2021-I NDA/NA Solved Paper

Paper I: Mathematics

1. The smallest positive integer n for which $\left(\frac{1-i}{1+i}\right)^{n^2} = 1$ where $i = \sqrt{-1}$, is

(*a*) 2 (*b*) 4 (*c*) 6 (*d*) 8

2. The value of x, satisfying the equation $\log_{\cos x} \sin x = 1$, where $0 < x < \frac{\pi}{2}$, is

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

3. If Δ is the value of the determinant $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$, then what is the value of the following determinant?

$$\begin{vmatrix} pa_1 & b_1 & qc_1 \\ pa_2 & b_2 & qc_2 \\ pa_3 & b_3 & qc_3 \end{vmatrix}$$

$(p \neq 0 \text{ or } 1, q \neq 0 \text{ or } 1)$

(*a*) $p\Delta$ (*b*) $q\Delta$ (*c*) $(p+q)\Delta$ (*d*) $pq\Delta$

4. If $C_0, C_1, C_2, ..., C_n$ are the coefficients in the expansion of $(1+x)^n$, then what is the value of ${}^nC_1 + {}^nC_2 + {}^nC_3 + ... {}^nC_n$?

(*a*) 2^n (*b*) $2^n - 1$

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

5. If $a + b + c = 4$ and $ab + bc + ca = 0$, then what is the value of the following determinant?

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$$

(*a*) 32 (*b*) –64

(*c*) –128 (*d*) 64

6. The number of integer values of k, for which the equation $2 \sin x = 2k + 1$ has a solution, is

(*a*) zero (*b*) one (*c*) two (*d*) four

7. If $a_1, a_2, a_3, ..., a_9$ are in GP, then what is the value of the following determinant?

$$\begin{vmatrix} \ln a_1 & \ln a_2 & \ln a_3 \\ \ln a_4 & \ln a_5 & \ln a_6 \\ \ln a_7 & \ln a_8 & \ln a_9 \end{vmatrix}$$

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

8. If the roots of the quadratic equation $x^2 + 2x + k = 0$ are real, then

(*a*) $k < 0$ (*b*) $k \leq 0$

(*c*) $k < 1$ (*d*) $k \leq 1$

9. If $n = 100!$, then what is the value of the following?

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + ... + \frac{1}{\log_{100} n}$$

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

10. If $z = 1 + i$, where $i = \sqrt{-1}$, then what is the modulus of $z + \frac{2}{z}$?

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

11. If A and B are two matrices such that AB is of order $n \times n$, then which one of the following is correct?

(*a*) A and B should be square matrices of same order

(*b*) Either A or B should be a square matrix

(*c*) Both A and B should be of same order

(*d*) Orders of A and B need not be the same

12. How many matrices of different orders are possible with elements comprising all prime numbers less than 30?

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

13. Let, $A = \begin{vmatrix} p & q \\ r & s \end{vmatrix}$ where p, q, r and s are any four different prime numbers less than 20. What is the maximum value of the determinant?

(*a*) 215 (*b*) 311 (*c*) 317 (*d*) 323

14. If A and B are square matrices of order 2 such that $\det(AB) = \det(BA)$, then which one of the following is correct?

(*a*) A must be a unit matrix

(*b*) B must be a unit matrix

(*c*) Both A and B must be unit matrices

(*d*) A and B need not be unit matrices

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15. What is $\cot 2x \cot 4x - \cot 4x \cot 6x - \cot 6x \cot 2x$ equal to?
(a) –1 (b) 0 (c) 1 (d) 2

16. If $\tan x = -\frac{3}{4}$ and x is in the second quadrant, then what is the value of $\sin x.\cos x$?
(a) $\frac{6}{25}$ (b) $\frac{12}{25}$ (c) $-\frac{6}{25}$ (d) $-\frac{12}{25}$

17. What is the value of the following?
$\operatorname{cosec}\left(\frac{7\pi}{6}\right)\sec\left(\frac{5\pi}{3}\right)$
(a) $\frac{4}{3}$ (b) 4 (c) –4 (d) $-\frac{4}{\sqrt{3}}$

18. If the determinant $\begin{vmatrix} x & 1 & 3 \\ 0 & 0 & 1 \\ 1 & x & 4 \end{vmatrix} = 0$ then what is x equal to?
(a) –2 or 2 (b) –3 or 3 (c) –1 or 1 (d) 3 or 4

19. What is the value of the following?
$\tan 31° \tan 33° \tan 35° \ldots \tan 57° \tan 59°$
(a) –1 (b) 0 (c) 1 (d) 2

20. If $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & x(x+1) \\ 3x(x-1) & x(x-1)(x-2) & x(x+1)(x-1) \end{vmatrix}$
then what is $f(-1) + f(0) + f(1)$ equal to?
(a) 0 (b) 1 (c) 100 (d) –100

21. The equation $\sin^{-1} x - \cos^{-1} x = \frac{\pi}{6}$ has
(a) no solution
(b) unique solution
(c) two solutions
(d) infinite number of solutions

22. What is the value of the following?
$(\sin 24° + \cos 66°)(\sin 24° - \cos 66°)$
(a) –1 (b) 0 (c) 1 (d) 2

23. A chord subtends an angle 120° at the centre of a unit circle. What is the length of the chord?
(a) $\sqrt{2}$ – 1 units (b) $\sqrt{3}$ – 1 units
(c) $\sqrt{2}$ units (d) $\sqrt{3}$ units

24. What is $(1 + \cot\theta - \operatorname{cosec}\theta)(1 + \tan\theta + \sec\theta)$ equal to?
(a) 1 (b) 2 (c) 3 (d) 4

25. What is $\frac{1+\tan^2\theta}{1+\cot^2\theta} - \left(\frac{1-\tan\theta}{1-\cot\theta}\right)^2$ equal to?
(a) 0 (b) 1 (c) $2\tan\theta$ (d) $2\cot\theta$

26. What is the interior angle of a regular octagon of side length 2 cm?
(a) $\frac{\pi}{2}$ (b) $\frac{3\pi}{4}$ (c) $\frac{3\pi}{5}$ (d) $\frac{3\pi}{8}$

27. If $7\sin\theta + 24\cos\theta = 25$, then what is the value of $(\sin\theta + \cos\theta)$?
(a) 1 (b) $\frac{26}{25}$ (c) $\frac{6}{5}$ (d) $\frac{31}{25}$

28. A ladder 6 m long reaches a point 6 m below the top of a vertical flagstaff. From the foot of the ladder, the elevation of the top of the flagstaff is 75°. What is the height of the flagstaff?
(a) 12 m (b) 9 m
(c) $(6+\sqrt{3})$m (d) $(6+3\sqrt{3})$m

29. The shadow of a tower is found to be x metre longer, when the angle of elevation of the sun changes from 60° to 45°. If the height of the tower is $5(3+\sqrt{3})$m, then what is x equal to?
(a) 8 m (b) 10 m (c) 12 m (d) 15 m

30. If $3\cos\theta = 4\sin\theta$, then what is the value of $\tan(45° + \theta)$?
(a) 10 (b) 7 (c) $\frac{7}{2}$ (d) $\frac{7}{4}$

31. $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$ holds, when
(a) $x \in R$ (b) $x \in R - (-1, 1)$ only
(c) $x \in R - \{0\}$ only (d) $x \in R - [-1, 1]$ only

32. If $\tan A = \frac{1}{7}$, then what is $\cos 2A$ equal to?
(a) $\frac{24}{25}$ (b) $\frac{18}{25}$ (c) $\frac{12}{25}$ (d) $\frac{6}{25}$

33. The sides of a triangle are m, n and $\sqrt{m^2+n^2+mn}$. What is the sum of the acute angles of the triangle?
(a) 45° (b) 60° (c) 75° (d) 90°

34. What is the area of the triangle ABC with sides a = 10 cm, c = 4 cm and angle B = 30°?
(a) 16 cm^2 (b) 12 cm^2
(c) 10 cm^2 (d) 8 cm^2

35. Consider the following statements
1. $A = \{1, 3, 5\}$ and $B = \{2, 4, 7\}$ are equivalent sets.
2. $A = \{1, 5, 9\}$ and $B = \{1, 5, 5, 9, 9\}$ are equal sets.
Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

36. Consider the following statements
1. The null set is a subset of every set.
2. Every set is a subset of itself.
3. If a set has 10 elements, then its power set will have 1024 elements.
Which of the above statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

37. Let R be a relation defined as xRy if and only if $2x + 3y = 20$, where $x, y \in N$. How many elements of the form (x, y) are there in R?
(a) 2 (b) 3 (c) 4 (d) 6

38. Consider the following statements
1. A function $f: Z \to Z$, defined by $f(x) = x + 1$, is one-one as well as onto.
2. A function $f: N \to N$, defined by $f(x) = x + 1$, is one-one but not onto.
Which of the above statement(s) is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

39. Consider the following in respect of a complex number z.

1. $\overline{(z^{-1})} = (\overline{z})^{-1}$
2. $zz^{-1} = |z|^2$

Which of the above is/are correct?

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

40. Consider the following statements in respect of an arbitrary complex number z.

1. The difference of z and its conjugate is an imaginary number.
2. The sum of z and its conjugate is a real number.

Which of the above statement(s) is/are correct?

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

41. What is the modulus of the complex number $i^{2n+1}(-i)^{2n-1}$, where $n \in N$ and $i = \sqrt{-1}$?

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

42. If α and β are the roots of the equation $4x^2 + 2x - 1 = 0$, then which one of the following is correct?

(*a*) $\beta = -2\alpha^2 - 2\alpha$
(*b*) $\beta = 4\alpha^2 - 3\alpha$
(*c*) $\beta = \alpha^2 - 3\alpha$
(*d*) $\beta = -2\alpha^2 + 2\alpha$

43. If one root of $5x^2 + 26x + k = 0$ is reciprocal of the other, then what is the value of k?

(*a*) 2 (*b*) 3 (*c*) 5 (*d*) 8

44. In how many ways can a team of 5 players be selected from 8 players so as not to include a particular player?

(*a*) 42 (*b*) 35 (*c*) 21 (*d*) 20

45. What is the coefficient of the middle term in the expansion of $(1 + 4x + 4x^2)^5$?

(*a*) 8064 (*b*) 4032 (*c*) 2016 (*d*) 1008

46. What is $C(n, 1) + C(n, 2) + ... + C(n, n)$ equal to?

(*a*) $2 + 2^2 + 2^3 + ... + 2^n$
(*b*) $1 + 2 + 2^2 + 2^3 + ... + 2^n$
(*c*) $1 + 2 + 2^2 + 2^3 + ... 2^{n-1}$
(*d*) $2 + 2^2 + 2^3 + ... + 2^{n-1}$

47. What is the sum of the coefficients of first and last terms in the expansion of $(1 + x)^{2n}$, where n is a natural number?

(*a*) 1 (*b*) 2 (*c*) n (*d*) $2n$

48. If the first term of an AP is 2 and the sum of the first five terms is equal to one-fourth of the sum of the next five terms, then what is the sum of the first ten terms?

(*a*) –500 (*b*) – 250
(*c*) 500 (*d*) 250

49. Consider the following statements:

1. If each term of a GP is multiplied by same non-zero number, then the resulting sequence is also a GP.
2. If each term of a GP is divided by same non-zero number, then the resulting sequence is also a GP.

Which of the above statements is/are correct?

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

50. How many 5-digit prime numbers can be formed using the digits 1, 2, 3, 4, 5 if the repetition of digits is not allowed?

(*a*) 5 (*b*) 4 (*c*) 3 (*d*) 0

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

(*a*) $x^2 - 5x + 4$
(*b*) $x^2 - 5x + 6$
(*c*) $x^2 + 3x + 3$
(*d*) $x^2 - 3x + 1$

52. If x^2, x, –8 are in AP, then which one of the following is correct?

(*a*) $x \in \{-2\}$ (*b*) $x \in \{4\}$
(*c*) $x \in \{-2, 4\}$ (*d*) $x \in \{-4, 2\}$

53. The third term of a GP is 3. What is the product of its first five terms?

(*a*) 81
(*b*) 243
(*c*) 729
(*d*) Cannot be determined due to insufficient data

54. The element in the ith row and the jth column of a determinant of third order is equal to $2(i + j)$. What is the value of the determinant?

(*a*) 0 (*b*) 2 (*c*) 4 (*d*) 6

55. With the numbers 2, 4, 6, 8, all the possible determinants with these four different elements are constructed. What is the sum of the values of all such determinants?

(*a*) 128 (*b*) 64 (*c*) 32 (*d*) 0

56. What is the radius of the circle $4x^2 + 4y^2 - 20x + 12y - 15 = 0$?

(*a*) 14 units (*b*) 10.5 units
(*c*) 7 units (*d*) 3.5 units

57. A parallelogram has three consecutive vertices (–3, 4), (0, –4) and (5, 2). The fourth vertex is

(*a*) (2, 10) (*b*) (2, 9) (*c*) (3, 9) (*d*) (4, 10)

58. If the lines $y + px = 1$ and $y - qx = 2$ are perpendicular, then which one of the following is correct?

(*a*) $pq + 1 = 0$ (*b*) $p + q + 1 = 0$
(*c*) $pq - 1 = 0$ (*d*) $p - q + 1 = 0$

59. If A, B and C are in AP, then the straight line $Ax + 2By + C = 0$ will always pass through a fixed point. The fixed point is

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

60. If the image of the point (–4, 2) by a line mirror is (4, –2), then what is the equation of the line mirror?

(*a*) $y = x$ (*b*) $y = 2x$ (*c*) $4y = x$ (*d*) $y = 4x$

61. Consider the following statements in respect of the points $(p, p - 3)$, $(q + 3, q)$ and (6, 3)

1. The points lie on a straight line.
2. The points always lie in the first quadrant only for any value of p and q.

Which of the above statement(s) is/are correct?

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

62. What is the acute angle between the lines $x - 2 = 0$ and $\sqrt{3}x - y - 2 = 0$?

(*a*) 0° (*b*) 30° (*c*) 45° (*d*) 60°

63. The point of intersection of diagonals of a square ABCD is at the origin and one of its vertices is at $A(4, 2)$. What is the equation of the diagonal BD?

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

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

64. If any point on a hyperbola is $(3\tan\theta, 2\sec\theta)$, then what is the eccentricity of the hyperbola?

(*a*) $\frac{3}{2}$ (*b*) $\frac{5}{2}$ (*c*) $\frac{\sqrt{11}}{2}$ (*d*) $\frac{\sqrt{13}}{2}$

65. Consider the following with regard to eccentricity (e) of a conic section

1. $e = 0$ for circle
2. $e = 1$ for parabola
3. $e < 1$ for ellipse

Which of the above are correct?

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

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

66. What is the angle between the two lines having direction ratios <6, 3, 6> and <3, 3, 0>?

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

67. If l, m, n are the direction cosines of the line $x - 1 = 2(y + 3) = 1 - z$, then what is $l^4 + m^4 + n^4$ equal to?

(*a*) 1 (*b*) $\frac{11}{27}$ (*c*) $\frac{13}{27}$ (*d*) 4

68. What is the projection of the line segment joining $A(1, 7, -5)$ and $B(-3, 4, -2)$ on Y-axis?

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

69. What is the number of possible values of k for which the line joining the points $(k, 1, 3)$ and $(1, -2, k + 1)$ also passes through the point $(15, 2, -4)$?

(*a*) Zero (*b*) One (*c*) Two (*d*) Infinite

70. The foot of the perpendicular drawn from the origin to the plane $x + y + z = 3$ is

(*a*) (0, 1, 2) (*b*) (0, 0, 3)

(*c*) (1, 1, 1) (*d*) (–1, 1, 3)

71. A vector $r = a\hat{i} + b\hat{j}$ is equally inclined to both x and y axes. If the magnitude of the vector is 2 units, then what are the values of a and b respectively?

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

(*c*) $\sqrt{2}, \sqrt{2}$ (*d*) 2, 2

72. Consider the following statements in respect of a vector $\vec{c} = \vec{a} + \vec{b}$, where $|\vec{a}| = |\vec{b}| \neq 0$.

I. $\vec{c}$ is perpendicular to $(\vec{a} - \vec{b})$.

II. $\vec{c}$ is perpendicular to $(\vec{a} \times \vec{b})$.

Which of the above statements is/are correct?

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

73. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}| = 4$, then which one of the following is correct?

(*a*) $\vec{a}$ and $\vec{b}$ must be unit vectors

(*b*) $\vec{a}$ must be parallel to $\vec{b}$

(*c*) $\vec{a}$ must be perpendicular to $\vec{b}$

(*d*) $\vec{a}$ must be equal to $\vec{b}$

74. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are coplanar, then what is $(2\vec{a} \times 3\vec{b}) \cdot 4\vec{c} + (5\vec{b} \times 3\vec{c}) \cdot 6\vec{a}$ equal to?

(*a*) 114 (*b*) 66 (*c*) 0 (*d*) –66

75. Consider the following statements:

I. The cross product of two unit vectors is always a unit vector.

II. The dot product of two unit vectors is always unity.

III. The magnitude of sum of two unit vectors is always greater than the magnitude of their difference.

Which of the above statements are not correct?

(*a*) I and II only (*b*) II and III only

(*c*) I and III only (*d*) I, II and III

76. If $\lim_{x \to a} \frac{a^x - x^a}{x^a - a^a} = -1$ then what is the value of a?

(*a*) –1 (*b*) 0 (*c*) 1 (*d*) 2

77. A particle starts from origin with a velocity (in m/s) given by the equation $\frac{dx}{dt} = x + 1$. The time (in second) taken by the particle to traverse a distance of 24 m is

(*a*) ln24 (*b*) ln5 (*c*) 2ln5 (*d*) 2ln4

78. What is $\int_0^a \frac{f(a-x)}{f(x) + f(a-x)} dx$ equal to?

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

79. What is $\lim_{x \to -1} \frac{x^3 + x^2}{x^2 + 3x + 2}$ equal to?

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

80. If $\int_0^a [f(x) + f(-x)] dx = \int_{-a}^a g(x) dx$ then what is $g(x)$ equal to?

(*a*) $f(x)$ (*b*) $f(-x) + f(x)$

(*c*) $-f(x)$ (*d*) None of these

81. What is the area bounded by $y = \sqrt{16 - x^2}, y \geq 0$ and the X-axis?

(*a*) 16π sq. units (*b*) 8π sq. units

(*c*) 4π sq. units (*d*) 2π sq. units

82. The curve $y = -x^3 + 3x^2 + 2x - 27$ has the maximum slope at

(*a*) $x = -1$ (*b*) $x = 0$ (*c*) $x = 1$ (*d*) $x = 2$

83. A 24 cm long wire is bent to form a triangle with one of the angles as 60°. What is the altitude of the triangle having the greatest possible area?

(*a*) $4\sqrt{3}$ *cm* (*b*) $2\sqrt{3}$ cm

(*c*) 6 cm (*d*) 3 cm

84. If $f(x) = e^{|x|}$, then which one of the following is correct?

(*a*) $f'(0) = 1$ (*b*) $f'(0) = -1$

(*c*) $f'(0) = 0$ (*d*) $f'(0)$ does not exist

85. What is $\int \frac{dx}{\sec x + \tan x}$ equal to?

(*a*) $\ln(\sec x) + \ln|\sec x + \tan x| + c$
(*b*) $\ln(\sec x) - \ln|\sec x + \tan x| + c$
(*c*) $\sec x \tan x - \ln|\sec x - \tan x| + c$
(*d*) $\ln|\sec x + \tan x| - \ln|\sec x| + c$

86. What is $\int \frac{dx}{\sec^2(\tan^{-1} x)}$ equal to?

(*a*) $\sin^{-1} x + c$ (*b*) $\tan^{-1} x + c$
(*c*) $\sec^{-1} x + c$ (*d*) $\cos^{-1} x + c$

87. If $x + y = 20$ and $P = xy$, then what is the maximum value of P?

(*a*) 100 (*b*) 96 (*c*) 84 (*d*) 50

88. What is the derivative of $\sin(\ln x) + \cos(\ln x)$ with respect to x at $x = e$?

(*a*) $\frac{\cos 1 - \sin 1}{e}$ (*b*) $\frac{\sin 1 - \cos 1}{e}$
(*c*) $\frac{\cos 1 + \sin 1}{e}$ (*d*) 0

89. If $x = e^t \cos t$ and $y = e^t \sin t$, then what is $\frac{dx}{dy}$ at $t = 0$ equal to?

(*a*) 0 (*b*) 1 (*c*) $2e$ (*d*) -1

90. What is the maximum value of $\sin 2x.\cos 2x$?

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

91. What is the derivative of e^x with respect to x^e?

(*a*) $\frac{xe^x}{ex^e}$ (*b*) $\frac{e^x}{x^e}$
(*c*) $\frac{xe^x}{x^e}$ (*d*) $\frac{e^x}{ex^e}$

92. If a differentiable function $f(x)$ satisfies $\lim_{x\to -1} \frac{f(x)+1}{x^2-1} = -\frac{3}{2}$, then what is $\lim_{x\to -1} f(x)$ equal to?

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

93. If the function $f(x) = \begin{cases} a + bx & , \quad x < 1 \\ 5 & , \quad x = 1 \\ b - ax & , \quad x > 1 \end{cases}$

is continuous, then what is the value of $(a + b)$?

(*a*) 5 (*b*) 0 (*c*) 15 (*d*) 20

94. Consider the following statements in respect of the function $f(x) = \sin x$

I. $f(x)$ increases in the interval $(0, \pi)$.

II. $f(x)$ decreases in the interval $\left(\frac{5\pi}{2}, 3\pi\right)$.

Which of the above statement is/are correct?

(*a*) I only (*b*) II only
(*c*) Both I and II (*d*) Neither I nor II

95. What is the domain of the function $f(x) = 3^x$?

(*a*) $(-\infty, \infty)$ (*b*) $(0, \infty)$
(*c*) $[0, \infty)$ (*d*) $(-\infty, \infty) - \{0\}$

96. If the general solution of a differential equation is $y^2 + 2cy - cx + c^2 = 0$, where c is an arbitrary constant, then what is the order of the differential equation?

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

97. What is the degree of the following differential equation?

$$x = \sqrt{1 + \frac{d^2y}{dx^2}}$$

(*a*) 1 (*b*) 2
(*c*) 3 (*d*) Degree is not defined

98. Which one of the following differential equations has the general solution $y = ae^x + be^{-x}$ be

(*a*) $\frac{d^2y}{dx^2} + y = 0$ (*b*) $\frac{d^2y}{dx^2} - y = 0$
(*c*) $\frac{d^2y}{dx^2} + y = 1$ (*d*) $\frac{dy}{dx} - y = 0$

99. What is the solution of the following differential equation?

$$\ln\left(\frac{dy}{dx}\right) + y = x$$

(*a*) $e^x + e^y = c$ (*b*) $e^{x+y} = c$
(*c*) $e^x - e^y = c$ (*d*) $e^{x-y} = c$

100. What is $\int e^{(2\ln x + \ln x^2)} dx$ equal to?

(*a*) $\frac{x^4}{4} + C$ (*b*) $\frac{x^3}{3} + C$
(*c*) $\frac{2x^5}{5} + C$ (*d*) $\frac{x^5}{5} + C$

101. Consider the following measures of central tendency for a set of N numbers

I. Arithmetic mean
II. Geometric mean

Which of the above uses/use all the data?

(*a*) I only (*b*) II only
(*c*) Both I and II (*d*) Neither I nor II

102. The numbers of Science, Arts and Commerce graduates working in a company are 30, 70 and 50 respectively. If these figures are represented by a pie chart, then what is the angle corresponding to Science graduates?

(*a*) 36° (*b*) 72°
(*c*) 120° (*d*) 168°

103. For a histogram based on a frequency distribution with unequal class intervals, the frequency of a class should be proportional to

(*a*) the height of the rectangle
(*b*) the area of the rectangle
(*c*) the width of the rectangle
(*d*) the perimeter of the rectangle

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104. The coefficient of correlation is independent of

(*a*) change of scale only

(*b*) change of origin only

(*c*) both change of scale and change of origin

(*d*) neither change of scale nor change of origin

105. The following table gives the frequency distribution of number of peas per pea pod of 198 pods

Number of peas	1	2	3	4	5	6	7
Frequency	4	33	76	50	26	8	1

What is the median of this distribution?

(*a*) 3 (*b*) 4

(*c*) 5 (*d*) 6

106. If M is the mean of n observations

$x_1 - k, x_2 - k, x_3 - k, \ldots x_n - k$, where k is any real number, then what is the mean of

$x_1, x_2, x_3, \ldots, x_n$?

(*a*) M (*b*) $M + k$

(*c*) $M - k$ (*d*) kM

107. What is the sum of deviations of the variate values 73, 85, 92, 105, 120 from their mean?

(*a*) –2 (*b*) –1

(*c*) 0 (*d*) 5

108. Let x be the HM and y be the GM of two positive numbers m and n. If $5x = 4y$, then which one of the following is correct?

(*a*) $5m = 4n$ (*b*) $2m = n$

(*c*) $4m = 5n$ (*d*) $m = 4n$

109. If the mean of a frequency distribution is 100 and the coefficient of variation is 45%, then what is the value of the variance?

(*a*) 2025 (*b*) 450

(*c*) 45 (*d*) 4.5

110. Let two events A and B be such that $P(A) = L$ and $P(B) = M$. Which one of the following is correct?

(*a*) $P(A|B) < \frac{L+M-1}{M}$ (*b*) $P(A|B) > \frac{L+M-1}{M}$

(*c*) $P(A|B) \geq \frac{L+M-1}{M}$ (*d*) $P(A|B) = \frac{L+M-1}{M}$

111. For which of the following sets of numbers do the mean, median and mode have the same value?

(*a*) 12, 12, 12, 12, 24 (*b*) 6, 18, 18, 18, 30

(*c*) 6, 6, 12, 30, 36 (*d*) 6, 6, 6, 12, 30

112. The mean of 12 observations is 75. If two observations are discarded, then the mean of the remaining observations is 65. What is the mean of the discarded observations?

(*a*) 250

(*b*) 125

(*c*) 120

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

113. If k is one of the roots of the equation $x(x + 1) + 1 = 0$, then what is its other root?

(*a*) 1 (*b*) $-k$

(*c*) k^2 (*d*) $-k^2$

114. The geometric mean of a set of observations is computed as 10. The geometric mean obtained when each observation x_i is replaced by $3x_i^4$ is

(*a*) 810 (*b*) 900

(*c*) 30000 (*d*) 81000

115. If $P(A \cup B) = \frac{5}{6}$, $P(A \cap B) = \frac{1}{3}$ and $P(\bar{A}) = \frac{1}{2}$, then which of the following is/are correct?

I. A and B are independent events.

II. A and B are mutually exclusive events.

Select the correct answer using the code given below.

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

116. The average of a set of 15 observations is recorded, but later it is found that for one observation, the digit in the tens place was wrongly recorded as 8 instead of 3. After correcting the observation, the average is

(*a*) reduced by $\frac{1}{3}$ (*b*) increased by $\frac{10}{3}$

(*c*) reduced by $\frac{10}{3}$ (*d*) reduced by 50

117. A coin is tossed twice. If E and F denote occurrence of head on first toss and second toss respectively, then what is $P(E \cup F)$ equal to?

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

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

118. In a binomial distribution, the mean is $\frac{2}{3}$ and variance is $\frac{5}{9}$. What is the probability that random variable $X = 2$?

(*a*) $\frac{5}{36}$ (*b*) $\frac{25}{36}$

(*c*) $\frac{25}{54}$ (*d*) $\frac{25}{216}$

119. If the mode of the scores 10, 12, 13, 15, 15, 13, 12, 10, x is 15, then what is the value of x?

(*a*) 10 (*b*) 12

(*c*) 13 (*d*) 15

120. If A and B are two events such that $P(A) = \frac{3}{4}$ and $P(B) = \frac{5}{8}$, $P(A) = \frac{3}{4}$ and $P(B) = \frac{5}{8}$, then consider the following statements

I. The minimum value of $P(A \cup B)$ is $\frac{3}{4}$.

II. The maximum value of $P(A \cap B)$ is $\frac{5}{8}$.

Which of the above statements is/are correct?

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

Paper II: General Ability

PART-A

Synonyms

Directions: Each question in this section consists of a sentence with an underlined word followed by four words. Select the option that is nearest in meaning to the underlined word and mark your answer.

1. Her smile was **contagious**.
(*a*) arrogant (*b*) disrespectful
(*c*) sarcastic (*d*) catching

2. Her **dynamic** nature impressed everyone.
(*a*) enduring (*b*) attentive
(*c*) evolutionary (*d*) jealous

3. She was **lamenting** her destiny.
(*a*) celebrating (*b*) bemoaning
(*c*) blaming (*d*) making

4. Under his leadership the company grew in an **organic** manner.
(*a*) natural (*b*) speedy
(*c*) unusual (*d*) disciplined

5. His charm lies in his **oratory**.
(*a*) deceit (*b*) eloquence (*c*) looks (*d*) nobility

6. She is a **patron** of art and culture.
(*a*) entrepreneur (*b*) admirer
(*c*) critique (*d*) backer

7. **Arrogance** is a hallmark of his nature.
(*a*) concern (*b*) unpretentiousness
(*c*) conceit (*d*) simplicity

8. She undertook a **reconnaissance** of the entire issue.
(*a*) revaluation (*b*) ratification
(*c*) investigation (*d*) regularisation

9. My daughter is my **replica**.
(*a*) pride (*b*) clone (*c*) love (*d*) original

10. The **sardonic** nature of her stories made her stand out among the contemporary writers.
(*a*) compassionate (*b*) insightful
(*c*) mocking (*d*) comic

Antonyms

Directions: Each question in this section consists of a sentence with an underlined word followed by four words. Select the option that is opposite in meaning to the underlined word and mark your answer.

11. He found her extremely **attractive** and charming.
(*a*) unnatural (*b*) modern
(*c*) repulsive (*d*) disapproving

12. The sky is **boundless**.
(*a*) high (*b*) vast
(*c*) expansive (*d*) finite

13. The sky is **clear** today.
(*a*) bright (*b*) opaque (*c*) cloudless (*d*) blue

14. I have a fascination for **deep** waters.
(*a*) dark (*b*) light
(*c*) dangerous (*d*) shallow

15. My boss has been too **generous**.
(*a*) stingy (*b*) rough (*c*) evil (*d*) hostile

16. Spring is a time of **plenty**.
(*a*) ugliness (*b*) scarcity (*c*) roughness (*d*) dryness

17. He is an **industrious** workman.
(*a*) active (*b*) productive
(*c*) lazy (*d*) disloyal

18. Plants **grow** in abundance here.
(*a*) shrivel (*b*) stretch (*c*) spread (*d*) enlarge

19. She **rarely** comes here.
(*a*) seldom (*b*) never
(*c*) always (*d*) frequently

20. She is a rather **crooked** woman.
(*a*) polite (*b*) generous
(*c*) straightforward (*d*) happy

Idioms and Phrases

Directions: Given below are some idioms/phrases followed by four alternative meanings to each. Choose the response (*a*), (*b*), (*c*) or (*d*), whichever is the most appropriate meaning and mark your answer.

21. Overstep the mark
(*a*) To tell people how successful you are
(*b*) To step into someone else's areas of expertise
(*c*) To upset someone by doing/saying more than you should
(*d*) To do something in an excited way

22. Palsy-walsy friends
(*a*) Good friends
(*b*) Friends who help each other in difficult situations
(*c*) Friends by choice and not by chance
(*d*) Unfriendly

23. Open a Pandora's box
(*a*) To do something that causes a lot of new problems that you did not expect
(*b*) To do something out of compulsion
(*c*) To do something beyond expectation
(*d*) To do something out of the box, that brings award and ceremonies for you

24. Pull your socks up
(*a*) To get well-dressed for the occasion
(*b*) Improve your work or behaviour
(*c*) To speak in an honest way without hesitation
(*d*) To be in control of an organisation, often secretly

25. To get under somebody's skin
(*a*) To deceive someone (*b*) To admire someone
(*c*) To annoy someone (*d*) To support someone

26. Turn topsy-turvy
(*a*) To completely change something
(*b*) To completely evaluate something
(*c*) To enjoy yourself greatly
(*d*) To exhaust yourself completely

27. A clarion call
(*a*) A trumpet call (*b*) An intimidating voice
(*c*) A strong request (*d*) An urgent order

28. Fire in the belly
(*a*) Fear and hatred (*b*) Powerful ambition
(*c*) Love and dedication (*d*) Lethargy and indifference

29. A hunky-dory situation
(*a*) There are serious issues among people
(*b*) There are no problems and people are happy
(*c*) There is war and bloodshed all over
(*d*) There is no work, only enjoyment

30. Give somebody a leg up
(*a*) To pull someone down
(*b*) To deceive and betray someone
(*c*) To help someone for their livelihood
(*d*) To help someone to be successful

Spotting Errors

Directions: Each question 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. If you find no error, your response should be indicated as (*d*).

31. (*a*) You don't have
(*b*) a monopoly on suffering;
(*c*) other people don't have problems too.
(*d*) No error

32. (*a*) If you say that someone
(*b*) you admire has feet of clay,
(*c*) you mean that they have hidden faults.
(*d*) No error

33. (*a*) He refused to change
(*b*) his decision;
(*c*) he refused it point out.
(*d*) No error

34. (*a*) The importance of trade in Mughal times reinforced
(*b*) the cultural definition of wealth as something
(*c*) comprising of movable property.
(*d*) No error

35. (*a*) In the nineteenth century,
(*b*) most traditional scholars
(*c*) tried to stay clear from the imperial Government.
(*d*) No error

36. (*a*) He began his discussion by pointing over
(*b*) that men and women
(*c*) had different biological functions.
(*d*) No error

37. (*a*) Though he is poor,
(*b*) but he is
(*c*) honest.
(*d*) No error

38. (*a*) My mother
(*b*) has been doing
(*c*) everything for the family.
(*d*) No error

39. (*a*) When learning to dive
(*b*) it is important
(*c*) to relax in between and take breaks.
(*d*) No error

40. (*a*) I have the opportunity
(*b*) to study
(*c*) in America next year.
(*d*) No error

Fill in the Blanks

Directions: Each of the following sentences in this section has a blank space and four words or group of words given after the sentence. Select the word or group of words you consider most appropriate for the blank space and mark your answer.

41. There was a time when West Germany was a distinct _____ .
(*a*) policy (*b*) polity
(*c*) abstract (*d*) hierarchy

42. I was _____ with the film; I had expected it to be better.
(*a*) disappointed (*b*) disappointing
(*c*) annoying (*d*) prejudiced

43. It was a _____ experience. Everybody was shocked.
(*a*) terrified (*b*) horrified
(*c*) terrifying (*d*) denouncing

44. Elephants _____ when they perceive danger.
(*a*) trumpet (*b*) frolic (*c*) whine (*d*) sing

45. The first film on Tagore was such a success that now they are going to make a _____
(*a*) serial (*b*) sequence (*c*) sequel (*d*) sequential

46. The United Nations had _____ 2020 as the International Year of Plant Health.
(*a*) ruled (*b*) ordered
(*c*) foretold (*d*) declared

47. My brother is _____ punctual, but he is late today.
(*a*) normatively (*b*) primarily
(*c*) normally (*d*) basically

48. My son is very _____; he trusts everyone.
(*a*) fallible (*b*) gullible
(*c*) sensible (*d*) credible

49. Mahatma Gandhi was a lover of humanity and a _____ believer in the goodness of human nature.
(*a*) staunch (*b*) powerful (*c*) cheerful (*d*) hopeful

50. I wish I _____ her before we met.
(*a*) know (*b*) have known
(*c*) knew (*d*) known

PART-B

51. Consider the following statements about light year.
1. Light year is a unit for measurement of very large distances.
2. Light year is a unit for measurement of very large time intervals.
3. Light year is a unit for measurement of intensity of light.

Which of the statements given above is/are correct?
(*a*) 1, 2 and 3 (*b*) 2 and 3
(*c*) 1 and 2 (*d*) Only 1

52. Which one of the following regarding density of water at atmospheric pressure is correct?
(*a*) Density of water at 4°C is 1000 kg/m^3.
(*b*) Density of water at 0°C is 1000 kg/m^3.
(*c*) Density of water at 0°C is 100 kg/m^3.
(*d*) Density of water at 4°C is 10 kg/m^3.

53. Which of the following pairs of physical phenomena and the discoverer is/are correctly matched?
1. James Chadwick : Photoelectric effect
2. Albert Einstein : Neutron
3. Marie Curie : Radium

Select the correct answer using the codes given below.

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

(*c*) 2 and 3 (*d*) Only 3

54. LED (a semiconductor device) is an abbreviation that stands for

(*a*) Licence for Energy Detector

(*b*) Light Energy Device

(*c*) Light Emitting Diode

(*d*) Lost Energy Detector

55. The statement "friction force is a contact force while magnetic force is a non-contact force" is

(*a*) always true

(*b*) true only at 0°C

(*c*) a false statement

(*d*) Either true or false depending upon the temperature of the surroundings

56. Which one of the following is the chemical formula of hypobromous acid?

(*a*) $HBrO_4$ (*b*) HOBr

(*c*) HBr (*d*) $HBrO_3$

57. The composition of gases in exosphere is

(*a*) helium and hydrogen (*b*) neon and oxygen

(*c*) neon and hydrogen (*d*) helium and neon

58. Which one of the following is not used as a raw material in the manufacture of glass?

(*a*) Soda (*b*) Alumina

(*c*) Borax (*d*) Gypsum

59. In electrolytic refining of copper, the electrolyte is a solution of

(*a*) acidified copper chloride (*b*) acidified copper sulphate

(*c*) potassium chloride (*d*) sodium sulphate

60. Solder is an alloy of

(*a*) Cu and Sn (*b*) Fe and Zn

(*c*) Pb and Sn (*d*) Ag and Zn

61. Which one of the following statements about dihydrogen (H_2) is not correct?

(*a*) H_2 is lighter than air and insoluble in water.

(*b*) H_2 is inert at room temperature due to high H—H bond dissociation enthalpy.

(*c*) H_2 reacts with alkali metals at high temperature to yield metal hydrides.

(*d*) A mixture of NO_2 and H_2 is known as Syngas.

62. Which of the following sets of elements has the same valency?

(*a*) Na, Mg, Ca (*b*) Na, Mg, Al

(*c*) Mg, Ca, K (*d*) Mg, Ca, Ba

63. Which one of the following is the lowest possible temperature?

(*a*) 0° celsius (*b*) −73° celsius

(*c*) −173° celsius (*d*) −273° celsius

64. Numerically two thermometers, one in Fahrenheit scale and another in Celsius scale shall read same at

(*a*) −40° (*b*) 0°

(*c*) −273° (*d*) 100°

65. The image we see in plane mirror is

(*a*) real and thus can be photographed

(*b*) virtual and nearer than the object

(*c*) virtual and is laterally inverted

(*d*) The real but cannot be photographed

66. Which one of the following colours may be obtained by combining green and red colours?

(*a*) Blue (*b*) Magenta

(*c*) Pink (*d*) Yellow

67. Which of the following are the primary colours of light?

(*a*) Yellow, red and green

(*b*) Blue, red and green

(*c*) Violet, red and yellow

(*d*) Indigo, violet and green

68. According to the new cartesian sign convention, which one of the following is correct in respect of the formula $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$, where symbols have their usual meanings?

(*a*) It applies only to spherical mirrors.

(*b*) It applies only to spherical lenses.

(*c*) It applies to spherical mirrors as well as spherical lenses.

(*d*) It is an invalid formula.

69. Movement of materials to different parts of cytoplasm and nucleus is generally carried out by

(*a*) Ribosomes (*b*) Mitochondria

(*c*) Lysosomes (*d*) Endoplasmic reticulum

70. In mitochondria, ATP synthesising chemical reactions take place in the

(*a*) outer membrane (*b*) matrix

(*c*) inner membrane (*d*) DNA of mitochondria

71. Squamous epithelial cells are found in the inner lining of

(*a*) oesophagus (*b*) small intestine

(*c*) ducts of salivary gland (*d*) kidney

72. Transformation of meristematic cells into specific permanent tissues occurs by the process of

(*a*) cell differentiation (*b*) cell division

(*c*) cell multiplication (*d*) cell regeneration

73. The gaseous product of a process in plants is a requirement for another vital process that releases energy. Given below are four combinations of the process and product. Identify the correct answer.

(*a*) Respiration and nitric oxide

(*b*) Transpiration and water vapour

(*c*) Photosynthesis and oxygen

(*d*) Germination and carbon dioxide

74. In a dicot pot herb, vaseline/vegetable oil was applied on the upper surface of one leaf (experimental leaf 1) and on the lower surface of another leaf (experimental leaf 2). Vaseline/Vegetable oil was not applied on the control leaf. The plant was deliberately not watered for several days. Which leaf will dry up last?

(*a*) Experimental leaf 1

(*b*) Experimental leaf 2

(*c*) Control leaf

(*d*) All the leaves will dry up simultaneously

75. Which one of the following statements is not correct for light rays?

(*a*) Light travels at different speeds in different media.

(*b*) Light travel at almost 300 million metres per second in air.

(*c*) Light speeds down as it leaves a water surface and enters the air.

(*d*) Light speeds up as it leaves a glass surface and enters the air.

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76. A glass prism splits white light into different colours. This phenomenon is called dispersion of light by prism. Which one of the following statements is correct?
(*a*) Red light will deviate the most and it is because of the reflection of light.
(*b*) Violet light will deviate the most and it is because of the refraction of light.
(*c*) Red light will deviate the most and it is because of the refraction of light.
(*d*) Violet light will deviate the most and it is because of the reflection of light.

77. A current of 1.0 A is drawn by a filament of an electric bulb for 10 minutes. The amount of electric charge that flows through the circuit is
(*a*) 0.1 C (*b*) 10 C
(*c*) 600 C (*d*) 800 C

78. Which one of the following formulae does not represent electrical power?
(*a*) I^2R (*b*) IR^2
(*c*) VI (*d*) V^2/R

79. The sound created in a big hall persists because of the repeated reflections. The phenomenon is called
(*a*) reverberation (*b*) dispersion
(*c*) refraction (*d*) diffraction

80. When light is scattered by a molecule and the frequency of the scattered light is changed, this phenomenon is called
(*a*) Rayleigh scattering (*b*) Raman effect
(*c*) Photoelectric effect (*d*) Rutherford scattering

81. Which one of the following statements about the cleansing action of soap is not true?
(*a*) The oil and dirt gets collected in the centre of the micelle.
(*b*) Soap micelle scatter light.
(*c*) Soaps are ammonium salts of long chain carboxylic acids.
(*d*) Soap forms insoluble precipitates with the calcium and magnesium ions in hard water.

82. Hydrogenation of vegetable oils using nickel catalyst is an example of
(*a*) substitution reaction
(*b*) elimination reaction
(*c*) addition reaction
(*d*) free-radical polymerisation

83. Which one of the following materials is not an allotrope of carbon?
(*a*) Diamond (*b*) Graphene
(*c*) Fly ash (*d*) Fullerene

84. Which one of the following reactions does not result in the evolution of hydrogen gas?
(*a*) Reaction of zinc metal with dilute sulphuric acid solution
(*b*) Mixing water to Plaster of Paris
(*c*) Heating zinc metal with sodium hydroxide solution
(*d*) Reaction of potassium metal with water

85. Which one of the following acids is predominantly found in tomatoes?
(*a*) Acetic acid (*b*) Tartaric acid
(*c*) Oxalic acid (*d*) Lactic acid

86. Which one of the following conclusions could not be derived from Rutherford's α-particle scattering experiment?
(*a*) Most of the space in the atom is empty.
(*b*) The radius of the atom is about 10^5 times the radius of the nucleus.
(*c*) Electrons move in a circular path of fixed energy called orbits.
(*d*) Nearly all the mass of the atom resides in the nucleus.

87. Reaction of quick lime (CaO) with water to produce slaked lime ($Ca(OH)_2$) is an example of
(*a*) displacement reaction
(*b*) endothermic reaction
(*c*) decomposition reaction
(*d*) exothermic reaction

88. Which one of the following is not a bio-mass energy source?
(*a*) Wood (*b*) Nuclear reactor
(*c*) Gobar gas (*d*) Coal

89. Twinkling of stars is due to
(*a*) particular frequencies of the starlight.
(*b*) reflection of starlight from the oceanic surface.
(*c*) atmospheric refraction of starlight.
(*d*) magnetic field of earth.

90. Which one of the following cannot be the unit of frequency of a sound wave?
(*a*) dB (*b*) s^{-1}
(*c*) Hz (*d*) min^{-1}

91. 'Beats' is a phenomenon that occurs when frequencies of two harmonic waves are
(*a*) equal (*b*) far apart
(*c*) multiples of each other (*d*) nearly same

92. Light waves are incident on an air-glass boundary. Some of the light waves are reflected and some are refracted in the glass. Which one of the following properties is the same for the incident wave and the refracted wave?
(*a*) Speed (*b*) Direction
(*c*) Brightness (*d*) Frequency

93. Which one of the following statements is true for a simple harmonic oscillator?
(*a*) Force acting is directly proportional to the displacement from the mean position and is in same direction.
(*b*) Force acting is directly proportional to the displacement from the mean position and is in opposite direction.
(*c*) Acceleration of the oscillator is constant.
(*d*) The velocity of the oscillator is not periodic.

94. During seed germination, the part of the embryo which grows into root is
(*a*) radicle (*b*) plumule
(*c*) cotyledon (*d*) epicotyl

95. In a typical flower, germinating pollen grains pass through several parts of the gynoecium before they reach the ovule. A list of the parts of gynoecium is given below in different combinations. Choose the combination that represents the correct sequence of pollen tube pathway/journey.
(*a*) Style, Stigma, Ovary
(*b*) Stigma, Style, Ovary
(*c*) Pistil, Stigma, Ovary
(*d*) Ovary, Pistil, Style

96. If human blood is placed in a 2% detergent solution, what will happen to the RBC?
(*a*) The RBC will shrink.
(*b*) The RBC will swell and become turgid.
(*c*) The RBC will swell and burst.
(*d*) The RBC will lyse.

97. The major source of vitamins and minerals for vegetarians is
(*a*) black gram and wheat
(*b*) rice and mustard
(*c*) vegetables and fruits
(*d*) soya bean and milk

98. If a ray of light enters from a rarer medium to a denser medium at zero angle of incidence, it would
(*a*) reflect back
(*b*) go straight
(*c*) turn towards right
(*d*) bend at 45º

99. Mirage is an illustration of
(*a*) only dispersion of light
(*b*) only reflection of light
(*c*) only total internal reflection of light
(*d*) both refraction and total internal reflection of light

100. Common salt (NaCl) is not used as a raw material for preparation of which one of the following compounds?
(*a*) Bleaching powder (*b*) Baking soda
(*c*) Plaster of Paris (*d*) Washing soda

101. Which one of the following Harappan sites was a specialied centre for making shell object?
(*a*) Lothal (*b*) Balakot
(*c*) Amri (*d*) Kot Diji

102. Which one of the following was not a part of the dhamma of KingAshoka?
(*a*) Honouring the king
(*b*) Tolerance of religions other than one's own
(*c*) Respecting Brahmanas
(*d*) Promoting the welfare of his subjects

103. Which of the following statements about Saguna Bhakti traditions is/are correct?
1. Saguna Bhakti traditions focus on the worship of specific deities such as Vishnu or his avatars.
2. In Saguna Bhakti traditions, Gods and Goddesses are conceptualised in anthropomorphic forms.

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

104. At which one of the following places was a Shiva temple not constructed under the patronage of the Chola rulers?
(*a*) Chidambaram
(*b*) Thanjavur
(*c*) Gangaikonda Cholapuram
(*d*) Naneghat

105. Which of the following statements about the Deccan Riots Commission is/are correct?
1. The Commission did not hold enquiries in the district which were not affected.
2. The Commission did record statements of ryots, sahukars eye-witnesses.

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

106. Which one of the following is the correct meaning of ziyarat?
(*a*) Pilgrimage to the tombs of sufi saints.
(*b*) The practice of revenue farming.
(*c*) The death anniversary of a sufi Shaikh.
(*d*) A form of Islamic divorce.

107. Keppel Island is completely bleached mainly due to the expansion of
(*a*) Starfish (*b*) Blue whale
(*c*) Octopus (*d*) Sea horse

108. Which one of the following rivers is not a tributary of river Brahmaputra?
(*a*) River Manas (*b*) River Kameng
(*c*) River Mahananda (*d*) River Subansiri

109. Which one of the following is not a minor plate?
(*a*) Cocos plate (*b*) Nazca plate
(*c*) Caroline plate (*d*) Antarctic plate

110. Advantage(s) of tectonic activity in Iceland include(s)
1. Source of natural geothermal energy
2. Creation of new land
3. Attraction of tourists

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

111. The process whereby certain minerals absorb water, expand and change is called as
(*a*) Hydration (*b*) Oxidation
(*c*) Hydrolysis (*d*) Carbonation

112. Which one of the following is the longest Latitude?
(*a*) 90 degree Latitude
(*b*) 23-5 degree Latitude
(*c*) 0·0 degree Latitude
(*d*) 66·5 degree Latitude

113. If it is 12.00 Noon in India, on which meridian will it be 7:00 am of the same day?
(*a*) 7.5 degree E. Longitude
(*b*) 7.5 degree W. Longitude
(*c*) 75 degree E. Longitude
(*d*) 75 degree W. Longitude

114. Who among the following was considered to be the preceptor of Mirabai?
(*a*) Dadu (*b*) Raidas
(*c*) Ramanand (*d*) Surdas

115. Consider the following statements about the Mahanavami Dibba
1. It was the name of a giant box of sweets distributed at the Mahanavami festival.
2. It was the name of a massive platform with a base covered with relief carvings.

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

116. Which one of the following statements about the Ain-i-Akbari is not correct?
(*a*) It was written by Abu'l Fazl.
(*b*) It is a part of a larger work called Akbar Nama.
(*c*) It describes the Mughal Empire as having a diverse population and a composite culture.
(*d*) It was later revised by Sadullah Khan on the orders of Shah Jahan.

117. Swami Dayanand Saraswati
1. was opposed to the worship of idols of Gods and Goddesses.
2. regarded the Vedas as infallible.
3. had met and had discussions with Ishwar Chandra Vidyasagar.

Which of the statements given above are correct?
(*a*) 1, 2 and 3 (*b*) 2 and 3
(*c*) 1 and 3 (*d*) 1 and 2

118. Consider the following statements.
1. Muhammadan Anglo-Oriental College was founded at Aligarh by Sayyid Ahmad Khan.
2. Sayyid Ahmad Khan was a great believer in religious toleration, and Hindus, Paris and Christians had contributed to the funds of his college.

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

119. Basket-of-eggs topography is related to
(*a*) Drumlins (*b*) Eskers
(*c*) Cirques (*d*) Moraines

120. Which one of the following planets has the highest density?
(*a*) Mercury (*b*) Venus
(*c*) Jupiter (*d*) Earth

121. Point of Origin of Earthquake wave is known as
(*a*) Epicentre (*b*) Focus
(*c*) Photosphere (*d*) Seismic Zone

122. The maximum depth of Lithosphere is found in the
(*a*) Pacific Ocean (*b*) Siberian Plain
(*c*) Patagonian Desert (*d*) Himalayan Mountains

123. A large body of magmatic material that cools in the deeper depth of the Earth's crust and develops in the form of large domes is known as
(*a*) Batholiths (*b*) Lacoliths
(*c*) Lopoliths (*d*) Phacoliths

124. Which one of the following Oil Refineries is not located in Assam?
(*a*) Tatipaka (*b*) Numaligarh
(*c*) Bongaigaon (*d*) Digboi

125. Where and when did Mahatma Gandhi make his first public appearance in India on coming back from South Africa after two decades?
(*a*) Champaran in 1917
(*b*) Lucknow in 1916
(*c*) Banaras Hindu University in 1916
(*d*) Ahmedabad in 1918

126. When and where was the demand for "Purna Swaraj" or complete independence made by the Indian National Congress?
(*a*) Bombay, 1885 (*b*) Lahore, 1929
(*c*) Kheda, 1917 (*d*) Bombay, 1942

127. Which one of the following provides for the complete equality of men and women in India?
(*a*) Articles 14 and 15 of the Constitution of India
(*b*) Fifth Schedule of the Constitution of India
(*c*) The Indian Independence Act
(*d*) Article 20 of the Constitution of India

128. Which of the following statements about the non-permanent member of the Security Council of the United Nation is/are correct?
1. Their total number is now 10 but was originally only 6.
2. They are elected for a term of two years only.

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

129. At which of the following was the American Declaration of Independence adopted on 4th July, 1776?
(*a*) Washington Conference
(*b*) San Francisco Confernee
(*c*) Second Continental Congress
(*d*) First Continental Congress

130. Who among the following was the head of the Government that was overthrown by the Bolsheviks in the 1917 Revolution?
(*a*) Alexander Kerensky (*b*) Prince Lvov
(*c*) Grand Duke Sergei (*d*) Tsar Nicholas II

131. Which one of the following is not a form of non-permanent member of the Security condensation?
(*a*) Dew (*b*) Fog
(*c*) Frost (*d*) Sleet

132. Which one of the following clouds is a rain-bearing cloud?
(*a*) Cumulus cloud (*b*) Stratus cloud
(*c*) Nimbus cloud (*d*) Cirrus cloud

133. Which one of the following countries is intensive subsistence agriculture not predominantly practised?
(*a*) India (*b*) Japan
(*c*) Canada (*d*) Indonesia

134. The Headquarters of South-Eastern Railway is located at
(*a*) Bilaspur (*b*) Secunderabad
(*c*) Kolkata (*d*) Bhubaneswar

135. Bharatmala Pariyojana is related to
(*a*) Interlinking of Northern and Southern Indian rivers in a garland shape.
(*b*) Networks of National Highways in India.
(*c*) Interlinking of all cities of India through Railways.
(*d*) Interlinking of all industrial regions of India through pipelines.

136. The natural vegetation which covers maximum geographical areas of India is
(*a*) Tropical deciduous forests (*b*) Tropical thorn forests
(*c*) Montane forests (*d*) Tropical evergreen forests

137. River Beas, flowing from Himachal Punjab, joins the river.
(*a*) Indus (*b*) Setluj
(*c*) Chenab (*d*) Ravi

138. With regard to the Constitution of India, which one of the following statements is not correct?
(*a*) The words - Socialist and Secular, were not originally part of the Constitution.
(*b*) The Preamble states the objects of the Constitution of India,
(*c*) The Preamble is enforceable in a Court of Law.
(*d*) A Republic refers to the people as the source of all authority under the Constitution.

139. Which one of the following is not a power of the Speaker of the Lok Sabha?
(*a*) Speaker shall preside over the House of the People.
(*b*) Speaker will cast vote in the first instance in the House.
(*c*) Speaker will have power to maintain order within the House of the People.
(*d*) Speaker can adjourn the House or suspend the meeting till there is a quorum.

140. Which one of the following is included in Article 51A (Part IV A) of the Constitution of India?
(*a*) Fundamental Duties
(*b*) Suspension of Fundamental Rights
(*c*) Special Powers of Governors
(*d*) Writs

141. As per the data up to November, 2020, released by the Union Finance Ministry, which one of the following countries ranks 1 in terms of ODI (Outward Direct Investment) for the year 2020 - 21?
(*a*) USA (*b*) Singapore
(*c*) Mauritius (*d*) United Kingdom

142. 'Exercise Desert Knight - 21' is a bilateral air exercise between the Indian Air Force and the Air Force of which one of the following countries?
(*a*) USA (*b*) France
(*c*) Britain (*d*) Israel

143. Tableau of which one of the following States/Union Territory was adjudged best in the Republic Day Parade, 2021?
(*a*) Ladakh (*b*) Uttar Pradesh
(*c*) Tripura (*d*) Uttarakhand

144. In the recently concluded elections in December 2020, Faustin-Archange Touadera has won a second term in office as President of one of the following countries. Identify the country.
(*a*) Central African Republic
(*b*) Republic of South Africa
(*c*) Republic of Ghana
(*d*) Republic of Mozambiqu.

145. Which one of the following statements is not correct in respect of the 'Legion of Merit' award?
(*a*) This award is conferred by the President of the United States of America.
(*b*) This award was conferred to the Prime Minister of India in December, 2020.
(*c*) This was also awarded to the Prime Minister of Australia, Scott Morrison.
(*d*) It is the highest civilian award of the United States of America.

146. Which one of the following statements is most appropriate about 'Exercise Kavach'?
(*a*) It is a military exercise of the Indian Army only.
(*b*) It is a joint military exercise involving the Indian Army and the Indian Navy only.
(*c*) It is a joint military exercise involving the Indian Army, the Indian Navy and the Indian Air Force only.
(*d*) It is a joint military exercise involving the Indian Army, the Indian Navy, the Indian Air Force and also the Indian Coast Guard.
It is a joint military exercise involving all the armed forces.

147. Recently a state of emergency has been declared in which one of the following countries?
(*a*) Maldives (*b*) Bhutan
(*c*) Nepal (*d*) Myanmar

148. Which one of the following teams is the winner of the Syed Mushtaq Ali Trophy, 2021?
(*a*) Uttar Pradesh (*b*) Punjab
(*c*) Tamil Nadu (*d*) Baroda

149. Which country has replaced Maldives to host the 2023 Indian Ocean Island Games?
(*a*) Madagascar (*b*) Sri Lanka
(*c*) India (*d*) Mauritius

150. Identify the correct reason, out of the following, about Claire Polosak for being in the news.
(*a*) She has been honoured with the Pulitzer Prize.
(*b*) She recently won a Grand Slam championship.
(*c*) She became the first female match official to conduct a men's cricket test match.
(*d*) She has been conferred with the Gandhi Peace Prize.

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ANSWER KEY

Paper I: Mathematics

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

Paper II: General Ability

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

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EXPLANATION

Paper I: Mathematics

1. (*a*) $\left(\frac{1-i}{1+i}\right)^{n^2} = 1$, where $i = \sqrt{-1}$

On multiplying numerator and denominator by $1 - i$, we get

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

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

$$\Rightarrow (-i)^{n^2} = (-i)^4 \Rightarrow n^2 = 4$$

$$\Rightarrow n = 2$$

2. (*c*) $\log_{\cos x} \sin x = 1$, where $0 < x < \frac{\pi}{2}$

$$\Rightarrow (\cos x)^1 = \sin x$$

$$\Rightarrow \cos x = \sin x$$

$$\Rightarrow \tan x = 1 \Rightarrow x = \pi/4$$

3. (*d*) $\therefore \begin{vmatrix} pa_1 & b_1 & qc_1 \\ pa_2 & b_2 & qc_2 \\ pa_3 & b_3 & qc_3 \end{vmatrix}$

$$= p \cdot q \cdot \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = pq\Delta$$

4. (*b*) $\because (1+x)^n = {}^nC_0 + {}^nC_1 x + {}^nC_2$

$x^2 + ... + {}^nC_n x^n$

On putting $x = 1$

${}^nC_1 + {}^nC_2 + ... + {}^nC_n = 2^n - {}^nC_0 = 2^n - 1$

5. (*b*) **Hint:** Expand the determinant and Solve.

6. (*c*) Given, $2 \sin x = 2k + 1$

$-1 \le \sin x \le 1$

$\Rightarrow -2 \le 2 \sin x \le 2$

$-2 - 1 \le 2 \sin x - 1 \le 2 - 1$

$\Rightarrow -3 \le 2k \le 1$

$$\frac{-3}{2} \le k \le \frac{1}{2} \Rightarrow -1.5 \le k \le 0.5$$

$\therefore$ Integer values of k are -1 and 0

7. (*a*) **Hint:** Let $a_1 = a$, $a_2 = ar$ ... $a_9 = ar^8$. Now solve the determinant.

8. (*d*) Given quadratic equation is $x^2 + 2x + k = 0$

Since, roots are real

$\Rightarrow D \ge 0$

$\Rightarrow (2)^2 - 4(1)(k) \ge 0 \Rightarrow k \le 1$

9. (*b*) $\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + ... + \frac{1}{\log_{100} n}$

$= \log_n 2 + \log_n 3 + \log_n 4 + ... + \log_n 100$

$= \log_n(2.3.4.5 \ ... \ 100) = \log_{100!}(100!) = 1$

10. (*b*) $z = 1 + i$, where $i = \sqrt{-1}$

$$\left|z + \frac{2}{z}\right| = \left|(1+i) + \frac{2}{(1+i)}\right| = 2$$

$$= \left|(1+i) + \frac{2}{(1+i)} \times \frac{(1-i)}{(1-i)}\right| = 2$$

11. (*d*) Given that, order of matrix $AB = n \times n$

If we take $A_{n \times m}$ and $B_{m \times n}$, then AB will be of order $n \times n$.

12. (*c*) Number of prime numbers less than 30 = 10

$\therefore$ Possible order of matrices with 10 elements

$= 10 \times 1, 1 \times 10, 2 \times 5, 5 \times 2$

13. (*c*) $A = \begin{vmatrix} p & q \\ r & s \end{vmatrix}$, prime numbers less than 20

p and s must be maximum and r and q must be minimum for maximum values of A.

Then, $r = 2$, $q = 3$, $p = 17$, $s = 19$

$\therefore A = 17 \times 19 - 2 \times 3$

$= 323 - 6 = 317$

14. (*d*) Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}$ then, $|AB| = |BA|$

Therefore, we can say that A and B need not be the unit matrices.

15. (*c*) $\because \cot 6x = \cot(2x + 4x)$

$$= \frac{\cot 2x \cdot \cot 4x - 1}{\cot 2x + \cot 4x}$$

$\Rightarrow \cot 6x.\cot 2x + \cot 6x.\cot 4x$

$= \cot 2x.\cot 4x - 1$

$\therefore \cot 2x.\cot 4x - \cot 4x.\cot 6x - \cot 6x.\cot 2x = 1$

16. (*d*) Given, $\tan x = \frac{-3}{4}$ and x is in the 2nd quadrant.

If perpendicular be $3k$ and base be $4k$, then

Hypotenuse $= \sqrt{(3k)^2 + (4k)^2} = 5k$

$$\therefore \sin x = \frac{3}{5} \text{ and } \cos x = \frac{-4}{5}$$

$$\therefore \sin x \cdot \cos x = \frac{3}{5} \times \left(\frac{-4}{5}\right) = \frac{-12}{25}$$

17. (*c*) $\operatorname{cosec}\left(\frac{7\pi}{6}\right) \cdot \sec\left(\frac{5\pi}{3}\right)$

$= \operatorname{cosec}\left(\pi + \frac{\pi}{6}\right) \cdot \sec\left(2\pi - \frac{\pi}{3}\right)$

$= \operatorname{cosec}\frac{\pi}{6} \cdot \sec\frac{\pi}{3} = -2 \times 2 = -4$

18. (*c*) Expand determinant and equate it to zero.

19. (*c*) $\tan 31° . \tan 33° . \tan 35° ... \tan 57° . \tan 59°$

$= \tan 31°. \tan 33°. \tan 35° \times \tan 45° \times \tan(90° - 33°). \tan(90° - 31°)$

$= (\tan 31° . \cot 31°).(\tan 33° . \cot 33°).(\tan 35° . \cot 35°) = 1$

20. (*a*) **Hint:** $f(-1) + f(0) + f(1)$

$= 0 + 0 + 0 = 0$

21. (*b*) $\because \sin^{-1} x - \cos^{-1} x = \frac{\pi}{6}$ ...(i)

$$\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2} \quad ...(ii)$$

Adding Eqs. (i) and (ii), we get

$$2\sin^{-1} x = \frac{\pi}{6} + \frac{\pi}{2} \Rightarrow 2\sin^{-1} x = \frac{2\pi}{3}$$

$$\Rightarrow x = \frac{\sqrt{3}}{2}$$

Therefore, the given equation has a unique solution.

22. (*b*) $(\sin 24° + \cos 66°)(\sin 24° - \cos 66°)$

$= (\sin 24° + \cos 66°)(\cos 66° - \cos 66°)$

$= 0$

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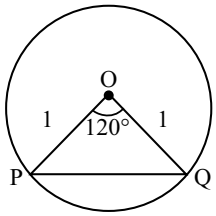
23. (*d*) Given, radius of the circle = 1 unit



$\angle POQ = 120°$

By using cosine rule,

$$\cos 120° = \frac{OP^2 + OQ^2 - PQ^2}{2 \cdot OP \cdot OQ}$$

$$\Rightarrow \frac{-1}{2} = \frac{1+1-x^2}{2 \cdot 1 \cdot 1} \Rightarrow -1 = 2 - x^2$$

$\Rightarrow x = \sqrt{3}$ units

24. (*b*) **Hint:** Put $\theta = 45°$

25. (*a*) **Hint:** Put $\theta = 60°$

26. (*b*) **Hint:** Interior angle of a regular polygon is $\frac{(n-2)}{n} \times 180°$ where n is the no. of sides. Here, $n = 8$.

27. (*d*) **Hint:** $\frac{7}{25}\sin\theta + \frac{24}{25}\cos\theta - 1$

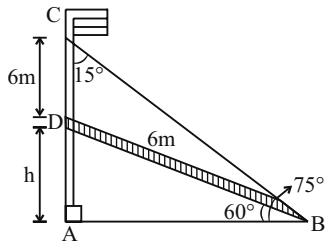
On comparing with $\sin 2\theta + \cos 2\theta = 1$, we get

$$\sin\theta = \frac{7}{25} \text{ and } \cos\theta = \frac{24}{25}$$

Hence, $\sin\theta + \cos\theta = \frac{7}{25} + \frac{24}{25} = \frac{31}{25}$

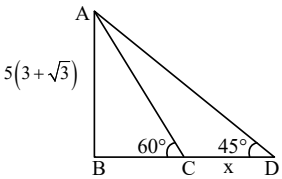
28. (*d*) **Hint:** Let AC be a vertical flagstaff.

$\therefore CD = 6$ m, $BD = 6$ m and $\angle CBD = 75°$



Now find $h + 6$. which is equal to $(3\sqrt{3} + 6)$ m.

29. (*b*) **Hint:**



Find BC, Then BD

30. (*b*) If $3\cos\theta = 4\sin\theta \Rightarrow \tan\theta = \frac{3}{4}$

$$\therefore \tan(45° + \theta) = \frac{\tan 45° + \tan\theta}{1 - \tan 45° \cdot \tan\theta}$$

$= 7$

31. (*a*) Since, $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$ for all $x \in R$.

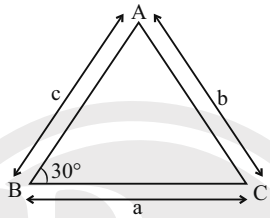
32. (*a*) $\because \cos 2A = \frac{1 - \tan^2 A}{1 + \tan^2 A}$

$$= \frac{1 - (1/7)^2}{1 + (1/7)^2} = \frac{24}{25}$$

33. (*b*) Let $AB = m$, $AC = n$ and $BC = \sqrt{m^2 + n^2 + mn}$

Use cosine rule to find cos A

34. (*c*) Given, $a = 10$ cm, $c = 4$ cm, $\angle B = 30°$



$\because$ Area of triangle $= \frac{1}{2}ac\sin(\angle B)$

$= 10$ cm^2

35. (*c*) $A = \{1, 3, 5\}$ and $B = \{2, 4, 7\}$

As number of elements are same in both the sets therefore A and B are equivalent sets.

If $A = \{1, 5, 9\}$, $B = \{1, 5, 5, 9, 9\} = \{1, 5, 9\}$

$\because$ Elements are same in A and B

$\therefore A$ and B are equal sets

36. (*d*) Since we know that null set is a subset of every set and every set is a subset of itself.

If $n(A) = 10$

$\therefore n(P(A)) = 2^{10} = 1024$

$\therefore$ All the given statements are true.

37. (*b*) $y = \frac{20 - 2x}{3}$

All ordered pair which satisfies the given relations are (1, 6),(4, 4),(7, 2).

$\therefore n(R) = 3$

38. (*c*) **Statement 1**

$f: Z \to Z$; $f(x) = x + 1$

Let $f(x_1) = f(x_2)$

$\Rightarrow x_1 + 1 = x_2 + 1$

$\Rightarrow x_1 = x_2 \Rightarrow f$ is one-one in Z.

Since, every element of co-domain has its pre-image in domain. Therefore, f is onto.

Statement 2

$f: N \to N$

$f(x) = x + 1$

Let $f(x_1) = f(x_2)$

$\Rightarrow x_1 + 1 = x_2 + 1 \Rightarrow x_1 = x_2$

Hence, f is one-one in N.

But there is no element in N such that $f(x) = 1$. Hence, f is not onto on N.

39. (*a*) **Statement 1:** Let us suppose,

$z = x + iy \Rightarrow \bar{z} = x - iy$

$$(\bar{z})^{-1} = \frac{1}{x - iy} = \frac{x + iy}{x^2 + y^2}$$

Also, $z^{-1} = \frac{1}{x + iy} = \frac{x - iy}{x^2 + y^2}$

$$\left(\overline{z^{-1}}\right) = \frac{x + iy}{x^2 + y^2} = (\bar{z})^{-1}$$

Therefore, statement 1 is correct.

Statement 2:

$|z| = \sqrt{x^2 + y^2}$

$\Rightarrow |z|^2 = x^2 + y^2$

But, $zz^{-1} = (x + iy)\frac{(x - iy)}{x^2 + y^2}$

Hence, statement 2 is wrong.

40. (*c*) **Statement 1:** Suppose that $z = x + iy$ and $\bar{z} = x - iy$

$\therefore z - \bar{z} = x + iy - x + iy = 2iy$ which is an imaginary number.

Therefore, statement 1 is correct.

Statement 2: Also, $z + \bar{z} = x + iy + x - iy = 2x$ which is real.

Therefore, Statement 2 is correct.

41. (*b*) Let $z = i^{2n+1}(-i)^{2n-1}$, where $n \in N$

$= (i)^{2n}(i)(-i)^{2n}(-i)^{-1}$

$$= (-1)^n (i)(-1)^n \left(-\frac{1}{i}\right) = -1$$

$\therefore |z| = 1$

42. (*a*) Given quadratic equation $4x^2 + 2x - 1 = 0$ ...(i)

If α, β are the roots of Eq. (i), then these value will satisfy the given equation.

$4\alpha^2 + 2\alpha - 1 = 0$ ...(ii)

and $4\beta^2 + 2\beta - 1 = 0$ ...(iii)

From Eq. (i),

Sum of roots $= \frac{-2}{4} \Rightarrow \alpha + \beta = \frac{-1}{2}$

$\Rightarrow \beta = \frac{-1}{2} - \alpha$

On putting the value of β in Eq. (iii),

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

$\Rightarrow \beta = -2\alpha^2 - 2\alpha$

43. (*c*) Let the roots be α and $\frac{1}{a}$.

$\therefore \alpha \times \frac{1}{\alpha} = \frac{k}{5} \Rightarrow k = 5$

44. (*c*) ${}^{8-1}C_5 = {}^{7}C_5 = \frac{7 \times 6}{1 \times 2} = 21$

45. (*a*) $(1 + 4x + 4x^2)^5 = \{(1 + 2x)^2\}^5$

$x = (1 + 2x)^{10}$

Number of terms = 10 + 1 = 11

$\therefore$ Middle term $= \left(\frac{11+1}{2}\right)$th term

$= 6^{th}$ term

$T_6 = T_{5+1} = {}^{10}C_5(2x)^5$

$= {}^{10}C_5 \times 2^5 \times x^5 = 8064\, x^5$

46. (*c*) $C(n, 1) + C(n, 2) + ... + C(n, n)$

$= 2^n - 1$

Now, we shall solve the option to check whether sum is $2^n - 1$ or not.

Let's take

$S = 1 + 2 + 2^2 + 2^3 + ... + 2^{n-1}$ which forms a GP.

Where $a = 1,\ r = \frac{2}{1} = 2 > 1$

$\because S = \frac{a(r^n - 1)}{r - 1} = 2^n - 1$

47. (*b*) The sum coefficient of first and last term of the expansion $= {}^{2n}C_0 + {}^{2n}C_{2n} = 1 + 1 = 2$

48. (*b*)

49. (*c*)

50. (*d*) Given digits are 1, 2, 3, 4, 5

Since, the sum of digits

$= 1 + 2 + 3 + 4 + 5 = 15$ is divisible by 3.

$\Rightarrow$ There is no prime number.

51. (*b*) If $f(x + 1) = x^2 - 3x + 2$

$\therefore f(x) = (x - 1)^2 - 3(x - 1) + 2$

$= x^2 - 5x + 6$

52. (*c*) If $x^2, x, -8$ are in AP, then

$2x = x^2 - 8 \Rightarrow (x - 4)(x + 2) = 0$

$x \in \{-2, 4\}$

53. (*b*) $ar^2 = 3$

$a_1 \cdot a_2 \cdot a_3 \cdot a_4 \cdot a_5 = a^5 \cdot r^{10} = (3)^5 = 243$

54. (*a*) **Hint:** Expand the determinant after solving, here value of determinant = 0

55. (*d*) Given numbers are 2, 4, 6, 8.

$\therefore$ We can form determinant of order 2.

Number of determinants = 4 × 3 × 2 × 1 = 24

$\therefore$ Sum of the values of all determinants = 0.

56. (*d*) $4x^2 + 4y^2 - 20x + 12y - 15 = 0$

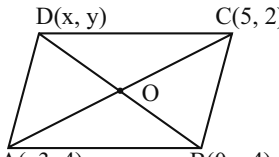
$\Rightarrow x^2 + y^2 - 5x + 3y - \frac{15}{4} = 0$

Here, $g = \frac{-5}{2}, f = \frac{3}{2}, c = \frac{-15}{4}$

$\therefore$ Radius $= \sqrt{g^2 + f^2 - c}$

$= \sqrt{\frac{25}{4} + \frac{9}{4} + \frac{15}{4}} = 3.5$ unit

57. (*a*)



Use mid-point formula to calculate the coordinates of *O*.

58. (*c*) **Hint:** Slope of the product of perpendicular lines is – 1.

59. (*d*) Given: *A*, *B*, *C* are in *AP*.

$\Rightarrow A - 2B + C = 0$ ...(i)

On comparing $A - 2B + C = 0$ with the given line $Ax + 2By + C = 0$, we get $x = 1, y = -1$

Hence, line $Ax + 2By + C = 0$ will pass through (1, –1)

60. (*b*) Let $P = (-4, 2)$ and Image point, $P' = (4, -2)$

$\therefore$ Mid-point of

$PP' = \left(\frac{-4+4}{2}, \frac{2+(-2)}{2}\right) = (0, 0)$

Slope of $PP' = \frac{-2-2}{4-(-4)}$

$= \frac{-4}{8} = \frac{-1}{2}$

Since, PP' and mirror line are perpendicular.

Slope of line mirror

$= \frac{-1}{\text{Slope of } PP'} = \frac{-1}{-1/2} = 2$

$\therefore$ Equation of a line mirror is, $y - 0 = 2(x - 0)$

$\Rightarrow y = 2x$

61. (*a*) **Statement 1:** For three points $A(x_1, y_1)$, $B(x_2, y_2)$ and $(C(x_3, y_3)$ are said to be collinear if $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0$

$\therefore$ Statement 1 is correct.

Statement 2: But it's not necessary that the collinear points lie in the first quadrant only.

$\therefore$ Statement 2 is wrong.

62. (*b*) $\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|$

$= \left|\frac{\frac{m_2}{m_1} - 1}{\frac{1}{m_1} + m_2}\right| = \frac{1}{\sqrt{3}}$

$\Rightarrow \theta = 30°$

63. (*a*)

64. (*d*) Given $x = 3\tan\theta, y = 2\sec\theta$

$\frac{x}{3} = \tan\theta, \frac{y}{2} = \sec\theta$

$\because \sec^2\theta - \tan^2\theta = 1$

$\frac{y^2}{4} - \frac{x^2}{9} = 1$ which represents conjugate Hyperbola.

$\Rightarrow a^2 = 9, b^2 = 4$

$\therefore e = \sqrt{1 + \frac{a^2}{b^2}} = \sqrt{1 + \frac{9}{4}} = \sqrt{\frac{13}{4}}$

$= \frac{\sqrt{13}}{2}$

65. (*d*) All the statements are correct.

66. (*b*) **Hint:**

$\cos\theta = \left|\frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2}\sqrt{a_2^2 + b_2^2 + c_2^2}}\right|$

67. (*b*) $x - 1 = 2(y + 3) = 1 - z$

$\Rightarrow \frac{x-1}{2} = \frac{y-(-3)}{1} = \frac{1-z}{-2}$

$\therefore$ Direction ratios are <2, 1, – 2 >

$\therefore$ Direction cosines are

$l = \frac{2}{3}, m = \frac{1}{3}, n = \frac{-2}{3}$

$\therefore l^4 + m^4 + n^4$

$= \left(\frac{2}{3}\right)^4 + \left(\frac{1}{3}\right)^4 + \left(\frac{-2}{3}\right)^4 = \frac{11}{27}$

68. (*c*) $A = (1, 7, -5)$ and $B = (-3, 4, -2)$

$\therefore$ Direction ratios of

$AB = <(-3 - 1), (4 - 7), (-2 + 5)>$

$= < -4, -3, 3 >$

$\Rightarrow a = -4, b = -3, c = 3$

Direction cosines of Y-axis = <0,1,0>

$l = 0, m = 1, n = 0$

$\therefore$ Projection of AB on Y-axis = $|al + bm + cn|$

$= |-4 \times 0 + (-3) \times 1 + 3 \times 0| = 3$

69. (*c*) Let $A = (k, 1, 3)$, $B = (1, -2, k+1)$ and $C = (15, 2, -4)$

Since, line AB passes through C also. So, the points A, B and C are collinear.

$$\therefore \begin{vmatrix} k & 1 & 3 \\ 1 & -2 & k+1 \\ 15 & 2 & -4 \end{vmatrix} = 0$$

$\Rightarrow 2k^2 - 21k - 115 = 0$

$\Rightarrow k$ has two values as the above equation is a quadratic equation.

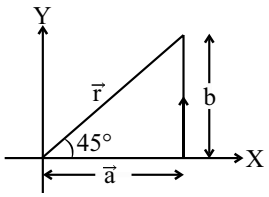
70. (*c*) Perpendicular distance from origin to the plain is

$$d = \left|\frac{0+0+0-3}{\sqrt{1^2+1^2+1^2}}\right| = \sqrt{3}$$

$\because$ distance between origin & (1, 1, 1) is $\sqrt{3}$ & (1, 1, 1) is on the plane.

So, foot of the perpendicular to the plane is (1, 1, 1).

71. (*c*)



Since, $\vec{r}$ is equally inclined from both axis. Hence, $\vec{r}$ makes 45° from the X-axis.

$\therefore \vec{a} = |\vec{r}| \cos 45° = \sqrt{2}$ and $\vec{b} = |\vec{r}| \sin 45° = \sqrt{2}$

72. (*c*) **Statement 1:** Consider, $\vec{c} \cdot (\vec{a} - \vec{b}) = (\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})$

$= |\vec{a}|^2 - |\vec{b}|^2 = |\vec{b}|^2 - |\vec{b}|^2 = 0$

$\Rightarrow \vec{c}$ is perpendicular to $(\vec{a} - \vec{b})$.

Statement 1 is true.

Statement 2:

Also, $\vec{c} \cdot (\vec{a} \times \vec{b}) = (\vec{a} + \vec{b}) \cdot (\vec{a} \times \vec{b})$

$= \vec{a} \cdot (\vec{a} \times \vec{b}) + \vec{b} \cdot (\vec{a} \times \vec{b}) = 0 + 0 = 0$

$\Rightarrow \vec{c}$ is perpendicular to $(\vec{a} \times \vec{b})$

Statement 2 is true.

73. (*c*) We have, $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}| = 4$

$\Rightarrow |\vec{a} + \vec{b}|^2 = |\vec{a} - \vec{b}|^2$

$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 + 2\vec{a} \cdot \vec{b} = |\vec{a}|^2 + |\vec{b}|^2 - 2\vec{a} \cdot \vec{b}$

$\Rightarrow 4\,\vec{a} \cdot \vec{b} = 0 \Rightarrow \vec{a} \cdot \vec{b} = 0$

$\Rightarrow a$ must be perpendicular to b.

74. (*c*) We have a, b and c are coplanar $\Rightarrow [\vec{a}\ \vec{b}\ \vec{c}] = 0$ ...(i)

$\therefore (2\vec{a} \times 3\vec{b}) \cdot 4\vec{c} + (5\vec{b} \times 3\vec{c}) \cdot 6\vec{a}$

$= 24[\vec{a}\ \vec{b}\ \vec{c}] + 90[\vec{a}\ \vec{b}\ \vec{c}]$

$[(\vec{a} \times \vec{b}) \cdot \vec{c} = [\vec{a}\ \vec{b}\ \vec{c}] = [\vec{b}\ \vec{c}\ \vec{a}]]$

$= 24 \times 0 + 90 \times 0 = 0$ [form (i)]

75. (*d*) **Statement 1:** Let $\vec{a}$ and $\vec{b}$ s.t. then, $|\vec{a}| = |\vec{b}| = 1$

$|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$ is not always unit vector as $\vec{a} \times \vec{b} = |\vec{a}||\vec{b}| \sin\theta\ \hat{n}$

where, $\sin\theta \in [-1, 1]$

Therefore, statement 1 is incorrect.

Statement 2: Let $\vec{a}$ and $\vec{b}$ are s.t. $|a| = |\vec{b}| = 1$

then, $\vec{a} \times \vec{b} = |\vec{a}||\vec{b}| \cos\theta$

where, $\cos\theta \in [-1, 1]$

So, this is not unity.

Therefore, statement 2 is also incorrect.

Statement 3: Let $\vec{a} = \hat{i}$ and $\vec{b} = \hat{j}$

$\Rightarrow |\vec{a}| = 1, |\vec{a}| = 1$

then, $|\vec{a} + \vec{b}| = |\hat{i} + \hat{j}| = \sqrt{2}$

& $|\vec{a} - \vec{b}| = |\hat{i} - \hat{j}| = \sqrt{2}$

So, statement 3 is also incorrect.

76. (*c*) $\lim\limits_{x \to a} \dfrac{a^x - x^a}{x^a - a^a} = -1$

$\Rightarrow \dfrac{a^a \log_e a - a \cdot a^{a-1}}{a \cdot a^{a-1}} = -1$

(L' Hospital' rule)

$\Rightarrow \log_e a = 0 \Rightarrow a = e^0 = 1$

77. (*c*) $\dfrac{dx}{dt} = x + 1 \Rightarrow \dfrac{dx}{x+1} = dt$

$\Rightarrow \int \dfrac{dx}{x+1} = \int dt$

(Integrating on both sides)

$\Rightarrow l\text{n}(x + 1) = t + c$, where c is a contant. ...(i)

Since, at $t = 0$, distance $x = 0$

$l\text{n}(0 + 1) = 0 + c \Rightarrow c = 0$

$\therefore l\text{n}(x + 1) = t$ [from (i)]

At $x = 24$, $t = l\text{n}(24 + 1)$

$= l\text{n}25 = l\text{n}5^2 = 2l\text{n}5$

78. (*d*) $Let\ I = \int_0^a \dfrac{f(a-x)}{f(x) + f(a-x)}\,dx$ ...(i)

$\Rightarrow I = \int_0^a \dfrac{f(x)}{f(a-x) + f(x)}\,dx$

(By $x \to a - x$) ...(ii)

Adding (i) and (ii)

$2I = \int_0^a \dfrac{f(a-x) + f(x)}{f(a-x) + f(x)}\,dx = [x]_0^a = a$

$\Rightarrow I = \dfrac{a}{2}$

79. (*b*) **Hint:** Use L'Hospital's rule

80. (*a*) We have,

$$\int_0^a [f(x) + f(-x)]\,dx = \int_{-a}^a g(x)\,dx$$

If $g(x) = f(x)$

Let $I = \int_{-a}^a g(x)\,dx$

$\Rightarrow I = \int_{-a}^a f(x)\,dx$ ...(i)

$I = \int_{-a}^a f(-x)\,dx$

$\left[\because \int_a^b f(x)\,dx = \int_a^b f(a+b-x)\,dx\right]$ ...(ii)

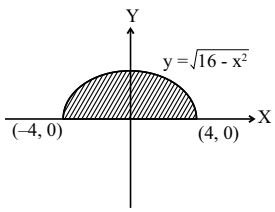
Adding (i) and (ii), we get

$\Rightarrow 2I = 2\int_0^a [f(x) + f(-x)]\,dx$

$\Rightarrow \int_{-a}^a g(x)\,dx = \int_0^a [f(x) + f(-x)]\,dx$

So, $g(x) = f(x)$

81. (*b*)



$\therefore$ Required area $= \int_{-4}^4 \sqrt{16 - x^2}\,dx$

$= 2\int_0^4 \sqrt{16 - x^2}\,dx$

$= 2\left[\dfrac{x}{2}\sqrt{16 - x^2} + \dfrac{16}{2}\sin^{-1}\dfrac{x}{4}\right]_0^4$

$= 2[0 + 8\sin^{-1}1]$

$= 8\pi$ sq. units

82. (*c*) **Hint:** Find the maxima of $f'(x)$

83. (*a*) **Hint:** The area of triangle with fixed perimeter is maximum when it is equilateral.

84. (*d*) **Hint:** Given that, $f(x) = e^{|x|}$

$$\Rightarrow f(x) = \begin{cases} e^x & ;\ x \geq 0 \\ e^{-x} & ;\ x < 0 \end{cases}$$

At $x = 0$ calculate L.H.D and R.H.D

85. (*d*) Let,

$$I = \int \frac{1}{(\sec x + \tan x)} \times \frac{(\sec x - \tan x)}{(\sec x - \tan x)} dx$$

$$I = \int \frac{(\sec x - \tan x)}{\sec^2 x - \tan^2 x} dx$$

$$= \int \frac{(\sec x - \tan x)}{1} dx$$

$$I = \int \sec x \, dx - \int \tan x \, dx$$

$$I = \ln|\sec x + \tan x| - \ln|\sec x| + C$$

86. (*b*) Let $I = \int \frac{dx}{\sec^2(\tan^{-1} x)}$

$$\Rightarrow I = \int \frac{dx}{1 + \tan^2(\tan^{-1} x)} = \int \frac{dx}{1 + x^2}$$

$$= \tan^{-1} x + C$$

87. (*a*) We have, $x + y = 20 \Rightarrow y = 20 - x$

Now, $P = xy = x(20 - x) = 20x - x^2$

For maxima $\frac{dP}{dx} = 20 - 2x = 0$

$\Rightarrow x = 10$

At $x = 10, \frac{d^2P}{dx^2} = -2 < 0$

$\therefore$ P is maximum at $x = 10$ and $y = 10$

$\therefore$ Maximum value of $P = xy = 10 \times 10 = 100$

88. (*a*) **Hint:** Find $\frac{dy}{dx}$ at $x = e$

89. (*b*) $\frac{dx}{dy} = \frac{dx/dt}{dy/dt} = \frac{e^t(\cos t - \sin t)}{e^t(\cos t + \sin t)}$

at $t = 0, = \frac{dx}{dy} = 1$

90. (*a*) Let $y = \sin 2x . \cos 2x$

$$\Rightarrow y = \frac{1}{2}\sin 4x$$

$\because -1 \le \sin 4x \le 1$

$$\Rightarrow \frac{-1}{2} \le \frac{1}{2}\sin 4x \le \frac{1}{2}$$

$\therefore$ Maximum value $= \frac{1}{2}$

91. (*a*) Suppose that, $y_1 = e^x$ and $y_2 = x^e$

$$\therefore \frac{dy_1}{dy_2} = \frac{\frac{dy_1}{dx}}{\frac{dy_2}{dx}} = \frac{e^x}{ex^{e-1}} = \frac{xe^x}{ex^e}$$

92. (*b*) We have, $\lim_{x \to -1} \frac{f(x)+1}{x^2 - 1} = \frac{-3}{2}$

$\because \lim_{x \to -1} \frac{f(x)+1}{x^2 - 1}$ has denominator equal to 0 at $x = -1$

$$\Rightarrow \lim_{x \to -1} f(x) + 1 = 0$$

$$\Rightarrow \lim_{x \to -1} f(x) = -1$$

93. (*a*) We have, $f(x) = \begin{cases} a + bx & , \ x < 1 \\ 5 & , \ x = 1 \\ b - ax & , \ x > 1 \end{cases}$

$f(x)$ is continuous.

So, $f(x)$ is continuous at $x = 1$

$$\Rightarrow \lim_{x \to 1^-} f(x) = f(1) = \lim_{x \to 1^+} f(x)$$

$$\Rightarrow \lim_{x \to 1^-} (a + bx) = 5$$

$\Rightarrow a + b = 5$

94. (*b*) **Hint:** statement 1 is incorrect and statement 2 is correct.

95. (*a*) $\because$ We know that, domain of exponential function is $(-\infty, \infty)$.

96. (*a*) We have, $y^2 + 2cy - cx + c^2 = 0$

Since, the equation has only one constant or parameter.Hence, order of the differential equation = 1.

97. (*a*) Let $x = \sqrt{1 + \frac{d^2y}{dx^2}}$

$$\Rightarrow x^2 = 1 + \left(\frac{d^2y}{dx^2}\right)^1$$

$\therefore$ Degree = 1

98. (*b*) We have, $y = ae^x + be^{-x}$

$$\therefore \frac{dy}{dx} = ae^x - be^{-x}$$

$$\Rightarrow \frac{d^2y}{dx^2} = ae^x + be^{-x} = y$$

$$\therefore \frac{d^2y}{dx^2} - y = 0$$

99. (*c*) We have, $\ln\left(\frac{dy}{dx}\right) + y = x$

$$\Rightarrow \frac{dy}{dx} = e^{x-y} \Rightarrow e^x dx = e^y dy$$

$\Rightarrow \int e^x dx = \int e^y dy$ (Integrating on both sides)

$e^x = e^y + c \Rightarrow e^x - e^y = c$

100. (*d*) Suppose $I = \int e^{(2\ln x + \ln x^2)} dx$

$$= \int e^{(\ln x^2 + \ln x^2)} dx = \int x^4 dx$$

$$I = \frac{x^5}{5} + C$$

101. (*c*) We know that,

$$\text{A.M.} = \frac{\sum_{i=1}^{N} a_i}{N} \text{ \& G.M.} = \sqrt[n]{\prod_{i=1}^{N} a_i}$$

Thus, both uses all data, as their formula contains all a_i's.

102. (*b*) The ratio of Science, Arts and Commerce graduates

$= 30 : 70 : 50 = 3 : 7 : 5$

$\therefore$ Angle corresponding to Science graduates

$$= \frac{3}{3+7+5} \times 360° = 72°$$

103. (*b*) **Hint:** From the definition of histogram.

104. (*c*) We know that coefficient of correlation is independent of change of scale and change of origin.

105. (*a*)

No. of Peas	1	2	3	4	5	6	7	
Frequency	4	33	76	50	26	8	1	$\sum f = 198$
c.f.	4	37	113	163	189	197	198	

Here N = 198 (even)

So,Median

$$= \frac{99^{th} \text{ term} + 100^{th} \text{ term}}{2}$$

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

106. (*b*) Mean

$$= \frac{(x_1 - k) + (x_2 - k) + (x_3 - k) + \ldots + (x_n - k) + nk}{n}$$

$$= M + k$$

107. (*c*) $\text{Mean} = \frac{73 + 85 + 92 + 105 + 120}{5} = 95$

$\therefore$ Sum of deviations from their mean

$= (73 - 95) + (85 - 95) + (92 - 95)$

$+ (105 - 95) + (120 - 95) = 0$

108. (*d*) H.M. of m and $n = \frac{2mn}{m+n} = x$ ...(i)

G.M. of m and $n = \sqrt{mn} = y$ ...(ii)

Now,

$$5\left(\frac{2mn}{m+n}\right) = 4\sqrt{mn} \qquad (\because 5x = 4y)$$

$$\Rightarrow (m - 4n)(4m - n) = 0$$

$\Rightarrow m = 4n$ or $n = 4m$

109. (*a*) We have, $CV = 45\% = 0.45$ & Mean, $\bar{x} = 100$

$$\because CV = \frac{\sigma}{\bar{X}} \Rightarrow 0.45 = \frac{\sigma}{100}$$

$\Rightarrow \sigma^2 = 45^2 = 2025$

110. (*c*) We have, $P(A) = L$, $P(B) = M$

$$\because P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$= \frac{P(A) + P(B) - (A \cup B)}{P(B)}$$

$$\therefore P(A \mid B) = \frac{L + M - P(A \cup B)}{M}$$

$\therefore P(A \cup B) \le 1 \Rightarrow -P(A \cup B) \ge -1$

So, $P(A \mid B) \ge \frac{L + M - 1}{M}$

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111. (*b*) **Hint:** Mean
$= \frac{6+18+18+18+30}{5} = 18$
Mean = Mode = Median

112. (*b*) **Hint:** Mean of discarded observations
$= \frac{900-650}{2} = 125$

113. (*c*) Let other root be β
We have, $x(x + 1) + 1 = 0$
$\Rightarrow x^2 + x + 1 = 0$
As k is root of the equation.
$k^2 = -1 - k$ ...(i)
Now, sum of roots $\beta + k = -1 \Rightarrow \beta = -1 - k = k^2$

114. (*c*) Let geometric mean of $x_1, x_2, x_3, ..., x_n$ is $G = 10$.
Then, geometric mean of $x_1^2, x_2^2, x_3^2, ..., x_n^2$ is G^2
& geometric mean of $kx_1^2, kx_2^2, ..., kx_n^2$ is kG^2.
$\therefore$ Required geometric mean
$= 3(10)^4 = 30000$

115. (*a*) **Statement-1:**

$$\because P(\bar{A}) = \frac{1}{2} \Rightarrow P(A) = 1 - \frac{1}{2} = \frac{1}{2}$$

$$\therefore P(B) = P(A \cup B) - P(A) + P(A \cap B) = \frac{2}{3}$$

$$\because P(A \cap B) = \frac{1}{3} = \frac{1}{2} \times \frac{2}{3} = P(A) \cdot P(B)$$

So, A & B are independent.
Statement-1 is correct.
Statement-2:

$$\because P(A \cup B) = \frac{5}{6} \neq \frac{7}{6} = \frac{1}{2} + \frac{2}{3} = P(A) + P(B)$$

$\Rightarrow$ Statement-2 is wrong.

116. (*c*) $\because$ As per the questions, number 3 was misreaded as 8 at tens place.
So, the average is increased by $\frac{(8-3)\times 10}{15} = \frac{10}{3}$
So, the average should be reduced by $\frac{10}{3}$.

117. (*c*) Sample space = $\{HH, HT, TH, TT\}$
Now, $E = \{HH, HT\}$ & $F = \{TH, HH\}$
$\therefore E \cup F = \{HT, HH, HT\}$ $\therefore P(E \cup F) = \frac{3}{4}$

118. (*d*)

$$\text{Mean} = np = \frac{2}{3} \text{ \& Variance} = npq = \frac{5}{9}$$

$$\therefore q = \frac{5}{6}, p = \frac{1}{6} \text{ and } n = 4.$$

$$\therefore P(X = 2) = {}^4C_2 p^2 q^{4-2}$$

$$= \frac{4\times 3}{2} \times \left(\frac{1}{6}\right)^2 \times \left(\frac{5}{6}\right)^2 = \frac{25}{216}$$

119. (*d*) Since, frequency of all other numbers is same. So, 15 to be mode, 15 should have highest frequency, which is possible if x is 15.

120. (*c*) **Hint:** $P(A \cup B)$ will be minimum if $P(A \cap B)$ is maximum and vice-versa.

Paper II: General Ability

1. (*d*) 'Contagious' means an emotion, feeling or attitude that is likely to spread to and affect others. Hence, 'catching' is its correct synonym.

2. (*c*) 'Dynamic' refers to process constantly in state of flux, growing, changing or evolving. Hence, 'evolutionary' is its correct synonym.

3. (*b*) 'Lamenting' means to express regret or sorrow about something. Hence, 'bemoaning' is its correct synonym.

4. (*a*) Here, 'Organic' is characterised by gradual or natural development. Hence, 'natural' is its correct synonym.

5. (*b*) 'Oratory' means the art of speaking in public effectively. Hence, 'eloquence' is its correct synonym.

6. (*d*) 'Patron' refers to a person who gives support to someone or something with words or money. Hence, 'backer' is its correct synonym.

7. (*c*) 'Arrogance' describes to someone who has an exaggerated sense of their own worth or importance often by an overbearing manner. Hence, 'conceit' is its correct synonym.

8. (*c*) 'Reconnaissance' refers to a preliminary survey to gain information. Hence, 'investigation' is its correct synonym.

9. (*b*) 'Replica' means an exact copy or closely resemble to something. Hence, 'clone' is its correct synonym.

10. (*c*) 'Sardonic' means someone humerous in an unkind way that shows they do not respect someone or something. Hence, 'mocking' is its correct synonym.

11. (*c*) 'Attractive' means pleasing or appealing to look at. Hence, 'repulsive' meaning extremely unpleasant or unacceptable is its correct antonym.

12. (*d*) 'Boundless' means unlimited or having no boundaries or limits. Hence, 'finite' meaning definite or definable, 'limits' is its correct antonym.

13. (*b*) The antonym of clear is 'opaque', which means not able to be seen through or not transparent.

14. (*d*) The antonym of deep is 'shallow', which means an area of sea or lake or river where the water is not very deep.

15. (*a*) The antonym of generous is 'stingy', which means not generous especially with money.

16. (*b*) The antonym of plenty is 'scarcity', which means insufficiency or shortness of supply.

17. (*c*) 'Industrious' means hard-working and habitually active. Hence, 'lazy' is its correct antonym.

18. (*a*) The antonym of grow is 'shrivel', which means to wrinkle, dry or smaller.

19. (*d*) 'Rarely' means not very often or seldom. Hence, 'frequently' meaning something done often or at regular intervals is its correct antonym.

20. (*c*) 'Crooked' means dishonest or criminal. Hence, 'straightforward' meaning honest and candid is its correct antonym.

21. (*c*) The idiom 'overstep the mark' means to behave in a completely unacceptable way.

22. (*a*) The phrase 'palsy-walsy friends' means friendly or appearing to be friendly in a very intimate or hearty way.

23. (*a*) The idiom 'open a Pandora's box' means to begin or introduce something that causes many troubles and problems.

24. (*b*) The idiom 'pull your socks up' means telling someone that they must do better.

25. (*c*) The idiom 'to get under somebody's skin' means to irritate or bother someone.

26. (*a*) The phrase 'turn topsy-turvy' means to be in state of chaos or disorder.

27. (*c*) The idiom 'a clarion call' means a strongly expressed demand or request for action.

28. (*b*) The idiom 'fire in the belly' means a powerful sense of ambition or determination.

29. (*b*) The idiom 'a hunky-dory situation' means a very satisfactory and pleasant situation.

30. (*d*) The idiom 'give somebody a leg up' means to help someone/achieve something and become successful.

31. (*c*) Remove 'don't' in part (*c*). The use of 'too' in the sentence shows that a further point with a similar meaning is being added.

32. (*d*) There is no error, the given sentence is grammatically correct.

33. (*c*) The preposition 'to' should be used before the phrasal verb 'point out'. Replace 'it' with 'to'.

34. (*c*) A preposition 'of' is used after the verb 'comprised' so, replace comprising with 'comprised'.

35. (*c*) The preposition 'from' should be replaced by 'of' to make the sentence correct.

36. (*a*) 'Pointing over' should be replaced by 'pointing at', which means to say something to make someone aware of a situation.

37. (*b*) 'But' should not be used with 'though'. Remove 'but' to make the sentence grammatically correct.

38. (*b*) Replace 'has been doing' with 'does' to make the sentence grammatically correct.

39. (*a*) Replace 'when' with 'while' to make the sentence grammatically correct.

40. (*d*) There is no error, the given sentence is grammatically correct.

41. (*b*) 'Polity' means an organised society; a state as a political entity.

42. (*a*) 'Disappointed' means failed to fulfil the hopes or expectations of.

43. (*c*) 'Terrifying' means causing extreme fear and it is the most appropriate word.

44. (*a*) The loud scream or call that elephants make is called 'trumpet'.

45. (*c*) 'Sequel' means a published, broadcast or recorded work that continues the story or develops the theme of an earlier one.

46. (*d*) 'Declared' means formally asserted or announced.

47. (*c*) 'Normally' means under normal or usual conditions.

48. (*b*) 'Gullible' means easily persuaded to believe something or easily tricked.

49. (*a*) 'Staunch' means very loyal, devoted and committed in attitude.

50. (*c*) 'Knew' is the appropriate word.

51. (*d*) Light year is a unit for measurement of distances. It is used to express the distances of celestial bodies.

52. (*a*) Density of water at 4°C is 1000 kg/m^3.

53. (*d*) James Chadwick : Neutron

Albert Einstein : Photoelectric effect

Marie Curie : Radium

54. (*c*) LED stands for Light Emitting Diode.

55. (*a*) When two bodies come into contact only then friction force comes into play.

56. (*b*) HOBr is the chemical formula of hypobromous acid.

57. (*a*) Exosphere → Hydrogen, helium, nitrogen, oxygen and CO_2.

58. (*d*) Glass is made from raw materials like soda, borax and alumina etc.

59. (*b*) In the electrolytic refining of copper, electrolyte is $CuSO_4$ solution + dil. H_2SO_4.

60. (*c*) Solder is a mixture of lead (Pb) and tin (Sn). It is used to weld electrical wires.

61. (*d*) Syngas is a mixture of Hydrogen and CO.

62. (*d*) Mg, Ca, Ba belong to Group 2 of the periodic table having valency 2.

63. (*d*) The lowest possible temperature is the absolute zero. Absolute zero is precisely equivalent to −273.15 degrees celsius on celsius scale.

64. (*a*) The relation between the Fahrenheit and Celsius scale is

$$\frac{(°F-32)}{180}=\frac{°C}{100}$$

Now, let us assume that Fahrenheit and Celsius scale coincide at x°, therefore,

$$\Rightarrow \frac{(°x-32)}{180}=\frac{°x}{100}$$

On solving,

$$\frac{5}{9}(°x-32)=°x$$

$$x=-40°$$

65. (*c*) The image in a plane mirror is virtual, erect same size and laterally inverted.

66. (*d*) Yellow colour is obtained by combining green and red colours. It is a secondary colour.

67. (*b*) Primary colours of light are blue, red and green. This is the essential method used to create the precepting of a broad range of colours.

68. (*a*) It is called mirror formula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

69. (*d*) Endoplasmic reticulum is a membrane bound cell organelle that serve as a channels for the transport of materials between various regions of the cytoplasm or between the cytoplasm and the nucleus. It also involved in protein and lipid synthesis.

70. (*c*) ATP synthesising chemical reaction in mitochondria takes place in inner-mitochondrial membrane. It contains the ATP synthesis complex or oxisome or F_1-particles which are the site of Electron Transportation System (ETS) of aerobic cellular respiration.

71. (*a*) Columnar epithelial cells are found in the inner lining of intestine. The ducts of salivary gland and the tubular part of nephrons of kidney composed of cuboidal epithelium.

72. (*a*) Cell differentiation is the process by which dividing or meristematic cells transform into permanent tissue taking up a permanent shape, size and function.

73. (*c*) During photosynthesis in plants, oxygen gas is produced as a by-product which is required for aerobic cellular respiration to produce energy (ATP). Photosynthesis occurs in chloroplast while aerobic cellular respiration occurs in mitochondria.

74. (*b*) In dicot plants, stomata are generally found in lower surface of leaves and applying vaseline/vegetable oil will close these stomata, thus preventing the water loss through transpiration and drying process will take a lot more time compare to other leaves.

75. (*c*) Speed of light in air is 3×10^8 m/s and its speed slows down as it enters in rarer medium.

76. (*b*) VIBGYOR (increasing order of wavelength). Refractive index is inversely proportional to wavelength. So, violet light will deviate the most. Also, dispersion is based on refraction.

77. (*c*) $Q = It = 1 \times 10 \times 60 = 600C$

78. (*b*) Electric power is the rate per unit time at which electrical energy is transferred by an electric circuit,

$$P = I^2R = \frac{V^2}{R} = VI$$

79. (*a*) Reverberation is the phenomenon of the persistence of sound after it has been stopped due to multiple reflections from surface within a closed surface.

80. (*b*) When light is scattered by a molecule and the frequency of the scattered light is changed, this phenomenon is called Raman effect.

81. (*c*) Detergents are ammonium or sulphonate salts of long chain carboxylic acids. Soap is a mixture of sodium salts of naturally occurring fatty acids.

82. (*c*) Hydrogenation of vegetable oils using nickel catalyst is an example of addition reaction.

83. (*c*) Diamond, graphene and fullerene are three allotropes of pure carbon. Fly ash is not an allotrope of carbon.

84. (*b*)

$$CaSO_4 \cdot \frac{1}{2}H_2O + H_2O \rightarrow CaSO_4 \cdot 2H_2O.$$

85. (*c*) Oxalic acid is predominantly found in tomatoes. Its amount in tomatoes is 50mg per 100g.

86. (*c*) The concept of electrons moving in a circular path with fixed energy was put forward by Bohr.

87. (*d*) $CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (aq)$

$\downarrow$

(Evolution of heat)

The above reaction proceeds with an evolution of heat which means it is exothermic.

88. (*b*) Nuclear reactors are sources of nuclear energy, not bio-mass energy. Wood, gobar gas and coal are the organic or bio-mass sources of energy.

89. (*c*) The twinkling of a star is due to atmospheric refraction of starlight. The starlight on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth.

90. (*a*) We know that,

$$\text{Frequency} = \frac{1}{\text{Time period}}$$

Apart from this, the SI unit of frequency is hertz (Hz).

91. (*d*) When two sound waves of approximately equal frequency are produced simultaneously, the intensity of the resultant sound wave increases or decreases with time. This change in the intensity of sound is called beats.

92. (*d*) Frequency of refracted and reflected wave never changes because the frequency does not depends on the medium.

93. (*b*) $F = -kx$ (SHM equation)

where, x = displacement from mean position and F = acting force. Negative sign represents direction is opposite to each other.

94. (*a*) In a germinated seed radicle represents a future root and plumule represent a future shoot.

95. (*b*) Stigma provides a landing platform for the pollen grain. After landing on stigma pollen grain starts developing a pollen tube, it passes through the elongated style and reaches the ovary to release male gametes in embryo sac of ovule.

96. (*a*) Detergent solution is a hypertonic solution, if human blood is placed in it, then the RBCs found in blood will shrink due to exosmosis, i.e. movement of water from its higher concentration (RBC) to lower concentration (Detergent solution) through cell membrane of RBCs.

97. (*c*) Vegetables and fruits are the rich source of vitamins and minerals for vegetarians.

98. (*b*) When light falls normally on the interface of two medium, then light travels in straight line.

99. (*d*) A mirage is a naturally occurring optical phenomenon in which light rays bend away from the normal via refraction and undergoes TIR.

100. (*c*) Preparation of Plaster of Paris doesn't require the use of NaCl. It is simply obtained by heating gypsum ($CaSO_4 \cdot 2H_2O$) at 120°C in a rotary kiln.

101. (*b*) Among the given options, Harappan sites specialised centre for making shell object is Balakot. The other site was Nageshwar.

102. (*a*) Honouring the king was not a part of the Dhamma of king Ashoka. He advocated tolerance towards all religions and sought conquest through Dhamma and not war.

103. (*c*) Both the statements about Saguna Bhakti are correct.

104. (*d*) Shiva Temple was not constructed at Naneghat under the patronage of the Chola rulers. Chola empire was not extended to this region therefore no temple was build in the region.

105. (*c*) The Deccan Riots Commission was set up by the British Parliament in 1878. The commission did'nt hold inquiries in areas unaffected by it and also did'nt recorded the statements of royats, sahukars and eye-witnesses.

106. (*a*) In Islam, ziyara or ziyarat is a form of pilgrimage to sites associated with Muhammad, his family members and descendants.

107. (*a*) Keppel Island is completely bleached mainly due to the expansion of starfish. Keppel Island is located in the southern Great Barrier reef.

108. (*c*) Among the given options, Mahananda river is not a tributary of river Brahmaputra. Tributaries of Brahmaputra: left-Lhasa River, Nyang River, Parlung Zangbo, Lohit River, Dhansiri River, Kolong River/ right-Kameng River, Manas River, Beki River, Raidak River, Jaldhaka River, Teesta River, Subansiri River.

109. (*d*) Antarctic plate is not a minor plate. There are 15 minor plates. They are Somali Plate, Nazca Plate , Indian Plate , Amurian Plate , Sunda Plate, Philippine Sea Plate, Okhotsk Plate, Arabian Plate, Yangtze Plate, Caribbean Plate , Cocos Plate , Caroline Plate ,Scotia Plate, Burma Plate, New Hebrides Plate.

110. (*c*) The tectonic plates whose turbulent interactions formed Iceland, are the Eurasian tectonic plate and the North American tectonic plate. Spanning the Mid-Atlantic Ridge, Iceland emerged as a result of the divergent, spreading, boundary between these two plates and the activity of Iceland′s own hotspot or mantle plume.

111. (*a*) The process whereby certain minerals absorb water, expand and change is called as Hydration. Hydration expands volume and also results in rock deformation.

112. (*c*) The longest latitude is 0° latitude, known as the Equator which divides the Earth into two equal halves, the northern hemisphere and two southern hemisphere.

113. (*d*) If it is 12:00 Noon in India, on 75 degree, W. Longitude it will be 7:00 am of the same day.

Current time in India = 12:00 PM

Time at required meridian = 7:00 AM

Difference in time = 5 Hours, and this time at meridian (7:00 AM) is 5 hours behind. Hence, it is west direction.

As we know the Earth takes 24 hours, for one complete rotation, so

24 hours = 360° 1 hour = $\frac{360}{24}$ = 15°, thus the Earth rotates 15 degree in/ hour

In 5 hours = 5 × 15° = 75°

Hence, at 75° West longitude, the time

will be 7:00 AM.

114. (*b*) Guru Raidas, was the preceptor of Mirabai. He was low class leather worker.

115. (*b*) Mahanavami Dibba was the name of massive platform with a base covered with relief carvings. It was the King's palace in Vijayanagara though there is no definite evidence.

116. (*d*) Badshah Nama was written by Abul Hamid Lahori was later revised by Sadullah Khan on the orders of Shah Jahan.

117. (*a*) All the statements are correct.

118. (*c*) Muhammadan Anglo-Oriental College was founded in 1875 by Sir Syed Ahmad Khan, known as Muhammadan Anglo Oriental Collegiate School. He believed that all religions had a certain underlying unity which could be called practical morality.

119. (*a*) Basket of eggs topography is related to Drumlins. Drumlins are forms of rounded hummocks resulting from the deposition of glacial till which look like inverted boat or spoon.

120. (*d*) Earth has the highest density. It is made of dense material and it is heavy planet. The average Density of Earth is 5.5 grams/cm^3.

121. (*b*) The focus is the place inside Earth's crust where an earthquake originates. The point on the Earth's surface directly above the focus is the epicenter.

122. (*a*) The maximum depth lithosphere is found in the pacific ocean. Mariana Trench is located in the western Pacific Ocean, it is the deepest oceanic trench on Earth and the deepest part of the Earth.

123. (*a*) A large body of magmatic material that cools in the deeper depth of the Earth's crust and develops in the form of large domes is known as Batholiths.

124. (*a*) Tatipaka Oil Refinery is not located in Assam, it is located in Andhra Pradesh. It was established in 2001.

125. (*c*) Gandhi's first public appearance in India was on the occasion of the opening ceremony of the Banaras Hindu University in February 1916. He returned from South Africa in 1915.

126. (*b*) The Indian National Congress, on 19th December, 1929, passed the 'Purna Swaraj' – (total independence) resolution – at its Lahore session.

127. (*a*) Article 14 and 15 of the constitution of India provides for the complete equality of men and women in India. Article (12-35) comes under fundamental rights.

128. (*c*) The UNSC is composed of total 15 members, 5 permanent and 10 non-permanent. Permanent members are China, France, the Russian Federation, the United Kingdom, and the United States and Ten non-permanent members: Elected for two-year terms by the General Assembly.

129. (*c*) The United States Declaration of Independence is the pronouncement adopted by the Second Continental Congress meeting in Philadelphia, Pennsylvania, on 4th July, 1776.

130. (*d*) Tsar Nicolas II was the head of the Government that was overthrown by the Bolsheviks in the 1917 Revolution.

131. (*d*) Sleet is Rain and snow mixed is precipitation composed of rain and partially melted snow.

132. (*c*) Nimbus cloud is a rain-bearing cloud. Nimbus clouds are dark clouds as they carry a substantial quantity of water droplets.

133. (*c*) Intensive subsistence agriculture is not predominantly practised in Canada.

134. (*c*) The Headquarters of South-Eastern Railway is located at Kolkata (Gardern Reach).

135. (*b*) Bharatmala Pariyojana is an umbrella program for the highways sector envisaged by the Ministry of Road Transport and Highways. To optimise the efficiency of freight and passenger movement across the country by bridging critical infrastructure gaps through effective interventions.

136. (*a*) Tropical deciduous forest are the most wide spread forests of India. They are also called the monsoon forests and spread over the region receiving rainfall between 200 cm and 70 cm.

137. (*b*) River Beas, flowing from Himachal, Punjab, joint the river Sutlej. It is a river in north India, rises in Himalayas and flows for some 470 km to the Sutlej river in the state Punjab.

138. (*c*) A preamble is an introductory statement in a document that explains the document's philosophy and objectives. Preamble is neither enforceable nor justifiable in a court of law.

139. (*b*) The speaker is the head of Lok Sabha. But he does not cast vote in the first instance in the house. He can only cast his vote when both the government and the opposition get equal votes on a particular law or a motion.

140. (*a*) Fundamental Duties. Incorporated in Part IV-A of the Constitution by the 42nd Constitutional Amendment Act, 1976 on the recommendations of Swaran Singh Committee. It is borrowed from the constitution of Russia.

141. (*b*) In outward direct investment ranking upto Nov. 2020, Singapore stood at the top with 1295.48$ million. An Outward Direct Investment (ODI) is a business strategy in which a domestic firm expands its operations to a foreign country.

142. (*b*) Air Force Station Jodhpur from 20th to 24th January, 2021. The exercise is unique as it includes fielding of Rafale aircraft by both sides and is indicative of the growing interaction between the two premier Air Forces.

143. (*b*) The Uttar Pradesh tableau was given the award for best tableau. The theme of the tableau was Ayodhya: cultural Heritage of Uttar Pradesh.

144. (*a*) In recently concluded elections in December 2020, Faustin—Archange Touadera has now a second term in office as President of central African Republic.

145. (*d*) Legion of Merit award is the U.S. military most prestigious award that is given for exceptionally meritorious conduct in the performance of outstanding services and achievements. This award was confused to the Prime Minister of India in December, 2020. It was also awarded to the Prime Minister of Australia, Scott Morrison.

146. (*d*) It is a joint military exercise involving all the armed forces. The exercise involves synergised application of maritime surveillance assets, coordinated air and maritime strikes, air defence, submarine and landing operations.

147. (*d*) In Myanmar, the state of emergency has been declared. It was declared on 1st February, 2021. The emergency was declared for one year.

148. (*c*) Tamil Nadu won the Syed Mushtaq Ali Trophy, 2021. It is a domestic Twenty 20 cricket championship in India. The inaugural season (2006-07) was also won by Tamilnadu.

149. (*a*) Madagascar replaced Maldives to host the 2023 Indian Ocean Island Games. The 2023 Indian ocean island Games will be the 11th edition of multi-sport event for athletes.

150. (*c*) Claire Polosak is the first woman umpire in men ODI and first female umpire in domestic men's game.

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