



9. The inverse matrix of  $\begin{bmatrix} 2 & -3 \\ -4 & 2 \end{bmatrix}$  is
- (a)  $-\frac{1}{8}\begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$  (b)  $-\frac{1}{8}\begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix}$   
 (c)  $\frac{1}{8}\begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$  (d)  $\frac{1}{8}\begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix}$
10. If  $A$  is a square matrix, then  $(A + A^T)$  is  
 (a) null matrix (b) an identity matrix  
 (c) a symmetric matrix (d) a skew-symmetric matrix
11. A matrix which is symmetric and skew-symmetric is  
 (a) orthogonal matrix (b) idempotent matrix  
 (c) null matrix (d) None of these
12. What is the number of digits in  $(20)^{64}$ ?  
 (if  $\log_{10} 2 = 0.301$ )  
 (a) 81 (b) 82 (c) 83 (d) 84
13. Which one of the following statement is correct?  
 The numbers  $\log_6 7, \log_{42} 7, \log_{294} 7$  in  
 (a) AP (b) HP  
 (c) GP (d) None of these
14. If  $y = \tan^{-1} \left[ \frac{\sqrt{1+x^2} - 1}{x} \right]$ , then  
 (a)  $\left(\frac{dy}{dx}\right)_{x=0} = 1$  (b)  $\left(\frac{dy}{dx}\right)_{x=0} = \frac{1}{2}$   
 (c)  $\left(\frac{dy}{dx}\right)_{x=0} = 0$  (d) None of these
15. If  $x = \sin^{-1}(t)$  and  $y = \log(1 - t^2)$ , then  $\frac{d^2y}{dx^2}$  is  
 equal to  
 (a)  $\frac{2}{1-t^2}$  (b)  $-\frac{2}{1-t^2}$   
 (c)  $\frac{1}{1-t^2}$  (d) None of these
16.  $\frac{d}{dx}(a^x + x^a)$  is equal to  
 (a)  $x(a)^{x-1} + a(x)^{a-1}$  (b)  $\frac{a^x}{\log a} + \frac{x^a}{\log x}$   
 (c)  $a^x \log a + x^a (\log x)$  (d) None of these
17.  $\frac{d}{dx}(\cos x^\circ)$  is equal to  
 (a)  $-\sin x^\circ$  (b)  $-\frac{\pi}{180} \sin x^\circ$   
 (c)  $-\frac{180}{\pi} \sin x^\circ$  (d) None of these
18. If the sum of 'n' terms of a series is a quadratic expression in 'n', then the series is  
 (a) GP (b) HP  
 (c) AP (d) None of these
19. If roots of the equation  $ax^2 + bx + c = 0$  are in the ratio  $\lambda : 1$ , then the value of  $\frac{\lambda}{(\lambda + 1)^2}$  is  
 (a)  $\frac{bc}{a}$  (b)  $\frac{ca}{b}$   
 (c)  $\frac{ca}{b^2}$  (d)  $\frac{bc}{a^2}$
20. If  $x = 3 + i$ , then the value of the expression  $x^3 - 3x^2 - 8x + 15$  is  
 (a) -15 (b) -1  
 (c) 8 (d) 3
21. If  $\log_{10}(x^2 - 6x + 45) = 2$ , then the value of  $x$   
 (a) 6, 9 (b) 10, 5  
 (c) 9, 5 (d) 11, -5
22. If  $A, B$  and  $C$  are three sets, then  $A \times (B \cup C)$  is equal to  
 (a)  $(A \times B) \cap (A \times C)$  (b)  $(A \cap B) \times (A \cap C)$   
 (c)  $(A \times B) \cup (A \times C)$  (d) None of these
23. The relation 'less than' in the set of natural number is  
 (a) symmetric (b) transitive  
 (c) reflexive (d) equivalence relation
24. If  $R'$  is the set of all straight lines in a plane and the relation  $R$  is defined by  $aRb$  if  $a \perp b$  for  $a, b \in R'$ , then  
 (a)  $R$  is reflexive (b)  $R$  is symmetric  
 (c)  $R$  is anti-symmetric (d) None of these
25. If the AM and HM of two numbers are 25 and 4, then their GM is  
 (a) 10 (b) 9  
 (c) 16 (d) None of these
26.  $\lim_{x \rightarrow \frac{\pi}{4}} \frac{\cos x - \sin x}{x - \left(\frac{\pi}{4}\right)}$  is equal to  
 (a) -1 (b)  $-\frac{1}{\sqrt{2}}$  (c)  $\sqrt{2}$  (d)  $-\sqrt{2}$
27. The value of  $\int_0^{\pi/2} \log \tan x \, dx$   
 (a)  $\pi \log_e 2$  (b)  $-\frac{\pi}{2} \log_e 2$   
 (c) 0 (d)  $e$
28.  $\int \frac{dx}{a^2 \cos^2 x + b^2 \sin^2 x}$  is equal to  
 (a)  $\tan^{-1} \left( \frac{a}{b} \tan x \right) + C$  (b)  $\frac{1}{ab} \tan^{-1} \left( \frac{b}{a} \cot x \right) + C$   
 (c)  $\frac{1}{ab} \tan^{-1} \left( \frac{b}{a} \tan x \right) + C$  (d) None of these
29. If  $A = \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix}$  and  $A^2 - KA - 5I = 0$ , then  $K$  is equal to  
 (a) 5 (b) 3 (c) 7 (d) 4

30. The value of the determinant

$$\begin{vmatrix} -a^2 & -ab & ac \\ ba & -b^2 & bc \\ ac & -bc & c^2 \end{vmatrix}$$
 is

- (a)  $abc$  (b)  $a^2b^2c^2$   
 (c) 1 (d) 0

31. Solution of the differential equation

$$\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = C$$
 is

- (a)  $\tan x + \tan y = C$  (b)  $\tan x \tan y = C$   
 (c)  $\tan x - \tan y = C$  (d)  $\tan x \sec y = C$

32. The solution of the differential equation

$$\frac{dy}{dx} + \frac{y}{x} = x^n$$
 is

- (a)  $\frac{y}{x} = C$  (b)  $y + x = C$   
 (c)  $yx = \frac{x^{n+2}}{n+2} + C$  (d)  $y = \frac{x^n}{n+2} + C$

33. The necessary condition for a maximum or minimum of a function  $f(x)$  is

- (a)  $\frac{df}{dx} \neq 0$  (b)  $\frac{d^2f}{dx^2} = +ve$   
 (c)  $\frac{d^2f}{dx^2} = -ve$  (d)  $\frac{df}{dx} = 0$

34. The value of  $\int_0^{\pi/2} \frac{\sin^2 x - \cos^2 x}{\sin^3 x + \cos^3 x} \, dx$  is

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

35. The conic  $17x^2 - 12xy + 8y^2 + 46x - 28y + 17 = 0$  represents

- (a) circle (b) ellipse  
 (c) parabola (d) hyperbola

36. The expression

$$\cos(A - B)\cos(A + B) - \sin(A - B)\sin(A + B)$$

is equal to

- (a)  $2\sin A \cos B$  (b)  $\sin 2A$   
 (c)  $\cos 2A$  (d)  $2\cos A \sin B$

37. If  $\tan A = \frac{1}{2}$  and  $\tan B = \frac{1}{3}$ , then what is the value

- of  $\tan(2A + B)$ ?  
 (a) 1 (b) 2 (c) 3 (d) 4

38. If  $\omega$  is a complex cube root of unity, then the value of  $\omega^{99} + \omega^{100} + \omega^{101}$  is

- (a) 1 (b) -1  
 (c) 3 (d) 0

39. The number 1753 in binary notation is

- (a)  $(11011011101)_2$  (b)  $(11011111001)_2$   
 (c)  $(11011011001)_2$  (d) None of these

40. If the determinant  $\begin{vmatrix} x & 1 & 3 \\ 0 & 0 & 1 \\ 1 & x & 4 \end{vmatrix} = 0$ , then  $x$  is equal to

- (a) 2 or -2 (b) 3 or -3  
 (c) 1 or -1 (d) 3 or 4

41. The class marks of a distribution are 6, 10, 14, 18, 22, 26, 30, then the class size is

- (a) 4 (b) 2  
 (c) 5 (d) 7

42. A graph representing cumulative frequency is termed as

- (a) ogive (b) bar charts  
 (c) pie charts (d) histogram

43. A committee of 3 is to be chosen from a group consisting of 4 men and 5 women. If the selection is made at random, then the probability that two of the members of committee are men, is given by

- (a)  $\frac{3}{14}$  (b)  $\frac{5}{14}$   
 (c)  $\frac{1}{21}$  (d)  $\frac{8}{21}$

44. The value of the integral  $\int_{-2}^2 |1 - x^2| \, dx$

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

45. The value of the scalar triple product  $[\mathbf{a} + \mathbf{b}, \mathbf{c} + \mathbf{b}, \mathbf{c}]$  is

- (a) 0 (b) 1  
 (c)  $|\mathbf{a}||\mathbf{b}||\mathbf{c}|$  (d) None of these

46. The area of the triangle with vertices

$$\mathbf{i} + \mathbf{j}, \mathbf{i} + \mathbf{k}, \mathbf{j} + \mathbf{k}$$

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

47. Distance between the planes

- $2x - 2y + z + 1 = 0$  and  $4x - 4y + 2z + 3 = 0$  is  
 (a)  $\frac{1}{2}$  (b)  $\frac{1}{3}$  (c)  $\frac{1}{6}$  (d) 0

48. The maximum value of  $\sin x + \cos x$  is

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

49. The value of  $[\mathbf{a} - \mathbf{b}, \mathbf{b} - \mathbf{c}, \mathbf{c} - \mathbf{a}]$

- (a) 0 (b) 1  
 (c) 2 (d) None of these

50. The number of vectors of unit length perpendicular to the vector  $\mathbf{a} = (1, 1, 0)$  and  $\mathbf{b} = (0, 1, 1)$  is

- (a) one (b) two  
 (c) three (d) None of these

51. A tower of height 15 m stands vertically on the ground. From a point on the ground the angle of elevation of the top of the tower is found to be  $30^\circ$ . What is the distance of the point from the foot of the tower?

- (a)  $15\sqrt{3}$  m (b)  $10\sqrt{3}$  m (c)  $5\sqrt{3}$  m (d) 30 m

52. A husband and wife appear in an interview for two vacancies at the same post. The probability of husband selection is  $\frac{1}{5}$  and that of wife selection is  $\frac{1}{3}$ . What is the probability that only one of them will be selected.

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

53. The points  $(a, b)$   $(0, 0)$   $(-a, -b)$ ,  $(ab, b^2)$  are  
 (a) vertices of parallelogram (b) vertices of rectangle  
 (c) vertices of square (d) collinear

54. The eccentricity of the ellipse  $\frac{x^2}{25} + \frac{y^2}{9} = 1$  is

- (a)  $\frac{2}{5}$  (b)  $\frac{4}{5}$   
 (c)  $\frac{3}{5}$  (d) None of these

55. The number of the diagonal of octagon is

- (a) 48 (b) 40  
 (c) 28 (d) 20

56. If  $|\mathbf{a}| = |\mathbf{b}|$  and  $|\mathbf{a} \times \mathbf{b}| = 1$ , then the value of  $|\mathbf{a} + \mathbf{b}|$  is equal to

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

57. If  $\mathbf{b}$  is a non-zero vector of modulus  $b$  and  $\alpha$  is a non-zero scalar, then  $k\mathbf{b}$  is a unit vector. If the value of  $\mathbf{b}$  is equal to

- (a)  $k$  (b)  $|k|$   
 (c)  $\frac{1}{|k|}$  (d)  $\frac{1}{k}$

58. If  $\mathbf{a}$  and  $\mathbf{b}$  are two unit vectors inclined at an angle  $\frac{\pi}{3}$ , then the value of  $|\mathbf{a} + \mathbf{b}|$  is

- (a) greater than 1 (b) less than 1  
 (c) equal to 1 (d) equal to 0

59. The base of decimal number system is

- (a) 8 (b) 2  
 (c) 10 (d)  $e$

60. A unit vector perpendicular to the two vectors  $\mathbf{i} + 2\mathbf{j} - \mathbf{k}$  and  $2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$  is equal to

- (a)  $35(5\mathbf{i} - 3\mathbf{j} - \mathbf{k})$  (b)  $\sqrt{35}(5\mathbf{i} - 3\mathbf{j} - \mathbf{k})$   
 (c)  $\frac{1}{\sqrt{35}}(5\mathbf{i} - 3\mathbf{j} - \mathbf{k})$  (d) None of these

61. Convert  $(55.625)_{10}$  into binary number

- (a)  $(110111.101)_2$  (b)  $(101111.111)_2$   
 (c)  $(111001.101)_2$  (d) None of these

62. Convert  $(1111)_2$  to its decimal equivalent

- (a) 13 (b) 14 (c) 15 (d) 16

63. If  $x = 1 + a + a^2 + \dots \infty$ ,  $(a < 1)$ ,

$$y = 1 + b + b^2 + \dots \infty, (b < 1),$$

then the value of  $1 + ab + a^2b^2 + \dots \infty$  is

- (a)  $\frac{xy}{x+y-1}$  (b)  $\frac{xy}{x+y+1}$  (c)  $\frac{xy}{x-y-1}$  (d)  $\frac{xy}{x-y+1}$

64. The sum of  $n$  terms of an AP be  $3n^2 + 5$ , then the number of terms which is equal to 159?

- (a) 13 (b) 21  
 (c) 27 (d) None of these

65. The purpose of Tabulation is

- (a) to simplify presentation only  
 (b) to simplify presentation as well as facilitate comparison  
 (c) to facilitate comparison only  
 (d) None of the above

66. The probability of having a king and a queen when the two cards are drawn at random from a pack of 52 cards is

- (a)  $\frac{16}{663}$  (b)  $\frac{8}{663}$   
 (c)  $\frac{4}{663}$  (d) None of these

67.  $\int e^{\log \cos x} dx$  is equal to

- (a)  $\sin x + C$  (b)  $-\sin x + C$   
 (c)  $e^{\cos x} + C$  (d) None of these

68.  $\int a^x dx$  is equal to

- (a)  $\frac{a^x}{\log a} + C$  (b)  $a^x \log a + C$   
 (c)  $\frac{a^{x+1}}{x+1} + C$  (d) None of these

69.  $\int \sin^3 x \cos x dx$  is equal to

- (a)  $\frac{1}{4} \cos^4 x + C$  (b)  $\frac{1}{4} \sin^4 x + C$   
 (c)  $\sin^4 x + C$  (d)  $\cos^4 x + C$

70. The velocity  $v$  of a particle moving in a straight line is given by the following  $v^2 = 2s^2 + 4s + 5$ , its acceleration at  $s = 5$  is

- (a) 10 (b) 12  
 (c) 14 (d) 75

71. If  $\omega$  is a cube root of unity, then the value of  $(1+3\omega+3\omega^2)^{10} + (3+\omega+3\omega^2)^{10} + (3+3\omega+3\omega^2)^{10}$  is

- (a) 0 (b) 1  
 (c)  $1+\omega$  (d)  $1+\omega^2$

72. If  $z_k = \cos \frac{\pi}{2^k} + i \sin \left( \frac{\pi}{2^k} \right)$ , then  $z_1 \cdot z_2 \cdot z_3 \dots \infty$  is equal to

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

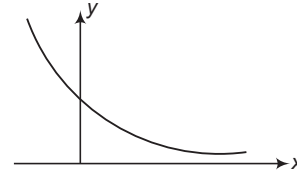
73. Set of natural number of elements is not closed  
 (a) for addition operation (b) for subtraction operation  
 (c) for multiplication operation (d) None of these
74. The inverse of matrix  $A$  exists, if  $A$  is a square matrix and  
 (a)  $A=0$  (b)  $A \neq 0$  (c)  $|A|=0$  (d)  $|A| \neq 0$
75. If  $\sin 2A = \lambda \sin 2B$ , then what is the value of  $\frac{\tan(A+B)}{\tan(A-B)}$ ?  
 (a)  $\frac{\lambda-1}{\lambda+1}$  (b)  $\frac{\lambda+1}{\lambda-1}$  (c)  $\frac{\lambda^2-1}{\lambda^2+1}$  (d)  $\sqrt{\frac{\lambda-1}{\lambda+1}}$
76. What is the value of  $\sin 10^\circ + \sin 50^\circ - \sin 70^\circ$ ?  
 (a) 1 (b) 0  
 (c)  $\frac{1}{2}$  (d) 2
77. If  $\theta + \phi = \frac{\pi}{6}$ , then what is the value of  $(\sqrt{3} + \tan \theta)(\sqrt{3} + \tan \phi)$ ?  
 (a) 1 (b) -1  
 (c) 4 (d) -4

**Directions** (Q.Nos. 78-81) *The following four items consist of two statements, one labelled as Assertion (A) and the other as Reason (R). Examine two statements carefully and answer to these items.*

- (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true but R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.
78. **Assertion (A)** The number of triangles that can be formed by joining the mid-points of any three adjacent faces of a cube is 120.  
**Reason (R)** If there are  $n$  points on a plane and none of them are collinear, then the number of triangles that can be formed is  $C(n, 3)$ .
79. **Assertion (A)** The number of selection of 20 distinct things taken 8 at a time is same as that taken 12 at a time.  
**Reason (R)**  $C(n, r) = C(n, s)$ , if  $n = r + s$
80. **Assertion (A)**  $\frac{1}{8}, \log_2 a, \log_a a^2$  are in GP but not in AP.  
**Reason (R)**  $x, y$  and  $z$  are in GP as well as in AP. If  $x = y = z$ .
81. **Assertion (A)** If  $z_1 = 3 + \sqrt{-4}$  and  $z_2 = 3 + \sqrt{-25}$ , then  $\frac{z_1}{z_2}$  is a complex number.

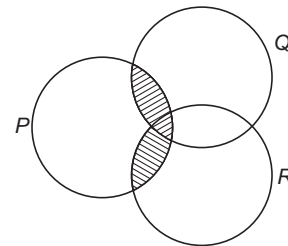
**Reason (R)** If  $z_1$  and  $z_2$  are a complex number then  $\frac{z_1}{z_2}$  is always complex number.

82. The above curve shows the graph of  $a^x$  under which one of the following condition



- (a)  $a \geq 1$  (b)  $a > 1$   
 (c)  $0 < a \leq 1$  (d)  $0 < a < 1$

83. What does the shaded region represented in the given figure below?



- (a)  $(P \cup Q) - (P \cap Q)$  (b)  $P \cap (Q \cup R)$   
 (c)  $(P \cap Q) \cap (P \cap R)$  (d)  $(P \cap Q) \cup (P \cap R)$

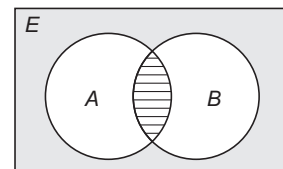
84. The definition of mode fails, if  
 (a) the maximum frequency is not repeated  
 (b) the maximum frequency is repeated  
 (c) the maximum frequency occur in the middle  
 (d) the curve drawn with the help of given data is symmetrical

85. What are the last two digit of the number  $9^{200}$ ?  
 (a) 19 (b) 21  
 (c) 41 (d) 01

86. If  $\frac{2x}{2x^2 + 5x + 2} > \frac{1}{x + 1}$ , then  
 (a)  $-2 > x > -1$  (b)  $-2 \geq x \geq -1$   
 (c)  $-2 < x < -1$  (d)  $-2 < x \leq -1$

87. If  $R$  is an equivalence relation on a set  $A$ , then  $R$  is  
 (a) reflexive and symmetric only  
 (b) reflexive and transitive only  
 (c) transitive and symmetric only  
 (d) reflexive, symmetric, transitive

88. Consider the following Venn diagram.



If  $|A| = 15, |B| = 12, |E| = 42$  and  $|A \cup B| = 22$ , then the area represent by the shaded portion in the above diagram is

- (a) 25 (b) 27  
 (c) 32 (d) 37

89. Consider the following statements  
 I. The value of median and Mode can be determined graphically.  
 II. Range is the best measure of dispersion  
 III. Mean, median and mode have the same unit.  
 Which of the statement given above are correct?

- (a) I only (b) I and III  
 (c) II and III (d) All of these

90. What is the value of  $\lim_{x \rightarrow 0} \frac{\sin |x|}{x}$ ?

- (a) 1 (b) -1  
 (c)  $\infty$  (d) None of these

91. What is the derivative of  $y = x|x|$ ?

- (a)  $|x| + x$  (b)  $2x$   
 (c)  $-2|x|$  (d)  $2|x|$

92. If the centre of sphere

$$ax^2 + by^2 + cz^2 - 2x + 4y + 2z - 3 = 0$$

is  $\left(\frac{1}{2}, -1, -\frac{1}{2}\right)$ , what is the value of  $b$ ?

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

93. Which one of the following statement is correct in respect of the curve  $4y - x^2 - 8 = 0$ ?

- (a) The curve is increasing in  $(-4, 4)$   
 (b) The curve is increasing in  $(-4, 0)$   
 (c) The curve is increasing in  $(0, 4)$   
 (d) None of the above

94. The angle between the lines  $\frac{x+1}{3} = \frac{y-1}{4} = \frac{z-2}{3}$

and the plane  $2x - 3y + z + 4 = 0$  is

- (a)  $\cos^{-1}\left(-\frac{4}{\sqrt{406}}\right)$  (b)  $\sin^{-1}\left(-\frac{4}{\sqrt{406}}\right)$   
 (c)  $\sin^{-1}\left(\frac{4}{\sqrt{406}}\right)$  (d) None of these

95. If the line  $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-R}{2}$  lies on a plane

$3x - 2y + z = 7$ , then the value of  $R$  is

- (a) -2 (b) -1 (c) 1 (d) 2

96. The locus of the point of intersection of perpendicular tangent to a parabola is

- (a) line (b) circle  
 (c) hyperbola (d) parabola

97.  $\lim_{x \rightarrow \infty} (3^x + 4^x)^{1/x}$  is equal to

- (a)  $3e$  (b)  $4e$  (c) 3 (d) 4

98. Let  $R$  be a relation on the set of natural number ( $N$ ) defined by  $R = \{(x, y) : 2x + y = 41\}$ , then  $R$  is

- (a) reflexive (b) symmetric  
 (c) transitive (d) None of these

99. The real root of the equation  $x^2 + 4|x| + 3 = 0$

- (a) -1, -3 (b) 1, 3  
 (c) -3, 3 (d) None of these

100. If one root of the equation

$$3x^4 - 10x^3 + 4x^2 - x - 6 = 0$$
 is  $\frac{1+i\sqrt{3}}{2}$ ,

then the other roots are

- (a)  $-\frac{1+i\sqrt{3}}{2}, -\frac{2}{3}, -3$  (b)  $\frac{1-i\sqrt{3}}{2}, -\frac{2}{3}, 3$   
 (c)  $\frac{1-i\sqrt{3}}{2}, \frac{2}{3}, -3$  (d) None of these

101. If the points  $A(1, 2), B(2, 4)$  and  $C(3, a)$  are collinear, then what is the length of  $BC$ ?

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

102. If  $a, b$  and  $c$  are three positive numbers in an AP, then

- (a)  $ac > b^2$  (b)  $b^2 > a + c$   
 (c)  $ab + bc \leq 2ac$  (d)  $ab + bc \geq 2ac$

103. What is the value of  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ , if  $a^3 + b^3 + c^3 = 0$ ?

- (a) 0 (b) 1 (c)  $3abc$  (d)  $-3abc$

104. If  $A$  is a square matrix such that  $A - A^T = 0$ , then which one of the following is correct?

- (a)  $A$  must be a null matrix (b)  $A$  must be a scalar matrix  
 (c)  $A$  must be a unit matrix (d) None of these

105. In throwing of two dice, what is the number of exhaustive events?

- (a) 6 (b) 12 (c) 36 (d) 18

106. In how many ways can a bowler take four wickets in a single six ball over?

- (a) 6 (b) 15 (c) 20 (d) 30

107. If a set  $X$  contains  $n$  ( $n > 5$ ) elements, then what is the number of subset of  $X$  containing less than 5 element?

- (a)  $C(n, 4)$  (b)  $C(n, 5)$  (c)  $\sum_{r=0}^5 C(n, r)$  (d)  $\sum_{r=0}^4 C(n, r)$

108. For non-empty set  $A, B$  and  $C$  the following two statements are given

**Statement P**  $A \cap (B \cup C) = (A \cap B) \cup C$

**Statement Q**  $C$  is a subset of  $A$ .

Which one of the following is correct?

- (a)  $P \Leftarrow Q$   
 (b)  $P \Leftrightarrow Q$   
 (c)  $P \Rightarrow Q$   
 (d) Nothing can be said about the correctness of the three

109. How many arbitrary constants are there in the equation of a plane?

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

110. What is the value of  $0.\overline{2} + 0.\overline{23}$ ?

- (a)  $0.\overline{43}$  (b)  $0.\overline{45}$   
 (c)  $0.\overline{223}$  (d) None of these

111. In a binomial distribution the probability of getting a success is  $\frac{1}{4}$  and standard deviation is 3, then its mean is  
 (a) 10 (b) 8  
 (c) 12 (d) 6
112. Which of the following statement is true for binomial distribution with parameter  $n$  and  $p$ ?  
 I.  $n$  is a positive integer.  
 II.  $0 < p < 1$   
 III.  $0 \leq p \leq 1$   
 Select the correct code given below.  
 (a) II only (b) I and II  
 (c) I only (d) I and III
113. The number of terms in the expansion of  $(a + b + c)^n$  will be  
 (a)  $n + 1$  (b)  $\frac{(n + 1)(n + 2)}{2}$   
 (c)  $(n + 3)$  (d) None of these
114. The expansion of  $\frac{1}{(4 - 3x)^{1/2}}$  by binomial theorem will be valid, if  
 (a)  $x > 1$  (b)  $x < 1$   
 (c)  $|x| < 1$  (d)  $-\frac{2}{3} < x < \frac{2}{\sqrt{3}}$
115. The number of diagonals in a polygon of ' $m$ ' sides are  
 (a)  $\frac{1}{2}m(m - 5)$  (b)  $\frac{1}{2}m(m - 1)$  (c)  $\frac{1}{2}m(m - 3)$  (d)  $\frac{1}{2}m(m - 2)$
116. How many words can be formed from the letters of the word DELHI. If L comes in the middle in every word.  
 (a) 24 (b) 12 (c) 6 (d) 60
117. If  $\frac{1}{a} < \frac{1}{b}$ , then  
 (a)  $|a| > |b|$  (b)  $a > b$   
 (c)  $a < b$  (d) None of these
118. If  $\frac{x - 1}{x - 2} > 0$ , then  
 (a)  $(x - 1)(x - 2) > 0$   
 (b)  $(x - 1)(x - 2) > 0$  provided  $x = 2$   
 (c)  $(x - 1) > 0$   
 (d) None of the above
119. Projection of the vector  $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$  on the vector  $4\mathbf{i} - 4\mathbf{j} + 7\mathbf{k}$  is  
 (a)  $\frac{9}{19}$  (b)  $\frac{19}{9}$  (c)  $\frac{\sqrt{6}}{19}$  (d)  $\frac{19}{\sqrt{6}}$
120. If  $\left|z - \frac{2}{z}\right| = 6$ , then the greatest value of  $|z|$  is  
 (a) 36 (b)  $\sqrt{11}$   
 (c)  $3 - \sqrt{11}$  (d)  $3 + \sqrt{11}$

# Paper 2

## Part-A (English)

**Directions** (Q.Nos. 1-10) *In this section 03 short passages are given. After the passages, you will find several questions based on the passage. First read the passage and then answer the questions based on it. Give your answers on the basis of information given in passage and opinion of the author.*

### Passage 1

Density currents are currents that are kept in motion by the force if acting on a relatively small density difference caused by variations in salinity, temperature or sediment concentration. As noted above, salinity and temperature variations produce stratification in oceans. Below the surface layer, which is disturbed by waves and is lighter than deeper waters because it is warmer or less saline, the oceans composed of layers of water that have distinctive chemical and physical characteristics, which move more or less independently of each other and do not lose their individuality by mixing even after they have flowed for hundreds of kilometers from their point of origin.

- Density Currents are
  - Currents due to gravity and kept in motion by density difference
  - Currents due to difference caused by variations in different parameters
  - Kept in motion by difference caused by variation in different parameters
  - Due to density differences in ocean
- The meaning of word Stratification is
  - Layered
  - Storage
  - Tides
  - Variations
- Which one is true about the layers of water underneath the ocean?
  - They move their chemicals hundred of kilometers without mixing
  - They move losing individuality and mixing
  - They move without losing individuality to hundred of kilometers
  - They loose their individuality by mixing and move hundred kilometers

## Passage 2

What is to happen about transport? Evidently there are huge and important changes in prospect. A decade or so from now, there will have been yet another transformation in the way in which people and their goods are moved from place to place. Old techniques are being faced with attenuation or even extinction, sometimes because better methods of travelling have come along but sometimes simply because the old methods have become intolerable. The development of recent decades most likely to continue is the tendency for alternative methods of travel to co-exist and so to offer potential travellers a choice. Within large cities, underground transport is usually an alternative to several ways of travelling on the surface. Roads, railways and airlines are in competition and there are people who still cross the North Atlantic by sea.

- According to passage Transportation is
  - Changing
  - Static
  - Improving
  - Facing challenges
- Meaning of Attenuation is
  - Strange
  - You
  - Being less in number
  - We
- Potential Traveller will have more choices because
  - New methods are being introduced
  - New and old methods co-exist at same time
  - New methods will replace old methods
  - New methods are better and more in variety
- Last sentence of passage indicates
  - Transportation by ship is one of less preferred method
  - Transportation by ship is not used these days
  - Transportation by ship is slow and time consuming
  - None of the above

## Passage 3

Chemical engineering was not originally science based in the same sense as electrical engineering. Although the chemical industry was firmly based on science of chemistry, the role of the chemical engineer was originally merely to provide vessels, pipes, pumps and so on to enable a reaction to be carried out under the conditions specified by the chemist. It is true that there are early examples in which engineering interacted with science, and the scientist influenced the process *i.e.*, the lead-chamber sulphuric acid process, the Solvay ammonia-soda process and Haber Bosch ammonia synthesis. In general, however, the chemical engineer had little influence on the process, and there was very little science involved in chemical engineering. The most difficult part of the job was the choice of the right materials of construction, but until quite recently science has been of little help in this respect.

- According to the passage
  - Role of chemical engineer was not so vital at the inception of this science
  - Electrical engineering is original science but not chemical engineering
  - Chemical engineer has a little influence on the chemical process
  - Chemical engineering is influenced by scientists

- What can be said about Haber Bosch ammonia synthesis and Solvay ammonia-soda process?
  - Purely engineering based processes
  - Dependent on engineering of chemicals only
  - An interaction of engineering and science both
  - Purely chemistry based processes
- Chemical engineers position as depicted in passage can be described as
  - Timid
  - Cuffed
  - Constrained
  - Futuristic

**Directions** (Q.Nos. 11-20) *Each of following items consists of a sentence followed by a word or group of words. You are required to answer the Synonym of the word in capital and bold letters as per the context.*

- It is a **FAD** and will not last long.
    - Enthusiasm
    - Anger
    - Fashion
    - Jealousy
  - Fashion industry is ruled by **VANITY**.
    - False Pride
    - Pace
    - Courage
    - Illusion
  - You can recognize him from his **CORPULENT** body.
    - Obese
    - Lanky
    - Pale
    - Reddish
  - The village **INUNDATED** with water during the monsoon.
    - Washed
    - Destroyed
    - Flooded
    - Defied
  - Some of the clauses of Jan Lokpal bill are **MOOT**.
    - Useless
    - Anticipatory
    - Debatable
    - Anti-Social
  - It is not easy to surpass the **RIGMAROLE** of Government tender acquisition.
    - Long and lengthy process
    - Corrupt officers
    - Unjustified conditions
    - Professional work culture
  - JETTISON** all your doubts for success.
    - Submerge
    - Throw out
    - Kill
    - Improve
  - You cannot challenge his **PROBITY**.
    - Courage
    - Intelligence
    - Integrity
    - Knowledge
  - This plan seems to be **QUIXOTIC**.
    - Hidden
    - Well Conceived
    - Imaginative
    - Full Proof
  - Bridge looks **PUISSANT** enough for high level of earthquake.
    - Strong
    - Weak
    - Susceptible
    - Large
- Directions** (Q.Nos. 21-30) *Each of following items consists of a sentence followed by a word or group of words. You are required to answer the Antonym of the word in capital and bold letters as per the context.*
- His **PENCHANT** for books is beyond reason.
    - Dislike
    - Inclination
    - Love
    - Collection

22. Delhi Metro trains run on station **DWELL** time technology for punctuality.  
 (a) Combination (b) Wander  
 (c) Timely Stoppage (d) Safe
23. What is the response of Baba Ramdev for Government's **OVERTURES**?  
 (a) Threats (b) Advances (c) Orders (d) Meetings
24. Indian boundary is **CONTIGUOUS** with Pakistan and China but not with America.  
 (a) In touch (b) In question  
 (c) In controversy (d) In harmony
25. Aim of this project is to be self dependent and make government aid **OBLIVIOUS**.  
 (a) Redundant (b) Necessary  
 (c) Mandatory (d) Formality
26. Because of her **CLAUSTROPHOBIA** she cannot use any elevator.  
 (a) Fear of small and closed spaces  
 (b) A disease of low blood pressure  
 (c) A phobia of travelling vertical  
 (d) Fear of travelling in group in lift
27. This book is a literary **MAGNUM- OPUS** on the life of Sachin Tendulkar.  
 (a) Documentary (b) Historical  
 (c) Actual depiction (d) A great work of art
28. **OBNOXIOUS** comments of Andrew Symonds were taken very seriously by the Indian Cricket team.  
 (a) Offensive (b) Pleasant  
 (c) Personal (d) Racial
29. This statement of Finance Minister regarding robust growth of Indian Economy in next quarter looks **WHIMISICAL** at first sight.  
 (a) Promising (b) Fanciful (c) Untrue (d) Composed
30. In no time she **RECAPITULATED** the points discussed in meeting on a sheet of paper.  
 (a) Summary  
 (b) Write in fast but accurate manner  
 (c) Write in full detail  
 (d) Important points

**Directions** (Q.Nos. 31-40) *In the following items, some parts of sentence have been jumbled up. You are required to rearrange these parts which are labelled as P, Q, R and S to produce the correct sentence. Choose proper sequence and mark in your answer sheet.*

31. P : Hussain was  
 Q : of some means  
 R : born in  
 S : a working class family  
 (a) PQRS (b) PSRQ (c) PRSQ (d) QRSP
32. P : of the entire episode  
 Q : one interesting outcome  
 R : has been  
 S : a sudden improvement in him  
 (a) SRQP (b) QPRS (c) SRPQ (d) PRSQ

33. P : to muslim community  
 Q : its sentiments  
 R : if the article hurt  
 S : the author apologized  
 (a) QRSP (b) SQPR  
 (c) SPRQ (d) PRSQ
34. P : involved a  
 Q : the appraisal  
 R : quantitative assessment  
 S : of the plan  
 (a) QPRS (b) QPSR  
 (c) RSPQ (d) RSPQ
35. P : simultaneously recounts  
 Q : the historic moments  
 R : and political happenings during his times  
 S : the biographical book of Mr K N Raj  
 (a) QRSP (b) SPQR  
 (c) QSPR (d) SPRQ
36. P : grow Bt Brinjal  
 Q : to feed the population  
 R : where is need to  
 S : when India produces enough brinjal  
 (a) SRQP (b) SQRQ  
 (c) RPQS (d) SQPR
37. P : this background is  
 Q : the changing role of caste  
 R : necessary to understand  
 S : in Indian society  
 (a) PRQS (b) PRSQ  
 (c) PSQR (d) SQPR
38. P : most floods  
 Q : a knee jerk response from  
 R : the government machinery  
 S : evoke  
 (a) PQRS (b) PQSR  
 (c) PSQR (d) QPSR
39. P : it was found that  
 Q : peer networks played  
 R : a role in the absence of  
 S : parent – child communication  
 (a) PQRS (b) PQSR (c) PSQR (d) QPSR
40. P : to promote  
 Q : tourism  
 R : the Paschim Banga Government  
 S : has been taking several innovative steps  
 (a) RSPQ (b) PQSR (c) PSQR (d) QPSR

**Directions** (Q.Nos. 41-50) *You have been given a sentence in which there is some error. You are required to find out that part of sentence and mark it as your answer on the answer sheet. Error may be related to grammer, construction usage or anything else.*

41. Her tooth (a)/has been (b)/paining for(c)/the last two days. (d)

42. The teacher was (a)/saying that (b)/one must do (c)/his duty honesty. (d)
43. It is useful (a)/to keep oneself (b)/abreast with(c)/all happenings. (d)
44. It is known fact (a)/that the English (b)/is an(c)/international language. (d)
45. India broke (a)/all previous records(b)/during this year's(c)/cricket match.(d)
46. He behaves (a)/as if (b)/he was the chief (c)/of the organization.(d)
47. Of the two men (a)/in the office (b)/the fat one is elder(c)/to the thin one. (d)
48. Police could not (a)/ascertain the (b)/the reason of (c)/girl's death. (d)
49. The police have been (a)/accused of (b)/connivance along the thieves (c)/in this case. (d)
50. Persons engaged (a)/in teaching line (b)/lead a (c)/comfortable life. (d)

## Part-B (General Ability)

51. Who led the team of Indian Scientist's to South Pole?  
(a) Rasik Ravindra (b) AC Bhaktivedanta  
(c) Roddam Narsimha (d) N Rangaswamy
52. The XII South Asian Games will be held in which country?  
(a) India (b) Maldives (c) China (d) Bangladesh
53. History of the Roman empire written by contemporaries were called  
(a) Annals (b) Papyrus  
(c) Ta Chin (d) Augustan age
54. Which of the following statements regarding Comptroller and Auditor General of India is not correct?
1. He controls the entire financial system of the country at both Union and State levels.
  2. His office is modelled upon that of the Auditor General under the Government of India Act, 1919.
  3. He can be removed only on an address from lower House of Parliament on grounds of proved misbehaviour incapacity.
  4. His salary is charged from Consolidated Fund of India.
- Select the correct answer using the codes given below  
(a) 1 and 2 (b) 1, 2 and 3  
(c) 2 and 3 (d) All are wrong
55. The powers of Rajya Sabha with regards to Money Bill are  
(a) It can reject the money  
(b) It can amend it by virtue of its own powers  
(c) It must return the Bill to Lok Sabha within a period of 14 days with or without recommendations  
(d) It must return the Bill to Lok Sabha within a period of 1 month with or without recommendations
56. Which of the following statements regarding Lok Adalats is correct?
1. The Lok Adalats have received statutory status under Legal Services Authorities Act, 1987.
  2. Both state or district authorities can organise Lok Adalats at convenient places.
  3. The award of Lok Adalat is final and binding upon all parties in dispute.
  4. It has the jurisdiction over all matters falling within the jurisdiction of civil criminal or revenue courts or tribunal courts.
- Select the correct answer using the codes given below  
(a) 1 and 2  
(b) 3 and 4  
(c) 2, 3 and 4  
(d) All of the above
57. Match the following
- | S. No. | Defence Production Units | Factories at |
|--------|--------------------------|--------------|
| A.     | Praga Tools              | 1. Avadi     |
| B.     | Heavy Vehicles Factory   | 2. Mumbai    |
| C.     | Mazagaon Docks Ltd       | 3. Hyderabad |
| D.     | GRSE                     | 4. Kolkata   |
- Codes**
- |     |   |   |   |   |     |   |   |   |   |
|-----|---|---|---|---|-----|---|---|---|---|
|     | A | B | C | D |     | A | B | C | D |
| (a) | 3 | 2 | 1 | 4 | (b) | 3 | 1 | 2 | 4 |
| (c) | 2 | 3 | 1 | 4 | (d) | 1 | 2 | 3 | 4 |
58. The important factors which determine the temperature of a particular place on Earth's surface are  
1. Distribution of land and water.  
2. Nature of the surface.  
3. Convection and Turbulence.  
4. Mountain barriers.
- Select the correct answer using the codes given below  
(a) 1 and 2 (b) 1, 2 and 3  
(c) 2, 3 and 4 (d) All of these
59. Tobin tax refers to  
(a) tax on imports from South-East Asian nations  
(b) tax on exports from Special Economic zones  
(c) tax on stock markets levied by government  
(d) tax on foreign exchange transactions

60. Which was the first state to launch Mobile Number Portability?  
 (a) Haryana (b) Delhi  
 (c) Kerela (d) Karnataka
61. Arrange the following countries in the order of their increasing or ranks in Global Hunger Index 2011  
 1. China 2. Sri Lanka  
 3. Pakistan 4. Nepal  
 5. India 6. Bangladesh  
 Select the correct answer using the codes given below  
 (a) 1-5-2-3-6-4 (b) 1-3-5-2-6-4  
 (c) 1-6-5-3-2-4 (d) 1-2-4-3-5-6
62. The Sri Lankan ruler Meghavarman sent a missionary to which Guptan king to build a Buddhist temple at Gaya?  
 (a) Chandragupta I (b) Samudragupta  
 (c) Chandragupta II (d) Skandgupta

63. Match the following

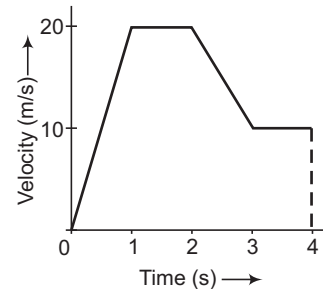
A. Ordinance making power of President	1. Art-72
B. Pardonining power of President	2. Art-356
C. State Emergency power of President	3. Art-339
D. Power of President to appoint a commission for the welfare of Schedule Tribes in states	4. Art-123

Codes

A	B	C	D	A	B	C	D
(a) 4	1	3	2	(b) 2	1	3	4
(c) 3	1	2	4	(d) 4	1	2	3

64. Arrange in sequence the following layers of Earth's atmosphere from top to bottom  
 1. Tropopause 2. Stratosphere  
 3. Ozonosphere 4. Stratopause  
 5. Troposphere  
 Select the correct answer using the codes given below  
 (a) 3-4-2-1-5 (b) 2-4-1-5-3  
 (c) 5-1-2-4-3 (d) 5-4-2-1-3
65. Which of the following statements is not correct?  
 (a) Prithvi is India's first indigenously built tactical surface to surface missile having range capability of 250 km  
 (b) Trishul is short range surface to air missile  
 (c) Akash is medium range multi target surface to air missile with range capability of 25 km  
 (d) Nag is 2nd generation anti tank guided missile with a range capability of 4 km
66. An object, when projected vertically upward, covers a distance  $d$  during the time of its flight. If there were no gravity, the distance covered by it during the same time is equal to  
 (a) zero (b)  $4d$   
 (c)  $2d$  (d)  $d$

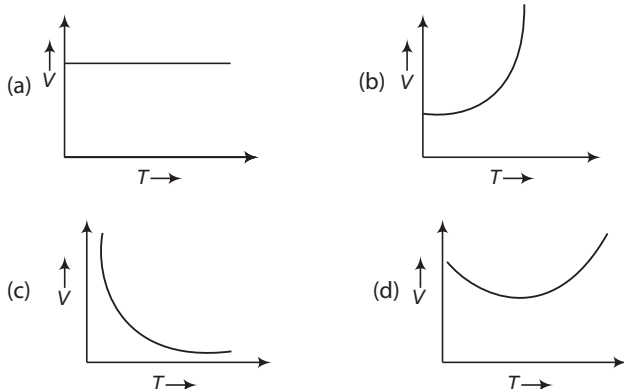
67. A person standing on the floor of an elevator drops a coin. If the elevator is stationary, the coin reaches at the floor of elevator is time  $t_1$  and if it is moving uniformly in upward direction then coin reaches in time  $t_2$ . Which one among the following is correct?  
 (a)  $t_1 < t_2$   
 (b)  $t_1 > t_2$   
 (c)  $t_1 = t_2$   
 (d)  $t_1$  and  $t_2$  depends on the speed of elevator
68. A particle at rest suddenly disintegrates into two particles of equal masses which start moving. The two fragments will  
 (a) move in the same direction with equal velocities  
 (b) move in the opposite directions with equal velocities  
 (c) move in any two directions with any velocities  
 (d) move in opposite directions with unequal velocities
69. The variation of velocity of particle moving along a straight line is shown as



The distance travelled by the particle in 4 s is  
 (a) 60 m (b) 55 m (c) 25 m (d) 30 m

70. If there is a planet on which the value of the acceleration due to its gravity is one-nineth of that at the Earth, the frequency of oscillation of a simple pendulum on the planet will be  
 (a) one - nineth (b) nine times  
 (c) one-third (d) three times
71. If the Earth suddenly stops rotating, the weight of objects at either pole would  
 (a) be the same as before (b) be greater  
 (c) be less (d) vary with latitude
72. Railway tracks are banked on curves so that  
 (a) no frictional force may be produced  
 (b) the weight of the train is reduced  
 (c) necessary centrifugal force may be obtained from the horizontal component of the reaction provided by the Earth  
 (d) necessary centripetal force may be obtained from the horizontal component of the reaction provided by the Earth
73. A Kelvin thermometer and a Fahrenheit thermometer used to record temperature of a melting metal, read the same. What will a Celsius thermometer read at that temperature?  
 (a)  $232^\circ$  (b)  $276^\circ$   
 (c)  $301.25^\circ$  (d)  $574.25^\circ$

74. Critical angle of light passing from glass to air is minimum for light of  
 (a) violet colour (b) green colour  
 (c) yellow colour (d) red colour
75. The force  $F$  acting on a body moving in a circle of radius  $r$  is always perpendicular to its instantaneous velocity  $v$ . The work done by the force on the body in one complete rotation is  
 (a) zero (b)  $F \cdot v$  (c)  $F \cdot r$  (d)  $F \cdot 2\pi r$
76. Two bar magnets of the same mass, same length and breadth but having magnetic moments  $M$  and  $2M$  are joined together pole to pole and suspended by a string. The time of oscillation of this assembly in a magnetic field of strength  $H$  is 3 s. If now the polarity of one of the magnets is changed and the combination is again made to oscillate in the same field, the time of oscillation is  
 (a) 3 s (b)  $3\sqrt{3}$  s  
 (c)  $\sqrt{3}$  s (d) 6 s
77. Instruments can be protected from outside magnetic effect by surrounding them with  
 (a) glass shield (b) iron shield  
 (c) rubber shield (d) brass shield
78. Two electric bulbs whose resistances are in the ratio of 1 : 2 are connected in parallel to a constant voltage. The powers dissipated in them have the ratio  
 (a) 1 : 1 (b) 1 : 2  
 (c) 1 : 4 (d) 2 : 1
79. An electron is accelerated through 1V potential difference. Its velocity will be nearly  
 (a)  $6 \times 10^5$  cm/s (b)  $6 \times 10^5$  m/s  
 (c)  $6 \times 10^{-5}$  m/s (d)  $4 \times 10^{-5}$  cm/s
80. According to Bohr's theory, the radius of the first orbit in hydrogen atom is  $0.528 \text{ \AA}$ . The radius of fourth orbit is  
 (a)  $1.23 \text{ \AA}$  (b)  $2.25 \text{ \AA}$  (c)  $8.45 \text{ \AA}$  (d)  $8.98 \text{ \AA}$
81. The relation between the volume and temperature of a sample of water in the range  $0^\circ\text{C}$  to  $10^\circ\text{C}$  is best represented by the graph



82. A planoconvex lens of focal length 20 cm, silvered at the plane surface, will behave as a convergent mirror of focal length (refractive index of lens = 1.5)  
 (a) 20 cm (b) 40 cm (c) 30 cm (d) 10 cm
83. During a nuclear fusion reaction  
 (a) two light nuclei combine to give a heavier nucleus and possibly other products  
 (b) a heavy nucleus bombarded by thermal neutrons breaks up  
 (c) a light nucleus bombarded by thermal neutrons breaks up  
 (d) a heavy nucleus breaks into two fragments by itself
84. Match the entries of Column I and Column II for hydrogen atom

Column I	Column II
A. Electron jumps from $n = 4$ to $n = 2$ state	1. Lyman series
B. Electron transition takes place from higher orbit to 1st orbit	2. Balmer series
C. Electron jumps from $n = 2$ to $n = 1$ state	3. Visible region of spectrum
D. Transition of electron from higher orbit to $n = 2$ state	4. Ultraviolet region of spectrum

**Codes**

A	B	C	D	A	B	C	D
(a) 1	2	1,3	2,4	(b) 2,3	1,4	1,4	2,3
(c) 2	1,3	1	2,4	(d) 2,4	1	3,4	2

85. If  $M$  is the mass and  $R$  is the radius, then match the moment of inertia for the given objects about the indicated axes.

Object	M.I
A. Circular ring	1. $\frac{7}{5}MR^2$ about tangent
B. Hollow sphere	2. $\frac{5}{4}MR^2$ about tangent
C. Circular disc	3. $2MR^2$ about tangent 1 to plane
D. Solid sphere	4. $\frac{5}{3}MR^2$ about tangent

**Codes**

A	B	C	D	A	B	C	D
(a) 2	4	1	3	(b) 4	3	1	2
(c) 3	1	2	4	(d) 4	1	3	2

**Directions** (Q.Nos. 86-89) In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Read them carefully and then mark the choice as under.

- (a) If both A and R are true and R is the correct explanation of A.  
 (b) If both A and R are true but R is not the correct explanation of A.  
 (c) If A is true but R is false.  
 (d) If both A and R are false.
86. **Assertion (A)** No two electric field lines can intersect one another at any point in space.  
**Reason (R)** Electric field lines always start from a positive charge and end on a negative charge.

- 87. Assertion(A)** Direction of current flow in a conductor is opposite to the flow of conduction electrons in it.  
**Reason(R)** Electrons are negatively charged particles.
- 88. Assertion (A)** Forces of action and reaction never cancel each other and each of them produces its own effect.  
**Reason (R)** Action- reaction forces are equal and opposite.
- 89. Assertion(A)** The shape of a liquid drop is spherical.  
**Reason (R)** The pressure inside the drop is greater than that outside.
- 90.** Who introduced the farming system in British India?  
 (a) William Bentinck (b) Lord Cornwallis  
 (c) Warren Hastings (d) Lord Wellesley
- 91.** Which of the following is not correct?  
 (a) Factory Acts of 1881-Lord Ripon  
 (b) Factory Acts of 1891-Lord Landsdowne  
 (c) Farming System-Lord Cornwallis  
 (d) Ryotwari System-Lord Wellesley
- 92. Statement I** Sub tropical Jet streams have altitude 8-12 km, width 12-40 km, depth 1-3 km. They are 3 dimensional entities.  
**Statement II** They are high velocity westerlies with circum global presence having curved path.  
 (a) Only I is correct (b) Only II is correct  
 (c) Both I and II are correct (d) Neither I nor II is correct
- 93.** The heat budget is based on which of the following components?  
 (a) Total amount of insolation received by Earth  
 (b) The amount of insolation which is reflected back without absorption  
 (c) Long wave terrestrial radiation  
 (d) All of the above
- 94.** World Meteorological Organization is located at  
 (a) Geneva (b) London  
 (c) New York (d) Washington DC
- 95.** Which of the following is not among the five doctrines of Jainism?  
 (a) Non-violence  
 (b) Truth  
 (c) Do not steal  
 (d) Non existence of God and soul
- 96.** What was Vivekananda's special contribution to Hindu culture and civilization?  
 (a) He exposed the weakness of Hindu culture and then by freed the Indians to think of its revitalisation  
 (b) He injected fresh life into Indian culture by infusing humanistic values of western culture into it  
 (c) For the first time in the modern age he loudly proclaimed before the world the superiority of Hindu culture and civilization  
 (d) He spread its true message throughout the country
- 97.** Who was the President of the Congress at the time of Moderate-Extremist split?  
 (a) Pherozeshah Mehta (b) Rasbehari Ghosh  
 (c) Madan Mohan Malaviya (d) Dinshaw Wacha
- 98.** On September 20, 1932 Mahatma Gandhi began a fast unto death in Yervada jail against  
 (a) British repression of the satyagrahis  
 (b) violation of the Gandhi-Irwin Pact  
 (c) granting of communal award by Ram Say Mac Donald  
 (d) communal riots in Calcutta
- 99.** Arrange the following in chronological order  
 1. Cabinet Mission  
 2. Cripps Mission  
 3. Wavell Plan  
 4. Quit India Movement  
 5. CR Formula  
 (a) 1, 2, 3, 4, 5 (b) 2, 4, 5, 3, 1 (c) 3, 2, 5, 4, 1 (d) 2, 3, 1, 5, 4
- 100.** Who was the chief guest on 63rd Republic day?  
 (a) Mahinda Rajapakse (b) Yenglik Senbatra  
 (c) Vladimir Putin (d) Ram Baran Yadav
- 101.** Read the following statements and mark the correct statement(s)  
 1. Arrival of the monsoon is a gradual process.  
 2. The Bay of Bengal branch of monsoon is deflected by the orientation of the mountains into the Indo Gangetic Plains of North India.  
 3. The variability of monsoon rain is highest over North-East India.  
 4. The Easterly jet suddenly shifts Southwards with the advent of the monsoons.  
 Select the correct answer using the codes given below  
 (a) Only 1 (b) 1 and 2  
 (c) 1, 2 and 3 (d) All of these
- 102.** What were the Hindu counterparts to the movements of Tabligh and Tanzin?  
 (a) Satya Shodhak Movement  
 (b) Shuddhi and Sangathan  
 (c) Self Respect Movement  
 (d) Rashtriya Swayam Sevak Sangh
- 103.** Which leader opined 'we will not achieve any succession our labours if we croak once a year like a frog'?  
 (a) BG Tilak (b) Lala Lajpat Rai  
 (c) Bipin Chandra Pal (d) Subhash Chandra Bose
- 104.** The Head quarters of the Ghadar party was at  
 (a) Moscow (b) Berlin  
 (c) San Francisco (d) Karachi
- 105.** A man slept in a closed room with a coal fire burning in the room. He became unconscious due to the formation of  
 (a) carbon dioxide in the room  
 (b) coke  
 (c) carboxyhaemoglobin in his blood  
 (d) charcoal

106. The different layers in graphite are held together by  
 (a) covalent bonding (b) dative bonding  
 (c) hydrogen bonding (d) van der waal's forces
107. Producer gas is a mixture of  
 (a) air and water (b) CO, H<sub>2</sub> and N<sub>2</sub>  
 (c) CO and N<sub>2</sub> (d) CO and H<sub>2</sub>
108. Pick up the correct statement.  
 (a) All ores are minerals (b) All minerals are ores  
 (c) A mineral cannot be an ore (d) An ore cannot be a mineral
109. Ruby is a red colour gem. Its red colour is due to the presence of  
 (a) iron oxide (b) zinc oxide  
 (c) chromium oxide (d) calcium oxide
110. Which of the following metals is used for making boats because it does not corrode by sea water?  
 (a) Cu (b) Ni (c) W (d) Ti
111. Which of the following is used in endoscopy?  
 (a) Optical fibers (b) Glass fibers  
 (c) Glass wool (d) Nylon fibers

**Direction** (Q.No. 112) *In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Read them carefully, and mark the choice as under.*

112. **Assertion (A)** In Rutherford's gold foil experiment, very few  $\alpha$ -particles are deflected back.  
**Reason (R)** Nucleus present inside the atom is heavy.  
 (a) If both A and R are correct and R is the correct explanation of the A  
 (b) If both A and R are correct but R is not the correct explanation of the A  
 (c) If A is correct but R is incorrect  
 (d) If A is incorrect but R is correct
113. Which of the following compound does not follow octet rule?  
 (a) CO<sub>2</sub> (b) PCl<sub>3</sub> (c) ICl (d) ClF<sub>3</sub>
114. As a result of osmosis, the volume of the solution  
 (a) gradually decreases  
 (b) gradually increases  
 (c) is not affected  
 (d) first increases and then decreases
115. Which of the following does not liberate O<sub>2</sub> in Bunsen burner?  
 (a) MgO (b) NaNO<sub>3</sub> (c) Pb<sub>3</sub>O<sub>4</sub> (d) KClO<sub>3</sub>
116. Match List I with List II and select the correct answer using the codes given below.

List I (Common name)	List II (Chemical formulae)
A. Washing soda	1. Na <sub>2</sub> CO <sub>3</sub>
B. Marble	2. NaHCO <sub>3</sub>
C. Baking soda	3. Na <sub>2</sub> CO <sub>3</sub> · 10 H <sub>2</sub> O
D. Soda ash	4. CaCO <sub>3</sub>

**Codes**

A	B	C	D	A	B	C	D
(a) 4	2	3	1	(b) 3	4	2	1
(c) 3	4	1	2	(d) 4	3	2	1

117. Select the correct statement(s).  
 I. Starch is the chief food reserve of the plants.  
 II. Starch is a single compound.  
 III.  $\alpha$ -amylose is a linear polymer.  
 (a) I, II and III (b) I and III  
 (c) II and III (d) Only I
118. The metal which gives photoelectrons most easily is  
 (a) Lithium (b) Sodium  
 (c) Calcium (d) Cesium
119. The compound which contains ionic as well as covalent bonds is  
 (a) C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub> (b) CH<sub>3</sub>I (c) KCN (d) H<sub>2</sub>O<sub>2</sub>
120. An isotone of  ${}_{32}\text{Ge}^{76}$  is  
 I.  ${}_{32}\text{Ge}^{77}$  II.  ${}_{33}\text{As}^{77}$   
 III.  ${}_{34}\text{Se}^{77}$  IV.  ${}_{34}\text{Se}^{78}$   
 (a) I and II (b) II and III  
 (c) II and IV (d) II, III and IV
121. A soda water bottle has pH  
 (a) <7 (b) >7  
 (c) =7 (d) Unpredictable
122. In which one of the following reactions nitrogen is not reduced?  
 (a) NO<sub>2</sub> → NO<sub>2</sub><sup>-</sup> (b) NO<sub>3</sub><sup>-</sup> → NO  
 (c) NO<sub>3</sub><sup>-</sup> → NO<sub>4</sub><sup>+</sup> (d) NH<sub>4</sub><sup>+</sup> → N<sub>2</sub>
123. Kosi and Tista river originates in which mountain?  
 (a) Nanga Parbat (b) Nanda Devi  
 (c) Kanchenjunga (d) Mt Everest
124. The ruins of Hampi, once the capital of great Vijayanagar kingdom is situated on the bank of which river?  
 (a) Godavari (b) Krishna (c) Cauveri (d) Tapi
125. Match the following
- |                 |                |
|-----------------|----------------|
| A. Chilka Lake  | 1. Gujarat     |
| B. Sambhar Lake | 2. Odisha      |
| C. Lonar Lake   | 3. Rajasthan   |
| D. Nal Lake     | 4. Maharashtra |
- Codes**
- | A     | B | C | D | A     | B | C | D |
|-------|---|---|---|-------|---|---|---|
| (a) 2 | 4 | 3 | 1 | (b) 3 | 2 | 4 | 1 |
| (c) 4 | 3 | 2 | 1 | (d) 2 | 3 | 4 | 1 |
126. Match the following
- |                               |                          |
|-------------------------------|--------------------------|
| A. Servants of Indian Society | 1. Devendranath Tagore   |
| B. Dharma Sabha               | 2. Gopal Krishna Gokhale |
| C. Tatvabodhini Sabha         | 3. Rammohan Roy          |
| D. Atmiya Sabha               | 4. Radhakanta Deb        |
|                               | 5. Keshab Chandra Sen    |

**Codes**

A	B	C	D	A	B	C	D
(a) 2	4	1	3	(b) 2	4	3	1
(c) 1	2	3	4	(d) 1	4	3	2

127. Which of the following statements regarding India's Strategic Nuclear Command is not correct?  
 (a) It was established in 2004  
 (b) Air Marshal Asthana was its Commander in Chief at the time of establishment  
 (c) It is the custodian of all India's nuclear weapons, missiles and assets  
 (d) It executes all aspects of India's Nuclear Policy
128. Which of the following is not correctly matched?

Regional Commands of Army	Head Quarters
(a) Central Command	Lucknow
(b) Northern Command	Udhampur
(c) Western Command	Chandimandir
(d) Southern Command	Chennai

129. Put the following social legislation in a chronological order  
 1. Outlawing of the practice of human sacrifice.  
 2. Declaring of slavery as illegal in India.  
 3. Caste Disabilities Removal Act.  
 4. Legalising of marriage of widows.  
 (a) 2, 1, 3, 4 (b) 1, 2, 3, 4  
 (c) 1, 2, 4, 3 (d) 2, 3, 1, 4

130. The acid present in spinach is  
 (a) lactic acid (b) oxalic acid  
 (c) citric acid (d) tartaric acid
131. Which of the following is a genetically modified crop product characterized by fulfilment of eye nutrition?  
 (a) Golden rice (b) Padma  
 (c) Bt cotton (d) Flovr savr

132. Consider the following items  
 I. Acromegaly  
 II. Diabetes insipidus  
 III. Tetany  
 IV. Diabetes mellitus  
 Which of the above are considered as pituitary disorders?  
 (a) I and III (b) I, II and III  
 (c) I and II (d) I, III and IV

133. Consider the following statements  
 I. Bats are mammals  
 II. They are nocturnal in habit  
 III. They have wings which are actually modified forelimbs  
 Which of the statements given above is/are true?  
 (a) Only I  
 (b) I and II  
 (c) II and III  
 (d) All of the above

**Directions** (Q.Nos. 134-137) *In the following questions a statement of Assertion (A) is followed by a statement, of Reason (R). Read them carefully, and mark the choice as under.*

- (a) If both A and R are true and R is the correct explanation of A  
 (b) If both A and R are true and R is not the correct explanation of A  
 (c) If A is true but R is false  
 (d) If A is false but R is true
134. **Assertion (A)** Haemophilia is a genetic disorder.  
**Reason (R)** Its genes are located in the differential segment of X-chromosome.
135. **Assertion (A)** Malaria is caused by *Plasmodium* sp.  
**Reason (R)** *Plasmodium* is present in the saliva of female *Anopheles* mosquito.
136. **Assertion (A)** Rabies is a viral disease.  
**Reason (R)** Filariasis is transmitted by *Aedes* mosquito.
137. **Assertion (A)** Gonorrhoea is a bacterial disease.  
**Reason (R)** It spreads through sexual contact, common toilets and under clothes.

**Directions** (Q.Nos. 138-140) *The following question consist of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answer using the codes given below.*

- (a) Both the statements are individually true and Statement II is correct explanation of Statement I  
 (b) Both the statements are individually true but Statement II is not correct explanation of Statement I  
 (c) Statement I is true but Statement II is false  
 (d) Statement I is false but Statement II is true
138. **Statement I** Blood pressure is arterial blood pressure.  
**Statement II** It is measured by sphygmomanometer.
139. **Statement I** Chlorofluorocarbons are unstable chemicals destroy ozone layers.  
**Statement II** Ozone layer protect us from UV-rays.
140. **Statement I** Monsoons are not observed wherever large areas of land are surrounded by oceans.  
**Statement II** Temperature contrast between land and sea must be very pronounced to set up a massive energy to be able to generate a monsoon.
141. Which of the following information is correct?  
 (a) Vijayanta is the first indigenous tank  
 (b) T-55 and T-72 are the two important Soviet built battle tanks  
 (c) Arjun is the most sophisticated battle tank designed by DRDO  
 (d) All are correct
142. Clouds tend to cool the atmosphere by  
 1. reflecting solar radiation.  
 2. refracting solar radiation.  
 3. scattering solar radiation.

Select the correct answer using the codes given below

- (a) Only 1 (b) 1 and 2  
(c) Only 3 (d) 1 and 3

143. This soil come into existence due to weathering of ancient crystalline and metamorphic rocks. The soil is poor in lime, magnesia, phosphates, nitrogen and humus but rich in potash. The main parent rocks are acid granites and gneisses. The soil reffered above is

- (a) Red soils (b) Black soils  
(c) Laterite soils (d) Alluvial soils

144. Which among the following is/are classified as mid-altitude clouds?

1. Nimba stratus 2. Alto stratus  
3. Alto cumulus 4. Cirro stratus

Select the correct answer using the codes given below

- (a) 1 and 2 (b) 2 and 3  
(c) 1, 2 and 3 (d) All of these

145. Match the following

A. Biosphere reserve	1. Sambhar lake
B. National park	2. Karakoram
C. Wet land	3. Panna
D. Wildlife Sanctuary	4. Nilgiri

**Codes**

- |       |   |   |   |       |   |   |   |
|-------|---|---|---|-------|---|---|---|
| A     | B | C | D | A     | B | C | D |
| (a) 4 | 2 | 1 | 3 | (b) 4 | 3 | 1 | 2 |
| (c) 2 | 3 | 1 | 4 | (d) 3 | 4 | 1 | 2 |

146. Tsunamis are caused by

1. under sea earthquakes.  
2. landslides.  
3. volcanic eruptions.  
4. meteorites and asteroids.

Select the correct answer using the codes given below

- (a) 1 and 2 (b) 1, 2, and 3  
(c) 1, 2 and 4 (d) All of these

147. The principal chemical constituents of the atmosphere which contribute to the green house effect are

1. Carbon 2. Nitrogen  
3. Sulphur 4. Phosphorous

Select the correct answer using the codes given below

- (a) 1 and 2 (b) 2 and 3  
(c) 1, 3 and 4 (d) All of these

148. Match the following

A. Tropical wet evergreen and semi evergreen	1. Timber, rose-wood, poan, aini and telsur
B. Wet temperate forests	2. Sal, teak and sandal
C. Tropical deciduous forest	3. Short trees of acacias and phorbias
D. Dry Savanna	4. Permanent grasslands

**Codes**

- |       |   |   |   |       |   |   |   |
|-------|---|---|---|-------|---|---|---|
| A     | B | C | D | (b) 2 | 3 | 4 | 1 |
| (a) 1 | 4 | 2 | 3 | (d) 4 | 1 | 2 | 3 |
| (c) 4 | 2 | 1 | 3 |       |   |   |   |

149. Which of the following statements with respect to isotherms are true?

- They are relatively more irregular in the Northern hemisphere than the Southern hemisphere.
- The isotherms, while passing from continents to oceans get disorted at their margins.
- Wherever there are cold ocean currents, the isotherms bend towards the equator.
- In the Eastern part of the North Atlantic the isotherms show a longer amount of deviation towards North.

Select the correct answer using the codes given below

- (a) Only 1 (b) 1 and 2  
(c) 1, 2 and 3 (d) All of these

150. Arrange the following States/Union Territories in ascending order in terms of tribal population % in their total population on the basis of census 2011

1. Asom 2. Meghalaya  
3. Nagaland 4. Mizoram  
5. Lakshadweep

- (a) 5-1-3-2-4 (b) 5-1-3-4-2  
(c) 4-3-2-5-1 (d) 5-1-2-3-4

# Answers with Explanations

## Paper 1

1. (d) Let  $z = x + iy$

$$\text{So, } \bar{z} = x - iy$$

$$\begin{aligned} \text{Now, } z^2 + \bar{z} &= (x + iy)^2 + (x - iy) \\ &= [x^2 - y^2 + (2xy)i] + (x - iy) \\ &= (x^2 - y^2 + x) + i(2xy - y) = 0 \end{aligned}$$

$$\text{So, } x^2 - y^2 + x = 0$$

$$\text{and } 2xy - y = 0$$

$$\text{Now, from } 2xy - y = 0$$

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

$$y = 0 \text{ or } x = \frac{1}{2}$$

$$\text{If } y = 0, \text{ then } x^2 + x = 0$$

$$\Rightarrow x(x + 1) = 0$$

$$x = 0 \text{ or } x = -1$$

$$\text{If } x = \frac{1}{2}, \text{ then } x^2 - y^2 + x = 0$$

$$\frac{1}{4} - y^2 + \frac{1}{2} = 0$$

$$\Rightarrow y = \pm \frac{\sqrt{3}}{2}$$

Thus, the given equation has four solutions.

2. (b) Let  $z = x + iy$

$$|z^2 - 1| = |z|^2 + 1$$

$$|(x + iy)^2 - 1| = |x + iy|^2 + 1$$

$$|x^2 - y^2 + 2xyi - 1| = x^2 + y^2 + 1$$

$$(x^2 - y^2 - 1)^2 + 4x^2y^2 = (x^2 + y^2 + 1)^2$$

$$\begin{aligned} (x^2 - y^2)^2 - 2(x^2 - y^2) + 1 + 4x^2y^2 \\ = (x^2 + y^2)^2 + 1 + 2(x^2 + y^2) \end{aligned}$$

$$\begin{aligned} x^4 + y^4 - 2x^2y^2 - 2x^2 + 2y^2 + 1 + 4x^2y^2 \\ = x^4 + y^4 + 2x^2y^2 + 1 + 2x^2 + 2y^2 \end{aligned}$$

$$4x^2 = 0$$

$$x = 0$$

Thus,  $z$  lies on imaginary axis.

3. (c) Let  $z_1, z_2$  and  $z_3$  be three complex numbers.

$\therefore z_1, z_2$  and  $z_3$  are in AP.

$$2z_2 = z_1 + z_3$$

i.e.,  $z_2$  is the mid-point of the line segment joining  $z_1$  and  $z_3$ .

So,  $z_1, z_2$  and  $z_3$  lies on a straight line.

4. (d) When  $x < 0$ , then  $|x| = -x$

$$\text{So, equation becomes } x^2 + 5x + 6 = 0$$

$$x = -2 \text{ or } -3$$

when  $x > 0$ , then  $(x) = x$

$$\text{So, equation becomes } x^2 + (-5x) + 6 = 0$$

$$x^2 - 5x + 6 = 0$$

$$x = 2 \text{ or } 3$$

Number of solutions = 4

5. (a) Equation is  $y \frac{dy}{dx} = y - 1$

Using separation of variable

$$dx = \frac{y-1}{y} dy$$

$$dx = \left(1 - \frac{1}{y}\right) dy$$

Integrating both sides

$$\int dx = \int \left(1 - \frac{1}{y}\right) dy$$

$$x = y - \log y + C$$

...(i)

Put  $x = 0$ , then  $y = 1$  in Eq. (i)

$$0 = 1 - \log 1 + C$$

$$C = -1$$

Because 'C' has one value, so we get unique solution.

6. (d) The degree of differential equation is the degree of the highest order derivative involving in equation. Given equation doesn't define the highest order therefore degree of differential equation cannot be determined.

$$7. (d) \frac{dy}{dx} = \frac{3x - 4y - 2}{3x - 4y - 3}$$

$$\text{Let } 3x - 4y = X$$

$$3 - 4 \frac{dy}{dx} = \frac{dX}{dx}$$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{4} \left(3 - \frac{dX}{dx}\right)$$

So, the given equation

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

$$\frac{3}{4} - \frac{1}{4} \frac{dX}{dx} = \frac{X-2}{X-3}$$

$$-\frac{1}{4} \frac{dX}{dx} = \frac{X-2}{X-3} - \frac{3}{4}$$

$$-\frac{1}{4} \frac{dX}{dx} = \frac{X+1}{4(X-3)}$$

$$-\frac{(X-3)}{(X+1)} dX = dx$$

$$-\left(1 - \frac{4}{X+1}\right) dX = dx$$

$$\left(-1 + \frac{4}{X+1}\right) dX = dx$$

On integration

$$\begin{aligned}
 -X + 4 \log(X + 1) &= x + 4C \\
 4 \log(x + 1) &= X + x + 4C \\
 4 \log(3x - 4y + 1) &= 3x - 4y + x + 4C \\
 4 \log(3x - 4y + 1) &= 4x - 4y + 4C \\
 \log(3x - 4y + 1) &= x - y + C
 \end{aligned}$$

8. (c)  $x^2 = 4\mu y$

On differentiating  $2x = 4\mu \frac{dy}{dx}$

$$2x = \frac{x^2}{y} \times \frac{dy}{dx} \quad \left( \because 4\mu = \frac{x^2}{y} \right)$$

$$2x = \frac{x^2}{y} \left( -\frac{dx}{dy} \right) \quad (\because \text{for orthogonal } m_1 m_2 = -1)$$

$$2xy \, dy = -x^2 \, dx$$

$$2y \, dy = -x \, dx$$

On integrating

$$y^2 = -\frac{x^2}{2} + \frac{C}{2}$$

$$2y^2 + x^2 = C$$

9. (a) We know that,

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

So,  $\begin{bmatrix} 2 & -3 \\ -4 & 2 \end{bmatrix}^{-1} = \frac{1}{4 - (12)} \begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$

$$= -\frac{1}{8} \begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$$

$$= -\frac{1}{8} \begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$$

10. (a)  $(A + A^T)^T = (A)^T + (A^T)^T$

$$= (A)^T + A = A + A^T$$

$\therefore A + A^T$  is symmetric.

11. (c) Let  $A = [a_{ij}]$  is a matrix which is symmetric and skew-symmetric, so

$$a_{ij} = a_{ji}, \forall i, j$$

If  $A$  is a skew-symmetric matrix.

$\therefore a_{ij} = -a_{ji}$

$$a_{ij} = -a_{ij} \quad (\because a_{ij} = a_{ji})$$

$$2a_{ij} = 0$$

$$a_{ij} = 0$$

$\Rightarrow A$  is null matrix.

12. (d) Let  $A = (20)^{64}$

$$\begin{aligned}
 \log A &= \log (20)^{64} = 64 \log 20 \\
 &= 64 \log (10 \times 2) \\
 &= 64 [1 + 0.3010] \\
 &= 64 \times 1.3010 \\
 &= 83.264
 \end{aligned}$$

Number of digits =  $83 + 1 = 84$

13. (c)  $\therefore$

$$(42)^2 = 6 \times 294$$

$$\therefore (\log_{42} 7)^2 = \log_6 7 \times \log_{294} 7$$

So,  $\log_6 7, \log_{42} 7$  and  $\log_{294} 7$ , are in GP.

14. (b)

$$y = \tan^{-1} \left[ \frac{\sqrt{1+x^2}-1}{x} \right]$$

Put

$$x = \tan \theta$$

$$y = \tan^{-1} \left[ \frac{\sqrt{1+\tan^2 \theta}-1}{\tan \theta} \right] = \tan^{-1} \left[ \frac{\sec \theta - 1}{\tan \theta} \right]$$

$$= \tan^{-1} \left[ \frac{1 - \cos \theta}{\sin \theta} \right]$$

$$y = \tan^{-1} \left[ \frac{1 - \left(1 - 2 \sin^2 \frac{\theta}{2}\right)}{2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2}} \right] = \tan^{-1} \left[ \tan \frac{\theta}{2} \right] = \frac{\theta}{2}$$

$$y = \frac{1}{2} \tan^{-1} x$$

$$\frac{dy}{dx} = \frac{1}{2} \times \frac{1}{1+x^2}$$

$$\left[ \frac{dy}{dx} \right]_{x=0} = \frac{1}{2(1+0)} = \frac{1}{2}$$

15. (b)

$$x = \sin^{-1}(t)$$

$$y = \log(1-t^2)$$

$$\frac{dx}{dt} = \frac{1}{\sqrt{1-t^2}} \quad \frac{dy}{dx} = \frac{1}{1-t^2} (-2t)$$

$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = -\frac{2t}{\sqrt{1-t^2}}$$

$$\frac{d^2y}{dx^2} = \frac{d}{dt} \left[ -\frac{2t}{\sqrt{1-t^2}} \right] \frac{dt}{dx}$$

$$= \frac{-2\sqrt{1-t^2} - (-2t) \cdot \frac{1}{2}(1-t^2)^{-1/2}(-2t)}{1-t^2} \times \sqrt{1-t^2}$$

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

16. (d)  $\frac{d}{dx}(a^x + x^a) = a^x \log_e a + a(x)^{a-1}$

17. (b) We know that,  $\pi^c = 180^\circ$

$$1^\circ = \left( \frac{\pi}{180} \right)^c$$

$$x^\circ = \left( \frac{\pi x}{180} \right)^c$$

$$\frac{d}{dx} \left[ \cos \left( \frac{\pi x}{180} \right) \right] = -\sin \left( \frac{\pi x}{180} \right) \times \frac{\pi}{180} = -\frac{\pi}{180} \sin x^\circ$$

18. (c) Given,  $S_n = an^2 + bn + c$

$$S_{n-1} = a(n-1)^2 + b(n-1) + c$$

We know that,  $T_n = S_n - S_{n-1}$

$$T_n = [an^2 + bn + c] - [a(n^2 + 1 - 2n) + bn - b + c]$$

$$T_n = an^2 + bn + c - an^2 - a + 2an - bn + b - c$$

$$T_n = 2an - a + b$$

Given expression is linear in 'n'.

So, series is an AP.

19. (c) Let the roots be  $\lambda r$  and  $r$ .

$$\therefore \lambda r + r = -\frac{b}{a}$$

$$\Rightarrow r(\lambda + 1) = -\frac{b}{a} \quad \dots(i)$$

$$\lambda r^2 = \frac{c}{a} \quad \dots(ii)$$

$$\frac{\lambda r^2}{r^2(\lambda + 1)^2} = \frac{c/a}{(-b/a)^2} = \frac{c}{a} \times \frac{a^2}{b^2} = \frac{ac}{b^2}$$

20. (a) Expression is  $x^3 - 3x^2 - 8x + 15$

$$x^2(x - 3) - 8x + 15$$

$$(3 + i)^2(i) - 8(3 + i) + 15 \quad (\because x = 3 + i)$$

$$(9 + i^2 + 6i)i - 24 - 8i + 15$$

$$(9 - 1 + 6i)i - 24 - 8i + 15$$

$$8i - 6 - 24 - 8i + 15 = -15$$

21. (d)  $\log_{10}(x^2 - 6x + 45) = 2$

$$\log_{10}(x^2 - 6x + 45) = 2 \times \log_{10} 10 \quad (\because \log_{10} 10 = 1)$$

$$\log_{10}(x^2 - 6x + 45) = \log_{10} 100$$

$$x^2 - 6x + 45 = 100$$

$$x^2 - 6x - 55 = 0$$

$$x^2 - 11x + 5x - 55 = 0$$

$$x(x - 11) + 5(x - 11) = 0$$

$$x = -5 \text{ or } 11$$

22. (c)  $A \times (B \cup C) = (A \times B) \cup (A \times C)$  (distributive law)

23. (b) Let  $a, b$  and  $c$  be any number.

$$\text{If } a < b \text{ and } b < c \Rightarrow a < c$$

So,  $R$  is transitive.

24. (b)  $aRb$  defined by  $\Rightarrow a \perp b$

$bRa$  means  $b \perp a$

It is true, therefore  $R$  is symmetric. ( $\because aRb = bRa$ )

25. (a) Let  $A, H$  and  $G$  be the arithmetic mean.

Harmonic mean and Geometric mean respectively.

$$\text{We know that, } G^2 = A \times H = 25 \times 4 = 100$$

$$G = 10$$

$$26. (d) \lim_{x \rightarrow \frac{\pi}{4}} \left[ \frac{\cos x - \sin x}{x - \frac{\pi}{4}} \right] \quad \left( \frac{0}{0} \text{ indeterminate form} \right)$$

Using L' Hospital rule,

$$\lim_{x \rightarrow \frac{\pi}{4}} \left[ \frac{-\sin x - \cos x}{1} \right] = -\sin \frac{\pi}{4} - \cos \frac{\pi}{4} = -\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}}$$

$$= -\sqrt{2}$$

$$27. (c) I = \int_0^{\pi/2} \log \tan x \, dx \quad \dots(i)$$

Using property of definite integral

$$\int_0^a f(x) \, dx = \int_0^a f(a-x) \, dx$$

$$I = \int_0^{\pi/2} \log \tan \left( \frac{\pi}{2} - x \right) \, dx$$

$$= \int_0^{\pi/2} \log \cot x \, dx$$

... (ii)

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

$$2I = \int_0^{\pi/2} \log \tan x \, dx + \int_0^{\pi/2} \log \cot x \, dx$$

$$= \int_0^{\pi/2} \log (\tan x \times \cot x) \, dx$$

$$= \int_0^{\pi/2} \log 1 \, dx \quad (\because \log 1 = 0)$$

$$2I = 0$$

$$I = 0$$

$$28. (c) I = \int \frac{dx}{a^2 \cos^2 x + b^2 \sin^2 x}$$

On dividing by  $\cos^2 x$  in numerator and denominator

$$I = \int \frac{\sec^2 x \, dx}{a^2 + b^2 \tan^2 x}$$

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

$$= \int \frac{dt/b}{a^2 + t^2}$$

$$= \frac{1}{b} \left[ \frac{1}{a} \tan^{-1} \left( \frac{t}{a} \right) \right]$$

$$= \frac{1}{ab} \cdot \tan^{-1} \left( \frac{b \tan x}{a} \right) + C$$

$$29. (a) A = \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix}$$

$$A^2 = A \times A = \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 10 & 15 \\ 15 & 25 \end{bmatrix}$$

$$KA = K \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix}$$

$$\therefore A^2 - KA - 5I = \begin{bmatrix} 10 & 15 \\ 15 & 25 \end{bmatrix} - K \begin{bmatrix} 1 & 3 \\ 3 & 4 \end{bmatrix} - 5 \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$0 = \begin{bmatrix} 10 - K - 5 & 15 - 3K \\ 15 - 3K & 25 - 4K - 5 \end{bmatrix}$$

$$10 - K - 5 = 0 \Rightarrow K = 5$$

**Alternate method** We know that, every square matrix satisfy its characteristic equation

$$|A - \lambda I| = 0$$

$$\begin{vmatrix} 1 - \lambda & 3 \\ 3 & 4 - \lambda \end{vmatrix} = (1 - \lambda)(4 - \lambda) - 9 = 0$$

$$\Rightarrow \lambda^2 - 5\lambda - 5 = 0 \quad (\text{put } \lambda = A)$$

$$\Rightarrow A^2 - 5A - 5 = 0$$

$$\Rightarrow \begin{vmatrix} -a^2 & -ab & ac \\ ba & -b^2 & bc \\ ac & -bc & c^2 \end{vmatrix} \quad K = 5$$

On taking common a, b, c from R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>

$$\Rightarrow abc \begin{vmatrix} -a & -b & c \\ a & -b & c \\ a & -b & c \end{vmatrix}$$

On taking common -b, c from C<sub>2</sub>, C<sub>3</sub>

$$\Rightarrow -ab^2c^2 \begin{vmatrix} -a & 1 & 1 \\ a & 1 & 1 \\ a & 1 & 1 \end{vmatrix} = 0$$

∴ C<sub>2</sub> and C<sub>3</sub> are identical.

31. (b) Differential equation is  $\sec^2 x \tan y \, dx + \sec^2 y \tan x \, dy = 0$

$$\int \frac{\sec^2 x}{\tan x} \, dx + \int \frac{\sec^2 y}{\tan y} \, dy = \int 0$$

$$\log \tan x + \log \tan y = \log C$$

$$\tan x \cdot \tan y = C$$

32. (c) Equation is  $\frac{dy}{dx} + \frac{y}{x} = x^n$

On comparing with  $\frac{dy}{dx} + Py = Q \Rightarrow P = \frac{1}{x}, Q = x^n$

IF =  $e^{\int P \, dx} = e^{\int \frac{1}{x} \, dx} = e^{\log x} = x$

Solution is  $y \times IF = \int Q \times IF \, dx + C$

$$y \times x = \int x^n \times x \, dx + C$$

$$xy = \int x^{n+1} \, dx + C$$

$$xy = \frac{x^{n+2}}{n+2} + C$$

33. (d)  $\frac{df}{dx} = 0$

34. (a)  $I = \int_0^{\pi/2} \frac{\sin^2 x - \cos^2 x}{\sin^3 x + \cos^3 x} \, dx$

Replace x by  $\left(\frac{\pi}{2} - x\right)$

$$I = \int_0^{\pi/2} \frac{\sin^2\left(\frac{\pi}{2} - x\right) - \cos^2\left(\frac{\pi}{2} - x\right)}{\sin^3\left(\frac{\pi}{2} - x\right) + \cos^3\left(\frac{\pi}{2} - x\right)} \, dx$$

$$= \int_0^{\pi/2} \frac{\cos^2 x - \sin^2 x}{\cos^3 x + \sin^3 x} \, dx$$

$$= - \int_0^{\pi/2} \frac{\sin^2 x - \cos^2 x}{\sin^3 x + \cos^3 x} \, dx$$

$$= -I$$

Property :  $\int_0^a f(a-x) \, dx = \int_0^a f\{a-(a-x)\} \, dx = \int_0^a f(x) \, dx$

So,  $2I = 0 \Rightarrow I = 0$

35. (b)  $17x^2 - 12xy + 8y^2 + 46x - 28y + 17 = 0$

On comparing with  $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$

$$a = 17, h = -6, b = 8, g = 23, f = -14, c = 17$$

Now,  $\Delta = abc + 2fgh - af^2 - bg^2 - ch^2 \neq 0$

Also,  $ab = 17 \times 8 = 126$

$$h^2 = 36$$

$$ab > h^2$$

So, it is an ellipse.

36. (c)  $\cos(A-B)\cos(A+B) - \sin(A-B)\sin(A+B)$

$$\cos(A-B+A+B) = \cos 2A$$

Using  $\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B$

37. (c)  $\tan A = \frac{1}{2}, \tan B = \frac{1}{3}$

$$\tan(2A+B) = \frac{\tan 2A + \tan B}{1 - \tan 2A \cdot \tan B}$$

$$\left(\because \tan 2A = \frac{2 \tan A}{1 - \tan^2 A}\right)$$

$$= \frac{\left(\frac{2 \tan A}{1 - \tan^2 A}\right) + \tan B}{1 - \left(\frac{2 \tan A}{1 - \tan^2 A}\right) \times \tan B}$$

$$= \frac{\frac{4}{3} + \frac{1}{3}}{1 - \frac{4}{3} \times \frac{1}{3}} = \frac{5/3}{5/9} = 3$$

$$= \frac{4}{3} + \frac{1}{3} = \frac{5}{3}$$

$$\left(\because \tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \cdot \tan B}\right)$$

38. (d)  $\omega^{99} + \omega^{100} + \omega^{101} \quad (\because 1 + \omega + \omega^2 = 0 \text{ and } \omega^3 = 1)$

$$\omega^{99} [1 + \omega + \omega^2] = 0$$

$$\omega^{99} \times 0 = 0$$

$$(\because 1 + \omega + \omega^2 = 0)$$

39. (c)

2	1753	1
2	876	0
2	438	0
2	219	1
2	109	1
2	54	0
2	27	1
2	13	1
2	6	0
2	3	1
	1	

$$(1753)_{10} = (11011011001)_2$$

40. (c) Expanding the determinant by II<sup>nd</sup> row

$$(-1) \begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix} = 0; -[x^2 - 1] = 0; x^2 = 1; x = \pm 1$$

41. (a) Class-size = Difference between two consecutive class marks  
= 10 - 6 = 4

42. (a) ogive

43. (b) Committee of 3 is to be chosen from 4 men and 5 women, so required probability

$$\begin{aligned} &= \frac{{}^4C_2 \times {}^5C_1}{{}^9C_3} = \frac{4!}{2!2!} \times \frac{5!}{1!4!} \\ &= \frac{4 \times 3}{2} \times 5 = \frac{5}{14} \end{aligned}$$

44. (b)  $\int_{-2}^2 |1-x^2| dx = \int_{-2}^{-1} |1-x^2| dx + \int_{-1}^1 |1-x^2| dx + \int_1^2 |1-x^2| dx$   
 $= \int_{-2}^{-1} -(1-x^2) dx + \int_{-1}^1 (1-x^2) dx + \int_1^2 (x^2-1) dx$   
 $= \int_{-2}^{-1} (x^2-1) dx + \int_{-1}^1 (1-x^2) dx + \int_1^2 (x^2-1) dx$   
 $= \left(\frac{x^3}{3} - x\right)_{-2}^{-1} + \left(x - \frac{x^3}{3}\right)_{-1}^1 + \left(\frac{x^3}{3} - x\right)_{1}^2$   
 $= \left[\left(-\frac{1}{3} + 1\right) - \left(-\frac{8}{3} + 2\right)\right] + \left[\left(1 - \frac{1}{3}\right) - \left(-1 + \frac{1}{3}\right)\right]$   
 $\quad + \left[\left(\frac{8}{3} - 2\right) - \left(\frac{1}{3} - 1\right)\right]$   
 $= -\frac{1}{3} + 1 + \frac{8}{3} - 2 + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3}$   
 $= -\frac{7}{3} + \frac{11}{3} + \frac{8}{3} = 4$

Using the property

$$\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx, \text{ where } a < c < b$$

45. (a)  $[a \ b \ c] = a \cdot (b \times c) = b \cdot (c \times a) = c \cdot (a \times b)$

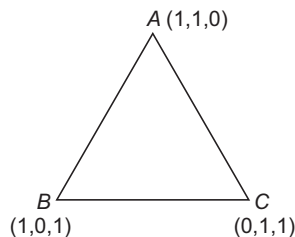
Using the given property,

$$\begin{aligned} [a \ b + c \ a + b + c] &= (a + b + c) \cdot (a \times (b + c)) \\ &= (a + b + c) \cdot (a \times b + a \times c) \\ &= a \cdot (a \times b) + a \cdot (a \times c) + b \cdot (a \times b) + b \cdot (a \times c) \\ &\quad + c \cdot (a \times b) + c \cdot (a \times c) \\ &= [a \ a \ b] + [a \ a \ c] + [b \ a \ b] + [b \ a \ c] + [c \ a \ b] + [c \ a \ c] \\ &= 0 + 0 + 0 - [a \ b \ c] + [a \ b \ c] + 0 = 0 \end{aligned}$$

46. (b) Area of triangle

$$= \frac{1}{2} |AB \times AC| \quad \dots(i)$$

$$\begin{aligned} AB &= PV \text{ of } B - PV \text{ of } A \\ &= (1, 0, 1) - (1, 1, 0) \\ &= i + 0 \cdot j + k - i - j - 0 \cdot k \\ &= -j + k \end{aligned}$$



$$AC = -i + k$$

$$\frac{1}{2} |AB \times AC| = \frac{1}{2} \begin{vmatrix} i & j & k \\ 0 & -1 & 1 \\ -1 & 0 & 1 \end{vmatrix} = \frac{1}{2} |-i + j - k| = \frac{\sqrt{3}}{2} \text{ (on solving)}$$

47. (c) Given equation of plane  $2x - 2y + z + 1 = 0 \quad \dots(i)$

$$\text{and} \quad 4x - 4y + 2z + 3 = 0$$

$$\text{or} \quad 2x - 2y + z + 3/2 = 0 \quad \dots(ii)$$

Plane Eqs. (i) and (ii) are parallel to each other.

So, the distance between parallel planes

$$\begin{aligned} &= \frac{\left| \frac{3}{2} - 1 \right|}{\sqrt{4 + 4 + 1}} = \frac{1}{\sqrt{2}} \\ &= \frac{1}{2} = \frac{1}{6} \end{aligned}$$

48. (b) Given,  $f(x) = \sin x + \cos x$

We know that,

$$\sqrt{a^2 + b^2} \geq (a \sin x + b \cos x) \geq -\sqrt{a^2 + b^2}$$

Put,  $a = b = 1$

$$\sqrt{1+1} \geq (\sin x + \cos x) \geq -\sqrt{1+1}$$

$$\Rightarrow \sqrt{2} \geq (\sin x + \cos x) \geq -\sqrt{2}$$

So, maximum value of  $f(x)$  is  $\sqrt{2}$ .

49. (a) Since,  $a - b + b - c + c - a = 0$

So, the vectors are coplanar.

Therefore,  $[a - b \ b - c \ c - a] = 0$

50. (b) The vector perpendicular to  $a$  and  $b$  is

$$a \times b = \begin{vmatrix} i & j & k \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{vmatrix} = i - j + k$$

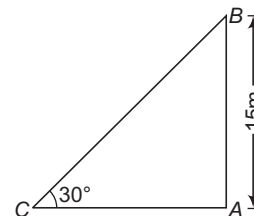
Since, the length of this vector is  $\sqrt{3}$  the unit vector perpendicular to  $a$  and  $b$  is

$$\frac{a \times b}{|a \times b|} = \pm \frac{1}{\sqrt{3}} (i - j + k)$$

Hence, there are two vectors.

51. (a) Let  $AB$  be a tower whose height is 15 m.

Angle of elevation of the top of tower from point  $C$  is  $30^\circ$ .



So,  $AB = 15 \text{ m}, C = 30^\circ$

$$\text{In } \Delta BAC, \quad \tan 30^\circ = \frac{AB}{AC}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{15}{AC} \Rightarrow AC = 15\sqrt{3} \text{ m}$$

52. (b) Let the probability of husband and wife selection be denoted by P(A) and P(B).

It is being given that,  $P(A) = \frac{1}{5}$ ,  $P(B) = \frac{1}{3}$

Only one of them will be selected

$$= P(A \cap \bar{B}) + P(\bar{A} \cap B) = P(A) \times P(\bar{B}) + P(\bar{A}) \times P(B)$$

$$= \frac{1}{5} \times \left[1 - \frac{1}{3}\right] + \left[1 - \frac{1}{5}\right] \times \frac{1}{3} = \frac{1}{5} \times \frac{2}{3} + \frac{4}{5} \times \frac{1}{3} = \frac{6}{15} = \frac{2}{5}$$

53. (b) Let the given points be P(a, b), Q (0, 0) K(-a, -b), S(ab, b<sup>2</sup>).

$$\text{Area of quadrilateral PQRS} = \frac{1}{2} \begin{vmatrix} x_1 - x_3 & y_1 - y_3 \\ x_2 - x_4 & y_2 - y_4 \end{vmatrix}$$

$$= \frac{1}{2} \begin{vmatrix} 2a & 2b \\ -ab & -b^2 \end{vmatrix} = 0$$

So, the points are collinear.

54. (b) Equation of ellipse is  $\frac{x^2}{25} + \frac{y^2}{9} = 1$

Here, a<sup>2</sup> = 25 and b<sup>2</sup> = 9

$$b^2 = a^2 (1 - e^2)$$

$$9 = 25 (1 - e^2) \quad (\because a > b)$$

$$\Rightarrow \frac{9}{25} = 1 - e^2$$

$$e^2 = 1 - \frac{9}{25}$$

$$e = \frac{4}{5}$$

55. (d) Number of diagonals in 'n' sided polygon =  $\frac{1}{2} n (n - 3)$

So, in octagon, number of diagonals =  $\frac{1}{2} \times 8 \times (8 - 3) = 20$

56. (c)  $|a \times b| = 1$  (given)

$$|a| |b| \sin \theta = 1 \quad (\because a \times b = |a||b| \sin \theta \hat{n})$$

$$\sin \theta = 1 \quad (\because |a| = |b|)$$

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

Now,  $|a + b|^2 = |a|^2 + |b|^2 + 2a \cdot b$

$$= 1 + 1 + 2|a||b| \cos \theta \quad (\because a \cdot b = |a||b| \cos \theta)$$

$$= 2 + 2 \cos \theta$$

$$= 2 [1 + \cos \theta] = 2 [1 + \cos 90^\circ]$$

$$= 2$$

$$|a + b| = \sqrt{2}$$

57. (c)  $|k \cdot b| = 1; |k| |b| = 1$

$$|k| \cdot b = 1 \quad (\because |b| = b)$$

$$b = \frac{1}{|k|}$$

58. (a) Since, a and b are two unit vectors, therefore

$$|a| = |b| = 1$$

Now,  $|a + b|^2 = |a|^2 + |b|^2 + 2a \cdot b$

$$= 1 + 1 + 2|a||b| \cos \theta$$

$$(\because a \cdot b = |a||b| \cos \theta)$$

$$= 2 + 2 \times 1 \times 1 \cos \frac{\pi}{3}$$

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

$$|a + b| = \sqrt{3}$$

$$\text{So, } |a + b| > 1$$

59. (c) Base = 10

60. (c) Let  $\hat{n}$  be the vector normal to a and b.

$$\therefore a = i + 2j - k, b = 2i + 3j + k$$

$$|a \times b| = \begin{vmatrix} i & j & k \\ 1 & 2 & -1 \\ 2 & 3 & 1 \end{vmatrix} = 5i - 3j - k$$

$$|a \times b| = \sqrt{(5)^2 + (-3)^2 + (-1)^2} = \sqrt{35}$$

Now,  $\hat{n} = \frac{a \times b}{|a \times b|} = \frac{5i - 3j - k}{\sqrt{35}}$

61. (a) Converting 55 to binary number

2	55	1
2	27	1
2	13	1
2	6	0
2	3	1
	1	

Converting (0.625)<sub>10</sub> into binary

$$0.625 \times 2 = 1.250 = 0.250 + 1$$

$$0.250 \times 2 = 0.500 = 0.500 + 0$$

$$0.500 \times 2 = 1 = 0 + 1$$

So, (0.625)<sub>10</sub> = (0.101)<sub>2</sub>

Now, (55.625)<sub>10</sub> = (110111.101)<sub>2</sub>

62. (c) Converting (1111)<sub>2</sub> into decimal

$$(1111)_2 = 1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 1 \times 2^3$$

$$= 1 \times 1 + 1 \times 2 + 1 \times 4 + 1 \times 8 = (15)_{10}$$

63. (a)  $\therefore x = 1 + a + a^2 + \dots \infty$

$$x = \frac{1}{1-a} \Rightarrow a = \frac{x-1}{x}$$

$\therefore y = 1 + b + b^2 + \dots \infty$

$$y = \frac{1}{1-b} \Rightarrow b = \frac{y-1}{y}$$

$$\therefore 1 + ab + a^2b^2 + \dots \infty = \frac{1}{1-ab}$$

$$= (1-ab)^{-1} = \left(1 - \frac{x-1}{x} \times \frac{y-1}{y}\right)^{-1}$$

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

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

64. (c)  $S_n = 3n^2 + 5 \Rightarrow S_{n-1} = 3(n-1)^2 + 5$   
 $T_n = S_n - S_{n-1} = (3n^2 + 5) - [3(n-1)^2 + 5]$   
 $= [3n^2 + 5] - [3(n^2 + 1 - 2n) + 5]$   
 $= [3n^2 + 5] - [3n^2 - 6n + 3 + 5]$   
 $= 3n^2 + 5 - 3n^2 + 6n - 8$

$T_n = 6n - 3$   
 Now,  $T_n = 159$  (given)  
 $6n - 3 = 159$   
 $6n = 162$   
 $n = \frac{162}{6} = 27$

65. (b)

66. (b) There are 52 cards in a pack out of those 4 cards are king and 4 cards for queen. Drawing two cards from a pack of 52 cards,

Required probability =  $\frac{{}^4C_1 \times {}^4C_1}{{}^{52}C_2}$   
 $= \frac{4!}{1!3!} \times \frac{4!}{1!3!} = \frac{4 \times 4}{52 \times 51} \times 2$   
 $= \frac{16 \times 2}{52 \times 51} = \frac{16}{26 \times 51} = \frac{8}{13 \times 51}$   
 $= \frac{8}{663}$

67. (a)  $\because e^{\log f(x)} = f(x)$   
 $\therefore e^{\log \cos x} = \cos x$   
 $\int e^{\log \cos x} dx = \int \cos x dx$   
 $= \sin x + C$

68. (a)  $\int a^x dx = \int \frac{a^x}{\log_e a} + C$

69. (b)  $\int \sin^3 x \cos x dx$   
 Let  $\sin x = t, \cos x dx = dt$   
 $\int t^3 dt = \frac{t^4}{4} + C$   
 $= \frac{1}{4} \sin^4 x + C$

70. (b)  $v^2 = 2s^2 + 4s + 5$   
 Differentiating it,  $2v \frac{dv}{ds} = 2(2s) + 4$   
 $2v \frac{dv}{ds} = 4s + 4$   
 $v \frac{dv}{ds} = 2s + 2$

At  $s = 5$  Acceleration =  $2 \times 5 + 2 = 12$

71. (a)  $(1 + 3\omega + 3\omega^2)^{10} + (3 + \omega + 3\omega^2)^{10} + (3 + 3\omega + \omega^2)^{10}$   
 $= (1 + 3(\omega + \omega^2))^{10} + (\omega + 3(1 + \omega^2))^{10} + [3(1 + \omega) + \omega^2]^{10}$

$= [1 + 3(-1)]^{10} + [\omega + 3(-\omega)]^{10} + (3(-\omega^2) + \omega^2)^{10}$   
 $= (-2)^{10} + (-2\omega)^{10} + (-2\omega^2)^{10}$   
 $= (-2)^{10} [1 + \omega^{10} + \omega^{20}] = (-2)^{10} [1 + \omega + \omega^2] = (-2)^{10} \cdot 0$   
 $= 0$

$\therefore (\because \omega^3 = 1 \text{ and } 1 + \omega + \omega^2 = 0)$

72. (a)  $z_k = \cos\left(\frac{\pi}{2^k}\right) + i \sin\left(\frac{\pi}{2^k}\right) = e^{i\frac{\pi}{2^k}}$  ( $e^{i\theta} = \cos\theta + i\sin\theta$ )  
 Put  $k = 1, 2, 3, \dots$   
 $z_1 \cdot z_2 \cdot z_3 \dots z_\infty = \left[ \cos\left(\frac{\pi}{2}\right) + i \sin\left(\frac{\pi}{2}\right) \right]$   
 $\left[ \cos\left(\frac{\pi}{2^2}\right) + i \sin\left(\frac{\pi}{2^2}\right) \right] \dots$

$= e^{i\frac{\pi}{2}} \cdot e^{i\left(\frac{\pi}{2^2}\right)} \dots$   
 $= e^{i\left[\frac{\pi}{2} + \frac{\pi}{2^2} + \frac{\pi}{2^3} + \dots\right]} = e^{i\left[\frac{\pi/2}{1-1/2}\right]} = e^{i\pi}$  ( $\because S_\infty = \frac{a}{1-r}$ )  
 $= \cos \pi + i \sin \pi = -1$

73. (b)  $1 - 1 = 0 \notin N$

74. (d)  $|A| \neq 0$

i.e., Matrix A must be non-singular.

75. (b)  $\sin 2A = \lambda \sin 2B \Rightarrow \frac{\sin 2A}{\sin 2B} = \frac{\lambda}{1}$

Using componendo and dividendo,

$\frac{\sin 2A + \sin 2B}{\sin 2A - \sin 2B} = \frac{\lambda + 1}{\lambda - 1}$   
 $\frac{2 \sin(A+B) \cdot \cos(A-B)}{2 \cos(A+B) \cdot \sin(A-B)} = \frac{\lambda + 1}{\lambda - 1}$   
 $\frac{\tan(A+B)}{\tan(A-B)} = \frac{\lambda + 1}{\lambda - 1}$

76. (b)  $\sin 10^\circ + \sin 50^\circ - \sin 70^\circ = \sin 10^\circ - (\sin 70^\circ - \sin 50^\circ)$

$= \sin 10^\circ - (2 \cos 60^\circ \times \sin 10^\circ)$   
 $= \sin 10^\circ [1 - 2 \cos 60^\circ]$   
 $= \sin 10^\circ \left[1 - 2 \times \frac{1}{2}\right] = 0$

77. (c)  $\theta + \phi = \frac{\pi}{6}$

Taking tan on both side  $\tan(\theta + \phi) = \tan \frac{\pi}{6}$

$\frac{\tan \theta + \tan \phi}{1 - \tan \theta \tan \phi} = \frac{1}{\sqrt{3}}$

$\sqrt{3} \tan \theta + \sqrt{3} \tan \phi = 1 - \tan \theta \tan \phi$

$\sqrt{3} \tan \theta + \sqrt{3} \tan \phi + \tan \theta \tan \phi = 1$

$3 + \sqrt{3} \tan \theta + \sqrt{3} \tan \phi + \tan \theta \tan \phi = 4$

$\sqrt{3}(\sqrt{3} + \tan \theta) + (\sqrt{3} + \tan \theta) \tan \phi = 4$

$(\sqrt{3} + \tan \theta)(\sqrt{3} + \tan \phi) = 4$

78. (a) Number of triangle formed by joining the mid-point of faces  
 $= {}^6C_3 = \frac{6!}{3!3!} = 120$

If n points in a plane and none of them are collinear, then number of triangle =  ${}^nC_3$

Both A and R are true and R is the correct explanation of A.

79. (c)  ${}^{20}C_8 = \frac{20!}{8!12!}$ ,  ${}^{20}C_{12} = \frac{20!}{12!8!}$

Both are same also  ${}^nC_x = {}^nC_y$

$\Rightarrow x + y = n$

So, option (a) is correct.

80. (a)  $\because \frac{1}{8}, \log_a a, \log_a a^2$  are in GP.

$[\log_a a]^2 = \frac{1}{8} \times \log_a a^2$

$\left(\frac{1}{2}\right)^2 = \frac{1}{8} \times 2 = \frac{1}{4}$

So, these terms are in GP.

If x,y,z are in AP.

$\Rightarrow 2y = x + z$

$\Rightarrow 2x = 2x \quad (\because x = y = z)$

If x,y,z are in GP.

$\Rightarrow y^2 = x^2$

$\Rightarrow x^2 = x^2 \quad (\because x = y = z)$

Both A and R are true.

81. (a)  $z_1 = 3 + \sqrt{-4} = 3 + 4i$

$z_2 = 3 + \sqrt{-25} = 3 + 5i$

$\frac{z_1}{z_2} = \frac{3 + 4i}{3 + 5i} \times \frac{3 - 5i}{3 - 5i}$

$= \frac{(3 + 4i)(3 - 5i)}{9 - 25i^2}$

$= \frac{9 - 15i + 12i - 20i^2}{9 + 25} = \frac{29 - 3i}{34}$

Both A and R are true.

82. (d)

83. (d) Shaded Region is  $(P \cap Q) \cup (P \cap R)$ .

84. (d)

85. (d)  $(9)^{200} = (1 + 8)^{200} = 1 + {}^{200}C_1(8) + {}^{200}C_2(8)^2 + \dots$   
 $= 1 + 1600 + 1273600 + \dots$

So, last two digit are 01.  $[(1 + x)^n = 1 + {}^nC_1x + {}^nC_2x^2 + \dots]$

86. (c)  $\frac{2x}{2x^2 + 5x + 2} > \frac{1}{x + 1}$

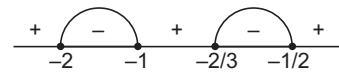
$\frac{2x}{(2x + 1)(x + 2)} - \frac{1}{x + 1} > 0$

$\frac{2x(x + 1) - (x + 2)(2x + 1)}{(x + 1)(x + 2)(2x + 1)} > 0$

$\frac{2x^2 + 2x - 2x^2 - x - 4x - 2}{(x + 1)(x + 2)(2x + 1)} > 0$

$-\frac{3x + 2}{(x + 1)(x + 2)(2x + 1)} > 0$

$\frac{(x + 2)(x + 1)(3x + 2)(2x + 1)}{(x + 1)^2(x + 2)^2(2x + 1)^2} < 0$



Now, equating it equal to zero.

$x = -\frac{2}{3}, -1, -2, -\frac{1}{2}$

So,  $-2 < x < -1$

87. (d)

88. (a) Area (shaded) =  $n(A \cap B) + n(A \cup B)'$

$|E| = 42, |A| = 15, |B| = 12, |A \cup B| = 22$

So,  $n(A \cup B)' = E - n(A \cup B)$

$= 42 - 22 = 20$

Also,  $n(A \cap B) = n(A) + n(B) - n(A \cup B)$

$22 = 15 + 12 - n(A \cap B)$

$\Rightarrow n(A \cap B) = 5$

Therefore,  $n(A \cap B) + n(A \cup B)' = 5 + 20 = 25$

89. (a)

90. (d) LHL =  $\lim_{x \rightarrow 0} \frac{\sin|x|}{x} = \lim_{x \rightarrow 0} \frac{\sin(-x)}{x}$

$= \lim_{x \rightarrow 0} -\frac{\sin x}{x} = -1 \quad \left(\because \lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1\right)$

RHL =  $\lim_{x \rightarrow 0} \frac{\sin|x|}{x} = \lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$

LHL  $\neq$  RHL

So, answer is option (d).

91. (d)  $f(x) = x|x|$

$f(x) = \begin{cases} -x^2, & \text{if } x < 0 \\ x^2, & \text{if } x > 0 \end{cases}$

$f'(x) = 2x, \text{ if } x > 0 = -2x, \text{ if } x < 0 \Rightarrow f'(x) = 2|x|$

92. (a) Equation of sphere

$ax^2 + by^2 + cz^2 - 2x + 4y + 2z - 3 = 0$

Put  $a = b = c$

$bx^2 + by^2 + bz^2 - 2x + 4y + 2z - 3 = 0$

$x^2 + y^2 + z^2 - \frac{2}{b}x + \frac{4}{b}y + \frac{2}{b}z - \frac{3}{b} = 0$

Centre =  $\left(\frac{1}{b}, -\frac{2}{b}, -\frac{1}{b}\right)$ ; But centre is  $\left(\frac{1}{2}, -1, -\frac{1}{2}\right)$ .

Therefore,  $b = 2$

93. (c)  $4y - x^2 - 8 = 0$

$\Rightarrow y = \frac{x^2 + 8}{4} \Rightarrow \frac{dy}{dx} = \frac{1}{4} \cdot 2x = \frac{x}{2}$

For function increasing  $\frac{dy}{dx} > 0$   
 $\frac{x}{2} > 0 \Rightarrow x > 0$

Hence, the curve increasing in (0, 4).

94. (b) Equation of line  $\frac{x+1}{3} = \frac{y-1}{4} = \frac{z-2}{2}$

Comparing with  $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$   
 $l = 3, m = 4, n = 2$

and the equation of plane  $2x - 3y + z + 4 = 0$

Compare with  $ax + by + cz + d = 0$   
 $a = 2, b = -3, c = 1$

Now, let the angle be  $\theta$ .

$$\sin \theta = \frac{al + bm + cn}{\sqrt{a^2 + b^2 + c^2} \sqrt{l^2 + m^2 + n^2}}$$

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

$$= \frac{6 - 12 + 2}{\sqrt{14} \sqrt{29}} = -\frac{4}{\sqrt{406}}$$

$$\theta = \sin^{-1}\left(\frac{-4}{\sqrt{406}}\right)$$

95. (b) Equation of line  $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-R}{2}$

Comparing with  $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$   
 $\alpha = 4, \beta = 2, \gamma = R$

These points line of a plane

$$3x - 2y + z = 7$$

$$3(4) - 2(2) + R = 7 \Rightarrow 12 - 4 + R = 7$$

$$R = -1$$

96. (a) Straight line i.e., axis of parabola.

97. (d) Let  $y = \lim_{x \rightarrow \infty} (3^x + 4^x)^{1/x}$

$$\log y = \lim_{x \rightarrow \infty} \frac{1}{x} \log (3^x + 4^x)$$

$$\log y = \lim_{x \rightarrow \infty} \frac{\log (3^x + 4^x)}{x} \quad \left(\frac{\infty}{\infty} \text{ form}\right)$$

Using L' Hospital rule,

$$\log y = \lim_{x \rightarrow \infty} \frac{1}{3^x + 4^x} [3^x \log 3 + 4^x \log 4]$$

$$= \lim_{x \rightarrow \infty} \frac{(4)^x \left[ \log 4 + \left(\frac{3}{4}\right)^x \log 3 \right]}{(4)^x \left[ 1 + \left(\frac{3}{4}\right)^x \right]}$$

$$= \lim_{x \rightarrow \infty} \frac{\log 4 + \left(\frac{3}{4}\right)^x \log 3}{1 + \left(\frac{3}{4}\right)^x} = \frac{\log 4 + 0}{1 + 0} = \log 4$$

$$y = 4$$

98. (d)  $R = \{(x, y) : 2x + y = 41\}$

$$xRx \Rightarrow 2x + x = 41 \Rightarrow 3x = 41$$

$$x = \frac{41}{3} \notin \mathbb{N}$$

So, R is not reflexive.

$$xRy \Rightarrow 2x + y = 41$$

$$yRx \Rightarrow 2y + x = 41$$

$$xRy \neq yRx$$

Hence, R is not symmetric and R is not transitive.

99. (d)  $x^2 + 4|x| + 3 = 0$

Case I  $|x| = x$ , when  $x > 0$

$$x^2 + 4x + 3 = 0$$

$$x = -1, -3$$

Case II When  $x < 0, |x| = -x$

So, equation becomes

$$x^2 - 4x + 3 = 0 \Rightarrow x = 1, 3$$

No root is common. So, answer is option (d).

100. (b) Equation is  $3x^4 - 10x^3 + 4x^2 - x - 6 = 0$

One root is  $\frac{1+i\sqrt{3}}{2}$ , so the other root is  $\frac{1-i\sqrt{3}}{2}$ .

Other root be  $\alpha$  and  $\beta$ .

Sum of the roots  $\frac{1+i\sqrt{3}}{2} + \frac{1-i\sqrt{3}}{2} + \alpha + \beta = -\left(-\frac{10}{3}\right) = \frac{10}{3}$

$$\frac{1}{2} + \frac{1}{2} + \alpha + \beta = \frac{10}{3}$$

$$\alpha + \beta = \frac{7}{3} \quad \dots(i)$$

Product of the roots  $\left(\frac{1+i\sqrt{3}}{2}\right)\left(\frac{1-i\sqrt{3}}{2}\right)\alpha\beta = -\frac{6}{3} = -2$

$$\frac{1}{4}[1+3]\alpha\beta = -2 \Rightarrow \alpha\beta = -2 \quad \dots(ii)$$

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

$$\alpha = -\frac{2}{3} \text{ and } \beta = 3$$

101. (b)  $\because A(1, 2), B(2, 4)$  and  $C(3, a)$  are collinear, then area of triangle should be zero.

$$\Rightarrow \begin{vmatrix} 1 & 2 & 1 \\ 2 & 4 & 1 \\ 3 & a & 1 \end{vmatrix} = 0$$

$$1[4-a] - 2[2-3] + 1[2a-12] = 0$$

$$4-a+2+2a-12=0 \Rightarrow a=6$$

Coordinate of C are (3, 6).

Length of BC =  $\sqrt{(2-3)^2 + (6-4)^2} = \sqrt{5}$

102. (d)  $\because a, b$  and  $c$  are in AP.

$$\Rightarrow 2b = a + c$$

If  $a, b$  and  $c$  are in HP, then  $b = \frac{2ac}{a+c}$

Now,  $AM > HM \Rightarrow b > \frac{2ac}{a+c} \Rightarrow ab + bc \geq 2ac$

103. (c)  $\Delta = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$

$$R_1 \rightarrow R_1 + R_2 + R_3$$

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

$$= (a+b+c) \begin{vmatrix} 1 & 1 & 1 \\ b & c & a \\ c & a & b \end{vmatrix}$$

$$C_1 \rightarrow C_1 - C_2, C_2 \rightarrow C_2 - C_3$$

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

Expand with respect to  $R_1$

$$(a+b+c)[(b-c)(a-b) - (c-a)^2]$$

$$(a+b+c)[ab+bc+ca - a^2 - b^2 - c^2]$$

$$= 3abc - (a^3 + b^3 + c^3) = 3abc$$

$\therefore a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$   
and  $a^3 + b^3 + c^3 = 0$  (given)

104. (d)  $\because A = A^T \Rightarrow A$  is symmetric matrix.

105. (c) Exhaustive events =  $6 \times 6 = 36$

106. (b) Total number of ways

$$= {}^6C_4 = \frac{6!}{2!4!} = 15 \quad \left( \because {}^nC_r = \frac{n!}{r!(n-r)!} \right)$$

107. (d) Number of subsets of  $x$  containing less than 5 element

$$= {}^nC_0 + {}^nC_1 + {}^nC_2 + {}^nC_3 + {}^nC_4$$

$$= \sum_{r=0}^4 {}^nC_r = \sum_{r=0}^4 C(n, r)$$

108. (a)  $P : A \cap (B \cup C) = (A \cap B) \cup C$

$$\therefore A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$$

$$= (A \cap B) \cup C \quad (\because C \subseteq A)$$

$Q : C$  is a subset of  $A$ .  
Therefore,  $P \Leftrightarrow Q$

109. (c) Equation of plane be  $ax + by + cz + d = 0$   
So, number of arbitrary constants = 4 (a, b, c, d)

110. (b) We know that,  $\bar{X} = \frac{X}{9}, \overline{XY} = \frac{XY}{99}$

Therefore,  $0.\bar{2} = \frac{2}{9} \Rightarrow 0.2\bar{3} = \frac{23}{99}$ ; Now,  $\frac{2}{9} + \frac{23}{99} = \frac{45}{99} = 0.\bar{45}$

111. (c) Probability of getting a success (p) =  $\frac{1}{4}$

Probability of not getting a success (q) =  $1 - \frac{1}{4} = \frac{3}{4}$

$$SD = 3$$

$$\sqrt{\text{variance}} = 3 \Rightarrow \text{variance} = 9$$

$$npq = 9$$

$$n \times \frac{1}{4} \times \frac{3}{4} = 9 \Rightarrow n = 48$$

$$\text{Mean} = np = 48 \times \frac{1}{4} = 12$$

112. (b)  $\because p + q = 1$  and  $p, q > 0$

113. (b)  $(a + b + c)^n = [a + (b + c)]^n$

$$= (a)^n + {}^nC_1 a^{n-1}(b+c) + {}^nC_2 (a)^{n-2}(b+c)^2 + \dots$$

Number of terms =  $1 + 2 + 3 + \dots + (n + 1)$

$$= \sum (n + 1) = \frac{1}{2}(n + 1)(n + 2)$$

114. (d) Expression is  $\frac{1}{(4-3x)^2} = \frac{1}{4^2 \left[1 - \frac{3x}{4}\right]^2}$

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

It is valid only when  $\left|\frac{3x}{4}\right| < 1 \Rightarrow -\frac{4}{3} < x < \frac{4}{3}$

115. (c) Number of diagonals in a  $m$  side polygon =  ${}^mC_2 - m$

$$= \frac{m!}{2!(m-2)!} - m$$

$$= \frac{m(m-1)}{2} - m = \frac{1}{2}m(m-1) - m$$

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

116. (a) In the word 'DELHI'

When, we fix L in mid place the first two letters arranged in  ${}^4P_2$  ways, then last two words can be arranged in  ${}^2P_2$  ways.

Total number of ways =  ${}^4P_2 \times {}^2P_2 = 24$

117. (d) If a and b are same sign.

$$\frac{1}{a} < \frac{1}{b}, \text{ then } a > b$$

If a and b are opposite, then

$$\frac{1}{a} < \frac{1}{b}, \text{ then } a < b$$

So, correct answer is option (d).

118. (a)  $\frac{x-1}{x-2} > 0 \Rightarrow \frac{(x-1)(x-2)}{(x-2)^2} > 0$

$\Rightarrow x \in (1, 2)$

119. (b) Projection of the vector  $\mathbf{A} = \mathbf{i} - 2\mathbf{j} + \mathbf{k}$  on the vector  $\mathbf{B}$

$$= 4\mathbf{i} - 4\mathbf{j} + 7\mathbf{k}$$

$$= \frac{\mathbf{A} \cdot \mathbf{B}}{|\mathbf{B}|} = \frac{4 + 8 + 7}{\sqrt{(4)^2 + (-4)^2 + (7)^2}}$$

$$= \frac{19}{\sqrt{16 + 16 + 49}} = \frac{19}{\sqrt{81}} = \frac{19}{9}$$

120. (d) Given,  $\left|z - \frac{2}{z}\right| = 6$

$$\Rightarrow z - \frac{2}{z} = \pm 6 \Rightarrow z^2 - 2 = \pm 6z$$

$$\Rightarrow z^2 - 6z - 2 = 0 \text{ or } z^2 + 6z - 2 = 0$$

$$\Rightarrow z = \frac{6 \pm \sqrt{36+8}}{2} \text{ or } z = \frac{-6 \pm \sqrt{36+8}}{2}$$

$$\Rightarrow z = \frac{6 \pm \sqrt{44}}{2} \text{ or } z = \frac{-6 \pm \sqrt{44}}{2}$$

$$\Rightarrow z = \frac{6 \pm 2\sqrt{11}}{2} \text{ or } z = \frac{-6 \pm 2\sqrt{11}}{2}$$

$$\Rightarrow z = 3 \pm \sqrt{11} \text{ or } z = -3 \pm \sqrt{11}$$

$$\Rightarrow z = 3 + \sqrt{11}, 3 - \sqrt{11}, -3 + \sqrt{11}, -3 - \sqrt{11}$$

$$\Rightarrow |z| = |3 + \sqrt{11}|, |3 - \sqrt{11}|, |-3 + \sqrt{11}|, |-3 - \sqrt{11}|$$

$$\Rightarrow |z| = 3 + \sqrt{11}, (\sqrt{11} - 3), (\sqrt{11} - 3), (3 + \sqrt{11})$$

So, maximum value of  $|z| = 3 + \sqrt{11}$  and minimum value of  $|z| = \sqrt{11} - 3$

**Paper 2**

- (c) First sentence of the passage is self explanatory. Density currents are kept in motion by a force created by variations of different parameters.
- (a) Stratification is a process of forming strata's. Layers of ocean or strata's of ocean are same things.
- (c) One thing is clear that they do not loose individuality, yes they move to hundreds of kilometers is also clear, these two things are only in option (c).
- (c) Option (b) is not true, transportation is changing and introduction of new methods of transportation speaks of improvement in the field. Various methods are facing the challenges but not the transportation.
- (c)
- (b) New and old both methods when available at same time increase the option for travellers.  
Although all seems to be true but correct option is (b).
- (a) Word 'still' in the sentence indicates that sea travel is least preferred. Option (b) can be ignored as some people are still using ships. Nothing has been discussed about the speed and time so, option (c) is also not true.
- (a) All the other options are in present while the passage is in past tense so, these can not be the answers. Although these look true.
- (c) These are the processes which have something from science and something from engineering so an interaction of the both. There is not a single sentence which shows other options of pure base.
- (c) He is a chemical engineer but does not have any influence on the process and can give valuable output to the process. Role is limited to only pipes, vessels etc but not the whole so he is very much constrained.
- (c) Anything that remains in fashion or popular for a short time is called FAD. Do not you remember the fashion of long hairs, middle-parted, after the success of film 'Tere Naam' this is an example of fad.
- (a) Vanity is showing grandeur and feeling important in himself. False Pride is perfect word. Fashion industry is full of people with this pompousness and self illusion. Make-up box of the women is also called vanity box.
- (a) A corpulent body means overweight and fleshy. Obese is another word for it. Lanky is tall and thin. Pale is yellowish. Reddish is red.
- (c) Option (a) seems funny. Rain is not there to wash a village. But, if the word wash is used figuratively then it can mean to destroy. But, here the meaning of word is flooded.
- (c) This word can be seen in the newspaper daily in reference to anything which is controversial and a debate is going on this topic. Debatable is the answer.
- (a) Rigmaroles are lengthy and confusing gol-gol processes. In our country unfortunately Government departments are full of these never ending processes.
- (b) Jettison is a word from the sea terminology when there is danger of ship being overloaded and going to sink for its weight they will throw out some of unnecessary items from ship in the sea. This is Jettison.
- (c) Integrity, probity, uprightness, honesty all are highly replaceable and carry a sense of correctness. Other options carry positive sense but not right in this context.
- (c) It is a quality of high minds -to dream in the day, to make plans that are impossible to achieve, to far fetch the conclusions, to see things from eyes of imagination. Imagination is correct word. Are you a Quixotic?
- (a) After reading the sentence you can tell the meaning of word even if you do not know the meaning initially. To fight earthquake you need strength no weakness. So, it is about strong.  
Next time do not rely on the sentence given in question remember the word.
- (a) Special liking for something is Penchant. Check the pronunciation of the word it is also interesting. Opposite is dislike. We Indians have penchant of cricket.
- (b) Dwell means abode, residing, residents etc. It antonym would be wander.
- (a) Offers made to somebody are called overtures .When you threat someone you are surely not offering him. So, threat is proper opposite of it.
- (b) To be contiguous means to lie with each other but special thing is lying in contact. Boundaries are in contact. Other options are irrelevant.
- (b) Last time I read this word, it was in an advertisement of a company. It says our aim is to be self dependent and make government help oblivious. This was the advertisement of Delhi Metro Rail Project. They were thinking of earning money from their ticket sales and by renting their properties. So, they were in the process of making government help redundant. Option (b) is right opposite.
- (a) Phobia is fear not confidence. Claustrophobia means phobia of small spaces.
- (d) Magnum –opus is a great work of art. This may be in writing, in painting or in some other forms of art. A great book is being written about Sachin and this may also contain blood signature of Sachin and be unique in style. This is Magnum-opus. Another example is magnum –opus of Tyeb Mehta fetching crores of rupees.
- (b) "You obnoxious breed \_\_\_\_\_" this is very popular

statement of cricket world which ashamed the game. Obnoxious is offensive. Pleasant is its antonym.

29. (d) Whimsical means eccentric, capricious. Its antonym would be composed.
30. (c) Recapitulate means to note down the main points. To summary is near synonym.
31. (c) Very easy question. Just choose the subject, verb and object and put them in sequence you will get the answer. Means are related to a family not Hussain.
32. (b) One interesting outcome of the entire episode has been a sudden improvement in him. No other option makes valid sentence.
33. (c) Subject of this sentence can be Muslim community or author. But 'to' has been put ahead of Muslim community so subject is latter one, more over verb is only in the part S. So starting part is S and to whom author will apologize. Next part is P and sequence is SPRQ
34. (a) The appraisal involved a quantitative assessment of the plan.
35. (b) You will find it easy to start the sentence from the part S then word simultaneously is critical as it indicates the involvement of two things at the same time and in part Q and R you will find them.
36. (b) Proper sequence can be SQRP or RPQS. But second one is good when a preceding sentence is given. If only one sentence is to be selected then first one is better.
37. (a) This background is necessary to understand the changing role of caste in Indian Society.  
Starting sentence is easy to find with having 'is'. Q cannot follow also S is starting with 'in' so it can not fit. Correct one is R. QS is proper in every respect.
38. (c) Knee jerk response is the key phrase that can tell the sequence. Knee jerk response cannot be from floods, it can be from only Governments so QR is easy to find. S has a verb and can be put with floods in part P so PS should also be there. Both sub sequences are given in option (c), giving proper meaning to the sentence.
39. (a) Roles are played and this role-play word is the hit for combination of Q and R. P is proper starting sentence due to 'that'. Proper sequence is PQRS.
40. (a) While going through parts, one will come to innovative steps and who can take innovative steps, definitely a Government. This logic will give you RS. Other sub sequence will be PQ.
41. (c) Aching is right not paining for a tooth. Pain is due to hurting or cutting of a body part.
42. (d) 'One's duty' is right expression not his duty.
43. (c) 'Abreast of' is right not 'abreast with'.
44. (b) 'The' will not be used ahead of name of language *i.e.*, English.
45. (b) Records itself are related to past achievements then there is no need of putting previous before records.
46. (c) As if will take 'were' with it, not was.
47. (c) Elder and younger are the words used in blood relations not in official ones, so older will replace elder.
48. (c) Reason is wrong; we ascertain the cause of death.
49. (c) 'Connivance along' is wrong 'connivance with' is right. This is standard English, can not be changed.
50. (d) 'In teaching profession' is better than 'in teaching line'. It is slang.
51. (a) The first Indian expedition to the South Pole successfully reached the pole last year, almost a century (99 years) after the Norwegian Roald Amudsen became the first human to reach the Southern most point of the Earth.  
The eight member team left from the Indian base station Maitri and reached South Pole in 9 days on November 22, 2010.
52. (a) It is scheduled to take place in Delhi in 2012. Originally, Bhutan was selected to host the game but it expressed its inability to host the games. So, Delhi stepped in to host of the Games. With this 12th edition of the games, India becomes 2nd country to host the games three times (Kolkata, 1987 and Chennai, 1995).
53. (a) Annals are a concise form of historical representation which record events chronologically, year by year.
54. (c) CAG's office modelled upon Government of India Act, 1935. His removal requires address from both the houses.  
CAG audits and reports on all expenditure from the Contingency Funds and Consolidated Fund and Public Accounts of Union, State and each Union territories having a Legislative Assembly as to whether such expenditure has been in accordance with the law.
55. (c) The Speaker of the Lok Sabha decides whether a bill is Money bill or not. A Money Bill can be introduced only in the House of the People.  
After a Money Bill has been passed by the House of the People, it shall be transmitted (with the Speaker's certificate that it is a Money Bill) to the Council of States for its recommendations. The Council of States cannot reject a Money Bill nor amend it by virtue of its own powers. It must, within a period of fourteen days from the date of receipt of the bill, return the bill to the House of the People which may thereupon either accept or reject all or any of the recommendations of the Council of States.
56. (d) Lok Adalat is a newer way of settling disputes both quickly and inexpensively. Lok Adalats were initially started and encouraged by a few judges of the Supreme Court of India as a way of promoting the voluntary settlements of disputes inexpensively and expeditiously. No appeal has been provided for an award from Lok Adalats to any court.
57. (b) Praga Tools — Hyderabad  
Heavy Vehicles Factory — Avadi  
Mazagaon Docks Ltd — Mumbai  
GRSE — Kolkata
58. (d) 1. Land and water surfaces react differently to the incoming solar radiation.  
2. Different kind of surfaces based on their colour and structure reflects different amounts of solar radiation.  
3. Intense daytime heating of the surface produces convection currents in atmosphere which transport heat to upper layers and moderate the temperature of particular place.  
4. Mountain ranges block the movements of air from one place to another and thus control the weather and climate of a locality.
59. (d) Tobin tax, suggested by Nobel Laureate James Tobin, is a tax

on all spot conversions of one currency into another. Under Tobin tax, at each exchange of a currency into another a small tax is levied. It was devised to cushion exchange rate fluctuations.

60. (a) It allows a subscriber to opt for the service provider of his choice but retain his mobile number. The number gets ported to the new provider. It was launched from 21st January, 2011.

Countries	Rank
China	4
Sri Lanka	36
Pakistan	59
Nepal	54
India	67
Bangladesh	70

Gabon ranked 1st in the Index.

The GHI is a multidimensional statistical tool used to describe the state of countries hunger situation. It measures progress and failures in the global fight against hunger.

It is developed by International Food Policy Research Institute and the Irish NGO concern worldwide.

62. (b) Samudragupta extended his reign to far North-West and his prestige and influence even reached outside India.

63. (d) A. The President has the power to legislate by ordinances at a time when it is not possible to have a Parliamentary enactment on the subject immediately. The ordinance may relate to any subject in respect of which Parliament has the right to legislate.

B. The President has the power to grant pardon reprieve, respite, suspension, remission or commutation in respect of punishment or sentence by court martial or in all cases where the sentence is one of death.

C. The President is given the power to make a "Proclamation of Emergency" on the ground of threat to the security of India or any part thereof by war, external aggression or armed rebellion-National Emergency, or incase of Constitutional breakdown in a state.

D. The President at any time can appoint a commission for the welfare of the ST in the states.

64. (a) The atmosphere is divided into 5 significant spheres based on temperature characteristics

**Troposphere** is the lowermost part of the atmosphere in which we live and in which most clouds form. It is also called the convective region as all the convective activities occur here e.g., cyclones, anticyclones and thunder storms.

**Tropopause** is a shallow layer separating troposphere from the next thermal layer of the atmosphere i.e., the stratosphere. It is the upper limit of most clouds and storms.

**Stratosphere** begins at the tropopauses. Temperature in its lower part does not change with altitude. The upper boundary of stratosphere is called Stratopause. Above this level there is steep rise in temperature.

**Ozonosphere** (Mesosphere) lies above stratopause and has the maximum concentration of ozone which absorbs the harmful ultraviolet rays of the Sun. Ionosphere lies next to ozonosphere and exosphere is the last significant sphere of atmosphere.

65. (d) Nag is a fourth generation "Fire and Forget" antitank missile developed by DRDO under the Integrated Guided Missile Development Programme. It weighs 42 kg and can engage targets upto 4-5 km range.

66. (c) Let initial velocity of upward projection of the object be, then under gravity maximum height covered by it

$$h = \frac{u^2}{2g}, \text{ in time } t = \frac{u}{g}$$

$$\therefore \text{Total time of flight, } T = 2t = \frac{2u}{g} \text{ and } d = 2h = \frac{u^2}{g}$$

In the absence of gravity, total distance is covered in same time

$$= u.T$$

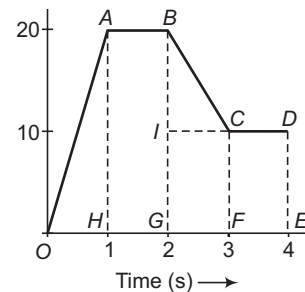
$$= u \times \frac{2u}{g} = \frac{2u^2}{g} = 2d$$

67. (c) As the coin behaves as a freely falling body having acceleration  $g$  either the lift is at rest or in uniform motion (upward/downward direction), the time taken by the coin in both the cases is same i.e.,  $t_1 = t_2$ .

68. (b) When a particle at rest suddenly disintegrates into two particles of equal masses, then due to principle of conservation of linear momentum, the two fragments will move in opposite directions with equal velocities.

69. (c) The distance travelled by the particle in 4 s is equal to the area between time velocity graph and time axis.

The required area = (Area of OAH + Area of ABGH + Area of BCI + Area of IDEG)



$$= \left( \frac{20}{2} \times 1 + 20 \times 1 + \frac{10}{2} \times 1 + 10 \times 1 \right) = 55 \text{ m}^2$$

Hence, the distance travelled = 55 m

70. (c) The frequency of oscillation,  $n = \frac{1}{T}$

$$\therefore T = 2\pi \sqrt{\frac{l}{g}}$$

$$\therefore n_{\text{earth}} = \frac{1}{2\pi} \sqrt{\frac{g}{l}}$$

and 
$$n_{\text{planet}} = \frac{1}{2\pi} \sqrt{\frac{g}{ql}}$$

$$\therefore \frac{n_{\text{planet}}}{n_{\text{earth}}} = \frac{1}{3}$$

or 
$$n_{\text{planet}} = \frac{1}{3} n_{\text{earth}}$$

71. (a) As the value of  $g$  at the poles remains unchanged whether the earth is rotating or not, therefore the weight of objects at either pole would be the same as before.

72. (d) The railway tracks are banked on the curves because the horizontal component of the reaction provided by the earth provides the required centripetal force.

73. (c) Let the common reading on Kelvin and Fahrenheit thermometer is  $x$ .

By the relation

$$\frac{K - 273}{100} = \frac{F - 32}{180}$$

$$\Rightarrow \frac{x - 273}{100} = \frac{x - 32}{180}$$

or  $9(x - 273) = 5(x - 32)$

or  $4x = 2297$

or  $x = 574.25 \text{ K or } ^\circ\text{F}$

$\therefore$  Reading on Celsius thermometer  
 $= 574.25 - 273 = 301.25^\circ\text{C}$

74. (a) The critical angle for glass-air medium

$$\text{air } n_{\text{glass}} = \frac{1}{\sin i_c}$$

or  $\sin i_c = \frac{1}{n_g}$

*i.e.*, critical angle  $\propto \frac{1}{\text{refractive index}}$

The refractive index of a medium or material depends upon the wavelength of the light falling on it. Refractive index of a medium is minimum for red light and maximum for violet light. Therefore, the critical angle for violet colour of light passing from glass to air is minimum.

75. (a) At any point of the circle the instantaneous velocity is along the tangent and the force along the radius. Thus, they are perpendicular to each other.

Work done,  $W = 0$

76. (b) The time period in first case,

$$T_1 = 2\pi \sqrt{\frac{K}{(M_1 + M_2)H}}$$

The time period in second case,

$$T_2 = 2\pi \sqrt{\frac{K}{(M_1 - M_2)H}}$$

Hence,  $\frac{M_1 + M_2}{M_1 - M_2} = \frac{(T_2)^2}{(T_1)^2}$

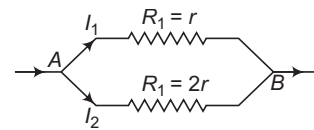
Hence,  $M_1 = 2M, M_2 = M$  and  $T_1 = 3$

$\therefore \frac{2M + M}{2M - M} = \frac{(T_2)^2}{(3)^2} \Rightarrow 3 = \frac{(T_2)^2}{9}$

or  $T_2 = \sqrt{27} = 3\sqrt{3} \text{ s}$

77. (b) The instruments can be protected by shielding with a hollow envelope of soft iron sheet. The magnetic field lines will crowd into the soft iron envelope so the region of space inside will remain protected from magnetic fields.

78. (d) The given situation can be shown as



According to question,

$$V_A - V_B = I_1 R_1 = I_2 R_2$$

$$\Rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1} \quad \dots(i)$$

Also,  $\frac{H_1}{H_2} = \frac{I_1^2 R_1 t}{I_2^2 R_2 t}$   
 $= \left(\frac{I_1}{I_2}\right)^2 \times \frac{R_1}{R_2}$

From Eq. (i), we get

$$\frac{H_1}{H_2} = \left(\frac{R_2}{R_1}\right)^2 \times \frac{R_1}{R_2} = \frac{R_2}{R_1} = \frac{2r}{r} = \frac{2}{1}$$

79. (b) When an electron is accelerated, then

$$eV = \frac{1}{2}mv^2$$

or  $v = \sqrt{\frac{2eV}{m}}$

or  $v = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 1}{9.1 \times 10^{-31}}}$

$$= \sqrt{\frac{2 \times 1.6 \times 10^{12}}{9.1}}$$

$$= 0.6 \times 10^6 = 6 \times 10^5 \text{ m/s}$$

80. (c) Radius of  $n$ th Bohr orbit in hydrogen atom

$$r \propto n^2$$

$\therefore \frac{r_4}{r_1} = \left(\frac{4}{1}\right)^2 = 16$

or  $r_4 = 16r_1 = 16 \times 0.528 = 8.45 \text{ \AA}$

81. (d) With in the range  $0^\circ\text{C}$  to  $4^\circ\text{C}$  water contracts on heating and expands on cooling *i.e.*, its coefficient of volume expansion is negative with in this range. This behaviour of water between  $0^\circ\text{C}$  and  $4^\circ\text{C}$  is called anomalous expansion. From the given graphs, graph  $d$  represents anomalous expansion of water correctly.

82. (d) A Planoconvex lens of focal length  $f = -20 \text{ cm}$  and refractive index  $n = 1.5$  will have radius of curvature of its curved surface  $R$  by

$$\frac{1}{f} = (n - 1) \left( \frac{1}{R} - \frac{1}{\infty} \right)$$

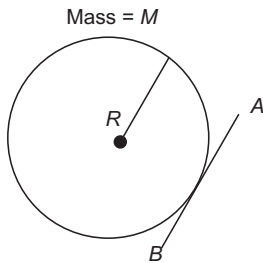
$\Rightarrow R = (n - 1)f = (1.5 - 1) \times (-20)$   
 $= -10 \text{ cm}$

A planoconvex lens with its plane surface silvered behave as a convergent mirror of focal length

$$f = \frac{-R}{2(n - 1)} = \frac{-(-10)}{2(1.5 - 1)} = +10 \text{ cm}$$

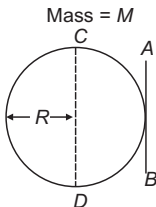
83. (a) During a nuclear fusion, two light nuclei under condition of high temperature and pressure, combine to give a heavier nucleus and possibly other products.
84. (b) As electron jumps from  $n = 4$  state (or any other state having  $n > 2$ ) to  $n = 2$  state, they results a spectral line of Balmer series and it lies in the visible region of electromagnetic spectrum. When electron jump from any higher state  $n \geq 2$  to ground state corresponding to  $n = 1$ , they results in a spectral line of Lyman series and it lies within the ultraviolet region of spectrum.
85. (b) **For circular ring**, MI about tangent and perpendicular to its plane.

$$\begin{aligned}
 I_T &= I_C + MR^2 && \text{(By parallel axes theorem)} \\
 &= MR^2 + MR^2 && (\because I_C = MR^2) \\
 &= 2MR^2
 \end{aligned}$$



**For hollow sphere**, MI about tangent

$$I_T = I_C + MR^2 \quad \text{(By parallel axes theorem)}$$



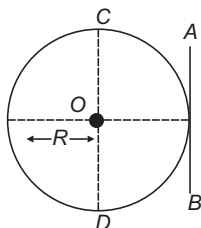
$$\begin{aligned}
 &= \frac{2}{3}MR^2 + MR^2 && \left( \because I_C = \frac{2}{3}MR^2 \right) \\
 &= \frac{5}{3}MR^2
 \end{aligned}$$

**For circular disc**, MI about tangent

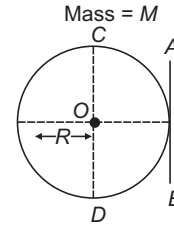
Applying parallel axes theorem

$$I_T = \text{MI of disc about diameter} + MR^2$$

$$\frac{MR^2}{4} + MR^2 = \frac{5MR^2}{4}$$



**For solid sphere**, MI about tangent applying parallel axes theorem



$$\begin{aligned}
 I_T &= \text{MI about diameter} + MR^2 \\
 &= \frac{2}{5}MR^2 + MR^2 + MR^2 \\
 &= \frac{7}{5}MR^2
 \end{aligned}$$

86. (b) Two electric field lines do not intersect one another if they do so then at the point of intersection, there will be two possible directions of electric field which is impossible. The electric field lines always start from a positive charge and end on a negative charge. So, both assertion and reason are true, but reason is not the correct explanation of assertion.
87. (a) Conventional direction of current is taken as the direction of flow of positive charge through a conductor. As electrons are negatively charged particles, hence they flow in a direction opposite to the direction of conventional current. Hence, both assertion and reason are true and reason is the correct explanation of assertion.
88. (b) Forces of action and reaction never cancel each other and each of them produces its own effect because the action and reaction forces never act on the same body. Action-reaction forces are equal and opposite. Hence, both assertion and reason are true but reason is not the correct explanation of assertion.
89. (b) The shape of a liquid drop is spherical because due to surface tension property drop wants to have minimum surface area and for a given volume surface area is minimum for spherical shape. The pressure inside the drop is greater than that outside. So, both assertion and reason are true but reason is not the correct explanation of assertion.
90. (c) In 1772, under Warren Hastings, the East India Company took over revenue collection directly in the Bengal Presidency.
91. (c) Farming System was adopted by Warren Hastings in 1772. Lord Cornwallis was established permanent settlement in 1793.
92. (c) **Jet streams** are fast flowing, narrow air currents found in the atmosphere of some planets, including Earth. The main jet streams are located near the tropopause, the transition between the troposphere (where temperature decreases with altitude). [1] The major jet streams on Earth are Westerly winds (flowing West to East). Their paths typically have a meandering shape; jet streams may start, stop, split into two or more parts, combine into one stream, or flow in various directions including the opposite direction of most of the jet. The strongest jet streams are the polar jets, at around 7-12 km (23000-39000 ft) above sea level, and the higher and somewhat weaker subtropical jets at around 10 -16 km (33000-52000 ft). The Northern hemisphere and the Southern hemisphere each have both a polar jet and a subtropical jet. The Northern hemisphere polar jet flows over the

middle to Northern latitudes of North America, Europe, and Asia and their intervening oceans, while the Southern hemisphere polar jet mostly circles Antarctica all year round.

Jet streams are caused by a combination of a planet's rotation on its axis and atmospheric heating (by solar radiation and, on some planets other than Earth, internal heat). Jet streams form near boundaries of adjacent air masses with significant differences in temperature, such as the polar region and the warmer air towards the equator.

93. (d) The balance between the incoming heat and the outgoing heat in the atmosphere is known as Earth's heat budget.
94. (a) WMO provides scientific voice on the state and behaviour of the Earth's atmosphere.
95. (d) Non existence of God and Soul was the doctrine of Buddhism.
96. (a) He achieved this to great effect at the world Parliament of Religions held at Chicago in 1893.
97. (b) The debate and disagreement between the moderates and extremists in the INC led to the Surat split of Congress in 1907. The extremists wanted to extend the Swadeshi and Boycott Movement from Bengal to the rest of the country and extend boycott to every form of association with the colonial government. The moderates wanted to confine the movement to Bengal and to limit it to the boycott of foreign goods.
98. (c) He commenced the 'fast unto death' in jail to secure abolition of separate electorates for Harijans in Communal Award. But, separate electorates for untouchables was supported by Bhimrao Ramji Ambedkar.
99. (b) 1. 1946-The cabinet mission was sent by British Government in 1946, to find a solution to the political deadlock between the two major parties, Congress and Muslim League.  
2. March 1942-Sir Stafford Cripps was sent with constitutional proposals by the British Government to get the cooperation of the Indian people in order to deal with the 2nd World War situation.  
3. 1945-Wavell Plan was the plan of action framed by Lord Wavell, the Viceroy of India about the future of India with British administration. The plan suggested reconstitution of the Viceroy's Executive Council in which the viceroy was to select persons nominated by the political parties. Reservations were also made for cast-Hindus, Muslims and other communities.  
4. On July 14, 1942 the INC passed resolution demanding complete independence from the British Government. The draft proposed massive civil disobedience if the British did not accede to the demands.  
5. It was a proposal formulated by CRajagopalachari to solve the political deadlock between All India Muslim League and INC. It proposed for a plebiscite of all the peoples in the regions where Muslims made majority.
100. (c) Yenglik Senbatra, newly elected Prime Minister of Thailand was the chief guest on 63rd Republic day.
101. (b) 3. The variability of monsoon rain is lowest over North-East and highest over North-West India.  
4. The Easterly jet suddenly shifts Northwards with advent of monsoon due to low pressure system generated on Tibetan plateau.
102. (b) This socio political movement was started by Arya Samaj and its founder Swami Dayanand Saraswati and his follower Swami Shradhanand in North India in early 1900s. It aimed at abolishing the practice of untouchability by converting the outcasts from other religions to Hinduism.
103. (a) Tilak was an extremist leader and opposed the moderates style of petition and presentation before government through their annual meeting held once a year in the month of December.
104. (c) It was a movement founded by Punjabi Indians in US and Canada with the aim to liberate India from British rule. The party was formed in 1913, under the leadership of Har Dayal and Sohan Singh Bhakna.
105. (c) In a closed room carbon monoxide (CO) is formed by the incomplete combustion of coal. It is an extremely poisonous gas and combines chemically with haemoglobin present in the blood to form carboxyhaemoglobin and makes it unfit for carrying oxygen to the tissues. Hence, the man becomes unconscious.
106. (d) Two different layers in graphite are held together by weak van der Waal's forces. The distance between two successive sheets is  $3.40 \text{ \AA}$ . This large distance indicates that the carbon sheets in graphite are held together by weak van der Waal's forces of attraction.
107. (c) Producer gas is a mixture of carbon monoxide (CO) and nitrogen ( $\text{N}_2$ ). It is prepared by burning coke in a limited supply of air.
108. (a) All ores are minerals but all minerals are not ores.
109. (c) The red colour of ruby is due to the presence of chromium oxide.
110. (d) Titanium (Ti) does not corrode by sea water. Hence, it is used for making boats.
111. (a) Optical fibre is used in endoscope through which doctors look inside a patient's body specially stomach during endoscopy.
112. (b) In Rutherford's gold foil experiment, very few  $\alpha$ -particles are deflected back because nucleus present inside the atom is heavy but small.
113. (d)  $\text{ClF}_3$  does not follow octet rule since the valence shell of the central atom i.e., Cl has 10 electrons.
114. (b) As a result of osmosis, the volume of the solution increases because net flow of the solvent into the solution.
115. (a) Magnesium oxide (MgO) has high melting point. Hence, it does not decompose in Bunsen burner to give  $\text{O}_2$  gas. All other compounds decompose to give  $\text{O}_2$  gas.
- $$2\text{Pb}_3\text{O}_4 \xrightarrow{\Delta} 6\text{PbO} + \text{O}_2$$
- $$2\text{NaNO}_3 \xrightarrow{\Delta} 2\text{NaNO}_2 + \text{O}_2$$
- $$2\text{KClO}_3 \xrightarrow{\Delta} 2\text{KCl} + 3\text{O}_2$$
116. (b) Washing soda is sodium carbonate decahydrate ( $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$ ).  
Marble is calcium carbonate ( $\text{CaCO}_3$ ).

Baking soda is sodium hydrogen carbonate ( $\text{NaHCO}_3$ ).

Soda ash is sodium carbonate ( $\text{Na}_2\text{CO}_3$ ).

117. (b) Starch is the chief food reserve in the plants. It is a mixture of  $\alpha$ -amylose and  $\beta$ -amylose or amylopectin.  $\alpha$ -amylose is a linear polymer while  $\beta$ -amylose or amylopectin is a highly branched polymer.
118. (d) Cesium has lowest ionization energy. Hence, it gives photo electrons most easily.
119. (c)  $\text{K}^+ \text{C} \equiv \text{N}$  contains ionic as well as covalent bonds.
120. (c) Neutrons in  ${}_{32}\text{Ge}^{76} = 76 - 32 = 44$   
 Neutrons in  ${}_{32}\text{Ge}^{77} = 77 - 32 = 45$   
 Neutrons in  ${}_{33}\text{As}^{77} = 77 - 33 = 44$   
 Neutrons in  ${}_{34}\text{Se}^{77} = 77 - 34 = 43$   
 Neutrons in  ${}_{32}\text{Ge}^{78} = 78 - 32 = 46$   
 Hence,  ${}_{32}\text{Ge}^{76}$ ,  ${}_{33}\text{As}^{77}$ ,  ${}_{34}\text{Se}^{78}$  are isotones.
121. (a) Soda water is  $\text{CO}_2$  dissolved in water and hence is acidic i.e., pH.
122. (d)  $\text{NO}_2 \xrightarrow{+4} \text{NO}_3^- \xrightarrow{+3}$   
 $\text{NO}_3^- \xrightarrow{+5} \text{NO}^+ \xrightarrow{+2}$   
 $\text{NO}_3^- \xrightarrow{+5} \text{NH}_4^+ \xrightarrow{-3}$   
 $\text{NH}_4^+ \xrightarrow{-3} \text{N}_2 \xrightarrow{0}$
123. (c) Kanchenjunga is the 3rd highest mountain of the world and located along the India-Nepal border in the Himalayas.
124. (b) Vijayanagar empire was established by Harihara and Bukka Raya in 1336, in Deccan plateau in South India. Hampi in modern Karnataka is now a world heritage site.
125. (d) Chilka Lake — Odisha  
 Sambhar Lake — Rajasthan  
 Lonar Lake — Maharashtra  
 Nal Lake — Gujarat
126. (a) A. Founded by moderate leader of INC, Gopal Krishna Gokhale on June 12, 1905 in Pune. He wanted to promote social and human development in India through this organisation to overthrow the British rule.  
 B. Founded by Radhakant Deb in 1829 along with his conservative Hindu friends to protest against the abolition of Sati by William Bentinck in December 1829.  
 C. Established by Devendranath Tagore on 6 October 1839. It was a reform movement organization to popularize Brahmodharma or Brahma faith and propagate the spirit of Hindu scripture.  
 D. Founded in 1815, by Rammohan Roy for the dissemination of the religious truth and the promotion of free discussions of theological subjects.
127. (a) Nuclear Command Authority established in 2003, is the Nodal agency for all command, control and operational decisions regarding India's nuclear weapon stockpile.
128. (d) Head Quarters of Southern Command is situated at Poona in Maharashtra.
129. (a) A-1848 during Lord Harding  
 B-1843 Lord Ellenborough  
 C-1850 During Dalhousie  
 D-1856 Dalhousie.
130. (b) Oxalic acid is found in spinach, citric acid in citrus fruits, lactic acid in curd and tartaric acid in tamarind, grapes and unripe mangoes.
131. (a) Golden rice is genetically modified rice containing B carotens and iron. B carotene is precursor of vitamin-A necessary for eye functioning.
132. (c) Acromegaly is caused by excess of growth hormone after adult size is reached. Diabetes insipidus is caused by the deficiency of ADH. Diabetes mellitus is caused due to deficiency of insulin hormone. Tetany is caused due to hyposecretion of parathormone.
133. (d) Bats are mammals. They are nocturnal frugivorous (fruit eater) and show true flight with the help of patagia. They have wings which are actually modified wings.
134. (a) 135. (b) 136. (c) 137. (b)
138. (b) Blood pressure is the pressure exerted by the blood on the wall of blood vessels in which it is present. Usually it is measured in arteries by sphygmomanometer invented by Karot Koff (1905).
139. (b) Ozone layer is present in stratosphere and protect us from UV rays. Chlorofluorocarbons are stable chemicals and destroyed ozone layer.
140. (c) Monsoon is a seasonal reversal of wind accompanied by corresponding changes in precipitation. High temperature contrast is required to set up massive energy to generate monsoon. But when the land and sea distribution is homogenous, high temperature contrast can not be build up so the monsoon does not occur there.
141. (d) Vijayanta is the main battle tank built in India. It was the first indigeneous tank of the Indian Army. The tank entered into service in 1965.  
 Arjun is a third generation main battle tank developed by India's DRDO. The tank is named for Arjun, a character in the Indian Epic, Mahabharata. It entered service with Indian Army in 2004.
142. (d) Reflection and scattering sends the solar rays back into space and does not let it enter the Earth's atmosphere.
143. (a) **Types of Soil found in India**  
 Indian soils are generally divided into four broad types. These soil types are (1) alluvial soils, (2) regur soils : (3) red soils and (4) laterite soils  
**Alluvial Soils** This is the most important and widespread category. It covers 40% of the land area. In fact the entire Northern Plains are made up of these soils. They have been brought down and deposited by three great Himalayan rivers-Sutlej, Ganga and Brahmaputra and their tributaries. Through a narrow corridor in Rajasthan they extend into the plains of Gujarat. They are common in Eastern coastal plains and in the deltas of Mahanadi, Godavari, Krishna and Cauveri.  
**Regur Soils** These soils are black in colour and are also known as black soils. Since, they are ideal for growing cotton, they are also called cotton soils, in addition to their normal nomenclature

of regur soils. These soils are most typical of the Deccan trap (Basalt) region spread over North-West Deccan plateau and are made up of lava flows. They cover the plateaus of Maharashtra, Saurashtra, Malwa and Southern Madhya Pradesh and extends Eastwards in the South along the Godavari and Krishan Valleys.

**Red Soils** These soils are developed on old crystalline rocks under moderate to heavy rainfall conditions. They are deficient in phosphoric acid, organic matter and nitrogenous material. Red soils cover the Eastern part of the peninsular region comprising Chhotanagpur, Odisha, Eastern Madhya Pradesh, Telangana, the Nilgiris and Tamil Nadu plateau. They extended Northwards in the West along the Konkan coast of Maharashtra.

**Laterite Soils** The laterite soils is the result of intense leaching owing to heavy tropical rains. They are found along the edge of plateau in the East covering small parts of Tamil Nadu, and Odisha and a small part of Chhotanagpur in the North and Meghalaya in the North-East.

144. (c) 1. Nimbo stratus is uniform, dark, flat, low, featureless clouds that produce precipitation. It forms at mid-altitude but subsides into altitude ranges during precipitation.
2. Alto stratus is thin and uniform cloud at mid altitude.
3. Alto cumulus is medium sized puffy, patchy, scattered clouds often in linear bands.
4. Cirro stratus is thin, wispy and appears in sheets. It is a high altitude cloud located above thunder stomheads.
145. (b) A. Biosphere reserve protect larger areas of natural habitat than a national park or animal sanctuary. Here protection is granted not only to flora and fauna but also to the human communities who in habit these regions and their ways of life. Nilgiri Biosphere Reserve established in 2000.
- B. There are 166 national parks in India to safeguard the habitats of conservation reliant species. Panna National Park was established in Madhya Pradesh in 1973.
- C. A wetland is an area of land whose soil is saturated with water either permanently or seasonally. These are the transitional zones between permanently aquatic and dry terrestrial ecosystems. Sambhar lake of India recognized in 1990.
- D. Karakoram is a high altitude sanctuary located in Leh district of J&K. It has migratory population of Chiru or "Tibetan Antelope".
146. (d) It is a series of water waves caused by the displacement of a large volume of a body of water, typically an ocean or a large lake. Earthquakes, volcanic eruptions and other under water explosions have the potential to generate a tsunami.
147. (d) The green house effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric green house gases and is re-radiated in all directions. Since part of this is re-radiated back towards the surface, the temperature of lower atmosphere and the surface increases leading to global warming.
148. (a) Savanna is a permanent grasslands. Sal, Teak and Sandal are wet temperate forests.
149. (d) 1. Irregular distribution of land and sea in Northern hemisphere.
2. Due to difference in temperature of land and sea.
3. Cold ocean currents marks sharp temperature change with surrounding water.
4. Due to combined effect of warm ocean currents of Gulf stream and the North Atlantic Drif and the Southerly winds.
150. (d)
- |             |   |        |
|-------------|---|--------|
| Meghalaya   | — | 85.94% |
| Nagaland    | — | 89.15% |
| Mizoram     | — | 94.46% |
| Lakshadweep | — | 94.51% |
| Asom        | — | 12.41% |