All India 2022

CBSE Board Solved Paper Term-I

Time Allowed : 90 Minutes ***Maximum Marks : 40***

General Instructions:

(i) This question paper comprises **50** questions out of which **40** questions are to be attempted as per instructions. All questions carry equal marks.

(ii) The question paper consists of **three** Sections – Section **A**, **B** and **C**.

(iii) Section **A** contains **20** questions Attempt any **16** questions from Q. No. **1** to **20.**

(iv) Section **B** also contains **20** questions. Attempt any **16** questions from Q. No. **21** to **40**.

(v) Section **C** contains **10** questions including one Case Study. Attempt any **8** from Q. No. **41** to **50.**

(vi) There is only one correct option for every Multiple Choice Question (MCQ). Marks will not be awarded for answering more than one option.

(vii) There is no negative marking.

SECTION - A

In this section, attempt any 16 questions out of questions 1–20. Each question is of one mark.

1. Differential of log [log(log x^5)] w.r.t. x is

(a) $\dfrac{5}{x\log(x^5)\log(\log x^5)}$ (b) $\dfrac{5}{x\log(\log x^5)}$

(c) $\dfrac{5x^4}{\log(x^5)\log(\log x^5)}$ (d) $\dfrac{5x^4}{\log x^5 \log(\log x^5)}$

2. The number of all possible matrices of order 2 × 3 with each entry 1 or 2 is

(a) 16 (b) 6 (c) 64 (d) 24

3. A function f : R → R is defined as $f(x) = x^3 + 1$. Then the function has

(a) on minimum value

(b) no maximum value

(c) both maximum and minimum values

(d) neither maximum value nor minimum value

4. If $\sin y = x\cos(a+y)$, then $\dfrac{dx}{dy}$ is

(a) $\dfrac{\cos a}{\cos^2(a+y)}$ (b) $\dfrac{-\cos a}{\cos^2(a+y)}$

(c) $\dfrac{\cos a}{\sin^2 y}$ (d) $\dfrac{-\cos a}{\sin^2 y}$

5. The points on the curve $\dfrac{x^2}{9}+\dfrac{y^2}{25}=1$, where tangent is parallel to x-axis are

(a) $(\pm 5, 0)$ (b) $(0, \pm 5)$ (c) $(0, \pm 3)$ (d) $(\pm 3, 0)$

6. Three points P$(2x, x+3)$, Q$(0, x)$ and R$(x+3, x+6)$ are collinear, then x is equal to

(a) 0 (b) 2 (c) 3 (d) 1

7. The principal value of $\cos^{-1}\left(\dfrac{1}{2}\right)+\sin^{-1}\left(-\dfrac{1}{\sqrt{2}}\right)$ is

(a) $\dfrac{\pi}{12}$ (b) π (c) $\dfrac{\pi}{3}$ (d) $\dfrac{\pi}{6}$

8. If $(x^2+y^2)^2 = xy$, then $\dfrac{dy}{dx}$ is

(a) $\dfrac{y+4x(x^2+y^2)}{4y(x^2+y^2)-x}$ (b) $\dfrac{y-4x(x^2+y^2)}{x+4(x^2+y^2)}$

(c) $\dfrac{y-4x(x^2+y^2)}{4y(x^2+y^2)-x}$ (d) $\dfrac{4y(x^2+y^2)-x}{y-4x(x^2+y^2)}$

9. If a matrix A is both symmetric and skew symmetric, then A is necessarily a

(a) Diagonal matrix (b) Zero square matrix

(c) Square matrix (d) Identity matrix

10. Let set X = {1, 2, 3} and a relation R is defined in X as : R = {(1, 3), (2, 2), (3, 2)}, then minimum ordered pairs which should be added in relation R to make it reflexive and symmetric are

(a) {(1,1), (2, 3), (1, 2)}
(b) {(3, 3), (3, 1), (1, 2)}
(c) {(1, 1), (3, 3), (3, 1), (2, 3)}
(d) {(1, 1), (3, 3), (3, 1), (1, 2)}

11. A linear programming problem is as follows:

Minimise $Z = 2x + y$

Subject to the constraints $x \geq 3, x \leq 9, y \geq 0$

$x - y \geq 0, x + y \leq 14$

The feasible region has

(a) 5 corner points including (0, 0) and (9, 5)
(b) 5 corner points including (7, 7) and (3, 3)
(c) 5 corner points including (14, 0) and (9, 0)
(d) 5 corner points including (3, 6) and (9, 5)

12. The function $f(x) = \begin{cases} \dfrac{e^{3x} - e^{-5x}}{x}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$

is continuous at $x = 0$ for the value of k, is

(a) 3 (b) 5 (c) 2 (d) 8

13. If C_{ij} denotes the cofactor of element p_{ij} of the matrix $P = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & 2 & 4 \end{bmatrix}$, then the value of $C_{31}.C_{23}$ is

(a) 5 (b) 24 (c) –24 (d) –5

14. The function $y = x^2 e^{-x}$ is decreasing in the interval

(a) $(0, 2)$ (b) $(2, \infty)$
(c) $(-\infty, 0)$ (d) $(-\infty, 0) \cup (2, \infty)$

15. If $R = \{(x, y): x, y \in Z, x^2 + y^2 \leq 4\}$ is a relation in set Z, then domain of R is

(a) {0, 1, 2} (b) {–2, –1, 0, 1, 2}
(c) {0, –1, –2} (d) {–1, 0, 1}

16. The system of linear equations

$5x + ky = 5, 3x + 3y = 5$

will be consistant

(a) $k \neq -3$ (b) $k = -5$
(c) $k = 5$ (d) $k \neq 5$

17. The equation of the tangent to the curve $y(1 + x^2) = 2 - x$, where it crosses the x-axis is

(a) $x - 5y = 2$ (b) $5x - y = 2$
(c) $x + 5y = 2$ (d) $5x + y = 2$

18. If $\begin{bmatrix} 3c+6 & a-d \\ a+d & 2-3b \end{bmatrix} = \begin{bmatrix} 12 & 2 \\ -8 & -4 \end{bmatrix}$ are equal, then value of $ab - cd$ is

(a) 4 (b) 16
(c) –4 (d) –16

19. The principal value of $\tan^{-1}\left(\tan\dfrac{9\pi}{8}\right)$ is

(a) $\dfrac{\pi}{8}$ (b) $\dfrac{3\pi}{8}$ (c) $-\dfrac{\pi}{8}$ (d) $-\dfrac{3\pi}{8}$

20. For two matrices $P = \begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix}$ and $Q^T = \begin{bmatrix} -1 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$

$P - Q$ is

(a) $\begin{bmatrix} 2 & 3 \\ -3 & 0 \\ 0 & -3 \end{bmatrix}$ (b) $\begin{bmatrix} 4 & 3 \\ -3 & 0 \\ -1 & -2 \end{bmatrix}$

(c) $\begin{bmatrix} 4 & 3 \\ 0 & -3 \\ -1 & -2 \end{bmatrix}$ (d) $\begin{bmatrix} 2 & 3 \\ 0 & -3 \\ 0 & -3 \end{bmatrix}$

SECTION - B

In this section, attempt any 16 questions out of questions 21–40. Each question is of one mark.

21. The function $f(x) = 2x^3 - 15x^2 + 36x + 6$ is increasing in the interval

(a) $(-\infty, 2) \cup (3, \infty)$ (b) $(-\infty, 2)$
(c) $(-\infty, 2] \cup [3, \infty)$ (d) $[3, \infty)$

22. If $x = 2\cos\theta - \cos 2\theta$ and $y = 2\sin\theta - \sin 2\theta$, then $\dfrac{dy}{dx}$ is

(a) $\dfrac{\cos\theta + \cos 2\theta}{\sin\theta - \sin 2\theta}$ (b) $\dfrac{\cos\theta - \cos 2\theta}{\sin 2\theta - \sin\theta}$

(c) $\dfrac{\cos\theta - \cos 2\theta}{\sin\theta - \sin 2\theta}$ (d) $\dfrac{\cos 2\theta - \cos\theta}{\sin 2\theta + \sin\theta}$

23. What is the domain of the function $\cos^{-1}(2x - 3)$?

(a) [–1, 1] (b) (1, 2) (c) (–1, 1) (d) [1, 2]

24. A matrix $A = [a_{ij}]_{3 \times 3}$ is defined by

$$a_{ij} = \begin{cases} 2i + 3j & , i < j \\ 5 & , i = j \\ 3i - 2j & , i > j \end{cases}$$

The number of elements in A which are more than 5, is

(a) 3 (b) 4 (c) 5 (d) 6

25. If a function f defined by

$$f(x) = \begin{cases} \dfrac{k\cos x}{\pi - 2x} & , \text{if } x \neq \dfrac{\pi}{2} \\ 3 & , \text{if } x = \dfrac{\pi}{2} \end{cases}$$

is continuous at $x = \dfrac{\pi}{2}$, then the value of k, is

(a) 2 (b) 3 (c) 6 (d) –6

26. For the matrix $X = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, $(X^2 - X)$ is

(a) $2I$ (b) $3I$ (c) I (d) $5I$

27. Let $X = \{x^2 : x \in N\}$ and the function $f : N \to X$ is defined by $f(x) = x^2, x \in N$. Then this function is

(a) injective only (b) not bijective
(c) surjective only (d) bijective

28. The corner points of the feasible region for a linear programming problem are $P(0, 5)$, $Q(1, 5)$, $R(4, 2)$ and $S(12, 0)$. The minimum value of the objective function $Z = 2x + 5y$ is at the point

(a) P (b) Q
(c) R (d) S

29. The equation of the normal to the curve $ay^2 = x^3$ at the point (am^2, am^3) is

(a) $2y - 3mx + am^3 = 0$
(b) $2x + 3my - 3am^4 - am^2 = 0$
(c) $2x + 3my + 3am^4 - 2am^2 = 0$
(d) $2x + 3my - 3am^4 - 2am^2 = 0$

30. If A is a square matrix of order 3 and $|A| = -5$, then $|\text{adj } A|$ is

(a) 125 (b) –25 (c) 25 (d) ±25

31. The simplest form of $\tan^{-1}\left[\dfrac{\sqrt{1+x} - \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}}\right]$ is

(a) $\dfrac{\pi}{4} - \dfrac{x}{2}$ (b) $\dfrac{\pi}{4} + \dfrac{x}{2}$

(c) $\dfrac{\pi}{4} - \dfrac{1}{2}\cos^{-1} x$ (d) $\dfrac{\pi}{4} + \dfrac{1}{2}\cos^{-1} x$

32. If for the matrix $A = \begin{bmatrix} \alpha & -2 \\ -2 & \alpha \end{bmatrix}$, $|A^3| = 125$, then the value of α is

(a) ±3 (b) – 3 (c) ±1 (d) 1

33. If $y = \sin(m \sin^{-1} x)$, then which one of the following equations is true?

(a) $(1 - x^2)\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} + m^2 y = 0$

(b) $(1 - x^2)\dfrac{d^2y}{dx^2} - x\dfrac{dy}{dx} + m^2 y = 0$

(c) $(1 + x^2)\dfrac{d^2y}{dx^2} - x\dfrac{dy}{dx} - m^2 y = 0$

(d) $(1 + x^2)\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} - m^2 x = 0$

34. The principal value of $[\tan^{-1}\sqrt{3} - \cot^{-1}(-\sqrt{3})]$ is

(a) π (b) $-\dfrac{\pi}{2}$ (c) 0 (d) $2\sqrt{3}$

35. The maximum value of $\left(\dfrac{1}{x}\right)^x$ is

(a) $e^{1/e}$ (b) e (c) $\left(\dfrac{1}{e}\right)^{1/e}$ (d) e^e

36. Let matrix $X = [x_{ij}]$ is given by $X = \begin{bmatrix} 1 & -1 & 2 \\ 3 & 4 & -5 \\ 2 & -1 & 3 \end{bmatrix}$. Then the matrix $Y = [m_{ij}]$, where m_{ij} = Minor of x_{ij}, is

(a) $\begin{bmatrix} 7 & -5 & -3 \\ 19 & 1 & -11 \\ -11 & 1 & 7 \end{bmatrix}$ (b) $\begin{bmatrix} 7 & -19 & -11 \\ 5 & -1 & -1 \\ 3 & 11 & 7 \end{bmatrix}$

(c) $\begin{bmatrix} 7 & 19 & -11 \\ -3 & 11 & 7 \\ -5 & -1 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} 7 & 19 & -11 \\ -1 & -1 & 1 \\ -3 & -11 & 7 \end{bmatrix}$

37. A function $f : R \to R$ defined by $f(x) = 2 + x^2$ is

(a) not one-one
(b) one-one
(c) not onto
(d) neither one-one nor onto

38. A linear programming problem is as follow:
maximise / minimise objective function $Z = 2x - y + 5$
Subject to the constraints
$3x + 4y \leq 60$
$x + 3y \leq 30$
$x \geq 0, y \geq 0$
If the corner points of the feasible region are A(0, 10), B(12, 6), C(20, 0) and O(0, 0), then which of the following is true?

(a) Maximum value of Z is 40
(b) Minimum value of Z is – 5
(c) Difference of maximum and minimum values of Z is 35
(d) At two corner points, value of Z are equal

39. If x = –4 is a root of $\begin{vmatrix} x & 2 & 3 \\ 1 & x & 1 \\ 3 & 2 & x \end{vmatrix} = 0$, then the sum of the other two roots is

(a) 4 (b) – 3
(c) 2 (d) 5

40. The absolute maximum value of the function $f(x) = 4x - \dfrac{1}{2}x^2$ in the interval $\left[-2, \dfrac{9}{2}\right]$ is

(a) 8 (b) 9
(c) 6 (d) 10

SECTION - C

Attempt any 8 questions out of the questions 41-50. Each question is of one mark.

41. In a sphere of radius r, a right circular cone of height h, having maximum curved surface area is inscribed. The expression for the square of curved surface of cone is

(a) $2\pi^2 rh(2rh + h^2)$ (b) $\pi^2 hr(2rh + h^2)$

(c) $2\pi^2 r(2rh^2 - h^3)$ (d) $2\pi^2 r^2(2rh - h^2)$

42. The corner points of the feasible region determined by a set of constraints (linear inequalities) are P(0, 5), Q(3, 5), R(5, 0) and S(4, 1) and the objective function is $Z = ax + 2by$ where $a, b > 0$. The condition on a and b such that the maximum Z occurs at Q and S is

(a) $a - 5b = 0$ (b) $a - 3b = 0$

(c) $a - 2b = 0$ (d) $a - 8b = 0$

43. If curves $y^2 = 4x$ and $xy = c$ cut at right angles, then the value of c is

(a) $4\sqrt{2}$ (b) 8

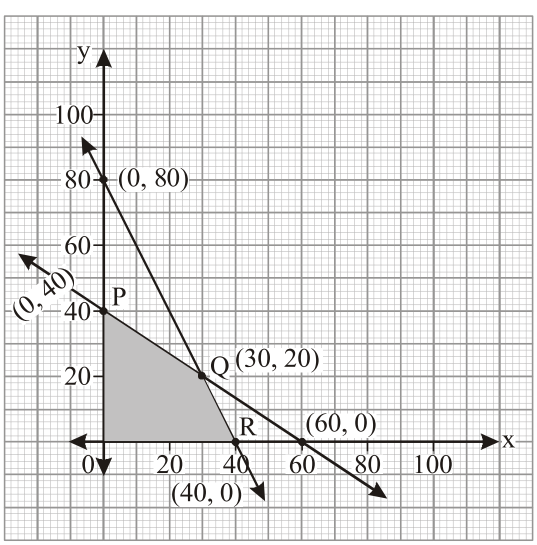
(c) $2\sqrt{2}$ (d) $-4\sqrt{2}$

44. The inverse of the matrix $X = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ is

(a) $24\begin{bmatrix} 1/2 & 0 & 0 \\ 0 & 1/3 & 0 \\ 0 & 0 & 1/4 \end{bmatrix}$ (b) $\frac{1}{24}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(c) $\frac{1}{24}\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ (d) $\begin{bmatrix} 1/2 & 0 & 0 \\ 0 & 1/3 & 0 \\ 0 & 0 & 1/4 \end{bmatrix}$

45. For an L.P.P. the objective function is $Z = 4x + 3y$ and the feasible region determined by a set of constraints (linear inequations) is shown in the graph.



Which one of the following statements is true?

(a) Maximum value of Z is at R.

(b) Maximum value of Z is at Q.

(c) Value of Z at R is less than the value at P.

(d) Value of Z at Q is less than the value at R.

Case Study

In a residential society comprising of 100 houses, there were 60 children between the ages of 10-15 years. They were inspired by their teachers to start composting to ensure that biodegradable waste is recycled. For this purpose, instead of each child doing it for only his/her house, children convinced the Residents Welfare Association to do it as a society initiative. For this they identified a square area in the local park. Local authorities charged amount of ₹ 50 per square metre for space so that there is no misuse of the space and Resident Welfare Association takes it seriously. Association hired a labourer for digging out 250 m^3 and he charged ₹ 400 ×(depth)^2. Association will like to have minimum cost.

Based on this information, answer the any 4 of the following questions.

46. Let side of square plot is x m and its depth is h metres, then cost c for the pit is

(a) $\frac{50}{h} + 400h^2$ (b) $\frac{12500}{h} + 400h^2$

(c) $\frac{250}{h} + h^2$ (d) $\frac{250}{h} + 400h^2$

47. Value of h (in m) for which $\frac{dc}{dh} = 0$ is

(a) 1.5 (b) 2

(c) 2.5 (d) 3

48. $\frac{d^2c}{dh^2}$ is given by

(a) $\frac{25000}{h^3} + 800$ (b) $\frac{500}{h^3} + 800$

(c) $\frac{100}{h^3} + 800$ (d) $\frac{500}{h^3} + 2$

49. Value of x (in m) for minimum cost is

(a) 5 (b) $10\sqrt{\frac{5}{3}}$

(c) $5\sqrt{5}$ (d) 10

50. Total minimum cost of digging the pit (in ₹) is

(a) 4100 (b) 7500

(c) 7850 (d) 3220