Name ___________________ Section______ Roll No.__________

CRPF PUBLIC SCHOOL, ROHINI, DELHI
PRE-BOARD - 1 EXAMINATION (2024-25)
CLASS XII
MATHEMATICS (SET-A)

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. This Question paper contains - **five sections** A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.

2. Section A has **18 MCQ's and 02 Assertion Reasoning based questions** of 1 mark each.

3. Section B has **5 Very Short Answer (VSA)-type questions** of 2 marks each.

4. Section C has **6 Short Answer (SA)-type questions** of 3 marks each.

5. Section D has **4 Long Answer (LA)-type questions** of 5 marks each.

6. Section E has **3 source based/case based/passage based/integrated units of assessment** (4 marks each) with sub parts.

SECTION – A (MCQ) 1 Mark Questions	
Q1	Let R be a relation in the set N given by $R=\{(a,b): a=b-2, b>6\}$. Then (a) $(8,7)\in R$ (b) $(6,8)\in R$ (c) $(3,8)\in R$ (d) $(2,4)\in R$
Q2	If A is a square matrix of order 3 such that $\lvert adj\ A\rvert=144$, the value of $\lvert A^T\rvert$ is: (a) 0 (b) 144 (c) $\pm$ 12 (d) 12
Q3	If $A=\begin{bmatrix} 0 & x+2 \\ 2x-3 & 0 \end{bmatrix}$ is a skew-symmetric matrix, then x is equal to: (a) $\frac{1}{3}$ (b) 5 (c) 3 (d) 1
Q4	The function $f(x)$ = tan $x - x$ (*a*) always increases (*b*) always decreases (*c*) never increases (*d*) sometimes increases and sometimes decreases
Q5	If A = $\begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$ and 2A + B is a null matrix, then B is equal to : (a) $\begin{bmatrix} 6 & 8 \\ 10 & 4 \end{bmatrix}$ (b) $\begin{bmatrix} -6 & -8 \\ -10 & -4 \end{bmatrix}$ (c) $\begin{bmatrix} 5 & 8 \\ 10 & 3 \end{bmatrix}$ (d) $\begin{bmatrix} -5 & -8 \\ -10 & -3 \end{bmatrix}$

Q6	If $A=\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ and A^2 is the identity matrix, then x is equal to (a) 0 (b) 1 (c) 2 (d) -1
Q7	Sum of order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3+\left(\frac{dy}{dx}\right)^5+4x=0$ is (a) 6 (b) 3 (c) 4 (d) 5
Q8	$\int_{-\pi/4}^{\pi/4} x^3 \cos^2 x \, dx$ is equal to (a) 0 (b) -1 (c) 1 (d) 2
Q9	The greatest integer function defined by $f(x)=[x]$, $1<x<3$ is not differentiable at $x=$ (a) 0 (b) 1 (c) 2 (d) $\frac{3}{2}$
Q10	The solution of the differential equation $\frac{dx}{x}+\frac{dy}{y}=0$ is : (a) $\frac{1}{x}+\frac{1}{y}=C$ (b) $\log x - \log y = C$ (c) $xy = C$ (d) $x + y = C$
Q11	The minimum value of $z = 3x + 8y$ subject to the constraints $x \le 20$, $y \ge 10$ and $x \ge 0$, $y \ge 0$ is : (a) 80 (b) 140 (c) 0 (d) 60
Q12	Corner points of feasible region for an LPP are (0,2) , (3,0), (6,0) (6,8) and (0,5). Let $F = 4x + 6y$ be the objective function. Minimum value of F occurs at (a) (0,2) (b) (3,0) (c) The mid-point of the line segment joining the points (0,2)and (3,0) only (d) Any point on the line segment joining the points (0,2) and (3,0)
Q13	For the function $f(x)=x^3$, $x=0$ is a point of (a) local maxima (b) local minima (c) non-differentiability (d) inflexion
Q14	If $P(A \cap B) = \frac{1}{8}$ and $P(\bar{A}) = \frac{3}{4}$, then $P\left(\frac{B}{A}\right)$ is equal to : (a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{6}$ (d) $\frac{2}{3}$

Q15	If a vector makes an angle of $\frac{\pi}{4}$ with the positive directions of both x-axis and y-axis, then the angle which it makes with positive z-axis is : (a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$ (c) $\frac{\pi}{2}$ (d) 0
Q16	$\int 2^{x+2} dx$ is equal to : (a) $2^{x+2} + C$ (b) $2^{x+2} \log 2 + C$ (c) $\frac{2^{x+2}}{\log 2} + C$ (d) $2 \cdot \frac{2^x}{\log 2} + C$
Q17	$\int \frac{x+3}{(x+4)^2} e^x dx = ?$ (a) $\frac{e^x}{x+4} + c$ (b) $\frac{e^x}{x+3} + c$ (c) $\frac{1}{(x+4)^2} + c$ (d) $\frac{e^x}{(x+4)^2} + c$
Q18	Direction cosines of a line perpendicular to both x – axis and z – axis are (a) 1, 0, 1 (b) 1, 1, 1 (c) 0, 0, 1 (d) 0, 1, 0

Assertion Reasoning Based Questions

Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R.**

In the light of the above statements, choose the ***most appropriate*** answer from the options given below

a. Both **A** and **R** are correct and **R** is the correct explanation of **A**
b. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
c. **A** is correct but **R** is not correct
d. **A** is not correct but **R** is correct

Q19	*Assertion (A) :* For matrix $A = \begin{bmatrix} 1 & \cos\theta & 1 \\ -\cos\theta & 1 & \cos\theta \\ -1 & -\cos\theta & 1 \end{bmatrix}$, where $\theta \in [0, 2\pi]$, $\|A\| \in [2, 4]$. *Reason (R) :* $\cos\theta \in [-1, 1], \forall \theta \in [0, 2\pi]$.
Q20	*Assertion (A) :* A line through the points (4, 7, 8) and (2, 3, 4) is parallel to a line through the points (– 1, – 2, 1) and (1, 2, 5). *Reason (R):* Lines $\vec{r} = \vec{a_1} + \lambda \vec{b_1}$ and $\vec{r} = \vec{a_2} + \mu \vec{b_2}$ are parallel if $\vec{b_1} \cdot \vec{b_2} = 0$.

	SECTION – B (Very Short Answer (VSA)-type questions) 2 Marks Each
Q21	Evaluate $\sin^{-1}\left(\sin\frac{3\pi}{4}\right) + \cos^{-1}(\cos\pi) + \tan^{-1}(1)$. **OR** Evaluate the following: $\sin\left(\frac{\pi}{6} - \sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)\right)$
Q22	If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ represents two adjacent sides of a parallelogram, find a unit vectors parallel to the diagonal of the parallelogram.
Q23	The area of the circle is increasing at a uniform rate of 2 cm^2/sec. How fast is the circumference of the circle increasing when the radius r = 5 cm ? **OR** Show that the function f given by $f(x) = \sin x + \cos x$, is strictly decreasing in the interval $\left(\frac{\pi}{4}, \frac{5\pi}{4}\right)$.
Q24	Show that the function $f(x) = 4x^3 - 18x^2 + 27x - 7$ has neither maxima nor minima.
Q25	If $y = (\sin^{-1}x)^2$, then find $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx}$.
	SECTION – C (Short Answer (SA)-type questions) 3 Marks Each
Q26	Solve the following L.P.P. graphically : Maximise $Z = 60x + 40y$ Subject to $x + 2y \le 12$ $2x + y \le 12$ $4x + 5y \ge 20$ $x, y \ge 0$
Q27	Two balls are drawn at random one by one with replacement from an urn containing equal number of red balls and green balls. Find the probability distribution of number of red balls. Also, find the mean of the random variable. **OR** The random variable X has the following probability distribution where a and b are some constants : (table below) If the mean E(X) = 3, then find values of a and b and hence determine $P(X \ge 3)$.

X	1	2	3	4	5
P(X)	0.2	a	a	0.2	b

Q28	Find : $\int \frac{2x}{(x^2+1)(x^2-4)}\,dx$. **OR** Evaluate : $\int \frac{2x+1}{\sqrt{3+2x-x^2}}\,dx$
Q29	Find the general solution of the differential equation : $(x^2+1)\frac{dy}{dx}+2xy=\sqrt{x^2+4}$ **OR** Find the particular solution of the differential equation $(xe^{\frac{y}{x}}+y)\,dx = x\,dy$, given that $y = 1$ when $x = 1$.
Q30	Find the area of the region bounded by the lines $x - 2y = 4$, $x = -1$, $x = 6$ and x-axis, using integration.
Q31	Differentiate the following function with respect to x $y = (sinx)^x + sin^{-1}\sqrt{x}$
SECTION – D (Long Answer (LA)-type questions) 5 Marks Each	
Q32	Find the inverse of matrix $A=\begin{bmatrix} 2 & 3 & 4 \\ 3 & -2 & 2 \\ 4 & 2 & -3 \end{bmatrix}$ Hence solve the given system of equations: $2x+3y+4z=17,\ 3x-2y+2z=11,\ 4x+2y-3z=8$.
Q33	Find the shortest distance between the lines whose vector equations are : $\vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ and $\vec{r} = 3\hat{i} - 3\hat{j} - 5\hat{k} + \mu(-2\hat{i} + 3\hat{j} + 8\hat{k})$ **OR** Find the co-ordinates of the foot of the perpendicular drawn from the point (2, 3, –8) to the line $\frac{4-x}{2} = \frac{y}{6} = \frac{1-z}{3}$. Also, find the perpendicular distance of the given point from the line.

Q34 Evaluate : $\int_{-5}^{0} \left(|x| + |x+2| + |x+5|\right) dx$

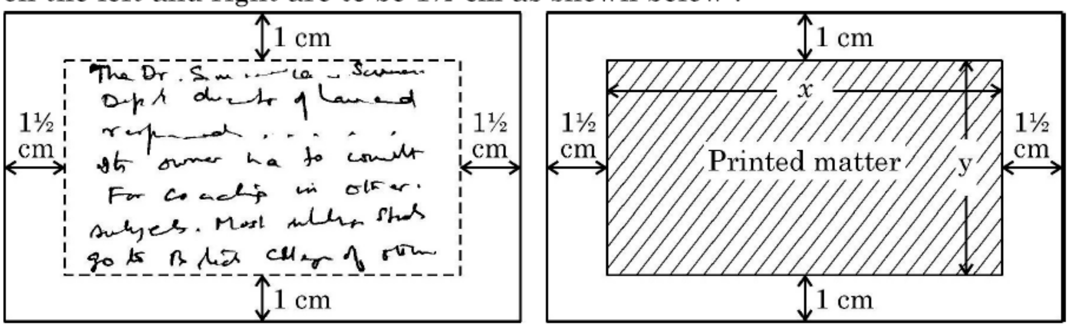
OR

Evaluate : $\int_{0}^{\frac{\pi}{2}} \sin 2x \tan^{-1}(\sin x)\, dx$

Q35 Let $f : \mathbb{R} - \left\{-\frac{4}{3}\right\} \rightarrow \mathbb{R}$ be a function defined as $f(x) = \frac{4x}{3x+4}$. Show that f is a one-one function. Also, check whether f is an onto function or not.

SECTION – E (Case Study Based Questions) 4 Marks Each

Q36 A rectangular visiting card is to contain 24 sq.cm. of printed matter. The margins at the top and bottom of the card are to be 1 cm and the margins on the left and right are to be 1½ cm as shown below :



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

(i) Write the expression for the area of the visiting card in terms of x.

(ii) Obtain the dimensions of the card of minimum area.

Q37 A shopkeeper sells three types of flower seeds A1, A2, A3. They are sold in the form of a mixture, where the proportions of these seeds are 4: 4: 2 respectively. The germination rates of three types of seeds are 45%, 60%, and 35%respectively.

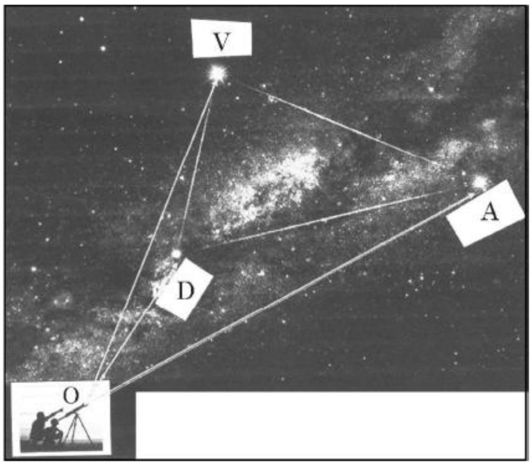
Based on the above information:

(a) Calculate the probability that a randomly chosen seed will germinate.

(b) Calculate the probability that the seed is of type A2, given that a randomly chosen seed germinates.

Q38

An instructor at the astronomical centre shows three among the brightest stars in a particular constellation. Assume that the telescope is located at O(0, 0, 0) and the three stars have their locations at the points D, A and V having position vectors $2\hat{i} + 3\hat{j} + 4\hat{k}$, $7\hat{i} + 5\hat{j} + 8\hat{k}$ and $-3\hat{i} + 7\hat{j} + 11\hat{k}$ respectively.



Based on the above information, answer the following questions :

(i) How far is the star V from star A ? **1**

(ii) Find a unit vector in the direction of $\overrightarrow{DA}$. **1**

(iii) Find the measure of $\angle VDA$. **2**

OR

(iii) What is the projection of vector $\overrightarrow{DV}$ on vector $\overrightarrow{DA}$? **2**