Test Booklet Series

A

Test Booklet No. 5100

M.Sc. Entrance Examination, Sept., 2021

Subject : MATHEMATICS

Roll No. of the Candidate: .....

Signature of the Candidate: .....

Date of Examination: .....

Signature of the Invigilator(s)

1. .....

2. .....

Time : 90 Minutes

Maximum Marks : 70

IMPORTANT INSTRUCTIONS

(i) The question paper is in the form of Test-Booklet containing **70 (Seventy)** questions. Each question carries four answers marked (A), (B), (C) and (D), out of which only one is correct.

(ii) On receipt of the Test-Booklet (Question Paper), the candidate should immediately check it and ensure that it contains all the pages, i.e., **70** questions. Discrepancy, if any, should be reported by the candidate to the invigilator within 10 minutes of receiving the Test-Booklet.

(iii) The separate Answer-Sheet is inside the booklet. On this sheet there are **70** rows of four circles each. One row pertains to one question.

(iv) The candidate should write his roll number at the places provided on the cover page of the Test-Booklet and on the Answer-Sheet and NOWHERE ELSE.

(v) No second Test-Booklet and Answer-Sheet will be given to a candidate. The candidates are advised to be careful in handling it and writing the answer on the Answer-Sheet.

(vi) For every correct answer of the question **One (1) mark will be awarded.** For every unattempted question, Zero (0) mark shall be awarded. **There is no Negative Marking.**

(vii) Marking shall be done only on the basis of answers responded on the Answer-Sheet.

(viii) To mark the answer on the Answer-Sheet, candidate should darken the appropriate circle in the row of each question with Blue or Black pen.

(ix) For each question only one circle should be darkened as a mark of the answer adopted by the candidate. If more than one circle for the question are found darkened or with one black circle any other circle carries any mark, the question will be treated as not attempted.

(x) The candidates should not remove any paper from the Test-Booklet. Attempting to remove any paper shall be liable to be punished for use of unfair means.

(xi) Rough work may be done on the sheet(s) at the end.

(xii) *Mobile telephones (even on Switch-off mode) and such other electronic devices are not allowed inside the examination hall.*

(xiii) No candidate shall be permitted to leave the examination hall before the expiry of the time.

DO NOT OPEN THIS QUESTION BOOKLET UNTIL ASKED TO DO SO.

SEAL

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PART–A
GENERAL KNOWLEDGE AND ANALYTICAL SKILLS

1. Which continent has the highest number no. of countries is the statement?

(A) Asia

(B) Europe

(C) North America

(D) Africa

2. India's first mission to the moon was launched in which year?

(A) 1969

(B) 2005

(C) 2008

(D) 1998

3. Which country is also known as the 'Land of Thousand Lakes'?

(A) Iceland

(B) Norway

(C) Finland

(D) Switzerland

4. Which of the following is not imposed by the Central government?

(A) Agricultural tax

(B) Corporation tax

(C) Custom duty

(D) Sales tax

5. Who is the woman Indian Golfer who qualified for the Tokyo Olympics?

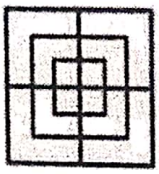
(A) Neha Tripathi

(B) Shaili Chopra

(C) Aditi Ashok

(D) Tvesa Malik

6. Count the number of squares in the given figure.



(A) 8

(B) 12

(C) 15

(D) 18

7. Cursory : Desultory : : Conversant : ?

(A) Acquainted

(B) Close

(C) Disease

(D) Advantage

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8. One evening before sunset Rekha and Hema were talking to each other face to face. If Hema's shadow was exactly to the right of Hema, which direction was Rekha facing?
(A) North
(B) South
(C) East
(D) Data Inadequate

9. P, Q, R, S, T, U, V and W are sitting round the circle and are facing the center: P is second to the right of T who is the neighbor of R and V. S is not the neighbor of P. V is the neighbor of U. Q is not between S and W. W is not between U and S.
By counting clockwise, how many people are seated between P and V?
(A) 1
(B) 2
(C) 3
(D) 4

10. Poignant : Touching : : Relevant : ?
(A) Execute
(B) Calm
(C) Common
(D) Fairness

11. Catherine walks 4 miles in the direction of west then he turns to his right and walks further 3 miles, how far is he exactly from the starting point (in miles) ?
(A) 6
(B) 7
(C) 5
(D) 8

12. Eight friends A, B, C, D, E, F, G and H are sitting in circular arrangements. E is fourth to the right of B. A is to the third right of E. D is between A and F. C is fourth to the left of A. H is between G and C.
Who is seated immediately next to A?
(A) G
(B) H
(C) C
(D) B

13. A, B, C, D, E, and F are sitting around a circular table facing the center. D is between C and F; B is to the left of A; B is diagonally opposite to D; and E is between C and B. How many people are seated between E and A if counted clockwise?
(A) 1
(B) 2
(C) 4
(D) 3

14. **Statement :** Large number of people has become critically ill after consuming spurious liquor from a local shop.
Courses of Action :
I. The Government should immediately close down all the shops selling liquor till the stocks are tested for presence of toxicity.
II. The owner of the liquor shop should be asked to leave the town and open a shop elsewhere.
III. The owner of the liquor shop should immediately be arrested and tried for criminal negligence.
(A) Only I and II follow
(B) Only II and III follow
(C) Only III follows
(D) Only I and III follow

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15. Find the letter in the 8th position when the alphabets are written in alphabetical order from the right

(A) P
(B) Q
(C) S
(D) O

16. Constant : Broken : : Abhor : ?

(A) Chatter
(B) Concealed
(C) Admire
(D) Search

17. Where is the 'International Court of Justice' headquarters located?

(A) Amsterdam
(B) Berlin
(C) The Hague
(D) Washington

18. Who wins the VLCC Femina Miss India World 2020?

(A) Manasa Varanasi
(B) Manika Sheokand
(C) Manya Singh
(D) Prema Harsha

19. MINISTER : SERMON

(A) politician: promises
(B) doctor: diagnosis
(C) heckler: interruptions
(D) curator: museum

20. Identify the error :
They / are seeing / a cricket match / with great interest.

(A) They
(B) are seeing
(C) a cricket match
(D) with great interest

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PART–B
MATHEMATICS

21. If $A = \begin{pmatrix} 1 & 2 \\ 5 & 7 \end{pmatrix}$, then A^{-1} =

(A) $\frac{1}{3}\begin{pmatrix} -7 & 2 \\ 5 & -1 \end{pmatrix}$

(B) $\frac{1}{3}\begin{pmatrix} -7 & 2 \\ 5 & -1 \end{pmatrix}$

(C) $\begin{pmatrix} -7 & 2 \\ 5 & -1 \end{pmatrix}$

(D) None of these

22. A matrix A is called idempotent provided:

(A) $AA' = I$

(B) $AA^{-1} = I$

(C) $A^2 = I$

(D) None of these

23. The approx. positive root of the equation:

$$x^3 - 12.2\,x^2 + 7.45\,x + 42 = 0$$

lying between $x = 11$ and $x = 12$ by regulafalsi method is given by

(A) 11.4994

(B) 11.1194

(C) 11.1994

(D) 11.9994

24. If A is a 3×4 matrix and after reducing it into echelon form, all the rows are non - zero then rank (A) =

(A) 1

(B) 0

(C) 3

(D) 4

25. Partial differential equation can be formed by eliminating ..... from the relation

$$z = f\left(\frac{y}{x}\right) + \phi(xy)$$

(A) the arbitrary constants

(B) the arbitrary function f

(C) the arbitrary function ϕ

(D) the arbitrary functions f and ϕ

26. If $\phi(x, y, z) = 3x^2y - y^3z^2$, value of grad. ϕ at the point $(1, -2, -1)$ is given by

(A) $-12i + 9j - 16k$

(B) $12i - 9j - 6k$

(C) $-12i - 9j - 16k$

(D) None of these

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27. A unit vector normal to the surface $x^2 + 3y^3 + 2z^2 = 6$ at point (2, 0, 1) is given by

(A) $\frac{1}{\sqrt{2}}(i + k)$

(B) $i - j + k$

(C) $\frac{1}{\sqrt{3}}(i + k)$

(D) None of these

28. The laplace transformation is one of the important tool for solving

(A) Linear differential equations

(B) Constant coefficient ordinary differential equations

(C) Partial differential equations

(D) All of these

29. The laplace transform of $t^2 \sin(2t)$ is given by

(A) $(12s^2 - 18) / (s^2 + 4)^3$

(B) $(12s^2 - 16) / (s^2 - 4)^3$

(C) $(2s^2 - 16) / (s^2 + 8)^3$

(D) $(12s^2 - 16) / (s^2 + 4)^3$

30. The inverse lapace of

$$\frac{s+1}{[(s+1)^2+4][(s+1)^2+1]}$$

is given by

(A) $1/3\ e^t\ [\cos(t) - \cos(2t)]$.

(B) $1/3\ e^{-t}\ [\cos(t) + \cos(2t)]$.

(C) $1/3\ e^t\ [\cos(t) + \cos(2t)]$.

(D) $1/3\ e^{-t}\ [\cos(t) - \cos(2t)]$.

31. If $\phi(x, y, z) = c$ represent a family of surfaces for different values of constants c, then...

(A) $\nabla\phi$ is a vector normal to the surface $\phi(x, y, z) = c$

(B) $\nabla\phi$ is a vector tangent to the surface $\phi(x, y, z) = c$

(C) $d\phi = \frac{\partial\phi}{\partial x}dx + \frac{\partial\phi}{\partial y}dy + \frac{\partial\phi}{\partial z}dz$ is a vector normal to the surface $\phi(x, y, z) = c$

(D) $\nabla\phi$ is a vector normal to the surface $\phi(x, y, z) = 0$

32. The laplace transform of $e^t \sin t$ is given by

(A) $(s - 1) / \{a^2 + (s - 1)^2\}$

(B) $a / \{a^2 + (s - 1)^2\}$

(C) $s / \{a^2 + (s - 1)^2\}$

(D) $a/\{a^2 + (s + 1)^2\}$

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33. The value of $L^{-1}\frac{1}{(s+2)^4}$ is given by

(A) $e^{-t}.\frac{t^3}{6}$

(B) $e^{-2t}.\frac{t^3}{9}$

(C) $e^{-2t}.\frac{t^3}{6}$

(D) $e^{-2t}.\frac{t^2}{6}$

34. In an iterative method, the amount of computation depends on the _____

(A) Number of variables

(B) Degree of accuracy

(C) Rounding of errors

(D) Ease of using the operators

35. The value of $\lim_{(x,y)\to(0,0)}\frac{2xy}{3x^2+y^2}$ is given by the option:

(A) 0

(B) 1

(C) Limit does not exist

(D) -1

36. Using Runge Kutta (fourth order) method, Where $\frac{dy}{dx} = x + y$ and $y(0) = 1$, approximation to $y(0.1)$ correct to five decimal places in steps of $h = 0.1$ is given by option :

(A) 2.11133

(B) 1.11034

(C) 1.21135

(D) 1.23230

37. Laplace transform of Dirac delta function is

(A) 0

(B) 1

(C) 2

(D) 3

38. The n^{th} derivative of the function $y = x^4/\{(x-1)(x-2)\}$ is

(A) $(-1)^n n!\left[\frac{16}{(x-2)^{n+1}}-\frac{1}{(x-1)^{n+1}}\right]\ (n>2)$

(B) $n!\left[\frac{16}{(x-2)^{n+1}}-\frac{1}{(x-1)^{n+1}}\right]\ (n>0)$

(C) $(-1)^n\left[\frac{16}{(x-2)^{n+1}}-\frac{1}{(x-1)^{n+1}}\right]$

(D) $(-1)^{n+1}n!\left[\frac{16}{(x-2)^{n+1}}-\frac{1}{(x-1)^{n+1}}\right](n>2)$

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39. If $y = b\left\{\cos m \log\frac{x}{m}\right\}$, which is correct

(A) $x^2y_{n+2} + (2n + 1)x\, y_{n+1} - (n^2 + m^2)\, y_n = 0$

(B) $x^2y_{n+2} + (n + 1)x\, y_{n+1} + (n^2 + m^2)\, y_n = 0$

(C) $x^2y_{n+2} - (2n + 1)x\, y_{n+1} + (n^2 + m^2)\, y_n = 0$

(D) $x^2y_{n+2} + (2n + 1)x\, y_{n+1} + (n^2 + m^2)\, y_n = 0$

40. Using the expansion of tan $(x + h)$, the value of tan 46° correct to 4 significant figures is (where $\pi = 3.14159$)

(A) 0.5151

(B) 1.5051

(C) 1.1131

(D) 1.0355

41. The system

$$x + 2y - 3z = -1$$

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

$$5x + 3y - 4z = 2$$

is

(A) Inconsistent

(B) Consistent with trivial solution

(C) Consistent with unique solution

(D) Consistent with more than one solution

42. The total work done in moving a particle in a force field given by $F = 3xyi - 5zj + 10xk$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$ is

(A) 0

(B) 203

(C) 3/4

(D) 303

43. The Newton Raphson method is also known as _____

(A) Tangent method

(B) Chord method

(C) Secant method

(D) Diameter method

44. Given that $u = \tan^{-1}\left(\frac{x^3 + y^3}{x + y}\right)$, the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

(A) $\sin u$

(B) $\sin 2u$

(C) $\sin 3u$

(D) $\tan u$

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45. If $y = \sin(\log x)$ then the value of $x^2y_2 + xy_1 + y =$

(A) 0

(B) 1

(C) 2

(D) 3

46. If $V = \pi r^2 h$ is the volume of a right circular cylinder of radius r and height h, r is measured with an error of no more that 2% and h with an error of no more than 0.5%, the resulting maximum possible error in the computation of V is

(A) 45 %

(B) 4.0 %

(C) 4.5 %

(D) 0.5 %

47. The temperature at a point (x, y) on a metal plate is $T(x, y) = 4x^2 - 4xy + y^2$. An ant on the plate walks around the circle of radius 5 centered at the origin. What are the highest and lowest temperatures encountered by the ant?

(A) (125°, 0°)

(B) (12.5°, 0°)

(C) (125°, 5°)

(D) (135°, 0°)

48. n^{th} derivative of $y = x^{n-1} \log x$ is given by

(A) $\frac{n!}{x}$

(B) $\frac{(n+1)!}{x}$

(C) $\frac{(n-1)!}{x}$

(D) $\frac{(n-1)!}{2x}$

49. Using the Laplace transforms, the solution of initial value problem, $y'' + 4y' + 5y = f(t)$, $y(o) = 0$, $y'(o) = 0$, where $f(t)$ is a periodic function of period 2π and is defined in one period where $f(t) = 2$ for $0 \le t < 2\pi$ is given by

(A) $y = \frac{2}{5} - \frac{2}{5} e^{-2t} \cos t - \frac{4}{5} e^{-2t} \sin t$

(B) $y = \frac{2}{5} - \frac{2}{5} e^{-t} \cos t - \frac{4}{5} e^{-2t} \sin t$

(C) $y = \frac{2}{5} - \frac{2}{5} e^{-2t} \cos t - e^{-2t} \sin t$

(D) $y = \frac{2}{5} - \frac{2}{5} e^{-2t} \cos t + \frac{4}{5} e^{-2t}$

50. The laplace transform of $t^2 \sin(2t)$ is given by

(A) $(12s^2 - 18) / (s^2 + 4)^3$

(B) $(12s^2 - 16) / (s^2 - 4)^3$

(C) $(2s^2 - 16) / (s^2 + 8)^3$

(D) $(12s^2 - 16) / (s^2 + 4)^3$

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51. The Particular Integral of the equation : $(D^3 - 7D^2 + 10D)y = e^{2x} \sin x$ is given by

(A) $\frac{e^x}{50}(7\cos x - \sin x)$

(B) $\frac{e^{2x}}{50}(7\cos x - \sin x)$

(C) $\frac{e^{2x}}{50}(7\cos x + \sin x)$

(D) $\frac{e^{2x}}{5}(7\cos x + \sin x)$

52. The value of $\int_c \frac{z}{2z-5} dz$, where C is the circle $|z| = 2$ is

(A) 0

(B) 2

(C) 3/4

(D) 2

53. If $\phi(x, y) = \frac{x}{x^2+y^2}$, the magnitude of the directional derivative along a line making an angle 30° with the positive direction of x-axis at point (0, 2) is given by

(A) $\frac{\sqrt{5}}{8}$

(B) $\frac{1}{\sqrt{2}}(i + k)$

(C) $\frac{\sqrt{3}}{8}$

(D) $\frac{\sqrt{3}}{8} i$

54. In which option, algebraic structure is not semi group

(A) (N, +)

(B) (Z, –)

(C) (N, +), (Z, –)

(D) None of these

55. The value of p for which the vector field $v = (2x + y)i + (3x - 2z)j + (x + pz)k$ is solenoidal is

(A) 0

(B) 2

(C) –2

(D) 1

56. For the values of a, b, c for which vector $V = (x + y + az)i + (bx + 3y - z)j + (3x + cy + z)k$ is irrotational is given by

(A) $a = 12, b = 51, c = -1$

(B) $a = 2, b = -1, c = -1$

(C) $a = 2, b = 1, c = -1$

(D) $a = 3, b = 1, c = -1$

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57. For the non-homogenous system of equations AX = B, if C be the augmented matrix, then the system has infinitely many solutions, provided

(A) rank (A) = rank (C) = no. of variables

(B) rank (A) $\neq$ rank (C)

(C) rank (A) = rank (C) < no. of variables

(D) None of these.

58. Using Green's theorem, value of

$$\int_c (x^2 + xy)dx + (x^2 + y^2)\, dy$$

where c is the square formed by the lines $y = \pm 1$, $x = \pm 1$.

(A) $\frac{3}{8}$

(B) $\frac{5}{12}$

(C) 1

(D) 0

59. A non-homogenous system of linear equations is

(A) always consistent

(B) always inconsistent

(C) cannot say definitely

(D) None of the above

60. If $u = e^{xyz}$ then value of u_{yz} is

(A) $e^{xyz}\{x + x^2yz\}$

(B) $e^{xyz}\{x - x^2yz\}$

(C) $e^{xyz}\{x + xyz\}$

(D) $e^{xyz}\{x - xyz\}$

61. If $y = (\sin^{-1} x)^2$. Then

(A) $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - n^2y_n = 0$

(B) $(1 + x^2)y_{n+2} + (2n + 1)xy_{n+1} - n^2y_n = 0$

(C) $(1 - x^2)y_{n+2} + (2n + 1)xy_{n+1} + n^2y_n = 0$

(D) None of these

62. A vector field F is given by

$$F = \sin y\, i + x\,(1 + \cos y)j,$$

Then value of integral $\int_C F \cdot d\bar{r}$. Where C is the circular path given by $x^2 + y^2 = a^2$

(A) $3\pi a^2$

(B) $2\pi a^2$

(C) πa^2

(D) $\frac{1}{2}\pi a^2$

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63. The solution of the differential equation : $(D2 - D'^2 + D + 3D' - 2)z = 0$ is given by

(A) $z = e^{-2x} f(y + x) + e^{x} g(y - x)$

(B) $z = e^{-x} f(y - x) + xe^{-x} g(y - x)$

(C) $z = e^{x} f(y - x) + xe^{-x} g(y - x)$

(D) $z = e^{-x} f(y - x) + xe^{x} g(y - x)$

64. Particular integral of

$$(D^2 - D'^2)z = \cos(x + y)$$

is given by

(A) $\frac{x}{2} \cos(x + y)$

(B) $x \sin(x + y)$

(C) $2x \sin(x + y)$

(D) $\frac{x}{2} \sin(x + y)$

65. If $u = \sin^{-1} \frac{\sqrt{x} - \sqrt{y}}{\sqrt{x} + \sqrt{y}}$, then $\frac{\partial u}{\partial x} =$

(A) $\frac{-x}{y} \frac{\partial u}{\partial y}$

(B) $\frac{-y}{x} \frac{\partial u}{\partial y}$

(C) 0

(D) None of these

66. What is the main difference between Jacobi's and Gauss-Seidal ?

(A) Deviation from the correct answer is more in Gauss Seidal

(B) Convergence in Jacobi's method is faster

(C) Computations in Jacobi's can be done in parallel but not in Gauss-Seidal

(D) Gauss seidal cannot solve the system of linear equations in three variables whereas Jacobi can

67. The Cauchy Integral theorem states that if $f(z)$ is analytic in a simple connected domain D, then $\oint f(z)dz = 0$ on every simple closed path C in D. The condition of analyticity in this theorem is

(A) Sufficient

(B) Necessary and sufficient

(C) Necessary

(D) None of these

68. By method of variation of parameters, the solution of equation $y'' + y = \text{cosec } x$ is given by

(A) $A \cos x + B \sin x - (x \sec x + \log \tan x)$

(B) $A \cos x + B \sin x + x \cos x + \sin x . \log \sin x$

(C) $A \cos x . \sin x - \cos x \log (\sec x . \tan x)$

(D) $A \cos x + B \sin x - x \cos x + \sin x . \log \sin x$

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69. The function $f(z) = \sqrt{xy}$ is ..... at the origin even though C – R equations are ..... thereat.

(A) not analytic, satisfied

(B) analytic, not satisfied

(C) continuous, satisfied

(D) not continuous, not satisfied

70. The system of equations :

$$-2x + y + z = a,$$

$$x - 2y + z = b,$$

$$x + y - 2z = c$$

doesn't have a solution unless

(A) $a + b + c = 0$

(B) $a - b + c = 0$

(C) $a + b - c = 0$

(D) None of these.

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