NTA CUET (UG) - 2023

Section II - Mathematics

Time Allowed : 60 Minutes **Marks :** 200

General instructions:

(i) For every correct answer, 5 marks will be awarded.
(ii) 1 mark will be deducted for every wrong answer.
(iii) The question paper has two sections
Part A (Common) : 15 mandatory questions covering both Mathematics and Applied Mathematics
Part B1 (Core Mathematics) : 35 questions out of which 25 questions are compulsory
Part B2 (Applied Mathematics) : 35 questions on Applied mathematics out of which 25 questions are compulsory.
(iv) Out of **Part B1 and Part B2**, the candidate has to **attempt 25 questions only in any one section**.

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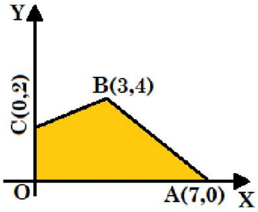
Part A : Common
(Compulsory Section)

Q01. The feasible region for a LPP is shown in the given figure. The maximum value of $Z = 2x + 5y$ is

(a) 15
(b) 10
(c) 36
(d) 26



Q02. If the probability distribution of a random variable X is as shown below.

X	-1	0	1	2	3
P(X)	K	$\frac{1}{5}$	2K	$\frac{3}{10}$	K

Then the value of K is

(a) $\frac{3}{8}$ (b) $\frac{1}{4}$ (c) $\frac{5}{8}$ (d) $\frac{1}{8}$

Q03. In a linear programming problem, the objective function is always

(a) linear (b) quadratic (c) cubic (d) biquadratic

Q04. If $x = a\left(t - \frac{1}{t}\right)$, $y = b\left(t + \frac{1}{t}\right)$, then $\frac{dy}{dx} =$

(a) $\frac{x}{y}$ (b) $\frac{b^2x}{a^2y}$ (c) $\frac{bx}{ay}$ (d) $\frac{a^2y}{b^2x}$

Q05. The area enclosed between $y^2 = 4x$, $x = 1$, $x = 4$ in first quadrant is

(a) $\frac{28}{3}$ sq. units (b) $\frac{27}{2}$ sq. units (c) $\frac{25}{2}$ sq. units (d) $\frac{27}{5}$ sq. units

Q06. Match List-I with List-II. Match the integrating factors.

	List-I (Differential Equation)		List-II (Integrating Factor)
(A)	$\frac{dy}{dx} + 3y = e^{-2x}$	(I)	$\frac{1}{x}$
(B)	$x\frac{dy}{dx} + y = 3x^2$	(II)	e^{-x}
(C)	$x\frac{dy}{dx} - y = 3x^2$	(III)	x
(D)	$\frac{dy}{dx} - y = x$	(IV)	e^{3x}

Choose the correct answer from the questions given below.

(a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(d) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

Q07. $\int \left(x + \frac{1}{x}\right)^2 dx$ equals

(a) $\frac{x^3}{3} + \frac{1}{x} - 2x + c$ (b) $\frac{x^3}{3} - \frac{1}{x} + 2x + c$ (c) $\frac{x^3}{3} - \frac{1}{x} - 2x + c$ (d) $\frac{x^3}{3} + \frac{1}{x} + 2x + c$

Q08. If m and n are respectively the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^5 + 6\frac{\left(\frac{d^2y}{dx^2}\right)^3}{\frac{d^3y}{dx^3}} + \frac{d^3y}{dx^3} = x^2 + 5$, then

(a) $m = 3, n = 3$ (b) $m = 2, n = 3$ (c) $m = 3, n = 2$ (d) $m = 3, n = 5$

Q09. The mean number of heads in two tosses of a coin is

(a) 2 (b) $\frac{1}{2}$ (c) 1 (d) $\frac{3}{2}$

Q10. Given $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} x & y \\ 1 & 4 \end{bmatrix}$. If $A = B$, then x and y are

(a) $x = 2, y = 3$ (b) $x = 1, y = 2$ (c) $x = 3, y = 2$ (d) $x = -2, y = -3$

Q11. If order of matrix A is $m \times p$ and order of matrix B is $p \times n$, then what is the order of matrix AB?

(a) $m \times p$ (b) $m \times n$ (c) $p \times n$ (d) $m \times 2$

Q12. The sum of the products of elements of any row with the cofactors of corresponding elements is equal to

(a) the value of the determinant (b) 0

(c) sum of cofactors (d) adjoint of matrix

Q13. If the function $f(x) = x^4 - 62x^2 + ax + 9$ attains its local maximum value at $x = 1$, then a is equal to

(a) 120 (b) 110 (c) 100 (d) 90

Q14. The slope of the tangent to the curve $x = at^2,\ y = 2at$ at 't' is

(a) $\frac{1}{t}$ (b) $\frac{1}{t^2}$ (c) $-\frac{1}{t}$ (d) $-\frac{1}{t^2}$

Q15. If $\begin{vmatrix} 3x & 4 \\ 7 & x \end{vmatrix} = \begin{vmatrix} 6 & 3 \\ 2 & 1 \end{vmatrix}$, then

(a) $x^2 = \frac{26}{3}$ (b) $x^2 = \frac{25}{3}$ (c) $x^2 = \frac{23}{3}$ (d) $x^2 = \frac{28}{3}$

Part B1 : Core Mathematics

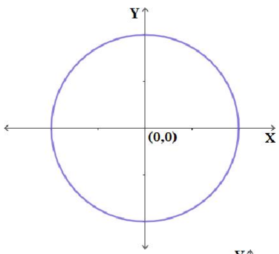
Q16. If $A = \begin{bmatrix} 1 & -2 & 3 \\ -4 & 2 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ 3 & -4 \\ 2 & 4 \end{bmatrix}$, then product AB is

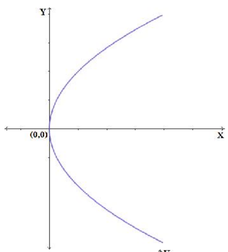
(a) not possible (b) $\begin{bmatrix} 1 & -6 & 6 \\ 8 & -8 & 16 \end{bmatrix}$ (c) $\begin{bmatrix} 9 \\ 19 \\ 15 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 18 \\ 10 & 16 \end{bmatrix}$

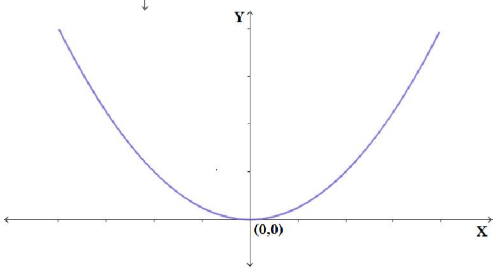
Q17. The degree of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)\right]^3 = \left(\frac{d^2y}{dx^2}\right)^2$ is

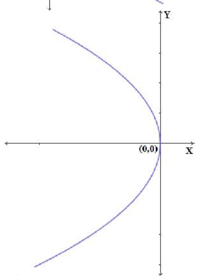
(a) 1 (b) 2 (c) 3 (d) 4

Q18. Which of the following graphs represent a function?

(a)


(b)


(c)


(d)


Q19. The two curves $x^3 - 3xy^2 + 15 = 0$ and $3x^2y - y^3 + 17 = 0$

(a) cut at right angles (b) touch each other (c) cut at an angle $\frac{\pi}{4}$ (d) cut at an angle $\frac{\pi}{3}$

Q20. If $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x}, & x \neq \frac{\pi}{2} \\ 3, & x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$, then k is

(a) 6 (b) 4 (c) 3 (d) 2

Q21. The area enclosed between the curve $y = x^2 + 2$ and x-axis between $x = 0$ and $x = 3$ is

(a) 14 sq. units (b) 15 sq. units (c) 16 sq. units (d) 18 sq. units

Q22. The interval in which the function $f(x) = 2x^3 - 3x^2 - 36x + 7$ is strictly decreasing is

(a) $(-3, -2)$ (b) $(-2, 3)$ (c) $(2, 3)$ (d) $(2, -3)$

Q23. Let $A = \begin{bmatrix} 1 & -2 & 3 \\ 1 & 2 & 1 \\ \lambda & 2 & -3 \end{bmatrix}$. If A^{-1} does not exist, then $\lambda =$

(a) -2 (b) 2 (c) 1 (d) -1

Q24. Let $a \le \tan^{-1}x + \cot^{-1}x + \sin^{-1}x \le b$. If a and b denote the minimum and maximum possible values of a and b respectively, then

(a) $a = 0, b = \pi$ (b) $a = 0, b = \frac{\pi}{2}$ (c) $a = \frac{\pi}{2}, b = \pi$ (d) $a = -\frac{\pi}{2}, b = \frac{\pi}{2}$

Q25. The vector equation of the line joining the points (–2, –3, –4) and (1, –2, 4) is

(a) $\vec{r} = (-2\hat{i} - 3\hat{j} - 4\hat{k}) + \lambda(\hat{i} - 2\hat{j} + 4\hat{k})$ (b) $\vec{r} = (2\hat{i} + 3\hat{j} + 4\hat{k}) + \lambda(3\hat{i} - \hat{j} + 8\hat{k})$

(c) $\vec{r} = (-2\hat{i} - 3\hat{j} - 4\hat{k}) + \lambda(3\hat{i} + \hat{j} + 8\hat{k})$ (d) $\vec{r} = (2\hat{i} + 3\hat{j} + 4\hat{k}) + \lambda(3\hat{i} + \hat{j} + 8\hat{k})$

Q26. $\int \frac{\sqrt{\tan x}}{\sin x \cos x} dx$ equals

(a) $2\sqrt{\tan x} + c$ (b) $2\sqrt{\cot x} + c$ (c) $\sqrt{\tan x} + c$ (d) $\frac{2}{\sqrt{\tan x}} + c$

Q27. If a, b and c are all different from zero and $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = 0$, then the value of $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$ is

(a) 0 (b) abc (c) -1 (d) $\frac{1}{abc}$

Q28. If A and B are invertible matrices of order 3, $|A| = 2$ and $|(AB)^{-1}| = -\frac{1}{6}$, then the value of $|B|$ is

(a) 3 (b) -3 (c) 2 (d) $\frac{1}{6}$

Q29. Match List-I with List-II.

	List-I		List-II
(A)	If A and B are mutually exclusive events, then $P(A \cup B) =$	(I)	$\frac{P(A \cap B)}{P(B)}, P(B) \neq 0$
(B)	If A and B are independent events, then $P(A \cap B) =$	(II)	$\frac{P(A \cap B)}{P(A)}, P(A) \neq 0$
(C)	If A and B are two events of a sample space of an experiment, then $P(A \mid B) =$	(III)	$P(A).P(B)$
(D)	If A and B are two events of a sample space of an experiment, then $P(B \mid A) =$	(IV)	$P(A) + P(B)$

Choose the correct answer from the questions given below.

(a) (A)-(IV), (B)-(III), (C)-(I), (D)-(II) (b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(c) (A)-(II), (B)-(III), (C)-(IV), (D)-(I) (d) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

Q30. The corner points of the feasible region determined by the system of linear constraints are (0, 0), (0, 40), (20, 40), (60, 20), (60, 0). The objective function is $z = 4x + 3y$.

Compare the quantity in Column-A and Column-B.

Column-A	Column-B
Maximum value of z	350

(a) The quantity in column A is greater
(b) The quantity in column B is greater
(c) The two quantities are equal
(d) The quantity in column B is greater than twice the quantity in column A

Q31. If $|\vec{a}|=3$ and $|\vec{b}|=4$, then a value of λ for which $\vec{a}+\lambda\vec{b}$ and $\vec{a}-\lambda\vec{b}$ are perpendicular is

(a) $\frac{9}{16}$ (b) $\frac{3}{4}$ (c) $\frac{3}{2}$ (d) $\frac{4}{3}$

Q32. The maximum value of $(\sin x)(\cos x)$ is

(a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\sqrt{2}$

Q33. Relation R on real numbers is defined as $R=\{(a,b): a \le b\}$. Then relation is

(a) reflexive and symmetric but not transitive (b) symmetric and transitive but not reflexive
(c) reflexive and transitive but not symmetric (d) equivalence relation

Q34. The derivative of $\sec(\tan\sqrt{x})$ with respect to x is

(a) $\frac{\sec(\tan\sqrt{x})\tan(\tan\sqrt{x})\sec^2\sqrt{x}}{2\sqrt{x}}$ (b) $\sec^2(\tan\sqrt{x})$

(c) $\frac{\sec(\tan\sqrt{x})\tan(\tan\sqrt{x})\sec^2\sqrt{x}}{x}$ (d) $\sec^2(\tan x^{1/3})$

Q35. Solution of differential equation $xdy - ydx = 0$ represents

(a) family of straight lines passing through origin (b) family of parabolas whose vertex is at origin
(c) family of circles whose centre is at origin (d) family of straight lines passing through (1, 1)

Q36. Area of the region bounded by the curve $y=\cos x$ and x-axis between $x=0$ and $x=\pi$ is

(a) 2 sq. units (b) 3 sq. units (c) 4 sq. units (d) 1 sq. units

Q37. Which of the following statements are correct?

(I) If $f: R \to R$ then $f(x)=|x|$ is continuous everywhere

(II) If $f: R \to R$ then $f(x)=|x|$ is continuous everywhere but not differentiable at $x=0$

(III) Let $f: R-\{0\} \to R$ then $f(x)=\frac{1}{x}$ is continuous everywhere

(IV) If $f: R \to R$ then $f(x)=|x-1|+|x-2|$ is continuous everywhere but not differentiable at exactly 2 points

(V) If $f: R \to R$ then $f(x)=\cot x$ is continuous everywhere

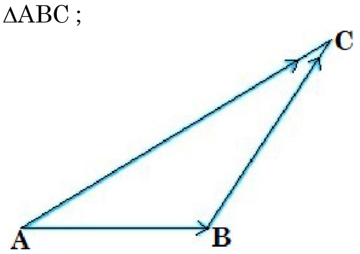
Choose the correct answer from the options given below.

(a) (I) only (b) (I), (III) only (c) (I), (II), (III), (IV) only (d) (IV), (V) only

Q38. If $\sin^{-1}x+\sin^{-1}y=\frac{2\pi}{3}$, then the value of $\cos^{-1}x+\cos^{-1}y$ is

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{6}$

Q39. In ΔABC;



(I) $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CA}=\vec{0}$ (II) $\overrightarrow{AB}+\overrightarrow{BC}-\overrightarrow{AC}=\vec{0}$
(III) $\overrightarrow{AB}+\overrightarrow{BC}-\overrightarrow{CA}=\vec{0}$ (IV) $\overrightarrow{AB}-\overrightarrow{CB}+\overrightarrow{CA}=\vec{0}$
(V) $\overrightarrow{AB}-\overrightarrow{CB}-\overrightarrow{CA}=\vec{0}$

Choose the correct answer from the options given below.

(a) (I), (II), (IV) only (b) (I), (II), (V) only (c) (II), (V) only (d) (I), (IV), (V) only

Q40. $\int e^x \sec x(1+\tan x)dx$ equals

(a) $e^x\sec x+c$ (b) $e^x\tan x+c$ (c) $e^x\sin x+c$ (d) $e^x\cos x+c$

Q41. The variance of number of heads in three tosses of a coin is

(a) $\frac{3}{2}$ (b) $\frac{3}{4}$ (c) 1 (d) 2

Q42. If matrix $A=\begin{bmatrix}3 & x\\ y & 0\end{bmatrix}$ and $A'=A$, then

(a) $x = y$ (b) $x = 0, y = 3$ (c) $x = 3, y = 0$ (d) $x + y = 3$

Q43. If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, then $A^2 - 5A + 7I =$

(a) O (b) I (c) 2I (d) 3I

Q44. The angle between the two planes $x + y - z = 3$ and $3x + 2y + z = 5$ is

(a) $\cos^{-1} 4$ (b) $\cos^{-1} \frac{2\sqrt{42}}{21}$ (c) $\cos^{-1} \frac{1}{4}$ (d) $\cos^{-1} \frac{1}{\sqrt{42}}$

Q45. The corner points of the feasible region determined by the following system of linear inequalities $2x + y \le 10$, $x + 3y \le 15$; $x, y \ge 0$ are (0, 0), (5, 0), (3, 4) and (0, 5). Let $z = px + qy$, where $p, q > 0$ condition on p and q so that maximum of z occurs at both (3, 4) and (0, 5) is

(a) $p = q$ (b) $p = 2q$ (c) $p = 3q$ (d) $q = 3p$

Q46. If a set P contains 5 elements and the set Q contains 8 elements, then the number of one-one functions from P to Q is

(a) ${}^8C_5$ (b) ${}^8C_5 \times 5!$ (c) 5^8 (d) 8^5

Q47. The equation of tangent to the curve given by $x = a\sin^3 t$, $y = b\cos^3 t$ at a point where $t = \frac{\pi}{2}$ is

(a) $x = 0$ (b) $y = 0$ (c) $y = \frac{\pi}{2}$ (d) $x = \frac{\pi}{2}$

Q48. The rate of change in area of a triangle having sides 10 cm and 12 cm when the variable angle between them is $\theta = 60^\circ$, is

(a) 30 cm^2/radian (b) 120 cm^2/radian (c) $30\sqrt{3}$ cm^2/radian (d) $60\sqrt{3}$ cm^2/radian

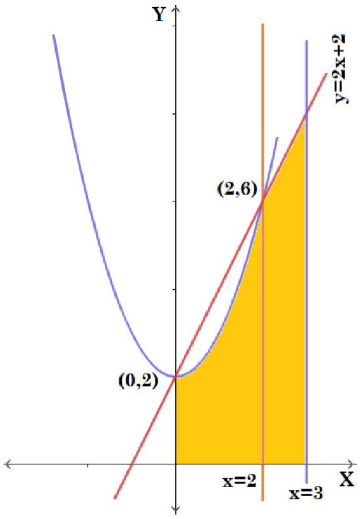
Q49. Which of the following regions will represent the shaded area in the given figure?

(a) $\{(x,y): 0 \le y \le x^2 + 2,\ 0 \le y \le 2x + 2,\ 0 \le x \le 3\}$

(b) $\{(x,y): 0 \le y \le x^2 + 2,\ y \ge 2x + 2,\ x \le 3\}$

(c) $\{(x,y): y \ge x^2 + 2,\ x \le 2,\ x \ge 0\}$

(d) $\{(x,y): y \ge x^2 + 2,\ x \ge 0,\ x \ge 3\}$



Q50. If the equation of a floor of a room is given by $x + y - z + 4 = 0$ and the equation of roof is given by $x + y - z + 5 = 0$. Then, the height of the room is

(a) $\frac{1}{6}$ units (b) $\frac{1}{3}$ units (c) $\frac{1}{\sqrt{3}}$ units (d) $\frac{1}{\sqrt{6}}$ units

ANSWERS

Q01.	(d)	Q02.	(d)	Q03.	(a)	Q04.	(a)	Q05.	(a)	Q06.	(a)	Q07.	(b)
Q08.	(c)	Q09.	(c)	Q10.	(a)	Q11.	(b)	Q12.	(a)	Q13.	(a)	Q14.	(a)
Q15.	(d)	Q16.	(d)	Q17.	(b)	Q18.	(c)	Q19.	(a)	Q20.	(a)	Q21.	(b)
Q22.	(b)	Q23.	(d)	Q24.	(a)	Q25.	(c)	Q26.	(a)	Q27.	(c)	Q28.	(b)
Q29.	(a)	Q30.	(b)	Q31.	(b)	Q32.	(b)	Q33.	(c)	Q34.	(a)	Q35.	(a)
Q36.	(a)	Q37.	(c)	Q38.	(b)	Q39.	(a)	Q40.	(a)	Q41.	(b)	Q42.	(a)
Q43.	(a)	Q44.	(b)	Q45.	(d)	Q46.	(b)	Q47.	(b)	Q48.	(a)	Q49.	(a)
Q50.	(c)												