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SECOND PRE-BOARD EXAMINATION, JANUARY 2025

CLASS: XII | **DATE: 6 .01.2025**
SUBJECT: MATHEMATICS (041) | **DURATION: 3 HOURS**
MAX. MARKS: 80 | **SET: A**

General Instructions:

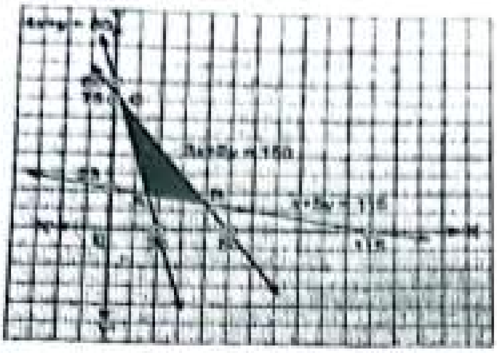
1. This Question paper consists of **6** printed pages and contains **38** questions.
2. The question paper is divided into five sections-Section **A, B, C, D** and **E.** Each section is compulsory. However, there are internal choices in some questions. Let
3. Section A has **18 MCQ's** and **2 Assertion-Reason** based questions of 1 mark each.
4. Section B has **5 Very Short Answer (VSA)** type questions of 2 marks each.
5. Section C has **6 Short Answer (SA)** type questions of 3 marks each.
6. Section D has **4 Long Answer (LA)** type questions of 5 marks each.
7. Section E has **3 source based/case based/passage based/integrated units of assessment of 4 marks** each with sub-parts.

Q NO.	**SECTION-A** **This section comprises multiple choice questions (MCQs) of 1 mark each.**	MARKS
1	A={1,2,3,4} . R is an equivalence relation on AxA defined by (a,b) R (c,d) if a+d=b+c. Find the equivalence class {(1,3)} (a) {(1,3) , (2,4)} (b) { 2,4} (c) {(2,4)} (d) (2,4)	1
2	The domain of the function f(x) = $sin^{-1}(x^2 -4)$ is (a)[-1, 1] (b) $[\sqrt{3}, \sqrt{5}]$ (c)$[-\sqrt{5}, -\sqrt{3}] \cup [\sqrt{3}, \sqrt{5}]$ (d) $[-\sqrt{5}, -\sqrt{3}) \cup (\sqrt{3}, \sqrt{5}]$	1
3	If A = $\begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $\lvert A^3 \rvert = 27$, then the value of α is (a) ± 2 (b)± 1 (c) $\pm\sqrt{5}$ (d) $\pm\sqrt{7}$	1
4	$\lvert A \rvert = 5$ where A is a matrix of order 2 , then $\lvert 4A^{-1} \rvert$ is equal to (a) $\frac{4}{5}$ (b) $\frac{16}{5}$ (c) $\frac{1}{80}$ (d) 40	1
5	If A is a matrix , A = $[a_{ij}]$ of order 3x3 is defined by $a_{ij} = \begin{cases} 2i+3j, & i<j \\ 5, & i=j \\ 3i-2j, & i>j \end{cases}$, then the number of elements in A more than 5 is (a) 4 (b) 3 (c) 5 (d) 6	1
6	If $\lvert A \rvert = \begin{vmatrix} 0 & 3p & 4-p \\ -3p & 0 & p^2-1 \\ p-4 & 1-p^2 & 0 \end{vmatrix}$ then the value of adj(adj A) is (a) 1 (b) 4 (c) 0 (d) -1	1

7	Derivative of $e^{\sin^{-1}x}$ with respect to $\cos^{-1}x$ is (a) $-e^{\sin^{-1}x}$ (b) $e^{\cos^{-1}x}$ (c) $e^{\frac{-1}{\sqrt{1-x^2}}}$ (d) $2x\, e^{\left(\frac{-1}{\sqrt{1-x^2}}\right)}$	1
8	If $A=[a_{ij}]$ of order 3x3 and A_{ij} is the co-factor of a_{ij} such that $\sum_{i=1}^{3} a_{i2}.A_{i2} = -7$, then A. (adj A) = k I , where I is identity matrix of order 3, then the value of k is (a) -7 (b) 49 (c) 7 (d) 343	1
9	A student observes an open-air honeybee nest on the branch of a tree, whose plane figure is parabolic in shape given by $x^2 = 4y$. Then the area (in sq. units) of the region bounded by the parabola $x^2 = 4y$ and the line $y = 4$ is: (a) $\frac{32}{3}$ (b) $\frac{64}{3}$ (c) $\frac{128}{3}$ (d) $\frac{256}{3}$	1
10	If $\int_0^2 2e^{2x}dx = \int_0^a e^x dx$, the value of a is: (a) 1 (b) 2 (c) 4 (d) $\frac{1}{2}$	1
11	If $\int_0^a \frac{1}{4+x^2}dx = \frac{\pi}{6}$, then the value of a is: (a) $\frac{\sqrt{3}}{2}$ (b) $2\sqrt{3}$ (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$	1
12	For any two events A and B, if $P(\overline{A}) = \frac{1}{2}$, $P(\overline{B}) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{4}$, then $P(\overline{A}/\overline{B})$ equals (a) $\frac{3}{8}$ (b) $\frac{8}{9}$ (c) $\frac{5}{8}$ (d) $\frac{1}{4}$	1
13	The number of corner points of the feasible region determined by constraints $x \geq 0,\ y \geq 0,\ x + y \geq 4$ is (a) 0 (b) 1 (c) 2 (d) 3	1
14	The differential equation $\frac{dy}{dx} = F(x, y)$ will not be a homogeneous differential equation, if $F(x, y)$ is (a) $\cos x - \sin\left(\frac{y}{x}\right)$ (b) $\frac{y}{x}$ (c) $\frac{x^2+y^2}{xy}$ (d) $\cos^2\left(\frac{x}{y}\right)$	1
15	Write the sum of order and degree of the differential equation $\frac{d}{dx}\{(\frac{dy}{dx})^4\} = 0$ (a) 4 (b) 3 (c) 5 (d) can not be determined	1
16	The unit vector perpendicular to both vectors $\hat{i} + \hat{k}$ and $\hat{i} - \hat{k}$ is (a) $2\hat{j}$ (b) $\hat{j}$ (c) $\frac{\hat{i}-\hat{k}}{\sqrt{2}}$ (d) $\frac{\hat{i}+\hat{k}}{\sqrt{2}}$	1
17	If $\vec{a}$ and $\vec{b}$ are two vectors such that $\|\vec{a}\| = 1$, $\|\vec{b}\| = 2$ and $\vec{a} \cdot \vec{b} = \sqrt{3}$, then the angle between $2\vec{a}$ and $-\vec{b}$ is (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{5\pi}{6}$ (d) $\frac{11\pi}{6}$	1

18 For the Linear Programming Problem the objective function is $Z = 6x + 3y$ and the feasible region is the shaded region as shown in the graph **1**

(Note: Figure is not to scale)



Which of the following are the constraints that determine the given feasible region?

(a) $x \geq 0, y \geq 0,\ 4x+y \geq 80,\ x + 5y \leq 115,\ 3x+2y \leq 150$
(b) $x \geq 0, y \leq 0,\ 4x+y \geq 80,\ x + 5y \geq 115,\ 3x+2y \geq 150$
(c) $x \geq 0, y \geq 0,\ 4x+y \geq 80,\ x + 5y \leq 115,\ 3x+2y \geq 150$
(d) $x \geq 0, y \geq 0,\ 4x+y \geq 80,\ x + 5y \geq 115,\ 3x+2y \leq 150$

Question numbers 19 and 20 are Assertion(A) and Reason(R) based questions carrying 1 mark each. Select the correct answer from the codes (a), (b), (c) and (d) as given below:

(a) Both Assertion (A) and Reason (R) are true and reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true but reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true and Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is true

19 A: $f(x) = e^{|x|}$ is continuous for all $x \in R$ but not differentiable at $x=0$ **1**
R: If f, g are continuous functions then $f(g(x))$ is also continuous .

20 A: If $f(x) = a\,(x - \cos x)$ is strictly decreasing in R , then a belongs to $(-\infty, 0)$ **1**
R: A function $f(x)$ is said to be decreasing in an interval (a,b) if $x_1 < x_2$ then $f(x_1) \geq f(x_2)$

SECTION-B

This section comprises very short answer (VSA) type questions of 2 marks each.

21 Evaluate $\sin^{-1}\sin\left(\frac{2\pi}{3}\right) + \cos^{-1}\cos\left(\frac{2\pi}{3}\right) + \tan^{-1}\tan\left(\frac{4\pi}{3}\right)$ **2**

22 For what value of k , the function f(x) , given by **2**

$$f(x) = \begin{cases} \frac{1-\cos 4x}{8x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$$ Is continuous at x=0.

OR

If $y^x = e^{(y-x)}$, Prove that $\frac{dy}{dx} = \frac{(1+\log y)^2}{\log y}$

23	Evaluate: $\int_0^1 \log\left(\frac{1}{x}-1\right)dx$	2
24	Position vectors of the points A, B and C as shown in the figure below are $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively.  If $\overrightarrow{AC}=\frac{5}{4}\overrightarrow{AB}$, express $\vec{c}$ in terms of $\vec{a}$ and $\vec{b}$. **OR** Check whether the lines given by equations $x=2\lambda+2,\ y=7\lambda+1,\ z=-3\lambda-3$ and $x=-\mu-2,\ y=2\mu+8,\ z=4\mu+5$ are perpendicular to each other or not.	2
25	Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a}=\hat{i}-\hat{j}+3\hat{k}$ and $\vec{b}=2\hat{i}-7\hat{j}+\hat{k}$.	2
	SECTION-C **This section comprises short answer (SA) type questions of 3 marks each.**	
26	A vertical tank has the shape of an inverted right circular cone with its axis vertical and vertex lowermost. Semi vertical angle is $\tan^{-1}(0.5)$. water is poured into it at a constant rate of 5 cubic metre per hour. Find the rate at which the level of water is rising at the instant when the depth of water in the tank is 4m.(Use $\pi=\frac{22}{7}$)	3
27	Evaluate $\int_1^3 (\|x-1\|+\|x-2\|+\|x-3\|)dx$ **OR** Find $\int \frac{e^x}{5-4e^x-e^{2x}}dx$	3
28	Find the particular solution of the differential equation $\frac{dy}{dx}+y\cot x = 2\cos x$, given that $y\left(\frac{\pi}{2}\right)=0$.	3
29	If vectors $\vec{a}$, $\vec{b}$ and $2\vec{a}+3\vec{b}$ are unit vectors, then find the angle between $\vec{a}$ and $\vec{b}$. **OR** If $\vec{a}$, $\vec{b}$ vectors of equal magnitude and α is the angle between them , then prove that $\frac{\|\vec{a}+\vec{b}\|}{\|\vec{a}-\vec{b}\|}=\cot(\alpha/2)$	3
30	Solve the following Linear Programming Problem graphically: Maximise $Z = 4x + y$ subject to the constraints : $x+y\le 50$ $3x+y\le 90$ $x\ge 0, y\ge 0$	3
		3

31 Four bad oranges are accidentally mixed with sixteen good oranges. Find the probability distribution of the number of bad oranges in a random draw of two oranges (without replacement). Also find the mean of the distribution.

OR

Probability that two shooters A and B hit a target is $\frac{1}{3}$ and $\frac{2}{5}$ respectively.If each shoots at the target , what is the probability that

(i) The target is hit.

(ii) Exactly one of them hits the target.

SECTION-D

This section comprises long answer type questions (LA) of 5 marks each

32. Find the values of a and b , if the function $f(x)=\begin{cases} ax^2+b\ , x<1 \\ 2x+1\ \ , x\geq 1 \end{cases}$ is differentiable at x=1 — 5

OR

If x=a(cos t+t sint) , y =a(sint - t cos t) $0< t < \frac{\pi}{2}$

Find (i) $\frac{d^2x}{dt^2}$ (ii) $\frac{d^2y}{dt^2}$ (iii) $\frac{d^2y}{dx^2}$.

33. If A = $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, find A^{-1}. Using A^{-1}solve the system of equations — 5

2x-3y+5z = 11

3x+2y-4z = -5

x+y-2z = -3.

34 If A_1 denotes the area of the region bounded by $y^2 = 4x,\ x = 1$ and x-axis in the first quadrant and A_2 denotes the area of the region bounded by $y^2 = 4x,\ x = 4$, find $A_1 : A_2$. — 5

35 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. — 5

OR

Find the shortest distance between the lines L_1 and L_2 given below

L_1: The line passing through (2, −1, 1) and parallel to $\frac{x}{1} = \frac{y}{1} = \frac{z}{3}$.

L_2: The line in Cartesian form , $\frac{y-1}{2} = \frac{z+2}{-1}$; x=1

SECTION-E

This section comprises 3 case study-based questions of 4 marks each.

Case Study - 1

36. An organization conducted a bike race under two different categories -Boys and Girls. There were 28 participants in all . Among all of them , finally three from category 1 and two from category 2 were selected for final round. Let B = { b_1, b_2, b_3 } and G = { g_1, g_2} where B,G respectively , represent the set of boys, girls selected .

Use the above information , answer the following questions:

1)How many one-one functions are possible from G to B

2) Is the function f: B→ G defined by f = {(b_1, g_1),(b_2, g_2),(b_3, g_1) } a (i) one- one , (ii) onto function? Justify . — 1

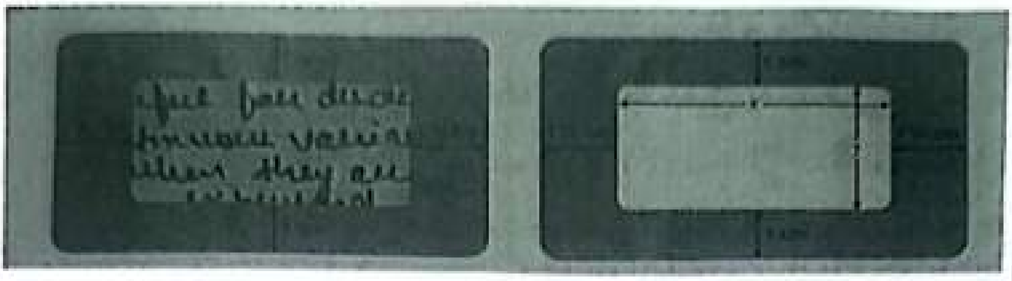
3)If relation R : G →G defined by R = { (x,y) : x and y are students of same sex; x,y ∈ G} . write all possible the reflexive relations as set of ordered pairs. 1

OR 2

If R is a relation on B given by R = { (b_1 , b_2),(b_2 , b_1)} , how many minimum pairs to be added to make it an equivalence relation. List them.

Case Study - 2

37.



A rectangular visiting card is to contain 24 sq. cm of printed matter with dimension x, y as marked in the figure.The margin at the top and bottom of the card are to be 1 cm and the margin on the left and right are to be $1\frac{1}{2}$cm. On the basis of the above information

(i) Write the expression for the area A of the card in terms of x 1

(ii) Find the value of x for which $\frac{dA}{dx} = 0$ 1

(iii) Find A if the area is least 2

OR

(iii)The perimeter of the the card having least area.

Case Study - 3

38. In an office three employees James, Sophia and Oliver process incoming copies of a certain form. James processes 50% of forms , Sophia process 20% and Oliver the remaining 30% of forms . James has an error rate of 0.06, where as the error rate of Sophia and Oliver is 0.04 , 0.03 respectively.

Based on the above information, answer the following questions

(i) Find the probability that Sophia processed and committed error 1

(ii) Find the probability of committing error in processing the form 1

(iii) The manager of the company selects a form at random from the days output of processed form . If the selected form has an error, find the probability that the form is not processed by James. 2

OR

(iv) Let E be the event of committing an error in processing the form and let E_1,E_2 and E_3 be the events that James, Sophia and Oliver processed the form .

Find the value of $\sum_{i=1}^{3} P(Ei/E)$.

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