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UPSC NDA Exam 2009-II Mathematics Solved  
Paper

1. If  $(1 + 3 + 5 + \dots + p) + (1 + 3 + 5 + \dots + q) = (1 + 3 + 5 + \dots + r)$  where each set of parentheses contains the sum of consecutive odd integers as shown, what is the smallest possible value of  $(p + q + r)$  where  $p > 6$  ?  
 (a) 12 (b) 21 (c) 45 (d) 54
2. Let  $A = \{x \mid x \leq 9, x \in N\}$ . Let  $B = \{a, b, c\}$  be the subset of  $A$  where  $(a + b + c)$  is a multiple of 3. What is the largest possible number of subsets like  $B$  ?  
 (a) 12 (b) 21 (c) 27 (d) 30
3. Let  $A = \{-1, 2, 5, 8\}$ ,  $B = \{0, 1, 3, 6, 7\}$  and  $R$  be the relation 'is one less than' from  $A$  to  $B$ , then how many elements will  $R$  contain ?  
 (a) 2 (b) 3 (c) 5 (d) 9
4. A mapping  $f : R \rightarrow R$  which is defined as  $f(x) = \cos x$ ;  $x \in R$  is  
 (a) One-one only  
 (b) Onto only  
 (c) One-one onto  
 (d) Neither one-one nor onto
5. If  $\alpha$  is a complex number such that  $\alpha^2 + \alpha + 1 = 0$ , then what is  $\alpha^{31}$  equal to ?  
 (a)  $\alpha$  (b)  $\alpha^2$   
 (c) 0 (d) 1
6. If  $x^2, y^2, z^2$  are in AP, then  $y + z, z + x, x + y$  are in  
 (a) AP  
 (b) HP  
 (c) GP  
 (d) None of the above
7. Natural numbers are divided into groups as (1), (2, 3), (4, 5, 6), (7, 8, 9, 10) and so on. What is the sum of the numbers in the 11th group ?  
 (a) 605 (b) 615  
 (c) 671 (d) 693
8. If  $\alpha, \beta$  are the roots of  $ax^2 + bx + b = 0$ , then what is  $\frac{\sqrt{\alpha}}{\sqrt{\beta}} + \frac{\sqrt{\beta}}{\sqrt{\alpha}} + \frac{\sqrt{b}}{\sqrt{a}}$  equal to ?  
 (a) 0 (b) 1  
 (c) 2 (d) 3
9. If the roots of  $ax^2 + bx + c = 0$  are  $\sin \alpha$  and  $\cos \alpha$  for some  $\alpha$ , then which one of the following is correct ?  
 (a)  $a^2 + b^2 = 2ac$  (b)  $b^2 - c^2 = 2ab$   
 (c)  $b^2 - a^2 = 2ac$  (d)  $b^2 + c^2 = 2ab$
10. What is the coefficient of  $x^4$  in the expansion of  $(1 + 2x + 3x^2 + 4x^3 + \dots)^{1/2}$  ?  
 (a) 1/4 (b) 1/16  
 (c) 1 (d) 1/128
11. If  $x = 2 + 2^{1/3} + 2^{2/3}$ , then what is the value of  $x^3 - 6x^2 + 6x$  ?  
 (a) 1 (b) 2  
 (c) 3 (d) -2
12. What is the value of  $\frac{(\log_{27} 9)(\log_{16} 64)}{\log_4 \sqrt{2}}$  ?  
 (a) 1 (b) 2  
 (c) 4 (d) 8
13. If  $X$  and  $Y$  are the matrices of order  $2 \times 2$  each and  $2X - 3Y = \begin{bmatrix} -7 & 0 \\ 7 & -13 \end{bmatrix}$  and  $3X + 2Y = \begin{bmatrix} 9 & 13 \\ 4 & 13 \end{bmatrix}$ , then what is  $Y$  equal to ?  
 (a)  $\begin{bmatrix} 1 & 3 \\ -2 & 1 \end{bmatrix}$  (b)  $\begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}$   
 (c)  $\begin{bmatrix} 3 & 2 \\ -1 & 5 \end{bmatrix}$  (d)  $\begin{bmatrix} 3 & 2 \\ 1 & -5 \end{bmatrix}$
14. If  $a, b, c$  are non-zero real numbers and  $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & a+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = 0$ , then what is the value of  $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$  ?  
 (a) 2 (b) 1  
 (c) -1 (d) 0
15. If a matrix  $A$  is symmetric as well as anti-symmetric, then which one of the following is correct ?  
 (a)  $A$  is a diagonal matrix  
 (b)  $A$  is a null matrix  
 (c)  $A$  is a unit matrix  
 (d)  $A$  is a triangular matrix
16. If  $A = \begin{bmatrix} 1 & -2 & -3 \\ 2 & 1 & -2 \\ 3 & 2 & 1 \end{bmatrix}$ , then which one of the following is correct ?  
 (a)  $A$  is symmetric matrix  
 (b)  $A$  is anti-symmetric matrix  
 (c)  $A$  is singular matrix  
 (d)  $A$  is non-singular matrix
17.  $A = \begin{vmatrix} 2a & 3r & x \\ 4b & 6s & 2y \\ -2c & -3t & -z \end{vmatrix} = \lambda \begin{vmatrix} a & r & x \\ b & s & y \\ c & t & z \end{vmatrix}$ , then what is the value of  $\lambda$  ?  
 (a) 12 (b) -12  
 (c) 7 (d) -7
18. What is the value of  $\begin{vmatrix} 1-i & \omega^2 & \omega \\ \omega^2+i & \omega & -i \\ 1-2i-\omega^2 & \omega^2-\omega & i-\omega \end{vmatrix}$ , where  $\omega$  is the cube root of unity ?  
 (a) -1 (b) 1  
 (c) 2 (d) 0
19. What is the length of arc of a circle of radius 5 cm subtending a central angle measuring  $15^\circ$  ?  
 (a)  $5\pi/12$  cm (b)  $7\pi/12$  cm  
 (c)  $\pi/12$  cm (d)  $\pi/5$  cm
20. What is the maximum value of  $\sin \theta \cos \theta$  ?  
 (a) 1 (b) 1/2  
 (c)  $1/\sqrt{2}$  (d)  $\sqrt{3}/2$
21. If  $\sin x + \operatorname{cosec} x = 2$ , then what is the value of  $\sin^4 x + \operatorname{cosec}^4 x$  ?  
 (a) 2 (b) 4  
 (c) 8 (d) 16

22. What is the value of  $\tan 15^\circ + \cot 15^\circ$  ?  
 (a)  $\sqrt{3}$  (b)  $2\sqrt{3}$   
 (c) 4 (d) 2
23. If  $A + B + C = \pi/2$ , then what is the value of  $\tan A \tan B + \tan B \tan C + \tan C \tan A$  ?  
 (a) 0 (b) 1  
 (c) -1 (d)  $\tan A \tan B \tan C$
24. If angles of a triangle are in the ratio 1 : 2 : 3, then what is the ratio of its corresponding sides ?  
 (a) 3 : 2 : 1 (b)  $1 : \sqrt{2} : \sqrt{3}$   
 (c)  $1 : \sqrt{3} : 2$  (d)  $2 : \sqrt{3} : 4$
25. If  $C(n, 12) = C(n, 8)$ , then what is the value of  $C(22, n)$  ?  
 (a) 131 (b) 231  
 (c) 256 (d) 292
26. If  $A = \begin{bmatrix} \omega & 0 \\ 0 & \omega^2 \end{bmatrix}$ , where  $\omega$  is cube root of unity, then what is  $A^{100}$  equal to ?  
 (a) A (b)  $-A$   
 (c) Null matrix (d) Identity matrix
27. What is the modulus of  $\frac{1+2i}{1-(1-i)^2}$  equal to ?  
 (a) 5 (b) 4  
 (c) 3 (d) 1
28. What is the value of  $(-\sqrt{-1})^{4n+3} + (i^{41} + i^{-257})^9$ , where  $n \in N$  ?  
 (a) 0 (b) 1  
 (c)  $i$  (d)  $-i$
29. If  $x = (1101)_2$  and  $y = (110)_2$ , then what is the value of  $x^2 - y^2$  ?  
 (a)  $(1000101)_2$  (b)  $(10000101)_2$   
 (c)  $(10001101)_2$  (d)  $(10010101)_2$
30. If  $(10x010)_2 - (11y1)_2 = (10z11)_2$ , then what are the possible values of the binary digits  $x, y, z$  respectively ?  
 (a) 0, 0, 1 (b) 0, 1, 0  
 (c) 1, 1, 0 (d) 0, 0, 0
31. The roots of the equation  $(x-p)(x-q) = r^2$ , where  $p, q, r$  are real, are  
 (a) always complex (b) always real  
 (c) always purely imaginary (d) None of these
32. If  $(\sin x + \operatorname{cosec} x)^2 + (\cos x + \sec x)^2 = k + \tan^2 x + \cot^2 x$ , then what is the value of  $k$  ?  
 (a) 8 (b) 7  
 (c) 4 (d) 3
33. A matrix  $X$  has  $(a+b)$  rows and  $(a+2)$  columns; and a matrix  $Y$  has  $(b+1)$  rows and  $(a+3)$  columns. If both  $XY$  and  $YX$  exist, then what are the values of  $a, b$  respectively ?  
 (a) 3, 2 (b) 2, 3  
 (c) 2, 4 (d) 4, 3
34. In a football championship 153 matches were played. Every team played one match with each other team. How many teams participated in the championship ?  
 (a) 21 (b) 18  
 (c) 17 (d) 15
35. The equation  $x - 2(x-1)^{-1} = 1 - 2(x-1)^{-1}$  has  
 (a) no roots (b) one root  
 (c) two equal roots (d) infinite roots
36. The number 0.0011 in binary system represents  
 (a) rational number  $3/8$  in decimal system  
 (b) rational number  $1/8$  in decimal system  
 (c) rational number  $3/16$  in decimal system  
 (d) rational number  $5/16$  in decimal system
37. The function  $y = \tan^{-1} x - x$   
 (a) is always decreasing  
 (b) is always increasing  
 (c) first increases and then decreases  
 (d) first decreases and then increases
38. If  $n(A) = 115, n(B) = 326, n(A-B) = 47$ , then what is  $n(A \cup B)$  equal to ?  
 (a) 373 (b) 165  
 (c) 370 (d) 394
39. What does the equation  $x dy = y dx$  represent ?  
 (a) A family of circles  
 (b) A family of parabolas  
 (c) A family of hyperbolas  
 (d) A family of straight lines
40. What is the value of  $k$  if the area bounded by the curve  $y = \sin kx, y = 0, x = \pi/k, x = \pi/(3k)$  is 3 sq unit ?  
 (a)  $1/2$  (b) 1  
 (c)  $3/2$  (d) 2
41. What is the solution of the differential equation  $x dy - y dx = xy^2 dx$  ?  
 (a)  $y + x^{-2} = c$  (b)  $y^2 + 2x^{-1} = c$   
 (c)  $y + x^{-1} = c$  (d)  $x^2 + 2xy^{-1} = c$   
 where  $c$  is a constant.
42. If  $f(x) = a + bx + cx^2$ , then what is  $\int_0^1 f(x) dx$  equal to ?  
 (a)  $[f(0) + 4f(1/2) + f(1)]/6$   
 (b)  $[f(0) + 4f(1/2) + f(1)]/3$   
 (c)  $[f(0) + 4f(1/2) + f(1)]$   
 (d)  $[f(0) + 2f(1/2) + f(1)]/6$
43. What is  $\int \frac{a+b \sin x}{\cos^2 x} dx$  equal to ?  
 (a)  $a \sec x + b \tan x + c$   
 (b)  $a \tan x + b \sec x + c$   
 (c)  $a \cot x + b \operatorname{cosec} x + c$   
 (d)  $a \operatorname{cosec} x + b \cot x + c$   
 where  $a, b, c$  are constants.
44. If  $e^x + xy = e$ , then what is the value of  $\frac{d^2y}{dx^2}$  at  $x=0$  ?  
 (a)  $e^{-1}$  (b)  $e^{-2}$   
 (c)  $e$  (d) 1
45. What is  $\int \frac{\log x}{(1+\log x)^2} dx$  equal to ?  
 (a)  $\frac{1}{(1+\log x)^3} + c$  (b)  $\frac{1}{(1+\log x)^2} + c$   
 (c)  $\frac{x}{(1+\log x)} + c$  (d)  $\frac{x}{(1+\log x)^2} + c$   
 where  $c$  is a constant.
46. If  $P(A)$  denotes the power set of  $A$  and  $A$  is the void set, then what is number of elements in  $P\{P\{P(A)\}\}$  ?  
 (a) 0 (b) 1  
 (c) 4 (d) 16
47. What is  $\lim_{x \rightarrow \infty} \left(\frac{x}{3+x}\right)^{3x}$  equal to ?  
 (a)  $e$  (b)  $e^3$   
 (c)  $e^{-9}$  (d)  $e^9$

48. Consider the following function  $f: R \rightarrow R$  such that  $f(x) = x$  if  $x \geq 0$  and  $f(x) = -x^2$  if  $x < 0$ . Then, which one of the following is correct ?  
 (a)  $f(x)$  is continuous at every  $x \in R$   
 (b)  $f(x)$  is continuous at  $x = 0$  only  
 (c)  $f(x)$  is discontinuous at  $x = 0$  only  
 (d)  $f(x)$  is discontinuous at every  $x \in R$
49. If  $\sqrt{1-x^2} + \sqrt{1-y^2} = a$ , then what is  $\frac{dy}{dx}$  equal to ?  
 (a)  $\sqrt{(1-x^2)(1-y^2)}$  (b)  $\sqrt{\frac{1-y^2}{1-x^2}}$   
 (c)  $\sqrt{\frac{1-x^2}{1-y^2}}$  (d) None of these
50. If  $x = \log t$  and  $y = t^2 - 1$ , then what is  $\frac{d^2y}{dx^2}$  at  $t = 1$  equal to ?  
 (a) 2 (b) 3 (c) -4 (d) 4
51. Which one of the following functions  $f: R \rightarrow R$  is injective ?  
 (a)  $f(x) = |x|$  for all  $x \in R$   
 (b)  $f(x) = x^2$  for all  $x \in R$   
 (c)  $f(x) = 11$  for all  $x \in R$   
 (d)  $f(x) = -x$  for all  $x \in R$
52. What is the derivative of  $\log_x 5$  with respect to  $\log_5 x$  ?  
 (a)  $-(\log_5 x)^{-2}$  (b)  $(\log_5 x)^{-2}$   
 (c)  $-(\log_x 5)^{-2}$  (d)  $(\log_x 5)^{-2}$
53. The velocity  $v$  of a particle at any instant  $t$  moving in a straight line is given by  $v = s + 1$  where  $s$  metre is the distance travelled in  $t$  second. What is the time taken by the particle to cover a distance of 9 m ?  
 (a) 1 s (b)  $(\log 10)$  s  
 (c)  $2 (\log 10)$  s (d) 10 s
54. The curve  $y^2 = -4ax$  ( $a > 0$ ) lies in  
 (a) First and fourth quadrants  
 (b) First and second quadrants  
 (c) Second and third quadrants  
 (d) Third and fourth quadrants
55. The circle  $x^2 + y^2 + 4x - 4y + 4 = 0$  touches  
 (a) Only the x-axis (b) Only the y-axis  
 (c) Both the axes (d) Neither of the axes
56. What is the value of  $n$  so that the angle between the lines having direction ratios  $(1, 1, 1)$  and  $(1, -1, n)$  is  $60^\circ$  ?  
 (a)  $\sqrt{3}$  (b)  $\sqrt{6}$   
 (c) 3 (d) None of these
57. What is the product of the perpendiculars from the two points  $(\pm\sqrt{b^2 - a^2}, 0)$  to the line  $ax \cos \phi + by \sin \phi = ab$  ?  
 (a)  $a^2$  (b)  $b^2$   
 (c)  $ab$  (d)  $a/b$
58. The middle point of the segment of the straight line joining the points  $(p, q)$  and  $(q, -p)$  is  $(r/2, s/2)$ . What is the length of the segment ?  
 (a)  $[(s^2 + r^2)^{1/2}]/2$  (b)  $[(s^2 + r^2)^{1/2}]/4$   
 (c)  $(s^2 + r^2)^{1/2}$  (d)  $s + r$
59. The direction cosines of a line are proportional to  $(2, 1, 2)$  and the line intersects a plane perpendicularly at the point  $(1, -2, 4)$ . What is the distance of the plane from the point  $(3, 2, 3)$  ?  
 (a)  $\sqrt{3}$  (b) 2  
 (c)  $2\sqrt{2}$  (d) 4
60. The foot of the perpendicular drawn from the origin to a plane is the point  $(1, -3, 1)$ . What is the intercept cut on the x-axis by the plane ?  
 (a) 1 (b) 3  
 (c)  $\sqrt{11}$  (d) 11
61. A line makes the same angle  $\alpha$  with each of the x and y axes. If the angle  $\theta$ , which it makes with the z-axis, is such that  $\sin^2 \theta = 2 \sin^2 \alpha$ , then what is the value of  $\alpha$  ?  
 (a)  $\pi/4$  (b)  $\pi/6$   
 (c)  $\pi/3$  (d)  $\pi/2$
62. What is the locus of a point which is equidistant from the point  $(m + n, n - m)$  and the point  $(m - n, n + m)$  ?  
 (a)  $mx = ny$  (b)  $nx = -my$   
 (c)  $nx = my$  (d)  $mx = -ny$
63. What is the equation of the sphere which has its centre at  $(6, -1, 2)$  and touches the plane  $2x - y + 2z - 2 = 0$  ?  
 (a)  $x^2 + y^2 + z^2 + 12x - 2y + 4z + 16 = 0$   
 (b)  $x^2 + y^2 + z^2 + 12x - 2y + 4z - 16 = 0$   
 (c)  $x^2 + y^2 + z^2 - 12x + 2y - 4z + 16 = 0$   
 (d)  $x^2 + y^2 + z^2 - 12x + 2y - 4z + 25 = 0$
64. What are the direction ratios of the line determined by the planes  $x - y + 2z = 1$  and  $x + y - z = 3$  ?  
 (a)  $(-1, 3, 2)$  (b)  $(-1, -3, 2)$   
 (c)  $(2, 1, 3)$  (d)  $(2, 3, 2)$
65. The ellipse  $\frac{x^2}{169} + \frac{y^2}{25} = 1$  has the same eccentricity as the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ . What is the ratio of  $a$  to  $b$  ?  
 (a)  $5/13$  (b)  $13/5$   
 (c)  $7/8$  (d)  $8/7$
66. If  $\hat{a}$  and  $\hat{b}$  are the unit vectors along  $\vec{a}$  and  $\vec{b}$  respectively, then what is the projection of  $\vec{b}$  on  $\vec{a}$  ?  
 (a)  $\vec{a} \cdot \vec{b}$  (b)  $\hat{a} \cdot \hat{b}$   
 (c)  $\hat{a} \cdot \vec{b}$  (d)  $|\vec{a} \times \vec{b}|$
67. What are the unit vectors parallel to xy-plane and perpendicular to the vector  $4\hat{i} - 3\hat{j} + \hat{k}$  ?  
 (a)  $\pm(3\hat{i} + 4\hat{j})/5$  (b)  $\pm(4\hat{i} + 3\hat{j})/5$   
 (c)  $\pm(3\hat{i} - 4\hat{j})/5$  (d)  $\pm(4\hat{i} - 3\hat{j})/5$
68. What is the vector in the xy-plane through origin and perpendicular to the vector  $\vec{r} = a\hat{i} + b\hat{j}$  and of the same length ?  
 (a)  $-a\hat{i} - b\hat{j}$  (b)  $a\hat{i} - b\hat{j}$   
 (c)  $-a\hat{i} + b\hat{j}$  (d)  $b\hat{i} - a\hat{j}$
69. Given  $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$  and  $\hat{b}$  is a unit vector co-directional with  $\hat{a}$ . If  $m$  is a scalar such that  $\hat{b} = m\vec{a}$ , then what is the value of  $m$  ?  
 (a)  $1/5$  (b)  $1/\sqrt{5}$   
 (c)  $1/29$  (d)  $1/\sqrt{29}$
70. The magnitude of the vectors  $\vec{a}$  and  $\vec{b}$  are equal and the angle between them is  $60^\circ$ . If the vectors  $\lambda\vec{a} + \vec{b}$  and

- $\vec{a} - \lambda \vec{b}$  are perpendicular to each other, then what is the value of  $\lambda$  ?  
 (a) 1 (b) 2  
 (c) 3 (d) 4
71. If  $|\vec{a}| = 3, |\vec{b}| = 4$  and  $|\vec{a} - \vec{b}| = 7$ , then what is the value of  $|\vec{a} + \vec{b}|$  ?  
 (a) 3 (b) 2  
 (c) 1 (d) 0
72. Consider the diagonals of a quadrilateral formed by the vectors  $3\hat{i} + 6\hat{j} - 2\hat{k}$  and  $4\hat{i} - \hat{j} + 3\hat{k}$ . The quadrilateral must be a  
 (a) Square (b) Rhombus  
 (c) Rectangle (d) None of these
73. If  $p = \sin(989^\circ) \cos(991^\circ)$ , then which one of the following is correct ?  
 (a)  $p$  is finite and positive  
 (b)  $p$  is finite and negative  
 (c)  $p = 0$   
 (d)  $p$  is undefined
74. If  $A = \frac{41\pi}{12}$ , then what is the value of  $\frac{1 - 3 \tan^2 A}{3 \tan A - \tan^3 A}$  ?  
 (a) -1 (b) 1  
 (c) 1/3 (d) 3
75. If  $\omega$  is the cube root of unity, then what is the conjugate of  $2\omega^2 + 3i$  ?  
 (a)  $2\omega - 3i$  (b)  $3\omega + 2i$   
 (c)  $2\omega + 3i$  (d)  $3\omega - 2i$
76. Consider the following statements  
 I. If  $\theta = 1200^\circ$ , then  $(\sec \theta + \tan \theta)^{-1}$  is positive.  
 II. If  $\theta = 1200^\circ$ , then  $(\operatorname{cosec} \theta - \cot \theta)$  is negative.  
 Which of the statements given above is/are correct ?  
 (a) I only (b) II only  
 (c) Both I and II (d) Neither I nor II
77. If  $\cot \theta = 2 \cos \theta$ , where  $(\pi/2) < \theta < \pi$ , then what is the value of  $\theta$  ?  
 (a)  $5\pi/6$  (b)  $2\pi/3$   
 (c)  $3\pi/4$  (d)  $11\pi/12$
78. If  $\cot \theta = 5/12$  and  $\theta$  lies in the third quadrant, then what is  $(2 \sin \theta + 3 \cos \theta)$  equal to ?  
 (a) -4  
 (b)  $-p^2$  for some odd prime  $p$   
 (c)  $(-q/p)$  where  $p$  is an odd prime and  $q$  a positive integer with  $(q/p)$  not an integer  
 (d)  $-p$  for some odd prime  $p$
79. What is the value of  $\cos(\pi/9) + \cos(\pi/3) + \cos(5\pi/9) + \cos(7\pi/9)$  ?  
 (a) 1 (b) -1  
 (c) -1/2 (d) 1/2
80. If in a  $\Delta ABC$ ,  $\cos B = (\sin A)/(2 \sin C)$ , then the triangle is  
 (a) Isosceles triangle (b) Equilateral triangle  
 (c) Right angled triangle (d) Scalene triangle
81. During a certain plane period a state out of a total budget of Rs 1400 crores had spent 28% of the total amount on Agriculture, 35% on Industry, 12% on Energy and 8% on Social Welfare, 105 crores on Education and the balance amount on Transport. What is the amount spent on Transport in crores of rupees ?  
 (a) 123 (b) 145  
 (c) 165 (d) 133
82. A class consists of 3 sections A, B and C with 35, 35 and 30 students respectively. The arithmetic means of the marks secured by students of sections A and B, who appeared for a test of 100 marks are 74 and 70 respectively. The arithmetic mean of the marks secured by students of section C, who appeared for a test in the same subject which carried 75 marks is 51. What is the average percentage of marks secured by all the 100 student of the three sections ?  
 (a) 70.0 (b) 70.8  
 (c) 65.0 (d) 67.5
83. In a town 35.4% of the people are not literates, 27% have education up to primary school, 18.6% have education up to middle school. The people with education up to high school are twice the number of people with education up to Pre-University. Of the remaining, 660 are graduates. If the population of the town is 15000, then what is the number of people with education up to high school ?  
 (a) 3120 (b) 1560  
 (c) 1460 (d) None of these
84. Three letters are randomly selected from the 26 capital letters of the English Alphabet. What is the probability that the letter 'A' will not be included in the choice ?  
 (a) 1/2 (b) 23/26  
 (c) 12/13 (d) 25/26
85. A coin is tossed 10 times. The number of heads minus the number of tails in 10 tosses is considered as the outcome of the experiment. What is the number of points in the sample space ?  
 (a) 10 (b) 11  
 (c) 21 (d) 99
86. In a study on the relationship between investment ( $X$ ) and profit ( $Y$ ), the following two regression equations were obtained based on the data on  $X$  and  $Y$   
 $3X + Y - 12 = 0$   
 $X + 2Y - 14 = 0.$   
 What is the mean  $\bar{X}$  ?  
 (a) 6 (b) 5  
 (c) 4 (d) 2
87. Following table gives the mean and variance of monthly demand for four products A, B, C and D in a supermarket
- | Product     | A  | B  | C  | D   |
|-------------|----|----|----|-----|
| Mean demand | 60 | 90 | 80 | 120 |
| Variance    | 12 | 25 | 36 | 16  |
- For which product the demand is consistent ?  
 (a) Product A (b) Product B  
 (c) Product C (d) Product D
88. What is the least value of the standard deviation of 5 integers, no two of which are equal ?  
 (a)  $\sqrt{5}$   
 (b) 2  
 (c)  $\sqrt{2}$   
 (d) No such least value can be computed
89. Two numbers are successively drawn from the set  $\{1, 2, 3, 4, 5, 6, 7\}$  without replacement and the outcomes recorded in that order. What is the number of elementary events in the random experiment ?  
 (a) 49 (b) 42  
 (c) 21 (d) 14

90. The probabilities of two events  $A$  and  $B$  are given as  $P(A) = 0.8$  and  $P(B) = 0.7$ . What is the minimum value of  $P(A \cap B)$ ?
- (a) 0 (b) 0.1  
(c) 0.5 (d) 1
91. Two numbers  $X$  and  $Y$  are simultaneously drawn from the set  $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ . What is the conditional probability of exactly one of the two numbers  $X$  and  $Y$  being even, given  $(X + Y) = 15$ ?
- (a) 1 (b)  $\frac{3}{4}$   
(c)  $\frac{1}{2}$  (d)  $\frac{1}{4}$
92. If  $x, 2x + 2, 3x + 3$  are the first three terms of a GP, then what is its fourth term?
- (a)  $-\frac{27}{2}$  (b)  $\frac{27}{2}$   
(c)  $-\frac{33}{2}$  (d)  $\frac{33}{2}$
93. Correlation between two variable is said to be perfect if
- (a) one variable increases, the other also increases  
(b) one variable increases, the other decreases  
(c) one variable increases, the other also increases proportionally  
(d) one variable increases, the other decreases proportionally
94. Consider the following statements
- I. The data, which are collected from the unit or individual respondents directly for the purpose of certain study or information are known as primary data.
- II. The data obtained in a census study are primary data. Which of the above statements is/are correct?
- (a) I only (b) II only  
(c) Both I and II (d) Neither I nor II
95. Given that  $P(A) = \frac{1}{3}$ ,  $P(B) = \frac{3}{4}$  and  $P(A \cup B) = \frac{11}{12}$ , then what is  $P(B/A)$ ?
- (a)  $\frac{1}{6}$  (b)  $\frac{4}{9}$   
(c)  $\frac{1}{2}$  (d)  $\frac{1}{3}$
96. If  $a, b$  and  $c$  are real numbers then the roots of the equation  $(x - a)(x - b) + (x - b)(x - c) + (x - c)(x - a) = 0$  are always
- (a) real (b) imaginary  
(c) positive (d) negative
97. If  $(\log_x x)(\log_3 2x)(\log_{2x} y) = \log_x x^2$ , then what is the value of  $y$ ?
- (a)  $\frac{9}{2}$  (b) 9  
(c) 18 (d) 27
98. If  $\log_k x \log_5 k = 3$ , then what is  $x$  equal to?
- (a)  $k^5$  (b)  $5k^3$   
(c) 243 (d) 125
99. Which term of the sequence  $20, 19\frac{1}{4}, 18\frac{1}{2}, 17\frac{3}{4}, \dots$  is the first negative term?
- (a) 27th (b) 28th  
(c) 29th (d) No such term exists
100. If  $\sin^{-1} x + \cot^{-1} (1/2) = \pi/2$ , then what is the value of  $x$ ?
- (a) 0 (b)  $1/\sqrt{5}$   
(c)  $2/\sqrt{5}$  (d)  $\sqrt{3}/2$
101. For the two equations  $x^2 + mx + 1 = 0$  and  $x^2 + x + m = 0$ , what is/are the value/values of  $m$  for which these equations have at least one common root?
- (a) -2 only (b) 1 only  
(c) -2 and 1 (d) -2 and -1

102. Looking from the top of a 20 m high building, the angle of elevation of the top of a tower is  $60^\circ$  and the angle of depression of its bottom is  $30^\circ$ . What is the height of the tower?
- (a) 50 m (b) 60 m  
(c) 70 m (d) 80 m
103. What is the value of  $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$ ?
- (a) 4 (b) 3  
(c) 2 (d) 1
104. Match List-I with List-II and select the correct answer using the code given below the lists

	List-I		List-II
A.	$\tan 15^\circ$	1.	$-2 - \sqrt{3}$
B.	$\tan 75^\circ$	2.	$2 + \sqrt{3}$
C.	$\tan 105^\circ$	3.	$-2 + \sqrt{3}$
		4.	$2 - \sqrt{3}$

Code :

- |       |   |   |
|-------|---|---|
| A     | B | C |
| (a) 4 | 1 | 2 |
| (b) 4 | 2 | 1 |
| (c) 3 | 2 | 1 |
| (d) 2 | 1 | 4 |
105. In a  $\triangle ABC$ ,  $a + b = 3(1 + \sqrt{3})$  cm and  $a - b = 3(1 - \sqrt{3})$  cm. If angle  $A$  is  $30^\circ$ , then what is the angle  $B$ ?
- (a)  $120^\circ$  (b)  $90^\circ$   
(c)  $75^\circ$  (d)  $60^\circ$
106. If  $N_a = \{ax \mid x \in N\}$ , then what is  $N_{12} \cap N_8$  equal to?
- (a)  $N_{12}$  (b)  $N_{20}$   
(c)  $N_{24}$  (d)  $N_{48}$
107. If  $X = \{(4^n - 3n - 1) \mid n \in N\}$  and  $Y = \{9(n - 1) \mid n \in N\}$ , then what is  $X \cup Y$  equal to?
- (a)  $X$  (b)  $Y$   
(c)  $N$  (d) A null set
108. Sets  $A$  and  $B$  have  $n$  elements in common. How many elements will  $(A \times B)$  and  $(B \times A)$  have in common?
- (a) 0 (b) 1  
(c)  $n$  (d)  $n^2$
109. If  $z$  is a complex number such that  $z + z^{-1} = 1$ , then what is the value of  $z^{99} + z^{-99}$ ?
- (a) 1 (b) -1  
(c) 2 (d) -2
110. In an AP, the  $m$ th term  $1/n$  and  $n$ th term is  $1/m$ . What is its  $(mn)$ th term?
- (a)  $1/(mn)$  (b)  $m/n$   
(c)  $n/m$  (d) 1
111. How many times does the digit 3 appear while writing the integers from 1 to 1000?
- (a) 269 (b) 271  
(c) 300 (d) None of these
112. Consider the following statements
- I. The coefficient of the middle term in the expansion of  $(1 + x)^8$  is equal to the middle term of  $(x + \frac{1}{x})^8$ .
- II. The coefficient of the middle term in the expansion of  $(1 + x)^8$  is less than the coefficient of the fifth term in the expansion of  $(1 + x)^7$ .
- Which of the above statements is/are correct?
- (a) I only (b) II only  
(c) Both I and II (d) Neither I nor II

113. When  $a$  and  $b$  are eliminated from the equation  $xy = ae^x + be^{-x}$ , the resulting differential equation is of
- (a) first order and first degree  
 (b) first order and second degree  
 (c) second order and first degree  
 (d) second order and second degree
114. If  $y = (1 + x^{1/4})(1 + x^{1/2})(1 - x^{1/4})$ , then what is  $\frac{dy}{dx}$  equal to?
- (a) 1 (b) -1  
 (c) 0 (d)  $-2x$
115. The velocity of telegraphic communication is given by  $v = x^2 \log(1/x)$ , where  $x$  is the displacement. For maximum velocity,  $x$  equals to?
- (a)  $e^{1/2}$  (b)  $e^{-1/2}$   
 (c)  $(2e)^{-1}$  (d)  $2e^{-1/2}$
116. What is the area bounded by the curve  $y = 4x - x^2 - 3$  and the  $x$ -axis?
- (a)  $2/3$  sq unit (b)  $4/3$  sq unit  
 (c)  $5/3$  sq unit (d)  $4/5$  sq unit
117. A function  $f$  is such that  $f'(x) = 6 - 4 \sin 2x$  and  $f(0) = 3$ . What is  $f(x)$  equal to?
- (a)  $6x + 2 \cos 2x$  (b)  $6x - 2 \cos 2x$   
 (c)  $6x - 2 \cos 2x + 1$  (d)  $6x + 2 \cos 2x + 1$
118. If  $f(x) = e^x$  and  $g(x) = \log x$ , then what is the value of  $(g \circ f)'(x)$ ?
- (a) 0 (b) 1  
 (c)  $e$  (d) None of these
119. Let  $g(x) = x^3 - 4x + 6$ . If  $f'(x) = g'(x)$  and  $f(1) = 2$ , then what is  $f(x)$  equal to?
- (a)  $x^3 - 4x + 3$  (b)  $x^3 - 4x + 6$   
 (c)  $x^3 - 4x + 1$  (d)  $x^3 - 4x + 5$
120. Let  $f : R \rightarrow R$  be defined by  $f(x) = |x|/x$ ,  $x \neq 0$ ,  $f(0) = 2$ . What is range of  $f$ ?
- (a)  $\{1, 2\}$  (b)  $\{1, -1\}$   
 (c)  $\{-1, 1, 2\}$  (d)  $\{1\}$

**Answers : Mathematics**

1	(b)	51	(d)	101	(c)
2	(d)	52	(a)	102	(d)
3	(b)	53	(b)	103	(a)
4	(d)	54	(c)	104	(b)
5	(a)	55	(c)	105	(d)
6	(b)	56	(b)	106	(c)
7	(c)	57	(a)	107	(b)
8	(a)	58	(c)	108	(d)
9	(c)	59	(b)	109	(d)
10	(c)	60	(d)	110	(d)
11	(b)	61	(a)	111	(b)
12	(c)	62	(c)	112	(a)
13	(c)	63	(c)	113	(c)
14	(c)	64	(a)	114	(b)
15	(b)	65	(b)	115	(b)
16	(d)	66	(a)	116	(b)
17	(b)	67	(a)	117	(d)
18	(d)	68	(d)	118	(b)
19	(a)	69	(d)	119	(d)
20	(b)	70	(a)	120	(c)
21	(a)	71	(c)		
22	(c)	72	(b)		
23	(b)	73	(b)		
24	(c)	74	(b)		
25	(b)	75	(a)		
26	(a)	76	(d)		
27	(d)	77	(a)		
28	(c)	78	(d)		
29	(b)	79	(d)		
30	(b)	80	(a)		
31	(b)	81	(d)		
32	(b)	82	(b)		
33	(b)	83	(c)		
34	(b)	84	(b)		
35	(a)	85	(b)		
36	(c)	86	(d)		
37	(a)	87	(d)		
38	(a)	88	(c)		



39	(d)	89	(b)
40	(a)	90	(c)
41	(d)	91	(a)
42	(a)	92	(a)
43	(b)	93	(c)
44	(b)	94	(c)
45	(c)	95	(c)
46	(d)	96	(a)
47	(c)	97	(b)
48	(a)	98	(d)
49	(d)	99	(b)
50	(d)	100	(b)