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FOR KUET EXAM PREPARATION

KUET 2021 Question Paper · M.Sc. Mathematics

EXAM	YEAR	TYPE	SUBJECT
KUET	2021	Question Paper	M.Sc. Mathematics

Sr. No. .....

ENTRANCE TEST-2021

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

MATHEMATICS

Question Booklet Series **A**

Total Questions : 60
Time Allowed : 70 Minutes

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.

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1. The infimum and supremum of the set $\left\{1+\frac{(-1)^n}{n} : n \in \mathbb{N}\right\}$ is :

   (A) $-1,\ 1$

   (B) $0,\ 1$

   (C) $-1,\ \frac{2}{3}$

   (D) $0,\ \frac{2}{3}$

2. For any positive real number a there exists a positive integer n such that :

   (A) $n > a$

   (B) $n < a$

   (C) $n = a$

   (D) None of the above

3. If A = {1, 2, 3 ... n} then the set of limit points of A is :

   (A) Countable

   (B) Uncountable

   (C) Empty

   (D) Singleton

4. A subset S of real numbers has a limit point if :

   (A) S is finite

   (B) S is countably infinite

   (C) S is infinite and bounded

   (D) S is uncountable

5. The sequence (ρ^n) converges for :

   (A) $\rho > 1$

   (B) $-1 \leq \rho < 1$

   (C) $\rho < -1$

   (D) $-1 < \rho \leq 1$

6. The sequence $(n + (-1)^n)$ is :

   (A) Convergent

   (B) Divergent

   (C) Oscillates finitely

   (D) Oscillates infinitely

7. The sequence (a_n) defined by the recursion formula $a_{n+1} = \sqrt{3a_n}$, $a_1 = 1$ is :

   (A) Monotonically decreasing

   (B) Monotonically increasing

   (C) Monotonically increasing and unbounded

   (D) Monotonically increasing and bounded.

8. The sequence (a_n) where $a_n = 1+\frac{1}{2}+\frac{1}{3}+...+\frac{1}{n}$ converges to :

   (A) 1

   (B) 0

   (C) $\frac{1}{2}$

   (D) None of the above

9. If $\sum_{n=1}^{\infty} a_n$ is convergent, then for some finite number $\alpha \geq 1$ the series :

(i) $\sum_{n=1}^{\infty} a_n$

(ii) $\sum_{n=1}^{\infty} \alpha a_n$

(A) (i) is convergent (ii) is divergent

(B) (i) is divergent (ii) is convergent

(C) Both are convergent

(D) Both are divergent

10. The series $\sum_{n=1}^{\infty} \left\{ (n^3+1)^{\frac{1}{3}} - n \right\}^p$ is :

(A) Convergent for p = 1

(B) Divergent for p = 1

(C) Divergent for all values of p

(D) None of the above

11. The series $x + \frac{x^2}{2} + \frac{x^3}{3} + \ldots$:

(A) Converges for $x > 1$

(B) Converges for $x < 1$

(C) Converges for $x = 1$

(D) Converges for all values of x

12. The series $1 - \frac{1}{2^p} + \frac{1}{3^p} - \frac{1}{4^p} \cdots$ converges for :

(A) $p > 1$

(B) $p < 1$

(C) $p > 0$

(D) $p < 0$

13. The maximum value of $(x - 1)^2 e^x$ is attained at :

(A) e

(B) –e

(C) 1

(D) –1

14. $\lim_{x \to \frac{\pi}{2}} \frac{\log\left(x - \frac{\pi}{2}\right)}{\tan x} =$

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

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

(C) 0

(D) 1

15. For which of the following functions Rolle's theorem fails ?

(A) $\sin x$; $x \in [-\pi, \pi]$

(B) $\frac{\sin x}{e^x}$; $x \in [0, \pi]$

(C) $|x|$; $x \in [-1, 1]$

(D) $x^3 - 4x$; $x \in [-2, 2]$

16. Which of the following functions doesn't have the Maclaurin's expansion :

(A) log x

(B) log(1 + x)

(C) log sec x

(D) log cos x

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17. The angle between tangent and radius vector for the curve $r = a(1 + \cos\theta)$ at $\theta = \frac{\pi}{2}$ is :

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

(B) $\frac{3\pi}{2}$

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

(D) $\frac{3\pi}{4}$

18. The curve $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ has the asymptotes :

(A) $y = \pm bx$

(B) $y = 0$

(C) $x = \pm by$

(D) $x = 0$

19. Which of the following is true for the functions

(i) $y = e^x$

(ii) $y = \log x$

(A) (i) is convex upwards (ii) is concave upwards

(B) (i) is concave upwards (ii) is convex upwards

(C) (i) is convex downwards (ii) is concave downwards

(D) (i) is concave downwards (ii) is convex downwards

20. Which of the following statements is true for the curve $x^4 + y^4 = 4a^2xy$?

(A) The curve is symmetrical w.r.t. $x + y = 0$

(B) The curve is symmetrical w.r.t. $x = 0$

(C) The curve is symmetrical w.r.t. $y = 0$

(D) The curve is symmetrical w.r.t. $x = y$

21. The functional sequence $f_n(x) = \frac{nx}{1 + n^2x^2}$ is :

(A) Uniformly convergent in [0, 1]

(B) Uniformly convergent in [–1, 1]

(C) Uniformly convergent in [–1, 0]

(D) Uniformly convergent in [1, 2]

22. The series $\sum_{n=1}^{\infty} f_n(x)$ is uniformly convergent on [a, b] if there exists a convergent series of positive numbers ΣM_n such that for all $x \in [a, b]$:

(A) $|f_n(x)| \leq M_n \ \forall \ n$

(B) $|f_n(x)| \geq M_n \ \forall \ n$

(C) $|f_n(x)| \leq \sqrt{M_n} \ \forall \ n$

(D) $|f_n(x)| \geq \sqrt{M_n} \ \forall \ n$

23. The limit of a sequence of functions is continuous if :

(A) Every function of the sequence is continuous

(B) The convergence is uniform

(C) Either (A) or (B)

(D) Both (A) and (B)

24. The function $f(x)=\begin{cases}3x-2 & , \quad x\le 0\\ x+1 & , \quad x>0\end{cases}$ is :

(A) Continuous

(B) Discontinuous at x = –1

(C) Discontinuous at x = 2

(D) Discontinuous at the origin

25. For $u=\log(\tan x+\tan y)$, $\sin 2x\frac{\partial u}{\partial x}+\sin 2y\frac{\partial u}{\partial y}=$

(A) 0

(B) 1

(C) 2

(D) 4

26. Leibnitz theorem is used to find :

(A) n^{th} derivative of sum of two functions

(B) n^{th} derivative of subtraction of two functions

(C) n^{th} derivative of product of two functions

(D) None of the above

27. $\lim\limits_{x\to 0}(1+x)^{\frac{1}{x}}=$

(A) 0

(B) 1

(C) $\frac{1}{e}$

(D) e

28. $\int\frac{dx}{1-4\cos^2 x}=$

(A) $\frac{1}{2\sqrt{3}}\log\frac{\tan x+\sqrt{3}}{\tan x-\sqrt{3}}$

(B) $\frac{1}{2\sqrt{3}}\log\frac{\tan x-\sqrt{3}}{\tan x+\sqrt{3}}$

(C) $\frac{1}{2\sqrt{3}}\log\frac{\tan x+2\sqrt{3}}{\tan x-2\sqrt{3}}$

(D) $\frac{1}{2\sqrt{3}}\log\frac{\tan x-2\sqrt{3}}{\tan x+2\sqrt{3}}$

29. $\int\frac{dx}{(x+1)\sqrt{x+2}}=$

(A) $\log\frac{\sqrt{x+2}}{\sqrt{x+2}}-1$

(B) $\log\frac{\sqrt{x+2}}{\sqrt{x+2}}+1$

(C) $\log\frac{\sqrt{x+2}+1}{\sqrt{x+2}-1}$

(D) $\log\frac{\sqrt{x+2}-1}{\sqrt{x+2}+1}$

30. If $f(m, n)=\int_0^{\pi/2}\cos^m x\cos nx\,dx$ then :

(A) $f(m, n)=\frac{n}{m+n}f(m+1, n+1)$

(B) $f(m, n)=\frac{m}{m+n}f(m+1, n+1)$

(C) $f(m, n)=\frac{n}{m+n}f(m-1, n-1)$

(D) $f(m, n)=\frac{m}{m+n}f(m-1, n-1)$

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31. For integer n, the Bessel functions $J_n(x)$ and $J_{-n}(x)$ are connected with the relation :

(A) $J_{-n}(x) = -J_n(x)$

(B) $J_{-n}(x) = (-1)^n J_n(x)$

(C) $J_{-n}(x) = -J_{-n}(x)$

(D) $J_{-n}(x) = (-1)^n J_{-n}(x)$

32. $\int J_n(x)\,dx =$

(A) $-J_2(x) - \frac{2}{x} J_2(x)$

(B) $J_2(x) - \frac{2}{x} J_2(x)$

(C) $-J_2(x) + \frac{2}{x} J_2(x)$

(D) None of the above

33. The Legendre polynomial for $m \neq n$,

$\int_{-1}^{1} P_m(x)\, P_n(x)\,dx =$

(A) –1

(B) 1

(C) 0

(D) None of the above

34. Which of the following sets is a group under multiplication modulo 8 ?

(A) {1, 3, 5, 7}

(B) {1, 2, 3, 4}

(C) {2, 4, 6, 8}

(D) {1, 2, 3, 4, 5, 6, 7}

35. What is the order of the dihedral group of square ?

(A) 2

(B) 4

(C) 6

(D) 8

36. Which of the following is not a group under multiplication ?

(A) $\mathbb{R} - \{0\}$

(B) $\mathbb{R}$

(C) {1, –1, i, –i}

(D) $\{1, \omega, \omega^2\}$

37. The identity of the set of positive rationals w.r.t. the binary operation $a * b = \frac{ab}{3}$ is :

(A) 0

(B) 1

(C) 3

(D) $\frac{1}{3}$

38. If G is a finite group of even order

(i) order of subgroup of G divides order of G

(ii) G has an element of order two.

(A) Only (i) is true

(B) Only (ii) is true

(C) Both are true

(D) Both are false

39. If H and K are subgroups of a group G of finite order and $O(H) > \sqrt{O(G)}$, $O(K) > \sqrt{O(G)}$, then :

(A) $O(H \cap K) = \sqrt{O(G)}$

(B) $O(H \cap K) = 1$

(C) $O(H \cap K) < 1$

(D) $O(H \cap K) > 1$

40. If $H \subseteq G$ be a subgroup of a group G then which of the following is not true ?

(A) $Ha = H$ if $a \in H$

(B) $Ha = H$ if $a \in G$

(C) $Ha = Hb$ if $ab^{-1} \in H$

(D) $ab^{-1} \in H$ if $Ha = Hb$

41. Which of the following statements is true ?

(A) Any finite group of order n is cyclic if it has an element of order n.

(B) Every cyclic group need not be abelian.

(C) The group of integers is not cyclic.

(D) None of the above

42. If M is a set of all matrices of the type $\begin{pmatrix} a & b \\ -\bar{b} & \bar{a} \end{pmatrix}$ where bars denote the complex conjugates, then M is a :

(A) Division ring

(B) Ring but not a division ring

(C) Field

(D) Not a ring

43. If R is a ring (i) $C = \{x \in R : xy = yx, \forall y \in R\}$, (ii) $N(a) = \{r \in R : ar = ra\}$ then :

(A) C is a subring, N(a) is not

(B) N(a) is a subring, C is not

(C) Both are subrings

(D) None is a subring

44. In a ring M of matrices of order 2 over integers the set $S = \left\{\begin{pmatrix} a & 0 \\ b & 0 \end{pmatrix} : a, b \in \mathbb{Z}\right\}$ is a :

(A) Right ideal

(B) Left ideal

(C) Two sided ideal

(D) None of the above

45. If R[x] denotes a polynomial ring over R then which of the following statements is true ?

(A) R is commutative if R[x] is commutative

(B) R[x] is commutative if R is commutative

(C) R has no proper zero divisors if R[x] has no proper zero divisors

(D) All the above

46. The union of two subgroups N_1 and N_2 of a group G is normal if :

(A) $N_1 \cap N_2 = \varphi$

(B) $N_1 \cap N_2 \neq \varphi$

(C) $N_1 \cup N_2 \neq \varphi$

(D) None of the above

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47. Which of the following is true for the groups $G_1 = \{1, -1, i, -i\}$ and $G_2 = (\mathbb{Z}, +)$?

(A) All subgroups of G_1 are normal

(B) All the subgroups of G_2 are normal

(C) Both (A) and (B)

(D) None of the above

48. If N is a normal subgroup of a group G then :

(A) $O\left(\frac{G}{N}\right) = O(G) - O(N)$

(B) $O\left(\frac{G}{N}\right) = O(G) + O(N)$

(C) $O\left(\frac{G}{N}\right) = O(G) . O(N)$

(D) $O\left(\frac{G}{N}\right) = \frac{O(G)}{O(N)}$

49. $\frac{dx}{dy} + Qx = Px^n$ is a Bernoulli's differential equation where P and Q are :

(A) Functions of x only

(B) Functions of x or constants

(C) Constants only

(D) Functions of y or constants

50. $\frac{1}{D^2+4}\cos 2x =$

(A) $\frac{x}{4}\sin 2x$

(B) $\frac{x}{-4}\sin 2x$

(C) $\frac{x}{4}\cos 2x$

(D) $\frac{x}{-4}\cos 2x$

51. If M and N are homogenous in Mdx + Ndy = 0 then the integrating factor is :

(A) Mx + Ny

(B) Mx – Ny

(C) $\frac{1}{Mx+Ny}$

(D) $\frac{1}{Mx-Ny}$

52. $\frac{1}{f(D)} e^{-x} V =$

(A) $e^{-x} \frac{1}{f(D)} V$

(B) $e^{-x+1} \frac{1}{f(D)} V$

(C) $e^{-x} \frac{1}{f(D+1)} V$

(D) $e^{-x} \frac{1}{f(D-1)} V$

53. The solution of the ordinary differential equation $y^2 \log y = xyp + p^2$ is :

(A) $\log x = cy + c^2$

(B) $\log y = cx + c^2$

(C) $\log y^2 = cx + c^2$

(D) $\log x^2 = cy + c^2$

54. The solution of the ordinary differential equation $p^2 = y^2 + 1$ is :

(A) $y = \sin(c \pm x)$

(B) $y = \cos(c \pm x)$

(C) $y = \sinh(c \pm x)$

(D) $y = \cosh(c \pm x)$

55. What is the singular solution of the differential equation $2px + y^2p^3$?

(A) $y = cx + \frac{c^3}{8}$

(B) $y = cx - \frac{c^3}{8}$

(C) $y^2 = cx - \frac{c^3}{8}$

(D) $y^2 = cx + \frac{c^3}{8}$

56. The singular solution of the ordinary differential equation $y = xp + \frac{a}{p}$ is :

(A) $y^2 = 4ax$

(B) $y^2 = -4ax$

(C) $x^2 = 4ay$

(D) $x^2 = -4ay$

57. The partial differential equation by eliminating the arbitrary constants of the equation $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ is :

(A) $z = px + qy$

(B) $2z = px + qy$

(C) $2z = px - qy$

(D) $z = px - qy$

58. What is the general solution of the partial differential equation $\frac{y^2z}{x}p + xzq = y^2$.

(A) $\varphi(x^3 - y^3, x^3 - z^3) = 0$

(B) $\varphi(x^3 + y^3, x^3 + z^3) = 0$

(C) $\varphi(x^3 - y^3, x^2 - z^2) = 0$

(D) $\varphi(x^3 + y^3, x^2 + z^2) = 0$

59. The complete solution of the partial differential equation $\sqrt{p} + \sqrt{q} = 1$ is :

(A) $z = -ax + \left(1 - \sqrt{a}\right)^2 y + c$

(B) $z = ax - \left(1 - \sqrt{a}\right)^2 y + c$

(C) $z = -ax - \left(1 - \sqrt{a}\right)^2 y + c$

(D) $z = ax + \left(1 - \sqrt{a}\right)^2 y + c$

60. What is the solution of the partial differential equation $x + qy = pq$?

(A) $az = \frac{1}{2}(y + ax)^2 + b$

(B) $az = \frac{1}{2}(y - ax)^2 + b$

(C) $az = (y + ax)^2 + b$

(D) $az = (y - ax)^2 + b$

ROUGH WORK

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