Board Paper of Class 12-Science Term-I 2021 Math Delhi(Set 4)

Total Time: 90

Total Marks: 40.0

Section A

Q.No.1: Differential of $\log\left[\log\left(\log x^5\right)\right]$ w.r.t *x* is
(a) $\frac{5}{x\log\left(x^5\right)\log\left(\log x^5\right)}$
(b) $\frac{5}{x\log\left(\log x^5\right)}$
(c) $\frac{5x^4}{\log\left(x^5\right)\log\left(\log x^5\right)}$
(d) $\frac{5x^4}{\log x^5\log\left(\log x^5\right)}$ **Marks:[1.00]**

Q.No.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 **Marks:[1.00]**

Q.No.3: A function *f* : R→R is defined as *f*(*x*) = x^3+1. Then the function has
(a) no minimum value
(b) no maximum value
(c) both maximum and minimum values
(d) neither maximum value nor minimum value **Marks:[1.00]**

Q.No.4: If sin *y* = *x* cos (*a* + *y*), then $\frac{dx}{dy}$ is

(a) $\frac{\cos\ a}{\cos^2\ (a+y)}$
(b) $\frac{-\cos\ a}{\cos^2\ (a+y)}$
(c) $\frac{\cos\ a}{\sin^2\ y}$
(d) $\frac{-\cos\ a}{\sin^2\ y}$ **Marks:[1.00]**

Q.No.5: The points on the curve $\frac{x^2}{9}+\frac{y^2}{25}=1$, where tangent is parallel to *x*-axis are
(a) $(\pm 5,\ 0)$
(b) $(0,\ \pm 5)$
(c) $(0,\ \pm 3)$
(d) $(\pm 3,\ 0)$ **Marks:[1.00]**

Q.No.6: Three points P(2*x*, *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 **Marks:[1.00]**

Q.No.7: The principal value of $\cos^{-1}\left(\frac{1}{2}\right)+\sin^{-1}\left(-\frac{1}{\sqrt{2}}\right)$ is
(a) $\frac{\pi}{12}$
(b) $\frac{\pi}{3}$
(c) π
(d) $\frac{\pi}{6}$ **Marks:[1.00]**

Q.No.8: If $(x^2 + y^2)^2 = xy$, then $\frac{dy}{dx}$ is

(a) $\frac{y+4x\left(x^2+y^2\right)}{4y(x^2+y^2)-x}$

(b) $\frac{y-4x\left(x^2+y^2\right)}{x+4(x^2+y^2)}$

(c) $\frac{y-4x\left(x^2+y^2\right)}{4y(x^2+y^2)-x}$

(d) $\frac{4y\left(x^2+y^2\right)-x}{y-4x(x^2+y^2)}$ **Marks:[1.00]**

Q.No.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 **Marks:[1.00]**

Q.No.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)}

Marks:[1.00]

Q.No.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) **Marks:[1.00]**

Q.No.12: The function $f(x) = \begin{cases} \frac{e^{3x} - e^{-5x}}{x}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$ is continuous at $x = 0$ for the value of k, as
(a) 3
(b) 5
(c) 2
(d) 8
Marks:[1.00]

Q.No.13: If C_{ij} denotes the cofactor of element p_{ij} of the matrix $\mathrm{P} = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & 2 & 4 \end{bmatrix}$, then the value of $C_{31} \cdot C_{23}$ is
(a) 5
(b) 24
(c) −24
(d) −5
Marks:[1.00]

Q.No.14: The function $y = x^2 e^{-x}$ is decreasing in the interval
(a) (0, 2)
(b) (2, ∞)
(c) (−∞, 0)
(d) (−∞, 0) ∪ (2, ∞)
Marks:[1.00]

Q.No.15: If R = {(x, y); x, y ∈ 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}
Marks:[1.00]

Q.No.16: The system of linear equations
$5x + ky = 5$
$3x + 3y = 5$
will be consistent if
(a) $k \neq -3$
(b) $k = -5$

(c) $k = 5$
(d) $k \neq 5$ **Marks:[1.00]**

Q.No.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) $5x + y = 2$ **Marks:[1.00]**

Q.No.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 **Marks:[1.00]**

Q.No.19: The principal value of $\tan^{-1}\left(\tan \frac{9\pi}{8}\right)$ is
(a) $\frac{\pi}{8}$
(b) $\frac{3\pi}{8}$
(c) $-\frac{\pi}{8}$
(d) $-\frac{3\pi}{8}$ **Marks:[1.00]**

Q.No.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) $\begin{bmatrix} 2 & 3 \\ 0 & -3 \\ 0 & -3 \end{bmatrix}$

Marks:[1.00]

Section B

Q.No.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) $[3, \infty)$

Marks:[1.00]

Q.No.22: If $x = 2\cos\theta - \cos 2\theta$ and $y = 2\sin\theta - 2\theta$, then $\frac{dy}{dx}$ is

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

(b) $\frac{\cos\theta - \cos 2\theta}{\sin 2\theta - \sin\theta}$

(c) $\frac{\cos\theta - \cos 2\theta}{\sin\theta - \sin 2\theta}$

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

Marks:[1.00]

Q.No.23: What is the domain of the function $\cos^{-1}(2x - 3)$?

(a) $[-1, 1]$

(b) $(1, 2)$

(c) $(-1, 1)$

(d) $[1, 2]$

Marks:[1.00]

Q.No.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 **Marks:[1.00]**

Q.No.25: If a function f defined by

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

is continuous at $x = \frac{\pi}{2}$, then the value of *k* is
(a) 2
(b) 3
(c) 6
(d) −6 **Marks:[1.00]**

Q.No.26: For the matrix $X = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, $(X^2 - X)$ is
(a) 2 I
(b) 3 I
(c) I
(a) 5 I **Marks:[1.00]**

Q.No.27: Let X = $\{x^2 : x \in \mathbf{N}\}$ and the function *f* : N → X is defined by $f(x) = x^2$, $x \in \mathbf{N}$. Then this function is
(a) injective only
(b) not bijective
(c) surjective only
(d) bijective **Marks:[1.00]**

Q.No.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 = 2*x* + 5*y* is at the point
(a) P
(b) Q
(c) R
(d) S **Marks:[1.00]**

Q.No.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) $2x + 3my - 3am^4 - 2am^2 = 0$

Marks:[1.00]

Q.No.30: If A is a square matrix of order 3 and |A| = −5, then |adj A| is
(a) 125
(b) −25
(c) 25
(d) ±25

Marks:[1.00]

Q.No.31: The simplest form of $\tan^{-1}\left[\frac{\sqrt{1+x}-\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}\right]$ is
(a) $\frac{\pi}{4}-\frac{x}{2}$
(b) $\frac{\pi}{4}+\frac{x}{2}$
(c) $\frac{\pi}{4}-\frac{1}{2}\cos^{-1}x$
(d) $\frac{\pi}{4}+\frac{1}{2}\cos^{-1}x$

Marks:[1.00]

Q.No.32: If for the matrix A = $\begin{bmatrix}\alpha & -2\\ -2 & \alpha\end{bmatrix}$, $\left|A^3\right| = 125$, then the value of α is
(a) $\pm$ 3
(b) −3
(c) $\pm$ 1
(d) 1

Marks:[1.00]

Q.No.33: If $y = \sin(m \sin^{-1} x)$, then which one of the following equations is true?
(a) $\left(1-x^2\right)\frac{d^2y}{dx^2}+x\frac{dy}{dx}+m^2y=0$
(b) $\left(1-x^2\right)\frac{d^2y}{dx^2}-x\frac{dy}{dx}+m^2y=0$
(c) $\left(1+x^2\right)\frac{d^2y}{dx^2}-x\frac{dy}{dx}-m^2y=0$
(d) $\left(1+x^2\right)\frac{d^2y}{dx^2}+x\frac{dy}{dx}-m^2x=0$

Marks:[1.00]

Q.No.34: The principal value of $\left[\tan^{-1}\sqrt{3}-\cot^{-1}\left(-\sqrt{3}\right)\right]$ is

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

Marks:[1.00]

Q.No.35: The maximum value of $\left(\frac{1}{x}\right)^{x}$ is

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

Marks:[1.00]

Q.No.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) $X = \begin{bmatrix} 7 & -5 & -3 \\ 19 & 1 & -11 \\ -11 & 1 & 7 \end{bmatrix}$

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

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

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

Marks:[1.00]

Q.No.37: A function *f*: **R** → **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 **Marks:[1.00]**

Q.No.38: A Linear Programming Problem is as follows:
Maximise / Minimise objective function Z = $2x - y + 5$
Subject to the constraints
$3x + 4y \le 60$
$x + 3y \le 30$
$x \ge 0, y \ge 0$
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 **Marks:[1.00]**

Q.No.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 **Marks:[1.00]**

Q.No.40: The absolute maximum value of the function $\mathrm{f}\left(x\right) = 4x - \frac{1}{2}x^2$ in the interval $\left[-2, \frac{9}{2}\right]$ is
(a) 8
(b) 9
(c) 6
(d) 10 **Marks:[1.00]**

Section C

Q.No.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) $2\pi^2 r^2 (2rh - h^2)$ **Marks:[1.00]**

Q.No.42: The corner points of the feasible region determined by a set of constrains (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) $a - 8b = 0$ **Marks:[1.00]**

Q.No.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) $-4\sqrt{2}$ **Marks:[1.00]**

Q.No.44: The inverse of the matrix $X = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ is

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

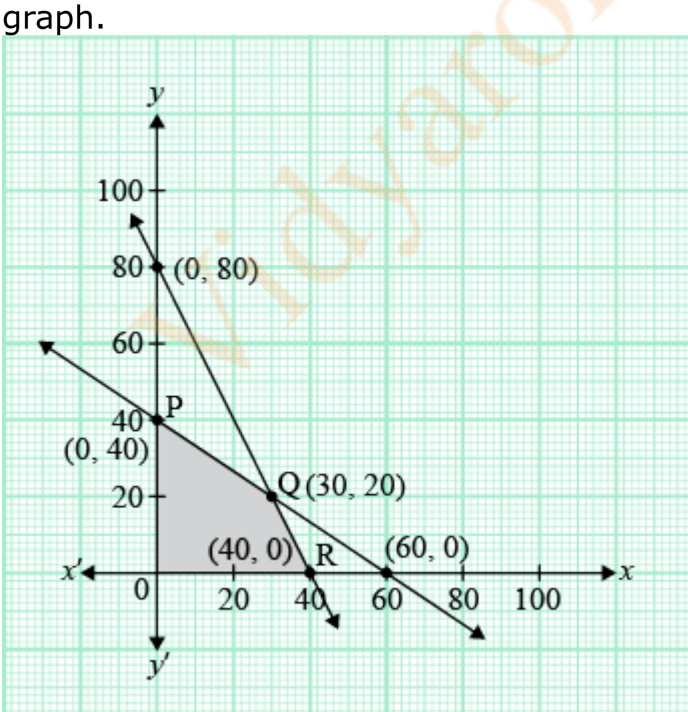
(b) $\frac{1}{24} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

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

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

Marks:[1.00]

Q.No.45: For an L.P.P. the objective function is Z = 4*x* + 3*y*, 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. **Marks:[1.00]**

Q.No.46: 

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 × $(\text{depth})^2$. Association will like to have minimum cost.
Based on this information, answer the any 4 of the following questions.
Let side of square plot is *x* m and its depth is *h* metres, then cost c for the pit is
(a) $\frac{50}{h} + 400\,h^2$
(b) $\frac{12500}{h} + 400\,h^2$
(c) $\frac{250}{h} + h^2$
(d) $\frac{250}{h} + 400\,h^2$ **Marks:[1.00]**

Q.No.47: 

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 × $(\text{depth})^2$. Association will like to have minimum cost.

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

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

(a) 1.5

(b) 2

(c) 2.5

(d) 3

Marks:[1.00]

Q.No.48: 

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 × $(\text{depth})^2$. Association will like to have minimum cost.

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

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

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

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

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

(b) $\frac{500}{h^3} + 2$

Marks:[1.00]

Q.No.49: 

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 × $(\text{depth})^2$. Association will like to have minimum cost.

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

Value of x (in m) for minimum cost is

(a) 5

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

(c) $5\sqrt{5}$

(d) 10

Marks:[1.00]

Q.No.50: 

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 × $(\text{depth})^2$. Association will like to have minimum cost.

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

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

(a) 4,100

(b) 7,500

(c) 7,850

(d) 3,220 **Marks:[1.00]**