(XII - math)

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. There is no negative marking.
6. All questions carry equal marks.

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

$\sin\left[\frac{\pi}{3} + \left(\sin^{-1}\frac{1}{2}\right)\right]$ ($\frac{\pi}{6}$) $\Rightarrow \sin\frac{\pi}{2} = 1$

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) $\frac{1}{2}$

$\lim_{x\to 0}\frac{\sin x}{x} = 1$

$\lim_{x\to 0}\frac{1-\cos kx}{x\sin x} = \frac{1}{2}$

$\lim_{x\to 0}\frac{2\sin^2\frac{kx}{2}}{x\sin x} = \frac{1}{2} \Rightarrow 2\cdot\frac{k^2}{4}\cdot\left(\frac{\sin\frac{kx}{2}}{\frac{kx}{2}}\right)^2\cdot\frac{x}{\sin x} = \frac{1}{2}$

$k^2 = 1$

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) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$

$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

$\begin{bmatrix} 0+1 & 0+0 \\ 0+0 & 1+0 \end{bmatrix}$

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

$|A| = 0$ → singular matrix

$\begin{vmatrix} k & 8 \\ 4 & 2k \end{vmatrix}$

$2k^2 - 32 = 0$

$2k^2 = 32 \quad k^2 = 16 \quad \boxed{k = \pm 4}$

5.	Find the intervals in which the function f given by f (x) = x ^{2} – 4x + 6 is strictly increasing:	1

$f'(x) = 2x - 4 = 0 \quad x = 2$

$-\infty \quad 2 \quad \infty$

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

−ve ← $(-\infty, 2)$ $(2, \infty)$ +ve

6.	Given that A is a square matrix of order 3 and | A | = - 4, then | adj A | is equal to:	1

$|adj\,A| = |A|^{n-1}$

a) -4	b) 4
c) -16	d) 16

$|adj\,A| = |-4|^{3-1} = (-4)^2 = 16$

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?	1

(1, 1) (2, 2) (3, 3)

1 2 3

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

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:	1

a) 8 Ans.	b) 10
c) 4	d) −8

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:	1

$m_1 m_2 = -1$

$y' = 1 - \frac{1}{x^2} = \left(\frac{x^2-1}{x^2}\right)\left(\frac{3}{4}\right) = -1$

$x > 0$

a) (2, 5/2)	b) (±2, 5/2)
c) (- 1/2, 5/2)	d) (1/2, 5/2)

$x^2 = 4$ $\boxed{x = 2}$

$x = \pm 2$

10.	sin (tan^{-1}x), where |x| < 1, is equal to:	1

$\sqrt{1+x^2}$ x 1

$\sin\left(\sin^{-1}\frac{x}{\sqrt{1+x^2}}\right) = \frac{x}{\sqrt{1+x^2}}$

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

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:	1

a) {1, 5, 9}	b) {0, 1, 2, 5}
c) ϕ	d) A

(1, 5) (1, 9) (5, 9) $|a-b|$

12.	If e^x + e^y = e^{x+y}, then $\frac{dy}{dx}$ is:	1

$\frac{e^x}{e^x \cdot e^y} + \frac{e^y}{e^x \cdot e^y} = 1$

a) e $^{y-x}$	b) e $^{x+y}$
c) – e $^{y-x}$	d) 2 e $^{x-y}$

$e^{-y} + e^{-x} = 1$

$-e^{-y}\frac{dy}{dx} - e^{x} = 0 \quad \frac{dy}{dx} = -\frac{e^{x}}{e^{-y}}$

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: **1**

a) 3×5 and m = n	b) 3×5
c) 3×3	d) 5×5

$[3\times n] + [m\times 5]$

(3×5)

14. If y = 5 cos x – 3 sin x, then $\frac{d^2y}{dx^2}$ is equal to: **1**

a) - y	b) y
c) 25y	d) 9y

$y' = -5\sin x - 3\cos x$

$y'' = -5\cos x + 3\sin x$

$y'' = -(y)$ $y''+y=0$

15. For matrix A = $\begin{bmatrix} 2 & 5 \\ -11 & 7 \end{bmatrix}$, $(adjA)'$ is equal to: **1**

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) $\begin{bmatrix} 7 & -5 \\ 11 & 2 \end{bmatrix}$

$adj A = \begin{bmatrix} 7 & -5 \\ 11 & 2 \end{bmatrix}$

$(adj A)' = \begin{bmatrix} 7 & 11 \\ -5 & 2 \end{bmatrix}$

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: **1**

$m_1 m_2 = -1$

$x = \pm 3$

$\frac{2x}{9} + \frac{2y}{16}\frac{dy}{dx} = 0$ $-\frac{dx}{dy} = \frac{9y}{16x} = 0$

$y = 0$

a) (0,±4)	b) (±4,0)
c) (±3,0)	d) (0, ±3)

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: **1**

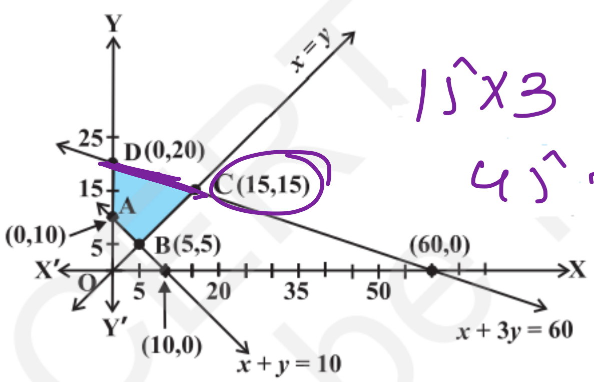
a) 7	b) -7
c) 0	d) 49

18. If y = $\log(\cos e^x)$, then $\frac{dy}{dx}$ is: **1**

$\frac{dy}{dx} = \frac{-\sin e^x \cdot e^x}{\cos e^x} \Rightarrow -e^x \tan e^x$

a) $\cos e^{x-1}$	b) $e^{-x}\cos e^x$
c) $e^x \sin e^x$	d) $-e^x \tan e^x$

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? **1**



$15\times 3 + 9\times 15$

$45 + 135 = 180$

180

a) Point B	b) Point C
c) Point D	d) every point on the line segment CD

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

$f'(x) = -2\sin x + 1 = 0$

$\sin x = \frac{1}{2}$

$x = 30^\circ$

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

$x_1^3 = x_2^3$

$\boxed{x_1 = x_2}$

$y = x^3$

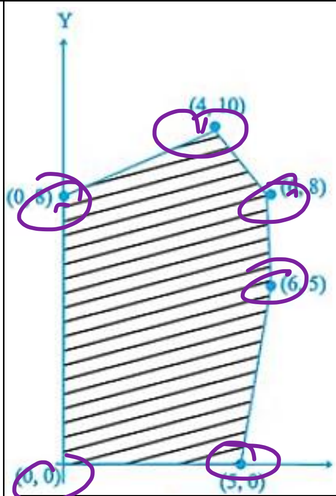
$x = y^{1/3}$

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



-24 at $(0,8)$

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 $\sin^{-1}x$, $\frac{1}{\sqrt{2}} < x < 1$, is: — 1

$x = \sin\theta$

$\sin^{-1}(\sin 2\theta)$

$2\sin^{-1}x$,

$= 1$

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

$\boxed{AB = I}$

$\begin{bmatrix} 6 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 6 \end{bmatrix}$

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

$\boxed{B^{-1} = \frac{1}{6}A}$

26. The real function f(x) = $2x^3 - 3x^2 - 36x + 7$ is: $6x^2 - 6x - 36 = 0$ — 1

a) Strictly increasing in $(-\infty, -2)$ and strictly decreasing in $(-2, \infty)$	$x^2 - x - 6 = 0$
b) Strictly decreasing in $(-2, 3)$	$x^2 - 3x + 2x - 6 = 0$
c) Strictly decreasing in $(-\infty, 3)$ and strictly increasing in $(3, \infty)$	$x(x-3) + 2(x-3) = 0$
d) Strictly decreasing in $(-\infty, -2) \cup (3, \infty)$	$(x+2)(x-3) = 0$

$-\infty \quad -2 \quad 3 \quad \infty$

$x = -2, 3$

27. Simplest form of $\tan^{-1}\left(\frac{\sqrt{1+\cos x}+\sqrt{1-\cos x}}{\sqrt{1+\cos x}-\sqrt{1-\cos x}}\right), \pi < x < \frac{3\pi}{2}$ is: — 1

a) $\frac{\pi}{4} - \frac{x}{2}$	b) $\frac{3\pi}{2} - \frac{x}{2}$
c) $-\frac{x}{2}$	d) $\pi - \frac{x}{2}$

from 28 do yourself

28. Given that A is a non-singular matrix of order 3 such that $A^2 = 2A$, then value of $|2A|$ is: — 1

a) 4	b) 8
c) 64	d) 16

29. The value of b for which the function $f(x) = x + \cos x + b$ is strictly decreasing over **R** is: — 1

a) $b < 1$	b) No value of b exists
c) $b \leq 1$	d) $b \geq 1$

30. Let R be the relation in the set N given by R = {(a, b) : a = b – 2, b > 6}, then: — 1

a) $(2,4) \in R$	b) $(3,8) \in R$
c) $(6,8) \in R$	d) $(8,7) \in R$

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: — 1

a) $x \in R$	b) $x = 0$
c) $x \in R - \{0\}$	d) $x = -1$ and 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: $Minimize\ Z = 30x + 50y$ 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	1
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: a) $75cm^2$ b) $7\sqrt{3}cm^2$ c) $75\sqrt{3}cm^2$ d) $5cm^2$	1
35.	If A is square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is equal to: a) A b) I + A c) I – A d) I	1
36.	If $\tan^{-1} x = y$, then: a) $-1 < y < 1$ b) $\frac{-\pi}{2} \leq y \leq \frac{\pi}{2}$ c) $\frac{-\pi}{2} < y < \frac{\pi}{2}$ d) $y \epsilon \{\frac{-\pi}{2}, \frac{\pi}{2}\}$	1
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: a) Surjective function b) Injective function c) Bijective function d) function	1
38.	For A = $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, then $14A^{-1}$ is given by: 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) $2\begin{bmatrix} -3 & -1 \\ 1 & -2 \end{bmatrix}$	1
39.	The point(s) on the curve $y = x^3 - 11x + 5$ at which the tangent is $y = x - 11$ is/are: a) (-2,19) b) (2, - 9) c) $(\pm 2, 19)$ d) (-2, 19) and (2, -9)	1
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
