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# NDA Solved PAPER 2019 - I

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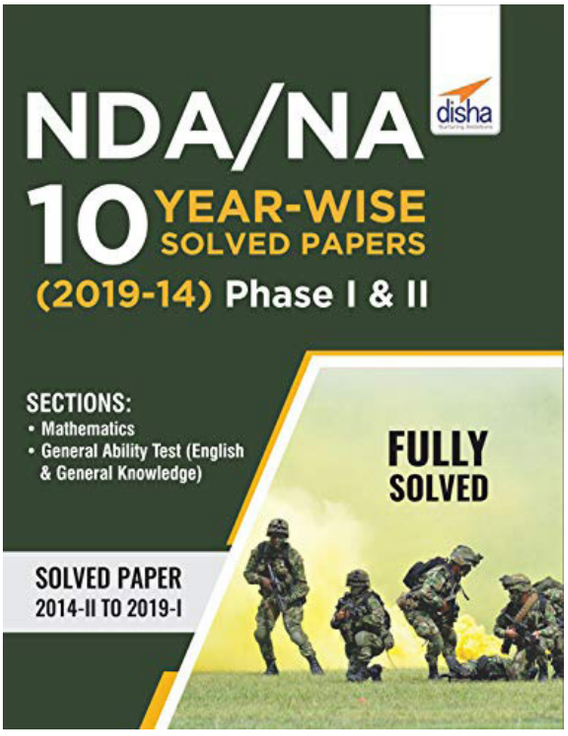


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# NDA SOLVED PAPER 2019 - I

## MATHEMATICS

**1.** What is the $n^{th}$ term of the sequence 25, –125, 625, –3125,...?
(a) $(-5)^{2n-1}$ (b) $(-1)^{2n}\,5^{n+1}$
(c) $(-1)^{2n-1}\,5^{n+1}$ (d) $(-1)^{n-1}\,5^{n+1}$

**2.** Suppose X = {1, 2, 3, 4} and R is a relation on X. If R = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 1), (2, 3). (3, 2)}, then which one of the following is correct?
(a) R is reflexive and symmetric, but not transitive
(b) R is symmetric and transitive, but not reflexive
(c) R is reflexiveand transitive, but not symmetric
(d) R is neither reflexive nor transitive, but symmetric

3. A relation R is defined on the set N of natural numbers as $xRy \Rightarrow x^2 - 4xy + 3y^2 = 0$, Then which one of the following is correct ?
(a) R is reflexive and symmetric, but not transitive
(b) R is reflexive and transitive , but not symmetric
(c) R is reflexive, symmetric and transitive
(d) R is reflexive, but neither symmetric nor transitive

4. If $A = \{x \in Z : x^2 - 1 = 0\}$ and $B = \{x \in Z : x^2 + x + 1 = 0\}$, where Z is set of complex numbers, then what is $A \cap B$ equal to ?
(a) Null set (b) $\left\{\frac{-1+\sqrt{3}\,i}{2}, \frac{-1-\sqrt{3}\,i}{2}\right\}$
(c) $\left\{\frac{-1+\sqrt{3}\,i}{4}, \frac{-1-\sqrt{3}\,i}{4}\right\}$ (d) $\left\{\frac{1+\sqrt{3}i}{2}, \frac{1-\sqrt{3}i}{2}\right\}$

5. Consider the following statements for the two non-empty sets A and B :
(1) $(A \cap B) \cup (A \cap \overline{B}) \cup (\overline{A} \cap B) = A \cup B$
(2) $(A \cup (\overline{A} \cap \overline{B})) = A \cup B$
Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

6. Let X be a non-empty set and let A, B, C be subsets of X. Consider the following statments :
(1) $A \subset C \Rightarrow (A \cap B) \subset (C \cap B)(A \cup B) \subset (C \cap B)$
(2) $(A \cup B) \subset (C \cap B)$ for all sets $B \Rightarrow A \subset C$
(3) $(A \cup B) \subset (C \cup B)$ for all sets $B \Rightarrow A \subset C$
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

7. If $B = \begin{bmatrix} 3 & 2 & 0 \\ 2 & 4 & 0 \\ 1 & 1 & 0 \end{bmatrix}$, then what is adjoint of B equal to ?
(a) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ -2 & -1 & 8 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 0 & -2 \\ 0 & 0 & -1 \\ 0 & 0 & 8 \end{bmatrix}$
(c) $\begin{bmatrix} 0 & 0 & 2 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ (d) It does not exist

8. What are the roots of the equation $|x^2 - x - 6| = x + 2$ ?
(a) –2, 1, 4 (b) 0, 2, 4
(c) 0, 1, 4 (d) –2, 2, 4

9. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then the matrix A is/an
(a) Singular matrix (b) Involutory matrix
(c) Nilpotent matrix (d) Idempotent matrix

10. If $\begin{bmatrix} x & -3i & 1 \\ y & 1 & i \\ 0 & 2i & -i \end{bmatrix} = 6 + 11i$, then what are the values of x and y respectively ?
(a) –3, 4 (b) 3, 4
(c) 3, – 4 (d) –3, – 4

11. The common roots of the equations $z^3 + 2z^2 + 2z + 1 = 0$ and $z^{2017} + z^{2018} + 1 = 0$ are
(a) –1, ω (b) 1, $\omega^2$
(c) –1, $\omega^2$ (d) ω, $\omega^2$

12. If C(20, n + 2) = C(20, n – 2), then what is n equal to ?
(a) 8 (b) 10
(c) 12 (d) 16

13. There are 10 points in a plane. No three of these points are in a straight line. What is the total number of straight lines which can be formed by joining the points?
(a) 90 (b) 45
(c) 40 (d) 30

14. The equation $px^2 + qx + r = 0$ (where p, q, r, all are positive) has distinct real roots a and b.
Which one of the following is correct ?
(a) a > 0, b > 0 (b) a < 0, b < 0
(c) a > 0, b < 0 (d) a < 0, b > 0

15. If A = {λ, (λ, μ)}, then the power set of A is
    (a) {ϕ, {ϕ}, {λ}, {λ, μ}}
    (b) {ϕ, {λ}, {{λ, μ}}, {λ, {λ, μ}}}
    (c) {ϕ, {λ}, {λ, μ}, {λ, {λ, μ}}}
    (d) {{λ}, {λ, μ}, {λ, {λ, μ}}}

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

In a school, all the students play at least one of three indoor games - chess, carrom and table tennis, 60 play chess, 50 play table tennis, 48 play carrom, 12 play chess and carrom, 15 play carrom and table tennis, 20 play table tennis and chess.

16. What can be the minimum number of students in the school?
    (a) 123 (b) 111
    (c) 95 (d) 63
17. What can be the maximum number of students in the school ?
    (a) 111 (b) 123
    (c) 125 (d) 135
18. If A is an identity matrix of order 3, then its inverse ($A^{-1}$)
    (a) is equal to null matrix (b) is equal to A
    (c) is equal to 3A (d) does not exist
19. A is a square matrix of order 3 such that its determinant is 4. What is the determinant of its transpose?
    (a) 64 (b) 36
    (c) 32 (d) 4
20. From 6 programmers and 4 typists, an office wants to recruit 5 people. What is the number of ways this can be done so as to recruit at least one typist ?
    (a) 209 (b) 210
    (c) 246 (d) 242
21. What is the number of terms in the expansion of $[(2x - 3y)^2 (2x + 3y)^2]^2$ ?
    (a) 4 (b) 5
    (c) 8 (d) 16
22. In the expansion of $(1 + ax)^n$, the first three terms are respectively 1, 12x and $64x^2$. What is n equal to?
    (a) 6 (b) 9
    (c) 10 (d) 12
23. The numbers 1, 5 and 25 can be three terms (not necessarily consecutive) of
    (a) only one AP
    (b) more than one but finite numbers of APs
    (c) infinite number of APs
    (d) finite number of GPs
24. The sum of $(p + q)^{th}$ and $(p - q)^{th}$ terms of an AP is equal to
    (a) $(2p)^{th}$ term (b) $(2q)^{th}$ term
    (c) Twice the $p^{th}$ term (d) Twice the $q^{th}$ term
25. If A is a square matrix of order n > 1, then which one of the following is correct ?
    (a) det (–A) = det A (b) det (–A) = $(-1)^n$ det A
    (c) det (–A) = – det A (d) det (–A) = n det A
26. What is the least value of 25 $\text{cosec}^2$ x + 36 $\sec^2$ x?
    (a) 1 (b) 11
    (c) 120 (d) 121

**Consider the following for the next 02 (two) items :**

Let A and B be (3 × 3) matrices with det A = 4 and det B = 3.

27. What is det (2AB) equal to ?
    (a) 96 (b) 72
    (c) 48 (d) 36
28. What is det ($3AB^{-1}$) equal to ?
    (a) 12 (b) 18
    (c) 36 (d) 48

**Consider the following for the next 02 (two) items:**

A complex number is given by $z = \dfrac{1+2i}{1-(1-i)^2}$

29. What is the modulus of z?
    (a) 4 (b) 2
    (c) 1 (d) $\frac{1}{2}$
30. What is the principal argument of z?
    (a) 0 (b) $\frac{\pi}{4}$
    (c) $\frac{\pi}{2}$ (d) π
31. What is the value of
    $\dfrac{\sin 34^\circ \cos 236^\circ - \sin 56^\circ \sin 124^\circ}{\cos 28^\circ \cos 88^\circ + \cos 178^\circ \sin 208^\circ}$ ?
    (a) –2 (b) –1
    (c) 2 (d) 1
32. tan 54° can be expressed as
    (a) $\dfrac{\sin 9^\circ + \cos 9^\circ}{\sin 9^\circ - \cos 9^\circ}$ (b) $\dfrac{\sin 9^\circ - \cos 9^\circ}{\sin 9^\circ + \cos 9^\circ}$
    (c) $\dfrac{\cos 9^\circ + \sin 9^\circ}{\cos 9^\circ - \sin 9^\circ}$ (d) $\dfrac{\sin 36^\circ}{\cos 36^\circ}$

**Consider the following for the next 03 (three) items:**

If p = X cos θ – Y sin θ, q = X sinθ + Y cos θ and $p^2 + 4pq + q^2 = AX^2 + BY^2$, $0 \le 0 \le \frac{\pi}{2}$.

33. What is the value of θ?
    (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$
    (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$
34. What is the value of A?
    (a) 4 (b) 3
    (c) 2 (d) 1
35. What is the value of B ?
    (a) –1 (b) 0
    (c) 1 (d) 2

**Consider the following for the next 02 (two) items:**

It is given that $\cos(\theta - \alpha) = a$, $\cos(\theta - \beta) = b$

36. What is $\cos(\alpha - \beta)$ equal to ?

(a) $ab + \sqrt{1-a^2}\sqrt{1-b^2}$ (b) $ab - \sqrt{1-a^2}\sqrt{1-b^2}$

(c) $a\sqrt{1-b^2} - b\sqrt{1-a^2}$ (d) $a\sqrt{1-b^2} + b\sqrt{1-a^2}$

37. What is $\sin^2(\alpha - \beta) + 2ab\cos(\alpha - \beta)$ equal to ?

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

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

38. If $\sin\alpha + \cos\alpha = p$, then what is $\cos^2(2\alpha)$ equal to ?

(a) $p^2$ (b) $p^2 - 1$

(c) $p^2(2 - p^2)$ (d) $p^2 + 1$

39. What is the value of $\sin^{-1}\frac{4}{5} + \sec^{-1}\frac{5}{4} - \frac{\pi}{2}$?

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

(c) $\pi$ (d) 0

40. If $\sin^{-1}\frac{2p}{1+p^2} - \cos^{-1}\frac{1-q^2}{1+q^2} = \tan^{-1}\frac{2x}{1-x^2}$, then what is x equal to ?

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

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

41. If $\tan\theta = \frac{1}{2}$ and $\tan\varphi = \frac{1}{3}$, then what is the value of $(\theta + \varphi)$ ?

(a) 0 (b) $\frac{\pi}{6}$

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

42. If $\cos A = \frac{3}{4}$, then what is the value of $\sin\left(\frac{A}{2}\right)\sin\left(\frac{3A}{2}\right)$?

(a) $\frac{5}{8}$ (b) $\frac{5}{16}$

(c) $\frac{5}{24}$ (d) $\frac{7}{32}$

43. What is the value of $\tan 75° + \cot 75°$ ?

(a) 2 (b) 4

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

44. What is the value of $\cos 46° \cos 47° \cos 48° \cos 49° \cos 50° .... \cos 135°$ ?

(a) –1 (b) 0

(c) 1 (d) Greater than 1

45. If $\sin 2\theta = \cos 3\theta$, where $0 < \theta < \frac{\pi}{2}$, then what is $\sin\theta$ equal to ?

(a) $\frac{\sqrt{5}+1}{4}$ (b) $\frac{\sqrt{5}-1}{4}$

(c) $\frac{\sqrt{5}+1}{16}$ (d) $\frac{\sqrt{5}-1}{16}$

46. If the roots of the equation $x^2 + px + q = 0$ are $\tan 19°$ and $\tan 26°$, then which one of the following is correct ?

(a) $q - p = 1$ (b) $p - q = 1$

(c) $p + q = 2$ (d) $p + q = 3$

47. What is the Fourth term of an AP of n terms whose sum is $n(n + 1)$ ?

(a) 6 (b) 8

(c) 12 (d) 20

48. What is $(1 + \tan\alpha \tan\beta)^2 + (\tan\alpha - \tan\beta)^2 - \sec^2\alpha \sec^2\beta$ equal to

(a) 0 (b) 1

(c) 2 (d) 4

49. If $p = \text{cosec}\,\theta - \cot\theta$ and $q = (\text{cosec}\,\theta + \cot\theta)^{-1}$, then which one of the following is correct ?

(a) $pq = 1$ (b) $p = q$

(c) $p + q = 1$ (d) $p + q = 0$

50. If the angles of a triangle ABC are in the ratio 1 : 2 : 3. then the corresponding sides are in the ratio

(a) 1 : 2 : 3 (b) 3 : 2 : 1

(c) $1 : \sqrt{3} : 2$ (d) $1 : \sqrt{3} : \sqrt{2}$

51. Consider the following statements :

1. For an equation of a line, $x\cos\theta + y\sin\theta = p$, in normal form, the length of the perpendicular from the point $(\alpha, \beta)$ to the line is $|\alpha\cos\theta + \beta\sin\theta + p|$.
2. The length of the perpendicular from the point $(\alpha, \beta)$ to the line $\frac{x}{a} + \frac{y}{b} = 1$ is $\left|\frac{a\alpha + b\beta - ab}{\sqrt{a^2 + b^2}}\right|$.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

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

52. A circle is drawn on the chord of a circle $x^2 + y^2 = a^2$ as diameter. The chord lies on the line $x + y = a$. What is the equation of the circle ?

(a) $x^2 + y^2 - ax - ay + a^2 = 0$

(b) $x^2 + y^2 - ax - ay = 0$

(c) $x^2 + y^2 + ax + ay = 0$

(d) $x^2 + y^2 + ax + ay - 2a^2 = 0$

53. The sum of the focal distances of a point on an ellipse is constant and equal to the

(a) length of minor axis

(b) length of major axis

(c) length of latus rectum

(d) sum of the lengths of semi-major and semi-minor axes

54. The equation $2x^2 - 3y^2 - 6 = 0$ represents
(a) a circle (b) a parabola
(c) an ellipse (d) a hyperbola

55. The two parabolas $y^2 = 4ax$ and $x^2 = 4ay$ intersect
(a) at two points on the line y = x
(b) only at the origin
(c) at three points one of which lies on y + x = 0
(d) only at (4a, 4a)

56. The points (1, 3) and (5, 1) are two opposite vertices of a rectangle. The other two vertices lie on the line y = 2x + c. What is the value of c?
(a) 2 (b) –2
(c) 4 (d) –4

57. If the lines 3y + 4x = 1, y = x + 5 and 5y + bx = 3 are concurrent, then what is the value of b?
(a) 1 (b) 3
(c) 6 (d) $\frac{1}{2}$

58. What is the equation of the straight line which is perpendicular to y = x and passes through (3, 2)?
(a) x – y = 5 (b) x + y = 5
(c) x + y = 1 (d) x – y = 1

59. The straight lines x + y – 4 = 0, 3x + y – 4 = 0 and x + 3y – 4 = 0 form a triangle, which is
(a) isosceles (b) right-angled
(c) equilateral (d) scalene

60. The circle $x^2 + y^2 + 4x - 7y + 12 = 0$, cuts an intercept on y-axis equal to
(a) 1 (b) 3
(c) 4 (d) 7

61. The centroid of the triangle with vertices A(2, –3, 3), B (5, –3, –4) and C (2, –3, –2) is the point
(a) (–3, 3, –1) (b) (3, –3, –1)
(c) (3, 1, –3) (d) (–3, –1, –3)

62. What is the radius of the sphere $x^2 + y^2 + z^2 - 6x + 8y - 10z + 1 = 0$?
(a) 5 (b) 2
(c) 7 (d) 3

63. The equation of the plane passing through the intersection of the planes 2x + y + 2z = 9, 4x – 5y – 4z = 1 and the point (3, 2, 1) is
(a) 10x – 2y + 2z = 28 (b) 10x + 2y + 2z = 28
(c) 10x + 2y – 2z = 28 (d) 10x – 2y – 2z = 24

64. The distance between the parallel planes 4x – 2y + 4z + 9 = 0 and 8x – 4y + 8z + 21 = 0 is
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{3}{2}$ (d) $\frac{7}{4}$

65. What are the direction cosines of z-axis ?
(a) < 1, 1, 1> (b) <1, 0, 0>
(c) <0, 1, 0> (d) <0, 0, 1>

66. If $\vec{a} = \hat{i} - 2\hat{j} + 5\hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - 3\hat{k}$ then what is $(\vec{b} - \vec{a}).(3\vec{a} + \vec{b})$ equal to?
(a) 106 (b) –106
(c) 53 (d) –53

67. If the position vectors of points A and B are $3\hat{i} - 2\hat{j} + \hat{k}$ and $2\hat{i} + 4\hat{j} - 3\hat{k}$ respectively, then what is the length of $\overrightarrow{AB}$ ?
(a) $\sqrt{14}$ (b) $\sqrt{29}$
(c) $\sqrt{43}$ (d) $\sqrt{53}$

68. If in a right-angled triangle ABC, hypotenuse AC = p, then what is $\overrightarrow{AB}.\overrightarrow{AC} + \overrightarrow{BC}.\overrightarrow{BA} + \overrightarrow{CA}.\overrightarrow{CB}$ equal to ?
(a) $p^2$ (b) $2p^2$
(c) $\frac{p^2}{2}$ (d) p

69. The sine of the angle between vectors $\vec{a} = 2\hat{i} - 6\hat{j} - 3\hat{k}$ and $\vec{b} = 4\hat{i} + 3\hat{j} - \hat{k}$
(a) $\frac{1}{\sqrt{26}}$ (b) $\frac{5}{\sqrt{26}}$
(c) $\frac{5}{26}$ (d) $\frac{1}{26}$

70. What is the value of λ for which the vectors $3\hat{i} + 4\hat{j} - \hat{k}$ and $-2\hat{i} + \lambda\hat{j} + 10\hat{k}$ are perpendicular?
(a) 1 (b) 2 (c) 3 (d) 4

71. What is the derivative of $\sec^2(\tan^{-1} x)$ with respect to x?
(a) 2x (b) $x^2 + 1$
(c) x + 1 (d) $x^2$

72. If $f(x) = \log_{10}(1 + x)$, then what is $4f(4) + 5f(1) - \log_{10} 2$ equal to ?
(a) 0 (b) 1
(c) 2 (d) 4

73. A function f defined by $f(x) = \ln(\sqrt{x^2 + 1} - x)$ is
(a) an even function
(b) an odd function
(c) Both even and odd function
(d) Neither even nor odd function

74. The domain of the function f defined by $f(x) = \log_x 10$ is
(a) x > 10 (b) x > 0 excluding x = 10
(c) x ≥ 10 (d) x > 0 excluding x = 1

75. $\lim_{x \to \infty} \frac{1 - \cos^3 4x}{x^2}$ is equal to
(a) 0 (b) 12
(c) 24 (d) 36

76. For r > 0, f(r) is the ratio of perimeter to area of a circle of radius r. Then f(1) + f(2) is equal to
(a) 1 (b) 2 (c) 3 (d) 4

77. If $f(x) = 3^{1+x}$, then f(x) f(y) f(z) is equal to
(a) f(x + y + z) (b) f(x + y + z + 1)
(c) f(x + y + z + 2) (d) f(x + y + z + 3)

78. The number of real roots for the equation $x^2 + 9 | x | + 20 = 0$ is
(a) Zero (b) One
(c) Two (d) Three

79. If f(x) = sin (cos x), then f' (x) is equal to
(a) cos (cos x) (b) sin (–sin x)
(c) (sin x) cos (cos x) (d) (–sin x) cos (cos x)

80. The domain of the function $f(x) = \sqrt{(2-x)(x-3)}$ is
(a) $(0, \infty)$ (b) $[0, \infty]$
(c) [2, 3] (d) (2, 3)

81. The solution of the differential equation

$\frac{dy}{dx} = \cos(y - x) + 1$ is
(a) $e^x[\sec(y - x) - \tan(y - x)] = c$
(b) $e^x[\sec(y - x) + \tan(y - x)] = c$
(c) $e^x \sec(y - x) \tan(y - x) = c$
(d) $e^x = c \sec(y - x) \tan(y - x)$

82. $\int_0^{\frac{\pi}{2}} | \sin x - \cos x | dx$ is equal to
(a) 0 (b) $2(\sqrt{2} - 1)$
(c) $2\sqrt{2}$ (d) $2(\sqrt{2} + 1)$

83. If y = a cos 2x + b sin 2x, then
(a) $\frac{d^2y}{dx^2} + y = 0$ (b) $\frac{d^2y}{dx^2} + 2y = 0$
(c) $\frac{d^2y}{dx^2} - 4y = 0$ (d) $\frac{d^2y}{dx^2} + 4y = 0$

84. A given quantity of metal is to be cast into a half cylinder (i,e, with a rectangular base and semicircular ends). If the total surface area is to be minimum, then the ratio of the height of the half cylinder to the diameter of the semicircular ends is
(a) $\pi : (\pi + 2)$ (b) $(\pi + 2) : \pi$
(c) 1 : 1 (d) None of the above

85. $\int_0^{\frac{\pi}{2}} e^{\sin x} \cos x \, dx$ is equal to
(a) e + 1 (b) e – 1
(c) e + 2 (d) e

86. If $f(x) = \frac{x-2}{x+2}, x \neq -2$, then what is $f^{-1}(x)$ equal to ?
(a) $\frac{4(x+2)}{x-2}$ (b) $\frac{x+2}{4(x-2)}$
(c) $\frac{x+2}{x-2}$ (d) $\frac{2(1+x)}{1-x}$

87. What is $\int \ln(x^2) dx$ equal to ?
(a) 2x ln(x) – 2x + c (b) $\frac{2}{x} + c$
(c) 2x ln(x) + c (d) $\frac{2\ln(x)}{x} - 2x + c$

88. The minimum distance from the point (4, 2) to $y^2 = 8x$ is equal to
(a) $\sqrt{2}$ (b) $2\sqrt{2}$
(c) 2 (d) $3\sqrt{2}$

89. The differential equation of the system of circles touching the y-axis at the origin is
(a) $x^2 + y^2 - 2xy\frac{dy}{dx} = 0$ (b) $x^2 + y^2 + 2xy\frac{dy}{dx} = 0$
(c) $x^2 - y^2 + 2xy\frac{dy}{dx} = 0$ (d) $x^2 - y^2 - 2xy\frac{dy}{dx} = 0$

90. Consider the following in respect of the differential equation :

$\frac{d^2y}{dx^2} + 2\left(\frac{dy}{dx}\right)^2 + 9y = x$

1. The degree of the differential equation is 1.
2. The order of the differential equation is 2.

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

91. What is the general solution of the differential equation $\frac{dy}{dx} + \frac{x}{y} = 0$?
(a) $x^2 + y^2 = c$ (b) $x^2 - y^2 = c$
(c) $x^2 + y^2 = cxy$ (d) $x + y = c$

92. The value of k which makes

$f(x) = \begin{cases} \sin x & x \neq 0 \\ k & x = 0 \end{cases}$ continuous at x = 0, is
(a) 2 (b) 1
(c) –1 (d) 0

93. What is the minimum value of $a^2x + b^2y$ where $xy = c^2$?
(a) abc (b) 2abc
(c) 3abc (d) 4abc

94. What is $\int e^{x\ln(a)} dx$ equal to ?
(a) $\frac{a^x}{\ln(a)} + c$ (b) $\frac{e^x}{\ln(a)} + c$
(c) $\frac{e^x}{\ln(ae)} + c$ (d) $\frac{ae^x}{\ln(a)} + c$

95. What is the area of one of the loops between the curve y = c sin x and x -axis ?
(a) c (b) 2c
(c) 3c (d) 4c

96. If $\sin\theta + \cos\theta = \sqrt{2}\cos\theta$, then what is $(\cos\theta - \sin\theta)$ equal to ?
(a) $-\sqrt{2}\cos\theta$ (b) $-\sqrt{2}\sin\theta$
(c) $\sqrt{2}\sin\theta$ (d) $2\sin\theta$

97. In a circle of diameter 44 cm, the length of a chord is 22 cm. What is the length of minor arc of the chord ?
(a) $\frac{484}{21}$cm (b) $\frac{242}{21}$cm
(c) $\frac{121}{21}$cm (d) $\frac{44}{7}$cm

98. If $\sin\theta = -\frac{1}{2}$ and $\tan\theta = \frac{1}{\sqrt{3}}$, then in which quadrant does $\theta$ lie ?
(a) First (b) Second
(c) Third (d) Fourth

99. How many three-digit even numbers can be formed using the digits 1, 2, 3, 4 and 5 when repetition of digits is **not** allowed ?
(a) 36 (b) 30
(c) 24 (d) 12

100. The angle of elevation of a tower of height h from a point A due South of it is x and from a point B due East of A is y. If AB = z, then which one of the following is correct ?
(a) $h^2(\cot^2 y - \cot^2 x) = z^2$
(b) $z^2(\cot^2 y - \cot^2 x) = h^2$
(c) $h^2(\tan^2 y - \tan^2 x) = z^2$
(d) $z^2(\tan^2 y - \tan^2 x) = h^2$

101. From a deck of cards, cards are taken out with replacement. What is the probability that the fourteenth card taken out is an ace ?
(a) $\frac{1}{51}$ (b) $\frac{4}{51}$
(c) $\frac{1}{52}$ (d) $\frac{1}{13}$

102. If A and B are two events such that P(A) = 0.5, P(B) = 0.6 and $P(A \cap B) = 0.4$, then what is $P(\overline{A \cup B})$ equal to ?
(a) 0.9 (b) 0.7
(c) 0.5 (d) 0.3

103. A problem is given to three students A, B and C whose probabilities of solving the problem are $\frac{1}{2}, \frac{3}{4}$ and $\frac{1}{4}$ respectively. What is the probability that the problem will be solved if they all solve the problem independently ?
(a) $\frac{29}{32}$ (b) $\frac{27}{32}$
(c) $\frac{25}{32}$ (d) $\frac{23}{32}$

104. A pair of fair dice is rolled. What is the probability that the second dice lands on a higher value than does the first ?
(a) $\frac{1}{4}$ (b) $\frac{1}{6}$
(c) $\frac{5}{12}$ (d) $\frac{5}{18}$

105. A fair coin is tossed and an unbiased dice is rolled together. What is the probability of getting a 2 or 4 or 6 along with head ?
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$
(c) $\frac{1}{4}$ (d) $\frac{1}{6}$

106. If A, B, C are three events, then what is the probability that at least two of these events occur together?
(a) $P(A \cap B) + P(B \cap C) + P(C \cap A)$
(b) $P(A \cap B) + P(B \cap C) + P(C \cap A) - P(A \cap B \cap C)$
(c) $P(A \cap B) + P(B \cap C) + P(C \cap A) - 2P(A \cap B \cap C)$
(d) $P(A \cap B) + P(B \cap C) + P(C \cap A) - 3P(A \cap B \cap C)$

107. If two variables X and Y are independent, then what is the correlation coefficient between them ?
(a) 1 (b) –1
(c) 0 (d) None of the above

108. Two independent events A and B are such that $P(A \cup B) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{6}$. If P (B) < P (A), then what is P(B) equal to ?
(a) $\frac{1}{4}$ (b) $\frac{1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{1}{6}$

109. The mean of 100 observations is 50 and the standard deviation is 10. If 5 is subtracted from each observation and then it is divided by 4, then what will be the new mean and the new standard deviation respectively ?
(a) 45, 5 (b) 11.25, 1.25
(c) 11.25, 2.5 (d) 12.5, 2.5

110. If two fair dice are rolled then what is the conditional probability that the first dice lands on 6 given that the sum of numbers on the dice is 8 ?
(a) $\frac{1}{3}$ (b) $\frac{1}{4}$
(c) $\frac{1}{5}$ (d) $\frac{1}{6}$

111. Two symmetric dice flipped with each dice having two sides painted red, two painted black, one painted yellow and the other painted white. What is the probability that both land on the same colour ?

(a) $\frac{3}{18}$ (b) $\frac{2}{9}$

(c) $\frac{5}{18}$ (d) $\frac{1}{3}$

112. There are n socks in a drawer, of which 3 socks are red. If 2 of the socks are chosen randomly and the probability that both selected socks are red is $\frac{1}{2}$, then what is the value of n?

(a) 3 (b) 4

(c) 5 (d) 6

113. Two cards are chosen at random from a deck of 52 playig cards. What is the probability that both of them have the same value?

(a) $\frac{1}{17}$ (b) $\frac{3}{17}$

(c) $\frac{5}{17}$ (d) $\frac{7}{17}$

114. In eight throws of a die, 5 or 6 is considered a success. The mean and standard deviation of total number of successes is respectively given by

(a) $\frac{8}{3}, \frac{16}{9}$ (b) $\frac{8}{3}, \frac{4}{3}$

(c) $\frac{4}{3}, \frac{4}{3}$ (d) $\frac{4}{3}, \frac{16}{9}$

115. A and B are two events such that $\bar{A}$ and $\bar{B}$ are mutually exclusive. If P(A) = 0.5 and P(B) = 0.6, then what is the value of P(A|B)?

(a) – (b) $\frac{1}{6}$

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

116. Consider the following statements :

1. The algebraic sum of deviations of a set of values from their arithmetic mean is always zero.
2. Arithmetic mean > Median > Mode for a symmetric distribution.

Which of the above statements is/are correct ?

(a) 1 only (b) 2 only

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

117. Let the correlation coefficient between X and Y be 0.6. Random variables Z and W are defined as Z = X + 5 and $W = \frac{Y}{3}$. What is the correlation coefficient between Z and W?

(a) 0.1 (b) 0.2

(c) 0.36 (d) 0.6

118. If all the natural numbers between 1 and 20 are multiplied by 3, then what is the variance of the resulting series ?

(a) 99.75 (b) 199.75

(c) 299.25 (d) 399.25

119. What is the probability that an interior point in a circle is closer to the centre than to the circumference ?

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

(c) $\frac{3}{4}$ (d) It cannot be determined

120. If A and B are two events, then what is the probability of occurrence of either event A or event B?

(a) P (A) + P(B) (b) P (A∪B)

(c) P (A ∩ B) (d) P(A) P(B)

## GENERAL ABILITY

### PART - A: English

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

1. Opening his letters (a) reading them carefully and sending (b) for this clerk he dictated answers with them (c) No error (d)

2. He was my school – friend (a) but becoming a great man, (b) he has grown proud enough to forget his old friends (c) No error (d)

3. Rabindranath Tagore, (a) a Nobel laureate and the author (b) of the national anthem found Shanthiniketan (c) No error (d)

4. The art of printing was introduced into England (a) during the reign of Edward IV (b) by William Caxton (c) a native of Kent No error (d)

5. From thirty years (a) he devoted himself to public affairs (b) without taking a holiday (c) No error (d)

6. If Ramesh will be promoted (a) | he will get (b) | a higher salary (c) | No error (d)

7. My brother goes (a) | to the office (b) | five day week (c) | No error (d)

8. If you lend Mohan a pen (a) | he will lend it to someone else (b) | and never you will get it back (c) | No error (d)

9. One of most widely spread (a) | bad habits (b) | is the use of tobacco (c) | No error (d)

10. A great part (a) | of Arabia (b) | is desert (c) | No error (d)

**DIRECTIONS :** *Each item in this section consists of a sentence with an underlined word followed by four words or group of words. Select the option that is* **nearest in meaning** *to the underlined word/ words and mark your response in your Answer Sheet accordingly.*

11. Some people complain when they encounter a small misfortune in the course of their thoroughly happy life.
(a) run into (b) run away
(c) run down (d) run with

12. This world is full of miseries.
(a) indifferent love (b) perfect happiness
(c) great suffering (d) moderate sympathies

13. A glance at a beautiful object gives us delight.
(a) wisdom (b) happiness
(c) purity (d) peace

14. It is terrible for people to die of starvation.
(a) starch (b) staple
(c) plenty (d) hunger

15. The university has constituted a grievance redressal committee to look into the matter.
(a) depression (b) complaint
(c) abrasion (d) gratefulness

16. Rakesh delivered a slanderous speech.
(a) abusive (b) praiseworthy
(c) moderate (d) inspiring

17. Suddenly, the sky was darkened by a gigantic bird.
(a) winged (b) small
(c) tiny (d) enormous

18. To abolish poverty would be to destroy the soil upon which mankind produces the virtues conducive to higher civilization.
(a) detest (b) eradicate
(c) nurture (d) assimilate

19. The Arabs who are not in the cities live in the desert throughout the year, shifting from one oasis to another.
(a) sandbank (b) mound
(c) dune (d) spring

20. The various facets of life can be found reflected in a large city.
(a) several (b) similar
(c) valuable (d) singular

**DIRECTIONS :** *Each item 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/words and mark your response in your Answer Sheet accordingly.*

21. Ramesh is a very dubious character.
(a) shady (b) suspicious
(c) trustworthy (d) doubtful

22. Do not indulge in unmindful activities, please.
(a) vigilant (b) careless
(c) stupid (d) fatuous

23. He is suffering from a curable disease.
(a) remediable (b) treatable
(c) terminal (d) operable

24. He was born on a very auspicious day.
(a) propitious (b) fortunate
(c) ominous (d) opportune

25. He has deeper hostility towards Mohan.
(a) animosity (b) belligerence
(c) malice (d) friendship

26. His life is rather monotonous.
(a) exciting (b) dreary
(c) tedious (d) uneventful

27. Macbeth is a morally repulsive character.
(a) abominable (b) attractive
(c) obnoxious (d) ugly

28. The serene beauty of Kashmir had a soothing effect on his mind.
(a) placid (b) pleasing
(c) tranquil (d) turbulent

29. Life is transient in nature.
(a) brief (b) momentary
(c) eternal (d) short-lived

30. Sohan is a vain person.
(a) modest (b) arrogant
(c) conceited (d) proud

**DIRECTIONS:** *Given below are some idioms/phrases followed by four alternative meanings to each. Choose the response (a), (b), (c) or (d) which is the most appropriate expression.*

31. A dark horse
(a) a black coloured horse
(b) a person who wins a race or competition although no one expected him to
(c) a person who keeps secrets
(d) an ignorant person

32. A show-stopper
    (a) someone who stops the show
    (b) someone who organizes the show
    (c) a performance that is extremely good
    (d) a fashionable person
33. A jack of all trades
    (a) someone who has many skills
    (b) a confident and not very serious young man
    (c) someone who has hit the jackpot
    (d) a great businessman
34. Fight tooth and nail
    (a) to quarrel with someone
    (b) to attack someone with a lot of force
    (c) to try hard to prevent something from happening
    (d) to try very hard to achieve something
35. Fair and square
    (a) in an honest way
    (b) in a critical way
    (c) neither very good nor very bad
    (d) in a foolish way

**DIRECTIONS:** *In this section each item consists of six sentences of a passage. Thc first and sixth sentences are given in the beginning as S1 and S6. The middle four sentences in each have been jumbled up and labelled P, Q, R and S. You are required to find the proper sequence of the four sentences and mark your response accordingly on the Answer Sheet.*

36. S1 : We do not know what to do with our knowledge.
    S6 : In the course of time they may rule over us altogether.
    P : For example, we are unable to manage our machines.
    Q : We already find it difficult to do without machines.
    R : Machines should be fed properly and waited upon attentively; otherwise they refuse to work or cause destruction.
    S : Science has given us superhuman powers, which we do not use properly.
    The proper sequence should be
    (a) S P R Q (b) P S Q R
    (c) Q R P S (d) S R P Q
37. S1 : The British rule in India has brought about moral, material, cultural and spiritual ruination of this great country.
    S6 : We are not to kill anybody but it is our *dharma* to see that the curse of this Government is blotted out.
    P : I regard this rule as a curse.
    Q : Sedition has become my religion.
    R : Ours is a non-violent battle.
    S : I am out to destroy this system of Government.
    The proper sequence should be
    (a) S P R Q (b) P S Q R
    (c) Q R P S (d) S R P Q

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

38. P. the urban local body elections
    Q. unidentified gunmen
    R. and injured another during
    S. shot dead two workers
    (a) Q S R P (b) P Q S R
    (c) S P R Q (d) R P S Q
39. P. both intense political and
    Q. this state has a history of
    R. of syncretic accomplishments
    S. religious contestation and
    (a) S Q P R (b) P Q S R
    (c) S Q R P (d) Q P S R
40. P the father also
    Q in his quest for justice
    R by the system
    S feels let down
    (a) S Q P R (b) P S R Q
    (c) S Q R P (d) P Q R S

**DIRECTIONS :** *In this section you have a passage. After the passage, you will find some items based on the passage. First, read the passage and answer the items based on it. You are required to select your answers based on the contents of the passage and opinion of the author only.*

**Passage**

I do not wish to suggest that because we were one nation we had no differences, but it is submitted that our leading men travelled throughout India either on foot or in bullock-carts. They learned one another's languages and there was no aloofness amongst them. What do you think could have been the intention of those farseeing ancestors of ours who established Setubandha (Rameshwar) in the South, Jagannath in the East and Haridwar in the North as places of pilgrimage ? You will admit they were no fools. They knew that worship of God could have been performed just as well at home. They taught us that those whose hearts were aglow with righteousness had the Ganges in their own homes. But they saw that India was one undivided land so made by nature. They, therefore, argued that it must be one nation. Arguing thus, they established holy places in various parts of India, and fired the people with an idea of nationality in a manner unknown in other parts of the world. And we Indians are one as no two Englishmen are. Only you and I and others who consider ourselves civilized and superior persons imagine that we are many nations. It was after the advent of railways that we began to believe in distinctions, and you are at liberty now to say that it is through the railways that we are beginning to abolish those distinctions. An opium-eater may argue the advantage of opium-eating from the fact that he began to understand the evil of the opium habit after having eaten it. I would ask you to consider well what I had said on the railways.

41. According to the author, India
    (a) has never been one nation
    (b) has been an aggregate of several nations
    (c) has always been one nation along with differences
    (d) became a nation after the British came

42. Why did the great sages of India establish pilgrimages in the different corners of the country ?
(a) Because they wanted to push people to travel to different places
(b) Because they could observe the underlying unity of the country as made by nature
(c) Because they themselves had travelled to these places
(d) Because they wanted people to be religious everywhere

43. In the passage, the author's attitude towards the railways is
(a) critical (b) sympathetic
(c) indifferent (d) apathetic

44. What does the author mean when he says that "whose hearts were aglow with righteousness had the Ganges in their own homes" ?
(a) One need not visit the Ganges to take holy bath
(b) The Ganges has been polluted, so one should bath at home
(c) One should take a holy dip in the Ganges to purity one's heart
(d) The purity of heart is superior to observance of any ritual

45. The paragraph is written in a
(a) dialogic style (b) prescriptive style
(c) descriptive style (d) analytical style

**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 indicate your response on the Answer Sheet accordingly.*

46. _____ forests prevent erosion.
(a) Lean (b) Dense
(c) Sparse (d) Tidy

47. Three people were arrested and an illegal arms unit was _____ by the police in a raid.
(a) revealed (b) searched
(c) discovered (d) busted

48. A woman got into the car and _____.
(a) drove off (b) broke down
(c) rode in (d) drove in

49. The lecture was not very interesting. In fact I _____ in the middle of it.
(a) showed off (b) put off
(c) dozed off (d) plugged off

50. The cops _____ murder by kin.
(a) suspect (b) afford
(c) manage (d) administer

## PART-B: GENERAL KNOWLEDGE

51. Which one of the following cell organelles does NOT possess nucleic acid ?
(a) Nucleolus (b) Chloroplast
(c) Ribosome (d) Plasma Membrane

52. Which one of the following cell organelles does NOT possess its own genetic material encoding proteins ?
(a) Ribosome (b) Nucleus
(c) Mitochondria (d) Chloroplast

53. Which one of the following is NOT a component of conducting tissue in plants ?
(a) Fibres (b) Tracheids
(c) Pericycle (d) Sieve tubes

54. Which one of the following organisms has vascular tissues?
(a) *Cladophora* (b) *Penicillium*
(c) *Marsilea* (d) *Anabaena*

55. Which one of the following organisms represents the primary consumer category in an ecosystem?
(a) Caterpillar (b) Crabapple tree
(c) Frog (d) Sparrowhawk

56. Spring tides refer to
(a) greatest difference in the sea level at high and low tides
(b) lowest difference in the sea level at high and low tides
(c) no difference in the sea level at high and low tides
(d) counteraction of gravitational pull of the Sun to that of Moon

57. Which one of the following energy is stored in the links between the atoms ?
(a) Nuclear energy (b) Chemical energy
(c) Potential energy (d) Thermal energy

58. The light energy escaping from the Sun can be spread by
(a) a shower of rain drops
(b) a plane mirror
(c) a convex lens
(d) a combination of a convex lens and a concave lens

59. The correct sequence of energy transfer that occurs when an apple falls to the ground is
(a) Gravitational potential energy → heat energy to air → kinetic energy → heat energy to ground and apple → sound energy
(b) Gravitational potential energy → sound energy → kinetic energy → heat energy to air → heat energy to ground and apple
(c) Gravitational potential energy → kinetic energy → heat energy to air → heat energy to ground and apple → sound energy
(d) Gravitational potential energy → kinetic energy → sound energy → heat energy to air → heat energy to ground and apple

60. Which one of the following minerals is used as a fuel in nuclear power stations ?
(a) Bauxite (b) Quartz
(c) Feldspar (d) Pitchblende

61. Which one of the following is NOT a synthetic detergent ?
(a) $CH_3(CH_2)_{10}CH_2O\ SO_3^-\ Na^+$
(b) $[CH_3(CH_2)_{15}–N–(CH_3)_3]^+\ Br^-$
(c) $CH_3(CH_2)_{16}COO^-Na^+$
(d) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$

62. Which one of the following is an example of a clean fuel ?
(a) Coke (b) Propane
(c) Petrol (d) Wax

63. Which one of the following metals does NOT react with cold water ?
(a) Calcium (Ca) (b) Potassium (K)
(c) Magnesium (Mg) (d) Sodium (Na)

64. In which of the following pairs are the ions isoelectronic ?
(a) $Mg^{2+}$, Ar (b) $Na^+$, $O^{2-}$
(c) $A1^{3+}$, $Cl^-$ (d) $K^+$, Ne

65. Which one of the following is used as a binder in paints ?
(a) Titanium dioxide (b) Novolac
(c) Phthalocyanine (d) Silicones

66. Which one of the following is NOT true in reference to Air mass ?
(a) Air mass forms either in tropical or in polar region
(b) Air mass develops on continents as well as over ocean
(c) Air mass develops in a cyclonic condition
(d) Air mass changes the weather conditions

67. National Water Academy, a centre of excellence in training and capacity building in water resource, is located at
(a) New Delhi (b) Kolkata
(c) Pune (d) Chennai

68. "Campos" and "Llanos", Tropical Savanna grasslands are generally found in
(a) Australia (b) Central Africa
(c) South America (d) East Asia

69. "Viticulture" is a common feature of which one of the following Australian cities ?
(a) Adelaide (b) Darwin
(c) Hobart (d) Brisbane

70. "Shamal" warm and dry wind is a "Local" wind found in
(a) East Asia (b) West Coast of Africa
(c) Sahara of Africa (d) Mesopotamia

71. "Inversion of Rainfall" is associated with
(a) Orographic rainfall
(b) Convectional rainfall
(c) Cyclonic rainfall (Tropical)
(d) Cyclonic rainfall (Temperate)

72. Who was the author of the book 'History of British India' ?
(a) Charles Grant (b) John Stuart Mill
(c) James Mill (d) William Jones

73. The Azamgarh Proclamation of August 25, 1857 stressed on which one of the following issues ?
(a) Hindu-Muslim divide
(b) Support to the English Government
(c) The return of the Badshahi
(d) The imposition of heavy Jumas (revenue demand)

74. Which Viceroy had made the observation, "It's a beautiful world if it wasn't for Gandhi ....." ?
(a) Lord Irwin (b) Lord Wavell
(c) Lord Mountbatten (d) Lord Willingdon

75. Which Indian businessman favoured 'healthy capitalism' in helping Gandhiji to work towards a 'common object' ?
(a) Ghanshyam Das Birla
(b) Ambalal Sarabhai
(c) Sir Biren Mookerjee
(d) T. T. K. Krishnamachari

76. The art piece "In Memoriam" was a creation of which one of the following European painters ?
(a) Thomas Jones Barker
(b) Joseph Noel Paton
(c) Thomas Daniell
(d) Charles D'Oyly

77. Which one of the following can charge an insulator ?
(a) Current electricity (b) Static electricity
(c) Magnetic field (d) Gravitational field

78. At 20°C, the speed of sound in water is approximately
(a) 330 m/s (b) 800 m/s
(c) 1500 m/s (d) 5000 m/s

79. Which one of the following could be the melting point of iron ?
(a) 25°C (b) 37°C
(c) 500°C (d) 1500°C

80. Let us consider a copper wire having radius $r$ and length $l$. Let its resistance be $R$. If the radius of another copper wire is $2r$ and the length is $l/2$ then the resistance of this, wire will be
(a) $R$ (b) $2R$
(c) $R/4$ (d) $R/8$

81. Basic scientific principle behind a nuclear reactor is
(a) Nuclear fusion
(b) Controlled nuclear fusion
(c) Uncontrolled nuclear fission
(d) Controlled nuclear fission

82. Which one of the following statements is NOT correct for the given reaction ?
$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$
(a) Iron is the reducing agent
(b) The solution turns green in colour after the reaction
(c) Copper is a more reactive metal than iron
(d) The reaction is an example of a redox reaction

83. Which one of the following is an organic acid ?
(a) Hydrochloric acid (b) Nitric acid
(c) Acetic acid (d) Sulphuric acid

84. Dinitrogen ($N_2$) and dioxygen ($O_2$) are the main constituents of air but they do not react with each other to form oxides of nitrogen because
(a) the reaction requires initiation by a catalyst
(b) oxides of nitrogen are unstable
(c) the reaction is endothermic and requires very high temperature
(d) the stoichiometry of $N_2$ and $O_2$ in air is not ideal for the reaction to take place

85. Who among the following has explained the phenomenon of photoelectric effect ?
(a) Max Planck (b) Albert Einstein
(c) Neils Bohr (d) Ernest Rutherford

86. The equivalent weight of oxalic acid in $C_2H_2O_4.2H_2O$ is
(a) 45 (b) 63
(c) 90 (d) 126

87. Which one of the following is NOT a west flowing river ?
(a) Periyar (b) Bharatpuzha
(c) Pamba (d) Tamraparni

88. Which one of the following rivers was earlier known as "Vitasta" ?
(a) Tista (b) Jhelum
(c) Tungabhadra (d) Bharatpuzha

89. River Sarda drains in the Northern Plains of Uttar Pradesh. Before entering in the Plains, Sarda is known as
(a) Saraswati (b) Bhagirathi
(c) Kali (d) Pindar

90. "Mission Indradhanush" is related to
(a) Bullet train project
(b) Agriculture development
(c) Women empowerment
(d) Full immunization

91. Which of the following is/are environmental effects of Rotation of the Earth ?
1. Daily or diurnal rhythm in day-light and air temperature
2. Flow path of both air and water are turned consistently in a side-ward direction
3. The movement of the tides
Select the correct answer using the code given below :
(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 3 only

92. Who among the following historians have described the Quit India movement as a 'spontaneous revolution' ?
(a) Gordon Johnson (b) David Arnold
(c) F G Hutchins (d) Peter Robb

The following 3 (three) items consist of two statements, Statement I and Statement II. Examine these two statements carefully and select the correct answer using the code given below :

**Code :**
(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true and Statement II is NOT the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

93. **Statement I :** Abul Fazl shaped, represented and articulated the ideas associated with the reign of Akbar
**Statement II :** The qualities of Abul Fazl impressed Akbar who found the former suitable as an adviser and spokesperson for his policies

94. **Statement I :** The Kisan manifesto adopted by the All India Kisan Sabha in August 1936 contained radical demands
**Statement II :** The All India Kisan Sabha was a part of the Congress and maintained close relationship with the Provincial Congress Committees

95. **Statement I :** The British ruled India through a modern bureaucracy headed by the Indian Civil Service, whose members were recruited through merit based on open competition
**Statement II :** The Indian Civil Service was based on the whole hearted participation of Indians

96. Two metallic wires $A$ and $B$ are made using copper. The radius of wire $A$ is $r$ while its length is $l$. A dc voltage $V$ is applied across the wire $A$, causing power dissipation, $P$. The radius of wire $B$ is $2r$, and its length is $2l$ and the same dc voltage $V$ is applied across it causing power dissipation $P_1$. Which one of the following is the correct relationship between $P$ and $P_1$ ?
(a) $P = 2P_1$ (b) $P = P_1/2$
(c) $P = 4P_1$ (d) $P = P_1$

97. Consider the following Statements about a solenoid :
1. The magnetic field strength in a solenoid depends upon the number of turns per unit length in the solenoid
2. The magnetic field strength in a solenoid depends upon the current flowing in the wire of the solenoid
3. The magnetic field strength in a solenoid depends upon the diameter of the solenoid
Which of the statements given above are correct ?
(a) 1, 2 and 3 (b) 1 and 3 only
(c) 2 and 3 only (d) 1 and 2 only

98. Light year is a unit of measurement of
(a) very large distances
(b) time interval in years
(c) amount of light received on earth in a year
(d) mass of atoms

99. The focal length of the objective lens of a telescope is 50 cm. If the magnification of the telescope is 25, then the focal length of the eye-piece is
(a) 12.5 cm (b) 5 cm
(c) 2 cm (d) 10 cm

100. Which one of the following forces is non-central and non-conservative ?
(a) Frictional force (b) Electric force
(c) Gravitational force (d) Mechanical force

101. On exposure to moist air, copper gains a green coat on its surface due to formation of which one of the following compounds ?
(a) Copper carbonate (b) Copper oxide
(c) Copper sulphate (d) Copper nitrate

102. Which one of the following will NOT produce carbon dioxide on reacting with an aqueous solution of hydrochloric acid ?
(a) Limestone (b) Quick Lime
(c) Chalk (d) Marble

103. Which one of the following substances is NOT a mixture?
(a) Ice (b) Ice-cream
(c) Air (d) Honey

104. Which one of the following is an example of Salt-Crystal growth ?
(a) Chemical weathering
(b) Physical weathering
(c) Biological weathering
(d) Bio-chemical weathering

105. Which one of the following is the correct sequence of proved coal reserves in the Indian States in decreasing order ?
(a) Jharkhand, Chhattisgarh, Odisha, West Bengal
(b) Jharkhand, Odisha, Chhattisgarh, West Bengal
(c) Odisha, West Bengal, Jharkhand, Chhattisgarh
(d) Odisha, Chhattisgarh, West Bengal, Jharkhand

106. Consider the following statements relating to Richter scale :
1. It was devised in 1935 by Charles F. Richter
2. It describes the quantity of energy released by a single earthquake
3. Richter Scale has no upper limit
Which of the statements given above is/are correct?
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

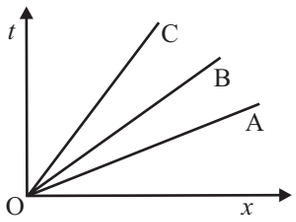
107. Which one of the following ocean currents is NOT a cold ocean current ?
(a) Canary current (b) California current
(c) Kuroshio current (d) Oyashio current

108. What is the time gap in occurrence of two successive tides at a given place on the ocean surface ?
(a) 12 hours (b) 12 hours 26 minutes
(c) 24 hours (d) 24 hours 52 minutes

109. Tooth enamel is made up of which one of the following calcium compounds ?
(a) Calcium carbonate (b) Calcium sulphate
(c) Calcium hydroxide (d) Calcium phosphate

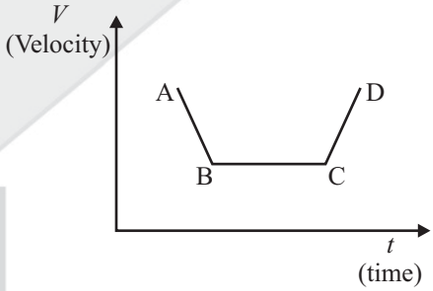
110. Suppose there are two planets, 1 and 2, having the same density but their radii are $R_1$ and $R_2$ respectively, where $R_1 > R_2$. The accelerations due to gravity on the surface of these planets are related as
(a) $g_1 > g_2$ (b) $g_1 < g_2$
(c) $g_1 = g_2$ (d) Can't say anything

111. The Sun is seen little before it rises and for a short while after it sets. This is because of
(a) total internal reflection
(b) atmospheric refraction
(c) apparent shift in the direction of Sun
(d) dispersion

112. 

The figure shown above gives the time ($t$) versus position ($x$) graphs of three objects $A$, $B$ and $C$. Which one of the following is the correct relation between their speeds $V_A$, $V_B$ and $V_C$, respectively at any instant ($t > 0$) ?
(a) $V_A < V_B < V_C$ (b) $V_A > V_B > V_C$
(c) $V_A = V_B = V_C \neq 0$ (d) $V_A = V_B = V_C = 0$

113. 1 dyne (a unit of force in CGS system) equals to
(a) $10^3$ g cm/s$^2$ (b) $10^{-3}$ g cm/s$^2$
(c) $10^5$ kg cm/s$^2$ (d) $10^{-5}$ kg cm/s$^2$

114. 

In the given velocity ($V$) versus time ($t$) graph, accelerated and decelerated motions are respectively represented by line segments
(a) $CD$ and $BC$ (b) $BC$ and $AB$
(c) $CD$ and $AB$ (d) $AD$ and $CD$

115. Which one of the following statements regarding a thermos flask is NOT correct?
(a) The walls of flask are separated by vacuum and made of glass which is a poor conductor of heat
(b) The glass walls themselves have shiny surfaces
(c) The surface of inner wall radiates good amount of heat and the surface of outer wall absorbs some of the heat that is radiated from the inner wall
(d) The cork supports are poor conductors of heat

116. 'Black hole' is a
(a) huge black star which has zero acceleration due to gravity on its surface
(b) star which has moderate acceleration due to gravity on its surface
(c) star which has collapsed into itself and has large acceleration due to gravity on its surface
(d) star which has collapsed into itself and has zero acceleration due to gravity on its surface

117. The formula for conversion between Fahrenheit and Celsius is
°F = $X$ + (1.8 × °C)
What is factor $X$ ?
(a) 32 (b) 22
(c) 98 (d) 42

118. When a beam of white light passes through a glass prism, the colour of light beam that deviates the least is
(a) Blue (b) Red
(c) Green (d) Violet

119. LIGO stands for
(a) Laser Interferometer Gravitational wave Observatory
(b) Light Interferometer Gravitational wave Observatory
(c) Light Induced Gravity Observatory
(d) Laser Induced Gaseous Optics

120. A fuse wire must be
(a) conducting and of low melting point
(b) conducting and of high melting point
(c) insulator and of high melting point
(d) insulator and of low melting point

121. Kamarajar Port was commissioned in 2001 to handle thermal coal requirements. It is situated along the coast of which Indian State ?
(a) Andhra Pradesh (b) Odisha
(c) Tamil Nadu (d) Karnataka

122. Which one of the following Union Territories of India is the smallest in terms of geographical area ?
(a) Daman and Diu
(b) Chandigarh
(c) Dadra and Nagar Haveli
(d) Lakshadweep

123. Which one of the following can be said to be essentially related to 'Polar Front Theory' ?
(a) Anticyclone
(b) Tropical Cyclone
(c) Temperate Cyclone
(d) Inter Tropical Convergence

124. Brahmaputra and Indus rivers are antecedent rivers. Which one of the following may be the true definition of an antecedent drainage ?
(a) Which follows the initial slope of the Himalaya
(b) Which existed before the Himalayan range came into existence
(c) Which followed the dip or rock beds of the Himalaya
(d) Which followed the strikes of rock beds of the Himalaya

125. The Karachi resolution of Congress in 1931 advocated which one of the following issues ?
(a) State shall not own or control key industries and services
(b) State shall handover the key industries and services to the Indian business groups
(c) State should allow the Indian business group to invest fifty per cent of the capital
(d) State shall own or control key industries and services

126. The treaty of Schonbrunn (1809) was signed after which one of the following battles ?
(a) Battle of Austerlitz (b) Battle of Tilsit
(c) Battle of Wagram (d) Battle of Lisbon

127. Which of the following statements about The New Model Unions is/are correct ?
1. The New Model Unions were formed in the 1850s
2. The New Model Unions were formed in the 1880s
3. The New Model Unions comprised a Labour Party idea
4. The New Model Unions excluded women in the 1920s

Select the correct answer using the code given below :
(a) 1 (b) 2
(b) 3 and 4 (d) 3 only

128. The Truman Doctrine of 1947 was announced to achieve which one of the following ?
(a) Containment of the USSR
(b) Increasing agricultural production in the USA
(c) Offering friendship to Europe
(d) Strengthening the UNO

129. Which of the following statements is/are correct ?
1. In 1948, Burma was admitted to the United Nations and immediately supported the USA in the Cold War
2. In 1948, Burma joined the United Nations but refused to denounce China as the aggressor in the Korean War

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

130. Who among the following presented 'The April Theses' to the Russian people in 1917 ?
(a) Stalin (b) Trotsky
(c) Bukharin (d) Lenin

131. An Election Commissioner can be removed from office on the recommendation of
(a) The Chief Justice of India
(b) The Chief Election Commissioner
(c) The President of India
(d) The Parliament

132. Which one of the following statements regarding the Rajya Sabha is NOT correct ?
(a) Its members are elected by the elected members of the Legislative Assembly of a State
(b) The election follows the system of proportional representation by means of a single transferable vote
(c) 1/3rd of its members retire after every two years
(d) It is a permanent body, but can be dissolved earlier by the President

133. Fundamental right guaranteed under which one of the following Articles of the Constitution of India is available only to the citizens of India ?
(a) Article 19 (b) Article 20
(c) Article 21 (d) Article 22

134. The treaty of Yandabo was signed in
(a) 1826 (b) 1825
(c) 1824 (d) 1823

135. In the Manusmriti which form of marriage results from the "Voluntary union of a maiden and her lover" ?
(a) Eighth form (b) Fifth form
(c) Seventh form (d) Sixth form

136. Consider the following description of the Samadhi of a former Prime Minister of India :
Central Samadhi platform comprises nine square black polished granite solid stone blocks, capped with a 'Diya' in the centre. The number nine holds significance and represents the navarasas, navaratras and navagrahas. Then placement of the nine-square Samadhi is in a circular lotus shaped pattern. The nine-square platform is accessed in four cardinal directions by pathways made in white composite tiles so that the floor does not get heated.
Identify the Samadhi :
(a) Shakti Sthal (b) Shantivan
(c) Sadaiv Atal (d) Veer Bhumi

137. IMBEX is a joint exercise conducted regularly between Armies of India and
(a) Malaysia (b) Maldives
(c) Mauritius (d) Myanmar

138. Who among the following was awarded The Hindu Prize in Fiction category for the year 2018 ?
(a) Neelum Saran Gour
(b) N Kalyan Raman
(c) Manoranjan Byapari
(d) Arunav Sinha

139. Who among the following was appointed as head of the seven member committee to look into revenue shortfall being faced by the states after the GST roll-out in India and suggest steps for augmenting collections ?
(a) Himanta Biswa Sharma
(b) Thomas Isaac
(c) Sushil Modi
(d) Capt Abhimanyu

140. The 15$^{th}$ Pravasi Bharatiya Divas, 2019 was held in
(a) New Delhi (b) Gandhi Nagar
(c) Prayagraj (d) Varanasi

141. Which one of the following cities was named by UNESCO as World Capital of Architecture for 2020 ?
(a) Tokyo (b) Johannesburg
(c) Rio de Janerio (d) New Delhi

142. Who among the following was named ICC's emerging player of the year 2018 ?
(a) Rishabh Pant (b) Josh Hazlewood
(c) Hasan Ali (d) Mustafizur Rahman

143. India's first private sector Howitzer gun-making unit is located at
(a) Jamshedpur (b) Kolkata
(c) Hazira (d) Gwalior

144. Which of the following pairs of old names and new names of islands in India is/are correctly matched ?
1. Ross Island : Shaheed Dweep
2. Neil Island : Netaji Subhas Chandra Bose Dweep
3. Havelock Island : Swaraj Dweep
Select, the correct answer using the code given below :
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 1 and 2 only (d) 3 only

145. Who among the following was posthumously conferred with the Ashoka Chakra, India's highest peacetime gallantry award, in 2019 ?
(a) Jyoti Prakash Nirala (b) Nazir Ahmad Wani
(c) Hangpan Dada (d) Mohan Nath Goswami

146. As per the code of the nomenclature, which one of the following is the correct way of writing a biological name ?
(a) Amoeba Proteus (b) Amoeba proteus
(c) amoeba proteus (d) Amoeba Proteus

147. Which one of the following statements regarding Electrocardiogram is correct ?
(a) Electrocardiogram is graphical representation of electrical activity of cornea
(b) Electrocardiogram is graphical representation of activity of kidney
(c) Electrocardiogram is graphical representation of activity of brain
(d) Electrocardiogram is graphical representation of electrical activity of heart

148. Which one of the following statements regarding Penicillin is correct ?
(a) Penicillin resistant bacteria can store this antibiotic in vacuole
(b) Penicillin resistant bacteria can degrade this antibiotic by an enzyme called β-lactamase
(c) Penicillin resistant bacteria can degrade this antibiotic by an enzyme called lactic acid dehydrogenase
(d) Penicillin is not absorbed by bacteria; so most bacteria are resistant

149. Which one of the following organelles of mammalian cell is rich in hydrolytic enzymes ?
(a) Mitochondria (b) Ribosomes
(c) Lysosome (d) Nucleus

150. Which one of the following statements regarding Cholera is correct ?
(a) Cholera is a disease that causes loss of memory
(b) Cholera is a disease of muscles due to consumption of alcohol
(c) Cholera is a disease due to consumption of contaminated food or water
(d) Cholera is a genetic disease

# HINTS & SOLUTIONS

## MATHEMATICS

1. (d) Given series 25, –125, 625, –3125 ..... is geometric progression.

$a = t_1 = 25, t_2 = -125$

$r = \frac{t_2}{t_1} = \frac{-125}{25} = -5$

$n^{th}$ term $(t_n) = ar^{n-1}$

$= (25)(-5)^{n-1}$

$= (5)^2 (-1)^{n-1} (5)^{n-1}$

$= (-1)^{n-1} (5)^{2+n-1}$

$= (-1)^{n-1} 5^{n+1}$

2. (d) Given, x = {1, 2, 3, 4}

R = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 1), (2, 3), (3, 2)}

R is reflexive, if aRa for all a ∈ x

(4, 4) ∉ R

∴ R is not reflexive ...(1)

R is transitive, if a R b, b R c ⇒ aR C for all a, b, c ∈ x

(1, 2), (2, 3), ∈ R, but (1, 3)∉ R

∴ R is not transitive ...(2)

R is symmetric, if a R b ⇒ b R a, for all a, b ∈ x

∴ R is symmetric ...(3)

From (1), (2), (3) we can say, R, is neither reflexive nor transitive, but symmetric.

∴ Correct option (d)

3. (d) Given, x R Y $\Rightarrow x^2 - 4xy + 3y^2 = 0$

$\Rightarrow x^2 - xy - 3xy + 3y^2 = 0$

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

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

Reflexive property :

x R x ⇒ (x – x ) (– 3x) = 0

So, R is reflexive ...(1)

Symmetric property:

Let us check using an example (1, 2) and (2, 1)

for (1, 2) ⇒ (1 – 2) (1 – 6) = (–1) (–5) = 10

For (2, 1) ⇒ (2 – 1) (2 – 3) = (1) (–1) = –1

So, R is not symmetric ...(2)

Transitive property :

For (9x, 3x) ⇒ (9x – 3x) (9x – 9x) = 0

for (3x, x) ⇒ (3x – 3x) (3x – 9x) = 0

For (9x, x) ⇒ (9x – x) (9x – 3x) ≠ 0

So, (9x, 3x) ∈ R, (3x, x) ∈ R but (9x, x) ∉ R

So, R is not transitive ...(3)

From (1), (2), (3), R is reflexive, but not symmetric and transitive.

4. (b) Given, A = {x ∈ z : $x^3 - 1 = 0$}

B = {x ∈ z : $x^2 + x + 1 = 0$}

The roots of $x^3 - 1 = 0$ are 1, w, $w^2$

The roots of $x^2 + x + 1 = 0$ are ω, $\omega^2$

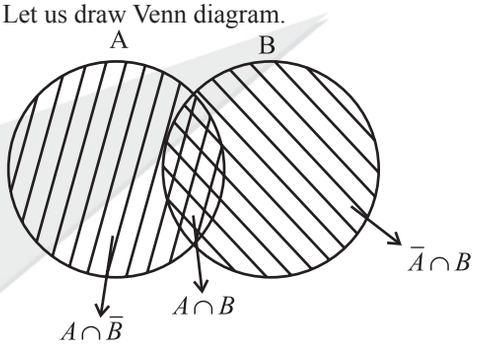
∴ A ∩ B = {1, ω, $\omega^2$} ∩ {ω, $\omega^2$}

= {ω, $\omega^2$}

$= \left\{\frac{-1+\sqrt{3}i}{2}, \frac{-1-\sqrt{3}i}{2}\right\}$

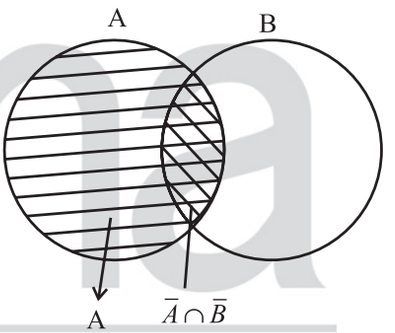
5. (a) 1. $(A \cap B) \cup (A \cap \bar{B}) \cup (\bar{A} \cap B) = A \cup B$

Let us draw Venn diagram.




∴ 1 is correct.

2. $A \cup (\bar{A} \cap \bar{B}) = A$




∴ 2 is not correct.

Correct option (a).

6. (b) Statements (2) and (3) are correct.

7. (a) $B = \begin{bmatrix} 3 & 2 & 0 \\ 2 & 4 & 0 \\ 1 & 1 & 0 \end{bmatrix}$

C factor matrix of

$$B = \begin{bmatrix} (4)(0)-(0)(1) & -[(2)(0)-(0)(1)] & (2)(1)-(4)(1) \\ -[2(0)-(0)(1)] & 3(0)-(0)(1) & -[(3)(1)-(2)(1)] \\ 2(0)-0(4) & -[3(0)-2(0)] & 3(4)-2(2) \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & -2 \\ 0 & 0 & -1 \\ 0 & 0 & 8 \end{bmatrix}$$

$$\text{Adjoint } B = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ -2 & -1 & 8 \end{bmatrix}$$

8. (d) Given, $|x^2 - x - 6| = x + 2$
$\therefore x^2 - x - 6 = x + 2$ and $x^2 - x - 6 = -(x + 2)$
$\Rightarrow x^2 - 2x - 8 = 0$
$\Rightarrow x^2 - x - 6 = -x - 2$
$\Rightarrow x^2 - 4x + 2x - 8 = 0$
$\Rightarrow x^2 = 4$
$\Rightarrow x(x - 4) + 2(x - 4) = 0$
$\Rightarrow x = +2, -2$
$\Rightarrow x = 4, -2$
$\therefore x = -2, 2, 4.$

9. (b) $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$$A^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} (1)(1)+(0)(0) & (1)(0)+(0)(1) \\ (0)(1)+(1)(0) & (0)(0)+(1)(1) \end{bmatrix}$$

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

$\therefore$ It is involuntary matrix.

10. (a) $\begin{bmatrix} x & -3i & 1 \\ y & 1 & i \\ 0 & 2i & -i \end{bmatrix} = 6 + 11i$

$\Rightarrow x[-i - (2i)(i)] - y[(-3i)(-i) - (2i)(1)] + 0 = 6 + 11i$
$\Rightarrow x(-i + 2) - y(-3 - 2i) = 6 + 11i$
$\Rightarrow -xi + 2x + 3y + 2yi = 6 + 11i$
$\Rightarrow (2x + 3y) + (-x + 2y)i = 6 + 11i$
$\therefore 2x + 3y = 6$ and $-x + 2y = 11$
Solving the equations,

$$\begin{array}{r} 2x + 3y = 6 \\ -2x + 4y = 22 \\ \hline 7y = 28 \Rightarrow y = 4 \end{array}$$

$2x + 3y = 6 \Rightarrow 2x + 12 = 6$
$\Rightarrow 2x = -6 \Rightarrow x = -3$
$\therefore x = -3, y = 4$

11. (b) Given equation, $z^3 + 2z^2 + 2z + 1 = 0$
$\Rightarrow z^3 - z^2 + z + z^2 - z + 1 + 2z^2 + 2z = 0$
$\Rightarrow (z + 1)(z^2 - z + 1) + 2z(z + 1) = 0$
$\Rightarrow (z + 1)(z^2 - z + 1 + 2z) = 0$
$\Rightarrow (z + 1)(z^2 + z + 1) = 0$
$\Rightarrow z = -1, \omega, \omega^2.$
$z^{2017} + z^{2018} + 1 = \omega + \omega^2 + 1 = 0$
$\therefore$ Common roots are $\omega, \omega^2$.

12. (b) Given, $C(20, n + 2) = C(20, n - 2)$
$\Rightarrow {}^{20}C_{n+2} = {}^{20}C_{n-2}$
$\Rightarrow 20 = n + 2 + n - 2 \quad (\because {}^nc_r = {}^nc_s \Rightarrow n = r + s)$
$\Rightarrow 20 = 2n$
$\Rightarrow n = 10$

13. (b) A straight line can be formed by joining 2 points.
$\therefore$ Total number of straight lines $= {}^{10}C_2$

$$= \frac{10 \times 9}{2 \times 1} = 45$$

14. (b) $px^2 + qx + r = 0$, (p, q, r are positive)
Whenever the coefficients and constant are positive in quadratic equation, its roots are always negative.
$\therefore a < 0, b < 0$

15. (b) $A = \{\lambda, \{\lambda, \mu\}\}$
Power set $= \{\phi, \{\lambda\}, \{\{\lambda, \mu\}\}, \{\lambda, \{\lambda, \mu\}\}\}$

16. (b) Number of students who play chess, $n(A) = 60$
Number of students who play tennis, $n(B) = 50$
Number of students who play carrom, $n(C) = 48$
Given, $n(A \cap B) = 20$
$n(B \cap C) = 15$
$n(A \cap C) = 12$
$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$
$= 60 + 50 + 48 - 20 - 15 - 12 + n(A \cap B \cap C)$
$= 111 + n(A \cap B \cap C)$
So, minimum number of students = 111

17. (b) $n(A \cup B \cup C) = 111 + n(A \cap B \cap C)$
Maximum number of students $= 111 + 12 = 123$

18. (b) Given, A is an identity matrix.
$\therefore A = I$
We know, $I^{-1} = I$
$\therefore A^{-1} = A$

19. (d) The determinant of transpose will not change. So, the determinant is equal to 4.

20. (c) Number of ways ${}^4C_1\,{}^6C_4 + {}^4C_2\,{}^6C_3 + {}^4C_3\,{}^6C_2 + {}^4C_4\,{}^6C_1$
$= (4)(15) + (6)(20) + (4)(15) + (1)(6)$
$= 60 + 120 + 60 + 6$
$= 246$

21. (b) $[(2x - 3y)^2 (2x + 3y)^2]^2$
$= [(4x^2 - 9y^2)^2]^2 = (4x^2 - 9y^2)^4$
$\therefore$ Number of terms $= 4 + 1 = 5$

22. (b) The first three terms in expansion of $(1 + ax)^n$ are ${}^nC_0$, ${}^nC_1 ax$, ${}^nC_2 a^2 x^2$
Given, ${}^nC_0 = 1$; ${}^nC_1 ax = 12x$; ${}^nC_2 a^2x^2 = 64x^2$

$\Rightarrow nax = 12x$; $\frac{n(n-1)}{2}a^2 = 64$

$\Rightarrow na = 12 \Rightarrow a = \frac{12}{n}$

$\therefore \frac{n(n-1)}{2}a^2 = 64 \Rightarrow \frac{n(n-1)}{2} \times \frac{144}{n^2} = 64$

$\Rightarrow \frac{n-1}{n} = \frac{64 \times 2}{144} = \frac{8}{9}$

$\therefore n = 9$

23. (c) Given, numbers 1, 5, 25
Let $p^{th}$ term $= 1 \Rightarrow a + (p - 1)d = 1$ ...(1)
Let $q^{th}$ term $= 5 \Rightarrow a + (q - 1)d = 5$ ...(2)

Let $r^{th}$ term = 25 $\Rightarrow$ a + (r – 1) d = 25 ...(3)
Applying (3) – (2) $\Rightarrow$ r – q = 25 – 5 = 20
Applying (2) – (1) $\Rightarrow$ q – p = 5 – 1 = 4

$\frac{r-q}{q-p}=\frac{20}{4}=5$ which is an integer.

So, the given series forms an AP.
Infinite AP's are possible.

24. (c) Let the first term of AP = a
Let the common difference of AP = d
$(p+q)^{th}$ term = $T_{p+q}$ = a + (p + q – 1) d
$(p-q)^{th}$ term = $T_{p-q}$ = a + (p – q – 1) d
$T_{p+q} + T_{p-q}$ = a + (p + q – 1) d + a + (p – q – 1) d
= 2a + (p + q – 1 + p – q – 1) d
= 2a + (2p – 2)d = 2 [a + (p – 1) d] = $2T_p$

25. (b) A is square matrix of order n > 1.
det (–A) = $(-1)^n$ det A

26. (d) 25 $cosec^2x$ + 36 $sec^2x$.
Minimum value = $(\sqrt{25}+\sqrt{36})^2$
= $(5 + 6)^2 = (11)^2 = 121$

27. (a) A and B are (3 × 3) matrices
det A = 4
det B = 3
$\therefore$ det (2AB) = $(2)^3$ |A| |B|
= $2^3$ (4) (3) = 8 (4) (3) = 96

28. (c) det ($3AB^{-1}$) = $(3)^3$ |A| $|B^{-1}|$
$=27\frac{|A|}{|B|}=27\times\frac{4}{3}=36$

29. (c) $z=\frac{1+2i}{1-(1-i)^2}$
$=\frac{1+2i}{1-(1-1-2i)}$
$=\frac{1+2i}{1+2i}=1$
$\therefore$ |z| = 1

30. (a) $z=\frac{1+2i}{1-(1-i)^2}=1=1+0.i$
$\therefore$ Principal argument of z = tanθ
$=\frac{0}{1}=0$
$\therefore$ θ = 0°

31. (a) $\frac{\sin 34^\circ\cos 236^\circ-\sin 56^\circ\sin 124^\circ}{\cos 28^\circ\cos 88^\circ+\cos 178^\circ\sin 208^\circ}$
$=\frac{\sin 34^\circ(-\cos 56^\circ)-\sin 56^\circ\cos 34^\circ}{\cos 28^\circ\sin 2^\circ+\cos 2^\circ\sin 28^\circ}$
$=\frac{-\sin 34^\circ\cos 56^\circ-\sin 56^\circ\cos 34^\circ}{\sin(28^\circ+2^\circ)}$
$=-\frac{\sin(34^\circ+56^\circ)}{\sin 30^\circ}=\frac{-\sin 90^\circ}{\sin 30^\circ}=\frac{-1}{\frac{1}{2}}=-2$

32. (c) tan 54° = tan (45° + 9°)
$=\frac{\tan 45^\circ+\tan 9^\circ}{1-\tan 45^\circ\cdot\tan 9^\circ}=\frac{1+\tan 9^\circ}{1-\tan 9^\circ}$
$=\frac{1+\frac{\sin 9^\circ}{\cos 9^\circ}}{1-\frac{\sin 9^\circ}{\cos 9^\circ}}=\frac{\cos 9^\circ+\sin 9^\circ}{\cos 9^\circ-\sin 9^\circ}$

Sol. (33-35):
p = x cosθ – y sinθ
q = x sinθ + y cosθ
Given, $p^2 + 4pq + q^2 = Ax^2 + By^2$

Let us take $\theta=\frac{\pi}{4}$.

$p=x\cos\frac{\pi}{4}-y\cos\frac{\pi}{4}=\frac{x-y}{\sqrt{2}}$

$q=x\sin\frac{\pi}{4}+y\cos\frac{\pi}{4}=\frac{x+y}{\sqrt{2}}$

$pq=\frac{x^2-y^2}{2}\Rightarrow 2pq=x^2-y^2$

$\Rightarrow 4pq = 2x^2 – 2y^2$ ...(1)
Now, $p^2 + q^2 = x^2 \cos^2\theta + y^2 \sin^2\theta – 2$ xy cosθ sinθ
$+ x^2 \sin^2\theta + y^2 \cos^2\theta + 2$xy sinθ cosθ = $x^2 + y^2$
...(2)
From (1), (2), $p^2 + q^2 + 4pq = x^2 + y^2 + 2x^2 – 2y^2$
$= 3x^2 – y^2$
Comparing this with the given form, we get
$\theta=\frac{\pi}{4}, A=3, B=-1$

33. (c) 34. (b) 35. (a)

36. (a) Given, cos (θ – α) = a $\Rightarrow$ sin (θ – α) = $\sqrt{1-a^2}$
cos (θ – β) = b $\Rightarrow$ sin (θ – β) = $\sqrt{1-b^2}$
$\therefore$ cos (α – β) = cos (θ – β – (θ – α))
= cos (θ – β) cos (θ – α) + sin (θ – β) sin (θ – α)
$=(b)(a)+\sqrt{1-b^2}\sqrt{1-a^2}$
$=ab+\sqrt{1-a^2}\sqrt{1-b^2}$

37. (a) $\sin^2(\alpha-\beta)+2ab\cos(\alpha-\beta)=1-\cos^2(\alpha-\beta)+2ab\cos(\alpha-\beta)$
$=1-\cos(\alpha-\beta)[\cos(\alpha-\beta)-2ab]$
$=1-(ab+\sqrt{1-a^2}\sqrt{1-b^2})\left[ab+\sqrt{1-a^2}\sqrt{1-b^2}-2ab\right]$
$=1-(\sqrt{1-a^2}\sqrt{1-b^2}+ab)(\sqrt{1-a^2}\sqrt{1-b^2}-ab)$
$=1-\left[(\sqrt{1-a^2}\sqrt{1-b^2})^2-(ab)^2\right]$

$= 1 - [(1 - a^2)(1 - b^2) - a^2b^2)$
$= 1 - (1 - b^2 - a^2 + a^2b^2 - a^2b^2)$
$= 1 - 1 + b^2 + a^2 = a^2 + b^2$

38. (c) $\sin\alpha + \cos\alpha = p$
$\Rightarrow (\sin\alpha + \cos\alpha)^2 = p^2$
$\Rightarrow \sin^2\alpha + \cos^2\alpha + 2\sin\alpha\cos\alpha = p^2$
$\Rightarrow 1 + \sin 2\alpha = p^2$
$\Rightarrow \sin 2\alpha = p^2 - 1$
$\cos^2 2\alpha = 1 - \sin^2 2\alpha = 1 - (p^2 - 1)^2$
$= 1 - (p^4 + 1 - 2p^2) = -p^4 + 2p^2$
$= p^2(2 - p^2)$

39. (d) $\sin^{-1}\frac{4}{5} + \sec^{-1}\frac{5}{4} - \frac{\pi}{2} = \sin^{-1}\frac{4}{5} + \cos^{-1}\frac{4}{5} - \frac{\pi}{2}$

$= \frac{\pi}{2} - \frac{\pi}{2} = 0$

40. (b) $\sin^{-1}\frac{2p}{1+p^2} - \cos^{-1}\frac{1-q^2}{1+q^2} = \tan^{-1}\frac{2x}{1-x^2}$

$\Rightarrow 2\tan^{-1}p - 2\tan^{-1}q = 2\tan^{-1}x$
$\Rightarrow \tan^{-1}p - \tan^{-1}q = \tan^{-1}x$

$\Rightarrow \tan^{-1}\frac{p-q}{1+pq} = \tan^{-1}x$

$\Rightarrow x = \frac{p-q}{1+pq}$

41. (c) $\tan\theta = \frac{1}{2}$

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

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

$= \frac{\frac{1}{2} + \frac{1}{3}}{1 - \left(\frac{1}{2}\right)\left(\frac{1}{3}\right)} = \frac{\frac{5}{6}}{\frac{5}{6}} = 1$

$\therefore \theta + \phi = \tan^{-1}(1) = \frac{\pi}{4}$

42. (b) $\cos A = \frac{3}{4}$

$\sin\left(\frac{A}{2}\right).\sin\left(\frac{3A}{2}\right) = \frac{1}{2}\left[2\sin\frac{A}{2}\sin\frac{3A}{2}\right]$

$= \frac{1}{2}\left[\cos\left(\frac{3A}{2} - \frac{A}{2}\right) - \cos\left(\frac{3A}{2} + \frac{A}{2}\right)\right]$

$= \frac{1}{2}[\cos A - \cos 2A] = \frac{1}{2}[\cos A - (2\cos^2 A - 1)]$

$= \frac{1}{2}[\cos A - 2\cos^2 A + 1]$

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

$= \frac{1}{2}\left[\frac{3}{4} - \frac{18}{16} + 1\right] = \frac{1}{2}\left[\frac{12 - 18 + 16}{16}\right] = \frac{1}{2}\left[\frac{10}{16}\right] = \frac{5}{16}$

43. (b) $\tan 75° + \cot 75° = 2 + \sqrt{3} + 2 - \sqrt{3} = 4$

44. (b) $\cos 46° \cos 47° \cos 48° \cos 49° ..... \cos 135°$
We know, $\cos 90° = 0$
$\therefore$ Given expression has $\cos 90°$ and so it's value is 0.

45. (b) $\sin 2\theta = \cos 3\theta$
$\Rightarrow \sin 2\theta = \sin(90° - 3\theta)$
$2\theta = 90° - 3\theta$
$\Rightarrow 5\theta = 90°$
$\Rightarrow \theta = 18°$

$\therefore \sin\theta = \sin 18° = \frac{\sqrt{5} - 1}{4}$

46. (a) Given, $\tan 19°$ and $\tan 26°$ are roots of $x^2 + px + q = 0$

$\therefore \tan 19° + \tan 26° = \frac{-p}{1} = -p$

$(\tan 19°)(\tan 26°) = \frac{q}{1} = q$

$\tan(19° + 26°) = \frac{\tan 19° + \tan 26°}{1 - \tan 19°\tan 26°}$

$\tan 45° = \frac{-p}{1-q}$

$\Rightarrow 1 = \frac{-p}{1-q}$

$\Rightarrow 1 - q = -p$
$\Rightarrow q - p = 1$

47. (b) Given, sum of n terms $(S_n) = n(n + 1)$
We know, $T_n = S_n - S_{n-1}$
$= [n(n + 1)] - [(n - 1)(n - 1 + 1)]$
$= n(n + 1) - (n - 1)n$
$= n(n + 1 - n + 1)$
$= 2n$
$\therefore$ Fourth term, $T_4 = 2(4) = 8$

48. (a) $(1 + \tan\alpha\tan\beta)^2 + (\tan\alpha - \tan\beta)^2 - \sec^2\alpha\sec^2\beta$
$= 1 + \tan^2\alpha\tan^2\beta + 2\tan\alpha\tan\beta + \tan^2\alpha + \tan^2\beta$
$-2\tan\alpha\tan\beta - \sec^2\alpha\sec^2\beta$
$= 1 + \tan^2\alpha\tan^2\beta + \tan^2\alpha + \tan^2\beta - \sec^2\alpha\sec^2\beta$
$= (1 + \tan^2\alpha)(1 + \tan^2\beta) - \sec^2\alpha\sec^2\beta$
$= \sec^2\alpha\sec^2\beta - \sec^2\alpha\sec^2\beta$
$= 0$

49. (b) $p = \operatorname{cosec}\theta - \cot\theta$
$q = (\operatorname{cosec}\theta + \cot\theta)^{-1}$
$\Rightarrow \frac{1}{q} = \operatorname{cosec}\theta + \cot\theta$

We know, $\operatorname{cosec}^2\theta - \cot^2\theta = 1$

$\Rightarrow$ (cosec θ + cot θ) (cosec θ – cot θ) = 1

$\Rightarrow \left(\frac{1}{q}\right)(p) = 1$

$\Rightarrow$ p = q

50. (c) Given, angles of triangle are in ratio 1 : 2 : 3
Consider, A = 30°, B = 60° and C = 90°
We know, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$\Rightarrow \frac{a}{\sin 30°} = \frac{b}{\sin 60°} = \frac{c}{\sin 90°}$

$\Rightarrow \frac{a}{\frac{1}{2}} = \frac{b}{\frac{\sqrt{3}}{2}} = \frac{c}{1}$

$\Rightarrow a : b : c = \frac{1}{2} : \frac{\sqrt{3}}{2} : 1 \ = 1 : \sqrt{3} : 2$

51. (d) The length of perpendicular from (α, β) to line
x cos θ + ysin θ – p = 0
| α cos θ + β sin θ – p|
∴ Statement 1 is false.
The length of perpendicular from (α, β) to line $\frac{x}{a} + \frac{y}{b} = 1$

$\frac{x}{a} + \frac{y}{b} = 1 \Rightarrow bx + ay - ab = 0$

So, perpendicular is $\left|\frac{b\alpha + a\beta - ab}{\sqrt{a^2 + b^2}}\right|$

∴ Statement 2 is also false.

52. (b) Given, equation of circle $\Rightarrow x^2 + y^2 = a^2$ ...(1)
Equation of chord $\Rightarrow$ x + y = a ...(2)
(1) $\Rightarrow x^2 + (a - x)^2 = a^2$
$\Rightarrow x^2 + a^2 + x^2 - 2ax = a^2$
$\Rightarrow 2x^2 = 2ax$
$\Rightarrow$ x = 0, a
When, x = 0, y = a and when x = a, y = 0.
∴ Points of intersection are (0, a) and (a, 0)
∴ Equation of circle with chord as diameter is
(x – 0) (x – a) + (y – a) (y – 0) = 0
$\Rightarrow$ x (x – a) + y (y – a) = 0
$\Rightarrow x^2 - ax + y^2 - ay = 0$
$\Rightarrow x^2 + y^2 - ax - ay = 0$

53. (b)

54. (d) Given equation, $2x^2 - 3y^2 - 6 = 0$
$\Rightarrow 2x^2 - 3y^2 = 6$
$\Rightarrow \frac{x^2}{3} - \frac{y^2}{2} = 1$
This equation represents hyperbola.

55. (a) The parabolas $y^2 = 4ax$ and $x^2 = 4ay$
They intersect at (0, 0) and (4a, 4a)
These points lie on y = x

56. (d) Given, opposite vertices of rectangle are A (1, 3) and C (5, 1)
We know, diagonals of rectangle bisect each other.
So, midpoint of AC lies on line y = 2x + c.
Mid point of AC $= \left(\frac{1+5}{2}, \frac{3+1}{2}\right) = \left(\frac{6}{2}, \frac{4}{2}\right) = (3, 2)$
y = 2x + c $\Rightarrow$ 2 = 2(3) + c
$\Rightarrow$ c = 2 – 6 = – 4

57. (c) Given lines, 3y + 4x = 1 $\Rightarrow$ 4x + 3y – 1 = 0
y = x + 5 $\Rightarrow$ x – y + 5 = 0
5y + bx = 3 $\Rightarrow$ bx + 5y – 3 = 0
Since, these lines are concurrent,

$$\begin{vmatrix} 4 & 3 & -1 \\ 1 & -1 & 5 \\ b & 5 & -3 \end{vmatrix} = 0$$

$\Rightarrow$ 4 (3 – 25) – 3 (–3 –5b) –1 (5 + b) = 0
$\Rightarrow$ 4 (–22) + 9 + 15b – 5 – b = 0
$\Rightarrow$ – 88 + 4 + 14b = 0
$\Rightarrow$ –84 + 14b = 0
$\Rightarrow$ b = 6

58. (b) Given line, y = x
$\Rightarrow$ x – y = 0
Slope of this line $= \frac{-1}{-1} = 1$
Slope of line perpendicular to this line = –1
The perpendicular line passes through (3, 2)
∴ Equation is y – 2 = – 1 (x – 3) $\Rightarrow$ y – 2 = – x + 3
$\Rightarrow$ x + y – 5 = 0 $\Rightarrow$ x + y = 5

59. (a) Given lines : $L_1 \equiv x + y - 4 = 0$
$L_2 \equiv 3x + y - 4 = 0$
$L_3 \equiv x + 3y - 4 = 0$
Slope of $L_1 = m_1 = \frac{-1}{1} = -1$
Slope of $L_2 = m_2 = \frac{-3}{1} = -3$
Slope of $L_3 = m_3 = \frac{-1}{3}$

Angle between $L_1$ and $L_2$
$\Rightarrow \tan\theta_1 = \left|\frac{-1-(-3)}{1+(-1)(-3)}\right| = \frac{-1+3}{1+3} = \frac{1}{2}$

Angle between $L_2$ and $L_3$
$\Rightarrow \tan\theta_2 = \left|\frac{-3-\left(\frac{-1}{3}\right)}{1+(-3)\left(\frac{-1}{3}\right)}\right| = \left|\frac{-9+1}{3+3}\right| = \frac{4}{3}$

Angle between $L_1$ and $L_3$

$$\Rightarrow \tan\theta_3 = \left|\frac{-1-\left(\frac{-1}{3}\right)}{1+(-1)\left(\frac{-1}{3}\right)}\right| = \left|\frac{-3+1}{3+1}\right| = \frac{1}{2}$$

$\therefore$ The triangle formed is an isosceles triangle.

60. (a) Given circle, $x^2 + y^2 + 4x - 7y + 12 = 0$
Comparing with general form of circle,
$ax^2 + by^2 + 2gx + 2fy + c = 0$,

$f = \frac{-7}{2}$ and $c = 12$.

y - intercept $= 2\sqrt{f^2 - c}$

$$= 2\sqrt{\left(\frac{-7}{2}\right)^2 - 12} = 2\sqrt{\frac{49}{4} - 12}$$

$$= 2\sqrt{\frac{49-48}{4}} = 2\left(\frac{1}{2}\right) = 1$$

61. (b) Given vertices of triangle are A (2, –3, 3), B (5, –3, –4) and C (2, –3, –2)

$$\text{Centroid} = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}, \frac{z_1+z_2+z_3}{3}\right)$$

$$= \left(\frac{2+5+2}{3}, \frac{-3-3-3}{3}, \frac{3-4-2}{3}\right)$$

$= (3, –3, –1)$

62. (c) The equation of sphere is
$x^2 + y^2 + z^2 - 6x + 8y - 10z + 1 = 0$.
Comparing the equation with general form of sphere,
$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz - d = 0$,

we get, $= \frac{-6}{2} = -3, v = \frac{8}{2} = 4, w = \frac{-10}{2} = -5, d = 1$

$$\text{Radius} = \sqrt{u^2 + v^2 + w^2 - d}$$

$$= \sqrt{(-3)^2 + (4)^2 + (-5)^2 - 1}$$

$$= \sqrt{9+16+25-1}$$

$$= \sqrt{49} = 7$$

63. (a) The equation of plane passing through the intersection of planes $2x + y + 2z = 9$ and $4x - 5y - 4z = 1$ is
$(2x + y + 2z - 9) + \lambda (4x - 5y - 4z - 1) = 0$
Given that this plane passes through (3, 2, 1)
$\Rightarrow 2(3) + 2 + 2(1) - 9 + \lambda [4(3) - 5(2) - 4(1) - 1] = 0$
$\Rightarrow 1 + \lambda(-3) = 0$

$$\Rightarrow \lambda = \frac{1}{3}$$

$$\therefore \text{Equation is } (2x+y+2z-9) + \frac{1}{3}(4x-5y-4z-1) = 0$$

$\Rightarrow 6x + 3y + 6z - 27 + 4x - 5y - 4z - 1 = 0$
$\Rightarrow 10x - 2y + 2z - 28 = 0$
$\Rightarrow 10x - 2y + 2z = 28$

64. (a) Given planes : $4x - 2y + 4z + 9 = 0$
$\Rightarrow 8x - 4y + 8z + 18 = 0$ ...(1)
$8x - 4y + 8z + 21 = 0$ (2)
Distance

$$= \frac{|d_1 - d_2|}{\sqrt{a^2+b^2+c^2}} = \frac{|18-21|}{\sqrt{64+16+64}} = \frac{3}{\sqrt{144}} = \frac{3}{12} = \frac{1}{4}$$

65. (d)

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

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

$$= \hat{i}(2-1) + \hat{j}(1+2) + \hat{k}(-3-5)$$

$$= \hat{i} + 3\hat{j} - 8\hat{k}$$

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

$$= 3\hat{i} - 6\hat{j} + 15\hat{k} + 2\hat{i} + \hat{j} - 3\hat{k}$$

$$= \hat{i}(3+2) + \hat{j}(-6+1) + \hat{k}(15-3)$$

$$= 5\hat{i} - 5\hat{j} + 12\hat{k}$$

$$(\vec{b} - \vec{a}).(3\vec{a} + \vec{b}) = (\hat{i} + 3\hat{j} - 8\hat{k}).(5\hat{i} - 5\hat{j} + 12\hat{k})$$

$= (1)(5) + (3)(–5) + (–8)(12)$
$= 5 - 15 - 96 = -106$

67. (d) Given, $\overrightarrow{OA} = 3\hat{i} - 2\hat{j} + \hat{k}$

$$\overrightarrow{OB} = 2\hat{i} + 4\hat{j} - 3\hat{k}$$

$$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$$

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

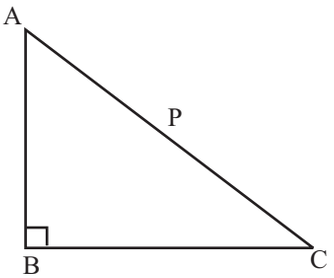
$$= \hat{i}(2-3) + \hat{j}(4+2) + \hat{k}(-3-1)$$

$$= -\hat{i} + 6\hat{j} - 4\hat{k}$$

Length of AB $= \sqrt{(-1)^2 + (6)^2 + (-4)^2}$

$$= \sqrt{1+36+16} = \sqrt{53}$$

68. (a) Hypotenuse, AC = P
BC is perpendicular to AB.




$\therefore \overrightarrow{BC}.\overrightarrow{BA} = 0$

$\therefore \overrightarrow{AB}.\overrightarrow{AC} + \overrightarrow{BC}.\overrightarrow{BA} + \overrightarrow{CA}.\overrightarrow{CB}$

$= \overrightarrow{AB}.\overrightarrow{AC} + 0 + \overrightarrow{AC}.\overrightarrow{BC}$

$= \overrightarrow{AC}\left(\overrightarrow{AB} + \overrightarrow{BC}\right)$

$= \overrightarrow{AC}.\overrightarrow{AC}$

$= \overrightarrow{AC}^2 = P^2$

69. (b) Given, $\vec{a} = 2\hat{i} - 6\hat{j} - 3\hat{k}$

$\vec{b} = 4\hat{i} + 3\hat{j} - \hat{k}$

$\vec{a}.\vec{b} = (2\hat{i} - 6\hat{j} - 3\hat{k}).(4\hat{i} + 3\hat{j} - \hat{k})$

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

$= 8 - 18 + 3 = -7$

$\Rightarrow |\vec{a}||\vec{b}|\cos\theta = -7 \Rightarrow \cos\theta = \frac{-7}{|\vec{a}||\vec{b}|}$

$= \frac{-7}{\sqrt{49}\sqrt{26}} = \frac{-1}{\sqrt{26}}$

$\sin\theta = \sqrt{1-\cos^2\theta} = \sqrt{1-\left(\frac{-1}{\sqrt{26}}\right)^2} = \sqrt{1-\frac{1}{26}}$

$= \sqrt{\frac{25}{26}} = \frac{5}{\sqrt{26}}$

70. (d) Given vectors are $3\hat{i} + 4\hat{j} - \hat{k}$ and $-2\hat{i} + \lambda\hat{j} + 10\hat{k}$.

If these are perpendicular, dot product is 0.

$(3\hat{i} + 4\hat{j} - \hat{k}).(-2\hat{i} + \lambda\hat{j} + 10\hat{k}) = 0$

$\Rightarrow (3)(-2) + (4)(\lambda) + (-10) = 0$

$\Rightarrow -6 + 4\lambda - 10 = 0$

$\Rightarrow 4\lambda = 16$

$\Rightarrow \lambda = 4$

71. (a) Let $y = \sec^2(\tan^{-1} x)$

Let $\tan^{-1} x = \theta \Rightarrow x = \tan\theta$

$y = \sec^2\theta = 1 + \tan^2\theta = 1 + x^2$

$\therefore \frac{dy}{dx} = \frac{d}{dx}(1 + x^2) = 2x$

72. (d) $f(x) = \log_{10}(1 + x)$

$4 \cdot f(4) + 5 \cdot f(1) - \log_{10}2$

$= 4 \cdot \log_{10}(1 + 4) + 5 \cdot \log_{10}(1 + 1) - \log_{10}2$

$= 4\log_{10}5 + 5\log_{10}2 - \log_{10}2$

$= 4\log_{10}5 + 4\log_{10}2$

$= 4(\log_{10}5 + \log_{10}2)$

$= 4(\log_{10}10) = 4$

73. (b) $f(x) = \ln(\sqrt{x^2+1} - x)$

$f(-x) = \ln(\sqrt{(-x)^2+1} - (-x))$

$= \ln(\sqrt{x^2+1} + x)$

$= \ln\left|\frac{\left(\sqrt{x^2+1} + x\right)(\sqrt{x^2+1} - x)}{\sqrt{x^2+1} - x}\right|$

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

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

$= -\ln(\sqrt{x^2+1} - x)$

$= -f(x)$

So, f(x) is odd function.

74. (d) $f(x) = \log_x 10$

Domain of logarithmic function is $x > 0$ excluding $x = 1$.

75. (c) $\lim_{x\to 0} \frac{1 - \cos^3 4x}{x^2}$

The given limit is in $\frac{0}{0}$ form. So, apply L'hospital rule.

$\lim_{x\to 0} \frac{-3\cos^2 4x(-\sin 4x)4}{2x}$

$= \lim_{x\to 0} \frac{12\cos^2 4x \sin 4x}{(2x)2} \times 2$

$= 24 \cdot \lim_{x\to 0} \cos^2 4x \cdot \frac{\sin 4x}{4x}$

$= 24(1) = 24$

76. (c) f(r) is ratio of perimeter to area of circle of radius r.

Perimeter of circle $= 2\pi r$

Area of circle $= \pi r^2$

$f(r) = \frac{2\pi r}{\pi r^2} = \frac{2}{r}$

So, $f(1) + f(2) = \frac{2}{1} + \frac{2}{2} = 2 + 1 = 3$

77. (c) $f(x) = 3^{1+x}$

$f(x) \cdot f(y) \cdot f(z) = 3^{1+x} \cdot 3^{1+y} \cdot 3^{1+z}$

$= 3^{1+x+1+y+1+z}$

$= 3^{3+x+y+z}$

$= 3^{1+x+y+z+2}$

$= f(x + y + z + 2)$

78. (a) $x^2 + 9|x| + 20 = 0$

The sum of three positive quantities can never be zero.

So, the equation has no solution.

79. (d) f(x) = sin (cos x)
f'(x) = cos (cosx ) . (– sin x)
= – sin x . cos (cos x)

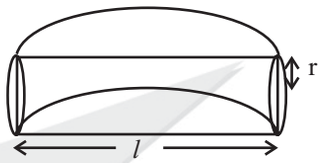
80. (c) $f(x)=\sqrt{(2-x)(x-3)}$
Here, (2 – x) (x – 3) ≥ 0
⇒ – (x – 2) (x – 3) ≥ 0
⇒ (x – 2) (x – 3) ≤ 0
⇒ x ∈ [2, 3]

81. (a) $\frac{dy}{dx}=\cos(y-x)+1$ ...(1)
Let $y-x=t \Rightarrow \frac{dy}{dx}-1=\frac{dt}{dx}$
$\therefore (1) \Rightarrow \frac{dt}{dx}+1=\cos t+1$
$\Rightarrow \frac{dt}{dx}=\cos t$
⇒ sec$t$ . dt = 1. dx
$\Rightarrow \int \sec t.dt=\int 1.dx$
⇒ log |sec$t$ + tan$t$| = x + c
⇒ – log |sec$t$ – tan$t$| = x + c
⇒ log |sec$t$ – tan$t$| = –x – c
⇒ log (sec (y – x) – tan (y – x) = –x – c
⇒ sec (y – x) – tan (y – x) = $e^{-x}$. $e^{-c}$
⇒ $e^x$ (sec (y – x ) – tan (y – x)) = c.

82. (b) $\int_0^{\frac{\pi}{2}} |\sin x-\cos x|\,dx$
$=\int_0^{\frac{\pi}{4}} \left|(\sin x-\cos x)\right|dx+\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \left|(\sin x-\cos x)\right|dx$
$=\int_0^{\frac{\pi}{4}} (\cos x-\sin x).dx+\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} (\sin x-\cos x).dx$
$=(\sin x+\cos x)_0^{\frac{\pi}{4}}+(-\cos x-\sin x)_{\frac{\pi}{4}}^{\frac{\pi}{2}}$
$=2\sqrt{2}-2 \;=2(\sqrt{2}-1)$

83. (d) y = a cos 2x + b sin 2x
$\Rightarrow \frac{dy}{dx}=-2a\sin 2x+2b\cos 2x$
$\Rightarrow \frac{d^2y}{dx^2}=-4a\cos 2x-4b\sin 2x$
$\Rightarrow \frac{d^2y}{dx^2}=-4(a\cos 2x+b\sin 2x)$
$\Rightarrow \frac{d^2y}{dx^2}=-4y$
$\Rightarrow \frac{d^2y}{dx^2}+4y=0$

84. (a) Volume of half cylinder with height 'l' and radius 'r'
$=\frac{1}{2}\pi r^2 l$ ...(1)
Surface area of half cylinder.




$S=l\times 2r+2\left(\frac{1}{2}\pi r^2\right)+2\left(\frac{1}{2}\pi rl\right)$
$S=2rl+\pi r^2+\pi rl$
$S=\frac{4V}{\pi r}+\frac{\pi.2V}{\pi r}+\pi r^2$ (from (1))
$\frac{ds}{dr}\Rightarrow \frac{-4V}{\pi r^2}-\frac{2V}{r^2}+2\pi r=0$
$\Rightarrow 2\pi r=\frac{4V}{\pi r^2}+\frac{2V}{r^2}\Rightarrow 2\pi r=\frac{4.\pi r^2 l}{2\pi r^2}+\frac{2}{r^2}.\frac{1}{2}\pi r^2 l$
$\Rightarrow \frac{l}{2r}=\frac{\pi}{\pi+2}$

85. (b) $\int_0^{\frac{\pi}{2}} e^{\sin x}.\cos x\,dx$
Let sin x = t ⇒ cosx. dx = dt
$\int_0^{\frac{\pi}{2}} e^{\sin x}.\cos x\,dx=\int_0^1 .e^t.dt$
$=(e^t)_0^1 = e^1 - e^0 = e - 1$

86. (d) $f(x)=y=\frac{x-2}{x+2}, x\neq -2$
$\frac{y}{1}=\frac{x-2}{x+2}\Rightarrow \frac{y+1}{y-1}=\frac{x-2+x+2}{x-2-x-2}$
$\Rightarrow \frac{y+1}{y-1}=\frac{2x}{-4}$
$\Rightarrow \frac{y+1}{y-1}=\frac{-x}{2}\Rightarrow x=-2\left(\frac{y+1}{y-1}\right)$
Now, y = $\frac{-2(x+1)}{x-1}=\frac{2(x+1)}{1-x}$

87. (a) $\int \ln(x^2).dx = 2\cdot\int \ln x.dx$

$= 2\int 1.\ln x.dx$

$= 2\,[\ln x.x - \int \frac{1}{x}.x.dx$

$= 2\ (x.\ \ln x - x) + c$

$= 2x\ \ln x - 2x + c$

88. (b) Given equation is $y^2 - 8x$

Take an arbitrary point on this curve. If we take y as P, then point is $\left(\frac{P^2}{8}, P\right)$.

The distance between $\left(\frac{P^2}{8}, P\right)$ and (4, 2) is

$$d^2 = \left(\frac{P^2}{8} - 4\right)^2 + (P-2)^2 \qquad ...(1)$$

$$= \frac{1}{64}(P^2-32)^2 + (P-2)^2$$

$$\Rightarrow 2d.\frac{dd}{dp} = \frac{1}{64}\times 2(P^2-32)\times 2P + 2(P-2)$$

$$= \frac{1}{16}(P^2-32)P + 2(P-2)$$

for minimum distance, $\frac{dd}{dp} = 0$

$\Rightarrow P^3 - 32P + 32P - 64 = 0$

$\Rightarrow P^3 = 64$

$\Rightarrow P = 4$

$$\therefore (1) \Rightarrow d^2 = \left(\frac{16}{8} - 4\right)^2 + (4-2)^2$$

$= (-2)^2 + (2)^2$

$= 8$

$\Rightarrow d = \sqrt{8} = 2\sqrt{2}$

89. (c) The equation of circle touching y-axis at origin is

$(x - \alpha)^2 + (y - 0)^2 = \alpha^2$

$\Rightarrow x^2 + \alpha^2 - 2\alpha x + y^2 = \alpha^2$

$\Rightarrow x^2 + y^2 - 2\alpha x = 0$

$$\Rightarrow x + \frac{y^2}{x} - 2\alpha = 0$$

Differentiating, $1 + \frac{x.2y.\frac{dy}{dx} - y^2}{x^2} = 0$

$$\Rightarrow x^2 + 2xy.\frac{dy}{dx} - y^2 = 0$$

90. (c) $\frac{d^2y}{dx^2} + 2\left(\frac{dy}{dx}\right)^2 + 9y = x$

Order =2

Degree = 1

91. (a) $\frac{dy}{dx} + \frac{x}{y} = 0$

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

$\Rightarrow y\,dy + x\,dx = 0$

$$\Rightarrow \frac{y^2}{2} + \frac{x^2}{2} + c = 0$$

$\Rightarrow y^2 + x^2 + 2c = 0$

$\Rightarrow x^2 + y^2 = c.$

92. (d) $f(x) = \begin{cases} \sin x, & x \neq 0 \\ k, & x = 0 \end{cases}$

Given, f(x) is continuous at x = 0

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

$\Rightarrow \lim_{x\to 0} \sin x = k$

$\Rightarrow k = 0$

93. (b) Let $p = a^2x + b^2y$ and $xy = c^2$

$$\Rightarrow y = \frac{c^2}{x} \qquad ...(1)$$

$$\Rightarrow P = a^2x + b^2\left(\frac{c^2}{x}\right)$$

Now, $\frac{dP}{dx} = 0 \Rightarrow a^2 - \frac{b^2c^2}{x^2} = 0$

$$\therefore y = \frac{c^2}{\frac{bc}{a}} = \frac{ac^2}{bc} = \frac{ac}{b}$$

$$\Rightarrow a^2 = \frac{b^2c^2}{x^2} \qquad \Rightarrow x = \frac{bc}{a}$$

$$\therefore P_{\min} = a^2\left(\frac{bc}{a}\right) + b^2\left(\frac{ac}{b}\right)$$

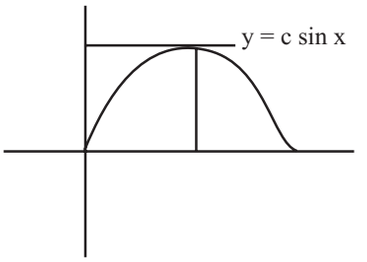
$= abc + abc = 2abc.$

94. (a) $\int e^{x\ln(a)}.dx$

$= \int e^x.dx$

$$= \frac{a^x}{\ln(a)} + c$$

95. (b) Area of one of loop between y = c sin x and x- axis



$= c + c$

$= 2c$

96. (c) $\sin\theta + \cos\theta = \sqrt{2}\cos\theta$ ...(1)

Let $\cos\theta - \sin\theta = P$ ...(2)

$(1)^2 + (2)^2 \Rightarrow \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta + \cos^2\theta + \sin^2\theta - 2\sin\theta\cos\theta = 2\cos^2\theta + p^2$

$\Rightarrow 2 = 2\cos^2\theta + p^2$

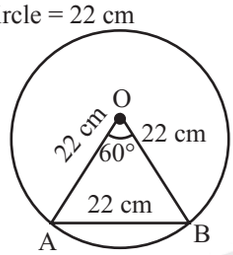
$\Rightarrow p^2 = 2(1 - \cos^2\theta) = 2\sin^2\theta$

$\Rightarrow p = \sqrt{2}\sin\theta$

97. (a) Given, diameter of circle = 44 cm.

radius of circle = 22 cm

Chord of circle = 22 cm



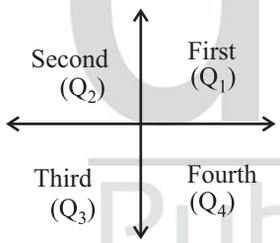

In figure $\Delta OAB$ is equilateral triangle. Angle is 60°.

So, arc is $\frac{1}{6}$ times circumference.

Length of arc $= \frac{1}{6}\times 2\pi r = \frac{1}{6}\times 2\times\frac{22}{7}\times 22$

$= \frac{484}{21}\text{cm}$

98. (c) $\sin\theta = \frac{-1}{2}, \tan\theta = \frac{1}{\sqrt{3}}$




sin θ is negative, tan θ is positive

θ lies in third quadrant.

99. (d) Given digits are 1, 2, 3, 4 and 5.

Total number of 3-digit even numbers = ${}^4C_2 \times {}^2C_1$.

$= \frac{3\times 4}{2} \times 2 = 12.$

100. (a)

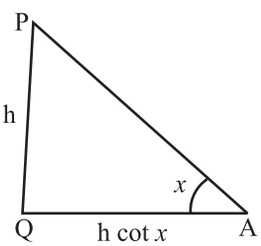



fig. (i)

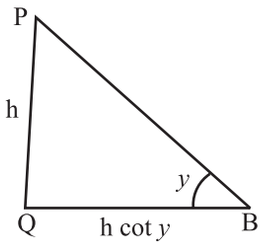



fig. (ii)

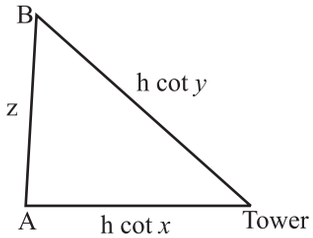



fig. (iii)

from figure (iii), $h^2\cot^2 y = z^2 + h^2\cot^2 x$

$\Rightarrow z^2 = h^2(\cot^2 y - \cot^2 x)$

101. (d) A deck of cards has 52 cards.

Probability of taking fourteenth card as Ace $= \frac{{}^4C_1}{{}^{52}C_1}$

$= \frac{4}{52} = \frac{1}{13}$

102. (d) P(A) = 0.5 , P(B) = 0.6, P (A∩B) = 0.4

$P(\overline{A\cup B}) = 1 - P(A\cup B)$

$= 1 - [P(A) + P(B) - P(A\cap B)]$

$= 1 - [0.5 + 0.6 - 0.4]$

$= 1 - 0.7 = 0.3$

103. (a) Given, $P(A) = \frac{1}{2}, P(B) = \frac{3}{4}, P(C) = \frac{1}{4}$

$P(\overline{A}) = 1 - \frac{1}{2} = \frac{1}{2}$

$P(\overline{B}) = 1 - \frac{3}{4} = \frac{1}{4}$

$P(\overline{C}) = 1 - \frac{1}{4} = \frac{3}{4}$

∴ Probability that problem will be solved if they solve independently is

$1 - (P(\overline{A}).P(\overline{B}).P(\overline{C})$

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

$= 1 - \frac{3}{32} = \frac{29}{32}$

104. (c) Possibilities of having higher number on second dice.

| First dice | Second dice |
|---|---|
| 1 | 2, 3, 4, 5, 6 → 5 possibilities |
| 2 | 3, 4, 5, 6 → 4 possibilities |
| 3 | 4, 5, 6 → 3 possibilities |
| 4 | 5, 6 → 2 possibilities |
| 5 | 6 → 1 possibility |

Total number of possibilities = 15

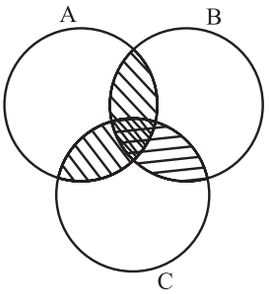
Total number of events = 36

∴ Probability $= \frac{15}{36} = \frac{5}{12}$

105. (c) Total number of events with dice and coin = 6 × 2 = 12
Number of possibilities = (2, H), (4, H) and (6, H) i.e., 3

$\therefore$ Probability $= \frac{3}{12} = \frac{1}{4}$

106. (c) $P(A \cap B) + P(B \cap C) + P(A \cap C) - 2P(A \cap B \cap C)$




107. (c) The correlation coefficient of two independent events is zero.

108. (b) $P(A \cup B) = \frac{2}{3}$

$P(A \cap B) = \frac{1}{6}$

Since, A and B are independent events,

$P(A \cap B) = P(A).P(B) = \frac{1}{6}$ ...(1)

$P(A \cup B) = \frac{2}{3} \Rightarrow P(A) + P(B) - P(A \cap B) = \frac{2}{3}$

$\Rightarrow P(A) + P(B) - \frac{1}{6} = \frac{2}{3}$

$\Rightarrow P(A) + P(B) = \frac{2}{3} + \frac{1}{6} = \frac{5}{6}$ ...(2)

from (1), (2), P(B) $= \frac{1}{3} \text{or} \frac{1}{2}$

$\because P(B) < P(A), P(B) = \frac{1}{3}$

109. (c) Number of observations (N) = 100
Mean $(\bar{x}) = 50$
Standard deviation (σ) = 10

New mean, $\bar{x}_1 = \frac{\Sigma \frac{x-5}{4}}{N} = \frac{1}{4}\left(\frac{\Sigma x}{N} - 5\right) = \frac{1}{4}(50-5)$

$= \frac{45}{4} = 11.25$

New standard deviation $(\sigma_1) = \sigma\left(\frac{x-5}{4}\right)$

$= \frac{1}{4}\sigma(x-5) = \frac{1}{4}\sigma(x) = \frac{10}{4} = 2.5$

110. (c) Total number of cases that sum is 8 are
(2, 6), (3, 5), (4, 4), (5, 3), (6, 2)
favourable case = (6, 2)

$\therefore$ Probability $= \frac{1}{5}$

111. (c) Sides of dice = R, R, B, B, Y, W
Total events with dice = 6 × 6 = 36
Favourable events = ${}^2C_1 . {}^2C_1 + {}^2C_1 . {}^2C_1 + {}^1C_1 . {}^1C_1 + {}^1C_1 . {}^1C_1$

= 4 + 4 + 2 + 2 = 10

$\therefore$ Probability $= \frac{10}{36} = \frac{5}{18}$

112. (b) Number of socks = n
Number of red socks = 3

Given, $\frac{{}^3C_2}{{}^nC_2} = \frac{1}{2}$

$\Rightarrow {}^nC_2 = 3 \times 2 = 6$
$\Rightarrow n = 4$

113. (a) Number of ways of selecting 2 cards from deck of cards = ${}^{52}C_2$
favourable cases = ${}^{13}C_2$

Probability $= \frac{{}^{13}C_2}{{}^{52}C_2} = \frac{\frac{13 \times 12}{2}}{\frac{52 \times 51}{2}} = \frac{13 \times 12}{52 \times 51} = \frac{1}{17}$

114. (b) 5 or 6 is success

$\therefore p = \frac{2}{6} = \frac{1}{3}$

$\therefore q = 1 - \frac{1}{3} = \frac{2}{3}$

n = 8

$\therefore$ Mean = np = $8\left(\frac{1}{3}\right) = \frac{8}{3}$

Standard deviation $= \sqrt{npq} = \sqrt{8\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)}$

$= \sqrt{\frac{16}{9}} = \frac{4}{3}$

115. (b) $\bar{A}$ and $\bar{B}$ are mutually exclusive

$\therefore P(\bar{A} \cap \bar{B}) = 0$

Given, P(A) = 0.5 $\Rightarrow P(\bar{A}) = 1 - 0.5 = 0.5$

P(B) = 0.6 $\Rightarrow P(\bar{B}) = 1 - 0.6 = 0.4$

$P(A \mid B) = \frac{P(A \cap B)}{P(B)} = \frac{1 - P(\bar{A} \cup \bar{B})}{P(B)}$

$= \frac{1 - (P(\bar{A}) + P(\bar{B}))}{P(B)} = \frac{1 - (0.5 + 0.4)}{0.6}$

$= \frac{1 - 0.9}{0.6} = \frac{0.1}{0.6} = \frac{1}{6}$

116. (a) Only the statement 1 is correct.

117. (d) Given, $r_{xy} = 0.6$

$z = x + 5; \; w = \frac{y}{3}$

$\Rightarrow b_{zx} = 1 \; \Rightarrow b_{wy} = \frac{1}{3}$

$$b_{xy} = b_{zx}\ b_{wy} = (1)\left(\frac{1}{3}\right) = \frac{1}{3}$$

$$\Rightarrow \frac{b_{zw}}{b_{xy}} = \frac{1}{3} \Rightarrow b_{zw} = \frac{b_{xy}}{3} = \frac{0.6}{3} = 0.2$$

118. (c) The series is 1, 2, 3, ..... 20

Variance $(\sigma) = \frac{\Sigma x^2}{n} - \Sigma(\bar{x})^2$

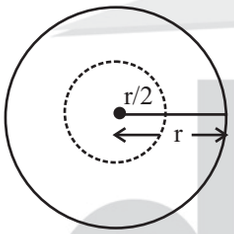
$$= \frac{n(n+1)(2n+1)}{6n} - \left(\frac{n(n+1)}{2n}\right)^2$$

$$= \frac{(n+1)}{12}(n-1)$$

$$= \frac{n^2-1}{12} = \frac{(20)^2-1}{12} = \frac{399}{12} = \frac{133}{4} = 33.25$$

$\because$ Numbers are multiplied by 3,
variance $(\sigma) = 33.25 \times 9 = 299.25$

119. (a) If r is the radius of circle, $A = \pi r^2$




$$\text{Probability} = \frac{\pi\left(\frac{r}{2}\right)^2}{\pi r^2}$$

$$= \frac{\pi r^2}{4} \times \frac{1}{\pi r^2} = \frac{1}{4}$$

120. (b) Probability of occurence of either event A or event B = P (A $\cup$ B).

## GENERAL ABILITY

### PART- A: ENGLISH

1. (c) Replace 'with' with the preposition 'to'.
2. (b) Insert the preposition 'after' before 'becoming'.
3. (c) Use the past form of 'found' i.e., 'founded'.
4. (a) Replace the preposition 'into' with 'in'.
5. (a) Replace the preposition 'from' with 'for'.
6. (a) Replace 'will be' with 'is' or 'gets'.
7. (c) Replace 'five day' with 'five days a'.
8. (c) The part has a structural error; use 'you will' before 'never'.
9. (d) No error
10. (d) No error
11. (a) 12. (c) 13. (b) 14. (d)
15. (b) 16. (a) 17. (d) 18. (b)
19. (d) 20. (a) 21. (c) 22. (a)
23. (c) 24. (c) 25. (d) 26. (a)
27. (b) 28. (d) 29. (c) 30. (a)
31. (b) 32. (c) 33. (a) 34. (c)
35. (a)
36. (a) S which starts with the noun 'Science' will come first as it continues the conversation started in S1. P will come next as it talks about the example of what has been said in S. Only one option starts with S followed by P, i.e., option (a); so, it is the answer.
37. (b) P will come first as it considers the 'British Rule' (discussed in S1) as a curse. Only one option starts with P, i.e., option (b); so, it is the answer.
38. (a) Unidentified gunmen shot dead two workers and injured another during the urban local body elections.
39. (d) This state has a history of both intense political and religious contestation and of syncretic accomplishments.
40. (b) The father also feels let down by the system in his quest for justice.
41. (c) It is clearly mentioned in the first sentence of the passage.
42. (b) It is clearly mentioned in the 7th, 8th and 9th sentence of the passage.
43. (a)
44. (d) It can clearly be inferred from the sentence.
45. (c)
46. (b) 'Dense' which means thick fits the blank correctly.
47. (c)
48. (a) 'Drive off' is a phrasal verb which means 'to leave in a car'.
49. (c) 'Doze off' is a phrasal verb which means 'to start to sleep, especially during the day and without intending to'.
50. (a) 'Suspect' which means 'a person thought to be guilty of a crime or offence' fits the sentence contextually.

### PART- B: GENERAL KNOWLEDGE

51. (d) Plasma membranes are subcellular structures, approximately 10 nm thick, that form a protective boundary around the cell as well as the cell's organelles. It is also called the cell membrane. The plasma membrane consists of a lipid bilayer that is semipermeable. The plasma membrane regulates the transport of materials entering and exiting the cell.

52. (a) The ribosome is a complex made of protein and RNA and which adds up to numerous million Daltons in size and assumes an important part in the course of decoding the genetic message reserved in the genome into protein. In 1955, George E. Palade discovered ribosomes. Ribosomes can be found floating within the cytoplasm or attached to the endoplasmic reticulum.

53. (c) The pericycle is a cylinder of parenchyma or sclerenchyma cells. The pericycle is located between the endodermis and phloem in plant roots. The pericycle regulates the formation of lateral roots by rapidly dividing near the xylem elements of the root. Pericycle is not a component of conducting tissue in plants.

54. (c) Marsilea is a genus of approximately 65 species of aquatic ferns of the family Marsileaceae. Marsilea has vascular tissue. The species of Marsilea are generally aquatic or amphibious in nature with their roots embedded in mud or damp soil.

55. (a) Caterpillars are the larval stage of members of the order Lepidoptera. Caterpillars, is a organism represent the primary consumer category in an ecosystem. Most caterpillars have cylindrical bodies consisting of multiple segments, with three pairs of true legs on the thorax and several pairs of short, fleshy prolegs on the abdomen.

56. (a) A spring tide refers to the 'springing forth' of the tide during new and full moon, at these times the high tides are higher and the low tides are lower. Spring tides are especially strong tides. This is due to the position of the moon and the sun in relation to the Earth and the resulting gravitational attraction at various stages in the lunar cycle.

57. (b) Chemical energy is stored in the links between the atoms. Chemical energy may be released during a chemical reaction, often in the form of heat; such reactions are called exothermic. Batteries, biomass, petroleum, natural gas, and coal are examples of stored chemical energy.

58. (a) The light energy escaping from the sun can be spread by a shower of rain drops.

59. (c) The correct sequence of energy transfer that occur when an apple falls to the ground is :

Gravitational potential energy → Kinetic energy → Heat energy to air → Heat energy to ground and apple → Sound energy.

60. (d) Pitchblende is a mineral comprised mainly of oxides of the element uranium, UO2, and UO3. It is also known by the name uraninite. Pitchblende is used as a fuel in nuclear power stations.

61. (d) A synthetic detergent is the sodium salt of sulphonic acid which has cleansing properties in water. It consists of a long hydrocarbon chain which is hydrophobic and a short ionic part which is hydrophilic. Examples: (i) Sodium lauryl sulphate and (ii) Sodium n-dodecyl sulphate.

62. (b) Clean fuel, is a Natural fuel, like compressed natural gas or liquefied petroleum gas, or a blend like gasohol. It produces less pollution than the alternatives and it is used as a substitute for fossil fuels. Examples of clean fuels include most types of ethanol, biodiesel, natural gas, biogas, electricity, propane and hydrogen.

63. (c) Magnesium is a chemical element with the symbol Mg. Magnesium is the ninth most abundant element in the universe. Its use as a structural material is limited since it burns at relatively low temperatures. Magnesium is frequently alloyed with aluminum, which makes aluminum easier to roll, extrude and weld.

64. (b) Isoelectronic refers to two atoms, ions or molecules that have the same electronic structure and the same number of valence electrons. Isoelectronic ions are ions that have the same number of electrons. There are many ions that are isoelectronic. Examples of Isoelectronic Ions and Elements: He, $Li^{+}$, He, $Be^{2+}$, Ar, $S^{2}$-, $Na^{+}$, $Mg^{2+}$.

65. (d) Binder refers to substances that hold the particles of pigment together in paint.

66. (c) Air mass is a volume of air defined by its temperature and water vapor content. Where an air mass receives it's characteristics of temperature and humidity is called the source region. Air masses are slowly pushed along by high-level winds, when an air mass moves over a new region. Air masses are characterized by their temperature and humidity properties.

67. (c) National Water Academy was set up in Central Water Commission by the Ministry of Water Resources, RD and GR, Govt. of India in the year 1988. It was established under USAID assistance and strengthened with the subsequent assistance received from the World Bank. National Water Academy is located at Pune.

68. (c) Campos and Llanos grasslands are found in South America. Campos and Llanos are tropical savanna grassland. The Campos, grassland with few trees or shrubs except near streams, lies between 24°S and 35°S; it includes parts of Brazil, Paraguay and Argentina, and all of Uruguay. Llanos grassland plain situated to the east of the Andes in Colombia and Venezuela, in northwestern South America. It is an ecoregion of the flooded grasslands and savannas biome.

69. (a) Viticulture is the cultivation and harvesting of grapes. It is a branch of the science of horticulture.

70. (d) Shamal northwesterly warm and dry wind is a local wind found in Iraq (Mesopotamia). This weather effect occurs anywhere from once to several times a year, mostly in summer but sometimes in winter.

71. (b) "Inversion of Rainfall" is associated with convectional rainfall. The convectional rainfall occurs due to the thermal convection currents caused due to the heating of ground due to insolation. The convectional rainfall is prevalent in equatorial regions.

72. (c) James mill was a Scottish economist and political philosopher. In his work, he divided the Indian history into three periods of Hindu, Muslim and British. James Mill published a three-volume work, A History of British India in 1817, in which he describes the acquisition of the Indian Empire by England and later the United Kingdom.

73. (c) The Azamgarh Proclamation of August 25, 1857 stressed on the return of the Badshahi. This proclamation was published in the Delhi Gazette in the midst of the "Great Mutiny" of 1857. The author was most probably Firoz Shah, a grandson of the Mughal emperor Bahadur Shah Zafar.

74. (b) Lord Wavell, who remained 23rd Viceroy of India from 1 October 1943 to 21 February 1947. The most important events during his tenure were Great Famine of Bengal (1943), Rajagopalachari Formula (1944), Simla conference (1945).

75. (a) Ghanshyam Das Birla was the man who laid the foundations of the Birla Empire. He was a close associate of Mahatma Gandhi and advised Gandhiji on economic policies. He was the founder of the Federation of Indian Chambers of Commerce and Industry (FICCI). Ghanshyam Das Birla favoured "healthy capitalism" in helping Gandhiji to work towards a "common object".

76. (b)

77. (b) Insulator can be charged by methods of friction and induction. Charge stored in this process will be static.

78. (c) Sound is a type of longitudinal, mechanical wave. They need a medium to propagate and will not travel through a vacuum. Sound travels at different speed in different media. The speed of sound is determined by the density (ρ) and compressibility (K) of the medium. According to the World Book Encyclopedia, Chicago: World Book, 1999. 601, "The speed of sound in Distilled Water at 77 °F (25 °C), 1496 m/s, 4908 ft/s" or 1496 m/s (1500 m/s).

79. (d) The temperature at which a solid and liquid phase may coexist in equilibrium. The term applies to pure liquids and solutions. It is also known as Freezing Point. The melting point of the iron is 2,800°F (1537.77778 Celsius (°C).

80. (d) Resistance $R = \frac{\rho l}{A}$

$$R_1 = \frac{\rho l}{A} = R$$

$$R_2 = \frac{\rho\left(\frac{l}{2}\right)}{\pi(2r)^2} = \frac{\rho l}{8A} = \frac{R}{8}$$

81. (d) Nuclear reactors operate on the principle of nuclear fission, the process in which a heavy atomic nucleus splits into two smaller fragments. The nuclear fragments are in very excited states and emit neutrons, other subatomic particles, and photons.

82. (c) Copper is not more reactive than iron. $Cu^{+}FeSO_4$ – $Cu^{+}FeSO_4$
As you can see, copper does not displace iron from its solution since it is less reactive than iron. A more reactive metal displaces a less reactive metal from its solution.

83. (c) Organic acid is a type of organic compound that typically has acidic properties. A common example of organic acids are called carboxyl acids, which are generally known as weak acids and do not totally dissociate in a medium such as water, unlike with strong minerals.
The simplest form of organic acids, such as acetic and formic, are typically used in stimulation treatments against corrosion for gas and oil, since these are less reactive compared to hydrochloric acid and other strong acids.

84. (c) It is because:
(i) the reaction is endothermic and requires very high temperature.
(ii) the reaction can be initiated only in presence of a catalyst.

(iii) oxides of nitrogen are unstable.

(iv) $N_2$ and $O_2$ are unreactive.

85. (b) Albert Einstein explained the phenomenon of photoelectric effect. The *photoelectric effect* is a phenomenon where electrons are emitted from the metal surface when the light *of* sufficient frequency is incident upon.

86. (b)

87. (d) The Thamirabarani River (Porunai) is a perennial river that originates from the Agastyarkoodam peak of Pothigai hills of the Western Ghats, above Papanasam in the Ambasamudram taluk. It flows through Tirunelveli and Tuticorin districts of the Tamil Nadu state of southern India into the Gulf of Mannar. This river flows towards north direction initially. However, it changes to east direction later.

88. (b) The river Jhelum is called Vitasta in the Rigveda. The Vitasta is mentioned as one of the major rivers by the holy scriptures of the Indo-Aryans- the Rigveda. It has been speculated that the Vitasta must have been one of the seven rivers (Sapta Sindhu) mentioned so many times in the Rigveda.

89. (c) **Sarda River** rises as the Kali River in far northern Uttarakhand state in the Great Himalayas on the eastern slopes of the Nanda Devi massif. The river then flows generally south-southwest, where it constitutes the border between Uttarakhand state and Nepal. Descending from the mountains, it enters the Indo-Gangetic Plain at Barmdeo Mandi (Nepal), widening there above the Sarda Barrage. Below that point it is known as the Sarda River. The Sarda then continues southeastward into India through northern Uttar Pradesh state before joining the Ghaghara River southwest of Bahraich, after a course of about 300 miles (480 km).

90. (d) Mission Indradhanush aims to increase full immunization coverage in India to at least 90% children by December 2018. It also aims to cover unvaccinated and partially vaccinated children in areas with low immunization coverage, in both urban and rural areas.

91. (d) The earth rotates on its axis taking approximately 24 hours to complete one rotation. It has some important environmental consequences:

i. Rotation creates a diurnal cycle of light and darkness, temperature, and humidity changes.

ii. Rotation requires the creation of standardized time zones. There are 24, one for each hour of the earth's rotation.

iii. Rotation causes the tides - the twice daily rise and fall of sea level. Tides are complicated because they are the result of both the gravity of the moon and the gravity of the sun. Sometimes the sun and the moon are lined up with the earth, but most of the time they are not. Tides are highest when the earth, sun and moon are in a straight line.

92. (c) On 8 August 1942 at the All-India Congress Committee session in Bombay, Mohandas Karamchand Gandhi launched the 'Quit India' movement. F G Hutchins wrote India's Revolution: Gandhi and the Quit India Movement. He published this book from Harvard University on 26th 1973. He described this revolution as a 'spontaneous revolution.

93. (a)

94. (b) The Kisan Manifesto that was adopted by the All-India Kisan Committee in August 1936 voiced such radical demands as abolition of zamindari, a limited tax on agricultural incomes, cancellation of debts and the like. The first all India based peasant organization was All India Kisan Sabha (AIKS), which was originally called All India Kisan Congress and since its inception it was mainly dominated by the communists and socialists. Thus both the statements are individual true and Statement II is NOT the correct explanation of Statement I.

95. (c) A competitive examination was organized in 1853, but the Indians could not seek entry. However, the system of reserving principal posts for the members of the covenanted service (means British) was introduced in 1858.

96. (a) Resis tance of wire $R = \rho\frac{l}{A} = \rho \cdot \frac{l}{\pi r^2}$

If $R_0$ is resistance of first wire, the resistance of second wire.

$$R = \rho \cdot \frac{2l}{\pi \cdot (2r)^2} = \frac{1}{2} \cdot \rho\frac{l}{\pi r^2} = \frac{R_0}{2}$$

$$R = \frac{V^2}{R_0} \text{ and } P_1 = \frac{V^2}{R_{0/2}} = 2P$$

97. (d) The magnetic field inside a solenoid is proportional to both the applied current and the number of turns per unit length. There is no dependence on the diameter of the solenoid, and the field strength doesn't depend

on the position inside the solenoid, i.e., the field inside is constant.

98. (a) A light-year is a unit of very large distance. It is the distance that light can travel in one year. Light moves at a velocity of about 300,000 kilometers (km) each second. So in one year, it can travel about 10 trillion km.

99. (c) Magnification $M = \left|\frac{f_0}{f_e}\right|$

$$f_e = \frac{50}{25} = 2 \text{ cm}$$

100. (a) **Non-conservative forces** are dissipative forces such as friction or air resistance. These forces take energy away from the system as the system progresses, energy that you can't get back. These forces are path dependent; therefore it matters where the object starts and stops.

101. (b) Copper metal when exposed to air turns green in colour due to corrosion. When copper vessel is exposed to air in rainy season, the metal reacts with gases and moisture and atmospheric gases to form a mixture of copper carbonate and copper hydroxide. This gives a green colour to the surface of copper metal.

The reaction is as follows:

$$2Cu + H_2O + CO_2 + O_2 \rightarrow Cu(OH)_2 + CuCO_3$$

102. (c) In the given options, marble, limestone, and baking soda are all either metal carbonates or bicarbonates. All these when react with a dilute acid then they produce carbon dioxide. Whereas lime which is calcium oxide when react with a dilute acid then they do not produce carbon dioxide.

For example, $CaO + \text{dil. } 2HCl \rightarrow CaCl_2 + H_2O$

Thus, lime when reacts with an acid then it produces salt and water but it does not produce carbon dioxide.

103. (a)

- Ice is a pure substance, as it is simply frozen water.
- Ice is a pure substance, as it is simply frozen water.
- Air is a mixture of primarily Nitrogen and Oxygen gas.
- Honey is a homogeneous mixture of various types of sugar compounds.

104. (b) Salt crystallization, the weathering by which is known as haloclasty, causes disintegration of rocks when saline solutions seep into cracks and joints in the rocks and evaporate, leaving salt crystals behind. These salt crystals expand as they are heated up, exerting pressure on the confining rock. Physical weathering is a term used in science that refers to the geological process of rocks breaking apart without changing their chemical composition.

105. (b) As a result of exploration carried out up to the maximum depth of 1200m by the GSI, CMPDI, SCCL and MECL etc, a cumulative total of 319.02 Billion tonnes of Geological Resources of Coal have so far been estimated in the country as on 1.4.2018. The details of state-wise geological resources of Coal (in million tonnes) are given as under:

| State | Proved | Indicated | Inferred | Total |
|---|---|---|---|---|
| **Total** | **148787** | **139164** | **31069** | **319020** |
| JHARKHAND | 45563 | 31439 | 6150 | 83152 |
| ODISHA | 37391 | 34165 | 7739 | 79295 |
| CHHATTISGARH | 20428 | 34576 | 2202 | 57206 |
| WEST BENGAL | 14156 | 12869 | 4643 | 31667 |
| MADHYA PRADESH | 11958 | 12154 | 3875 | 27987 |
| TELANGANA | 10475 | 8576 | 2651 | 21702 |

106. (b) The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. It is a logarithmic scale that runs from 1 to 9, though no upper limit exists, a magnitude 7 quake is 10 times more powerful than magnitude 6 quake.

107. (c) The Kuroshio is a warm northeasterly ocean current off the coast of Japan. This current is also called the gulf stream of the Pacific or Japan Current. It originates from the greater part of North Equatorial current, which divides east of the Philippines. The Kuroshio is the current running from Formosa to about 35 degrees N latitude.

108. (b) The periodical rise and fall of the sea level, once or twice a day, mainly due to the attraction of the sun and the moon, is called a tide. The most common tidal pattern featuring two high tides and two low tides each day. The successive high or low tides are

approximately of the same height. Although tides occur twice a day, their interval is not exactly 12 hours. Instead, they occur at regular intervals of 12 hours and 25 minutes.

109. (d) Tooth enamel is the hardest, most highly mineralized substance in the body. It forms the outer, most visible layer of each tooth. Enamel is composed of hydroxyapatite, a mineral compound of calcium and phosphate Enamel plays a very important role in protecting teeth from decay. Tooth enamel forms a strong barrier that shields the inner layers of teeth from the effects of acids and plaque.

110. (a) Acceleration due to gravity $g = \frac{GM}{R^2}$

$$g = \frac{G\rho\frac{4}{3}\pi R^2}{R^2}$$

$$g = \frac{4}{3}\pi G\rho R$$

$\Rightarrow g \propto R$

As $R_1 > R_2$

$g_1 > g_2$

111. (b) Due to refraction, rays from sun bends along the atmospheric layers and gives the illusion of early sunrise and late sunset. The sunrise or the sunset is early and delayed by nearly 2 minutes.

112. (b) From the given graph,

$$\frac{1}{\text{slope}} = \text{velocity}$$

$$\therefore \text{velocity} \propto \frac{1}{\text{slope}}$$

$\Rightarrow V_C < V_B < V_A$

113. (d) 1 dyne = 1 g cm s–2

$(10^{-3}\text{ kg})\,(10^{-2}\text{ m})\,(s^{-2})$

$10^{-5}$ kgm $s^{-2}$

114. (c) In path $A \rightarrow B$ velocity is decreasing with time, therefore $AB$ represents deceleration.

In path $B \rightarrow C$ velocity is constant with time.

In path $C \rightarrow D$ velocity is increasing with time, therefore $CD$ represents acceleration.

115. (c) The walls of thermos flask are separated by vacuum and made of glass which is poor conductor of heat. The glass walls themselves have shiny surfaces. The radiation emitted by inner wall and that absorbed by outer wall, both are negligible.

The cork supports are poor conductors of heat.

116. (c) A black hole is a region of space time exhibiting gravitational acceleration so strong that nothing—no particles or even electromagnetic radiation such as light—can escape from it.

117. (a) The relation between Fahrenheit and Celsius is

$F = 32 + (1{\cdot}8 \times C°)$

118. (b) In refraction through a glass prism, the emergent ray is deviated from its original direction by a certain angle. This angle is the angle of deviation. During dispersion of white light, the colour which deviates the least is red.

119. (a) The Laser Interferometer Gravitational-Wave Observatory **(LIGO)** is a large-scale physics experiment and observatory to detect cosmic gravitational waves and to develop gravitational-wave observations as an astronomical tool.

120. (a) A fuse wire is an electrical instrument used for reducing the damage of electrical appliances when a high current passes into the wire. A fuse wire should have more resistance and a low melting point

121. (c) Kamarajar Port Limited (Erstwhile & Ennore Port Limited), the 12th Major Port is situated on the East Coast of India about 20 km north of Chennai Port along the coastline, in the State of Tamil Nadu. Kamarajar Port is the first and presently only Corporatized Major Port under the management control of Kamarajar Port Limited (KPL). The port was declared as Major Port under the Indian Ports Act, 1908 in March 1999 and incorporated as Ennore Port Limited under the Companies Act, 1956 in October 1999. It was commissioned in 2001 to handle thermal coal requirements.

122. (d) Lakshadweep is the India's smallest Union Territory which consists of 36 islands with an area of 32 sq km. It is a uni-district Union Territory and is comprised of 12 atolls, 3 reefs, 5 submerged banks and 10 inhabited islands.

123. (c)

124. (b) Antecedent streams existed before the upliftment of upland or mountain across which they

have maintained their present courses through continuous down-cutting of their valleys. Many of the major Himalayan rivers are examples of antecedent streams e.g. the Indus, the Sutlej, the Ganga, the Ghagra, the Kali, the Gandak, the Kosi, the Brahmaputra.

125. (d) The Karachi session was presided by Sardar Patel. The congress adopted a resolution on Fundamental Rights and Economic Policy which represented the Party's Social, Economic and Political programme. It was later known as Karachi Resolution. Some important aspects of these resolutions were: Basic civil rights of freedom of speech, Freedom of Press, Freedom of assembly, Freedom of association, Equality before law Elections on the basis of Universal Adult Franchise Free and compulsory primary education. Substantial reduction in rent and taxes better conditions for workers including a living wage, limited hours of work. Protection of women and peasants Government ownership or control of key industries, mines, and transport. Protection of Minorities.

126. (c) Treaty of Schönbrunn, (Oct. 14, 1809), agreement signed at the Schloss Schönbrunn in Vienna after Austria's premature war of liberation against Napoleon collapsed with its defeat at Wagram and its failure to get the Prussian support it had expected.

127. (a) New Model Trade Unions (NMTU) were a variety of Trade Unions prominent in the 1850s and 1860s in the UK. The term was coined by Sidney and Beatrice Webb in their History of Trade Unionism (1894), although later historians have questioned how far New Model Trade Unions represented a 'new wave' of unionism, as portrayed by the Webbs.

128. (a) The Truman Doctrine was an American foreign policy whose stated purpose was to counter Soviet geopolitical expansion during the Cold War. It was announced to Congress by President Harry S. Truman on March 29, 1947.

129. (c)

130. (d) Vladimir Lenin presented 'The April Theses' to the Russian people in 1917.

131. (b) An Election Commissioner can be removed from office on the recommendation of The chief Election Commissioner.

132. (d) The maximum strength of the Rajya Sabha is fixed at 250, out of which, 238 are to be the representatives of the states and union territories (electedindirectly) and 12 are nominated by the president. Rajya Sabha has an indefinite term and not subject to dissolution (Article 83.1). The term of an Individual Rajya Sabha member is 6 years and one third of its members retire every two years, in accordance with the rules as prescribed by the parliament of India.

133. (a) Fundamental Rights available to only citizens and not foreigners: Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth (Article 15). Equality of opportunity in matters of public employment (Article 16). Six basic freedoms subject to reasonable restrictions (Article 19). Protection of language, script and culture of minorities (Article 29). Right of minorities to establish and administer educational institutions (Article 30).

134. (a) The Treaty of Yandabo was signed by Gen. Campbell from the British side and Governor of Legaing Maha Min Hla Kyaw Htin from the Burmese side on 24 February 1826.

135. (d)

136. (c) "Sadaiv Atal', the Samadhi of Bharat Ratna & former PMSh Atal Behari Vajpayee which will be dedicated to the nation on 25th Dec, 2018– reflects Atalji's personality as a poet, humanist, statesman & a great leader. The central Samadhi platform comprises of nine square black polished granite solid stone blocks, capped with a 'diya' in the center. The number nine holds significance and represents the *navarasas, navaratras* and *navagrahas.* The placement of the nine square Samadhi is in a circular lotus shaped pattern. The nine-square platform is accessed in four cardinal directions by pathways made in white composite tiles so that the floor does not get heated. The Samadhi is enclosed by nine bas-relief walls which have inscriptions of the prose/ poetry of Atalji which can be read by the visitor while taking a pradakshina on the outer circular path.

137. (d) India-Myanmar bilateral army exercise, IMBEX 2018-19, has begun at Chandimandir Military Station which houses the headquarters of the Western Command.

138. (a) The Hindu Literary Prize 2018 was awarded during

The Hindu Lit for Life 2019. The winners under different categories are mentioned below: English writer Neelum Saran Gour, author of Requiem in Raga Jankibagged The Hindu Prize 2018 for Fiction. Vinayak Varma's Angry Akku received The Hindu Young World-Goodbooks Award for Best Picture Book: Story. Activist Manoranjan Byapari, author of Interrogating my Chandal Life: An Autobiography of a Dalit, bagged The Hindu Prize 2018 for non-fiction.

139. (c) The GST Council has decided to set up a seven-member committee to look into revenue shortfall being faced by the states after the GST roll-out, and suggest steps for augmenting collections. The committee would be headed by Deputy Chief Minister and Finance Minister of Bihar Sushil Modi.

140. (d) The Prime Minister, Narendra Modi inaugurated the 15th Pravasi Bharatiya Diwas on January 22, 2019 in his parliamentary constituency, Varanasi, Uttar Pradesh. In the history of Pravasi Bhartiya Diwas, the event is being held for the first time in Varanasi, the cultural and spiritual capital of India.

141. (c) The Brazilian city of Rio de Janeiro has been named as the World Capital of Architecture for 2020 by the UNESCO (United Nations Educational, Scientific, and Cultural Organization). Rio will be the first city to receive the title under a program launched together by UNESCO and the International Union of Architects (UIA) in 2018.

142. (a) Rishabh Pant was names ICC's emerging player of the year 2018.

143. (c) On 19th January, Prime Minister Narendra Modi inaugurated the India'first Armoured Systems Complex (ASC) built by a private company – Larsen & Toubro (L&T) – at Hazira in Surat, Gujarat.

144. (d) Correct Matching is:

| | |
|---|---|
| Ross Island | Subhash Chandra Bose Island |
| Neil Island | Shaheed Dweep |
| Havelock Island | Swaraj Dweep |

145. (b) Lance Naik Nazir Ahmad Wani, who laid down his life during an anti-terror operation at Batagund village in J&K's Shopian in November last year, will be posthumously conferred with the Ashoka Chakra.

146. (b) The text of a scientific name is usually italicized to clarify that it is a scientific name written in binomial nomenclature. The generic epithet is always capitalized, while the specific epithet is written in lower-case.

147. (d) An electrocardiogram (ECG or EKG) is a test that checks how your heart is functioning by measuring the electrical activity of the heart. With each heart beat, an electrical impulse (or wave) travels through your heart. This wave causes the muscle to squeeze and pump blood from the heart.

148. (b) Penicillin resistant bacteria can degrade this antibiotic by an enzyme called β –lactamase.

149. (c) Lysosome organelles of mammalian cell is rich in hydrolytic enzymes.

150. (c) Cholera is an infectious disease that causes severe watery diarrhea, which can lead to dehydration and even death if untreated. It is caused by eating food or drinking water contaminated with a bacterium called Vibrio cholerae.