PPSC Lecturer Mathematics Solved Past Paper-2011

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PUNJAB PUBLIC SERVICE COMMISSION
WRITTEN TEST FOR THE POST OF LECTURER IN MATHEMATICS
2011

Time Allowed: Two Hours **Maximum Marks: 100**

1. A ring R is a Boolean Ring if, for all $x \in R$
   (A)✓ $x^2 = x$ (B) $x^2 = -x$ (C) $x^2 = 0$ (D) $x^2 = 1$
2. The group of Quaterninons is a non abelian group of order ________
   (A) 6 (B)✓ 8 (C) 10 (D) 4
3. Every group of prime order is ________
   (A) an abelian but not cyclic (B) an abelian group
   (C) a non-abelian group (D)✓ a Cyclic group

4. Any two conjugate subgroups of a group G are
   (A) Equivalent (B) Similar (C)✓ Isomorphic (D) None of these
5. If H is a subgroup of index ________ then H is a normal subgroup of G.
   (A)✓ 2 (B) 4 (C) Prime number (D) None of these
6. nZ is a maximal ideal of a ring Z if and only if n is ________
   (A)✓ Prime number (B) Composite number
   (C) Natural number (D) None of these
7. Let G be a cyclic group of order 24 generated by a then order of a^{10} is________
   (A) 2 (B)✓ 12 (C) 10 (D) None of these
8. If a vector space V has a basis of n vectors, then every basis of V must consist of exactly ________ vectors.
   (A) $n+1$ (B)✓ n (C) $n-1$ (D) None of these
9. An indexed set of vectors $(v_1, v_2 ..., v_r)$ in R^n is said to be________ if the vector equation $x_1v_1 + x_2v_2 + ... + x_pv_p = 0$ has only the trivial solution.
   (A)✓ Linearly independent (B) Basis
   (C) Linearly dependent (D) None of these
10. The set C_n of all, nth roots of unity for a fixed positive integer n is a group under ________
    (A) addition (B) addition modulo n
    (C)✓ multiplication (D) multiplication modulo n
11. Intersection of any collection of normal subgroups of a group G ________
    (A)✓ is normal subgroup (B) may not be normal subgroup
    (C) is cyclic subgroup (D) is abelian subgroup
12. $Z / 2Z$ is a quotient group of order ________
    (A) 1 (B) 2 (C)✓ infinite (D) None of these
13. A group G having order ________ where p is prime is always abelian.
    (A) p^4 (B)✓ p^2 (C) $2p$ (D) p^3
14. The number of conjugacy classes of symmetric group of degree 3 is ________
    (A) 6 (B) 2 (C)✓ 3 (D) 4
15. ________ is the set of all those elements of a group G which commutes with all other elements of G.
    (A) commutator subgroup (B)✓ centre of group

(C) automorphisam of G (D) None of these

16. What are Zero divisors in the Ring of integers modulo 6.

(A) $\bar{1},\bar{2},\bar{4}$ (B) $\bar{0},\bar{2},\bar{3}$ (C) $\bar{0},\bar{2},\bar{4}$ (D)✓ $\bar{2},\bar{3},\bar{4}$

17. If H is a normal subgroup of G, then $Na(H)$ = ________

(A) H (B)✓ G (C) {e} (D) None of these

18. An $n \times n$ matrix with n distinct eigenvalues is ________

(A)✓ Diagonalizable (B) Similar Matrix
(C) Not diagonalizable (D) None of these

19. Let $T: U \rightarrow V$ be a linear transformation from an n dimensional vector space U (F) to a vector space V(F) then

(A) dim N(T) + dim R(T) = 0 (B) dim (N(T) + R(T) = 2n
(C) dim N(T) + dim (R(T) = n^2 (D)✓ dim (N(T) + dim R(T) = n

20. The dimension of the row space or column space of a matrix is called the ________ of the matirx.

(A) Basis (B) Null Space (C)✓ Rank (D) None of these

21. $\underline{a} \times (\underline{b} \times \underline{c})$ is a vector lying in the plane containing vectors

(A)✓ $\underline{a}, \underline{b}$ and $\underline{c}$ (B) $\underline{a}$ and $\underline{c}$ (C) $\underline{b}$ and $\underline{c}$ (D) $\underline{b}$ and $\underline{a}$

22. The square matrix A and its transpose have the ________ eigenvalues.

(A)✓ Same (B) Different (C) unique (D) None of these

23. The set $S = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \end{bmatrix} \right\}$ of vectors in R^2 is ________

(A) Linearly Independent (B)✓ Linearly dependent
(C) Basis of R^2 (D) None of these

24. Let X and Y be vectors spaces over the field F with dim $X = m$ and dim $Y = n$ then the dim $Hom(X, Y)$ =

(A)✓ mn (B) n (C) n^m (D) m^2

25. All subgroups of an abelian group are ________ subgroups.

(A) cyclic (B)✓ normal (C) characteristic (D) None of these

26. The set of all solutions to the homogeneous equation $Ax = 0$ when A is an $m \times n$ matrix is ________

(A) Null space (B) Column space (C) Rank (D)✓ None of these

27. If 7 cards are dealt from an ordinary deck of 52 playing cards, what is the probability that at least 1 of them will be a queen?

(A) 0.4773 (B) 0.4774 (C) 0.4775 (D)✓ 0.4776

28. Let G be an abelian group. Then which one of the following is not true.

(A) every commutator of G is identity
(B) if m is divisor of order G then G must have subgroup of order m
(C) center of G is G itself
(D)✓ every subgroup of G is cyclic

29. Every group of order ≤ 5 is

(A) cyclic (B)✓ abelian (C) non abelian (D) none of these

30. Number of non-isomorphic groups of order 8 is ________
(A) 4 (B) 2 (C) 3 (D)✓ 5

31. Center of the group of quaternions Q_8 is of order
(A) 1 (B) 2 (C)✓ 8 (D) 4

32. $\underline{a} \bullet (\underline{b} \times \underline{c})$ is not equal to
(A)✓ $\underline{a} \bullet (\underline{c} \times \underline{b})$ (B) $(\underline{a} \times \underline{b}) \bullet \underline{c}$ (C) $\underline{b} \bullet (\underline{c} \times \underline{a})$ (D) $\underline{a} \bullet (\underline{a} \times \underline{b})$

33. Let *G* be a group. Then the derived group *G'* is subgroup of *G*.
(A) cyclic (B) abelian (C)✓ normal (D) none of these

34. Let *G* be a group. Then the factor group *G/G* is________
(A)✓ abelian (B) cyclic (C) normal (D) none of these

35. Finite simple abelian groups are of order
(A) 4 (B) prime power (C) power of 2 (D)✓ prime number

36. Set of integers Z is
(A) Field (B)✓ group under multiplication
(C) integral domain (D) division ring

37. Set of integers Z is__________of the set *Q* of rationals.
(A) prime ideal (B) subring (C)✓ maximal ideal (D) none of these

38. Solution set of the equation $1 + \cos x = 0$ is
(A) $\{\pi + n\pi : n \varepsilon Z\}$ (B) $\{2n\pi : n \varepsilon Z\}$
(C) $\{\frac{\pi}{2} + n\pi : n \varepsilon Z\}$ (D)✓ $\{\pi + 2n\pi : n \varepsilon Z\}$

39. Non-zero elements of a field form a group under
(A) addition (B)✓ multiplication (C) subtraction (D) division

40. Let *Q* be the set of rational numbers. Then $Q(\sqrt{3}) = \{a + b\sqrt{3} : a, b \varepsilon Q\}$ is a vector space over g with dimension
(A) 1 (B)✓ 2 (C) 3 (D) 4

41. Let *W* be a subspace of the space R^3. If dim $W = 0$ then *W* is a
(A) line through the origin 0 (B) plane through the origin 0
(C) entire space R^3 (D)✓ a point

42. Let $P_n(f)$ be a vector space of all polynomials of degree $\leq n$: Then
(A) dim $P_n(f) = n - 1$ (B) dim $P_n(f) = n$ (C)✓ $P_n(f) = n + 1$ (D) 2

43. A one to one linear transformation preserves ________
(A) basis but not dimension (B)✓ basis and dimension
(C) dimension but not basis (D) None of these

44. In the group $(Z, \circ)$ of all integers where $a \circ b = a + b + 1$ for $a, b \varepsilon Z$, the inverse of -3 is
(A) -3 (B) 0 (C)✓ 3 (D) 1

45. The set Z of all integers is not a vector space over the field R of real numbers under ordinary addition '+' multiplication 'X' of real numbers, because
(A) (Z, +) is a ring (B) (Z, +,x) is not a field
(C) (R,x) is not a group
(D)✓ ordinary multiplication of real numbers does not define a scalar multiplication of Z by R.

46. Let G be an abelian group. Then $\varphi : G \mapsto G$ given by ______ is an automorphism
(A) $\varphi(x) = x^3$ (B) $\varphi(x) = e$ (C) $\varphi(x) = x^2$ (D) $\varphi(x) = x^{-1}$

47. Let G be a group in which g2 = 1 for all g is G. Then G is ______
(A) abelian (B) cyclic (C) abelian but not cyclic (D) non-abelian

48. Let G = $\langle a, b: b^2 = 1 = a^3, ab = ba^{-1}\rangle$. Then the number of distinct left cosets of H = $\langle b\rangle$ in G is ______
(A) 1 (B) 2 (C) 4 (D) 3

49. A linear transformation T: U → V is one-to-one if and only if kernel of T is equal to
(A) U (B) V (C) {O} (D) Im(T)

50. For a scalar point function $\varphi(x, y, z)$, *div grad* φ is
(A) scalar point function (B) vector point function
(C) guage function (D) neither

51. A particle moves along a curve F = $(e^{-t}, 2\cos 3t, 2\sin 3t)$ where *t* time is. The velocity at *t* = 0 is
(A) (-1, 0, 6) (B) (-1,-6, 0) (C) (1, 2, 0) (D) (-1, 2, 2)

52. The coordinate surfaces for the cylindrical coordinates $x = r\cos\vartheta$, $y = r\sin\vartheta$, $z = z$ are given by
(A) $r = c$, $\vartheta = c$ (B) $r = c_1$, $\vartheta = c$, $z = c_3$
(C) $r = c_1$, $z = c_3$ (D) $\vartheta = c_2$, $z = c_3$

53. The metric coefficients in cylindrical coordinates are
(A) (1, 1, 1) (B) (1, 0, 1) (C) (1, *r*, 1) (D) neither

54. The value of the quantity $\delta_i x_i x_j$ is
(A) x_i (B) zero (C) x_i^2 (D) $x_i x_j$

55. A tensor of rank 5 in a space of 4 dimensions has components
(A) 5 (B) 4 (C) 625 (D) 1024

56. A vector is said to be irrotational if
(A) $\nabla\bar{F} = 1$ (B) $\nabla\bar{F} = 0$ (C) $\nabla \times \bar{F} = 0$ (D) none

57. The moment of inertia of a rigid hemisphere of mass *M* and radius a about a diameter of a base is
(A) $Ma^2/5$ (B) $Ma^2/2$
(C) $2Ma^2/5$ (D) more information needed

58. Radius of gyration of a rigid body of mass 4 gm having moment of inertia 32 $gm(cm)^2$ is:
(A) 8 $(cm)^2$ (B) $2\sqrt{2}$ cm (C) $\sqrt{2}$ cm (D) $2\sqrt{2}$ gm

59. Equation for the ellipsoid of inertia for a rigid body having moments and products of inertia 1_{xx} = 18 units 1_{yy} = 18 units, 1_{zz} = 36 units, 1_{xy} = -13.5 units, 1_{xz} = 0, 1_{yz} = 0.
(A) $18(x^2+y^2+z^2)-27xy = 1$ (B) $18(x^2+y^2+2z^2) - 27xy = 1$
(C) $18(x^2+y^2) + 2z^2 - 27xy = 1$ (D) more information needed

60. The neighborhood of 0, under the usual topology for the real line *r*, is
(A) $]\frac{-1}{2}, \frac{1}{2}]$ (B) $]-1, 0]$ (C) $]0, 1]$ (D) $[0, \frac{1}{2}[$

61. Let *A* = [0, 1] be a subset of *R* with Euclidean metric. Then interior of *A* is
(A) [0,1[(B)]0,1[(C) [0,1] (D)]0,1]

62. Number of non-isomorphic groups of order 8 is
(A)✓ 5 (B) 2 (C) 3 (D) 4

63. Suppose a and c are real numbers, $c > 0$, and f is defined on [−1, 1] by

$$f(x)=\begin{cases} x^a \sin(x^{-c}) & (\text{if } x \neq 0), \\ 0 & (\text{if } x = 0). \end{cases}$$

f is bounded if and only if
(A)✓ $a > 1 + c$ (B) $a > 2 + c$ (C) $a \geq 1 + c$ (D) $a \geq 2 + c$

64. Let $M_{2,3}$ be a vector space of all 2 x 3 matrices over R. Then dimension of $Hom(M_{2,3}, R^4)$
(A) 12 (B) 6 (C) 8 (D)✓ 24

65. Let $X = \{a,b,c,d,e\}$. Which one of the following classes of subsets of X is a topology on X.
(A) $T_1 = \{X, \phi, \{a\}, \{a,b\} \{a,c\}\}$
(B) $T_2 = \{X, \phi, \{a,b,c\}, \{a,b,d\} \{a,b,c,d\}\}$
(C)✓ $T_3 = \{X, \phi, \{a\}, \{a,b\} \{a,c,d\}, \{a,b,c,d\}\}$
(D) $T_4 = \{\phi, \{a\}, \{a,b\}, \{a,c\}\}$

66. Let $T = \{X, \phi, \{a\}, \{a,b\} \{a,c,d\}, \{a,b,c,d\}, \{a,b,e\}\}$ be a topology on $X = \{a,b,c,d,e\}$ and $A = \{a,b,c\}$ be the subset of X. The interior of A is
(A) {a,b,c} (B)✓ {a,b} (C) {a} (D) {b,c}

67. The value of $\sin(\cos^{-1}\frac{\sqrt{3}}{2})$ is
(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C)✓ $\frac{1}{2}$ (D) 1

68. The smallest field containing set of integers Z is
(A) $Q(\sqrt{2})$ (B)✓ Q (C) $Q(\sqrt{6})$ (D) $Q(\sqrt{3})$

69. Let R be the usual metric space. Then which of the following set is not closed.
(A) set of integers
(B)✓ set of rational numbers
(C) [0, 1]
(D)✓ $\{1, \frac{1}{2}, \frac{1}{3}, \ldots\}$ both are correct

70. Let R be the usual metric space and Z be the set of integers. Then clouser of Z is
(A)✓ Z
(B) set of rational numbers Q
(C) set of real number R
(D) set of natural numbers N

71. A subspace A of a complete metric space X is complete if and only if A is
(A)✓ X (B) open (C) closed (D) empty set

72. A subset A of a topological space X is open if and only if A is
(A)✓ A is neighbourhood of each of its points
(B) A is neighbourhood of some of its points
(C) A contains all of its limit points
(D) A contains all of its boundary points

73. Non-zero elements of a finite filed form .... group.
(A) non-cyclic
(B)✓ an abelian group but not cyclic
(C) non-abelian
(D) a cyclic

74. Let R be the cofinite topology. Then R is a
(A) T_0 but not T_1 (B)✓ T_1 but not T_2 (C) T_2 but not T_3 (D) T_3 but not T_1

75. Let $f(x) = \frac{x+5}{(x-1)(x-2)}$. Then range of f is

(A) Set of all real numbers R (B) $R-\{1, 2\}$
(C) R^+ (D) R^-

76. The value of $\int_0^1 xe^y\,dx$ is

(A) -1 (B) 1 (C) c (D) 2c

77. The solution of the congruence $4x \equiv 5 \pmod 9$ is

(A) $x \equiv 6 \pmod 9$ (B) $x \equiv 7 \pmod 9$ (C) $x \equiv 8 \pmod 9$ (D) $x \equiv 2 \pmod 9$

78. The series $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots$ is convergent for

(A) $|x| < 1$ only (B) $|x| \le 1$ (C) $-1 < x \le 1$ (D) all real values of x

79. The general solution of the differential equation $(x^2 + y^2)\,dx - 2xy\,dy = 0$ is

(A) $x^2 - cx -, y^2 = 0$, where c is an arbitrary constant
(B) $(x-y)^2 = cx$, where c is an arbitrary constant
(C) $x + y + 2xy = c$, where c is an arbitrary constant
(D) $y = x^2 - 2x + c$, where c is an arbitrary constant

80. Let f be defined on R by setting $f(x) = x$, if x is rational and $f(x) = 1 - x$ if x is irrational. Then

(A) f is continuous on R (B) f is continuous only at $x = \frac{1}{2}$

(C) f is continuous everywhere except at $x = \frac{1}{2}$

(D) f is discontinuous everywhere

81. The differential equation $ydx - 2xdy = 0$ represents

(A) a family of straight lines (B) a family of parabola
(C) a family of hyperbolas (D) a family of circles

82. A particular integral of the differential equation $(D^2 + 4)y = x$ is

(A) xc^{-2x} (B) $x \cos 2x$ (C) $x \sin 2x$ (D) $\frac{x}{4}$

83. The area of the cardioid $r = a(1 + \cos\theta)$ is equal to

(A) $4\pi a^2$ (B) $8\pi a$ (C) $\frac{3\pi a^2}{4}$ (D) $2\pi a^2$

84. The value of $\sqrt{3}\sin x + \cos x$ will be greatest when x is equal to

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{6}$

85. If a particle in equilibrium is subjected to four forces $F_1 - 2\hat{i} - 5\hat{j} + 6\hat{k}$, $F_2 = \hat{i} + 3\hat{j} - 7\hat{k}$
$F_3 = 2\hat{i} - 2\hat{j} - 3\hat{k}$ and F_4 then F_4 is equal to

(A) $-5\hat{i} + 4\hat{j} + 4\hat{k}$ (B) $5\hat{i} - 4\hat{j} - 4\hat{k}$ (C) $3\hat{i} - 2\hat{j} - \hat{k}$ (D) $3\hat{i} + \hat{j} - 10\hat{k}$

86. The function $f(x) = |x|+|x-1|$ is

(A) Continuous and differentiable for x = 0, x =1

(B) Continuous but not differentiable for x = 0, x =1
(C) Discontinuous but differentiable for x = 0, x = 1
(D) Neither continuous nor differentiable for x = 0, x –1

87. Evaluate $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{\frac{3}{x^3}}$

(A) 0 (B) e (C) $e^{\frac{1}{3}}$ (D) e^3

88. If z = x2 tan-1

$\left(\frac{y}{x}\right) - y^2 \tan^{-1}\left(\frac{x}{y}\right)$, then $\frac{\partial^2 z}{\partial x \partial y}$ is

(A) $\frac{x^2}{y^2}$ (B) $\frac{x^2+y^2}{x^2-y^2}$ (C) $\frac{x^2-y^2}{x^2+y^2}$ (D) None of these

89. The radius of curvature is

(A) Double the measure of curvature (B) Square the curvature
(C) Reciprocal of curvature (D) None of these

90. Suppose a and c are real numbers, c > 0, and f is defined on [–1, 1] by

$$f(x) = \begin{cases} x^a \sin(x^{-e}) & (\text{if } x \neq 0), \\ 0 & (\text{if } x = 0) \end{cases}$$

f is continuous if and only if

(A) a ≥ 1 (B) a > 1 (C) a ≥ 0 (D) a > 0

91. The value of $\int_0^{\infty} \frac{dx}{1+x^2}$ is

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) 0 (D) ∞

92. Which of the following function sis a bijection from R to R.

(A) $f(x) = x^2 + 1$ (B) $f(x) = x^3$ (C) $f(x) = \frac{(x^2+1)}{(x^2+2)}$ (D) $f(x) = x^2$

93. $f(z) = \frac{1}{z}$ is not uniformly continuous in the region

(A) 0≤|z|≤ 1 (B) 0≤|z|< 1 (C) 0<|z|< 1 (D) 0<|z|≤ 1

94. $f(z) = z^3 + 3i$ is ....

(A) analytic everywhere except $z = 3i$ (B) analytic everywhere except $z = 0$
(C) analytic everywhere except $z = -3i$ (D) analytic everywhere

If C is the circle |z| = 3, then $\oint_C \frac{dz}{1+z^2}$ is equal to

(A) 3 (B) 2 (C) 0 (D) 1

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96. The series $\sum_{n=0}^{\infty} \frac{n^1}{(2i)^n}$ is

(A) convergent
(B) absolutely convergent
(C) divergent
(D) none of these

97. The radius of convergence of sinh Z is

(A) $R = \infty$
(B) $R = 0$
(C) $R = 1$
(D) $R = 2$

98. Four married couples have bought 8 seats in a concert. In how many different ways can they be seated if each couple is to sit together?

(A) 24
(B) 96
(C) 384
(D) none of these

99. A coin is biased so that a head is twice as likely to occur as a tail. If the coin is tossed 3 times, then the probability of getting 2 tails and 1 head is

(A) $\frac{1}{9}$
(B) $\frac{2}{9}$
(C) $\frac{4}{9}$
(D) none of these

100. If X represents the outcome when a die is tossed. Then the expected value of X is

(A) $\frac{1}{2}$
(B) $\frac{5}{2}$
(C) $\frac{7}{2}$
(D) $\frac{3}{2}$