Subject Code - 041

Sample Question Paper
CLASS: XII
Session: 2021-22
Mathematics (Code-041)
Term - 1

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

General Instructions:
1. **This question paper contains three sections – A, B and C. Each part is compulsory.**
2. **Section - A has 20 MCQs, attempt any 16 out of 20.**
3. **Section - B has 20 MCQs, attempt any 16 out of 20**
4. **Section - C has 10 MCQs, attempt any 8 out of 10.**
5. **All questions carry equal marks.**
6. **There is no negative marking.**

SECTION – A

In this section, attempt any 16 questions out of Questions 1 – 20.
Each Question is of 1 mark weightage.

1. $\sin\left[\frac{\pi}{3} - \sin^{-1}\left(-\frac{1}{2}\right)\right]$ is equal to: — 1

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

2. The value of k (k < 0) for which the function f defined as — 1

$$f(x) = \begin{cases} \frac{1-\cos kx}{x\sin x}, & x \neq 0 \\ \frac{1}{2}, & x = 0 \end{cases}$$

is continuous at $x = 0$ is:

a) ± 1	b) -1
c) $\pm\frac{1}{2}$	d) $\frac{1}{2}$

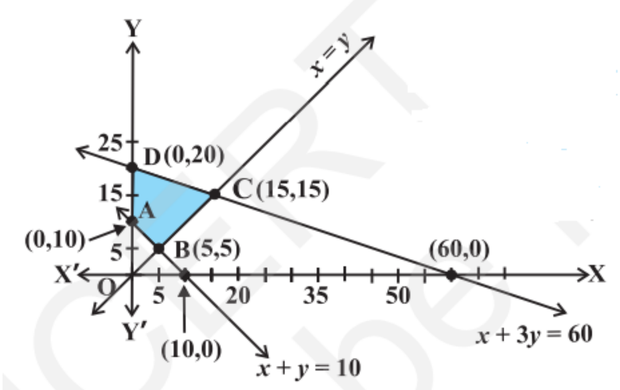
3. If A = $[a_{ij}]$ is a square matrix of order 2 such that $a_{ij} = \begin{cases} 1, & when\ i \neq j \\ 0, & when\ i = j \end{cases}$, then A^2 is: — 1

a) $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$	b) $\begin{vmatrix} 1 & 1 \\ 0 & 0 \end{vmatrix}$
c) $\begin{vmatrix} 1 & 1 \\ 1 & 0 \end{vmatrix}$	d) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

4. Value of k, for which A = $\begin{bmatrix} k & 8 \\ 4 & 2k \end{bmatrix}$ is a singular matrix is: — 1

a) 4	b) -4
c) ±4	d) 0

5.	Find the intervals in which the function f given by f (x) = $x^2 - 4x + 6$ is strictly increasing: a) $(-\infty, 2) \cup (2, \infty)$ b) $(2, \infty)$ c) $(-\infty, 2)$ d) $(-\infty, 2] \cup (2, \infty)$	1
6.	Given that A is a square matrix of order 3 and | A | = - 4, then | adj A | is equal to: a) -4 b) 4 c) -16 d) 16	1
7.	A relation R in set A = {1,2,3} is defined as R = {(1, 1), (1, 2), (2, 2), (3, 3)}. Which of the following ordered pair in R shall be removed to make it an equivalence relation in A? a) (1, 1) b) (1, 2) c) (2, 2) d) (3, 3)	1
8.	If $\begin{bmatrix} 2a+b & a-2b \\ 5c-d & 4c+3d \end{bmatrix} = \begin{bmatrix} 4 & -3 \\ 11 & 24 \end{bmatrix}$, then value of a + b – c + 2d is: a) 8 b) 10 c) 4 d) –8	1
9.	The point at which the normal to the curve y = $x + \frac{1}{x}$, x > 0 is perpendicular to the line 3x – 4y – 7 = 0 is: a) (2, 5/2) b) (±2, 5/2) c) (- 1/2, 5/2) d) (1/2, 5/2)	1
10.	sin ($\tan^{-1}x$), where |x| < 1, is equal to: a) $\frac{x}{\sqrt{1-x^2}}$ b) $\frac{1}{\sqrt{1-x^2}}$ c) $\frac{1}{\sqrt{1+x^2}}$ d) $\frac{x}{\sqrt{1+x^2}}$	1
11.	Let the relation R in the set A = {x ∈ Z : 0 ≤ x ≤ 12}, given by R = {(a, b) : |a – b| is a multiple of 4}. Then [1], the equivalence class containing 1, is: a) {1, 5, 9} b) {0, 1, 2, 5} c) ϕ d) A	1
12.	If $e^x + e^y = e^{x+y}$, then $\frac{dy}{dx}$ is: a) e^{y-x} b) e^{x+y} c) $-e^{y-x}$ d) $2e^{x-y}$	1

13.	Given that matrices A and B are of order 3×n and m×5 respectively, then the order of matrix C = 5A +3B is: a) 3×5 b) 5×3 c) 3×3 d) 5×5	1
14.	If y = 5 cos x – 3 sin x, then $\frac{d^2y}{dx^2}$ is equal to: a) - y b) y c) 25y d) 9y	1
15.	For matrix A = $\begin{bmatrix} 2 & 5 \\ -11 & 7 \end{bmatrix}$, $(adjA)'$ is equal to: a) $\begin{bmatrix} -2 & -5 \\ 11 & -7 \end{bmatrix}$ b) $\begin{bmatrix} 7 & 5 \\ 11 & 2 \end{bmatrix}$ c) $\begin{bmatrix} 7 & 11 \\ -5 & 2 \end{bmatrix}$ d) $\begin{bmatrix} 7 & -5 \\ 11 & 2 \end{bmatrix}$	1
16.	The points on the curve $\frac{x^2}{9}+\frac{y^2}{16}=1$ at which the tangents are parallel to y-axis are: a) $(0,\pm 4)$ b) $(\pm 4,0)$ c) $(\pm 3,0)$ d) $(0,\pm 3)$	1
17.	Given that A = $[a_{ij}]$ is a square matrix of order 3×3 and |A| = −7, then the value of $\sum_{i=1}^{3} a_{i2}A_{i2}$, where A_{ij} denotes the cofactor of element a_{ij} is: a) 7 b) -7 c) 0 d) 49	1
18.	If y = log($\cos e^x$), then $\frac{dy}{dx}$ is: a) $\cos e^{x-1}$ b) $e^{-x}\cos e^x$ c) $e^x \sin e^x$ d) $-e^x \tan e^x$	1
19.	Based on the given shaded region as the feasible region in the graph, at which point(s) is the objective function Z = 3x + 9y maximum?  a) Point B b) Point C c) Point D d) every point on the line segment CD	1

20. The least value of the function $f(x) = 2cosx + x$ in the closed interval $[0, \frac{\pi}{2}]$ is: — 1

a) 2	b) $\frac{\pi}{6} + \sqrt{3}$
c) $\frac{\pi}{2}$	d) The least value does not exist.

SECTION – B

In this section, attempt any 16 questions out of the Questions 21 - 40.
Each Question is of 1 mark weightage.

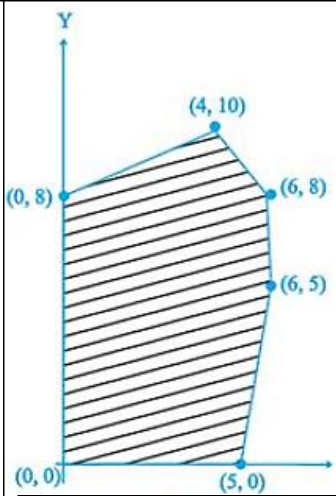
21. The function f: R⟶R defined as $f(x) = x^3$ is: — 1

a) One-on but not onto	b) Not one-one but onto
c) Neither one-one nor onto	d) One-one and onto

22. If x = a sec θ, y = b tan θ, then $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{6}$ is: — 1

a) $\frac{-3\sqrt{3}b}{a^2}$	b) $\frac{-2\sqrt{3}b}{a}$
c) $\frac{-3\sqrt{3}b}{a}$	d) $\frac{-b}{3\sqrt{3}a^2}$

23. In the given graph, the feasible region for a LPP is shaded. The objective function Z = 2x – 3y, will be minimum at: — 1



a) (4, 10)	b) (6, 8)
c) (0, 8)	d) (6, 5)

24. The derivative of $\sin^{-1}(2x\sqrt{1-x^2})$ w.r.t $\sin^{-1}x$, $-\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$, is: — 1

a) 2	b) $\frac{\pi}{2} - 2$
c) $\frac{\pi}{2}$	d) -2

25. If A = $\begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and B = $\begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$, then: — 1

a) $A^{-1} = B$	b) $A^{-1} = 6B$
c) $B^{-1} = B$	d) $B^{-1} = \frac{1}{6}A$

26.	The real function f(x) = $2x^3 - 3x^2 - 36x + 7$ is: a) Strictly increasing in $(-\infty, -2)$ and strictly decreasing in $(-2, \infty)$ b) Strictly decreasing in $(-2, 3)$ c) Strictly decreasing in $(-\infty, 3)$ and strictly increasing in $(3, \infty)$ d) Strictly decreasing in $(-\infty, -2) \cup (3, \infty)$	1
27.	Simplest form of $\tan^{-1}\left(\frac{\sqrt{1+cosx}+\sqrt{1-cosx}}{\sqrt{1+cosx}-\sqrt{1-cosx}}\right), \pi < x < \frac{3\pi}{2}$ is: a) $\frac{\pi}{4} - \frac{x}{2}$ b) $\frac{3\pi}{2} - \frac{x}{2}$ c) $-\frac{x}{2}$ d) $\pi - \frac{x}{2}$	1
28.	Given that A is a non-singular matrix of order 3 such that $A^2 = 2A$, then value of |2A| is: a) 4 b) 8 c) 64 d) 16	1
29.	The value of b for which the function $f(x) = x + cosx + b$ is strictly decreasing over **R** is: a) $b < 1$ b) No value of b exists c) $b \leq 1$ d) $b \geq 1$	1
30.	Let R be the relation in the set N given by R = {(a, b) : a = b – 2, b > 6}, then: a) (2,4) ∈ R b) (3,8) ∈ R c) (6,8) ∈ R d) (8,7) ∈ R	1
31.	The point(s), at which the function f given by $f(x) = \begin{cases} \frac{x}{\|x\|}, x < 0 \\ -1, x \geq 0 \end{cases}$ is continuous, is/are: a) $x \epsilon$ R b) $x = 0$ c) $x \epsilon$ R –{0} d) $x = -1$ and 1	1
32.	If A = $\begin{bmatrix} 0 & 2 \\ 3 & -4 \end{bmatrix}$ and kA = $\begin{bmatrix} 0 & 3a \\ 2b & 24 \end{bmatrix}$, then the values of k, a and b respectively are:	1

	a) $-6,-12,-18$	b) $-6,-4,-9$
	c) $-6,4,9$	d) $-6,12,18$

33. A linear programming problem is as follows: (1)

$Minimize\ Z = 30x + 50y$

subject to the constraints,

$$3x + 5y \geq 15$$
$$2x + 3y \leq 18$$
$$x \geq 0, y \geq 0$$

In the feasible region, the minimum value of Z occurs at

a) a unique point	b) no point
c) infinitely many points	d) two points only

34. The area of a trapezium is defined by function f and given by $f(x) = (10 + x)\sqrt{100 - x^2}$, then the area when it is maximised is: (1)

a) $75cm^2$	b) $7\sqrt{3}cm^2$
c) $75\sqrt{3}cm^2$	d) $5cm^2$

35. If A is square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is equal to: (1)

a) A	b) I + A
c) I – A	d) I

36. If $\tan^{-1} x = y$, then: (1)

a) $-1 < y < 1$	b) $\frac{-\pi}{2} \leq y \leq \frac{\pi}{2}$
c) $\frac{-\pi}{2} < y < \frac{\pi}{2}$	d) $y \in \{\frac{-\pi}{2}, \frac{\pi}{2}\}$

37. Let A = {1, 2, 3}, B = {4, 5, 6, 7} and let f = {(1, 4), (2, 5), (3, 6)} be a function from A to B. Based on the given information, f is best defined as: (1)

a) Surjective function	b) Injective function
c) Bijective function	d) function

38. For A = $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, then $14A^{-1}$ is given by: (1)

a) $14\begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$	b) $\begin{bmatrix} 4 & -2 \\ 2 & 6 \end{bmatrix}$
c) $2\begin{bmatrix} 2 & -1 \\ 1 & -3 \end{bmatrix}$	d) $2\begin{bmatrix} -3 & -1 \\ 1 & -2 \end{bmatrix}$

39. The point(s) on the curve $y = x^3 - 11x + 5$ at which the tangent is $y = x - 11$ is/are: (1)

a) (-2,19)	b) (2, - 9)
c) $(\pm 2, 19)$	d) (-2, 19) and (2, -9)

40. Given that A = $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ and $A^2 = 3I$, then: (1)

a) $1+\alpha^2+\beta\gamma=0$	b) $1-\alpha^2-\beta\gamma=0$
c) $3-\alpha^2-\beta\gamma=0$	d) $3+\alpha^2+\beta\gamma=0$

SECTION – C

In this section, attempt any 8 questions.
Each question is of 1-mark weightage.
Questions 46-50 are based on a Case-Study.

41. For an objective function $Z = ax + by$, where $a, b > 0$; the corner points of the feasible region determined by a set of constraints (linear inequalities) are (0, 20), (10, 10), (30, 30) and (0, 40). The condition on *a* and *b* such that the maximum Z occurs at both the points (30, 30) and (0, 40) is: 1

a) $b-3a=0$	b) $a=3b$
c) $a+2b=0$	d) $2a-b=0$

42. For which value of m is the line y = mx + 1 a tangent to the curve $y^2 = 4x$? 1

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

43. The maximum value of $[x(x-1)+1]^{\frac{1}{3}}$, $0 \le x \le 1$ is: 1

a) 0	b) $\frac{1}{2}$
c) 1	d) $\sqrt[3]{\frac{1}{3}}$

44. In a linear programming problem, the constraints on the decision variables x and y are $x-3y \ge 0, y \ge 0, 0 \le x \le 3$. The feasible region 1

a) is not in the first quadrant	b) is bounded in the first quadrant
c) is unbounded in the first quadrant	d) does not exist

45. Let A = $\begin{bmatrix} 1 & \sin\alpha & 1 \\ -\sin\alpha & 1 & \sin\alpha \\ -1 & -\sin\alpha & 1 \end{bmatrix}$, where $0 \le \alpha \le 2\pi$, then: 1

a) |A|=0	b) |A| $\epsilon(2,\infty)$
c) |A| $\epsilon(2,4)$	d) |A| $\epsilon[2,4]$

CASE STUDY

The fuel cost per hour for running a train is proportional to the square of the speed it generates in km per hour. If the fuel costs ₹ 48 per hour at speed 16 km per hour and the fixed charges to run the train amount to ₹ 1200 per hour.

Assume the speed of the train as v km/h.

	Based on the given information, answer the following questions.	
46.	Given that the fuel cost per hour is k times the square of the speed the train generates in km/h, the value of k is: a) $\frac{16}{3}$ b) $\frac{1}{3}$ c) 3 d) $\frac{3}{16}$	1
47.	If the train has travelled a distance of 500km, then the total cost of running the train is given by function: a) $\frac{15}{16}v + \frac{600000}{v}$ b) $\frac{375}{4}v + \frac{600000}{v}$ c) $\frac{5}{16}v^2 + \frac{150000}{v}$ d) $\frac{3}{16}v + \frac{6000}{v}$	1
48.	The most economical speed to run the train is: a) 18km/h b) 5km/h c) 80km/h d) 40km/h	1
49.	The fuel cost for the train to travel 500km at the most economical speed is: a) ₹ 3750 b) ₹ 750 c) ₹ 7500 d) ₹ 75000	1
50.	The total cost of the train to travel 500km at the most economical speed is: a) ₹ 3750 b) ₹ 75000 c) ₹ 7500 d) ₹ 15000	1
