NDA Solved Paper 2018-I

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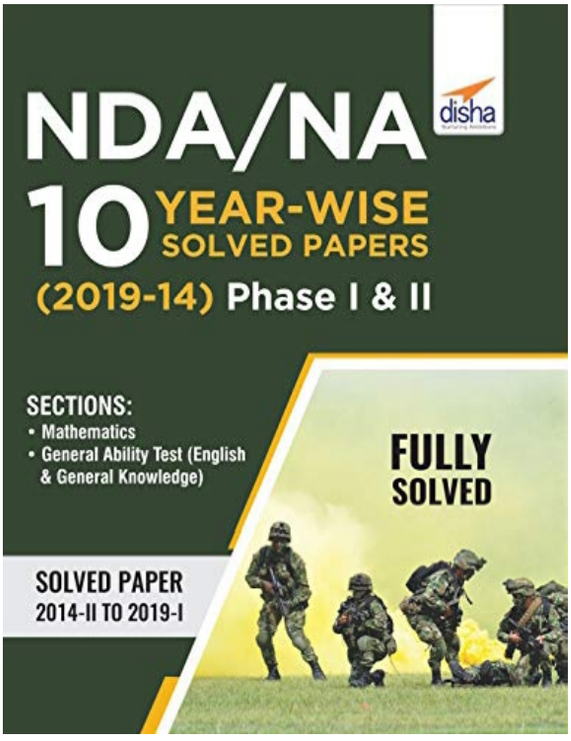

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NDA SOLVED PAPER 2018-I

MATHEMATICS

1. If $n \in N$, then $121^n - 25^n + 1900^n - (-4)^n$ is divisible by which one of the following?
(a) 1904 (b) 2000
(c) 2002 (d) 2006

2. If $n = (2017)!$, then what is
$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + ... + \frac{1}{\log_{2017} n}$$
equal to?
(a) 0 (b) 1
(c) $\frac{n}{2}$ (d) n

3. In the expansion of $(1 + x)^{43}$, if the coefficients of $(2r + 1)^{th}$ and $(r + 2)^{th}$ terms are equal, then what is the value of $r(r \neq 1)$?
(a) 5 (b) 14
(c) 21 (d) 22

4. What is the principal argument of $(-1 - i)$, where $i = \sqrt{-1}$?
(a) $\frac{\pi}{4}$ (b) $-\frac{\pi}{4}$
(c) $-\frac{3\pi}{4}$ (d) $\frac{3\pi}{4}$

5. Let α and β be real numbers and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct non-real roots with $Re(z) = 1$, then it is necessary that
(a) $\beta \in (-1, 0)$ (b) $|\beta| = 1$
(c) $\beta \in (1, \infty)$ (d) $\beta \in (0, 1)$

6. Let A and B be subsets of X and $C = (A \cap B') \cup (A' \cap B)$, where A' and B' are complements of A and B respectively in X. What is C equal to?
(a) $(A \cup B') - (A \cap B')$
(b) $(A' \cup B) - (A' \cap B)$
(c) $(A \cup B) - (A \cap B)$
(d) $(A' \cup B') - (A' \cap B')$

7. How many numbers between 100 and 1000 can be formed with the digits 5, 6, 7, 8, 9, if the repetition of digits is not allowed?
(a) 3^5 (b) 5^3
(c) 120 (d) 60

8. The number of non-zero integral solutions of the equation $|1 - 2i|^x = 5^x$ is
(a) Zero (No solution) (b) One
(c) Two (d) Three

9. If the ratio of AM to GM of two positive numbers a and b is 5 : 3, then a : b is equal to
(a) 3 : 5 (b) 2 : 9
(c) 9 : 1 (d) 5 : 3

10. If the coefficients of a^m and a^n in the expansion of $(1 + a)^{m+n}$ are α and β, then which one of the following is correct?
(a) $\alpha = 2\beta$ (b) $\alpha = \beta$
(c) $2\alpha = \beta$ (d) $\alpha = (m + n)\beta$

11. If $x + \log_{15}(1 + 3^x) = x \log_{15} 5 + \log_{15} 12$, where x is an integer, then what is x equal to?
(a) –3 (b) 2
(c) 1 (d) 3

12. How many four-digit numbers divisible by 10 can be formed using 1, 5, 0, 6, 7 without repetition of digits?
(a) 24 (b) 36
(c) 44 (d) 64

Consider the information given below and answer the two items (02) that follow:

In a class, 54 students are good in Hindi only, 63 students are good in Mathematics only and 41 students are good in English only. There are 8 students who are good in both Hindi and Mathematics. 10 students are good in all three subjects.

13. What is the number of students who are good in either Hindi or Mathematics but not in English?
(a) 99 (b) 107
(c) 125 (d) 130

14. What is the number of students who are good in Hindi and Mathematics but not in English?
(a) 18 (b) 12
(c) 10 (d) 8

15. If α and β are different complex numbers with $|\alpha| = 1$, then what is $\left|\frac{\alpha - \beta}{1 - \alpha\beta}\right|$ equal to?
(a) $|\beta|$ (b) 2
(c) 1 (d) 0

16. The equation $|1 - x| + x^2 = 5$ has
(a) a rational root and an irrational root
(b) two rational roots
(c) two irrational roots
(d) no real roots

17. The binary number expression of the decimal number 31 is
(a) 1111 (b) 10111
(c) 11011 (d) 11111

18. What is $i^{1000} + i^{1001} + i^{1002} + i^{1003}$ equal to (where $i = \sqrt{-1}$)?
(a) 0 (b) i
(c) –i (d) 1

19. What is $\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + ... + \frac{1}{\log_{100} N}$ equal to $(N \neq 1)$?
(a) $\frac{1}{\log_{100!} N}$ (b) $\frac{1}{\log_{99!} N}$
(c) $\frac{99}{\log_{100!} N}$ (d) $\frac{99}{\log_{99!} N}$

20. The modulus-amplitude form of $\sqrt{3} + i$, where $i = \sqrt{-1}$ is
(a) $2\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)$ (b) $2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$
(c) $4\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)$ (d) $4\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$

21. What is the number of non-zero terms in the expansion of $\left(1+2\sqrt{3}\,x\right)^{11} + \left(1-2\sqrt{3}\,x\right)^{11}$ (after simplification)?
(a) 4 (b) 5
(c) 6 (d) 11

22. What is the greatest integer among the following by which the number $5^5 + 7^5$ is divisible?
(a) 6 (b) 8
(c) 11 (d) 12

23. If $x = 1 - y + y^2 - y^3 + ...$ up to infinite terms, where $|y| < 1$, then which one of the following is correct?
(a) $x = \frac{1}{1+y}$ (b) $x = \frac{y}{1-y}$
(c) $x = \frac{y}{1+y}$ (d) $x = \frac{y}{1-y}$

24. What is the inverse of the matrix

$$A = \begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(a) $\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{pmatrix}$
(c) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{pmatrix}$ (d) $\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$

25. If A is a 2×3 matrix and AB is a 2×5 matrix, then B must be a
(a) 3×5 matrix (b) 5×3 matrix
(c) 3×2 matrix (d) 5×2 matrix

26. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$ and $A^2 - kA - I_2 = O$, where I_2 is the 2×2 identity matrix, then what is the value of k?
(a) 4 (b) –4
(c) 8 (d) –8

27. What is the number of triangles that can be formed by choosing the vertices from a set of 12 points in a plane, seven of which lie on the same straight line?
(a) 185 (b) 175
(c) 115 (d) 105

28. What is $C(n, r) + 2C(n, r-1) + C(n, r-2)$ equal to?
(a) $C(n+1, r)$ (b) $C(n-1, r+1)$
(c) $C(n, r+1)$ (d) $C(n+2, r)$

29. Let [x] denote the greatest integer function. What is the number of solutions of the equation $x^2 - 4x + [x] = 0$ in the interval [0, 2]?
(a) Zero (No solution) (b) One
(c) Two (d) Three

30. A survey of 850 students in a University yields that 680 students like music and 215 like dance. What is the least number of students who like both music and dance?
(a) 40 (b) 45
(c) 50 (d) 55

31. What is the sum of all two-digit numbers which when divided by 3 leave 2 as the remainder?
(a) 1565 (b) 1585
(c) 1635 (d) 1655

32. If $0 < a < 1$, the value of $\log_{10} a$ is negative. This is justified by
(a) Negative power of 10 is less than 1
(b) Negative power of 10 is between 0 and 1
(c) Negative power of 10 is positive
(d) Negative power of 10 is negative

33. The third term of a GP is 3. What is the product of the first five terms?
(a) 216
(b) 226
(c) 243
(d) Cannot be determined due to insufficient data

34. If x, $\frac{3}{2}$, z are in AP; x, 3, z are in GP; then which one of the following will be in HP?
(a) x, 6, z (b) x, 4, z
(c) x, 2, z (d) x, 1, z

35. What is the value of the sum $\sum_{n=2}^{11}\left(i^n + i^{n+1}\right)$, where $i = \sqrt{-1}$?
(a) i (b) 2i
(c) –2i (d) 1 + i

36. If $\sin x = \frac{1}{\sqrt{5}}, \sin y = \frac{1}{\sqrt{10}}$, where $0 < x < \frac{\pi}{2}$, $0 < y < \frac{\pi}{2}$, then what is $(x + y)$ equal to?

(a) π (b) $\frac{\pi}{2}$

(c) $\frac{\pi}{4}$ (d) 0

37. What is $\frac{\sin 5x - \sin 3x}{\cos 5x + \cos 3x}$ equal to?

(a) $\sin x$ (b) $\cos x$

(c) $\tan x$ (d) $\cot x$

38. What is $\sin 105° + \cos 105°$ equal to?

(a) $\sin 50°$ (b) $\cos 50°$

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

39. In a triangle ABC if $a = 2$, $b = 3$ and $\sin A = \frac{2}{3}$, then what is angle B equal to?

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

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{6}$

40. What is the principal value of $\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$?

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

(c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$

41. If x, x – y and x + y are the angles of a triangle (not an equilateral triangle) such that $\tan(x-y)$, $\tan x$ and $\tan(x+y)$ are in GP, then what is x equal to?

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

(c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

42. ABC is a triangle inscribed in a circle with centre O. Let $\alpha = \angle BAC$, where $45° < \alpha < 90°$. Let $\beta = \angle BOC$. Which one of the following is correct?

(a) $\cos\beta = \frac{1-\tan^2\alpha}{1+\tan^2\alpha}$ (b) $\cos\beta = \frac{1+\tan^2\alpha}{1-\tan^2\alpha}$

(c) $\cos\beta = \frac{2\tan\alpha}{1+\tan^2\alpha}$ (d) $\sin\beta = 2\sin^2\alpha$

43. If a flag-staff of 6 m height placed on the top of a tower throws a shadow of $2\sqrt{3}$ m along the ground, then what is the angle that the sun makes with the ground?

(a) 60° (b) 45°

(c) 30° (d) 15°

44. What is $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{3}{5}\right)$ equal to?

(a) 0 (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

45. A spherical balloon of radius r subtends an angle α at the eye of an observer, while the angle of elevation of its centre is β. What is the height of the centre of the balloon (neglecting the height of the observer)?

(a) $\frac{r\sin\beta}{\sin\left(\frac{\alpha}{2}\right)}$ (b) $\frac{r\sin\beta}{\sin\left(\frac{\alpha}{4}\right)}$

(c) $\frac{r\sin\left(\frac{\beta}{2}\right)}{\sin\alpha}$ (d) $\frac{r\sin\alpha}{\sin\left(\frac{\beta}{2}\right)}$

46. If $\frac{\sin(x+y)}{\sin(x-y)} = \frac{a+b}{a-b}$, then what is $\frac{\tan x}{\tan y}$ equal to?

(a) $\frac{a}{b}$ (b) $\frac{b}{a}$

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

47. If $\sin\alpha + \sin\beta = 0 = \cos\alpha + \cos\beta$, where $0 < \beta < \alpha < 2\pi$, then which one of the following is correct?

(a) $\alpha = \pi - \beta$ (b) $\alpha = \pi + \beta$

(c) $\alpha = 2\pi - \beta$ (d) $2\alpha = \pi + 2\beta$

48. Suppose cos A is given. If only one value of $\cos\left(\frac{A}{2}\right)$ is possible, then A must be

(a) An odd multiple of 90°

(b) A multiple of 90°

(c) An odd multiple of 180°

(d) A multiple of 180°

49. If $\cos\alpha + \cos\beta + \cos\gamma = 0$, where $0 < \alpha \le \frac{\pi}{2}$, $0 < \beta \le \frac{\pi}{2}$, $0 < \gamma \le \frac{\pi}{2}$, then what is the value of $\sin\alpha + \sin\beta + \sin\gamma$?

(a) 0 (b) 3

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

50. The maximum value of

$\sin\left(x + \frac{\pi}{5}\right) + \cos\left(x + \frac{\pi}{5}\right)$, where $x \in \left(0, \frac{\pi}{2}\right)$, is attained at

(a) $\frac{\pi}{20}$ (b) $\frac{\pi}{15}$

(c) $\frac{\pi}{10}$ (d) $\frac{\pi}{2}$

51. What is the distance between the points which divide the line segment joining (4, 3) and (5, 7) internally and externally in the ratio 2 : 3?

(a) $\frac{12\sqrt{17}}{5}$ (b) $\frac{13\sqrt{17}}{5}$

(c) $\frac{\sqrt{17}}{5}$ (d) $\frac{6\sqrt{17}}{5}$

52. What is the angle between the straight lines $(m^2 - mn)\,y = (mn + n^2)\,x + n^3$ and $(mn + m^2)\,y = (mn - n^2)\,x + m^3$, where $m > n$?

(a) $\tan^{-1}\left(\frac{2mn}{m^2+n^2}\right)$ (b) $\tan^{-1}\left(\frac{4m^2n^2}{m^4-n^4}\right)$

(c) $\tan^{-1}\left(\frac{4m^2n^2}{m^4+n^4}\right)$ (d) 45°

53. What is the equation of the straight line cutting off an intercept 2 from the negative direction of y-axis and inclined at 30° with the positive direction of x-axis?

(a) $x - 2\sqrt{3}y - 3\sqrt{2} = 0$

(b) $x + 2\sqrt{3}y - 3\sqrt{2} = 0$

(c) $x + \sqrt{3}y - 2\sqrt{3} = 0$

(d) $x - \sqrt{3}y - 2\sqrt{3} = 0$

54. What is the equation of the line passing through the point of intersection of the lines $x + 2y - 3 = 0$ and $2x - y + 5 = 0$ and parallel to the line $y - x + 10 = 0$?

(a) $7x - 7y + 18 = 0$ (b) $5x - 7y + 18 = 0$

(c) $5x - 5y + 18 = 0$ (d) $x - y + 5 = 0$

55. Consider the following statements:

1. The length p of the perpendicular from the origin to the line $ax + by = c$ satisfies the relation $p^2 = \frac{c^2}{a^2+b^2}$.
2. The length p of the perpendicular from the origin to the line $\frac{x}{a} + \frac{y}{b} = 1$ satisfies the relation $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$.
3. The length p of the perpendicular from the origin to the line $y = mx + c$ satisfies the relation $\frac{1}{p^2} = \frac{1+m^2+c^2}{c^2}$.

Which of the above is/are correct?

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

(c) 1 and 2 only (d) 2 only

56. What is the equation of the ellipse whose vertices are (± 5, 0) and foci are at (± 4, 0)?

(a) $\frac{x^2}{25} + \frac{y^2}{9} = 1$ (b) $\frac{x^2}{16} + \frac{y^2}{9} = 1$

(c) $\frac{x^2}{25} + \frac{y^2}{16} = 1$ (d) $\frac{x^2}{9} + \frac{y^2}{25} = 1$

57. What is the equation of the straight line passing through the point (2, 3) and making an intercept on the positive y-axis equal to twice its intercept on the positive x-axis?

(a) $2x + y = 5$ (b) $2x + y = 7$

(c) $x + 2y = 7$ (d) $2x - y = 1$

58. Let the coordinates of the points A, B, C be (1, 8, 4), (0, –11, 4) and (2, –3, 1) respectively. What are the coordinates of the point D which is the foot of the perpendicular from A on BC?

(a) (3, 4, –2) (b) (4, –2, 5)

(c) (4, 5, –2) (d) (2, 4, 5)

59. What is the equation of the plane passing through the points (–2, 6, –6), (–3, 10, –9) and (–5, 0, –6)?

(a) $2x - y - 2z = 2$ (b) $2x + y + 3z = 3$

(c) $x + y + z = 6$ (d) $x - y - z = 3$

60. A sphere of constant radius r through the origin intersects the coordinate axes in A, B and C. What is the locus of the centroid of the triangle ABC?

(a) $x^2 + y^2 + z^2 = r^2$ (b) $x^2 + y^2 + z^2 = 4r^2$

(c) $9(x^2 + y^2 + z^2) = 4r^2$ (d) $3(x^2 + y^2 + z^2) = 2r^2$

61. The coordinates of the vertices P, Q and R of a triangle PQR are (1, –1, 1), (3, –2, 2) and (0, 2, 6) respectively. If $\angle RQP = \theta$, then what is $\angle PRQ$ equal to?

(a) $30° + \theta$ (b) $45° - \theta$

(c) $60° - \theta$ (d) $90° - \theta$

62. The perpendiculars that fall from any point of the straight line $2x + 11y = 5$ upon the two straight lines $24x + 7y = 20$ and $4x - 3y = 2$ are

(a) 12 and 4 respectively

(b) 11 and 5 respectively

(c) Equal to each other

(d) Not equal to each other

63. The equation of the line, when the portion of it intercepted between the axes is divided by the point (2, 3) in the ratio of 3 : 2, is

(a) Either $x + y = 4$ or $9x + y = 12$

(b) Either $x + y = 5$ or $4x + 9y = 30$

(c) Either $x + y = 4$ or $x + 9y = 12$

(d) Either $x + y = 5$ or $9x + 4y = 30$

64. What is the distance between the straight lines $3x + 4y = 9$ and $6x + 8y = 15$?

(a) $\frac{3}{2}$ (b) $\frac{3}{10}$

(c) 6 (d) 5

65. What is the equation to the sphere whose centre is at (–2, 3, 4) and radius is 6 units?

(a) $x^2 + y^2 + z^2 + 4x - 6y - 8z = 7$

(b) $x^2 + y^2 + z^2 + 6x - 4y - 8z = 7$

(c) $x^2 + y^2 + z^2 + 4x - 6y - 8z = 4$

(d) $x^2 + y^2 + z^2 + 4x + 6y + 8z = 4$

66. If $\vec{a}$ and $\vec{b}$ are vectors such that $|\vec{a}| = 2$, $|\vec{b}| = 7$ and $\vec{a} \times \vec{b} = 3\hat{i} + 2\hat{j} + 6\hat{k}$, then what is the acute angle between $\vec{a}$ and $\vec{b}$?

(a) 30° (b) 45°
(c) 60° (d) 90°

67. Let $\vec{p}$ and $\vec{q}$ be the position vectors of the points P and Q respectively with respect to origin O. The points R and S divide PQ internally and externally respectively in the ratio 2 : 3. If $\overrightarrow{OR}$ and $\overrightarrow{OS}$ are perpendicular, then which one of the following is correct?

(a) $9p^2 = 4q^2$ (b) $4p^2 = 9p^2$
(c) $9p = 4q$ (d) $4p = 9q$

68. What is the moment about the point $\hat{i} + 2\hat{j} - \hat{k}$ of a force represented by $3\hat{i} + \hat{k}$ acting through the point $2\hat{i} - \hat{j} + 3\hat{k}$?

(a) $-3\hat{i} + 11\hat{j} + 9\hat{k}$ (b) $3\hat{i} + 2\hat{j} + 9\hat{k}$
(c) $3\hat{i} + 4\hat{j} + 9\hat{k}$ (d) $\hat{i} + \hat{j} + \hat{k}$

69. If $\vec{a} + 2\vec{b} + 3\vec{c} = \vec{0}$ and $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \lambda(\vec{b} \times \vec{c})$, then what is the value of λ?

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

70. If the vectors $\vec{k}$ and $\vec{A}$ are parallel to each other, then what is $k\vec{k} \times \vec{A}$ equal to?

(a) $k^2\vec{A}$ (b) $\vec{0}$
(c) $-k^2\vec{A}$ (d) $\vec{A}$

71. Which one of the following is correct in respect of the function $f : \mathbb{R} \to \mathbb{R}^+$ defined as $f(x) = |x + 1|$?

(a) $f(x^2) = [f(x)]^2$ (b) $f(|x|) = |f(x)|$
(c) $f(x + y) = f(x) + f(y)$ (d) None of the above

72. Suppose $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = \dfrac{x^2}{1 + x^2}$. What is the range of the function?

(a) [0, 1) (b) [0, 1]
(c) (0, 1] (d) (0, 1)

73. If $f(x) = |x| + |x - 1|$, then which one of the following is correct?

(a) f(x) is continuous at x = 0 and x = 1
(b) f(x) is continuous at x = 0 but not at x = 1
(c) f(x) is continuous at x = 1 but not at x = 0
(d) f(x) is neither continuous at x = 0 nor at x = 1

74. Consider the function $f(x) = \begin{cases} x^2 ln|x| & x \neq 0 \\ 0 & x = 0 \end{cases}$. What is $f'(0)$ equal to?

(a) 0 (b) 1
(c) –1 (d) It does not exist

75. What is the area of the region bounded by the parabolas $y^2 = 6(x - 1)$ and $y^2 = 3x$?

(a) $\dfrac{\sqrt{6}}{3}$ (b) $\dfrac{2\sqrt{6}}{3}$
(c) $\dfrac{4\sqrt{6}}{3}$ (d) $\dfrac{5\sqrt{6}}{3}$

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

Three sides of a trapezium are each equal to 6 cm. Let $\alpha \in \left(0, \dfrac{\pi}{2}\right)$ be the angle between a pair of adjacent sides.

76. If the area of the trapezium is the maximum possible, then what is α equal to?

(a) $\dfrac{\pi}{6}$ (b) $\dfrac{\pi}{4}$
(c) $\dfrac{\pi}{3}$ (d) $\dfrac{2\pi}{5}$

77. If the area of the trapezium is maximum, what is the length of the fourth side?

(a) 8 cm (b) 9 cm
(c) 10 cm (d) 12 cm

78. What is the maximum area of the trapezium?

(a) $36\sqrt{3}$ cm^2 (b) $30\sqrt{3}$ cm^2
(c) $27\sqrt{3}$ cm^2 (d) $24\sqrt{3}$ cm^2

79. What is $\int_0^{\pi} e^x \sin x \, dx$ equal to?

(a) $\dfrac{e^{\pi} + 1}{2}$ (b) $\dfrac{e^{\pi} - 1}{2}$
(c) $e^{\pi} + 1$ (d) $\dfrac{e^{\pi} + 1}{4}$

80. If $f(x) = \dfrac{x^2 - 9}{x^2 - 2x - 3}, x \neq 3$ is continuous at x = 3, then which one of the following is correct?

(a) f(3) = 0 (b) f(3) = 1.5
(c) f(3) = 3 (d) f(3) = –1.5

81. What is $\int_1^e x \, ln\, x \, dx$ equal to?

(a) $\dfrac{e + 1}{4}$ (b) $\dfrac{e^2 + 1}{4}$
(c) $\dfrac{e - 1}{4}$ (d) $\dfrac{e^2 - 1}{4}$

82. What is $\int_0^{\sqrt{2}} [x^2]dx$ equal to (where [.] is the greatest integer function)?

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

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

83. What is the maximum value of $16 \sin \theta - 12 \sin^2 \theta$?

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

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

84. If $f : \mathbb{R} \to S$ defined by $f(x) = 4 \sin x - 3 \cos x + 1$ is onto, then what is S equal to?

(a) $[-5, 5]$ (b) $(-5, 5)$

(c) $(-4, 6)$ (d) $[-4, 6]$

85. For f to be a function, what is the domain of f, if $f(x) = \frac{1}{\sqrt{|x|-x}}$?

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

(c) $(-\infty, \infty)$ (d) $(-\infty, 0]$

86. What is the solution of the differential equation $x\,dy - y\,dx = 0$?

(a) $xy = c$ (b) $y = cx$

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

87. What is the derivative of the function $f(x) = e^{\tan x} + ln(\sec x) - e^{\ell n x}$ at $x = \frac{\pi}{4}$?

(a) $\frac{e}{2}$ (b) e

(c) 2e (d) 4e

88. Which one of the following differential equations has a periodic solution?

(a) $\frac{d^2x}{dt^2} + \mu x = 0$

(b) $\frac{d^2x}{dt^2} - \mu x = 0$

(c) $x\frac{dx}{dt} + \mu t = 0$

(d) $\frac{dx}{dt} + \mu x t = 0$

where $\mu > 0$.

89. What is the period of the function $f(x) = \sin x$?

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

(c) π (d) 2π

90. What is $\int \frac{dx}{2^x - 1}$ equal to?

(a) $ln(2^x - 1) + c$ (b) $\frac{ln\left(1 - 2^{-x}\right)}{ln\,2} + c$

(c) $\frac{ln\left(2^{-x} - 1\right)}{2\,ln\,2} + c$ (d) $\frac{ln\left(1 + 2^{-x}\right)}{ln\,2} + c$

91. The order and degree of the differential equation $y^2 = 4a(x - a)$, where 'a' is an arbitrary constant, are respectively

(a) 1, 2 (b) 2, 1

(c) 2, 2 (d) 1, 1

92. What is the value of $\int_{\frac{-\pi}{4}}^{\frac{\pi}{4}} (\sin \times \tan x)dx$?

(a) $-\frac{1}{\sqrt{2}} + \ell n\left(\frac{1}{\sqrt{2}}\right)$ (b) $\frac{1}{\sqrt{2}}$

(c) 0 (d) $\sqrt{2}$

93. If $\int_a^b x^3 dx = 0$ and $\int_a^b x^2 dx = \frac{2}{3}$, then what are the values of a and b respectively?

(a) $-1, 1$ (b) $1, 1$

(c) $0, 0$ (d) $2, -2$

94. What is $\int_0^1 x(1-x)^9 dx$ equal to?

(a) $\frac{1}{110}$ (b) $\frac{1}{132}$

(c) $\frac{1}{148}$ (d) $\frac{1}{240}$

95. What is $\lim_{x \to 0} \frac{\tan x}{\sin 2x}$ equal to?

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

(c) 2 (d) Limit does not exist

96. What is $\lim_{h \to 0} \frac{\sqrt{2x+3h} - \sqrt{2x}}{2h}$ equal to?

(a) $\frac{1}{2\sqrt{2x}}$ (b) $\frac{3}{\sqrt{2x}}$

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

97. If f(x) is an even function, where $f(x) \neq 0$, then which one of the following is correct?
(a) $f'(x)$ is an even function
(b) $f'(x)$ is an odd function
(c) $f'(x)$ may be an even or odd function depending on the type of function
(d) $f'(x)$ is a constant function

98. If $y = e^{x^2} \sin 2x$, then what is $\frac{dy}{dx}$ at $x = \pi$ equal to?
(a) $(1+\pi)e^{\pi^2}$ (b) $2\pi e^{\pi^2}$
(c) $2e^{\pi^2}$ (d) e^{π^2}

99. What is the solution of $(1 + 2x)\,dy - (1 - 2y)\,dx = 0$?
(a) $x - y - 2xy = c$ (b) $y - x - 2xy = c$
(c) $y + x - 2xy = c$ (d) $x + y + 2xy = c$

100. What are the order and degree, respectively, of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 = y^4 + \left(\frac{dy}{dx}\right)^5$?
(a) 4, 5 (b) 2, 3
(c) 3, 2 (d) 5, 4

101. In a Binominal distribution, the mean is three times its variance. What is the probability of exactly 3 successes out of 5 trials?
(a) $\frac{80}{243}$ (b) $\frac{40}{243}$
(c) $\frac{20}{243}$ (d) $\frac{10}{243}$

102. Consider the following statements:
1. $P(\bar{A} \cup B) = P(\bar{A}) + P(B) - P(\bar{A} \cap B)$
2. $P(A \cap \bar{B}) = P(B) - P(A \cap B)$
3. $P(A \cap B) = P(B)P(A \mid B)$

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

103. If the correlation coefficient between x and y is 0.6, covariance is 27 and variance of y is 25, then what is the variance of x?
(a) $\frac{9}{5}$ (b) $\frac{81}{25}$
(c) 9 (d) 81

104. The probabilities that a student will solve Question A and Question B are 0.4 and 0.5 respectively. What is the probability that he solves at least one of the two questions?
(a) 0.6 (b) 0.7
(c) 0.8 (d) 0.9

105. Let $\bar{x}$ be the mean of $x_1, x_2, x_3, \ldots, x_n$. If $x_i = a + cy_i$ for some constants a and c, then what will be the mean of $y_1, y_2, y_3, \ldots, y_n$?
(a) $a + c\bar{x}$ (b) $a - \frac{1}{c}\bar{x}$
(c) $\frac{1}{c}\bar{x} - a$ (d) $\frac{\bar{x} - a}{c}$

106. Consider the following statements:
1. If the correlation coefficient $r_{xy} = 0$, then the two lines of regression are parallel to each other.
2. If the correlation coefficient $r_{xy} = +1$, then the two lines of regression are perpendicular to each other.

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

107. If $4x - 5y + 33 = 0$ and $20x - 9y = 107$ are two lines of regression, then what are the values of $\bar{x}$ and $\bar{y}$ respectively?
(a) 12 and 18 (b) 18 and 12
(c) 13 and 17 (d) 17 and 13

108. Consider the following statements:
1. Mean is independent of change in scale and change in origin.
2. Variance is independent of change in scale but not in origin.

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

109. Consider the following statements:
1. The sum of deviations from mean is always zero.
2. The sum of absolute deviations is minimum when taken around median.

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

110. What is the median of the numbers 4.6, 0, 9.3, –4.8, 7.6, 2.3, 12.7, 3.5, 8.2, 6.1, 3.9, 5.2?
(a) 3.8 (b) 4.9
(c) 5.7 (d) 6.0

111. In a test in Mathematics, 20% of the students obtained "first class". If the data are represented by a Pie-Chart, what is the central angle corresponding to "first class"?
(a) 20° (b) 36°
(c) 72° (d) 144°

112. The mean and standard deviation of a set of values are 5 and 2 respectively. If 5 is added to each value, then what is the coefficient of variation for the new set of values?
(a) 10 (b) 20
(c) 40 (d) 70

113. A train covers the first 5 km of its journey at a speed of 30 km/hr and the next 15 km at a speed of 45 km/hr. What is the average speed of the train?
(a) 35 km/hr (b) 37.5 km/hr
(c) 39.5 km/hr (d) 40 km/hr

114. Two fair dice are rolled. What is the probability of getting a sum of 7?

(a) $\frac{1}{36}$ (b) $\frac{1}{6}$

(c) $\frac{7}{12}$ (d) $\frac{5}{12}$

115. If A and B are two events such that $2P(A) = 3P(B)$, where $0 < P(A) < P(B) < 1$, then which one of the following is correct?

(a) $P(A|B) < P(B|A) < P(A \cap B)$
(b) $P(A \cap B) < P(B|A) < P(A|B)$
(c) $P(B|A) < P(A|B) < P(A \cap B)$
(d) $P(A \cap B) < P(A|B) < P(B|A)$

116. A box has ten chits numbered 0, 1, 2, 3, ..., 9. First, one chit is drawn at random and kept aside. From the remaining, a second chit is drawn at random. What is the probability that the second chit drawn is "9"?

(a) $\frac{1}{10}$ (b) $\frac{1}{9}$

(c) $\frac{1}{90}$ (d) None of the above

117. One bag contains 3 white and 2 black balls, another bag contains 5 white and 3 black balls. If a bag is chosen at random and a ball is drawn from it, what is the chance that it is white?

(a) $\frac{3}{8}$ (b) $\frac{49}{80}$

(c) $\frac{8}{13}$ (d) $\frac{1}{2}$

118. Consider the following in respect of two events A and B:

1. $P(A \text{ occurs but not } B) = P(A) - P(B)$ if $B \subset A$
2. $P(A \text{ alone or } B \text{ alone occurs}) = P(A) + P(B) - P(A \cap B)$
3. $P(A \cup B) = P(A) + P(B)$ if A and B are mutually exclusive

Which of the above is/are correct?

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

119. A committee of three has to be chosen from a group of 4 men and 5 women. If the selection is made at random, what is the probability that exactly two members are men?

(a) $\frac{5}{14}$ (b) $\frac{1}{21}$

(c) $\frac{3}{14}$ (d) $\frac{8}{21}$

120. The standard deviation σ of the first N natural numbers can be obtained using which one of the following formulae?

(a) $\sigma = \frac{N^2 - 1}{12}$ (b) $\sigma = \sqrt{\frac{N^2 - 1}{12}}$

(c) $\sigma = \sqrt{\frac{N - 1}{12}}$ (d) $\sigma = \sqrt{\frac{N^2 - 1}{6N}}$

GENERAL ABILITY

PART-A : ENGLISH

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

1. I do not want you to lead a life of sycophancy as you did during the foreign rule.
(a) admiration (b) love
(c) appreciation (d) flattery

2. In India, it has become easy to attack cultural artefacts these days.
(a) beckon (b) assault
(c) belch (d) appreciate

3. A local court granted bail to the criminal on Thursday.
(a) confessed (b) donated
(c) allowed (d) yielded

4. The judge told that he would analyze the evidence and then deliver the verdict.
(a) liberate (b) surrender
(c) transfer (d) pronounce

5. The growth and development of the peasant movement was indissolubly linked with the national struggle for freedom.
(a) firmly (b) vaguely
(c) individually (d) steadily

6. Weather conditions have been improving over the past few days.
(a) mending (b) amending
(c) becoming better (d) advancing

7. The confusion on the interlocutor's face was gratifying.
(a) government officer (b) party worker
(c) dialogist (d) revolutionary

8. He spends his money lavishly.
(a) hesitatingly (b) generously
(c) foolishly (d) carefully

9. The government's new policies will come into force from the next fiscal year.
(a) calendar (b) academic
(c) financial (d) leap

10. Abundant food was available for the soliders in the mess.
(a) little (b) plentiful
(c) delicious (d) wholesome

DIRECTIONS : *Each item in this section consists of a sentence with an underlined word/words 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.*

11. The country's economy must be geared to wartime requirements.
(a) subordinated to (b) related to
(c) adjusted to (d) unlinked to

12. Why does fire attract insects?
(a) discharge (b) destroy
(c) repel (d) remove

13. The party was excellent, and I would like to thank all the people concerned.
(a) cared (b) attentive
(c) dependable (d) uninvolved

14. He is very serious by temperament.
(a) grave (b) trivial
(c) sober (d) stupid

15. There are a few miscellaneous items to discuss in this meeting.
(a) pure (b) mixed
(c) homogenous (d) discordant

16. Due to the postal strike, the outgoing mail got delayed.
(a) urgent (b) incoming
(c) ordinary (d) speedy

17. He had a fine ear for music.
(a) small (b) close
(c) coarse (d) smooth

18. There is no likeness between him and his brother.
(a) unlikeliness (b) unlikelihood
(c) dissimilarity (d) disaffinity

19. Cultural diversity in the working place is good for business.
(a) uniformty (b) conformity
(c) identify (d) similarity

20. The company was liquidated within five years.
(a) bankrupt (b) closed down
(c) flourishing (d) privatised

DIRECTIONS : *Each item in this section has a sentence with three underlined parts labelled (a), (b) and (c). Read each sentences 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).*

21. The politician lost face in his constituency (a)
when he broke the pre-election promises (b)
he made to his people. (c) No error. (d)

22. At the request of the Defence Attorney, (a)
the jury were called (b)
and their individual verdicts were recorded. (c) No error. (d)

23. Frank Lloyd Wright has been acclaimed (a) by colleagues (b)
as the greater of all modern architects. (c) No error. (d)

24. In my younger days (a) I could run four miles (b) at a stretch. (c)
No error. (d)

25. The owner (a) as well as his servants (b) is honest (c) No error. (d)

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

26. Cry over spilt milk
(a) Complaning about a loss in the past
(b) Too much inquisitive about something
(c) When something is done badly to save money
(d) Dealing with a problem only in an emergency situation

27. Cut the mustard
(a) Prepare spices out mustard seeds
(b) To come up to expectations
(c) Making absurd expectations
(d) Very enthusiastic

28. Devil's advocate
(a) A dangerous person
(b) To present a counter argument
(c) Very argumentative person
(d) Creating an unpleasant situation

29. Don't count yout chickens before the eggs have hatched
(a) If you are not good at something, better to avoid that
(b) Don't make plans for something that might not happen
(c) Not to come up to expectations
(d) Don't put all your resources in one possibility

30. Give the benefit of doubt
(a) To be partial to someone
(b) To be judgemental
(c) Regard someone as innocent until proven otherwise
(d) Say something exactly right

DIRECTIONS : *In this section each item consist of six sentences of a passage. The 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.*

31. S1 : The Subsidiary Alliance system was extremely advantageous to the British.
S6 : The controlled the defence and the foreign relations of the protected ally.
P : They could now maintain a large army at the cost of Indian states
Q : If any war occurred in the territories
R : either of the British ally or of the Britishers
S : This enabled them to fight wars far away from their own territories
The proper sequence should be
(a) PQRS (b) PSQR
(c) QRPS (d) SRPQ

32. S1 : In reality, by signing a Subsidiary Alliance, an Indian state virtually signed away its independence.
S6 : In fact, the Indian ruler lost all vestiges of sovereignty in external matters.
P : of maintaining diplomatic relations
Q : It lost the right of self defence
R : with its neighbours
S : and of setting its disputes
The proper sequence should be
(a) P Q R S (b) R S P Q
(c) Q P S R (d) Q S R P

33. S1 : A mighty popular Revolt broke out in Northern and Central India in 1857
S6 : Millions of peasants, artisans and soliders fought heroically and wrote a glorious chapter.
P : Sepoys, or the Indian soliders of the Company's army
Q : but soon engulfed wide regions and involved the masses
R : and nearly swept away the British rule
S : It began with a mutiny of the
The proper sequence should be
(a) R S P Q (b) P Q R S
(c) S R P Q (d) Q R P S

34. S1 : The Indian Civil Service gradually developed into one of the most efficient and powerful civil services in the world.
S6 : though these qualities obviously served British, and not Indian interests.
P : and often participated in the making of policy
Q : independence, integrity and hard work
R : They developed certain traditions of
S : Its members exercised vast power
The proper sequence should be
(a) P Q R S (b) Q R S P
(c) R S Q P (d) S P R Q

35. S1 : The ruin of Indian handicrafts was reflected in the ruin of the towns and cities which were famous for their manufactures.
S6 : Centres were developed and laid waste.
P : Dacca, Surat, Murshidabad and many other rising industrial
Q : ravages of war and plunder, failed to
R : survive British conquest
S : Cities which had withstood the
The proper sequence should be
(a) P Q R S (b) S Q R P
(c) S R P Q (d) Q R S P

DIRECTIONS : *In this section you have few short passages. After each passage, you will find some items based on the passage. First, read a 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

The rule of the road means that in order that the liberties of all may be preserved, the liberties of everybody must be curtailed. When the policeman, say, at a road-crossing steps into the middle of the road and puts out his hand, he is the symbol not of tyramy but of liberty. You have submitted to a curtailment of private liberty in order that you may enjoy a social order which makes your liberty a reality. We have both liberties to preseve — our individual liberty and our social liberty. That is, we must have a judicious mixture of both. I shall not permit any authority to say that my child must go to this school or that, shall not permit any authority to say that my child must go to this school or that, shall specialize in science or arts. These things are personal. But if I say that my child shall have no education at all, then society will firmly tell me that my child must have education whether I like it or not.

36. According to the author, the "rule of the road" implies
(a) the role regulating the traffic on the road
(b) the principle on which a road is constructed to ensure safe traffic
(c) unrestricted freedom for all to lead a happy life
(d) restricted individual freedom to ensure freedom for all

37. The author thinks that when a policeman signals you to stop on a road-crossing, he is
(a) behaving in a whimiscal manner
(b) interfering with your freedom to use the road
(c) protecting the liberty of all to use the road
(d) mischievously creating hurdles in your way from some personal motive

38. The author is of the view that we should
(a) have absolute individual liberty without any restrictions imposed by the society
(b) have everything controlled by the society without any kind of individual liberty
(c) try to strike a sensible balance between our individual liberty and our social liberty
(d) have more of social liberty than individual liberty

39. The author holds that
(a) educating or not educating his child is a matter of personal liberty
(b) educating or not educating his child is also a matter of social liberty
(c) choosing the school for his child is a matter of social liberty
(d) choosing the subject of study for his child is a matter of social liberty

40. The most suitable title of the passage would be
(a) The Policeman at a Road Crossing
(b) The Laws of the Road
(c) Importance of Liberty
(d) Education of Children

Passage

My most interesting visitor comes at night, when the lights are still burning — a tiny bat who prefers to fly in through the open door, and will use the window only if there is no alternative. His object in entering the house is to snap up the moths that cluster around the lamps. All the bats I have seen fly fairly high, keeping near the ceiling; but this particular bat flies in low, like a dive-bomber, zooming in and out of chair legs and under tables. Once, he passed straight between my legs. Has his radar gone wrong, I wondered, or is he just plain crazy?

41. Consider the following statements:
1. The tiny bat flew in low like a dive-bomber.
2. The tiny bat like all bats keeps near the cieling.
3. It has lost direction because its radar has gone wrong.
4. It wants to entertain the author with its skill in the flying.

Which of the above statements may be assumed to be true from the information given in the passage?
(a) 1 only (b) 1 and 3
(c) 2 and 4 (d) 3 and 4

42. The bat entered the room
(a) because there was no alternative
(b) to eat the moths round the lamps
(c) as it had gone mad
(d) as it preferred to fly in through the open door

43. After comparing the habits of the tiny bat with those of other bats, the author was
(a) sure that this bat had lost its direction
(b) not sure of its preferences
(c) surprised to find that it was an expert flier
(d) unable to give the correct explanation for its behaviour

44. The author calls the tiny bat an "interesting visitor". This means
(a) the bat visits him at night
(b) the bat is interested in the moths
(c) this bat has peculiar qualities
(d) this bat surprises him by zooming in and out like a dive-bomber

45. What, according to you, can be the most suitable title for the passage?
(a) Someone visits me (b) Night of Mysteries
(c) My Nocturnal Visitor (d) A Funny Visitor

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. The tired traveller _____ on in the hope of finding some resting place.
(a) strolled (b) scurried
(c) paraded (d) plodded

47. The car was damaged beyond repair in the _____ accident.
(a) outrageous (b) ghastly
(c) nasty (d) heinous

48. They gave a _____ dinner to celebrate the occasion, which impressed every guest.
(a) austere (b) public
(c) sumptuous (d) summary

49. Once the _____ manuscript is received by the publishers, it is typed in double space.
(a) total (b) full
(c) complete (d) filled

50. I am used to _____ in queues.
(a) stand (b) standing
(c) stand up (d) standing still

PART-B : GENERAL KNOWLEDGE

51. Which one of the following statements is correct?
(a) Any energy transfer that does not involve temperature difference in some way is not heat
(b) Any energy transfer always requires a temperature difference
(c) On heating the length and volume of the object remain exactly the same
(d) Whenever there is a temperature difference, heat is the only way of energy transfer

52. If T is the time period of an oscillating pendulum, which one of the following statements is NOT correct?
(a) The motions repeats after time T only once
(b) T is the least time after which motion repeats itself
(c) The motion repeats itself after nT, where n is a positive integer
(d) T remains the same only for small angular displacements

53. If an object moves with constant velocity then which one of the following statements is NOT correct?
(a) Its motion is along a straight line
(b) Its speed changes with time
(c) Its acceleration is zero
(d) its displacement increases linearly with time

54. An object is moving with uniform acceleration a. Its initial velocity is u and after time t its velocity is v. The equation of its motion is $v = u + at$. The velocity (along y-axis) time (along x-axis) graph shall be a straight line
(a) passing through origin (b) with x-intercept u
(c) with y-intercept u (d) with slope u

55. What is the net force experienced by a bar magnet placed in a uniform magnetic field?
(a) Zero
(b) Depends upon length of the magnet
(c) Never zero
(d) Depends upon temperature

56. Which one of the following has maximum inertia?
(a) An atom (b) A molecule
(c) A one-rupee coin (d) A cricket ball

57. Which one of the following is the value of 1 kWh of energy converted into joules?
(a) 1.8×10^6 J (b) 3.6×10^6 J
(c) 6.0×10^6 J (d) 7.2×10^6 J

58. Which one of the following statements about gravitational force is NOT correct?
(a) It is experienced by all bodies in the universe
(b) It is a dominant force between celestial bodies
(c) It is a negligible force for atoms
(d) It is same for all pairs of bodies in our universe

59. Whether an object will float or sink in a liquid, depends on
(a) mass of the object only
(b) mass of the object and density of liquid only
(c) difference in the densities of the object and liquid
(d) mass and shape of the object only

60. Which one of the following devices is non-ohmic?
(a) Conducting copper coil
(b) Electric heating coil
(c) Semi conductor diode
(d) Rheostat

61. Which one of the following is the natural phenomenon based on which a simple periscope works?
(a) Reflection of light
(b) Refraction of light
(c) Dispersion of light
(d) Total internal reflection of light

62. Which one of the following frequency ranges is sensitive to human ears?
(a) 0 – 200 Hz (b) 20 – 20,000 Hz
(c) 200 – 20,000 Hz only (d) 2,000 – 20,000 Hz only

63. The accidental touch of Nettle leaves creates a burning sensation, which is due to inject of
(a) Hydrochloric acid (b) Methanoic acid
(c) Citric acid (d) Sulphuric acid

64. Which of the following properties is true for a tooth paste?
(a) It is acidic
(b) It is neutral
(c) It is basic
(d) It is made up of Calcium phosphate, the material of tooth enamel

65. Which one of the following gives the highest amount of hydrogen ions (H^+)?
(a) Sodium hydroxide solution
(b) Milk of magnesia
(c) Lemon juice
(d) Gastric juice

66. Brine is an aqueous solution of
(a) NaCl (b) NaOH
(c) $NaHCO_3$ (d) Na_2CO_3

67. Which one of the following is the chemical formula of Washing Soda?
(a) $NaHCO_3$ (b) $Na_2CO_3.10H_2O$
(c) $Na_2CO_3.5H_2O$ (d) NaOH

68. Which one of the following is NOT true for bleaching powder?
(a) It is used as a reducing agent in chemical industries
(b) It is used for bleaching wood pulp in paper factories
(c) It is used for disinfecting drinking water
(d) It is used for bleaching linen in textile industry

69. AIDS is caused by a virus whose genetic material is
(a) single stranded circular DNA
(b) double stranded DNA
(c) single stranded RNA
(d) double stranded RNA

70. Which one of the following is an organelle that is NOT found in prokaryotic cells?
(a) Cell wall
(b) Mitochondria
(c) Plasma membrane
(d) Ribosome

71. Which one of the following parts of body does NOT take part in the process of breathing?
(a) Bronchi (b) Bowman's capsule
(c) Diaphragm (d) Trachea

72. Which one of the following statements about classification of plants is correct?
(a) Thallophytes have well differentiated body design
(b) Funaria is a fungus
(c) All Pteridophytes are Phanerogams
(d) Vascular system is not found among Bryophytes

73. Which one of the following is the correct sequence of levels of hierarchy of classification of organisms from higher to lower?
(a) Phylum – Class – Order – Family – Genus
(b) Phylum – Class – Family – Order – Genus
(c) Family – Order – Class – Species – Genus
(d) Class – Family – Order – Species – Genus

74. Which one of the following statements about meristematic tissues in plants is correct?
(a) These are dead tissues and form wood
(b) They provide flexibility to plant due to their thickened walls
(c) These are present in the bark of a tree only
(d) Growth occurs in plants due to division of cells of these tissues

75. Which one of the following Union Territories has the highest female literacy rate?
(a) Chandigarh
(b) Lakshadweep
(c) Andaman and Nicobar Islands
(d) Puducherry

76. Consider the following statements about Roaring Forties :
1. They are strong Westerly winds found in the oceans of Southern Hemisphere.
2. The strong east to west air currents are caused by the combination of air being displaced from the Equator towards the South Pole and the earth's rotation and abundance of landmasses to serve as wind breaks.

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

77. Consider the following statements:
1. The doldrums is a low pressure area around Equator where the prevailing winds are calm.
2. Chinook is a hot and dry wind that blows in winter and therefore raises the temperature in a short time.

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

78. Which one of the following is the driest desert of the world?
(a) Atacama (b) Gobi
(c) Sahara (d) Kalahari

79. Which of the following statements about latent heat for a given substance is/are correct?
1. It is fixed at a given temperature.
2. It depends upon the temperature and volume.

3. it is independent of temperature and volume.
4. It depends on the temperature but independent of volume.

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

80. Which one of the following statements about the mass of a body is correct?
(a) It changes from one place to another
(b) It is same everywhere
(c) It depends on its shape
(d) It does not depend on its temperature

81. A ball balanced on a vertical rod is an example of
(a) stable equilibrium (b) unstable equilibrium
(c) neutral equilibrium (d) perfect equilibrium

82. Which of the following statements about a fluid at rest in a cup is/are correct?
1. Pressure is same at all the points in the fluid.
2. Pressureis exerted on the walls.
3. Pressure exists everywhere in the fluid.

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

83. Which one of the following devices is used to measure atmospheric pressure?
(a) Ammeter (b) Barometer
(c) Potentiometer (d) Lactometer

84. Which one of the following is the number of water molecules that share with two formula unit $CaSO_4$ in plaster of Paris?
(a) One (b) Two
(c) Five (d) Ten

85. How is carbon black obtained?
(a) By heating wood at high temperature in absence of air
(b) By heating coal at high temperature in absence of air
(c) By burning hydrocarbons in a limited supply of air
(d) By heating coal at high temperature in presence of air

86. Which one of the following properties is NOT true for graphite?
(a) Hybridisation of each carbon atom of sp^3
(b) Hybridisation of each carbon atom is sp^2
(c) Electrons are delocalized over the whole sheet of atoms
(d) Each layer is composed of hexagonal rings.

87. Which one of the following is the purest form of Carbon?
(a) Charcoal (b) Coke
(c) Fullerene (d) Carbon black

88. The Poisonous nature of Carbon monoxide (CO) is due to its
(a) insolubility in water
(b) ability to form a complex with haemoglobin
(c) ability to reduce some metal oxides
(d) property of having one sigma bond

89. Which one of the following elements is needed in the human body to transfer electrical signals by nerve cells?
(a) Lithium (b) Sodium
(c) Rubidium (d) Caesium

90. Who among the following first discovered cell?
(a) Robert Brown (b) Robert Hooke
(c) Leeuwenhoek (d) Rudolf Virchow

91. Which one of the following group of organisms forms a food chain?
(a) Grass, human and fish
(b) Grass, goat and human
(c) Tree, tree cutter and tiger
(d) Goat, cow and human

92. Which one of the following types of tissues will have contractile proteins?
(a) Nervous tissue (b) Muscle tissue
(c) Bone tissue (d) Blood tissue

93. If by an unknown accident the acid secreting cells of the stomach wall of an individual are damaged, digestion of which one of the following biomolecule will be affected to a greater extent?
(a) Protein only
(b) Lipid
(c) Carbohydrate only
(d) Protein and Carbohydrate

94. In which one of the following places, Headquarters of a Railway Zone is located?
(a) Kanpur (b) Lucknow
(c) Hajipur (d) New Jalpaiguri

95. Which of the following statements about Indian Academy of Highway Engineers is/are correct?
1. It is a registered society.
2. It is a collaborative body of both Central Government and State Governments.

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

96. Which one of the following is NOT a tributary of Indus River?
(a) Beas (b) Ravi
(c) Chenab (d) Tawi

97. Which one among the following is the largest tiger reserve of India in terms of area of the core/critical tiger habitat?
(a) Manas
(b) Pakke
(c) Nagarjunasagar Srisailam
(d) Periyar

98. Which one of the following is NOT a coastal depositional feature?
(a) Tombolo (b) Sand bar
(c) Stack (d) Spit

99. Which of the following is/are coastal erosional feature(s)?
1. Notch
2. Sea Arch
3. Cliff
4. Hook

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

100. Chemical weathering of rocks is much greater in a place with
(a) cold and dry climate (b) hot and humid climate
(c) hot and dry climate (d) cold and humid climate

101. Which of the following statements about specific heat of a body is/are correct?
1. It depends upon mass and shape of the body
2. It is independent of mass and shape of the body
3. It depends only upon the temperature of the body
Select the correct answer using the code given below:
(a) 1 only (b) 2 and 3
(c) 1 and 3 (d) 2 only

102. Which one of the following is an example of the force of gravity of the earth acting on a vibrating pendulum bob?
(a) Applied force (b) Frictional force
(c) Restoring force (d) Virtual force

103. Which one of the following statements about the refractive index of a material medium with respect to air is correct?
(a) It can be either positive or negative
(b) It can have zero value
(c) It is unity for all materials
(d) It is always greater than one

104. Which one of the following statements about magnetic field lines is NOT correct?
(a) They can emanate from a point
(b) They do not cross each other
(c) Field lines between two poles cannot be precisely straight lines at the ends
(d) There are no field lines within a bar magnet

105. Two convex lenses with power 2 dioptre are kept in contact with each other. The focal length of the combined lens system is
(a) 0.10m (b) 2m
(c) 4m (d) 0.25m

106. Which one of the following alkali metals has lowest melting point?
(a) Sodium (b) Potassium
(c) Rubidium (d) Caesium

107. Which one of the following metals is alloyed with sodium to transfer heat in a nuclear reactor?
(a) Potassium (b) Calcium
(c) Magnesium (d) Strontium

108. Which one of the following metals is used in the filaments of photo-electric cells that convert light energy into electric energy?
(a) Tungsten (b) Copper
(c) Rubidium (d) Aluminium

109. Which of the following statements about Ring of Fire is/are correct?
1. It is a zone of convergence plate boundaries
2. It is an active seismic and volcanic zone
3. It is associated with deep trench
Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 only (d) 1, 2 and 3

110. Which one of the following Himalayan vegetation species is found between the altitudes of 1800 to 2600 metres?
(a) Saal (b) Chir
(c) Spruce (d) Deodar

111. Which one of the following rivers is NOT a tributary of river Cauvery?
(a) Hemavati (b) Arkavati
(c) Indravati (d) Amravati

112. Which of the following conditions is/are essential for tea cultivation?
1. Tropical and sub-tropical climate
2. Heavy rainfall ranging from 150 cm to 250 cm
3. Soil should contain good amount of lime
Select the correct answer using the code given below:
(a) 1, 2 and 3 (b) 1 and 2 only
(c) 2 and 3 only (d) 1 only

113. Bharatmala Project is related to
(a) Improving road connectivity
(b) Interlinking ports and railways
(c) Interlinking of rivers
(d) Interlinking major cities with gas pipelines

114. Which one of the following is a local wind that blows out from Siberia?
(a) Bora (b) Purga
(c) Mistral (d) Blizzard

115. Which one of the following centres is NOT known for iron and steel industry?
(a) Bhadravati (b) Salem
(c) Vishakhapatnam (d) Renukoot

116. Which of the following are essential pre-requisites for establishment of a thermal power station?
1. Availability of fossil fuels
2. Proximity to a river, lake or sea
3. Good transport network
4. Proximity to an urban centre
Select the correct answer using the code given below:
(a) 1, 2 and 3 (b) 2 and 4
(c) 2 and 3 only (d) 1 and 3 only

117. Which of the following statements about 'Aadi Mahostav' held recently in New Delhi is/are correct?
1. The theme of the festival was 'A Celebration of the Spirit of Tribal Culture, Cuisine and Commerce'
2. The festival was organized by the Ministry of Tourism, Government of India
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

118. Light year is a unit for measurement of
(a) age of universe (b) very small time intervals
(c) very high temperature (d) very large distance

119. Which of the following statements about electromagnetic waves, sound waves and water waves is/are correct?
1. They exhibit reflection
2. They carry energy
3. They exert pressure
4. They can travel in vacuum

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

120. Thermal capacity of a body depends on the
(a) mass of the body only
(b) mass and shape of the body only
(c) density of the body
(d) mass, shape and temperature of the body

121. Who among the following first used the term 'Industrial Revolution' in English to describe the changes that occurred in British industrial development between 1760 and 1820?
(a) Karl Marx (b) Georges Michelet
(c) Amold Toynbee (d) Friedrich Engles

122. Which one of the following statements about the Olympe de Gouges (1748-1793) is correct?
(a) She declared that although citizens should have equal rights, they are not entitled to the same honours by the State
(b) She was a supporter of the Jacobin government
(c) She was jailed for treason by the National Assembly
(d) She declared that the nation is the union of woman and man

123. Who among the following built a model steam engine in 1698 called "Miner's Friend" to drain mines?
(a) Thomas Savery (b) Thomas Newcomen
(c) James Watt (d) Richard Arkwright

124. Which one of the following statements about Renaissance Humanist culture is NOT true?
(a) It slackened the control of religion over human life
(b) It believed that human nature was many-sided
(c) It was concerned with good manners
(d) It criticized material wealth, power and glory

125. Who gifted the Badshah Nama to King George in 1799?
(a) Abul Fazl (b) Abdul Hamid Lahori
(c) Nawab of Awadh (d) William Jones

126. What is the name of the award given to meritorious men in the Mughal Court in the form of a robe of honour that was once worn by the Emperor?
(a) Sarapa (b) Patka
(c) Padma murassa (d) Khilat

127. Who among the following social reformer started a society for the encourgement of widow remarriage in 1866 in Maharashtra?
(a) Bal Gangadhar Tilak (b) Jyotirao Phule
(c) Vishnushashtri Pandit (d) Pandita Ramabai

128. Name the first major voluntary association representing primarily Indian landlord interests that was set up in Calcutta in 1851?
(a) British Indian Association
(b) Landholder's Society
(c) Madras Native Association
(d) Bombay Association

129. Who among the following introduced the Permanent Settlement of Bengal in 1793?
(a) Lord Cornwallis (b) Lord Ripon
(c) Robert Clive (d) John Adam

130. Name the rebel who fought against the British in the battle of Chinhat in the course of the 1857 Revolt?
(a) Ahmadullah Shah (b) Shah Mal
(c) Mangal Pandey (d) Kunwar Singh

131. Who among the following are the two civil servants who assisted the Constituent Assembly in framing the Constitution of India?
(a) B.N. Rau and K.M. Munshi
(b) S.N. Mukherjee and Alladi Krishna swamy Aiyar
(c) B.N. Rau and S.N. Mukherjee
(d) K.M. Munshi and Alladi Krishna swamy Aiyar

132. Which member of the constituent Assembly proposed the resolution that the National Flag of India be a "horizontal tricolour of saffron, white and dark green in equal proportion", with a wheel in navy blue at the centre?
(a) Jawaharlal Nehru (b) B.R. Ambedkar
(c) Rajendra Prasad (d) Sardar Vallabhbhai Patel

133. Which of the following is/are NOT historical biography/ biographies?
1. Dipavamsa
2. Harshacharita
3. Vikramankadevacharita
4. Prithvirajavijaya

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

134. Which of the following pairs are correctly matched?

	Traveller	Country from
1.	Marco Polo	Italy
2.	Ibn Battuta	Morocco
3.	Nikitin	Russia
4.	Seydi Ali Reis	Turkey

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

135. Which of the following clans are included in the Agnikula Rajputs?
1. Pratiharas
2. Chaulukyas
3. Paramaras
4. Chahamanas

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

136. Who among the following was the author of Humayun Nama?
(a) Roshanara Begum
(b) Ruquaiya Sultan Begum
(c) Gulbadan Begum
(d) Gauhara Begum

137. Which one of the following about the Parliament of India is NOT correct?
(a) The Parliament consists of the President, the Lok Sabha and the Rajya Sabha
(b) There are no nominated members in the Lok Sabha

(c) The Rajya Sabha cannot be dissolved
(d) Some members of the Rajya Sabha are nominated by the President

138. Which one of the following statements with regard to the Comptroller and Auditor General (CAG) of India is NOT correct?
(a) He is appointed by the President of India
(b) He can be removed from office in the same way as the judge of the Supreme Court of India
(c) The CAG is eligible for further office under the Government of India after he has ceased to hold his office
(d) The salary of the CAG is charged upon the Consolidated Fund of India

139. The Superintendence, direction and control of elections in India is vested in
(a) The Supreme Court of India
(b) The Parliament of India
(c) The Election Commission of India
(d) The Chief Election Commissioner

140. Which of the following provision(s) of the Constitution of India became effective from 26th November 1949?
1. Elections
2. Citizenship
3. Emergency provisions
4. Appointment of the Judges

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

141. Which of the following statements regarding construction of Rohtang tunnel is NOT correct?
(a) It is located at an altitude of 5,000 feet
(b) It will provided all-year connectivity to Lahaul and Spiti Valley
(c) The tunnel is being built by the Border Roads Organization
(d) It will reduce the length of the Leh-Manali highway by approximately 50 km

142. Who among the following recently became the first woman pilot in Indian Navy?
(a) Astha Segal (b) Roopa A
(c) Sakthi Maya S (d) Shubhangi Swaroop

143. Who among the following Indians did NOT hold the title of Miss World?
(a) Reita Faria (b) Sushmita Sen
(c) Diana Hayden (d) Yukta Mookhey

144. Which one of the following countries has failed to quality for the first time in 60 years for the FIFA World Cup to be held in Russia in the year 2018?
(a) Mexico (b) Iran
(c) Saudi Arabia (d) Italy

145. The Defence Technology and Trade Initiative (DTTI) is a forum for dialogue on defence partnership between India and
(a) Russia
(b) United States of America
(c) Israel
(d) France

146. As per the policy applicable in 2017, how much Foreign Direct Investment (FDI) is permitted in the defence sector in India?
(a) 49 per cent through the automatic route
(b) 26 per cent through the government route
(c) 26 per cent through the automatic route and beyond that up to 49 per cent through the government route
(d) 75 per cent through the automatic route

147. Which one of the following countries did NOT participate in the 21st edition of Exercise Malabar?
(a) United States of America
(b) Japan
(c) India
(d) Australia

148. Justice Dalveer Bhandari of India was recently re-elected to the International Court of Justice after Christopher Greenwood pulled out before 12th round of voting. Christopher Greenwood was a nominee of
(a) Canada (b) Russia
(c) Britain (d) USA

149. In order to review the Income Tax Act, 1961 and to draft a new Direct Tax Law in consonance with economic needs of the country, the Government of India in November 2017 has constituted a Task Force. Who among the following is made the convenor of it?
(a) Shri Arvind Subramanian
(b) Shri Arbind Modi
(c) Shri Amitabh Kant
(d) Dr. Bibek Debroy

150. The 5th Global Conference on Cyber Space (GCCS) was held in New Delhi in November 2017. Which of the following statements about GCCS is/are correct?
1. The 4th version of GCCS was held in London.
2. The main theme of GCCS 2017 is 'Cyber4All: A Secure and Inclusive Cyberspace for Sustainable Development'.
3. 'Bindu' is the logo of GCCS 2017.

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

HINTS & SOLUTIONS

MATHEMATICS

1. (b) $n \in N$,
$121^n - 25^n + 1900^n - (-4^n)$
Let us substitute $n = 1$
We get, $(121)^1 - (25)^1 + (1900)^1 - (-4^1)$
$= 121 - 25 + 1900 + 4 = 2025 - 25 = 2000$
So, given expression is divisible by 2000

2. (b) $n = (2017)!$

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + ... + \frac{1}{\log_{2017} n}$$

$$= \frac{1}{\frac{\log n}{\log 2}} + \frac{1}{\frac{\log n}{\log 3}} + \frac{1}{\frac{\log n}{\log 4}} + ... + \frac{1}{\frac{\log n}{\log 2017}}$$

$$\left(\because \log_a b = \frac{\log_b}{\log_a}\right)$$

$$= \frac{\log 2}{\log n} + \frac{\log 3}{\log n} + \frac{\log 4}{\log n} + ... + \frac{\log 2017}{\log n}$$

$$= \frac{\log 2 + \log 3 + \log 4 + ... + \log 2017}{\log n}$$

$$= \frac{\log(2.3.4....2017)}{\log_n} \quad (\because \log a + \log b + \log c + ... = \log(a.b.c.....)$$

$$= \frac{\log(2017!)}{\log_n} = \frac{\log_n}{\log_n} = 1$$

3. (b) Given, in the expansion g $(1 + x)^{43}$, coefficients of $(2r + 1)^{th}$ term and $(r + 2)^{th}$ term are equal.

Coefficient of $(2r + 1)^{th}$ term $= {}^nC_{2r}$

Coefficient of $(r + 2)^{th}$ term $= {}^nC_{r+1}$

${}^nC_{2r} = {}^nC_{r+1}$

$\Rightarrow {}^{43}C_{2r} = {}^{43}C_{r+1} \quad (\because n = 43)$

$\Rightarrow 2r + r + 1 = 43$

$\Rightarrow 3r + 1 = 43$

$\Rightarrow 3r + 42 \Rightarrow r = 14$

4. (c) $z = x + iy = (-1 - i)$
$\therefore x = -1, y = -1$
This lies in 3rd Quadrant.
$\therefore \arg(z) = \theta - \pi$

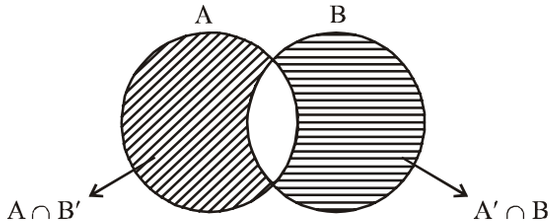
$$= \tan^{-1}\left(\frac{y}{x}\right) - \pi$$

$$= \tan^{-1}\left(\frac{-1}{-1}\right) - \pi = \tan^{-1}(1) - \pi$$

$$= \frac{\pi}{4} - \pi = \frac{-3\pi}{4}$$

5. (c) Let $z = x + iy$
$\therefore z^2 + \alpha z + \beta = (x + iy)^2 + \alpha(x + iy) + \beta$
$= x^2 - y^2 + 2ixy + \alpha x + i\alpha y + \beta$
Given, $z^2 + \alpha z + \beta = 0$
$\therefore x^2 - y^2 + 2ixy + \alpha x + i\alpha y + \beta = 0$
$\Rightarrow x^2 - y^2 + \alpha x + \beta + i(2xy + \alpha y) = 0 + i.0$
Comparing real and imaginary parts, we get
$x^2 - y^2 + \alpha x + \beta = 0; \quad ....(1)$
$y(2x + \alpha) = 0 \quad ....(2)$
$(2) \Rightarrow 2x + \alpha = 0 \quad (\because y \neq 0)$
$\Rightarrow 2(1) + \alpha = 0 \quad (\because$ Given $Re(z) = 1)$
$\Rightarrow \alpha = -2$
Now, (1)
$\Rightarrow x^2 - y^2 + \alpha x + \beta = 0$
$\Rightarrow (1)^2 - y^2 + (-2)(1) + \beta = 0$
$\Rightarrow 1 - y^2 - 2 + \beta = 0$
$\Rightarrow -1 - y^2 + \beta = 0$
$\Rightarrow \beta = 1 + y^2$
Since, $y \in R$ and $y \neq 0$,
β is always greater than 1.
So, $\beta \in (1, \infty)$

6. (c) $C = (A \cap B') \cup (A' \cap B)$
Let us draw venn diagram and compare it with options.



This also represents $(A \cup B) - (A \cap B)$

7. (d) Number between 100 and 1000 are 3-digit numbers.
It is given that the digits should not be repeated.
Number of given digits = 5.
In a 3-digit number, first number can be arranged in 5 ways.

Second number in 4 ways.
Third number in 3 ways.
$\therefore$ Numbers that can be formed $= 5 \times 4 \times 3 = 60$

8. (a) $|1-2i|^x = 5^x$

$$\Rightarrow \left(\left((1)^2+(-2)^2\right)^{\frac{1}{2}}\right)^x = 5^x \quad \because |x+iy| = \sqrt{x^2+y^2}$$

$$\Rightarrow (5)^{\frac{x}{2}} = 5^x \Rightarrow \frac{x}{2} = x \Rightarrow x = 2x \Rightarrow x = 0.$$

There is no non zero integral solution.

9. (c) A.M of two numbers $a, b = \frac{a+b}{2}$

G..M of two numbers $a, b = \sqrt{ab}$.

Given, $\frac{A.M}{G.M} = \frac{5}{3}$

$$\Rightarrow \frac{\left(\frac{a+b}{2}\right)}{\sqrt{ab}} = \frac{5}{3}$$

$$\Rightarrow \frac{a+b}{\sqrt{ab}} = \frac{10}{3}$$

$$\Rightarrow \frac{a^2+b^2+2ab}{ab} = \frac{100}{9} \quad \text{(Squaring on both sides)}$$

$\Rightarrow 9a^2 + 9b^2 + 18ab = 100ab$
$\Rightarrow 9a^2 - 82ab + 9b^2 = 0$
$\Rightarrow 9a^2 - 81ab - ab + 9b^2 = 0$
$\Rightarrow 9a(a-9b) - b(a-9b) = 0$
$\Rightarrow (9a-b)(a-9b) = 0$
$\Rightarrow 9a - b = 0;\ a - 9b = 0$
$\Rightarrow b = 9a;\ a = 9b$

$$\Rightarrow \frac{a}{b} = \frac{1}{9}; \frac{a}{b} = \frac{9}{1}$$

10. (b) $(1+a)^{m+n}$

α = coefficient of $a^m = {}^{m+n}C_m$

β = coefficient of $a^n = {}^{m+n}C_n$

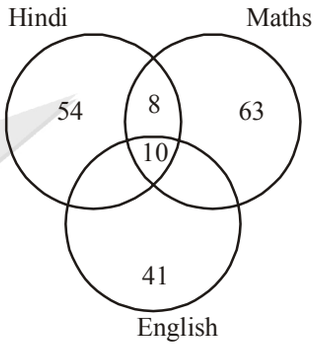
We know, ${}^nC_r = {}^nC_{n-r}$

$\therefore \beta = {}^{m+n}C_n = {}^{m+n}C_{m+n-n} = {}^{m+n}C_m = \alpha$
$\therefore \alpha = \beta$

11. (c) $x + \log_{15}(1+3^x) = x\log_{15}5 + \log_{15}12$
$\Rightarrow x.\log_{15}15 + \log_{15}(1+3^x) = x\log_{15}5 + \log_{15}12$
$(\because \log_{15}15 = 1)$
$\Rightarrow \log_{15}15^x + \log_{15}(1+3^x) = \log_{15}5^x + \log_{15}12$
$\Rightarrow \log_{15}15^x(1+3^x) = \log_{15}(5^x \times 12)$
$(\because \log a + \log b = \log ab)$
$\Rightarrow 15^x(1+3^x) = 5^x \times 12$
$\Rightarrow 3^x(1+3^x) = 12$
$\Rightarrow 3^x + 3^{2x} = 12.$
$x = 1$ satisfies the above equation.

12. (a) A number divisible by 10 means the last digit is 0.
So, the remaining 3 digits can be arranged in
$4 \times 3 \times 2$ ways $= 24$ ways.

13. (c) Let us represent the given data in Venn diagram as shown.



Number of students who are good in either Hindi or Maths but not in English $= 54 + 8 + 63 = 125$

14. (d) From the same Venn diagram,
Number of students who are good in Hindi and Maths but not English = 8

15. (c) Since, $|\alpha| = 1$
$\Rightarrow |\alpha|^2 = 1$
$\Rightarrow \alpha.\bar{\alpha} = 1 \quad \ldots(1)$

$$\therefore \left|\frac{\alpha-\beta}{1-\alpha\bar{\beta}}\right| = \left|\frac{\alpha-\beta}{\alpha.\bar{\alpha}-\alpha\bar{\beta}}\right| \quad \text{(from (1))}$$

$$= \left|\frac{\alpha-\beta}{\alpha(\bar{\alpha}-\bar{\beta})}\right|$$

$$= \frac{|\alpha-\beta|}{|\alpha||\alpha-\beta|} \quad (\because \text{since } |\bar{z}| = |z|)$$

$$= \frac{1}{|\alpha|} = \frac{1}{1} = 1$$

16. (a) $|1-x| + x^2 = 5$
$\Rightarrow |x-1| + x^2 = 5$
First case: If $x < 1$, $|x-1|$ is negative.
$\therefore \quad -(x-1) + x^2 = 5$
$\Rightarrow -x + 1 + x^2 = 5$
$\Rightarrow x^2 - x + 1 = 5$
$\Rightarrow x^2 - x - 4 = 0$

Roots are $\frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-4)}}{2(1)}$

$= \frac{1 \pm \sqrt{1+16}}{2} = \frac{1 \pm \sqrt{17}}{2}$

Since, $x < 1$, root cannot be $\frac{1+\sqrt{17}}{2}$. So, the root is $\frac{1-\sqrt{17}}{2}$, which is irrational.

Second case: If $x > 1$, $|x-1| = x-1$

$\therefore \quad |x-1| + x^2 = 5$

$\Rightarrow \quad x - 1 + x^2 = 5$

$\Rightarrow \quad x^2 + x - 6 = 0$

$\Rightarrow \quad x^2 + 3x - 2x - 6 = 0$

$\Rightarrow \quad x(x+3) - 2(x+3) = 0$

$\Rightarrow \quad x = 2, -3$

Since $x > 1$, root cannot be -3. So, root is 2 which is rational.

$\therefore$ given expression has one irrational root and one rational root.

17. (d) Decimal number = 31.

2	31	1
2	15	1
2	7	1
2	3	1
2	1	1
	0	

So, binary form of 31 is 11111.

18. (a) $i^{1000} + i^{1001} + i^{1002} + i^{1003}$

$= i^{1000}(1 + i + i^2 + i^3)$

$= i^{1000}(1 + i - 1 - i)$

$(\because i = \sqrt{-1} \quad \Rightarrow i^2 = -1 \,\&\, i^3 = i^2 . i = -i)$

$= 0$

19. (a) $\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + ... + \frac{1}{\log_{100} N}$

$= \frac{1}{\frac{\log N}{\log 2}} + \frac{1}{\frac{\log N}{\log 3}} + \frac{1}{\frac{\log N}{\log 4}} + ... + \frac{1}{\frac{\log N}{\log 100}}$

$\left(\because \log_a b = \frac{\log b}{\log a}\right)$

$= \frac{\log 2}{\log N} + \frac{\log 3}{\log N} + \frac{\log 4}{\log N} + ... + \frac{\log 100}{\log N}$

$= \frac{\log 2 + \log 3 + \log 4 + ... + \log 100}{\log N}$

$= \frac{\log(2.3.4....100)}{\log N}$

$= \frac{\log 100!}{\log N} = \frac{1}{\frac{\log N}{\log 100!}} = \frac{1}{\log_{100!} N}$

20. (b) Let $x + iy = \sqrt{3} + i$

Comparing real and imaginary parts, $x = \sqrt{3}, y = 1$

modulus-amplitude of $x + iy$ is $r(\cos\theta + \sin\theta)$, where

$r = \sqrt{x^2 + y^2}$ and $\theta = \tan^{-1}\left(\frac{y}{x}\right)$

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

and $\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = \frac{\pi}{6}$

$\therefore$ modulus-amplitude is $2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$.

21. (c) We know, in the expansion of $(x+y)^n + (x-y)^n$, of

n = even, then number of non zero terms is $\frac{n}{2} + 1$

n = odd, then number of non zero terms in $\frac{n+1}{2}$.

Here, $n = 11$ which is odd.

$\therefore$ number of non zero terms $= \frac{11+1}{2} = 6$.

22. (d) We know, $a^n + b^n$ is divisible by $(a + b)$, if n is odd.

Here, $n = 5$ is odd

$\therefore 5^5 + 7^5$ is divisible by $5 + 7 = 12$

23. (a) $x = 1 - y + y^2 - y^3 + ...$ up to infinite terms.

We can see that the given series is geometric progression, with $a = 1$ and $r = -y$

$\therefore S_\infty = \frac{a}{1-r} = \frac{1}{1-(-y)} = \frac{1}{1+y}$

$\therefore x = \frac{1}{1+y}$.

24. (a) $A = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

We know, $AA^{-1} = I$.

Let us take first option (a) as A^{-1}.

$\therefore AA^{-1} = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$$= \begin{bmatrix} \cos^2\theta+\sin^2\theta & -\sin\theta\cos\theta+\cos\theta\sin\theta & 0 \\ -\sin\theta\cos\theta+\cos\theta\sin\theta & \sin^2\theta+\cos^2\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

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

25. (a) A is 2×3 matrix
AB is 2×5 matrix
Let 'B' be $m \times n$ matrix
$[A]_{2\times3}\,[B]_{m\times n} = [AB]_{2\times5}$
number of columns of A = number of rows of B.
$\therefore m = 3$
we can observe that n = 5 from the product.
So, B is 3×5 matrix.

26. (a) $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$

$$A^2 = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 1+4 & 2+6 \\ 2+6 & 4+9 \end{bmatrix} = \begin{bmatrix} 5 & 8 \\ 8 & 13 \end{bmatrix}$$

$$A^2 - kA - I_2 = \begin{bmatrix} 5 & 8 \\ 8 & 13 \end{bmatrix} - \begin{bmatrix} k & 2k \\ 2k & 3k \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 5-k-1 & 8-2k-0 \\ 8-2k-0 & 13-3k-1 \end{bmatrix}$$

$$= \begin{bmatrix} 4-k & 8-2k \\ 8-2k & 12-3k \end{bmatrix}$$

Given, $A^2 - kA - I_2 = 0$
$\therefore 4-k=0 \Rightarrow k=4$

27. (a) To form a triangle, we need 3 points. 12 points are given.

So, ${}^{12}C_3$ triangles can be formed.

But, given that 7 points are on a straight line. selecting 3 points from this set will not form a triangle.

So, number of triangles formed = ${}^{12}C_3 - {}^{7}C_3$

$$= \frac{12!}{3!9!} - \frac{7!}{3!4!}$$

$$= \frac{12\times11\times10}{3\times2\times1} - \frac{7\times6\times5}{3\times2\times1} = 220 - 35 = 185$$

28. (d) $C(n,r) + 2C(n,r-1) + C(n,r-2)$

$$= {}^nC_r + 2\left({}^nC_{r-1}\right) + {}^nC_{r-2}$$

$$= {}^nC_r + {}^nC_{r-1} + {}^nC_{r-1} + {}^nC_{r-2}$$

$$\left(\because {}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r\right)$$

$$= {}^{n+1}C_r + {}^{n+1}C_{r-1}$$

$$= {}^{n+2}C_r = C(n+2, r)$$

29. (b) $x^2 - 4x + [x] = 0$
Given internal, [0, 2]
Case 1 : Let $0 \le x < 1$
$[x] = 0$
$\therefore x^2 - 4x + 0 = 0 \Rightarrow x(x-4) = 0 \Rightarrow x = 0, x = 4$
$x = 4$ can't be taken in $0 \le x < 1$

$\therefore \boxed{x = 0}$

Case 2 : Let $1 \le x < 2$
$[x] = 1$
$\therefore x^2 - 4x + 1 = 0$

roots are $\frac{4 \pm \sqrt{16-4}}{2} = \frac{4 \pm \sqrt{12}}{2} = 2 \pm \sqrt{3}$

In internal $1 \le x < 2$, $2 \pm \sqrt{3}$ are not the roots.
Case 3 : Let $x = 2$
$[x] = 2$
$\therefore x^2 - 4x + 2 = 0$

roots are $\frac{4 \pm \sqrt{16-8}}{2} = \frac{4 \pm \sqrt{8}}{2} = 2 \pm \sqrt{2}$

Since, x = 2, roots can't be $2 \pm \sqrt{2}$
$\therefore$ There is only one solution, x = 0

30. (b) Number of students who like music, n(m) = 680
Number of students who like dance, n(d) = 215
Total number of students, $n(m \cup d) = 850$
$n(m \cup d) = n(m) + n(d) - n(m \cap d)$
$\Rightarrow 850 = 680 + 215 - n(m \cap d)$
$\Rightarrow n(m \cap d) = 895 - 850 = 45$

31. (c) The numbers which divided by 3, leaving remainder 2 will be of the form $3x + 2$
Given, $3x + 2$ is 2-digit number
So, x can be from 3 to 32

$$\text{Sum of numbers} = \sum_{x=3}^{32}(3x+2)$$

$= 3(3+4+5+....+32) + (2+2+....)$ ....(1)
3, 4, 5 .... 32 is an A. P with $a = 3, d = 1, T_n = 32$
$\therefore T_n = a + (n-1)\,1$
$\Rightarrow 32 = 3 + (n-1)\,1$
$\Rightarrow n - 1 = 29 \Rightarrow n = 30$ terms
$\therefore (1) \Rightarrow 3(3+4+5+....+32) + (2+2+....\ 30 \text{ times})$

$$= 3\left(\frac{30}{2}(3+32)\right) + (2\times30) \quad \left(\because S_n = \frac{n}{2}(a+\ell)\right)$$

$$= \frac{90}{2}(35) + 60 = (45\times35) + 60$$

$= 1575 + 60 = 1635$

32. (b) $0 < a < 1$
Let $\log_{10} a = -x$
$\Rightarrow a = 10^{-x}$
10^{-x} can have values only between 0 and 1

33. (c) Given, 3rd term of G.P. = 3
Let 'a' be the first term and 'r' be the common ratio.
$\therefore ar^2 = 3$
We know, $T_1 = a, T_2 = ar, T_3 = ar^2, T_4 = ar^3, T_5 = ar^4$
$T_1.T_2.T_3.T_4.T_5 = (a)(ar)(ar^2)(ar^3)(ar^4)$
$= a^5r^{10} = (ar^2)^5 = 3^5 = 243$

34. (a) $x, \frac{3}{2}, z$ are in A.P
If a, b, c are in A.P $2b = a + c$
$\therefore 2\left(\frac{3}{2}\right) = x + z$
$\Rightarrow 3 = x + z$ ....(1)
x, 3, z are in G.P.
If a, b, c are in G.P. $b^2 = ac$
$\therefore 3^2 = xz$
$\Rightarrow 9 = xz$ ....(2)
If x, 6, z are in H.P. $\frac{2}{6} = \frac{1}{x} + \frac{1}{z}$
$\left(\because \frac{2}{b} = \frac{1}{a} + \frac{1}{c}, \text{if } a, b, c \text{ are is H.P.}\right)$
$\Rightarrow \frac{1}{3} = \frac{z + x}{xz} = \frac{3}{9} = \frac{1}{3} \quad (\text{from}(1)(2))$
L.H.S. = R.H.S.

35. (c) $\sum_{n=2}^{11}\left(i^n + i^{n+1}\right)$
We know, $i + i^2 + i^3 + i^4 = i - 1 - i + 1 = 0$.
Also, $i^3 + i^4 + i^5 + i^6 = 0$
The sum of 4 consecutive powers of i is always 0.

$$\therefore \sum_{n=2}^{11}\left(i^n + i^{n+1}\right) = i^2 + i^3 + i^3 + i^4 + i^4 + i^5 + i^5 + i^6 + i^6 + i^7 + i^7 + i^8 + i^8 + i^9 + i^9 + i^{10} + i^{10} + i^{11} + i^{11} + i^{12}$$

$$= \left(i^2 + i^3 + i^4 + i^5 + i^6 + i^7 + i^8 + i^9 + i^{10} + i^{11}\right) + \left(i^3 + i^4 + i^5 + i^6 + i^7 + i^8 + i^9 + i^{10} + i^{11} + i^{12}\right)$$

$= (i^2 + i^3 + 0) + (i^3 + i^4 + 0)$
$= i^2 + i^3 + i^3 + i^4$
$= i^2 + 2i^3 + i^4$
$= -1 + 2(-i) + 1$
$= -2i$

36. (c) $\sin x = \frac{1}{\sqrt{5}}, \sin y = \frac{1}{\sqrt{10}}, 0 < x < \frac{\pi}{2}, 0 < y < \frac{\pi}{2}$
$\because \cos x = \sqrt{1 - \sin^2 x}$ & $\cos y = \sqrt{1 - \sin^2 y}$
$\Rightarrow \cos x = \sqrt{1 - \frac{1}{5}}$ & $\cos y = \sqrt{1 - \frac{1}{10}}$
$\Rightarrow \cos x = \sqrt{\frac{4}{5}} = \frac{2}{\sqrt{5}}$ & $\cos y = \sqrt{\frac{9}{10}} = \frac{3}{\sqrt{10}}$.
$\sin(x + y) = \sin x \cos y + \cos x \sin y$
$= \frac{1}{\sqrt{5}} \cdot \frac{3}{\sqrt{10}} + \frac{2}{\sqrt{5}} \cdot \frac{1}{\sqrt{10}}$
$= \frac{5}{\sqrt{5} \cdot \sqrt{10}} = \frac{\sqrt{5} \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{10}} = \sqrt{\frac{5}{10}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$.
$\therefore \quad x + y = \sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = \frac{\pi}{4}$.

37. (c) $\frac{\sin 5x - \sin 3x}{\cos 5x + \cos 3x}$
$\sin c - \sin d = 2\cos\left(\frac{c + d}{2}\right)\sin\left(\frac{c - d}{2}\right)$
$\cos c - \cos d = 2\cos\left(\frac{c + d}{2}\right)\cos\left(\frac{c - d}{2}\right)$
$\therefore \frac{\sin 5x - \sin 3x}{\cos 5x + \cos 3x} = \frac{2\cos\left(\frac{5x + 3x}{2}\right)\sin\left(\frac{5x - 3x}{2}\right)}{2\cos\left(\frac{5x + 3x}{2}\right)\cos\left(\frac{5x - 3x}{2}\right)}$
$= \frac{\sin\left(\frac{2x}{2}\right)}{\cos\left(\frac{2x}{2}\right)} = \frac{\sin x}{\cos x} = \tan x.$

38. (c) $\sin 105° + \cos 105°$
$= \sin(60° + 45°) + \cos(60° + 45°)$
$= (\sin 60°. \cos 45° + \cos 60° \sin 45°) + (\cos 60° \cos 45° - \sin 60° \sin 45°)$
$= \frac{\sqrt{3}}{2} \cdot \frac{1}{\sqrt{2}} + \frac{1}{2} \cdot \frac{1}{\sqrt{2}} + \frac{1}{2} \cdot \frac{1}{\sqrt{2}} - \frac{\sqrt{3}}{2} \cdot \frac{1}{\sqrt{2}}$
$= \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$

39. (b) In ΔABC, $a = 2, b = 3$ and $\sin A = \frac{2}{3}$.
We know, $\frac{\sin A}{a} = \frac{\sin B}{b}$
$\Rightarrow \frac{\frac{2}{3}}{2} = \frac{\sin B}{3}$
$\Rightarrow \frac{2}{6} = \frac{\sin B}{3} \Rightarrow \sin B = \frac{6}{6} = 1$
$\Rightarrow B = \sin^{-1}(1)$ ....(1)
$= \frac{\pi}{2}$.

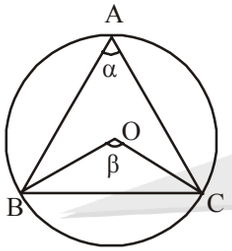
40. (c) $\sin^{-1}\left(\sin\frac{2\pi}{3}\right) = \sin^{-1}\left(\sin\left(\pi - \frac{\pi}{3}\right)\right)$

$= \sin^{-1}\left(\sin\frac{\pi}{3}\right) = \frac{\pi}{3}.$

41. (b) $x, x-y, x+y$ are angles of a triangle.
$\tan(x-y), \tan x, \tan(x+y)$ are in G.P.
Now, $x + x - y + x + y = \pi$ (Sum of angles of triangle)

$\Rightarrow 3x = \pi \quad \Rightarrow x = \frac{\pi}{3}.$

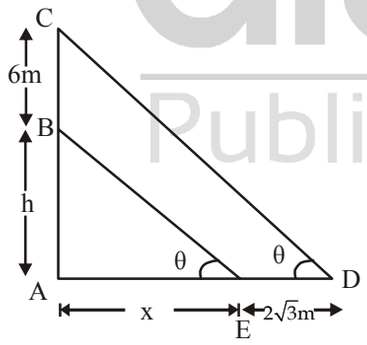
42. (a) $\angle BAC = \alpha, \angle BOC = \beta$



We know, from figure,
$\beta = 2\alpha$

$\therefore \cos\beta = \cos 2\alpha = \frac{1-\tan^2\alpha}{1+\tan^2\alpha}.$

43. (a)



AB is the tower. BC is flag staff.
The angles made by the shadows of tower and flag staff are same.

In $\Delta ABE, \tan\theta = \frac{h}{x}$ ....(1)

In $\Delta ACD, \tan\theta = \frac{h+6}{x+2\sqrt{3}}$ ....(2)

from (1), (2), $\frac{h}{x} = \frac{h+6}{x+2\sqrt{3}} \Rightarrow hx + 2\sqrt{3}h = hx + 6x$

$\Rightarrow \frac{h}{x} = \frac{6}{2\sqrt{3}} = \frac{3}{\sqrt{3}} = \frac{\sqrt{3}\cdot\sqrt{3}}{\sqrt{3}} = \sqrt{3}.$

from (1), $\tan\theta = \frac{h}{x} = \sqrt{3} \Rightarrow \theta = 60°.$

44. (b) $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{3}{5}\right)$

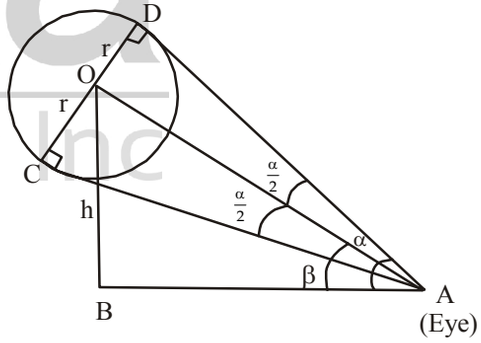
We know, $\tan^{-1}x + \tan^{-1}y = \tan^{-1}\left(\frac{x+y}{1-xy}\right)$

So, $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{3}{5}\right) = \tan^{-1}\left(\frac{\frac{1}{4}+\frac{3}{5}}{1-\left(\frac{1}{4}\right)\left(\frac{3}{5}\right)}\right)$

$= \tan^{-1}\left(\frac{\frac{5+12}{20}}{1-\frac{3}{20}}\right)$

$= \tan^{-1}\left(\frac{\frac{17}{20}}{\frac{17}{20}}\right) = \tan^{-1}(1) = \frac{\pi}{4}.$

45. (a) Let 'A' be the position of eye.
Let 'O' be the centre of spherical balloon.
Let 'h' be the height of centre of balloon.



From figure, in $\Delta OAD, \sin\frac{\alpha}{2} = \frac{OD}{OA} = \frac{r}{OA}$

$\Rightarrow OA = \frac{r}{\sin\frac{\alpha}{2}}$ ....(1)

In $\Delta OAB, \sin\beta = \frac{OB}{OA} = \frac{h}{OA}$

$\Rightarrow \quad h = OA \,.\, \sin\beta$

$= \frac{r.\sin\beta}{\sin\frac{\alpha}{2}}$ (from (1))

46. (a) $\frac{\sin(x+y)}{\sin(x-y)}=\frac{a+b}{a-b}$

Applying componendo and dividendo, we get

$$\frac{\sin(x+y)+\sin(x-y)}{\sin(x+y)-\sin(x-y)}=\frac{a+b+a-b}{a+b-a+b}$$

$$\Rightarrow \frac{2\sin\left(\frac{x+y+x-y}{2}\right)\cos\left(\frac{x+y-x+y}{2}\right)}{2\cos\left(\frac{x+y+x-y}{2}\right)\sin\left(\frac{x+y-x+y}{2}\right)}=\frac{2a}{2b}$$

$$\Rightarrow \frac{\sin x.\cos y}{\cos x.\sin y}=\frac{a}{b}$$

$$\Rightarrow \frac{\tan x}{\tan y}=\frac{a}{b}.$$

47. (b) $\sin\alpha+\sin\beta=0=\cos\alpha+\cos\beta$

$\sin\alpha+\sin\beta=0$

$\Rightarrow \sin\alpha=-\sin\beta$

$\Rightarrow \sin\alpha=\sin(\pi+\beta)$

$\Rightarrow \alpha=\pi+\beta$

48. (c) Given, $\cos\frac{A}{2}$ has only one value.

We know, $\cos A=2\cos^2\frac{A}{2}-1$

$$\Rightarrow 2\cos^2\frac{A}{2}=\cos A+1\Rightarrow \cos\frac{A}{2}=\sqrt{\frac{\cos A+1}{2}}$$

Since, $\cos\frac{A}{2}$ is single value, $\frac{\cos A+1}{2}=0$

$\Rightarrow \cos A=-1$

So, A is an odd multiple of 180°.

49. (b) $\cos\alpha+\cos\beta+\cos\gamma=0$ ....(1)

Given, $0<\alpha\le\frac{\pi}{2},0<\beta\le\frac{\pi}{2},0<\gamma\le\frac{\pi}{2}.$

(1) is satisfied when $\alpha=\frac{\pi}{2},\beta=\frac{\pi}{2}$ and $\gamma=\frac{\pi}{2}.$

$$\therefore \sin\alpha+\sin\beta+\sin\gamma=\sin\frac{\pi}{2}+\sin\frac{\pi}{2}+\sin\frac{\pi}{2}.$$

$=1+1+1=3.$

50. (a) Let $y=\sin\left(x+\frac{\pi}{5}\right)+\cos\left(x+\frac{\pi}{5}\right)$

$$\Rightarrow \frac{dy}{dx}=\cos\left(x+\frac{\pi}{5}\right)-\sin\left(x+\frac{\pi}{5}\right)$$

for maximum value, $\frac{dy}{dx}=0.$

$$\therefore \cos\left(x+\frac{\pi}{5}\right)-\sin\left(x+\frac{\pi}{5}\right)=0$$

$$\Rightarrow \frac{\cos\left(x+\frac{\pi}{5}\right)}{\sin\left(x+\frac{\pi}{5}\right)}=1$$

$$\Rightarrow \cot\left(x+\frac{\pi}{5}\right)=\cot\frac{\pi}{4}$$

$$\Rightarrow x+\frac{\pi}{5}=\frac{\pi}{4}$$

$$\Rightarrow x=\frac{\pi}{4}-\frac{\pi}{5}=\frac{5\pi-4\pi}{20}=\frac{\pi}{20}.$$

51. (a) Let A(x, y) be the point that divides (4, 3) and (5, 7) internally is ratio 2:3

$$A=(x,y)=\left(\frac{mx_2+nx_1}{m+n},\frac{my_2+ny_1}{m+n}\right)$$

$$=\left(\frac{10+12}{2+3},\frac{14+9}{2+3}\right)=\left(\frac{22}{5},\frac{23}{5}\right).$$

Let B(x′, y′) be point that divides (4, 3) and (5, 7) externally in ratio 2 : 3

$$B=(x',y')=\left(\frac{mx_2-nx_1}{m-n},\frac{my_2-ny_1}{m-n}\right)$$

$$=\left(\frac{10-12}{2-3},\frac{14-9}{2-3}\right)=(2,-5)$$

Distance between A and B $=\sqrt{(x'-x)^2+(y'-y)^2}$

$$=\sqrt{\left(2-\frac{22}{5}\right)^2+\left(-5-\frac{23}{5}\right)^2}$$

$$=\sqrt{\frac{(-12)^2}{25}+\frac{(-48)^2}{25}}$$

$$=\frac{12}{5}\sqrt{1+4^2}=\frac{12}{5}\sqrt{17}.$$

52. (b) Given straight lines are

$(m^2-mn)y=(mn+n^2)x+n^3$ ....(1)

$(mn+m^2)y=(mn-n^2)x+m^3$ ....(2)

$$(1)\Rightarrow y=\frac{(mn+n^2)}{m^2-mn}x+\frac{n^3}{m^2-mn}$$

So, slope of (1), $m_1=\frac{mn+n^2}{m^2-mn}$

$$(2)\Rightarrow y=\frac{mn-n^2}{mn+m^2}x+\frac{m^3}{mn+m^2}$$

So, slope of (2), $m_2 = \frac{mn - n^2}{mn + m^2}$

If α is the angle between lines (1), (2), then

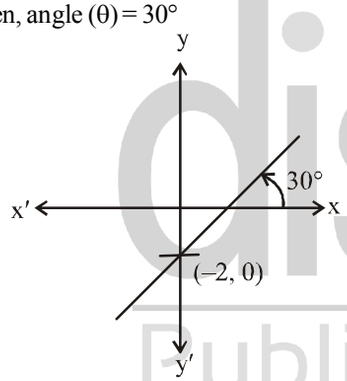
$$\tan\alpha = \frac{m_1 - m_2}{1 + m_1 m_2} = \frac{\frac{mn + n^2}{m^2 - mn} - \frac{mn - n^2}{mn + m^2}}{1 + \left(\frac{mn + n^2}{m^2 - mn}\right)\left(\frac{mn - n^2}{mn + m^2}\right)}$$

$$= \frac{(mn + n^2)(mn + m^2) - (mn - n^2)(m^2 - mn)}{(m^2 - mn)(mn + m^2) + (mn + n^2)(mn - n^2)}$$

$$= \frac{m^2n^2 + m^3n + mn^3 + m^2n^2 - m^3n + m^2n^2 + m^2n^2 - mn^3}{m^3n + m^4 - m^2n^2 - m^3n + m^2n^2 - mn^3 + mn^3 - n^4}$$

$$\tan\alpha = \frac{4m^2n^2}{m^4 - n^4} \Rightarrow \alpha = \tan^{-1}\left(\frac{4m^2n^2}{m^4 - n^4}\right)$$

53. (d) Given, angle $(\theta) = 30°$



$\therefore m = \tan 30° = \frac{1}{\sqrt{3}}$.

Point = (–2, 0) i.e., C = –2.

Slope-intercept form is $y = mn + c$

$\Rightarrow y = \frac{1}{\sqrt{3}}x - 2$

$\Rightarrow \sqrt{3}y = x - 2\sqrt{3}$

$\Rightarrow x - \sqrt{3}y - 2\sqrt{3} = 0$.

54. (c) Given lines,

$x + 2y - 3 = 0$ ....(1)

$2x - y + 5 = 0$ ....(2)

$(1) \times 2 \Rightarrow \quad 2x + 4y - 6 = 0$

$(2) \Rightarrow \quad 2x - y + 5 = 0$

$(-) \quad (+) \quad (-)$

$5y - 11 = 0 \Rightarrow y = \frac{11}{5}$.

$(1) \Rightarrow x + 2\left(\frac{11}{5}\right) - 3 = 0$

$\Rightarrow x + \frac{22}{5} - 3 = 0$

$\Rightarrow x + \frac{7}{5} = 0 \Rightarrow x = \frac{-7}{5}$.

Given, the required line is parallel to $y - x + 10 = 0$.

$\Rightarrow y = x - 10$

$\Rightarrow y = (1)x + (-10)$

$\therefore$ slope $(m) = 1$

$\therefore$ Required line with slope 1 and passing through $\left(\frac{-7}{5}, \frac{11}{5}\right)$ is

$y - y_1 = m(x - x_1)$

$\Rightarrow y - \frac{11}{5} = 1\left(x + \frac{7}{5}\right)$

$\Rightarrow 5y - 11 = 5x + 7 \Rightarrow 5x - 5y + 18 = 0$.

55. (c) 1: We know, the perpendicular distance from (x_1, y_1) to line $ax + by + c = 0$ is $\frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$

Here, $(x_1, y_1) = (0, 0)$ and distance = P.

$\therefore P = \frac{|a(0) + b(0) + (c)|}{\sqrt{a^2 + b^2}}$

$\Rightarrow P^2 = \frac{c^2}{a^2 + b^2}$

$\therefore$ 1 is correct.

2: Line is $\frac{x}{a} + \frac{y}{b} = 1 \Rightarrow \left(\frac{1}{a}\right)x + \left(\frac{1}{b}\right)y + (-1) = 0$

$$P = \frac{\left|\frac{1}{a}(0) + \frac{1}{b}(0) - 1\right|}{\sqrt{\frac{1}{a^2} + \frac{1}{b^2}}} = \frac{1}{\sqrt{\frac{1}{a^2} + \frac{1}{b^2}}}$$

$$\Rightarrow P^2 = \frac{1}{\frac{1}{a^2} + \frac{1}{b^2}} = \frac{a^2b^2}{b^2 + a^2}$$

$$\Rightarrow \frac{1}{P^2} = \frac{a^2 + b^2}{a^2b^2} = \frac{1}{a^2} + \frac{1}{b^2}$$

2 is correct.

3: Line is $y = mx + c \Rightarrow mx - y + c = 0$.

$\therefore P = \frac{|m(0) - 0 + c|}{\sqrt{m^2 + 1}}$

$\Rightarrow P^2 = \dfrac{c^2}{m^2+1} \Rightarrow \dfrac{1}{P^2} = \dfrac{m^2+1}{c^2}$

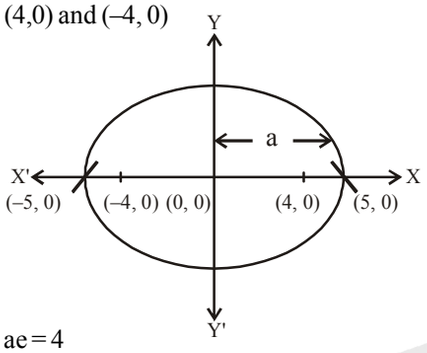
$\therefore$ 3 is wrong.

$\therefore$ only 1 and 2 are correct.

56. (a) Given,

vertices, (5, 0) and (–5, 0)

foci (4,0) and (–4, 0)



i.e., $ae = 4$

$\Rightarrow e = \dfrac{4}{a} = \dfrac{4}{5}.$

we know, $b^2 = a^2(1 - e^2)$

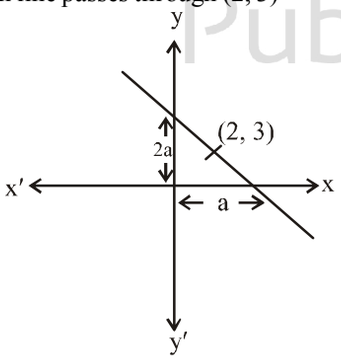
$= 5^2\left(1 - \left(\dfrac{4}{5}\right)^2\right)$

$= 25\left(\dfrac{25-16}{25}\right) = 9$

$\therefore a^2 = 25, b^2 = 9$

Equation of ellipse is $\dfrac{x^2}{25} + \dfrac{y^2}{9} = 1.$

57. (b) Given line passes through (2, 3)



Intercept form: $\dfrac{x}{a} + \dfrac{y}{b} = 1$

$\Rightarrow \dfrac{x}{a} + \dfrac{y}{2a} = 1$

$\Rightarrow 2x + y = 2a$ ....(1)

But this passes through (2, 3)

$\therefore 2a = 2(2) + 3 = 7$

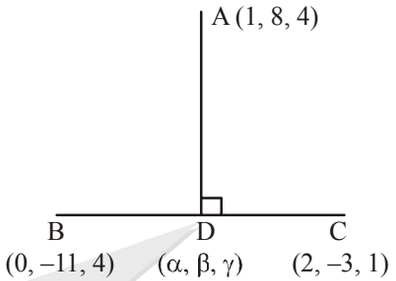
$\Rightarrow a = \dfrac{7}{2}.$

$\therefore$ Equation of line is $2x + y = 2\left(\dfrac{7}{2}\right)$

$\Rightarrow 2x + y = 7.$

58. (c) A(1, 8, 4), B(0, –11, 4), C(2, –3, 1)

Let $D = (\alpha, \beta, \gamma)$



Direction ratios of $BC = (x_2 - x_1, y_2 - y_1, z_2 - z_1)$

Let, $(a, b, c) = (2, 8, -3)$

Direction ratios of $AD = (x_2 - x_1, y_2 - y_1, z_2 - z_1)$

Let $(a', b', c') = (\alpha - 1, \beta - 8, \gamma - 4)$

Since, AD is perpendicular to BC,

$aa' + bb' + cc' = 0$

$\Rightarrow 2(\alpha - 1) + 8(\beta - 8) - 3(\gamma - 4) = 0.$

$\Rightarrow 2\alpha - 2 + 8\beta - 64 - 3\gamma + 12 = 0$

$\Rightarrow 2\alpha + 8\beta - 3\gamma - 54 = 0$ ....(1)

On substituting the options, we find option (c) is correct.

when $(\alpha, \beta, \gamma) = (4, 5, -2)$

$(1) \Rightarrow 2(4) + 8(5) - 3(-2) - 54 = 0$

$\Rightarrow 8 + 40 + 6 - 54 = 0$

$\Rightarrow 0 = 0.$

59. (a) We know, the equation of plane passing through 3 points (x_1, y_1, z_1), (x_2, y_2, z_2) and (x_3, y_3, z_3) is

$$\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ x_3 - x_1 & y_3 - y_1 & z_3 - z_1 \end{vmatrix} = 0.$$

So, the plane passing through points (–2, 6, –6), (–3, 10, –9) and (–5, 0, –6) is

$$\begin{vmatrix} x+2 & y-6 & z+6 \\ -1 & 4 & -3 \\ -3 & -6 & 0 \end{vmatrix} = 0$$

$\Rightarrow (x+2)(-18) - (y-6)(-9) + (z+6)(6+12) = 10$

$\Rightarrow -18x - 36 + 9y - 54 + 18z + 108 = 0$

$\Rightarrow -18x + 9y + 18z + 18 = 0$

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

$\Rightarrow 2x - y - 2z = 2.$

60. (c) Let the sphere passing through points A(a, 0, 0), B(0, b, 0), C(0, 0, c)

Equation of sphere is $x^2 + y^2 + z^2 - ax - by - cz = 0$

radius, $r = \dfrac{1}{2}\sqrt{a^2 + b^2 + c^2}$

$\Rightarrow a^2+b^2+c^2=4r^2$ ....(1)

(Squaring on both sides)

Let (α, β, γ) be centroid of sphere.

$$\therefore (\alpha,\beta,\gamma)=\left(\frac{a+0+0}{3},\frac{0+b+0}{3},\frac{0+0+c}{3}\right)$$

$$=\left(\frac{a}{3},\frac{b}{3},\frac{c}{3}\right)$$

$$\therefore \alpha^2+\beta^2+\gamma^2=\frac{a^2}{9}+\frac{b^2}{9}+\frac{c^2}{9}$$

$$=\frac{a^2+b^2+c^2}{9}$$

$$=\frac{4r^2}{9} \qquad \text{(from (1))}$$

$\Rightarrow 9(\alpha^2+\beta^2+\gamma^2)=4r^2$

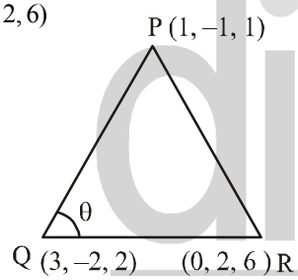
So, Locus is $9(x^2+y^2+z^2)=4r^2$.

61. (d) Given,

$P=(1,-1,1)$

$Q=(3,-2,2)$

$R=(0,2,6)$



Direction ratios of $PQ(a_1, b_1, c_1)=(3-1,-2+1,2-1)$

$=(2,-1,1)$

Direction ratios of $PR(a_2, b_2, c_2)=(0-1,2+1,6-1)$

$=(-1,3,5)$

Let us calculate, $a_1a_2+b_1b_2+c_1c_2$

$=(2)(-1)+(-1)(3)+(1)(5)$

$=-2-3+5=0.$

$\therefore PQ \perp PR$ i.e., $\angle QPR=90°$

In $\angle PQR$, $\angle P+\angle Q+\angle R=180° \Rightarrow 90°+\theta+\angle R=180°$

$\Rightarrow \angle R=90°-\theta$

62. (c) We know, the perpendicular distance (d) from point (x_1, y_1) to line $ax+by+c=0$ is $\dfrac{|ax_1+by_1+c|}{\sqrt{a^2+b^2}}$.

Let us find a point on line $2x+11y-5=0$.

for $x=0$, $2(0)+11y-5=0$

$\Rightarrow 11y-5=0$

$\Rightarrow y=\dfrac{5}{11}$.

So, $(x,y)=\left(0,\dfrac{5}{11}\right)$.

Let us find perpendicular distances of this point to the given lines.

$24x+7y=20$

$\Rightarrow 24x+7y-20=0$

$$d_1=\frac{\left|24(0)+7\left(\frac{5}{11}\right)-20\right|}{\sqrt{24^2+7^2}}=\frac{\left|\frac{35}{11}-20\right|}{\sqrt{625}}=\frac{\left|\frac{-185}{11}\right|}{25}=\frac{185}{11\times 25}=\frac{37}{55}$$

$4x-3y=2$

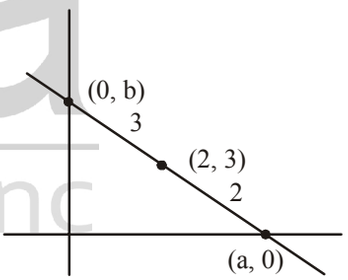
$\Rightarrow 4x-3y-2=0$

$$d_2=\frac{\left|4(0)-3\left(\frac{5}{11}\right)-2\right|}{\sqrt{16+9}}=\frac{\left|\frac{-15}{11}-2\right|}{\sqrt{25}}=\frac{37}{55}$$

$\therefore \quad d_1=d_2$

63. (d) Intercept form of line is $\dfrac{x}{a}+\dfrac{y}{b}=1$.

We know, the point which divides a line joining two points (x_1, y_1) and (x_2, y_2) in the ratio m:n is



$$\left(\frac{mx_2+nx_1}{m+n},\frac{my_2+ny_1}{m+n}\right)$$

Case 1: m:n = 2:3

$$\therefore (2,3)=\left(\frac{(2)(a)+3(0)}{2+3},\frac{2(0)+3(b)}{2+3}\right)$$

$$\Rightarrow (2,3)=\left(\frac{2a}{5},\frac{3b}{5}\right)$$

$$\Rightarrow \frac{2a}{5}=2 \quad ;\frac{3b}{5}=3$$

$\Rightarrow a=5; b=5.$

$\therefore$ Equation of line is $\dfrac{x}{5}+\dfrac{y}{5}=1 \Rightarrow x+y=5$

Case 2: m:n = 3:2

$$\therefore (2,3)=\left(\frac{3(a)+2(0)}{3+2};\frac{3(0)+2(b)}{3+2}\right)$$

$\Rightarrow (2,3) = \left(\frac{3a}{5}, \frac{2b}{5}\right)$

$\Rightarrow \frac{3a}{5} = 2; \frac{2b}{5} = 3$

$\Rightarrow a = \frac{10}{3}, b = \frac{15}{2}$

$\therefore$ Equation of line is $\frac{x}{\frac{10}{3}} + \frac{y}{\frac{15}{2}} = 1$

$\Rightarrow \frac{3x}{10} + \frac{2y}{15} = 1 \Rightarrow 9x + 4y = 30$

64. (b) Given lines, $L_1 = 3x + 4y - 9 = 0$

$L_2 = 6x + 8y - 15 = 0 \Rightarrow 3x + 4y - \frac{15}{2} = 0$.

Observe that the coefficients of x and y are same.

$\therefore L_1$ and L_2 are parallel lines.

Distance between parallel lines $= \frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}}$

$= \frac{\left|-9 + \frac{15}{2}\right|}{\sqrt{3^2 + 4^2}} = \frac{\left|\frac{-18+15}{2}\right|}{\sqrt{25}} = \frac{3}{10}$.

65. (a) Given, centre of sphere (h, k, l) = (–2, 3, 4)

radius (r) = 6 units.

Equation of sphere is $(x-h)^2 + (y-k)^2 + (z-\ell)^2 = r^2$

$\Rightarrow (x+2)^2 + (y-3)^2 + (z-4)^2 = 6^2$

$\Rightarrow x^2 + 4x + 4 + y^2 - 6y + 9 + z^2 - 8z + 16 = 36$

$\Rightarrow x^2 + y^2 + z^2 + 4x - 6y - 8z = 7$

66. (a) $|\vec{a}| = 2, |\vec{b}| = 7$.

$\vec{a} \times \vec{b} = 3\hat{i} + 2\hat{j} + 6\hat{k}$

We know, $\vec{a} \times \vec{b} = |\vec{a}||\vec{b}| \sin\theta \,.\, \hat{n}$ where $\hat{n}$ is unit vector.

$\Rightarrow |\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$

$\Rightarrow |3\hat{i} + 2\hat{j} + 6\hat{k}| = (2)(7)\sin\theta$

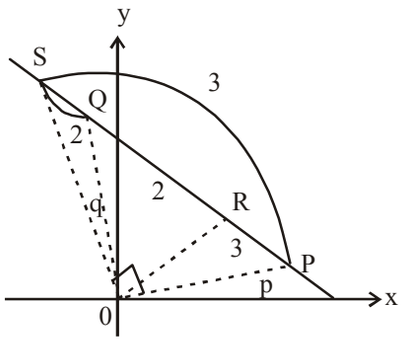
$\Rightarrow \sqrt{9 + 4 + 36} = (2)(7)\sin\theta$.

$\Rightarrow \pm 7 = (2)(7)\sin\theta$.

$\therefore \sin\theta = \pm\frac{1}{2}$.

$\sin\theta$ is acute angle, $\theta = 30°$

67. (a) R divides PQ internally in ratio 2:3



$\therefore \overrightarrow{OR} = \frac{2\vec{q} + 3\vec{p}}{5}$ ....(1)

S divides PQ externally in ratio 2:3

$\overrightarrow{OS} = \frac{2\vec{q} - 3\vec{p}}{2-3} = 3\vec{p} - 2\vec{q}$ ....(2)

Given, $\overrightarrow{OR}$ and $\overrightarrow{OS}$ are perpendicular.

$\therefore \left(\frac{3\vec{p} + 2\vec{q}}{5}\right)(3\vec{p} - 2\vec{q}) = 0$

$\Rightarrow 9p^2 - 4q^2 = 0 \Rightarrow 9p^2 = 4q^2$

68. (a) $\vec{r} = \left(2\hat{i} - \hat{j} + 3\hat{k}\right) - \left(\hat{i} + 2\hat{j} - \hat{k}\right)$

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

Moment $(\tau) = \vec{r} \times \vec{f}$

$= \left(\hat{i} - 3\hat{j} + 4\hat{k}\right) \times \left(3\hat{i} + \hat{k}\right)$

$= -3\hat{i} + 11\hat{j} + 9\hat{k}$

69. (d) $\vec{a} + 2\vec{b} + 3\vec{c} = \vec{0}$ ....(1)

$\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \lambda\left(\vec{b} \times \vec{c}\right)$ ....(2)

$(1) \times \vec{b} \Rightarrow \vec{b} \times \vec{a} + 2\vec{b} \times \vec{b} + 3\vec{b} \times \vec{c} = 0$

$\Rightarrow -\vec{a} \times \vec{b} + 0 + 3\vec{b} \times \vec{c} = 0$

$\Rightarrow \vec{a} \times \vec{b} = 3\vec{b} \times \vec{c}$ ....(3)

$(1) \times \vec{c} \Rightarrow \vec{c} \times \vec{a} + 2\vec{c} \times \vec{b} + 3\vec{c} \times \vec{c} = 0$

$\Rightarrow \vec{c} \times \vec{a} - 2\vec{b} \times \vec{c} + 0 = 0$

$\Rightarrow \vec{c} \times \vec{a} = 2\vec{b} \times \vec{c}$ ....(4)

$\therefore (2) \Rightarrow \vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \lambda\left(\vec{b} \times \vec{c}\right)$

$\Rightarrow 3\vec{b} \times \vec{c} + \vec{b} \times \vec{c} + 2\left(\vec{b} \times \vec{c}\right) = \lambda\left(\vec{b} \times \vec{c}\right)$ (from (3), (4))

$\Rightarrow 6\left(\vec{b} \times \vec{c}\right) = \lambda\left(\vec{b} \times \vec{c}\right)$

$\therefore \lambda = 6$

70. (b) Given, $\vec{k}$ and $\vec{A}$ are parallel vectors.

we know, cross product of parallel vectors is $\vec{0}$.

71. (d) Given, $f(x)=|x+1|$.

Let us check all options.

(a) $f(x)^2=|x^2+1|$

$(f(x))^2=(x+1)^2$.

So, $f(x)^2 \neq (f(x))^2$

(b) $f(|x|)=||x|+1|$

$|f(x)|=||x+1||=|x+1|$

$f(x) \neq |f(x)|$

(c) $f(x+y)=|x+y+1|$

$f(x)+f(y)=|x+1|+|y+1|$

$f(x+y) \neq f(x+f(y))$

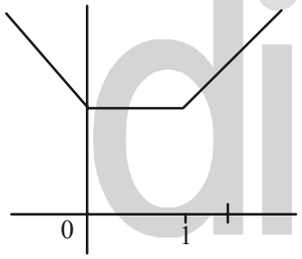
72. (a) $f(x)=\dfrac{x^2}{1+x^2}$

for $x=0, f(0)=0$

for $x=1,\ f(1)=\dfrac{1}{2}=0.5$

So, range is $[0, 1)$

73. (a) Given function is continuous at $x=0$ and 1.



74. (a) $f(x)=\begin{cases} x^2 \ell n|x| & x \neq 0 \\ 0 & x=0. \end{cases}$

$$f'(0)=\lim_{h\to 0}\frac{f(h)-f(0)}{h}$$

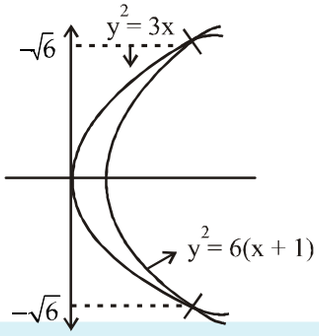
$$=\lim_{h\to 0}\frac{h^2.\ell n|h|-0}{h}$$

$$=\lim_{h\to 0} h.\ell n|h|$$

$=0$

75. (c) Given parabolas are $y^2=6(x-1)$ ....(1)

and $y^2=3x$ ....(2)



$y^2=6(x-1)$

$\Rightarrow \quad 6x-6=y^2$

$$\Rightarrow x=\frac{y^2+6}{6}=\frac{y^2}{6}+1$$

Also, $y^2=3x \Rightarrow x=\dfrac{y^2}{3}$.

Solving (1), (2), $3x=6(x-1)$

$\Rightarrow 3x=6x-6$

$\Rightarrow 3x=6 \Rightarrow x=2.$

$y^2=6 \Rightarrow y=\pm\sqrt{6}$.

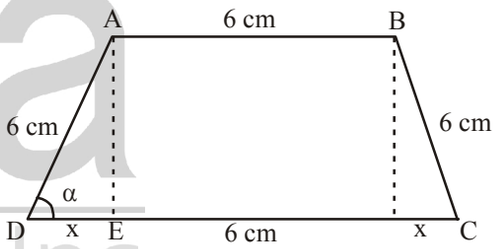
$\therefore$ Area

$$=\int_{-\sqrt{6}}^{\sqrt{6}}\left(\frac{y^2}{6}+1-\frac{y^2}{3}\right).dy=2\int_0^{\sqrt{6}}\left(1-\frac{y^2}{6}\right)dy=2\left[y-\frac{y^3}{18}\right]_0^{\sqrt{6}}$$

$$=2\left[\sqrt{6}-\frac{(\sqrt{6})^3}{18}\right]=2\times\frac{2\sqrt{6}}{3}=\frac{4\sqrt{6}}{3}.$$

76. (c) Length of three sides of trapezium = 6 cm

Let AE be height of trapezium.



In $\Delta ADE, AD^2=AE^2+DE^2$

$\Rightarrow 6^2=AE^2+x^2$

$\Rightarrow AE^2=36-x^2$

$$\Rightarrow AE=\sqrt{36-x^2}$$

$$\text{Area of trapezium}=\frac{1}{2}h(a+b)$$

$$=\frac{1}{2}\sqrt{36-x^2}\,(6+6+2x)$$

$$A=(6+x)\sqrt{36-x^2}.$$

Given, Area of trapezium is maximum.

$$\frac{dA}{dx}=\frac{d}{dx}\left[(6+x).\sqrt{36-x^2}\right]$$

$$=(6+x).\left(\frac{-2x}{2\sqrt{36-x^2}}\right)+\sqrt{36-x^2}$$

$$= \sqrt{36-x^2} - \frac{x(6+x)}{\sqrt{36-x^2}}$$

$$= \frac{36-x^2-6x-x^2}{\sqrt{36-x^2}} = \frac{36-6x-2x^2}{\sqrt{36-2x^2}}$$

$$\frac{dA}{dx} = 0 \Rightarrow 36-6x-2x^2 = 0$$

$\Rightarrow 2x^2+6x-36=0$

$\Rightarrow x^2+3x-18=0$

$\Rightarrow x^2+6x-3x-18=0$

$\Rightarrow x(x+6)-3(x+6)=0$

$(x+6)(x-3)=0$

$\Rightarrow$ $x=-6$ or 3. Since x cannot be negative. So, $x=3$.

$\therefore$ In ΔADE, $\cos\alpha = \frac{x}{6} = \frac{3}{6} = \frac{1}{2} \Rightarrow \alpha = \frac{\pi}{3}$.

77. (d) Fourth side, $DC = x+6+x$

$=3+6+3$

$=12$.

78. (c) Area $= (6+x)\sqrt{36-x^2}$

$= (6+3)\sqrt{36-3^2} = 9\sqrt{36-9} = 9\sqrt{27}$

$= 9\sqrt{9\times 3} = 27\sqrt{3}$.

79. (a) $\int_0^{\pi} e^x \sin x\,dx = I$

$I = \left(\sin x.e^x\right)_0^{\pi} - \int_0^{\pi} \cos x.e^x.dx$

$I = \left(\sin\pi.e^{\pi} - \sin 0.e^0\right) - \left\{\left[\cos x.e^x\right]_0^{\pi} - \int_0^{\pi} \sin x.e^x.dx\right\}$

$I = 0 - \left\{\left(\cos\pi.e^{\pi} - \cos 0.e^0\right) - I\right\}$

$I = -[-e^{\pi}-1] - I$

$\Rightarrow 2I = e^{\pi}+1 \Rightarrow I = \frac{e^{\pi}+1}{2}$.

80. (b) $f(x) = \frac{x^2-9}{x^2-2x-3}$

Given, the function is continuous at $x=3$.

$$f(3) = \lim_{x\to 3} \frac{x^2-9}{x^2-2x-3}$$

$$= \lim_{x\to 3} \frac{(x+3)(x-3)}{(x-3)(x+1)}$$

$$= \frac{3+3}{3+1} = \frac{6}{4} = \frac{3}{2} = 1.5.$$

81. (b) $\int_1^e x.\ell n\,x\,dx = \left[\ell nx.\frac{x^2}{2}\right]_1^e - \int_1^e \frac{1}{x}.x^2.dx$

$$= \left(\frac{e^2}{2}-0\right) - \frac{1}{2}\left(\frac{1}{2}\right)\left(x^2\right)_1^e = \frac{e^2}{2} - \frac{1}{4}\left(e^2-1\right) = \frac{2e^2-e^2+1}{4}$$

$$= \frac{e^2+1}{4}.$$

82. (a) $\int_0^{\sqrt{2}} \left[x^2\right] dx$

$= \int_0^1 \left[x^2\right] dx + \int_1^{\sqrt{2}} \left[x^2\right] dx$

$= 0 + \int_1^{\sqrt{2}} 1.dx$ ($\because$ [ ] is greatest integer function)

$= (x)_1^{\sqrt{2}} = \sqrt{2}-1$.

83. (c) $f(\theta) = 16\sin\theta - 12\sin^2\theta$

$f'(\theta) = 16\cos\theta - 24\sin\theta\cos\theta$

$f'(\theta) = 0 \Rightarrow \cos\theta(16-24\sin\theta) = 0$

$\Rightarrow \cos\theta = 0$ or $16-24\sin\theta = 0$

$\Rightarrow \theta = \frac{\pi}{2}$ or $\sin\theta = \frac{2}{3}$

$\therefore f\left(\frac{\pi}{2}\right) = 16\sin\frac{\pi}{2} - 12\sin^2\frac{\pi}{2} = 16-12 = 4$

and $f\left(\sin\theta = \frac{2}{3}\right) = 16\left(\frac{2}{3}\right) - 12\left(\frac{2}{3}\right)^2$

$= \frac{32}{3} - \frac{48}{9} = \frac{32}{3} - \frac{16}{3} = \frac{16}{3}$.

84. (d) $f(x) = 4\sin x - 3\cos x + 1$

To find range of this function, we have to find maximum and minimum values.

We know, for $a\sin\theta + b\cos\theta + c$, max value is $\sqrt{a^2+b^2}+c$ and minimum value is $-\sqrt{a^2+b^2}+c$.

$\therefore$ Maximum value $= \sqrt{(4)^2+(-3)^2}+1$

$= \sqrt{16+9}+1 = 5+1 = 6$

Minimum value $= -\sqrt{16+9}+1 = -5+1 = -4$

$\therefore$ Range, $S \in [-4, 6]$

85. (a) $f(x)=\dfrac{1}{\sqrt{|x|-x}}$

$|x|-x>0$ since the denominator cannot be zero.

$\therefore |x|>x$

for $x>0$, $x>x$ is not possible.

for $x<0, |x|>x$

$\Rightarrow 2x<0 \quad \Rightarrow x<0.$

$\therefore$ domain is $(-\infty, 0)$

86. (b) $xdy-ydx=0.$

$\Rightarrow xdy=ydx$

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

$\Rightarrow \log y=\log x+\log c$

$\Rightarrow \log y-\log x=\log c$

$\Rightarrow \log\left(\dfrac{y}{x}\right)=\log c$

$\Rightarrow \dfrac{y}{x}=c \Rightarrow y=cx.$

87. (c) $f(x)=e^{\tan x}+\ell n(\sec x)-e^{\ell n\, x}$

$f'(x)=e^{\tan x}.\sec^2 x+\dfrac{1}{\sec x}.\sec x\tan x-1$

$\left(\because e^{\ln x}=x \text{ and } \dfrac{d}{dx}(x)=1\right)$

$f'\left(\dfrac{\pi}{4}\right)=e^{\tan\frac{\pi}{4}}.\sec^2\dfrac{\pi}{4}+\tan\dfrac{\pi}{4}-1=2e+1-1$

$=2e.$

88. (a)

89. (d) Period of the function, sin x is 2π.

90. (b) $\displaystyle\int\frac{dx}{2^x-1}=\int\frac{dx}{\frac{1}{2^{-x}}}=\int\frac{2^{-x}}{1-2^{-x}}.dx$

Let $1-2^{-x}=t \quad \Rightarrow 2^{-x}.\log 2=\dfrac{dt}{dx}$

$\Rightarrow 2^{-x}=\dfrac{1}{\log 2}.\dfrac{dt}{dx} \Rightarrow 2^{-x}.dx=\dfrac{dt}{\log 2}$

$\therefore \displaystyle\int\frac{2^{-x}}{1-2^{-x}}dx=\frac{1}{\log 2}\int\frac{dt}{t}=\frac{1}{\log 2}(\log t)+c$

$=\dfrac{1}{\log 2}\left(\log\left(1-2^{-x}\right)\right)+c.$

91. (*)

92. (c) $\displaystyle\int_{\frac{-\pi}{4}}^{\frac{\pi}{4}}(\sin x-\tan x)dx.$

Let $f(x)=\sin x-\tan x$

$f(-x)=\sin(-x)-\tan(-x)$

$=-\sin x+\tan x=-(\sin x-\tan x)=-f(x).$

So, f(x) is an odd function.

We know $\displaystyle\int_{-a}^{a}f(x).dx=0$, if f(x) is odd function.

93. (a)

$\displaystyle\int_a^b x^3.dx=0$

$\Rightarrow \left(\dfrac{x^4}{4}\right)_a^b=0$

$\Rightarrow b^4-a^4=0$

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

$\Rightarrow b^2-a^2=0 \text{ (or) } b^2+a^2=0$

$\Rightarrow (b+a)(b-a)=0 \text{ (or) } b^2+a^2=0$

$\Rightarrow b=-a \text{ (or) } a=b \text{ (or) } b^2+a^2=0$

$\displaystyle\int_a^b x^2.dx=\frac{2}{3}$

$\Rightarrow \left(\dfrac{x^3}{3}\right)_a^b=\dfrac{2}{3}$

$\Rightarrow b^3-a^3=2$

Since, $b=-a$.

$\Rightarrow b^3-(-b^3)=2$

$\Rightarrow 2b^3=2$

$\Rightarrow b^3=1$

$\Rightarrow b=1, a=-1.$

94. (a) $\displaystyle\int_0^1 x(1-x)^9.dx$

$=\displaystyle\int_0^1(1-x)(1-(1-x))^9.dx \quad \left(\because\int_0^a f(x).dx=\int_0^a f(a-x).dx\right)$

$=\displaystyle\int_0^1(1-x).x^9.dx \;=\int_0^1\left(x^9-x^{10}\right).dx$

$=\left(\dfrac{x^{10}}{10}-\dfrac{x^{11}}{11}\right)_0^1=\dfrac{1}{10}-\dfrac{1}{11}=\dfrac{11-10}{110}=\dfrac{1}{110}.$

95. (a) $\displaystyle\lim_{x\to 0}\frac{\tan x}{\sin 2x}=\lim_{x\to 0}\frac{\frac{\tan x}{x}}{2\left(\frac{\sin 2x}{2x}\right)}=\frac{1}{2}.$

96. (d) Let $L=\displaystyle\lim_{h\to 0}\frac{\sqrt{2x+3h}-\sqrt{2x}}{2h}$

Rationalise the numerator, we get:

$L=\displaystyle\lim_{h\to 0}\left(\frac{\sqrt{2x+3h}-\sqrt{2x}}{2h}\times\frac{\sqrt{2x+3h}+\sqrt{2x}}{\sqrt{2x+3h}+\sqrt{2x}}\right)$

$$= \lim_{h\to 0} \frac{2x+3h-2x}{2h\left(\sqrt{2x+3h}+\sqrt{2x}\right)}$$

$$= \frac{3}{2\left(\sqrt{2x+0}+\sqrt{2x}\right)} = \frac{3}{4\sqrt{2x}}$$

97. (b) f(x) is an even function.
Let's see some examples
(1) If $f(x) = \cos x$, which is even function,
$f'(x) = -\sin x$, which is odd function.
(2) If $f(x) = x^2$, which is even function,
$f'(x) = 2x$, which is odd function.

98. (c) $y = e^{x^2}.\sin 2x$

$$\frac{dy}{dx} = 2.e^{x^2}.\cos 2x + 2xe^{x^2}.\sin 2x$$

$$= 2e^{x^2}\left(\cos 2x + x\sin 2x\right)$$

$$\left.\frac{dy}{dx}\right|_{x=\pi} = 2e^{\pi^2}\left(\cos 2\pi + \pi.\sin 2\pi\right)$$

$$= 2e^{\pi^2}\left(1+0\right) = 2.e^{\pi^2}$$

99. (a) $(1+2x)\,dy-(1-2y)\,dx = 0 \Rightarrow (1+2x)\,dy = (1-2y)\,dx$

$$\Rightarrow \frac{dy}{1-2y} = \frac{dx}{1+2x}$$

Integrating both sides, $\int \frac{dy}{1-2y} = \int \frac{dx}{1+2x}$

$$\Rightarrow \frac{-1}{2}\log(1-2y) = \frac{1}{2}\log(1+2x) + \frac{1}{2}\log c$$
$$\Rightarrow \log(1-2y) + \log(1+2x) = \log c$$
$$\Rightarrow (1+2x)(1-2y) = c$$
$$\Rightarrow 1+2x-2y-4xy = c$$
$$\Rightarrow 2x-2y-4xy = c$$
$$\Rightarrow x-y-2xy = c.$$

100. (c) $\left(\frac{d^3y}{dx^3}\right)^2 = y^4 + \left(\frac{dy}{dx}\right)^5$

order = 3, degree = 2

101. (a) Mean = np
Variance = npq
Given, np = 3npq

$$\Rightarrow q = \frac{1}{3}, p = \frac{2}{3}.$$

Also, Given n = 5 trials.
r = 3

we know, $p(x=r) = {}^nC_r.p^r.q^{n-r}$

$$p(x=3) = {}^5C_3.\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^2 = \frac{80}{243}.$$

102. (b) The statements (1) and (3) are true.

103. (d) Given, r = 0.6, covariance = 27, $\sigma^2_{(y)} = 25 \Rightarrow \sigma(y) = 5$

We know, $r = \frac{\text{covariance}(x,y)}{\sigma(x).\sigma(y)}$

$$\Rightarrow \sigma(x) = \frac{\text{covariance}(x,y)}{r.\sigma(y)} = \frac{27}{\left(\frac{6}{10}\right).5}$$

$$= \frac{27\times 2}{6} = 9.$$

$\Rightarrow \sigma^2(x) = 81.$

104. (b) Probability of solving Question A, P(A) = 0.4
Probability of solving Question B, P(B) = 0.5
$\therefore$ P(A′) = 1 − P(A) = 1 − 0.4 = 0.6
P(B′) = 1 − P(B) = 1 − 0.5 = 0.5
Probability to solve atleast one question = $P(A \cup B)$
$P(A \cup B) = 1 - P(A' \cap B')$
$= 1 - (0.6 \times 0.5)$
$= 1 - 0.3 = 0.7$

105. (d) Given, Mean of $x_i = \bar{x}$
Also, Given $x_i = a + cy_i$
$\therefore$ Mean of $a + cy_i = \bar{x}$
$\Rightarrow$ Mean of $cy_i = \bar{x} - a$

$$\Rightarrow \text{Mean of } y_i = \frac{\bar{x}-a}{c}$$

106. (d) We know, $\tan\theta = \left|\frac{1-r_{xy}^2}{r_{xy}}\right|\left(\frac{\sigma_x.\sigma_y}{\sigma_x^2.\sigma_y^2}\right)$.

If r_{xy} is 0, then $\tan\theta = \infty$ and lines are perpendicular.
If r_{xy} is 1, then the lines are parallel.

107. (c) $4x-5y+33 = 0$ (1)
$20x-9y = 107$ (2)

$(1)\times 5 \Rightarrow \quad 20x-25y+165 = 0$
$(2) \Rightarrow \quad 20x-9y-107 = 0$
$\quad\quad (-)\ \ (+)\ \ (+)$
$-16y+272 = 0 \Rightarrow 16y = 272 \Rightarrow y = 17.$

$(1) \Rightarrow 4x-5(17)+33 = 0$
$\Rightarrow 4x-85+33 = 0$
$\Rightarrow 4x = 52 \Rightarrow x = 13.$

108. (d) 1. Mean is dependent with change in origin.
2. Variance is independent with change in origin.

109. (c) Both the given statements are correct.

110. (b) By arranging the given numbers in ascending order,

$$-4.8, 0, 2.3, 3.5, 3.9, \underbrace{4.6, 5.2}_{\text{Middle terms}}, 6.1, 7.6, 8.2, 9.3, 12.7$$

$\therefore$ Median $= \dfrac{4.6+5.2}{2}$

$= \dfrac{9.8}{2} = 4.9$

111. (c) Central angle $= 20\%$ of $360° = \dfrac{20\times 360°}{100} = 72°$

112. (d) Given, Mean $= 5$

Standard deviation $= 2$

If 5 is added to each value, mean $= 5 + 5 = 10$.

Standard deviation will not change.

Coefficient of variation $= \dfrac{\text{Standard deviation}}{\text{Mean}} \times 100$

$= \dfrac{2}{10} \times 100 = 2 \times 10 = 20$

113. (d) Time taken by train to cover first $5\text{km} = \dfrac{\text{Distance}}{\text{Speed}}$

$= \dfrac{5}{30} = \dfrac{1}{6}\text{hr}$

Time taken by train to cover next $15\text{km} = \dfrac{15}{45} = \dfrac{1}{3}\text{hr}$.

Average speed $= \dfrac{5+15}{\frac{1}{6}+\frac{1}{3}}$

$= \dfrac{20}{\frac{1+2}{6}} = \dfrac{120}{3} = 40\text{km/hr}$

114. (b) When two dice are rolled, the events where we get sum of 7 is

$E = \{(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)\}$

$\therefore n(E) = 6$

Total number of events, $n(S) = 36$.

$\therefore$ probability $= \dfrac{n(E)}{n(S)} = \dfrac{6}{36} = \dfrac{1}{6}$

115. (b) Given, $2.P(A) = 3.P(B)$

$\Rightarrow \dfrac{2P(A)}{P(A\cap B)} = \dfrac{3P(B)}{P(A\cap B)}$

$\Rightarrow \dfrac{P(A\cap B)}{2.P(A)} = \dfrac{P(A\cap B)}{3P(B)}$

$\Rightarrow \dfrac{1}{2}.P\left(\dfrac{B}{A}\right) = \dfrac{1}{3}.P\left(\dfrac{A}{B}\right)$

$\Rightarrow P\left(\dfrac{B}{A}\right) < P\left(\dfrac{A}{B}\right)$.

116. (c) First chit can be drawn in 10 ways.

Second chit can be drawn in 9 ways.

Total number of events, $n(S) = 10 \times 9 = 90$.

Number of events of drawing chit numbered $9 = n(E) = 1$

Probability $= \dfrac{n(E)}{n(S)} = \dfrac{1}{90}$

117. (b) Probability of choosing one bag from two bags $= \dfrac{1}{2}$

Probability of choosing white ball from first bag $= \dfrac{3}{5}$

Probability of choosing white ball from second bag $= \dfrac{5}{8}$

$\therefore$ Required probability $= \dfrac{1}{2}\left(\dfrac{3}{5}+\dfrac{5}{8}\right)$

$= \dfrac{1}{2}\left(\dfrac{24+25}{40}\right) = \dfrac{1}{2}\times\dfrac{49}{40} = \dfrac{49}{80}$

118. (b) **Statement 1 :** If $B \subset A$, then

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

$\therefore$ It is correct.

Statement 2 : P(A alone or B alone)

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

$= P(A) + P(B) - 2P(-A\cap B)$

$\therefore$ It is false.

Statement 3 : If A, B are mutually exclusive events, then $P(A\cap B) = 0$

$\Rightarrow P(A\cup B) = P(A) + P(B)$

It is correct.

119. (a) $n(E) = {}^4C_2 \times {}^5C_1 = 6\times 5 = 30$.

$n(S) = {}^9C_3 = 84$

$\therefore$ probability $= P(E) = \dfrac{n(E)}{n(S)} = \dfrac{30}{84} = \dfrac{5}{14}$

120. (b) $\sigma^2 = \dfrac{1}{N}\sum_{i=1}^{N} X_i^2 - \left(\dfrac{1}{N}.\sum_{i=1}^{N} X_i\right)^2$

$= \dfrac{1}{N}\left(1^2+2^2+3^2+....+N^2\right) - \left(\dfrac{1}{N}(1+2+3+....+N)\right)^2$

$= \dfrac{1}{N}.\dfrac{N(N+1)(2N+1)}{6} - \left(\dfrac{1}{N}.\dfrac{N(N+1)}{2}\right)^2$

$= \dfrac{N^2-1}{12} \qquad \therefore \sigma = \sqrt{\dfrac{N^2-1}{12}}$.

GENERAL ABILITY

PART-A: ENGLISH

1. (d) 'Sycophancy' means 'obsequious behaviour towards someone important in order to gain advantage' so, 'flattery' will be its correct synonym.
2. (b) 'Attack' means 'to take aggressive action against

someone'. In this sentence, 'assault' is the best suited synonym as its means 'a concerned attempt to do something demanding or damage someone or something'.

3. (c) 'Grant' means 'agree to give or allow (something requested) to'. So 'allowed' will be its correct synonym.
4. (d) 'Deliver' when used in sentence which talks about a statement or a verdict means 'state in a formal manner' so, here, 'pronounce' which means 'declare or announce in a formal or solemn way' will be the correct synonym.
5. (a) 'Indissoluble' means 'unable to be destroyed' so, 'firmly' will be its correct synonym.
6. (c) 'Improving' means 'making or becoming better' so, 'becoming better' will be its correct synonym.
7. (c) 'Interlocutor' is a person who takes part in dialogue or conversation so, 'dialogist' will be its correct synonym.
8. (b) 'Lavishly' means 'in a very generous or extravagant manner' so, 'generously' will be its correct synonym.
9. (c) The word 'fiscal' denotes a financial year so, 'financial' will be the correct synonym.
10. (b) 'Abundant' means 'in large quantity' so, 'plentiful' will be its correct synonym.
11. (d) 'Geared to' means 'fitted with' so, 'unlinked to' which means 'detached to' will be its correct antonym.
12. (c) 'Repel' is the correct antonym of 'attract'.
13. (d) 'Concerned' means 'worried, troubled, or anxious' so, 'uninvolved' which means 'not connected or concerned with someone or something' will be its correct antonym.
14. (b) 'Serious' means 'demanding or characterized by careful consideration or application' so, 'trivial' which means 'of little value or importance' will be its correct antonym.
15. (a) 'Miscellaneous' means 'of various types or from different source' so 'pure' which means 'without any extraneous and unnecessary elements' will be its correct antonym.
16. (b) 'Incoming' is the correct antonym of 'outgoing'.
17. (c) 'Fine' means 'worthy of or eliciting admiration' so, 'coarse' which means rough or harsh' will be its correct antonym.
18. (c) 'Dissimilarity' is the correct antonym of 'likeness'.
19. (a) 'Uniformity' is the correct antonym of 'diversity'.
20. (c) 'Liquidated' means 'wind up the affairs of (a business) by ascertaining liabilities and apportioning assets' so, 'flourishing' which means 'developing rapidly and successfully' will be its correct antonym.
21. (c) The correct part will be 'he had made to his people'.
22. (b) The correct part will be 'The jury was called'.
23. (c) The correct part will be 'the greatest of all modern architects'.
24. (d) No error
25. (c) The correct part will be 'are honest'.
26. (a) The idiom 'cry over split milk' means 'to express regret about something that has already happened or cannot be changed'.
27. (b) The phrase 'cut the mustard' means 'come up to expectation; reach the required standard'.
28. (b) The idiom 'devil's advocate' is used for a person who expresses a contentious opinion in order to provoke debate or test the strength of the opposite arguments.
29. (b) The idiom 'don't count your chickens before the eggs have hatched' means don't make plans for something that is doubtful to happen.
30. (c) The phrase 'give the benefit of doubt' means 'a concession that a person of fact must be regarded as correct or justified, if the contrary has not been proven'.
31. (b) The correct sequence will be S1PSQRS6.
32. (c) The correct sequence will be S1QPSRS6.
33. (a) The correct sequence will be S1RSPQS6.
34. (d) The correct sequence will be S1SPRQS6
35. (b) The correct sequence will be S1SQRPS6.
36. (d) From the first sentence of the passage, it can easily be inferred that 'rule of the road' implies restricted individual freedom to ensure freedom for all.
37. (c) It is inherited in the second sentence fo the passage that when a policeman signals you to stop on a road-crossing, he is protecting the liberty of all to used the road.
38. (c) It can be inferred from the passage that the author is of the view that we should try to strike a sensible balance between our individual and social libety.
39. (b) It can be inferred from the last sentence that educating or not educating his child is also a matter of social liberty.
40. (c) Since the whole passage talks about the concept of liberty therefore, ' Importance of Liberty' appears to be the most suitable title for this passage.
41. (a) Statements 2, 3 and 4 are incorrect. Only statement 1 is correct.
42. (b) It can be inferred from the sentence 'His object in entering the house is to snap up the moths that cluster around the lamp'.
43. (d) It is clearly mentioned in the last line of the passage.
44. (c) The author calls the tiny bat an 'interesting visitor' because of its peculiar qualities like it prefers to fly in trough the open door and uses the window only if there is no alternative and it flies low unlike other bats, etc.
45. (c) The entire passage is based on the bat which is an interesting visitor to the author's home. Hence, 'My Nocturnal Visitor' is the best suited title passage.
46. (d) 'Plodded' which means 'walked doggedly and slowly with heavy steps' will be correct word to fill the black.
47. (c) 'Nasty' which means 'very bad or unpleasant' fills the blank contextually.
48. (c) 'Sumptuous' which means 'splendid and expensive-looking' is the most appropriate word to fill the blank correctly.
49. (c) 'Complete' is the most appropriate word which fills the blank correctly.
50. (b) The sentence requires a noun to fill the blank correctly hence, 'standing' is the correct word to fill the blank correctly.

PART- B : GENERAL KNOWLEDGE

51. (a) Any energy transfer that does not involve temperature difference in some way is not heat.
52. (a) The motions repeats after time T only once
53. (a) An object has constant velocity means that it is moving along a straight line, and as every second of time goes by, the object travels through the same number of meters.
54. (c) An object is moving with uniform acceleration a. Its initial velocity is u and after time t its velocity is v. The equation of its motion is v = u + at. The velocity (along y-axis) time (along x-axis) graph shall be a straight line with y-intercept u.
55. (a) The net force experienced by a bar magnet placed in a uniform magnetic field is Zero.
56. (d) A cricket ball has maximum inertia.
57. (b) kWh (kilowatt-hour) and Joules are two energy units. 1 watt is defined as 1 joule/second. So if you multiply a watt times seconds, you get Ws which is also a joule.
So 1kW is 1000W, and an hour is 60 seconds x 60 minutes.
So 1kWh = 3600kWs = 3,600,000Ws = 3,600,000J
So $1kWh = 3.6 \times 10^6 J$
58. (d) The gravitational force is a force that attracts any objects with mass. This is called Newton's Universal Law of Gravitation. The gravitational force on Earth is equal to the force the Earth exerts on you. At rest, on or near the surface of the Earth, the gravitational force equals your weight.
59. (c) Whether an object will float or sink in a liquid, depends on difference in the densities of the object and liquid.
60. (c) The device that does not follow ohm's law is known as a non-ohmic device. Examples of non ohmic devices are: thermistors, crystal rectifiers, vacuum tube, bulb, Semi conductor diode etc.
61. (d) Total internal reflection complete reflection of a ray of light within a medium such as water or glass from the surrounding surfaces back into the medium. The phenomenon occurs if the angle of incidence is greater than a certain limiting angle, called the critical angle.
62. (b) Hearing is one of the five senses of the body. The ears help the body to pick up sound waves and vibrations. The number of vibrations that are produced per second is called frequency. Frequency varies for each sound and is measured in hertz. Humans cannot hear sounds of every frequency. The range of hearing for a healthy young person is 20 to 20,000 hertz.
63. (b) Nettle leaves are rich in vitamins A and C, potassium, manganese etc. The Accidental touch of nettle leaves creates a burning sensation because it injects formic acid (also called called methanoic acid), acetylcholine and histamine when it comes in contact.
64. (c) Properties of tooth paste is basic. Toothpaste is a paste used as an accessory to clean and maintain health of teeth.
65. (d) Gastric juice gives the highest amount of the hydrogen ions. Gastric juice is responsible for breaking down foods you eat so digestion can continue in the small intestine.
66. (a) Sodium chloride (NaCl) and water (H_2O) solution is called as brine solution. The brine use in electrolysis involves using an electric current to bring about a chemical change and make new chemicals.
67. (b) The chemical formula of washing soda is $Na_2CO_3.10H_2O$, and its chemical name is Sodium Carbonate. It is also known as soda ash or soda crystals.
68. (a) Bleaching powder is not used as a reduction agent in chemical industries. Reducing agent a substance that tends to bring about reduction by being oxidized and losing electrons.
69. (c) Aids is caused by HIV Virus. HIV is a retrovirus, which means it carries single-stranded RNA. Its genetic material rather than the double-stranded DNA human cells carry.
70. (b)
71. (b) Fluid and small solutes are forced under pressure to flow from the glomerulus into the capsular space of the glomerular capsule. The Bowman's capsule is the filtration unit of the glomerulus and has tiny slits in which filtrate may pass through into the nephron.
72. (d) Mosses and liverworts are lumped together as bryophytes, plants lacking true vascular tissues, and sharing a number of other primitive traits. They also lack true stems, roots, or leaves, though they have cells that perform these general functions.
Bryophytes do not have a true vascular system and are unable to pull water and nutrients up from the ground at any significant distance. Lacking this specialised system distinguishes bryophytes from ferns and flowering plants. It is for this reason that they are considered to be rather primitive plants.
73. (a) Grouping of organism according to similarities and differences is termed classification. When an organism is classified into various categories, a hierarchy is maintained.
Accordingly, an organism belongs to Kingdom, Phylum, Class, Order, Family, Genus and Species in hierarchical order.
74. (d) Meristematic tissues, or simply meristems, are tissues in which the cells remain forever young and divide actively throughout the life of the plant. Cells within the meristematic tissues are self-renewing, so that each time they divide, one cell remains identical to the parent while the other can specialize and become part of another plant structure. The meristematic tissue is therefore self-sustaining.
75. (b) Highest female literacy (88.25) is reported in Lakshadweep among all the Union Territories.

76. (a) Roaring Forties are strong westerly winds in the oceans of Southern Hemisphere.
77. (c) Both the statements are correct.
78. (a) Atacama is the driest desert of the world. It is in the territorial region of Chile.
79. (d) Latent heat, energy absorbed or released by a substance during a change in its physical state (phase) that occurs without changing its temperature. It is fixed at a given temperature. It depends on the temperature but independent of volume.
80. (b)
81. (a) A ball balanced on a vertical rod is an example of unstable equilibrium.
82. (d) Fluid statics or hydrostatics is the branch of fluid mechanics that studies "fluids at rest and the pressure in a fluid or exerted by a fluid on an immersed body". It encompasses the study of the conditions under which fluids are at rest in stable equilibrium as opposed to fluid dynamics, the study of fluids in motion.
83. (b)
84. (a) The number of water molecules that share with two formula unit $CaSO_4$ in plaster of paris one. The chemical formula of plaster of Paris is $CaSO_4.1/2H_2O$. $CaSO_4.1/2H_2O$ means that two formula units of $CaSO_4$ shares one molecule of water.
85. (c) Carbon black is obtained by bunning hydrocarbons in a limited supply of air. Carbon black particles are usually spherical in shape and less regularly crystalline than graphite.
86. (a) The hybridization of each carbon atom is sp3, this statement is not right for graphite. The electronic configuration of carbon is 1s22s22p2. It is unique in that it has properties of both a metal and a non-metal.
87. (c) Fullerene is the purest form of carbon. A fullerene is an allotrope of carbon in the form of a hollow sphere, ellipsoid, tube, and many other shapes and sizes.
88. (b) The poisonous nature of carbon monoxide is due to its ability to form a complex with haemoglobin. Carbon monoxide is harmful when breathed because it displaces oxygen in the blood.
89. (b) Nerves carry signals from one end to another using a complex process involving the exchange of charged ions inside and outside. The main ions involved are sodium, potassium, chloride and calcium.
90. (b) The cell was first discovered by Robert Hooke in 1665 using a microscope. The first cell theory is credited to the work of Theodor Schwann and Matthias Jakob Schleiden in the 1830s.
91. (b) The term food chain refers to the sequence of events in an ecosystem, where one organism eats another and then is eaten by another organism. It starts with the primary source like the sun or hydrothermal vents where producers make food, continues with consumers or animals who eat the food, and ends with the top predator.
92. (b) Muscal And Skeletal Tissues Have Contractile Proteins.
93. (a) Hydrochloric acid breaks down proteins in the stomach to prepare them for digestion and kills bacteria that enter your stomach. It converts the inactive enzyme pepsinogen into the active enzyme pepsin, which is responsible for digesting proteins in the stomach.
94. (c) Hajipur is the Headquarters of East Central Railway which is one of the 18 railway zones in India. It is comprises Sonpur, Samastipur, Danapur, Mughalsarai, and Dhanbad divisions.
95. (c) The Academy was registered as a Society in January 1983.It started operations in Delhi since April 1985 with changed name of NITHE. It continued to operate in Delhi till Sept, 2001 and thereafter shifted to its own campus at NOIDA, UP w.e.f. Oct, 2001.Now the Academy organizes training for Highway Sector Engineers and professionals of Central / State Govts., Public & Private sectors. It also imparts training to Highway Professionals from Abroad under various training programs in SAARC countries, Colombo Plan countries and Afro-Asian countries, etc.
96. (d) Tawi is a river that flows through the city of Jammu, Kashmir. Tawi river is a major left bank tributary of Chenab River. The river originates from the lapse of Kali Kundi glacier and adjoining area south-west of Bhadarwah in Doda District.
97. (c) Nagarjunsagar-Srisailam Tiger Reserve (NSTR) is the largest tiger reserve in India . The reserve spreads over five districts, Nalgonda District, Mahbubnagar district, Kurnool District, Prakasam District and Guntur District. The total area of the tiger reserve is 3,568 km2 (1,378 sq mi). The core area of this reserve is 1,200 km2 (460 sq mi).
98. (c) In a coastal environment, deposition results in the accumulation of sediment. This happens when the forces responsible for transporting sediment in a coastal environment weaken and can no longer support the sediment. Depending on how and where the sediment is deposited, a variety of landforms such as Sand bar, Tombolo and Spit can be produced.
99. (a) Notch, Sea arch and Cliff are the coastal erosional features, while hook is one of the depositional features.
100. (b) Chemical weathering typically increases as temperatures rise and rain falls, which means rocks in hot and wet climates experience faster rates of chemical weathering than do rocks in cold, dry climates. Wet climates accelerate the rates of chemical weathering, caused when CO_2 in dirt mixes with air and water to form a weak acid. The weak acid breaks down rocks more rapidly in wet climates compared with dry ones.
101. (a) The specific heat is an intensive property that describes how much heat must be added to a particular substance to raise its temperature. It is depends of mass and shape of the body.
102. (c) The restoring force is a function only of position of the mass or particle. The restoring force is often referred to in simple harmonic motion.

103. (d) Refractive index of a medium with respect to air is the ratio of the velocity of light in air to the velocity of the light in the medium. It is also the ratio of the refractive index of the medium with respect to vacuum to the refractive index of air with respect to vacuum.
104. (d) Magnetic field lines are a visual tool used to represent magnetic fields. They describe the direction of the magnetic force on a north monopole at any given position.
105. (d) 0.25 m.
106. (d) Alkali metals Caesium has lowest melting point.Caesium is a chemical element with symbol Cs and atomic number 55. Alkali metals are very reactive, electropositive, monovalent metals forming strongly alkaline hydroxides.
107. (a) Potassium is alloyed with sodium in order to transfer heat in nuclear reactor. Their combination is denoted as NaK. Special precautions are required while using them as both are alkali metals and may explode in case of exposure to air. Sodium is the most important metal for nuclear reactions
108. (c) Photoelectric cell an electronic device whose electrical properties are modified by the action of light. Rubidium is the element used in the filament of photoelectric cell that convert light energy into electric energy.
109. (d) The Ring of Fire, also referred to as the Circum-Pacific Belt, is a path along the Pacific Ocean characterized by active volcanoes and frequent earthquakes. Its length is approximately 40,000 kilometers (24,900 miles). It traces boundaries between several tectonic plates–including the Pacific, Juan de Fuca, Cocos, Indian-Australian, Nazca, North American, and Philippine Plates. 75 % of Earth's volcanoes–more than 450 volcanoes–are located along the Ring of Fire. 90 % of Earth's earthquakes occur along its path, including the planet's most violent and dramatic seismic events.
110. (d) Deodar/devdar/devadar is a species of cedar native to the western Himalayas in Eastern Afghanistan, Northern Pakistan and India, Southwestern Tibet and Western Nepal, occurring at 1,500–3,200 m altitude.
111. (c) Indravati River is a tributary of the Godavari River. Its starting point is found to be the Ghats of Dandakaranya range, in the Kalahandi district of the state of Odisha, The River follows a westerly path and enters Jagadalpur in the state of Chhattisgarh. The river moves from here in a southern route, before eventually uniting with the Godavari at the borders of three states of Chhattisgarh, Maharashtra and Andhra Pradesh.
112. (b) Heavy rainfall up to 250 cm and tropical to sub-tropical climatic conditions favour tea plantations. Tea cultivation also needs acidic pH and thus lime is not needed for its growth.
113. (a) Bharatmala project is related to improving road connectivity across India. Under this project it is proposed to develop ring roads around 28 major cities across the country.
114. (b) Purga is a violent cold wind with drifting snow. It blows out from Siberia.
115. (d) Renukoot is a famous industrial town in Sonbhadra district of Uttar Pradesh famous for Aluminium plant (Hindalco). Except Renukoot all other places are famous for Iron and steel industry.
116. (a) Thermal power station are power stations which convert heat energy into electric energy. The basic mechanism is that: Use the heat energy to boil water, producing steams, The steam turbine spins and then drives the electric generator, Condense the steam into water for reusing, Repeat the cycle.
117. (a) "Aadi Mahotsav" a National Tribal Festival was being organized in New Delhi by the Ministry of Tribal Affairs and TRIFED to celebrate, cherish and promote the spirit of tribal craft, culture, cuisine and commerce. The theme of the festival was "A Celebration of the Spirit of Tribal Culture, Craft, Cuisine and Commerce".
118. (d) The light-year is a unit of length used to express astronomical distances. 9.46 trillion kilometres
$= 9.46 \times 1012$ kms
or 5.88 trillion miles $= 5.88 \times 1012$ miles.
119. (a) electromagnetic radiation refers to the waves of the electromagnetic field, propagating through space, carrying electromagnetic radiant energy. sound is a vibration that typically propagates as an audible wave of pressure, through a transmission medium such as a gas, liquid or solid. Water waves are surface waves, a mixture of longitudinal and transverse waves.
120. (a) The thermal capacity of an object, is defined as the Energy in Joules required to raise the temperature of a given object by 1° C. This is the 'specific heat' of the object multiplied by its mass and the change in temperature.
121. (c) The term 'Industrial Revolution' was used for the first time in English by the philosopher and economist Arnold Toynbee (1852-1883) to describe the changes that occurred in British industrial development between1760 and 1820.
122. (d) Olympe de Gouges was French social reformer and writer who challenged conventional views on a number of matters, especially the role of women as citizens. In her pamphlet she asserted not only that women have the same rights as men but also that children born outside of marriage should be treated as fairly as "legitimate" children in matters of inheritance.
123. (a) The first steam engine to be applied industrially was the "fire-engine" or "Miner's Friend", designed by Thomas Savery in 1698.
124. (d) Renaissance humanism is referred to as classical humanism that began in Italy during the renaissance era and spread across Europe from the 14th to 16th centuries. Renaissance humanism was used to differentiate the development of humanism during the Renaissance era from the earlier ones. It did not criticize material wealth, power and glory.

125. (c) Badshanama also referred as Padshanama translated as "chronicler of Emperor" were a number of books which recorded the reign of Mughal Emperor Shah Jahan. It became a genre in itself. The most important Badshanama is written by Abdul Hamid Lahori which was completed by Mohammad Waris by adding third volume to it. The Padshanama was gifted to King George by Nawab of Avadh in 1799 which is now preserved in the Royal Library of United Kingdom.

126. (d) The granting of titles to men of merit was an important aspect of Mughal polity. The title Asaf Khan was given for one of the highest ministers. Other awards included the robe of honour (khilat), a garment once worn by the emperor and imbued with his benediction. One gift, the Sarapa ("head to foot"), consisted of a tunic, a turban and a sash (patka). Jewelled ornaments were often given as gifts by the emperor. The lotus blossom set with jewels (padma murassa) was given only in exceptional circumstances.

127. (c) VishnuShastri Pandit is very active in Widow Marriage [Vidhava Vivah] Movement. They started Punar Vivahtojak Mandal for Widow Women to get married again. They have written Bramhan Kanya Vivah, English - Marathi Dictionary, Vidhava Vivah, Sanskrit Dictionary, & Smrutishastra etc Grantha's.

128. (a) British Indian Association were founded on October 29, 1851 at Calcutta with Radhakant Dev and Devendranath taigore as its President and Secretary respectively. Other members of the Association included Ramgopal Ghosh, Peary Chand Mitra and Krishnadas Pal. Its membership was kept exclusive to Indians. It was created after amalgamating the "Landholders Society" and "British India Society". This was the first political organization that brought the Indian Together.

129. (a) The Permanent Settlement of Bengal was introduced by the Governor-General Lord Cornwallis in 1793. This was basically an agreement between the company and the Zamindars to fix the land revenue. First enacted in Bengal, Bihar and Odisha, this was later followed in northern Madras Presidency and the district of Varanasi.

130. (a) The Battle of Chinhat was fought on the morning of 30 June 1857, between British forces and Indian rebels, at Ismailganj, near Chinhat (or Chinhut), Oude (Awad/ Oudh). The British were led by The Chief Commissioner of Oude, Sir Henry Lawrence. Maulvi Ahmaddulah Shah was the Indian rebel.

131. (c) Two civil servants, B.N. Rau and S.N. Mukharjee played an important role in framing the constitution of India. B.N. Rau, Constitutional Advisor to the Government of India, who prepared a series of background papers based on a close study of the political systems obtaining in other countries. S.N. Mukherjee had the ability to put complex proposals in clear legal language.

132. (a) Jawaharlal Nehru ,the member of the constituent assembly proposed the resolution that the national flag of India be a "horizontal tricolour of saffron, white and dark green in equal proportion", with a wheel in navy blue at the centre.

133. (a) Dipavamsa is not a historical biography. It is the earliest extant chronicle of Sri Lanka, of unknown authorship, deals with the history of the island from earliest times up to the reign of Mahasena (325-352).

134. (c) All pairs are correctly matched.

135. (c) The term Rajput starts coming in use from the 6th Century AD. They rose to prominence from the 6th century till 12th century and kept ruling in different parts of the country from Sultanate to Mughal Era and as rulers of the princely states till the departure of British from the country in 1947. This theory of Agnikula comes from the Prithvirajraso of Chandarbardai. This theory says that the forefathers of the Rajputs were born at Mount Abu. The four Rajput clans from Agnikunda are Chauhans, Chalukyas, Parmaras and Pratiharas.

136. (c) Humayun Nama, the History of Humayun was written by Gul-badan Begam, Humayun' s sister. She wrote Humayun nama at the behest of her nephew and at the emperor of India Jalal-ud-din Muhammad Akbar. Her account of the life and accomplishments of Humayun is considered very genuine and thorough.

137. (b) The Lok Sabha, as per the Constitution, consists of not more than five hundred and thirty Members chosen by direct election from territorial constituencies in the States, not more than twenty Members to represent the Union Territories [Article 81] and not more than two Members of the Anglo-Indian Community to be nominated by the President, if he/she is of the opinion that the Anglo-Indian Community is not adequately represented in the Lok Sabha [Article 331].

138. (c) The Comptroller and Auditor General (CAG) of India or the CAG is an authority, established by Article 148 of the Constitution of India, which audits all receipts and expenditure of the Government of India and the state governments, including those of bodies and authorities substantially financed by the government. The CAG is not eligible for further office, either under the GOVT. of India or of any state, after he ceases to hold his office.

139. (c) The Constitution of India has vested in the Election Commission of India the superintendence, direction and control of the entire process for conduct of elections to Parliament and Legislature of every State and to the offices of President and Vice President of India.

140. (b) Though, the constitution came into force on 26 January 1950, some provisions relating to Citizenship, Elections, provisional parliament, temporary & transitional provisions were given immediate effect on 26 November 1949. The articles which came into force on 26th Nov 1949 include articles 5, 6, 8, 9, 60, 324, 366, 372, 388, 391, 392 and 393.

141. (a) The tunnel is at an elevation of 10171 ft (3,100 meters).

142. (d) Shubhangi Swaroop became the first woman to be inducted into the Indian Navy as a pilot. Shubhangi, a

native of Bareilly, Uttar Pradesh, was part of the first batch of female officers to graduate from the Indian Naval Academy, Ezhimala, Kannur. A biotechnology engineer from VIT, she is also a national taekwondo champion.

143. (b) Sushmita Sen is an Indian film actress and model who was crowned Femina Miss India Universe in 1994 and she later won the Miss Universe 1994 contest at the age of 18. Sen is the first Indian woman to win the competition.

144. (d) Italy failed to qualify for first World Cup in 60 years after play-off defeat to Sweden.

145. (b) The defense technology and trade Initiative (DTTI) is forum for dialogue on defense partnership between India and USA. As part of Indo-US bilateral defense cooperation, the 7th Defence Technology and Trade Initiative, DTTI meeting was held between India and the US delegation in New Delhi in July, 2018.

146. (a) As per the extant FDI policy, foreign investment up to 49% is permitted under the automatic route. foreign investment beyond 49% and upto 100% is permitted through Government approval.

147. (d) The 21st edition of Ex Malabar was conducted at/ off the port of the East Coast of India from 09-17 July 2017. IN, US Navy and the Japan Maritime Self - Defence Force (JMSDF) participated in the exercise. The primary objective of the exercise was to enhance maritime cooperation and interoperability amongst the participating navies.

148. (c) India's nominee to the International Court of Justice (ICJ) Dalveer Bhandari was re-elected to the fifth and the last seat of the world court after Britain withdrew its candidate from the election.

149. (b) The Union Government has recently constituted a task force to review the Income Tax Act 1961 and draft a new direct tax law in consonance with current economic needs. CBDT member Arbind Modi will be the convener of task force while Chief Economic Adviser Dr. Arvind Subramanian will be a permanent Special Invitee. The task force will draft an appropriate direct tax legislation keeping in view the direct tax system in various countries, international best practices and economic needs of the country. It will submit its report within six months.

150. (c) India, for the first time ever hosted the 5th Global Conference on Cyber Space (GCCS), one of the world's largest conferences in the field of Cyber Space and related issues, on 23 & 24 November 2017, at Aerocity, New Delhi.