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

**Time Allowed: 90 minutes**                                  **Maximum Marks: 40**
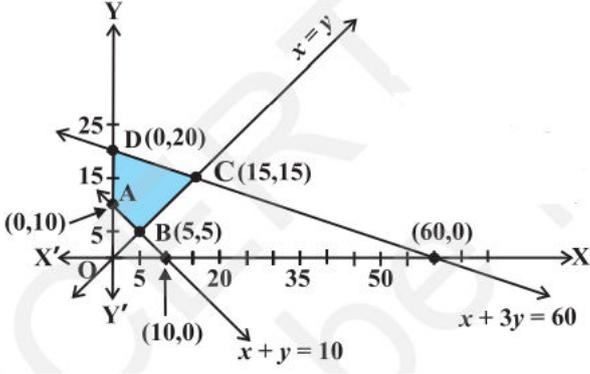
**General Instructions**:
1. **This question paper contains three sections – A, B and C. Each part is compulsory.**
2. **Section - A has 20 MCQs, attempt any 16 out of 20.**
3. **Section - B has 20 MCQs, attempt any 16 out of 20**
4. **Section - C has 10 MCQs, attempt any 8 out of 10.**
5. **All questions 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 $$f(x) = \begin{cases} \frac{1-\cos kx}{x\sin x}, & x \neq 0 \\ \frac{1}{2}, & x = 0 \end{cases}$$ is continuous at $x = 0$ is: | | 1 |
| | a) $\pm 1$ | 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: | 1 |
|---|---|---|

a)  (– ∞, 2) ∪ (2, ∞) | b)  (2, ∞)
c)  (−∞, 2) | d)  (– ∞, 2]∪ (2, ∞)

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

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

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 | 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 |
|---|---|---|

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

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

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)  $\phi$ | d)  A

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

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

| 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 | b) 5×3 |
|---|---|
| c) 3×3 | d) 5×5 |

| 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 |

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

| 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 |
|---|---|---|

| 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 |
|---|---|---|

| 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 |
|---|---|---|



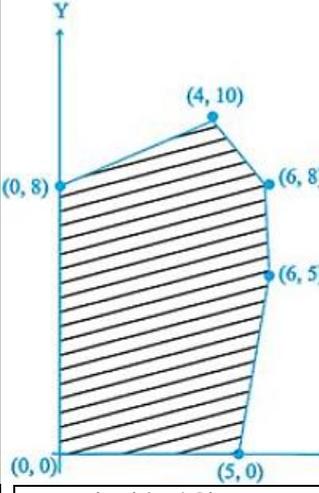| a) Point B | b) Point C |
|---|---|
| c) Point D | d) every point on the line segment CD |

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

| 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 $\theta$, y = b tan $\theta$, 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. <br> 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⁻¹x, $\quad -\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$, 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: | 1 |
|---|---|---|

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 $(-\infty, -2) \cup (3, \infty)$

| 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: | 1 |
|---|---|---|

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

| 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 $f(x) = x + cosx + b$ 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) $x \epsilon R$ | b) $x = 0$ |
|---|---|
| c) $x \epsilon R - \{0\}$ | 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:<br>$Minimize\ Z = 30x + 50y$<br>subject to the constraints,<br>$$3x + 5y \geq 15$$<br>$$2x + 3y \leq 18$$<br>$$x \geq 0, y \geq 0$$<br>In the feasible region, the minimum value of Z occurs at | 1 |
|---|---|---|

| 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) (±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: <br><br> a) $\dfrac{16}{3}$      b) $\dfrac{1}{3}$ <br> c) 3      d) $\dfrac{3}{16}$ | 1 |
| 47. | If the train has travelled a distance of 500km, then the total cost of running the train is given by function: <br><br> a) $\dfrac{15}{16}v + \dfrac{600000}{v}$      b) $\dfrac{375}{4}v + \dfrac{600000}{v}$ <br><br> c) $\dfrac{5}{16}v^2 + \dfrac{150000}{v}$      d) $\dfrac{3}{16}v + \dfrac{6000}{v}$ | 1 |
| 48. | The most economical speed to run the train is: <br><br> a) 18km/h      b) 5km/h <br> c) 80km/h      d) 40km/h | 1 |
| 49. | The fuel cost for the train to travel 500km at the most economical speed is: <br><br> a) ₹ 3750      b) ₹ 750 <br> c) ₹ 7500      d) ₹ 75000 | 1 |
| 50. | The total cost of the train to travel 500km at the most economical speed is: <br><br> a) ₹ 3750      b) ₹ 75000 <br> c) ₹ 7500      d) ₹ 15000 | 1 |

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