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FOR KUET EXAM PREPARATION

KUET 2022 Question Paper · M.Sc. Mathematics

EXAM	YEAR	TYPE	SUBJECT
KUET	2022	Question Paper	M.Sc. Mathematics

Sr. No. 453

ENTRANCE TEST-2022

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

MATHEMATICS

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series A

Roll No. : | | | | | | |

Instructions for Candidates :

1. Write your Entrance Test Roll Number in the space provided at the top of this page of Question Booklet and fill up the necessary information in the spaces provided on the OMR Answer Sheet.
2. OMR Answer Sheet has an Original Copy and a Candidate's Copy glued beneath it at the top. While making entries in the Original Copy, candidate should ensure that the two copies are aligned properly so that the entries made in the Original Copy against each item are exactly copied in the Candidate's Copy.
3. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.
4. Choose the correct / most appropriate response for each question among the options A, B, C and D and darken the circle of the appropriate response completely. The incomplete darkened circle is not correctly read by the OMR Scanner and no complaint to this effect shall be entertained.
5. Use only blue/black ball point pen to darken the circle of correct/most appropriate response. In no case gel/ink pen or pencil should be used.
6. Do not darken more than one circle of options for any question. A question with more than one darkened response shall be considered wrong.
7. There will be **'Negative Marking'** for wrong answers. Each wrong answer will lead to the deduction of 0.25 marks from the total score of the candidate.
8. Only those candidates who would obtain positive score in Entrance Test Examination shall be eligible for admission.
9. Do not make any stray mark on the OMR sheet.
10. Calculators and mobiles shall not be permitted inside the examination hall.
11. Rough work, if any, should be done on the blank sheets provided with the question booklet.
12. OMR Answer Sheet must be handled carefully and it should not be folded or mutilated in which case it will not be evaluated.
13. Ensure that your OMR Answer Sheet has been signed by the Invigilator and the candidate himself/ herself.
14. At the end of the examination, hand over the OMR Answer Sheet to the invigilator who will first tear off the original OMR sheet in presence of the Candidate and hand over the Candidate's Copy to the candidate.

SEAL

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1. $\lim_{x\to 0}\frac{e^{\sin x}-1}{x}$ equals :

(A) 0

(B) –1

(C) e

(D) 1

2. Let $f(x)=\begin{cases}1, & x\geq 0\\ -1, & x<0.\end{cases}$

$g(x)=\begin{cases}-1, & x\geq 0\\ 1, & x<0.\end{cases}$

Then which of the following is true at x = 0 ?

(A) f and g are continuous

(B) fg is discontinuous

(C) f + g is continuous

(D) None of the above

3. If $z=x^4y^2\sin^{-1}\left(\frac{y}{x}\right)$, then $x\frac{\partial z}{\partial x}+y\frac{\partial z}{\partial y}$ equals :

(A) 6z

(B) 3z

(C) 9z

(D) 6

4. Let $z = x^2 - 3y^2 + 20$, where $x = 2\cos t$ and $y = 2\sin t$. At $t=\frac{\pi}{4}$, $\frac{dz}{dt}$ equals :

(A) 16

(B) –16

(C) –8

(D) 8

5. What is the radius of curvature of the curve $s = a\sec\psi\tan\psi + a\log(\sec\psi + \tan\psi)$ at the point (s, ψ) ?

(A) $2a\sec^3\psi$

(B) $a\sec^3\psi$

(C) $2\sec^3\psi$

(D) None of the above

6. What is the angle between the radius vector and the tangent to the curve $r = a(1 + \sin\theta)$ at $\theta = \frac{\pi}{6}$?

(A) $\frac{\pi}{6}$

(B) $\frac{\pi}{2}$

(C) $\frac{\pi}{4}$

(D) None of the above

7. What is the pedal equation of the curve $a^2 = r^2\cos 2\theta$?

(A) $a^2 = rp$

(B) $a = rp$

(C) $a = r + p$

(D) None of the above

8. What is the number of asymptotes of the curve $r=\frac{a}{1-\cos\theta}$?

(A) 2

(B) 1

(C) 0

(D) None of the above

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9. On which of the following functions Rolle's theorem cannot be applied ?

(A) $f(x) = \sin x$ in $[0, \pi]$

(B) $f(x) = \sqrt{4-x^2}$ in $[-2, 2]$

(C) $f(x) = |x|$ in $[-1, 1]$

(D) $f(x) = x^2$ in $[-1, 1]$

10. In which of the following intervals, all the conditions of the Lagrange's mean value theorem is satisfied ?

(A) [2, 4]

(B) [1, 3]

(C) [–2, 2]

(D) None of the above

11. $\lim\limits_{x\to 0}\left(\dfrac{\ln(1+x)}{\sin x}\right)$ equals :

(A) –1

(B) 1

(C) 0

(D) None of the above

12. What is the maximum value of the function $f(x) = 2x^3 - 9x^2 - 24x - 20$?

(A) 1

(B) 7

(C) –7

(D) None of the above

13. $\int \dfrac{dx}{\sqrt{2x-x^2}}$ equals :

(A) $\cos^{-1}(x - 1)$

(B) $\sin^{-1}(x - 1)$

(C) $\sin(x - 1)$

(D) $\cos(x - 1)$

14. $\int \dfrac{e^x}{(e^x-1)(e^x+2)}dx$ equals :

(A) $\ln\left|\dfrac{e^x+1}{e^x+2}\right|^{\frac{1}{3}}$

(B) $\ln\left|\dfrac{e^x-1}{e^x+2}\right|^{\frac{1}{3}}$

(C) $\ln\left|\dfrac{e^x-1}{e^x-2}\right|^{\frac{1}{3}}$

(D) None of the above

15. $\dfrac{d}{dx}\int_0^{\cos x}(t^4+6)\,dt$ equals :

(A) $-x(\cos^4 x + 6)\sin x$

(B) $-x(\cos^4 x + 6)\cos x$

(C) $-(\cos^4 x + 6)\cos x$

(D) None of the above

16. The differential equation $(ay^2 + x + x^8)dx + (y^8 - y + bxy)dy = 0$ is exact if :

(A) b = a

(B) a = 1 and b = 3

(C) a = 3 and b = 1

(D) b = 2a

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17. What is the integrating factor for the differential equation

$$(x+1)\frac{dy}{dx} - y = e^{3x}(x+1)^2 \ ?$$

(A) $\frac{1}{1+x^2}$

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

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

(D) $1 + x$

18. What is the particular integral for the differential equation

$$(D + 2)(D - 1)^3y = (e^x + 1) \ ?$$

(A) $\frac{1}{18}x^3e^x - \frac{1}{2}$

(B) $18x^3e^x - 2$

(C) $\frac{1}{18}x^2e^x - \frac{1}{2}$

(D) None of the above

19. What is the general solution of the differential equation

$$(D^2 + 1)y = \cos 2x + e^{-x} \ ?$$

(A) $c_1\cos x + c_2\sin x - \frac{1}{3}\cos 3x + \frac{1}{2}e^{-x}$

(B) $(c_1 + c_2x)e^x + \frac{1}{3}\cos x + \frac{1}{2}e^{-x}$

(C) $c_1\cos x + c_2\sin x - \frac{1}{3}\cos 2x + \frac{1}{2}e^{-x}$

(D) None of the above

20. What is the general solution of the different equation

$$\left(\frac{dy}{dx}\right)^2 - 7\left(\frac{dy}{dx}\right) + 12 = 0 \ ?$$

(A) $(y - 3x - c)(y - 4x - c) = 0$

(B) $(y + 3x - c)(y - 4x - c) = 0$

(C) $(y - 3x - c)(y + 4x - c) = 0$

(D) None of the above

21. What is the general solution of the differen equation $p = \log(px - y)$, where $p = \frac{dy}{dx}$?

(A) $y = cx - e^x$

(B) $y = cx - e^c$

(C) $y = c - e^x$

(D) None of the above

22. If α is the degree and β is the order of differential equation

$$\left(\frac{d^2y}{dx^2}\right)^{\frac{1}{3}} = \left(y + \frac{dy}{dx}\right)^{\frac{1}{2}}.$$

Then $3\alpha + 5\beta$ equals :

(A) 29

(B) 18

(C) 28

(D) None of the above

23. The differential equation $(y - px)^2 = a^2(1+$ where $p = \frac{dy}{dx}$, is :

(A) Linear equation

(B) Lagrange's equation

(C) Clairaut's equation

(D) None of the above

24. What is the expansion of x^2 in terms of the Legendre polynomial ?

(A) $\frac{1}{2}[2p_2(x)+p_0(x)]$

(B) $\frac{1}{3}[2p_2(x)+3p_0(x)]$

(C) $\frac{1}{3}[2p_2(x)+p_0(x)]$

(D) None of the above

25. If $J_n(x)$ is the Bessel function, then $J_{-\frac{1}{2}}(x)$ equals :

(A) $\frac{2}{\pi x}$

(B) $\frac{\pi x}{2}$

(C) $\sqrt{\frac{2}{\pi x}}\sin x$

(D) None of the above

26. What is the general solution of the Bessel's differential equation

$$x^2\left(\frac{d^2y}{dx^2}\right)+x\left(\frac{dy}{dx}\right)+\left(x^2-\frac{9}{16}\right)y=0.$$

(A) $y=AJ_{\frac{9}{16}}(x)+BJ_{-\frac{9}{16}}(x)$

(B) $y=AJ_{\frac{3}{4}}(x)+BJ_{-\frac{3}{4}}(x)$

(C) $y=AJ_{\frac{4}{3}}(x)+BJ_{-\frac{4}{3}}(x)$

(D) None of the above

27. What is the partial differential equation obtained from $z = f(x^2 - y^2)$ by eliminating the arbitrary function ?

(A) $y\frac{\partial z}{\partial x}=x\frac{\partial z}{\partial y}$

(B) $x\frac{\partial z}{\partial x}=y\frac{\partial z}{\partial y}$

(C) $y\frac{\partial z}{\partial x}=z\frac{\partial z}{\partial y}$

(D) None of the above

28. What is the general solution of the partial differential equation $\frac{\partial z}{\partial x}+\frac{\partial z}{\partial y}=\sin x$?

(A) $\phi(x - y, z + \cos x) = 0$

(B) $\phi(xy, z + \cos x) = 0$

(C) $\phi(x - y, z + \sin x) = 0$

(D) $\phi(x - y, z\cos x) = 0$

29. What is the complete integral of the partial differential equation $z = px + qy - 2\sqrt{pq}$.

(A) $z = (ax + by)^2 - 2\sqrt{ab}$

(B) $z = axy - 2\sqrt{ab}$

(C) $z = ax + by - 2\sqrt{ab}$

(D) None of the above

30. At all points, the partial differential equation

$$\frac{\partial^2 u}{\partial x^2}+4\left(\frac{\partial^2 u}{\partial x\partial y}\right)+4\left(\frac{\partial^2 u}{\partial y^2}\right)=0$$

(A) is hyperbolic

(B) is elliptic

(C) is parabolic

(D) None of the above

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31. Which of the following statements is/are true ?

(1) The set $\left\{-1, -\frac{1}{2}, -\frac{1}{3}, -\frac{1}{4}, \ldots\right\}$ is bounded.

(2) The set $\left\{\frac{1}{3}, \frac{4}{5}, \frac{9}{7}, \frac{16}{9}, \ldots\right\}$ is bounded.

(A) Both (1) and (2) are true

(B) Only (1) is true

(C) Only (2) is true

(D) Neither (1) is true nor (2) is true

32. Which of the following is order complete ?

(A) set of rational numbers

(B) set of irrational numbers

(C) set of integers

(D) set of real numbers

33. What is number of limit points in a finite set ?

(A) 1

(B) 2

(C) infinite

(D) None of the above

34. Which of the following is uncountable ?

(A) set of all integers

(B) set P_n of all polynomial functions with integer coefficients

(C) set {1, 4, 9, 16, ...}

(D) set of all real numbers

35. What is the number of limit points of the seque {1, 2, 1, 4, 1, 6, 1, ...} ?

(A) one

(B) more than one but finite

(C) infinite

(D) 0

36. The sequence $\left\{1+\frac{1}{n}\right\}$

(A) converges to zero

(B) converges to 1

(C) converges to 2

(D) diverges to infinity

37. If $\lim_{n\to\infty} a_n = 9$, then $\lim_{n\to\infty}\left(\frac{(a_1 + a_2 + \ldots + a_n}{n}\right.$

equals :

(A) 0

(B) 3

(C) 9

(D) None of the above

38. Which of the following is NOT true ?

(A) A necessary and sufficient condition the convergence of a monotonic seque is that it is bounded.

(B) Every monotonic decreasing sequence wh is bounded below diverges.

(C) Every monotonic increasing sequence wh is not bounded above diverges.

(D) A monotonic increasing bounded ab sequence converges.

39. The series $\frac{1.2}{3^2.4^2}+\frac{3.4}{5^2.6^2}+\frac{5.6}{7^2.8^2}+.....$

(A) oscillates finitely

(B) oscillates infinitely

(C) is divergent

(D) is convergent

40. Which of the following statements is true ?

(1) the infinite series $\sum\frac{1}{n^{1+\frac{1}{n}}}$ is divergent

(2) the infinite series $\sum\frac{1}{n^{2+\frac{1}{n}}}$ is convergent

(A) Both (1) and (2) are true

(B) Only (1) is true

(C) Only (2) is true

(D) Neither (1) is true nor (2) is true

41. Which of the following statements is true ?

(1) The infinite series $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+....$ is conditionally convergent

(2) The infinite series $1-\frac{1}{2^3}+\frac{1}{3^3}-\frac{1}{4^3}+....$ is absolutely convergent

(A) Both (1) and (2) are true

(B) Only (1) is true

(C) Only (2) is true

(D) Neither (1) is true nor (2) is true

42. If $\sum U_n$ is a positive term series such that $\lim_{n\to\infty}(U_n)^{\frac{1}{n}}=t$, then the series converges if

(A) $t = 1$

(B) $t > 1$

(C) $t < 1$

(D) $t = 2$

43. Which of the following statements is/are true for the sequence $F_n(x) = x^n$ on $[0, 1]$?

(1) Uniformly convergent

(2) Pointwise convergent

(A) Both (1) and (2)

(B) Only (1)

(C) Only (2)

(D) Neither (1) nor (2)

44. If a sequence $\{f_n\}$ converges uniformly in $[a, b]$ and x_0 is a point of $[a, b]$ such that $\lim_{x\to x_0} f_n(x) = a_n$, $n = 1, 2, 3, ..., then :

(A) $\{a_n\}$ diverges

(B) $\{a_n\}$ converges

(C) $\lim_{x\to x_0} f(x) \neq \lim_{n\to\infty} a_n$

(D) $\lim_{x\to x_0} f(x) \neq a_n$

45. If R is the radius of convergence and β is the exact interval of convergence of the power series $\sum\frac{(x-1)^n}{2^n}$, then :

(A) $R = 2$ and $\beta = (-1, 3)$

(B) $R = 4$ and $\beta = (-1, 5)$

(C) $R = \infty$ and $\beta = (-1, 3)$

(D) None of the above

46. Which of the following forms a group ?

(A) {1, 2, 3} under multiplication modulo 4

(B) {1, –1, i, –i} under addition

(C) {0, 1, 2, 3} under multiplication modulo 4

(D) {1, 2, 3, 4} multiplication modulo 5

47. In the group $GL(2, Z_{11})$, the inverse of $\begin{pmatrix} 2 & 6 \\ 5 & 5 \end{pmatrix}$ is $\begin{pmatrix} k & k \\ k+1 & k-1 \end{pmatrix}$, then $5k + 3$ equals :

(A) 45

(B) 46

(C) 47

(D) None of the above

48. In the multiplicative group {1, –1, i, –i}, if x is the inverse of –1 and y is the inverse of i, then xy equals :

(A) i

(B) –i

(C) 1

(D) –1

49. For an abelian group G with a, b ∈ G and n a non-negative integer, which of the following statements is/are true ?

(1) $(ab)^n = a^n b^n$

(2) $(ab)^{-1} = a^{-1}b^{-1}$

(A) Both (1) and (2)

(B) Only (1)

(C) Only (2)

(D) Neither (1) nor (2)

50. Which of the following is NOT true for a group G of order 7 ?

(A) G is cyclic

(B) G is abelian

(C) G has no proper subgroups

(D) G has a unique proper subgroup

51. What is the number of proper subgroups of a finite cyclic group of order 12 ?

(A) One

(B) Two

(C) Four

(D) Six

52. What is the order of element 3 in the group $(\{0, 1, 2, 3, 4\}, +5)$?

(A) 4

(B) 5

(C) 6

(D) None of the above

53. Which of the following statements is/are true ?

(1) The intersection of any collection of normal subgroups is itself a normal subgroup.

(2) If H and K are subgroups of an abelian group G, then HK is a subgroup of G.

(A) Both (1) and (2)

(B) Only (1)

(C) Only (2)

(D) Neither (1) nor (2)

54. Which of the following statements is/are true ?

(1) A subgroup H of index 2 in a group G is a normal subgroup of G.

(2) If H and N are subgroups of a group G, with N normal in G, then $H \cap N$ is normal in G.

(A) Only (1)

(B) Only (2)

(C) Both (1) and (2)

(D) Neither (1) nor (2)

55. Which one of the following is NOT true ?

(A) A quotient group of an abelian group is abelian.

(B) A quotient group of a cyclic group is cyclic.

(C) The quotient group P_3/A_3 is an abelian group, where P_3 is the symmetric group of degree 3 and A_3 is the alternating group of order 3.

(D) The symmetric group P_3 of degree 3 is abelian.

56. The set M of all nxn matrices with their elements as real numbers is a :

(A) Commutative ring with unity

(B) Non-commutative ring with unity

(C) Non-commutative ring without unity

(D) Ring without zero divisors

57. The ring of integers is :

(A) A field

(B) An integral domain

(C) A division ring

(D) None of the above

58. The ring of all 2×2 matrices over rationals is :

(A) An integral domain

(B) A commutative ring

(C) A field

(D) None of the above

59. Which of the following is NOT order of a finite field ?

(A) 81

(B) 125

(C) 32

(D) 36

60. Which of the following statements is/are true ?

(1) A ring has more than one unity.

(2) A unit of a ring divides every element of the ring.

(A) Both (1) and (2)

(B) Only (1)

(C) Only (2)

(D) Neither (1) nor (2)

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