BANGALORE SAHODAYA SCHOOLS COMPLEX ASSOCIATION

PRE-BOARD EXAMINATION -1 (2025 − 2026)

GRADE XII

Date: 12.12.2025 **SET – 1** **Max Marks: 80**

Subject: Mathematics (041) **Time: 3 hours**

General Instructions:

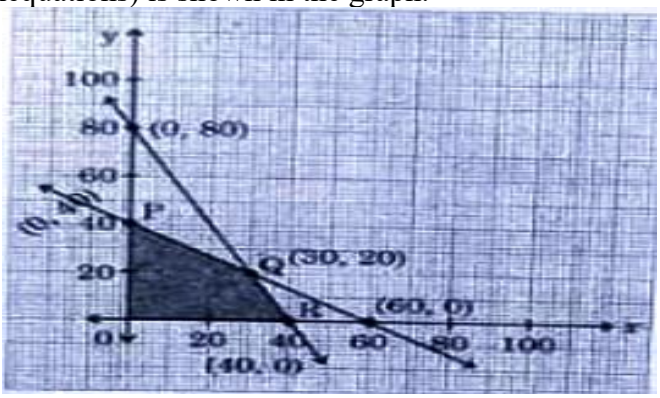
Read the following instructions very carefully and strictly follow them:

i) This Question paper contains **38** questions. All questions are compulsory.
ii) This Question paper is divided into five Sections - **A, B, C, D** and **E**.
iii) In Section **A**, Questions no. **1** to **18** are multiple choice questions (MCQs) and Questions no. **19** and **20** are Assertion - Reason based questions of **1** mark each.
iv) In Section **B**, Questions no. **21** to **25** are Very Short Answer - type questions, carrying **2** marks each.
v) In Section **C**, Questions no. **26** to **31** are Short Answer (SA) - type questions, carrying **3** marks each.
vi) In Section **D**, Questions no. **32** to **35** are Long Answer (LA) - type questions, carrying **5** marks each.
vii) In Section **E**, Questions no**. 36** to **38** are Case study - based questions, carrying **4** marks each.
viii) There is no overall choice. However, an internal choice has been provided in **2** questions in Section **B**, **3** questions in Section **C**, **2** questions in Section **D** and one subpart each in **2** questions of Section **E.**
ix) Use of calculators is not allowed.

SECTION A

Each questions carries 1 mark.

1.	If $4\sin^{-1}x + \cos^{-1}x = \pi$, then the value of $\sin^{-1}x + 4\cos^{-1}x$ is a) $\frac{\pi}{2}$ b) π c) $\frac{3\pi}{2}$ d) 2π	1
2.	If A $= \begin{bmatrix} 1 & 12 & 4y \\ 6x & 5 & 2x \\ 8x & 4 & 6 \end{bmatrix}$ is a symmetric matrix then $\begin{vmatrix} 2x & 1 \\ 1 & y \end{vmatrix} =$ a) -15 b) 16 c) -16 d) 15	1
3.	If A $= \begin{bmatrix} 7 & 0 & x \\ 0 & 7 & 0 \\ 0 & 0 & y \end{bmatrix}$ is a scalar matrix, then $(2y - x)^x$ is equal to a) 0 b) 1 c) 7 d) ±7	1
4.	Given that A is a square matrix of order 3 and det(A) = - 2, then $\lvert\text{adj}(2A)\rvert$ is equal to a) 2 b) 4 c) - 2^8 d) 2^8	1
5.	For the matrix A $= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, the inverse of matrix A is a) diag.(1 5 4) b) diag.(4 5 1) c) diag.(-1 -5 -4) d) diag.$(1\ \frac{1}{5}\ \frac{1}{4})$	1
6.	Value of determinant $\begin{vmatrix} \cos57^\circ & -\cos33^\circ \\ \sin57^\circ & \sin33^\circ \end{vmatrix}$ is a) 0 b) $\frac{1}{2}$ c) -1 d) 1	1

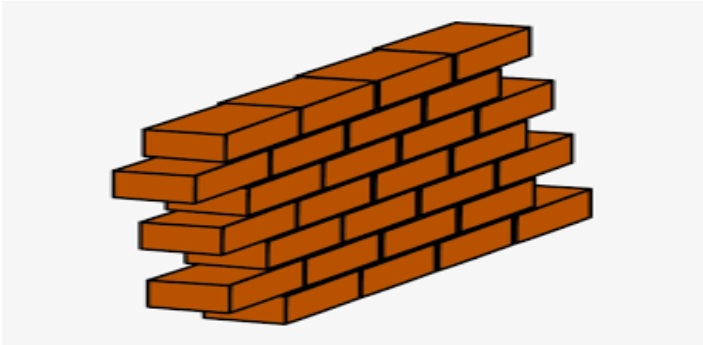
7.	If a function defined by f(x) = $\begin{cases} mx - \pi, & x < \pi \\ \sin x, & x \geq \pi \end{cases}$ is continuous at x = π, then the value of m is a) π b) 1 c) 0 d) -1	1
8.	The slope of the curve y = - x^3 + 3x^2 + 8x – 20 is maximum at a) $(1, -10)$ b) (1,10) c) (10,1) d) (-10,1)	1
9.	The values of μ so that f(x) = sinx – cosx - μx + C decreases for all real values of x are: a) $1 < \mu < \sqrt{2}$ b) $\mu \geq 1$ c) $\mu \geq \sqrt{2}$ d) $\mu < 1$	1
10.	Sum of the order and degree of the differential equation $\frac{d}{dx}\left(\left(\frac{dy}{dx}\right)^3\right) = 0$ is a) 2 b) 3 c) 0 d) 5	1
11.	For any integer n, the value of $\int_0^{\pi} e^{\sin^2 x} \cos^3(2n+1)x \, dx$ is a) 2 b) 1 c) 0 d) -1	1
12.	$\int \frac{x-3}{(x-1)^3} e^x$ dx is equal to a) $\frac{2e^x}{(x-1)^3} + c$ b) $\frac{-2e^x}{(x-1)^2} + c$ c) $\frac{e^x}{(x-1)} + c$ d) $\frac{e^x}{(x-1)^2} + c$	1
13.	A drone flies in a straight path represented by the vector $\vec{p} = (2\hat{i} + \hat{j} + 2\hat{k})$. A passenger is sitting in a moving train whose track is defined by the vector equation $\vec{r} = (1+\mu)\hat{i} + (2-\mu)\hat{j} + \mu\hat{k}$. The projected length of the drone's flight path on the train track is a) $\sqrt{3}$ units b) $\frac{4}{\sqrt{3}}$ units c) $\frac{3}{\sqrt{2}}$ units d) $\frac{5}{2\sqrt{3}}$ units	1
14.	Let $\vec{p} = 2\hat{i} + \hat{j} + 3\hat{k}$, $\vec{q} = \hat{i} - 2\hat{j} + \hat{k}$ and $\vec{r} = 4\hat{i} + \hat{j} - \hat{k}$ be three given vectors. Then $(3\vec{p}.\hat{j})\hat{i} + (\vec{q}.\hat{k})\hat{j} + (\vec{r}.\vec{p})\hat{k}$ = a) $3\hat{i} + \hat{j} - 6\hat{k}$ b) $3\hat{i} + \hat{j} + 6\hat{k}$ c) $3\hat{i} - \hat{j} + 6\hat{k}$ d) $3\hat{i} - \hat{j} - 6\hat{k}$	1
15.	Given that $\vec{a}+\vec{b}+\vec{c} = \vec{0}$, $\lvert\vec{a}\rvert = \sqrt{37}$, $\lvert\vec{b}\rvert = 3$ and $\lvert\vec{c}\rvert = 4$. If θ is the angle between $\vec{b}$ and $\vec{c}$, then a) $\theta = \pi$ b) $2\theta = \pi$ c) $3\theta = \pi$ d) $4\theta = \pi$	1
16.	For an L.P.P. the objective function is Z = 4x + 3y, and the feasible region determined by a set of constrains (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.	1

17.	Consider the following Linear Programming Problem. To maximize: Z = (ax + y) Subject to the contraints: $x \geq 0$, $y \geq 0$, $2x + y \leq 50$, $x + 2y \leq 40$. If $Z_{max} = 30$ is obtained at (20,10) for the linear programming problem given above, then the value of a = a) 0 b) 1 c) - 1 d) 2	1
18.	If P(A|B) = P(A$^{\|}$|B), then which of the following statements is true? a) P(A) = P(A$^{\|}$) b) P(A) = 2 P(B) c) $P(A \cap B) = \frac{1}{2} P(B)$ d) P(A∩B) = 2 P(B)	1
	ASSERTION – REASON BASED QUESTIONS **In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.** **(a) Both A and R are true and R is the correct explanation of A.** **(b) Both A and R are true and R is not the correct explanation of A.** **(c) A is true but R is false.** **(d) A is false but R is true.**	
19.	**Assertion**: The range of the function $f(x) = 2\sin^{-1}x + \frac{3\pi}{2}$, where $x \in [-1,1]$ is $\left[\frac{\pi}{2}, \frac{5\pi}{2}\right]$ **Reason**: The range of the principal value branch of $\sin^{-1}x$ is $[0,\pi]$.	1
20.	**Assertion**: If $\vec{P}$ and $\vec{Q}$ are two unit vectors inclined to x-axis at angles 30° and 120°, then $\left\|\vec{P} + \vec{Q}\right| = \sqrt{2}$. **Reason**: If $\vec{u}$ and $\vec{v}$ are parallel vectors, then $\vec{u} \times \vec{v} = 0$.	1
	SECTION B **Each questions carries 2 marks**	
21.	a) Evaluate $\cot^2\{\text{cosec}^{-1}(3)\} + \sin^2\{\cos^{-1}\left(\frac{1}{3}\right)\}$ **OR** b) Prove that : $\tan^{-1}\sqrt{x} = \frac{1}{2}\cos^{-1}\left(\frac{1-x}{1+x}\right)$, $x \in [0,1]$.	2
22.	If $x = a\sin^3\theta$, $y = b\cos^3\theta$, then find $3\left(\frac{d^2y}{dx^2}\right)$ at $\theta = \frac{\pi}{4}$.	2
23.	a) Evaluate: $\int \frac{2x+3}{x^2(x+3)}\,dx$ **OR** b) Using integration, find the area of the region bounded by the line y = 5x + 2, the x-axis and the ordinates x = - 2 and x = 2.	2
24.	If f(x + y) = f(x).f(y) ∀ x, y **∈ R** and f(5) = 2, **f**$^{\|}$(0) = 3, then using the definition of derivatives, find **f**$^{\|}$(5).	2
25.	If $\hat{a}$, $\hat{b}$ and $\hat{c}$ are unit vectors such that $\hat{a}.\hat{b} = \hat{a}.\hat{c} = 0$ and the angle between $\hat{b}$ and $\hat{c}$ is $\frac{\pi}{6}$, then prove that $\hat{a} = \pm 2(\hat{b} \times \hat{c})$.	2

	SECTION C **Each questions carries 3 marks**	
26.	Solve the following linear programming problem graphically: To maximize: Z = x + 2y Subject to constraints: $x \geq 0$, $y \geq 0$, $x+2y \geq 100$, $2x + y \leq 200$, $2x - y \leq 0$. Also, show that the minimum of Z occurs at more than two points.	3
27.	a) Using integration, find the area of the region bounded by the curve $y = \sqrt{4 - x^2}$, the lines $x = -\sqrt{2}$ and $x = \sqrt{3}$ and the x-axis. **OR** b) Make a rough sketch of the region $\{(x, y): 0 \leq y \leq x^2, 0 \leq y \leq x, 0 \leq x \leq 3\}$ and find the area of the region, using the method of integration.	3
28.	a) Show that the lines $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ intersect. Also find their point of intersection. **OR** b) Find the shortest distance between the pair of lines $\frac{x-1}{2} = \frac{y+1}{3} = z$ and $\frac{x+1}{5} = \frac{y-2}{1}$; $z = 2$.	3
29.	A kite is moving horizontally at the height of 151.5 meters. If the speed of kite is 10 m/sec, how fast is the string being let out; when the kite is 250 m away from the boy who is flying the kite? The height of the boy is 1.5 m.	3
30.	a) Given that $x \cos(p + y) + \cos p \sin(p + y) = 0$, then prove that $\cos p \frac{dy}{dx} = -\cos^2(p + y)$, where p is a constant. **OR** b) Find $\frac{dy}{dx}$, if $y = (x)^{sinx} . (sinx)^x + a^x . e^x$	3
31.	In a city, a survey was conducted among residents about their preferred mode of commuting. It was found that 50% people preferred using public transport, 35% preferred using a bicycle and 20% use both public transport and a bicycle. If a person is selected at random, find the probability that the person uses i) only public transport ii) a bicycle, given that they also uses the public transport. iii) neither public transport nor a bicycle.	3
	SECTION D **Each questions carries 5 marks**	
32.	If $A = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$, find BA and use this to solve the system of equations: $y + 2z = 8$; $x - y = -1$; $2x + 3y + 4z = 20$.	5
33.	a) Evaluate: $\int_0^{\pi/4} \frac{x}{(1 + cos2x + sin2x)} dx$ **OR** b) Evaluate: $\int \frac{5x - 3}{\sqrt{1 + 4x - 2x^2}} dx$	5
34.	a) Find the particular solution of the differential equation:	5

	$\frac{dy}{dx} = \cos x - 2y$. **OR** b) Solve the differential equation: $(\sqrt{x+y} + \sqrt{x-y})dx + (\sqrt{x-y} - \sqrt{x+y})\,dy = 0$.	
35.	Find the image of the point (1,2,1) with respect to the line $\frac{x-3}{1} = \frac{y+1}{2} = \frac{z-1}{3}$. Also find the equation of the line joining the given point and its image.	5
	SECTION E **Each questions carries 4 marks**	
36.	**CASE STUDY – 1**  A company is analysing its internal communication system between the five departments labelled as P, Q, R, S and T. The company has gathered the following data about one-way communication between departments. • Messages are sent from P to Q, P to R and P to S. • Messages are sent from Q to R and Q to T. • Messages are sent from R to T. • Messages are sent from S to T and S to Q. The company wants to represent this communication system using the concepts of relations and functions. Use the given data to answer the following questions. i) Is the communication relation (X) reflexive? Justify. ii) Is the communication relation (X) symmetric? Justify. iii) a) Represent the communication relation (X) as a set of ordered pairs. Also, state the domain and range of this relation. Is the communication relation (X) transitive? Justify your answer. **OR** iii) b) Does the communication relation (X) represent a function? Justify your answer.	1 1 2 2

37. **CASE STUDY - 2**



Read the following passage and then answer the following the questions given below.

A foreign client approaches **DEEKSHA BRICKS COMPANY** for a special type of bricks.
The client requests for few samples of bricks as per their requirements.
The solid rectangular brick is to be made from 1 cubic feet of clay of special type.
The brick must be 3 times as long as it is wide.

i) Let the length of brick is 'x', width is 'k' and height is 'h'. Obtain an expression in terms of 'h' and 'k'. 1

ii) Express the surface area (S) of the brick, as a function of 'k'.

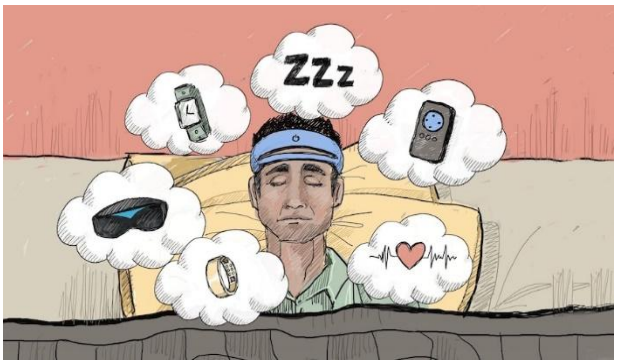
iii) a) Find $\frac{dS}{dk}$. At what value of k, $\frac{dS}{dk} = 0$? 1

Show that $\frac{d^2S}{dk^2}$ is positive, at this obtained value of k. What does it signify? 2

OR

iii) b) Find the minimum value of S, using second derivative test. 2

38. **CASE STUDY – 3**



Excessive use of digital devices can disrupt sleep patterns and lead to poor sleep quality. In a class of students aged 13 to 16 years, the students were grouped based on their daily screen time and its effect on their sleep.

- Group A: Spends more than 5 hours per day on screens (45% of students)
- Group B: Spends 3 to 5 hours per day on screens (35% of students)
- Group C: Spends less than 3 hours per day on screens (20% of students)

A sleep quality survey found the following.

	▪ 75% of Group A students reported poor sleep quality ▪ 60% of Group B students reported poor sleep quality ▪ 20% of Group C students reported poor sleep quality Using this information given above, answer the following questions. i) What is the total percentage of students who suffer from poor sleep quality? ii) A student is randomly selected and is found to have poor sleep quality. Find the probability that s/he belongs to Group A?	2 2

----------BEST OF LUCK----------