B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

NABET

INDIAN PUBLIC SCHOOLS' CONFERENCE

TERM -1 EXAMINATION 2025-26
MATHEMATICS
Marking Key

Class: XII A **Time: 3 hr**
Date: 10/09/25 **Max Marks: 80**
Admission no: **Roll no:**

General Instructions:

Read the following instructions very carefully and strictly follow them:

1. This Question paper contains 38 questions. All questions are compulsory.
2. This Question paper is divided into five Sections - A, B, C, D and E.
3. In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) with only one correct option and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
8. 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.
9. Use of calculator is not allowed. S

SECTION A

1 The number of possible reflexive relations on a set consisting of 3 elements is:

A) 512 **B) 64** C) 256 D) 128

2 If f: $[3,\infty) \rightarrow B$ $given\ by\ f(x) = x^2 - 6x + 14\ is\ a\ bijection\ ,then\ B\ is\ equal\ to$:

(A) $[3,\infty)$ **(B) $[5,\infty)$** (C) $(5,\infty)$ (D) R

3 If the set A contains 7 elements and the set B contains 10 elements, then the number of one-one functions from A to B

(A) ${}^{10}C_7$ **(B) ${}^{10}C_7 x7!$** (C) 7^{10} (D) 10^7

4 The principal value of $\sin^{-1}(-\frac{\sqrt{3}}{2})$ is:

(A) $-\frac{2\pi}{3}$ **(B) $-\frac{\pi}{3}$** (C) $\frac{4\pi}{3}$ (D) $\frac{5\pi}{3}$

5 The value of the expression $\sin\{cot^{-1}(cos(tan^{-1}1))\}$ is:

(A) 0 (B) 1 (C) $\frac{1}{\sqrt{3}}$ **(D)** $\sqrt{\frac{2}{3}}$

6 If A= $\begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$, n$\in N$, then A^{4n} equals

(A) $\begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ **(C)** $\begin{bmatrix} \mathbf{1} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} \end{bmatrix}$ (D) $\begin{bmatrix} -i & 0 \\ 0 & -i \end{bmatrix}$

7 If A= $\begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix}$ and A = A^T, then

(A) x=0, y=5 (B) x+y=5 **(C) x=y** (D) none of these

8 If A=$\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$, then A^3-2A^2 is

(A) a null matrix (B) an identity matrix (C) A (D) –A

9 The value of a for which the matrix A= $\begin{bmatrix} a & 2 \\ 2 & 4 \end{bmatrix}$is singular, is:

(A) 1 (B) 0 (C) -1 (D) 2

10. If A and B are square matrices of order 3 such that AB=6I, If$|A|$=12, then $|B|$is:

(A) ½ (B) 2 **(C) 18** (D) 54

11. If A is a square matrix of order 3 such that $|A|$ =-3, then $|-3AA'|$ equals

(A) 243 **(B) -243** (C) -27 (D) -81

12. If f(x) = log$|x|$, x≠0, then f'(x) is equal to

(A) 1/x (B) -1/x (C) 1/$|x|$ (D) -1/$|x|$

13 If f(x)= x^2-2x+4 and $\frac{f(5)-f(1)}{5-1} = f'(c)$, then the value of c is

(A) 0 **(B) 1** (C) 2 (D) 3

14. If the function f(x) = $\begin{cases} 3x - 8 & , if\ x \leq 5 \\ 2k, if\ x > 5 \end{cases}$, is continuous, then the value of k is:

(A) 2/7 **(B) 7/2** (C) 3/7 (D) 4/7

15 The radius of sphere is increasing at the rate of 0.2 cm/sec. The rate at which the volume of the sphere increases when radius is 15cm, is

(A) 12π **(B) 180 π** (C) 225 π (D) 3 π

16 If the function f(x) = 2x^2-kx+5 is increasing on $[1,2]$, then k lies in the interval

(A) (-∞, 4) (B) (4, ∞) (C) (-∞, 8) (D) (8,∞)

17 $\int |x|^3dx$ is equal to

(A) $-x^4/4 + C$ (B) $\frac{|x|^4}{4} + C$ (C) $x^4/4 + C$ **(D) none of these**

18 $\int 2^{x+2}dx$ is equal to

(A) 2^{x+2}+C (B) 2^{x+2}log2+C **(C) $\frac{2^{x+2}}{log2}$+C** (D) $\frac{2x+1}{log2}$+C

Assertion and Reasoning questions: In the following two 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 (A): If $\sin^{-1}x + \sin^{-1}y = \frac{\pi}{2}$, then $\cos^{-1}x + \cos^{-1}y = \frac{\pi}{2}$.
Reason (R): $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$. **A**

20 Assertion (A): The value of integral $\int_0^{\frac{\pi}{4}} \log(1 + tanx)\, dx$ is $\frac{\pi}{8}$log2
Reason (R): $\int_0^a f(x0dx = 1/2 \int_0^a [f(x) + f(2a - x)dx]$. **C**

SECTION B

21 Check whether relation R in the set Z of integers defined as R=$\{(a, b): a + b\ is\ "divisible\ by 2"\}$ is reflexive, symmetric or transitive.

Sol: Reflexive: (a,a)$\in R \forall a \in A$

Symmetric: If (a,b)$\in R, then\ a + b = 2\alpha \Rightarrow b + a = 2\alpha \Rightarrow (b, a) \in R.$

Transitive: If (a,b)$\in R\ and\ (b, c) \in R, then\ a + b = 2\alpha\ and$

$$b + c = 2\beta\ adding\ both\ we\ have\ a + c = 2k \Rightarrow (a, c) \in R$$

22 Simplify: $\cos(\frac{\pi}{2} + \sin^{-1}\frac{1}{\sqrt{3}})$

Sol: $-\sin(\sin^{-1}\frac{1}{\sqrt{3}}) = -\frac{1}{\sqrt{3}}$.

OR

Find the domain of the function: $\cos^{-1}(2x-3)$.

Sol: $1 \le x \le 2$, x$\in [1,2]$ or domain of function is $\in [1,2]$

23. If A is a square matrix of order 3 such that A^2=2A, then fin the value of $|A|$.

Sol: $|AA| = |2A| \Rightarrow |A||A| = 8|A| \Rightarrow |A| = 0, 8$

OR

D is a matrix of order 3which is both symmetric and skew symmetric Find D. show your steps.

Sol: D = -D', 2D = 0 , D=0

24 Find the value of P for which the function f(x) =$\begin{cases} \frac{1-cos4x}{x^2} & ,x \neq 0 \\ P & ,x = 0 \end{cases}$ is continuous at x=0.

Sol: $\lim_{x \to 0} f(x) = f(0) \Rightarrow \lim_{x \to 0} \frac{4x2sin^2 2x}{4x^2}$ =P ⇒ 8$\lim_{x \to 0} \left(\frac{sin2x}{2x}\right)^2$ = P =8.

25 A circular metallic plate expanding such that its area is constantly increasing with respect time. Milind claims that the rate of increase of its perimeter with respect to time is inversely proportional to its radius. Is Milind's claim correct? Justify your answer.

Sol: A = πr^2, P =$2\pi r \Rightarrow \frac{dp}{dt}$= $2\pi \frac{\frac{dA}{dt}}{2\pi r}$ = $\frac{dA}{dt}.\frac{1}{r}$, Thus Milind's claim is correct.

SECTION C

26 A function f:$[-4,4] \to [0,4]$ is given by f(x) = $\sqrt{16-x^2}$. Show that f is an onto function but not one-one function. Further find all possible values of 'a' for which f (a) =$\sqrt{7}$.

Sol: f(4)=0, f(-4) =0 function is not one-one as f(4)= f(-4) but 4≠-4.

f(x) =$\sqrt{16-x^2}$, Range is $[0,4]$ and given codomain is also $[0,4]$, hence unction is onto.

$\sqrt{16-a^2}$ = $\sqrt{7}$, a= ± 3

OR

Let R be the relation in the set Z of integers given by R= $\{(a, b): 2\ divides\ a - b\}$. Show that the relation R is transitive? Write the equivalence class$[0]$.

Sol: Let 2 divides 9a-b0 and 2 divides (b-c) so, 2 divides $[(a-b)+(b-c)]$, yes R is transitive . Equivalence class of 0 is $\{0\ \pm 2, \pm 4, \pm 6 \ldots\}$.

27 Achal wants to purchase 2kg of sugar, 10kg of wheat and 5kg of rice. In general store near his house, these groceries were priced at Rs. 50, Rs.35 and Rs. 40 per kg whereas in a supermarket, these groceries were priced Rs.44, Rs.30 and Rs. 38 per kg, respectively. The cost of travelling to the supermarket is Rs. 20. Using the matrix multiplication, find Achal's total savings if he buys the groceries from supermarket. Show your steps.

Sol: $\begin{bmatrix} 2 & 10 & 5 \end{bmatrix} \begin{bmatrix} 50 & 44 \\ 35 & 30 \\ 40 & 38 \end{bmatrix}$ = $\begin{bmatrix} 650 & 578 \end{bmatrix}$

Achal total saving is Rs. 650-578-20 = Rs.52.

28 Show that the determinant $\begin{vmatrix} x & sin\theta & cos\theta \\ -sin\theta & -x & 1 \\ cos\theta & 1 & x \end{vmatrix}$ is independent of θ.

Sol: Expand the determinant along R_1

$-x^3 - x + x\sin^2\theta + \sin\theta\cos\theta - \sin\theta\cos\theta + x\cos^2\theta$

$-x^3 - x + x = -x^3$

29 Find the intervals on which the function $f(x) = (x-1)^3(x-2)^2$,
(i) strictly increasing, (ii) strictly decreasing.

Sol: $f'(x) = (x-1)^2(x-2)(5x-8) = 0$

x= 1,2,8/5, Intervals are $(-\infty, 8/5)$, $(8/5, 2)$, $(2, \infty)$

(i) Increasing on intervals $(-\infty, 8/5) \cup (2, \infty)$
(ii) Decreasing on (8/5, 2).

OR

Find the absolute maximum value of the function $f(x) = 4x-(1/2)x^2$ in the interval $[-2, 9/2]$.

Sol: critical point is x=4, f(-2) = -10, f(4) = 8, f(9/2) = 7.875

Hence absolute max. Value is 8 at x=4

30. Find $\int \frac{2x+3}{x^2(x+3)}dx$

Sol: $\frac{2x+3}{x^2(x+3)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x+3}$ on solving for A, B and C

A= 1/3, B= 1 and C= -1/3

$\frac{2x+3}{x^2(x+3)} = \frac{1/3}{x} + \frac{1}{x^2} - \frac{1/3}{x+3}$, $I = \int \frac{1/3}{x} + \frac{1}{x2} - \frac{1/3}{x+3}$ dx

1/3 logx -1/x -1/3log9x+3)+C

31. If $x= a\sec^2\theta$, $y= a\tan^2\theta$, then find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{4}$.

Sol: $\frac{dx}{d\theta} = 3a\sec^2\theta\tan\theta$, $\frac{dy}{d\theta} = 3a\tan^2\theta\sec^2\theta$

$\frac{dy}{dx} = \sin\theta$, $\frac{d^2y}{dx^2} = \cos\theta\,\frac{d\theta}{dx} = \frac{\cos^2\theta}{3a\sin\theta}$, $(\frac{d^2y}{dx^2})_{\frac{\pi}{4}} = 1/12a$

SECTION D

32. The equation of path traversed by the ball headed by the footballer is $y= ax^2+bx+c$ (where $0 \leq x \leq 14$ $and\ a, b, c \in R\ and\ a \neq 0$) with respect to a XY

coordinate system in the vertical plane. The ball passes through the points (2, 13), (4, 25) and (14, 15). Determine the values of a,b and c by solving the system of linear equation in a,b and c using matrix method. Also find the equation of the path traversed by the ball.

Sol: 15= 4a+2b+c , 25 = 16a+4b+c, 15 = 196a+14b+c

A= $\begin{vmatrix} 4 & 2 & 1 \\ 16 & 4 & 1 \\ 196 & 14 & 1 \end{vmatrix}$, X = $\begin{vmatrix} a \\ b \\ c \end{vmatrix}$, B = $\begin{vmatrix} 15 \\ 25 \\ 15 \end{vmatrix}$, $|A|$ = -240,

adj(A) = $\begin{vmatrix} -10 & 12 & -2 \\ 180 & -192 & 12 \\ -560 & 336 & -16 \end{vmatrix}$

X= A^{-1}B , a= -1/2, b= 8, c= 1, so, the equation is y =-1/2x^2 +8x+1

OR

If A= $\begin{bmatrix} 2 & 1 & -3 \\ 3 & 2 & 1 \\ 1 & 2 & -1 \end{bmatrix}$, find $A^{-1}$and then solve the following system of equation 2x+y-3z =13 , 3x+2y+z =4, x+2y-z =8.

Sol: $|A|$= -1, A^{-1} = $1/-16\begin{bmatrix} -4 & -5 & 7 \\ 4 & 1 & -11 \\ 4 & -3 & 1 \end{bmatrix}$, X= A^{-1}B , $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ = $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

x=1,y=2, z=3

33. If $\sqrt{1-x^2}$ +$\sqrt{1-y^2}$ = a(x-y) Prove that $\frac{dy}{dx}$ = $\sqrt{\frac{1-y^2}{1-x^2}}$.

Sol: x= sin , y= sin$\emptyset$, $\sqrt{1-sin^2\theta}$ +$\sqrt{1-sin^2\emptyset}$ = a(sin θ-sin$c$),

cosθ+cos$\emptyset$ =a(sinθ-sin$\emptyset$), By applying allied angle formula

cot ($\frac{\theta-\emptyset}{2}$) = a, ($\frac{\theta-\emptyset}{2}$) = $\cot^{-1}$ a, $\theta - \emptyset = 2cot^{-1}a$

$\sin^{-1}$x –$\sin^{-1}$y = 2$\cot^{-1}$a   Diff. wrt x $\frac{dy}{dx}$ = $\sqrt{\frac{1-y^2}{1-x^2}}$.

34. Calculate the adjacent sides of a rectangle with given perimeter as 100cm and enclosing the maximum area.

Sol: Let x and y are the adjacent sides of rectangle, 2(x+y) =100, x+y =50

A= xy = x(50-x) = 50x-x^2, $\frac{dA}{dx}$ =50-2x = 0, x=25

$\frac{d^2A}{dx^2}$ =-2 $< 0, Hence, area\ will\ be$ max $at\ x = 25$. Adjacent sides are 25 and 25.

35. Evaluate $\int_0^{\pi} \frac{xtanx}{secx+tanx}dx$.

Sol: Using Property $\int_0^a f(x)dx = \int_0^a f(a-x)dx$

I $=\int_0^{\pi} \frac{(\pi-x)(-tanx)}{-secx-tanx}dx$ on adding 2I= $\int_0^{\pi} \frac{\pi tanx}{secx+tanx} = \frac{\pi}{2}\int_0^{\pi} \frac{sinx}{1+sinx}dx$

I $= \frac{\pi}{2}(\pi-2)$.

OR

Find: $\int \frac{3x+5}{\sqrt{x^2+2x+4}}$dx.

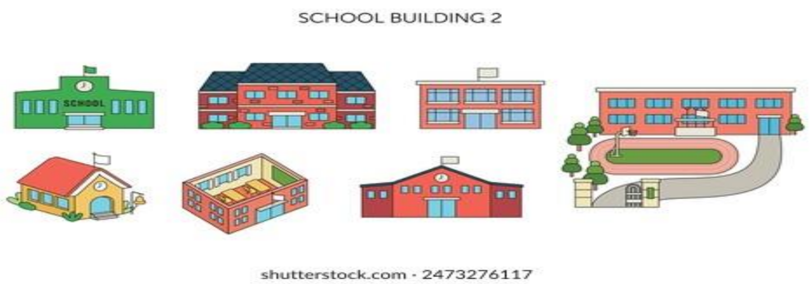
Sol: I = $3\int \frac{x+1}{\sqrt{x^2+2x+4}}$dx $+\int \frac{2}{\sqrt{(x+1)^2+(\sqrt{3})^2}}$dx

$=3\sqrt{x^2+2x+4}$ +2log $\left|(x+1)+\sqrt{x^2+2x+4}\right|$

SECTION E

36. Three schools DPS, CVC and KVS decided to organise a fair for collecting money for helping the flood victims. They sold handmade fans, mats and plates from recycled material at a cost of Rs. 25, Rs. 100 and Rs. 50 each, respectively. The numbers of articles sold are given as:

School /articles	DPS	CVC	KVS
Handmade fans	40	25	35
Mats	50	40	50
Plates	20	30	40



i) What is the total money collected by the school DPS?
ii) What is the total amount collected by school CVC and KVS?
iii) What is the total amount collected by school DPS, CVC and KVS?

Sol: i) 7000

ii) 14000

iii) 21000

37. A ball is thrown upwards. The height at time t is given by $h(t)=20t-5t^2$.

a) Find $h'(t)$.

b) When does the ball reach maximum height?

c) What is the maximum height?

Sol; i) 20-10t

ii) Max at t=2

iii) 20

38. Students of school are taken to railway museum to learn about railways heritage and its history. An exhibit in the museum depicted many rail lines on the track near the railway station. Let L be the set of all rail lines on the railway track and R be the relation on L defined by: R = $\{(l_1, l_2): l_1 \text{ is parallel to } l_2\}$.

On the basis of above information, answer the following questions:

a) Find whether the relation R is symmetric or not.

b) Find whether the relation R is transitive or not.

c) Of one of the rail lines on the railway track is represented by the equation

y=3x+2, then find the set of rail lines in R related to it.

Sol: i) Given relation is symmetric.

ii) Given relation is transitive.

iii) y= 3x+γ, where $\gamma \in R$.

****All The Best *****