy" means insanity or madness. Therefore, the correct answer is (c) insanity.

14. (d) The word "meticulous" means very careful and precise, and suggests a great attention to detail. Therefore, the correct answer is (d) scrupulous, which means very careful and thorough in carrying out one's work or duties.

15. (c) The word "exhilarating" means making one feel very happy, animated, or elated.

16. (a) The word "redemption" means the act of saving or regaining something or someone. Therefore, the correct answer is (a) retrieval, which means the act of getting or bringing something back.

17. (c) The word "contention" means competing or vying for something. Therefore, the correct answer is (c) chance of winning.

18. (b) The word "paraphernalia" means equipment or tools that are necessary for a particular activity. Therefore, the correct answer is (b) accessories, which refers to additional items added to something to make it more useful or attractive.

19. (c) The word "astonishment" means a feeling of great surprise or wonder. Therefore, the correct answer is (c) wonderment.

20. (b) The word "inordinate" means exceeding reasonable limits, excessive. Therefore, the correct answer is (b) exorbitant.

21. (a) S : I make at least three drafts of a song, P : because I feel, R : when you write something, Q : you remember it better

The correct sequence should be: SPRQ

22. (c) The sentence talks about a hostage situation where a gunman is holding someone captive and demanding ransom. The first part of the sentence is Q, which introduces the gunman and the hostage next, R provides additional information about the hostage, P the sentence by adding more details about the location of the situation. Then, S conclude, which explains what the gunman is demanding a ransom of ₹10 lakh. Therefore, the correct sequence is QRPS.

23. (b) The sentence talks about the situation in Ukraine and how the government is urging its citizens to leave the country. The first part of the sentence is R, which introduces the topic and explains what Ukraine is doing, Next, P provides more information about the situation by stating where people are living, and Then, S follows, which states the reason for the urge - living in Russia finally, Q concludes the sentence by adding more details about the urgency of the situation. Therefore, the correct sequence is RPSQ.

24. (c) The sentence talks about a cyclone hitting the southeastern coast of Madagascar and the potential consequences of it. The first part of the sentence is R, which introduces the cyclone and where it hit. Then, Q follows, which provides more information about the impact of the cyclone by describing the destruction it caused. Next, P talks about the potential consequences of the cyclone - flooding and food shortages. Finally, S concludes the sentence by stating what the impact of these consequences could be. Therefore, the correct sequence is RQPS.

25. (c) The sentence talks about the importance of utilizing water resources while also ensuring the protection of the ecology and aquatic life. The first part of the sentence is Q, which introduces the topic and talks about the need to use water resources. Then, R follows, which explains that these resources are used for different purposes. Next, S provides additional information about the importance of protecting the natural ecology, and finally, P concludes the sentence by stating the goal of utilizing these resources while also protecting the environment. Therefore, the correct sequence is QRSP.

26. (d) Q : the poor visibility, S : due to fog The correct sequence should be R : made the movement of traffic P : very difficult. Therefore, the correct sequence is QSRP.

27. (b) The sentence talks about the legal avenues available to patients to indict doctors. The first part of the sentence is R, which introduces the topic and states that there are multiple legal avenues available, Next, P explains the purpose of these legal avenues - to provide avenues for patients to indict doctors. Then, S follows, which specifies who is being indicted - the doctors. Finally, Q concludes the sentence by pointing out that this happens rarely the other way round. Therefore, the correct sequence is RPSQ.

28. (c) The sentence talks about life being a solo journey and how each person makes their own way through it. The first part of the sentence is R, which introduces the topic and states that life is a solo journey. Then, P follows, which provides a specific example of a solo journey - a flight. Next, S explains that each person makes their own journey. Finally, Q concludes the sentence by restating the idea that each person makes their own way through life. Therefore, the correct sequence is RPSQ.

29. (c) The sentence talks about how the adoption of the latest technologies and equipment has made a centre of excellence rare. The first part of the sentence is S, which introduces the idea that the adoption of the latest technologies and equipment

has played a role. Then, Q follows, which specifies what has been adopted - the latest technologies and equipment. P comes next, which explains how this adoption has made the centre evolve. Finally, R concludes the sentence by stating that the centre is now a rare centre of excellence. Therefore, the correct sequence is SQPR.

30. (d) The sentence talks about making a complaint in response to a notice. The first part of the sentence is R, which introduces the idea of having a complaint. Then, Q follows, which specifies that the complaint should be made in response to a notice. P comes next, which tells the reader to mark the complaint as important. Finally, S concludes the sentence by instructing the reader to send the complaint to the concerned authority. Therefore, the correct sequence is RQPS.

31. (a) The option that is opposite in meaning to the underlined word "fortify" is weaken.

32. (b) The answer is (b) murky. "Dazzling" means shining brightly or impressively, and "brilliant" means very intelligent or skillful. Therefore, the sentence suggests that the research was successful and produced an impressive outcome. "Murky," on the other hand, means unclear or confusing, which is the opposite of what the sentence is trying to convey. "Dazing" means causing someone to feel confused or bewildered, which is also not the intended meaning. "Fulgent" means shining brightly or dazzlingly, which is close in meaning to "dazzling," but it is not the opposite of it.

33. (d) The option that is opposite in meaning to the underlined word "clandestine" is public.

34. (b) The option that is opposite in meaning to the underlined word "bleak" is verdant.

35. (a) "Quietude" means calmness, tranquility, or peacefulness.

36. (d) The opposite of "audacity" which means boldness, daring or courage is politeness.

37. (c) The opposite of "abatement" which means the act of reducing or lessening something, is accumulation.

38. (c) The opposite of "exponential growth" is "meager," .

39. (c) The answer is ignorance, which is the opposite of sagacity (meaning wisdom, good judgement, or intelligence).

40. (c) The opposite of "culminates" is "originates".

41. (b) Explanation: The idiom "lion's share" refers to the largest and best part of something, just like a lion would take the largest and best part of a kill.

42. (a) The correct answer is (a) Reveal a secret. "Spill the beans" means to accidentally or intentionally disclose confidential or secret information to someone who is not supposed to know about it.

43. (d) The correct answer is (d) Inviting misfortune.

The idiom "cook someone's goose" means to ruin someone's chances of success or to cause them to fail. It can also refer to bringing about someone's downfall or destruction.

44. (d) The most appropriate answer is (a) Lost forever. The phrase "disappear into thin air" means to vanish suddenly and completely without leaving any trace, so the correct option is (a) Lost forever, as it conveys the idea of something being gone without any possibility of finding it again.

45. (a) The idiom "put the screws on" means to put pressure on someone in order to force them to do something. The correct answer is (a) "Forcing someone to do what you want." The expression comes from the idea of using screws to tighten or apply pressure to something, and is often used to describe a situation where someone is being coerced or threatened in order to get them to comply with someone else's wishes.

46. (c) The correct answer is (c) Avoid taking sides. "Sit on the fence" is an idiom which means to remain neutral or undecided in a dispute or conflict, and not to take any side.

47. (d) The most appropriate answer is (d) A clever person.

48. (b) Keep moving from one place to another. The phrase "from pillar to post" is often used to describe someone who is being sent from one place to another, usually without making any real progress.

49. (a) Very complicated system or machine for doing a simple task. The phrase "Heath Robinson" comes from the name of a British cartoonist and illustrator, William Heath Robinson, known for his drawings of absurdly complex contraptions made from everyday objects to achieve simple tasks.

50. (d) The correct answer is (d) Very close friends who are looked upon with suspicion. "As thick as thieves" means to have a very close friendship that is often viewed with suspicion by others because of their secretive or conspiratorial behavior.

51. (d) The correct answer is $W_1=10$kg and $W_2=10$kg. both are equal in manner.

52. (b) $R = 18$m

53. (b) In this case
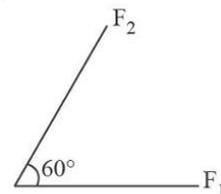
$$f_2 = \left(1 - \frac{a}{g}\right)f_1$$

54. (c) When the valve is opened both containers have equal amount of liquid in equilibrium. If the initial potential energy of liquid is P_1 and the final potential energy is P_2 then

$$P_1 = 2P_2.$$

55. (a) If a particle is moving in a circle of radius R with a constant speed v. Its average acceleration over the time when it moves half the circle

$$= \frac{v_2}{R}$$

56. (a)

We know that the resultant forces of two vectors can be given as:

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1 F_2 \cos\theta}$$
$$= \sqrt{5^2 + 5^2 + 2 \times 5 \times 5 \cos\theta}$$
$$= \sqrt{25 + 25 + 2 \times 5 \times 5 \times \frac{1}{2}}$$
$$= \sqrt{25 + 25 + 5^2}$$
$$= \sqrt{25 + 25 + 25}$$
$$= \sqrt{75}$$
$$= 8.6N$$

57. (b) Igneous rock or magmatic rock are formed through the cooling and solidification of magma or lava. Solidification into rock occurs either below the surface as intrusive rocks or on the surface as extrusive rocks. Example of Igneous rocks are Basalt, Dunite, Gabbro, Granite, Pegmatite etc. Hence slate is not an igneous rock.

58. (b) The correct answer is options (b), i.e. velocity of earthquake waves is higher in denser materials. P waves move faster and are the first to arrive at the surface of the earth.

59. (b) In terms of geological time scale, the quaternary period consists of two epochs : they are Holocene and Pleistocene.

60. (c) The correct sequence of arrangement of the given planets in descending order in their density in gm/cm³ are Earth > Venus > Jupiter > Saturn. Hence option (c) is the correct answer.

61. (b) According to the given option Eastern Australian current is not a Cold Current. It is a warm current which is formed from South Equatorial Current and reaching the Coast of Australia. Hence option (b) is the correct answer.

62. (a) Podsolization is a dominant soil forming process with leaching iron from soil layers. It usually occurs under forest or health vegetation. There soil is acidic with low humid humus and it is mainly found in Assam, Darjeeling, Uttarakhand, Himachal Pradesh in India.

63. (c) 'Keen Sword 23' is conducted between USA and Japan. It is a joint and bi-lateral fields training exercise. It is a combined capabilities and developed between III Marine Expeditionary force and The Japan self-defence force. Hence the correct option is (c).

64. (c) The Battle of Rezang La, an epic battle in hostile conditions was fought by the Indian Army in 1962, the Charlie Company of 13 Kumaon battalion. Kumaon Regiment fought Chinese attack at Rezang la Pass in Ladakh, hence the correct option is (c).

65. (a) Exercise Sea Vigil-22 took place along 7,516 km coastline of the country and Exclusive Economic Zone of the country. Its aim is to assess India's preparedness in the domain of maritime security and coastal defence.

66. (b) The correct answer is option (b). Virat Kohli is the only player to be adjudged as a player of the series in the ICC T-20 World Cup. England won ICC T-20 World Cup once.

67. (b) According to given option the correct answer is Benjamin List. Carolyn R. Bertozzi won nobel prize for Chemistry in 2022. Also Morten Meldal, K. Barry won nobel prize for Chemistry or in the field of Chemistry.

68. (c) Cell wall surrounds the plasma membrane of plant cells and it lacks in animals. It is the outermost covering of plant cell; provides tensile strength and protection against mechanical and osmotic stress.

69. (c) Prokaryotic cell are single celled microorganisms which includes bacteria and Archeas. It is single membrane encased by cell wall. Hence nucleus is absent in Prokaryotic Cell.

70. (c) In plant Cell, Mitochondria and Chloroplast contains their own DNA. Plant Cell are eukaryotic cells that vary in several fundamental factors. They have a membrane bound nucleus and organelles. Plants cell walls composed of Cellulose Chloroplasts contain the Pigment Chlorophyll to absorb light energy.

71. (d) The correct answer is more variation in offspring. It helps species to survive over long evolutionary time. Hence they are less likely to be affected by various diseases.

72. (a) The correct answer is cell wall. It is composed of a network of cellulose microfibrils. Its surrounds the plasma membrane of plant cell. Cell wall is outermost covering of a plant cell. It provides structural support, protection against infections.

73. (c) Browning of the chopped apple can be minimized by using lemon juice, orange and pineapple juice.

74. (b) The correct answer is option (b). Hydrocarbon is arranged as per the increasing order of their boiling points by Propone, Butane, Pentane, Octane.

75. (c) Separating funnel apparatus is used for separating benzene and water mixture. Separation funnel is made of glass which is used to separate two liquids.

76. (d) An iron nail dipped in copper sulphate solution turns brown. This is due to displacement reaction. A chemical reaction in which a more reactive element displaces a less reactive element from its compounds is called a displacement reaction.

77. (c) According to given options, keeping in plastic vessel is not the correct method for keeping the curd. Rest options are correct.

78. (a) Toothpaste prevents tooth decay by neutralizing the excess acidity. Toothpaste are basic in nature. Fluoride is the most effective caries inhabiting agent, it helps to prevent cavity.

79. (b) Quit India Movement is the correct answer. Kanaklata Barua, also called Birbala and Shaheed was an Indian Independence activist. She was shot dead by the Britishers while leading a procession bearing the National Flag during Quit Indian Movements in 1942.

80. (c) Positions and Salary of Mansabdari were indicated by a numerical designation Called Zat. Mansabdari systems was the administrative system introduced by Akbar during 1571. It is the system of ranking the government officials which determines their civil and military duties.

81. (c) The correct answer is Warren Hastings, the first Governor General of Bengal presidency. He was impeached in the year 1787 on the charge of administrative excess.

82. (a) Harishena composed the 'Prayag Prashasti' of Samudragupta. It is the pillar inscription found at Allahabad

which is written in sanskrit. Harishena was a Court poet of King Samudragupta. Prayag Prashasti also known as Allahabad Prashasti. It is the source to know about the Political History of Guptas.

83. (b) Vijayanagara Kingdom was founded by two brothers Harihar and Bukka. It is named after its Capital City of Vijayanagara. The first dynasty of Vijayanagar is known as Sangama. The most famous King of empire was Krishnadeva Raya.

84. (d) Tranquebar is the correct answer. This was the place where Danes establish their settlement in India. Hence the correct option is (d).

85. (c) The ratio between B'C' and A'D' is 1/2
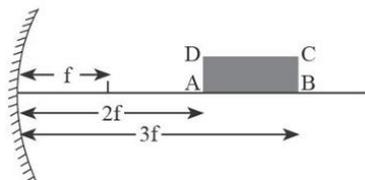
86. (c) The new reflected ray is at an angle α from the original reflected ray is $\alpha = 20$
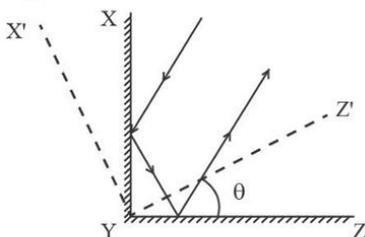
87. (c) The correct answer is $M_1 V_1 = M_2 V_2$.

88. (d) The correct answer is sound comes from a vibrating column of air inside as well as outside the flute. Sounds is one of the form of energy. Sound is mechanical wave so it travels through material medium.

89. (d) A positive charge is moving towards south in a space where magnetic field is pointing in north direction. The moving charge will experience no deflecting force. The charge particle experienced force when it is moving through magnetic field. $F = q (\vec{v} \times \vec{B})$, here q is charge particle,

B is the magnetic field , V is perpendicular velocity.

90. (b) Oxygen and Nitrogen is not a greenhouse gas. Greenhouse gases are carbon dioxide, methane, CFCs, ozone, water vapour. Hence according to the given option oxygen is not a greenhouse gas.

91. (c) X-ray have shorter wavelength of the electromagnetic spectrum. It can travel in vacuum. So, according to given options, due to their wavelengths being shorter, these can be used for radar systems is not true. X-rays was discovered by Wilhelm Conrad Roentgen.

92. (a) According to the given options in following questions the northernmost geographical location is New Delhi. However India's Northernmost point is Indira Col in J&K and Southernmost point is Indira Point at Great Nicobar.

93. (d) All three options are correct according to given statements. Hence lines of longitude also called meridian Hipparchus, a greek astronomer was the first to specify location using longitude and latitude as co-ordinates.

94. (a) The correct answer is Madhya Pradesh. It is a leading producer of manganese in India. Manganese is used to produce bleaching powder, paints, insecticides. Odisha has the highest reserve of manganese ore.

95. (d) Micas is mainly used in electrical and electronic industries. Mica deposits are found in the northern edge of the Chota Nagpur Plateau. Nellore in Andhra Pradesh is also an important mica producer in the country.

96. (b) According to Koppen's climate classifications the Northern plains of India have CWG climate. This type of climate is found in Northern Ganga plains. In this summer temperature rises to 40°C and in winter it falls to 27°C. Hence option (b) is the correct answer.

97. (a) According to the given statement all there options are correct about Lachit Borphukan. He was an Ahom commander known for his Leadership in the Battle Saraighat. On 24 November each year Lachit Day is celebrated in Assam to

commemorate the heroism of Borphukan and the victory of Assamese army at the Battle of Saraighat.

98. (c) The 4th edition of Joint military exercise "DUSTLIK" between Indian Army and Uzbekistan Army was held in Pithoragarh from Feb 20, 2023 to March 5, 2023. It is a part of military-to-military exchange programme. Yangiarik district of Uzbekistan hosted the 3rd edition of DUSTLIK on 2022.

99. (d) ISRO launched Vikram-S Rocket at Sriharikota. It is India's first privately developed rocket by ISRO. Vikram-S is developed by Hydrabad based start-up Skyroot Aerospace Private Limited.

100. (b) Modhera village of Gujarat recently declared as India's first 24x7 solar powered village. Hence option (b) is the correct answer.

101. (a) Uttarakhand state was adjudged the best in the Republic Day Parade 2023. The tableau was based on the theme "Manaskhand". In 2023, Republic Day, Abdel Fattah El-sisi was the chief guest. This year theme of Republic Day was Jan Bhagidari i.e. Participation of the Common People.

102. (a) Organisms that convert inorganic carbon dioxide into organic carbon compounds are Autotrophs. Example are Plants and Cyanobacteria. These organisms are able to produce their own source of foods and energy.

103. (a) The correct answer is $ATP + CO_2$ + Ethanol. Fermentation is the breaking down of sugar molecules into simpler compounds to produce substances that can be used in making chemical energy.

104. (b) After leaf peeling in a hypertonic solution the students examined the cells under a microscope and observed that the cells were plasmolysed. A stained epidermal leaf appeared pinkish red under microscope.

105. (c) The characteristic of fungi are they may be unicellular or filamentous. Fungi are eukaryotic, non-vascular, non-motile, heterotrophic organisms. Fungi lack chlorophyll and cannot perform photosynthesis. Hence according to the

given option, can carry out photosynthesis is not a characteristics of fungi.

106. (b) The plant body is attached to the substratum by rhizoids. Statements are correct about Bryophytes. The characteristics of Bryophytes are plants occurs in damp and shaded area. They lack true vegetative structure and have root like, stem-like structure.

107. (b) The specific purpose of using Potassium Hydroxide (KOH) during the saponification process is to obtain soaps which are soft on the skin.

108. (d) The current arrangement of the given metals in the decreasing order of their reactivity is

Sodium > Iron > Copper > Silver.

109. (d) The given statement is incorrect

110. (a) Ostwald's process is the popular method for manufacture of ammonia.

111. (d) For the manufacturing of glass, sand is widely used as a source of silica.

112. (d) The correct arrangement of halogens in the increasing order of their oxidising nature is

Br, I, Cr, F

113. (c) Water is responsible for the blue colour. Hence Copper sulphate pentahydrate turns white colour due to loss of water from blue copper sulphate. It has water which forms water vapour on heating, leaving white copper sulphate.

114. (c) Avogadro states that the equal volume of gases, when measured at the same temperature and pressure, contain an equal number of particles. Hence, option (c) is the correct answer.

115. (a) Sodium Azide into nitrogen is responsible for the given statements. Sodium azide is a fast acting chemical that appears as an odorless white solid. When mixed with acid it quickly changes to a toxic gas. Hence the electrical triggered which is charged by the car impact causes Sodium Azide to explode and convert to nitrogen gas inside the bag. So option (a) is the correct answer.

116. (a) Sylhet district of Eastern India held a referendum in 1947 to decide whether or not to join Pakistan. The Sylhet referendum was held on 6 July 1947. It is the district of Assam province of British India to decide whether the district would remain in undivided Assam and join the dominion of India or to join the dominion of Pakistan.

117. (c) Rabatak inscription written on Rock in the Bactrian language. In this inscription we got information about Kaniska, the King of Kushana empire, also refers to Kaniska as a King of Kings and as son of god. He was the grandson of Kadphises, the founder of Kushan empire. This inscription throws the important light on Kushana Genealogy.

118. (d) *Mrichchhakatika* is a Sanskrit drama written by Shudraka in 2nd century BC: This drama is a love story of a worthy Charudatta and Vasantasena. Bhasa was a Sanskrit author known for his work Swapnavasavadatta. Kalidasa was also a Sanskrit author known for his work Abhigyan Shankuntalam, Meghaduta etc.

119. (a) Yashovarman was a ruler of Kannauj who founded the Varman dynasty of Kannauj. The information about Yashovarman is derived from Gaudavaho, a Prakrit language poem written by Vakpati. Hence, the correct answer is option (a).

**120.** (--) Option not given, correct answer will be Udayabhadra.

121. (a) M. Copernicus proved that the Earth and other planets revolve around the Sun. Earth revolves in an elliptical orbit and not circular, so when the earth moves far from Sun then winter season occurs and when it moves close to Sun it gives summer season. hence this proves earth revolve around the Sun.

122. (d) In the given case,

The force required $= 0.1 \times 10 \times 2 = 2N$

$= 2$ Newton

123. (b) The correct answer is 160W.

124. (d)
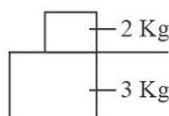
∴ Maximum value of the frictional force

$= 0.2 \times (2 + 3) \times 10$

$= 0.2 \times 50$

$= 10$ N

125. (b) Extension due to (mg) weight

$= 6$cm on earth

∴ Extension due to weight $\dfrac{mg}{6}$

$= \dfrac{6}{0} = 1$ cm

∴ 1 cm

126. (a) A pair of scissors is an example of second class lever.

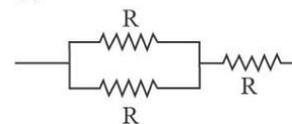**127.** (a) $R \propto \dfrac{l}{A} \propto \dfrac{\text{Length}}{\text{Area}}$

(Current) $I = \dfrac{V}{R}$

(R : Resistance, V = volt)

∴If length = double

$R = 2R$

and $I = \dfrac{I}{2}$

128. (c)

$=$

$=\ \dfrac{1}{2}R + R = \dfrac{3R}{2}$

129.(c) Bharatmala Pariyojana includes the development of Coastal Roads and improvement in the efficiency of National Corridors.

130. (c) Deendayal Port was earlier known as Kandla Port. It was renamed in 2017 under the Indian Port Act, 1908. This port was constructed in the 1950s. Deendayal Port is given the name of Pandit Deendayal Upadhaya who stood for poor section of society.

131. (b) The Counter Insurgency and Jungle Warfare School of Indian Army is situated at Vairengte, Mizoram. It was established in 1967. It is a centre of quality training for conduct of counter insurgency and counter terrorist operations.

132. (a) The correct answer is calcification. A soil process in which the surface soil is supplied with calcium in such a way that the soil collide are always close to saturation. Hence, it is the process of precipitation and accumulation of calcium carbonate. Core is about 3500 km in radius.

133. (d) Core is the innermost part of the earth. A solid inner core surrounded by a liquid outercore, separated by what has come to be known as Lehmann continuity.
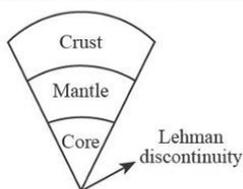
134. (d) Oak and Rhododendron found in Himalaya, according to given option. Himalayan tree has medicinal use. The current tree which came in endangered by IUCN is Himalayan yan yew. Other trees found in this region are Barch tree, Chir tree, etc.

135. (-) Intrusive Igneous rock are called plutonic. Examples of intrusive igneous rocks are diorite, gabbro, granite, peridotites, etc. These rocks are those rocks that are formed from the magma beneath the surface of the earth, also formed with the cooling of molten rock to a solid state. It leads to formation of various features such as sills, dikes, etc.

136. (a) 6.30 AM is the correct answer, if it is 12 noon in Delhi, then in London time will be 6.30 AM at the same time due to Indian Standard Time is ahead of GMT by 5.30 hours.

137. (c) Both one and two option is correct i.e., SYZYGY Conjunction, SYZYGY Opposition. Conjunction is a time during new moon when the sun and the moon lie on the same side of the earth. While SYZYGY opposition occurs during full moon when sun and moon are on opposite sides.

138. (d) The correct answer is Leonardo da Vinci. He is best known as an artist, scientist which make him true Renaissance man. The two best work of his was 'The Monalisa' and 'The Last Supper' work Leonardo's painting, drawing of the vitruvian man is also iconic. Hence, option (d) is the correct answer.

139. (d) The correct answer is Hernán Cortés, a Spanish hero known for conquering the Aztecs and claiming Mexico on behalf of Spain. Full name Hernán Cortés de Monroy y Pizarro Altamirano, Marquis of valley of Oxaca. Hence, the correct option is (d).

140. (d) Mathura is the correct answer, Kushanas are considered one of the Yuezhi tribe, they were known as Guishuang in Chinese sources. 'Kujula Kadphises was the first who lay the foundation of Kushanas empire in India. Kaniska was the great Kushana King, son of Vim Kadpasis. His main capital was Peshawar (Pushupurao). Kanishka convened the fourth Buddhist council at Kundalvana in Kashmir.

141. (a) The treaty of Yandabo ended the First Anglo-Burmese war. Treaty was signed on 24 February 1826. By this treaty Burmese agreed to cede to the Britishers – Assam, Manipur, Aratan, Tenesserim, coast south of Salween river. This treaty was formed in favour of Britishers and it came an end to "Maanar Din" in Assam.

142. (a) Plan allocations in agriculture and irrigation as percentage of total plan outlay was highest in Seventh Five Year Plan. This plan led stress on improving the production level of industries by upgrading technology. This plan was the first plan with the motto: food, work and productivity. Main moto to establish growth in areas of increasing economic productivity, food grains, generating employment.

143. (c) The UN COP-27 Summit relates to climate change. United Nations Framework Convention Climate Change (COP-27) took place in Egyptian coastal city of Sharm el-Sheikh, concluded with to establish and operationalize a loss and damage fund. The main objective is to stabilize greenhouse gas concentration.

144. (c) The correct answer is Singphos. This tribe is famous for tea cultivation in Assam. Assam State is the largest tea-growing region in India. Here variety of black tea which is grown in Brahmaputra Valley in north-east region. Assam tea is specially rich in amber colour, indigenous. The most famous variety is Camillia Sinensis Assamica.

145. (a) The correct answer is The Constitution (42nd Amendment, Act). Fundamental duties inserted in 42nd Amendment Act 1976 also this amendment added 51A in the Constitution. Fundamental Duties inspired by USSR constitutions and added IVA as a separate part in Constitution. Also 42nd Amendment Act also added words "Preamble" in Constitution.

146. (a) The correct answer is the force of gravity of the earth on the moon is greater than the force of gravity of the moon on earth. Hence option (a) is the correct one.

147. (c) 220 V— 80 W

$$\therefore \quad 1 V \quad — \quad \frac{80}{220} W$$

$$\therefore \quad 110 V = \frac{80}{220} \times 110$$

$$= 40 W.$$

148. (a) The correct is Red light deviates the most because red light has highest speed in Prism. Violet colour has shortest wavelength and less speed whereas red colour has longest wavelength and more speed, due to this red colour has least deviate.

149. (a) The speed of sound remain same for all frequencies in a given medium under the same physical conditions. Hence, the correct answer is option (a).

150. (c) Newtonian telescope is the correct answer. It is composed of primary mirror, which is mostly parabolic in shape and a smaller flat secondary mirror. Telescope using mirrors is called reflecting telescope. It helps astronomers to see more clearly far away objects in space.