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MUMBAI

SOLVED SAMPLE QUESTION PAPERS CLASS XII MATHEMATICS SESSION 2024-25

PREPARED BY SAIJI B R TA MATHS ZIET MUMBAI

Sample Paper -01, SESSION 2024-25

CLASS: XII MATHEMATICS (Code-041)

BLUE – PRINT

UNITS	**NAME OF CHAPTERS**	**SECTION A (Objective Type) (1 M EACH)**		**SECTION B (VSA) (2 MS EACH)**	**SECTION C (SA) (3 MS EACH)**	**SECTION D (LA) (5 MARKS EACH)**	**SECTION E (CBQ) (4 MS EACH)**	**TOTAL**
		MCQ	ARQ					
UNIT-I (Relations & Functions)	RELATIONS AND FUNCTIONS			2(1)		5*(1)		8(3)
	INVERSE TRIGONOMETRY FUNCTION		1(1)					
UNIT-II (Algebra)	MATRICES	2(2)						10(6)
	DETERMINANT	3(3)				5(1)		
UNIT-III (calculus)	CONTINUITY & DIFFERENTIABILITY	2(2)		2*(1)	3(1)			35(17)
	APPLICATION OF DERIVATIVE	2(2)					4*(1)	
	INTEGRATION	2(2)		2(1)	3*(1)	5*(1)		
	APPLICATION OF INTEGRATION			2*(1)	3(1)			
	DIFFERENTIAL EQUATION	2(2)			3*(1)			
UNIT-IV (Vectors & 3D)	VECTORS	1(1)		2(1)				14(6)
	THREE-DIMENSIONAL GEOMETRY	1(1)	1(1)			5(1)	4*(1)	
UNIT-V (LPP)	LPP	2(2)			3(1)			5(3)
UNIT-VI (Probability)	PROBABILITY	1(1)			3*(1)		4(1)	8(3)
	TOTAL	**18(18)**	**2(2)**	**10(5)**	**18(6)**	**20(4)**	**12(3)**	**80(38)**

(*) represents question with internal choice. Marks are mentioned outside brackets. No. of questions - within the brackets.

SAMPLE QUESTION PAPER-01

SESSION 2024-25

CLASS: XII

SUBJECT: -MATHEMATICS (041)

Time: - 3 Hours **Max Marks: - 80**

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 (VSA)-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.

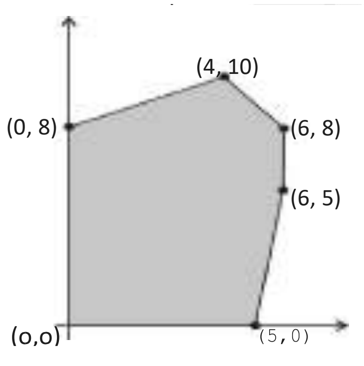
(vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.

(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 calculator is not allowed.

Q. No	**SECTION A** (This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18):	**Marks**
1	If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \cos\alpha & \sin\alpha \end{bmatrix}$, then $A + A' = I$, if the value of α is (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) π (d) $\frac{3\pi}{2}$	1
2	If A = [a_{ij}] is a symmetric matrix of order n, then (a) $a_{ij} = \frac{1}{a_{ij}}$ for all i,j (b) $a_{ij} \neq 0$ for all i,j (c) $a_{ij} = a_{ji}$ for all i,j (d) $a_{ij} = 0$ for all i, j	1
3	Let A be a non-singular square matrix of order 3 × 3 and |*adj* A| = 8 then $\|A\|$ is equal to (a) ± 64 (b) ± 16 (c) ± 8 (d) none of the these	1
4	For what value of x, matrix $\begin{bmatrix} 6-x & 4 \\ 3-x & 1 \end{bmatrix}$ is a singular matrix? (a) 1 (b) 2 (c) -1 (d) -2	1
5	If A and B are invertible matrices, then which of the following is not correct? (a) *adj* A = |A|. A^{-1} (b) $\det(A)^{-1} = [\det(A)]^{-1}$ (c) $(AB)^{-1} = B^{-1} A^{-1}$ (d) $(A + B)^{-1} = B^{-1} + A^{-1}$	1
6	The function $f(x) = [x]$, where $[x]$ denotes the greatest integer function, is continuous at	1

	(a) 4 (b) – 2 (c) 1 (d) 1.5	
7	Derivative of sec $(\tan^{-1}x)$ w.r.t. x is (a) $\frac{x}{\sqrt{1+x^2}}$ (b) $\frac{x}{1+x^2}$ (c) $x\sqrt{1+x^2}$ (d) $\frac{1}{\sqrt{1+x^2}}$	1
8	The rate of change of the area of a circle with respect to its radius r, at r = 6 cm is (a) 10 π (b) 12 π (c) 8 π (d) 11 π	1
9	On which of the following intervals is the function f given by $f(x) = x^{100} + \sin x - 1$ decreasing? (a) (0,1) (b)$(\frac{\pi}{2}, \pi)$ (c)$(0,\frac{\pi}{2})$ (d) None of these	1
10	$\int \frac{dx}{sin^2xcos^2x}\ is\ equal\ to$ (a)$\tan x + \cot x + c$ (b) $\sin x + \cos x + c$ (c) $\tan x - \cot x + c$ (d) $\sin x - \cos x + c$	1
11	The value of $\int_a^{-a} \sin^3 x\, dx$ is (a) a (b) a/3 (c) 1 (d) 0	1
12	The sum of the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} + 1 = 0\ is$ (a) 3 (b) 2 (c) 1 (d) 5	1
13	Integrating factor of the differential equation $x^2\frac{dy}{dx} + xy = x^3$ is: (a) x^2 (b) x (c)e^x (d) e^{x^2}	1
14	If $\vec{a}$ is nonzero vector of magnitude 'a' and λ is a nonzero scalar, then $\lambda\vec{a}$ is unit vector if (a) $\lambda = 1$ (b) $\lambda = -1$ (c) $a = \|\lambda\|$ (d) $a = \frac{1}{\|\lambda\|}$	1
15	The coordinates of the foot of the perpendicular drawn from the point (2, 5, 7) on the x-axis are given by (a) (2, 0, 0) (b) (5, 0, 0) (c) (7, 0, 0) (d) (0, 5, 7)	1
16	The feasible solution for a LPP is shown in given figure. Let Z = 3x-4y be the objective function. Minimum of Z occurs at a) (0,0) b) (0,8) c) (5,0) d) (4,10)  	1
17	Inequation y – x ≤ 0 represents (a) The half plane that contains the positive x-axis (b) Closed half plane above the line y = x, which contains positive y-axis (c) Half plane that contains the negative x-axis (d) None of these	1

18	If A and B are two events such that P(A) + P(B) - P(A and B) = P(A), then (a) P(B/A) =1 (b) P(A/B) =1 (c) P(A/B) =0 (d) P(B/A) =0	1

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

Both A and R are true and R is the correct explanation of A.

(a) **Both A and R are true but R is not the correct explanation of A.**

(b) **A is true but R is false.**

(c) **A is false but R is true.**

19	**A**: The Principal value of $\cos^{-1}\left(-\frac{1}{\sqrt{2}}\right) + 2\ \sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ is equal to $\frac{5\pi}{4}$ **R**: Domain of $\cos^{-1} x$ and $\sin^{-1} x$ are respectively $(0, \pi)$ and $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$	1
20	**A**: The following straight lines L_1 & L_2 are perpendicular to each other. $\frac{x+1}{2} = \frac{y-2}{5} = \frac{z+3}{4}\ and\ \frac{1-x}{-1} = \frac{y+2}{2} = \frac{3-z}{3}$ **R**: Let line L_1 passes through the point $(x_1, y_1, z_1,)$ and parallel to the vector whose direction ratios are a_1, b_1, and c_1, and let line L_2 passes through the point $(x_2, y_2, z_2,)$ and parallel to the vector whose direction ratios are a_2, b_2, and c_2, · Then the lines L_1 & L_2 are perpendicular if $a_1.a_2 + b_1.b_2 + c_1.c_2 = 0$	1

SECTION B

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	Check whether the relation R in the set **R** of real numbers, defined as R = $\{(a, b) : a \leq b^2\}$ is transitive.	2
22	Find $\frac{dy}{dx}$ of the function $y^x = x^y$ **OR** Find the values of *k* so that the function *f* is continuous at the indicated point $f(x) = \begin{cases} kx+1, & if\ x \leq \pi \\ \cos x, & if\ x > \pi \end{cases} \qquad at\ x = \pi$	2
23	Find primitive of the function: $\frac{\sin(tan^{-1}x)}{1+x^2}$	2
24	Using integration find the area of the region in the first quadrant enclosed by the circle $x^2 + y^2 = 25$. **OR** Using integration find the area of the region in the first quadrant enclosed by the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$.	2
25	If $\vec{a}, \vec{b}, \vec{c}$ are non-zero vectors such that $\lceil \vec{a} \rceil = 2, \lceil \vec{b} \rceil = 3, \lceil \vec{c} \rceil = 5$ and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. find the value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$.	2

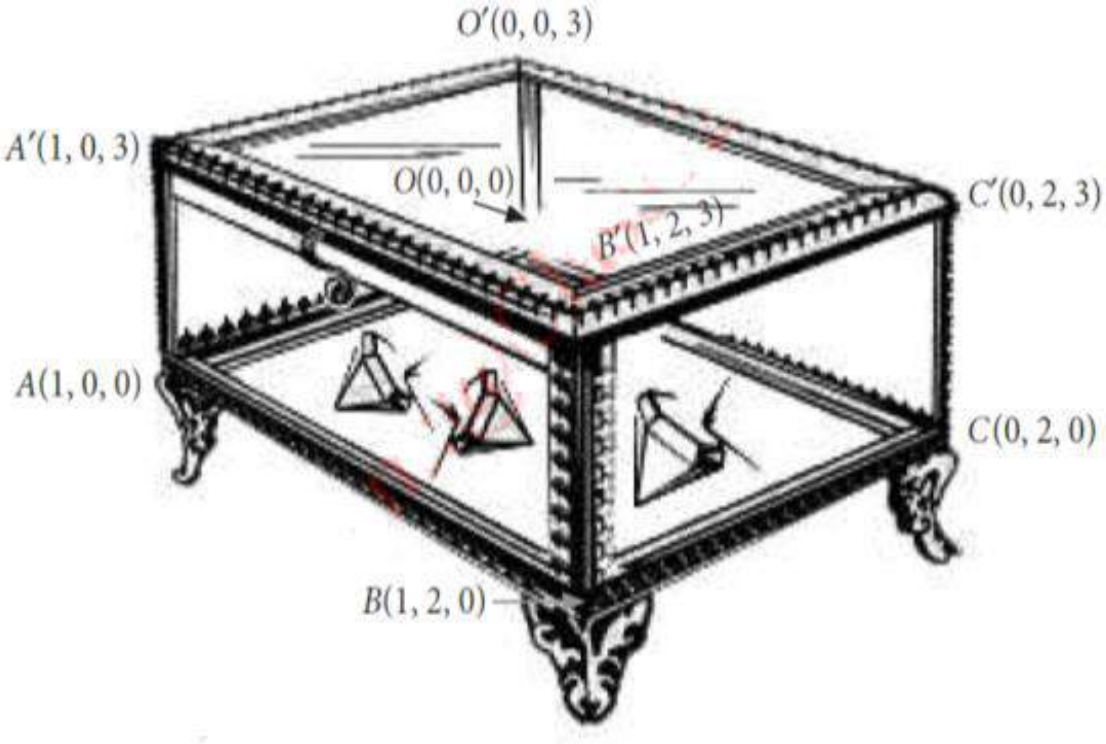
SECTION C

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26	If *y* = 3 cos (log *x*) + 4 sin (log *x*), show that $x^2y_2 + xy_1 + y = 0$	3

27	Evaluate: $\int \frac{\sin x}{\sin(x-a)} dx$ **OR** Evaluate:$\int_0^{\frac{\pi}{4}} \frac{\sin x+\cos x}{9+16\sin 2x}\ dx$	3
28	Find the area of the region bounded by the parabola $y = x^2$ and $y = \lvert x \rvert$.	3
29	Solve the differential equation $\frac{\mathrm{dy}}{\mathrm{dx}} = \frac{x+y}{x}$ **OR** Solve the differential equation $x\frac{\mathrm{dy}}{\mathrm{dx}} + 2y = x^2 \ ; (x \neq 0)$	3
30	Solve the following Linear Programming Problem graphically: Maximize Z = 5x + 2y, subject to the constraints: $x - 2y \leq 2$, $3x + 2y \leq 12$, $-3x + 2y \leq 3$, $x \geq 0$, $y \geq 0$.	3
31	Two numbers are selected at random (without replacement) from the first six positive integers. Let X denote the larger of the two numbers obtained. Find E(X). **OR** The random variable X has a probability distribution P(X) of the following form, where *k* is some number: $P(X)=\begin{cases} k\ , & if\ \ x = 0 \\ 2k\ , & if\ \ x = 1 \\ 3k\ , & if\ \ x = 2 \\ 0\ , & otherwise \end{cases}$ (a) Determine the value of *k*. (b) Find P (X < 2), (c) Find P (X≥2),	3
	SECTION D **(This section comprises of 4 long answer (LA) type questions of 5 marks each)**	
32	Let A = R – {3}, B = R – {1}. Let f : A → B be defined by f (x) = $\frac{x-2}{x-3}$ ∀ x ∈ A . Then show that f is bijective. **OR** Let n be a fixed positive integer. Define a relation R in Z as follows: ∀a, b ∈Z, aRb if and only if a – b is divisible by n . Show that R is an equivalence relation.	5

33	Determine the product $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ and use it to solve the system of equations $-4x + 4y + 4z = 16,$ $-7x + y + 3z = 4$ $5x - 3y - z = -4.$	5
34	Evaluate $\int \frac{\sqrt{x^2+1}\,[\log(x^2+1)-2\log x]}{x^4}$ dx **OR** Evaluate $\int_0^{\frac{\pi}{2}} \log\cos x\ dx.$	5
35	Find the vector equation & cartesian equations of the line which is perpendicular to the lines with equations $\frac{x+2}{1} = \frac{y-3}{2} = \frac{z+1}{4}\ and\ \frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and passes through the point (1,1,1). Also find the angle between the given lines.	5
	SECTION E (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)	
36	The Government declare that farmers can get Rs 300 per quintal for their Tomatoes on 1st July and after that, the price will be dropped by Rs 3 per quintal per extra day. Raman's father has 80 quintal of Tomatoes in the field on 1st July and he estimates that crop is increasing at the rate of 1 quintal per day.  Based on the above information, answer the following questions. (i) If x is the number of days after 1st July, then write price and quantity of Tomato in terms of x. (ii) Find the Revenue in terms of x. (iii) Find the number of days after 1st July, when Raman's father attains maximum revenue. **OR** On which day should Raman's father harvest the tomatoes to maximise his revenue?	1 1 2

37	In a diamond exhibition, a diamond is covered in cubical glass box having coordinates *O*(0, 0, 0), *A*(1, 0, 0), *B*(1, 2, 0), *C*(0, 2, 0), *O*’(0, 0, 3), *A*’ (1, 0, 3), *B*’ (1, 2, 3) and *C*’ (0, 2, 3).  Based on the above information, answer the following questions. **(**i)Find the Direction ratios of *OA* (ii) find the Equation of diagonal *OB*’ (iiI) find the Equation of Line *O’B*’	 1 1 2
38	Husband and wife appear in an interview for two vacancies in the same post. The probability of husband’s selection is $\frac{1}{7}$ and that of wife’s selection is $\frac{1}{5}$. Based on the above information, answer the following questions. (i) Both of them will be selected. (ii) Only one of them will be selected. 	2 2

MARKING SCHEME
SQP-01, 2024-25
CLASS: XII
SUBJECT: MATHEMATICS (041)

<table>
<tr><th>Q. No.</th><th>SECTION – A</th><th>Marks</th></tr>
<tr><td></td><td>
<table>
<tr><td>1</td><td>(b)</td><td>6</td><td>(d)</td><td>11</td><td>(d)</td><td>16</td><td>(b)</td></tr>
<tr><td>2</td><td>(c)</td><td>7</td><td>(a)</td><td>12</td><td>(d)</td><td>17</td><td>(a)</td></tr>
<tr><td>3</td><td>(d)</td><td>8</td><td>(b)</td><td>13</td><td>(b)</td><td>18</td><td>(b)</td></tr>
<tr><td>4</td><td>(b)</td><td>9</td><td>(d)</td><td>14</td><td>(d)</td><td>19</td><td>(c)</td></tr>
<tr><td>5</td><td>(d)</td><td>10</td><td>(c)</td><td>15</td><td>(a)</td><td>20</td><td>(a)</td></tr>
</table>
</td><td>20</td></tr>
<tr><td colspan="3">SECTION – B</td></tr>
<tr><td>21</td><td>Given a correct example
∴ R is not transitive.</td><td>1
1</td></tr>
<tr><td>22</td><td>Taking logarithm on both sides
Differentiating both sides with respect to x
So $\frac{dy}{dx} = \frac{y(y-x\log y)}{x(x-y\log x)}$
OR
$f(x)\ is\ continous\ at\ x = \pi$
$LHL = RHL = f(\pi)$
$k = \frac{-2}{\pi}$</td><td>1
1

1
1</td></tr>
<tr><td>23</td><td>Let $tan^{-1}x = t$
Primitive = - cos ($tan^{-1}x$) + c</td><td>½
1 ½</td></tr>
<tr><td>24</td><td>For correct diagram
$y = \sqrt{5^2 - x^2}$,
required area =$\frac{25\pi}{4}$ square units.
OR
For correct diagram
$y = \frac{4}{5}\sqrt{5^2 - x^2}$
required area =5π square units.</td><td>½
½
1
½
½

1</td></tr>
<tr><td>25</td><td>a,b,c are unit vectors
∴$|\vec{a}|$=2,$|\vec{b}|$=3,$|\vec{c}|$=5
$\vec{a} + \vec{b} + \vec{c} = \vec{0}$ (given)
∴$(\vec{a} + \vec{b} + \vec{c})^2 = 0$
∴$|\vec{a}|^2$+$|\vec{b}|^2$+$|\vec{c}|^2$ +2 $(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$
4+9+25+2 $(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$
∴$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -19$</td><td>1

1</td></tr>
</table>

	SECTION C	
26	$y = 3\cos(\log x) + 4\sin(\log x)$ $\frac{\mathrm{dy}}{\mathrm{dx}} = -3\sin(\log x)\frac{1}{x} + 4\cos(\log x)\frac{1}{x}$ $x\frac{\mathrm{dy}}{\mathrm{dx}} = -3\sin(\log x) + 4\cos(\log x)$ $x\frac{d^2y}{dx^2} + \frac{\mathrm{dy}}{\mathrm{dx}} = -3\cos(\log x)\frac{1}{x} - 4\sin(\log x)\frac{1}{x}$ $x^2\frac{d^2y}{dx^2} + x\frac{\mathrm{dy}}{\mathrm{dx}} = -\{3\cos(\log x) + 4\sin(\log x)\}$ $x^2y_2 + xy_1 + y = 0$	1 1 1
27	Put t =x-a So $\int \frac{\sin(t+a)}{\sin t}dt$ So ans is $\sin a \log\lvert\sin(x-a)\rvert + x\cos a + c$ **OR** Let sinx−cosx=t $\int_{-1}^{0}\frac{dt}{9+16(1-t^2)}$ Ans is $\frac{\log 9}{40}$	½ ½ 2 ½ 1 1 ½
28	For correct diagram A= $2\int_0^1 x\,dx\ - 2\int_0^1 x^2\,dx$ Required area = 1/3 sq. unit	½ 1 1 ½
29	It is a homogenous differential equation, Put y= vx Then dv = dx/x $\frac{y}{x} = \log cx$ $x = ke^{\frac{y}{x}}$ **OR** $\frac{dy}{dx} + 2\frac{y}{x} = x$ I.F. = x^2 y$x^2 = \frac{x^4}{4} + c$	1 1 1 ½ 1 1.5

<table>
<tr><td>30</td><td>correct graph
correct corner points
Hence, Z is maximum at x = $\frac{7}{2}$, y = $\frac{3}{4}$ and maximum value = 19</td><td>1
1
1</td></tr>
<tr><td>31</td><td>X can take values 2, 3, 4, 5, 6
(∵1 cannot be greater than the other selected number)
<table>
<tr><td>X</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>P(X)</td><td>$\frac{2}{30}$</td><td>$\frac{4}{30}$</td><td>$\frac{6}{30}$</td><td>$\frac{8}{30}$</td><td>$\frac{10}{30}$</td></tr>
<tr><td>X.P(X)</td><td>$\frac{4}{30}$</td><td>$\frac{12}{30}$</td><td>$\frac{24}{30}$</td><td>$\frac{40}{30}$</td><td>$\frac{60}{30}$</td></tr>
</table>
Mean of X=E(X)=∑X P(X) = $\frac{4+12+24+40+60}{30} = \frac{140}{30} = \frac{14}{3}$
OR
The random variable X has a probability distribution P(X) of the following form, where *k* is some number :
<table>
<tr><td>X</td><td>0</td><td>1</td><td>2</td><td>OTHERWISE</td><td></td></tr>
<tr><td>P(X)</td><td>K</td><td>2K</td><td>3K</td><td>0</td><td></td></tr>
</table>
(a) As Sum of all probabilities should be
⇒k+2k+3k=1 ⇒k=1/6
(b) P(x<2)=p(x=0)+p(x=1)=k+2k=3($\frac{1}{6}$)=$\frac{1}{2}$
(c) P(x≥2)=3k+0=3($\frac{1}{6}$)+0 = $\frac{1}{2}$</td><td>1
1
1
1
1
1</td></tr>
<tr><td></td><td>**SECTION D**</td><td></td></tr>
<tr><td>32</td><td>For ONE -ONE
For Onto:
OR
Reflexivity:
R is reflexive.
Symmetry:
R is symmetric
Transitivity:
R is transitive
∴R is Equivalence Relation.</td><td>2.5
2.5
1.5
1.5
2</td></tr>
<tr><td>33</td><td>$$\begin{bmatrix}-4 & 4 & 4\\-7 & 1 & 3\\5 & -3 & -1\end{bmatrix}\begin{bmatrix}1 & -1 & 1\\1 & -2 & -2\\2 & 1 & 3\end{bmatrix}=\begin{bmatrix}8 & 0 & 0\\0 & 8 & 0\\0 & 0 & 8\end{bmatrix}$$
$$B^{-1}=\frac{1}{8}\begin{bmatrix}1 & -1 & 1\\1 & -2 & -2\\2 & 1 & 3\end{bmatrix}$$
Matrix form of equations</td><td>1
1
1</td></tr>
</table>

	$\frac{1}{8}\begin{bmatrix}-4 & 4 & 4\\-7 & 1 & 3\\5 & -3 & -1\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}16\\4\\-4\end{bmatrix}$ X=$B^{-1}C$ Hence x = 1, y = 2 and z = 3.	2
34	$\int\sqrt{\frac{x^2+1}{x^2}}\ \log(\frac{x^2+1}{x^2})\ \frac{1}{x^3}\ dx$	1
	Put $\sqrt{\frac{x^2+1}{x^2}}=t$,Required answer = $-\frac{1}{3}\left[\frac{x^2+1}{x^2}\right]^{\frac{3}{2}}\left[\log\frac{x^2+1}{x^2}-\frac{2}{3}\right]+c$	1
	OR	
	Let I = $\int_0^{\frac{\pi}{2}}\log\cos x\ dx$ ---(i) Then, using P-4	3
	I = $\int_0^{\frac{\pi}{2}}\log\cos(\frac{\pi}{2}-x)\ dx=\int_0^{\frac{\pi}{2}}\log\sin x\ dx$ ---(ii)	
	$2I=\int_0^{\frac{\pi}{2}}\log(\sin x\cos x)\,dx$	1
	$2I=-\pi\log 2$	2
	I = $-\frac{\pi}{2}\log 2$	2
35	Find drs of required line where a=-4, b= 4 & c=-1	1
	Equation of required line in vector equation & cartesian equations: $\frac{x-1}{-4}=\frac{y-1}{4}=\frac{z-1}{-1}$	1
	& $\vec{r}=(\hat{\imath}+\hat{\jmath}+\hat{k})+\lambda(-4\hat{\imath}+4\hat{\jmath}-\hat{k})$	1
	And find angle $\theta=\cos^{-1}\frac{24}{\sqrt{609}}$	2
	SECTION E	
36	(i) $(300-3x)$ & $(80+x)$	1
	(ii) -3x^2 + 60x + 24000	1
	(iii) 10	2
	OR 11th July	
37	(i) Direction ratios of *OA =1,0,0*	1
	(ii) the Equation of diagonal *OB*'=$\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$	1
	(iiI) Equation of Line is *O'B*' =$\frac{x}{1}=\frac{y}{2}=\frac{z-3}{0}$	2
38	(i) $\frac{1}{35}$ (ii) $\frac{2}{7}$	2+2

SAMPLE QUESTION PAPER -02, 2024-25
BLUEPRINT
CLASS: XII MATHEMATICS (Code-041)

UNITS	**NAME OF CHAPTERS**	**SECTION A (Objective Type) (1 MARK EACH)**		**SECTION B (VSA) (2 MARKS EACH)**	**SECTION C (SA) (3 MARKS EACH)**	**SECTION D (LA) (5 MARKS EACH)**	**SECTION E (CBQ) (4 MARKS EACH)**	**TOTAL**
		MCQ	ARQ					
UNIT-I (Relations & Functions)	RELATIONS AND FUNCTIONS			2(1)		5*(1)		8(3)
	INVERSE TRIGONOMETRY FUNCTION		1(1)					
UNIT-II (Algebra)	MATRICES	2(2)						10(6)
	DETERMINANT	3(3)				5(1)		
UNIT-III (calculus)	CONTINUITY & DIFFERENTIABILITY	2(2)		2*(1)	3(1)			35(17)
	APPLICATION OF DERIVATIVE	2(2)					4*(1)	
	INTEGRATION	2(2)		2(1)	3*(1)	5*(1)		
	APPLICATION OF INTEGRATION			2*(1)	3(1)			
	DIFFERENTIAL EQUATION	2(2)			3*(1)			
UNIT-IV (Vectors & 3D)	VECTORS	1(1)		2(1)				14(6)
	THREE-DIMENSIONAL GEOMETRY	1(1)	1(1)			5(1)	4*(1)	
UNIT-V (LPP)	LPP	2(2)			3(1)			5(3)
UNIT-VI (Probability)	PROBABILITY	1(1)			3*(1)		4(1)	8(3)
	TOTAL	**18(18)**	**2(2)**	**10(5)**	**18(6)**	**20(4)**	**12(3)**	**80(38)**

(*) represents question with internal choice. Marks are mentioned outside brackets. No. of questions - within the brackets.

SAMPLE QUESTION PAPER-02
2024-25
CLASS: XII
SUBJECT: -MATHEMATICS (041)

Time: - 3 Hours **Max Marks: - 80**

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 (VSA)-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 calculator is not allowed.

Q. No	**<u>SECTION – A</u>** (This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18):	**Marks**
1	If $\begin{bmatrix} x-y & 2 \\ x & 5 \end{bmatrix} = \begin{bmatrix} 2 & 2 \\ 3 & 5 \end{bmatrix}$, then value of y is (a) 1 (b) 3 (c) 2 (d) 5	1
2	The A = $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then A ^{2} is equal to (a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	1
3	Let A be a non-singular square matrix of order 3 × 3 and |adj A| = 64 then $\|A\|$ is equal to (a) ± 64 (b) ± 16 (c) ± 8 (d) none of the these	1
4	If A = $\begin{vmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{vmatrix}$, then A^{-1} exists, if (a) $\lambda = 2$ (b) $\lambda \neq 2$ (c) $\lambda \neq -2$ (d) None of these	1
5	If A is a square matrix of order 3 $\times$ 3 such that $\|A\| = 2$, then the value of $\|adj(adj\ A)\|$ is (a)-16 (b) 16 (c) 0 (d) 2	1
6	The function $y = \|x-5\|$ is (a) Continuous at x = 5 (b) Differentiable at $x = 5$ (c) Both continuous and differentiable at $x = 5$ (d) Neither continuous nor differentiable at $x = 5$	1
7	Derivative of sec (tan^{-1}x) w.r.t. x is (a) $\frac{x}{\sqrt{1+x^2}}$ (b) $\frac{x}{1+x^2}$ (c) $x\sqrt{1+x^2}$ (d) $\frac{1}{\sqrt{1+x^2}}$	1
8	The function f(x)=x^x is decreasing in the interval: (a) $(0, e)$ (b) $(0, \frac{1}{e})$ (c) (0,1) (d) none of these	

9	For the function y=x^3+21,the value of x, when y increases 75 times as fast as x ,is (a)±3 (b)±5√3 (c)±5 (d)none of these	1
10	If $\int(sin2x - cos2x)dx = \frac{-1}{\sqrt{2}}\sin(2x - a) + c$,then $a =$ (a)$\frac{\pi}{4}$ (b) $-\frac{\pi}{4}$ (c) $\frac{5\pi}{4}$ (d) None of these	1
11	$\int \frac{e^{tan^{-1}x}}{1 + x^2} dx =$ (a)$\frac{e^{tan^{-1}x}}{1+x^2} + c$ (b) $x^2 e^{tan^{-1}x} + c$ (c) $e^{tan^{-1}x} + c$ (d)$\frac{e^{tan^{-1}x}}{x} + c$	1
12	The order of the differential equation $2x^3 \frac{d^2y}{dx^2}$ - $36 \frac{dy}{dx}$ + y = 0 is (a) 2 (b) 1 (c) 0 (d) not defined	1
13	The general solution of $\frac{dy}{dx} + y \tan x = \sec x$ is (a) $y \sec x = \tan x + C$ (b) $y \tan x = \sec x + C$ (c)$\tan x = y \tan x + C$ (d) $x \sec x = \tan y + C$	1
14	If $\vec{a} = 7i + j + 4k$ and $\vec{b} = 2i - 6j + 3k$, then the projection of $\vec{a}$ on $\vec{b}$ is $(a)\ \frac{11}{7}$ (b)$\frac{8}{7}$ (c) $\frac{-11}{7}$ (d) None of these	1
15	The equation of line passing through the point $(-2,4,-5)$ and parallel to the line $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$ is $(a)\ \frac{x-2}{3} = \frac{y-4}{5} = \frac{z-5}{6}$ (b) $\frac{x+2}{3} = \frac{y-4}{5} = \frac{z+5}{6}$ (c) $\frac{x+3}{-2} = \frac{y-4}{4} = \frac{z+8}{-5}$ (d) $\frac{x+2}{-2} = \frac{y-4}{4} = \frac{z+5}{-5}$	1
16	A linear programming problem is one that is concerned with (a) finding the optimal value (maximum or minimum) of a linear function of several variables. (b) finding the limiting values of a linear function of several variables (c) finding the lower limit of a linear function of several variables (d) finding the upper limits of a linear function of several variables.	1
17	Inequation y – x ≤ 0 represents (a) The half plane that contains the positive x-axis (b) Closed half plane above the line y = x, which contains positive y-axis (c) Half plane that contains the negative x-axis (d) None of these	1
18	If A and B are two events such that: P(A) = 0.40, P(B) = 0.35 and P(A U B) = 0.55, find P(B/A) is (a) $\frac{1}{2}$ (b)$\frac{4}{7}$ (c) $\frac{2}{7}$ (d) None of the above	1

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(a) **Both A and R are true and R is the correct explanation of A.**
(b) **Both A and R are true but 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):** The principal value branch of function $\cos^{-1} x$ is $[0, \pi]$ **Reason (R):** The value of $\cos^{-1}\left(\cos\frac{3\pi}{2}\right)$ is $\frac{3\pi}{2}$.	1
20	**Assertion (A):** Vector equation of a line which passes through two points whose position vector are $\vec{a}$ and $\vec{b}$ is $\vec{r} = \vec{a} + \lambda(\vec{b} - \vec{a})$. **Reason (R):** Vector equation of a line passing through the given point whose position vector is $\vec{a}$ and parallel to a given vector $\vec{b}$ is $\vec{r} = \vec{a} + \lambda\vec{b}$.	1

SECTION B

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

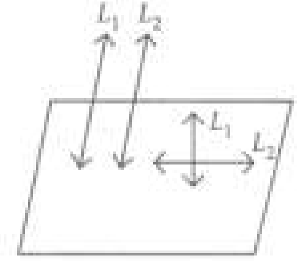
21	If the relation R is defined on a set A of people living in a Town by aRb, if and only if b lives within one kilometre from a, then check if the relation is reflexive, symmetric.	2
22	Find Derivative of $f(x) = tan^{-1}(\sqrt{1+x^2} + x)$ $with$ respect $to\ x.$ **OR** $If\ f(x) = \begin{cases} \frac{x^2-25}{x-5}, x \neq 5 \\ k \quad , x = 5 \end{cases}$ is continuous at x = 5 , find the value of k.	2
23	Integrate $\frac{2x}{x^2+3x+2}$.	2
24	Find the smaller area enclosed by the circle $x^2 + y^2 = 4$ and line x + y = 2. **OR** Find the area of the ellipse $x^2 + 9y^2 = 36$ using integration.	2
25	If $\vec{a}$ and $\vec{b}$ are vectors such that $\lvert\vec{a}\rvert = 2, \lvert\vec{b}\rvert = 3\ and\ \vec{a}.\vec{b} = 4$ then find $\lvert\vec{a} - \vec{b}\rvert$.	2

SECTION C

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26	If $x\sqrt{1+y} + y\sqrt{1+x} = 0\ and\ x \neq y\ , prove\ that\ \frac{dy}{dx} = -\frac{1}{(x+1)^2}$.	3
27	Integrate $\sqrt{x^2 + 4x + 6}$ OR Prove that $\int_0^{\frac{\pi}{2}} \frac{sin^2x}{sinx+cosx} dx = \frac{1}{\sqrt{2}}\log(\sqrt{2} + 1)$	3
28	Find the area of the minor segment of the circle $x^2 + y^2 = a^2$ cut off by the line $x = \frac{a}{\sqrt{2}}$.	3
29	Solve the differential equation $(\tan^{-1} y - x)dy = (1 + y^2)dx$ OR Solve the differential equation $\frac{dy}{dx} + 3y = e^{-2x}$	3

30	Solve the following problem graphically: Maximize Z = 3x+9y subject to x+3y $\leq 60, x + y \geq 10, x \leq y, x \geq 0, y \geq 0$	3
31	Two numbers are selected at random (without replacement) from the first six positive integers. Let X denote the larger of the two numbers obtained. Find E(X). **OR** Probability of solving specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$ respectively. If both try to solve the problem independently then find the probability that (a) The problem is solved (b) Exactly one of them solve the problem.	3
	SECTION D **(This section comprises of 4 long answer (LA) type questions of 5 marks each)**	
32	Let $A = R - \left\{\frac{3}{2}\right\}, B = R - \left\{\frac{3}{2}\right\}$. Let f : A → B be defined by f (x) = $\frac{3x-2}{2x-3}$ ∀ x ∈ A . Then show that f is bijective. **OR** Let n be a fixed positive integer. Define a relation R in Z as follows: ∀a, b ∈Z, aRb if and only if a – b is divisible by 4 . Show that R is an equivalence relation.	5
33	Find the the product $\begin{bmatrix} 1 & -2 & 0 \\ 2 & 1 & 3 \\ 0 & -2 & 1 \end{bmatrix} \begin{bmatrix} 7 & 2 & -6 \\ -2 & 1 & -3 \\ -4 & 2 & 5 \end{bmatrix}$ and using it solve the system of equations $x - 2y = 10,\ 2x + y + 3z = 8,\ -2y + z = 7.$	5
34	Evaluate:$I = \int \frac{1-x^2}{x(1-2x)} dx$ **OR** Evaluate: $\int_0^{\frac{\pi}{2}}(2\, logsin\, x - logsin\, 2\, x)dx.$	5
35	Find the shortest distance between $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$.	5
SECTION E (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)		
36	A student of class XII wants to construct a rectangular tank for his house that can hold 80 cubic feet of water. The top of the tank is open. The width of tank will be 5 ft but length and heights are variables. Building the tank cost Rs 20 per sq. ft for the base and Rs. 10 per square ft for the side.  Based on above information, answer the following: (i) Represent Total cost of tank as a function of h? (ii) What is the value of h at which the cost of tank is minimum?	1 1

	(iii) Find the least cost of tank? **OR** Find the total cost building the wall of tank.	2
37	If a_1, b_1, c_1 and a_2, b_2, c_2 are direction ratios of two lines say L_1 and L_2 respectively. Also, If l_1, m_1, n_1 and l_2, m_2, n_2 are direction cosines of two lines say L_1 and L_2 respectively. Based on the above information, answer the following questions  (a) What is the relation between the direction cosines of lines L1 and L_2, if L_1 is perpendicular to L_2? (b) What is the relation between the direction cosines of lines L1 and L_2, if L_1 is parallel to L_2? (c) Find the coordinates of the foot of the perpendicular drawn from the point A(1, 2, 1) to the line joining B(1, 4, 6) and C(5, 4, 4)? **OR** Find the direction ratios of the line which is perpendicular to the lines with direction ratios proportional to 4, -3, 5 and 3, 4,5.	1 1 2
38	In an office 3 employees Vinay, Sonia and Iqbal process incoming copies of a certain form. Vinay process 50 % of the forms. Sonia processes 20% and Iqbal the remaining 30% of the forms. Vinay has an error rate of 0.06. Sonia has an error rate of 0.04 and Iqbal has an error rate of 0.03  (i) What is the conditional probability that Sonia processes the form and an error is committed in processing? (ii) What is the total probability of committing an error in processing the form?	2 2

SAMPLE QUESTION PAPER- 02
2024-25
CLASS: XII
SUBJECT: MATHEMATICS (041)
MARKING SCHEME

<table>
<tr><th>Q. No .</th><th>Question
SECTION – A</th><th>Marks</th></tr>
<tr><td></td><td>
<table>
<tr><td>1</td><td>(a)</td><td>6</td><td>(a)</td><td>11</td><td>(c)</td><td>16</td><td>(a)</td></tr>
<tr><td>2</td><td>(d)</td><td>7</td><td>(a)</td><td>12</td><td>(a)</td><td>17</td><td>(b)</td></tr>
<tr><td>3</td><td>(c)</td><td>8</td><td>(b)</td><td>13</td><td>(a)</td><td>18</td><td>(a)</td></tr>
</table>
</td><td>20</td></tr>
</table>

4	(d)	9	(c)	14	**(d)**	19	**(c)**
5	(b)	10	(b)	15	**(b)**	20	**(a)**

	SECTION – B	
21	To show R is Reflexive. To show R is symmetric	1 1
22	$f(x) = \ tan^{-1}(\sqrt{1+x^2} \ + x)$ Simplest form of $f(x) = \frac{\pi}{4} + \frac{1}{2}\tan^{-1} x$ $f'(x) = \frac{1}{2(1+x^2)}$.	1 1
23	$\int \frac{2x}{x^2+3x+2}.\mathrm{dx} = \int \frac{2x}{(x+1)(x+2)} dx,$ $\frac{2x}{(x+1)(x+2)} = \frac{-2}{x+1} + \frac{4}{x+2},$ $\int \left[\frac{-2}{x+1} + \frac{4}{x+2}\right] dx = -2\log(x+1) + 4\log(x+2) + c.$	½ ½ 1
24	For correct Figure For finding Shaded Area = $\pi - 2$. **OR** For correct Figure For finding Shaded Area = 12π.	1 1 1 1
25	$\left\|\vec{a} - \vec{b}\right\|^2 = (\vec{a} - \vec{b}) = \|\vec{a}\|^2 + \left\|\vec{b}\right\|^2 - 2\vec{a}.\vec{b} = 4 + 9 - 8 = 5.$ $\left\|\vec{a} - \vec{b}\right\| = \sqrt{5}.$	1+1/2 1/2
	SECTION C	
26	$x\sqrt{1+y} = -y\sqrt{1+x}$ On squaring and simplification Correct derivative	1 1 1
27	$\int \sqrt{x^2 + 4x + 6}\, dx = \int \sqrt{(x+2)^2 + 2}\, dx$ $= \frac{x+2}{2}\sqrt{x^2+4x+6} + \log\left\|x + 2 + \sqrt{x^2+4x+6}\right\|$	1+1/2 1+1/2
28	For correct Figure For finding Shaded Area = $\frac{(\pi+2)}{4}a^2$.	1 2
29	For correct Integrating Factor For correct solution $x = \tan^{-1} y - 1 + ce^{-tan^{-1}y}$ **OR** For correct Integrating Factor For correct solution $e^{3x}y = e^x + c$.	1 2 1 2
30	Correct figure Shading correct feasible Region	1 1

	For Maximum value of Z.	1
31	For correct table For correct $E(x) = \frac{14}{3}$ **OR** (a) $P(Problem\ will\ be\ solved) = \frac{2}{3}$ (b) $P(\text{Exactly one of them solve the problem}) = \frac{1}{2}$	2 1 1+1/21 +1/2
	SECTION D	
32	For ONE -ONE For Onto:- **OR** **Reflexivity:** R is reflexive. **Symmetry:** R is symmetric **Transitivity:** R is transitive ∴R is Equivalence Relation.	2.5 2.5 1.5 1.5 2
33	For correct multiplication of matrices For correct inverse of coefficient matrix For correct solution $(x = 4, y = -3, z = 1)$.	1 2 2
34	$\frac{1-x^2}{x(1-2x)}$ *is an improper rational function, which can be rewritten as* $\frac{1-x^2}{x(1-2x)} = \frac{1}{2} + \frac{-\frac{x}{2}+1}{x(1-2x)}$ $\frac{-\frac{x}{2}+1}{x(1-2x)}=\frac{A}{x}+\frac{B}{(1-2x)}$ x−2=A(1−2x) +Bx On comparing of coefficient of x and constant, we get A=−2 and B=−3 $\frac{-\frac{x}{2}+1}{x(1-2x)}=\frac{-2}{x}+\frac{-3}{(1-2x)}$ $\int \frac{\frac{-x}{2}+1}{x(1-2x)}$dx = $\int \frac{-2}{x}\,dx + \int \frac{-3}{(1-2x)}\,dx$ $I = -2\,logx - 3\,\frac{\log(1-2x)}{-2} + c$ $I = -2\,logx + \frac{3}{2}log(1-2x) + c$ $I = \frac{x}{2} - 2\,logx + \frac{3}{2}log(1-2x) + c$	

	OR $\int_0^{\frac{\pi}{2}}(2\,logsin\,x - logsin\,2\,x)dx$ $I = \int_0^{\frac{\pi}{2}} log\left(\frac{sin^2 x}{2\,sin\,x\,cos\,x}\right)dx$ $I = \int_0^{\frac{\pi}{2}} log\left(\frac{tan\,x}{2}\right)dx$ $I = \int_0^{\frac{\pi}{2}} log\left(\frac{tan\left(\frac{\pi}{2}-x\right)}{2}\right)dx = I = \int_0^{\frac{\pi}{2}} log\left(\frac{cot\,x}{2}\right)dx$ $2I = \int_0^{\frac{\pi}{2}} \log\left(\frac{\tan x}{2}\right)\left(\frac{\cot x}{2}\right)dx = \int_0^{\frac{\pi}{2}} \log\left(\frac{1}{4}\right)dx$ $I = \frac{\pi}{4} log\left(\frac{\pi}{4}\right).$	
35	Correct formula Correct Answer	1 4
	SECTION E	
36	(a) $C(h) = 100\,h + 320 + \frac{1600}{h}$ (b) For $h = 4$ (c) 1120 **OR** 720	1 1 2
37	(a) $l_1l_2 + m_1m_2 + n_1n_2 = 1$ (b) $\frac{l_1}{l_2} = \frac{m_1}{m_2} = \frac{n_1}{n_2}$ **(c)** (3, 4, 5) OR The direction ratios of the line perpendicular to the lines with direction ratios proportional to 4, -3, 5 and 3, 4,5 are -5, -7, 7.	1 1 2
38	(i) 0.04 (ii) 0.045	2 2

SAMPLE PAPER 03 (2024-25)

BLUE PRINT

CLASS- XII **SUBJECT- MATHEMATICS (041)**

Time Allowed: - 3:00 Hours **Maximum marks: - 80**

S.NO	Name of Chapter	(MCQs & Assertion-Reason based) (1 mark)	VSA (2 Marks questions)	SA (3 Marks questions)	LA 5 Marks questions	(Case study-based question) (4 Marks)	TOTAL	UNIT WISE TOTAL
1	Relations and Functions	1(1)	-----	-----	1* (5)	-----	2 (6)	3 (8)
2	Inverse Trigonometric Functions		1* (2)	-----	-----	-----	1 (2)	
3	Matrices	1(1)	1(2)	-----	-----	-----	2(3)	6 (10)
4	Determinants	1 (1)+ 1(AS-R)(1)	-----	-----	1 (5)	-----	3 (7)	
5	Continuity and Differentiability	2 (2)	1*(2)	1 (3)	-----	-----	4 (7)	16 (35)
6	Applications of Derivatives	2(2)	1 (2)	-----	-----	1 (4) (1+1+2)	4(8)	
7	Integrals	2(2)	1 (2)	1 (3) +1*(3)	-----	-----	5(10)	
8	Applications of Integrals	-----	-----	-----	1 (5)	-----	1 (5)	
9	Differential equations	2 (2)	-----	1* (3)	-----	-----	3 (5)	
10	Vector Algebra	2(2)	-----	------	-----	1 (4) (1+1+2*)	3 (6)	7 (14)
11	Three-Dimensional Geometry	2(2) + 1(AS-R)(1)	----	-----	1* (5)	-----	4 (8)	
12	Linear Programming	2 (2)	-----	1(3)	-----	-----	3 (5)	

13	**Probability**	**1 (1)**	**-----**	**1* (3)**	**-----**	**1 (4) (1+1+2*)**	**3 (8)**	**6 (13)**
TOTAL		**20 (20)**	**5 (10)**	**6 (18)**	**4 (20)**	**3 (12)**	**38(80)**	**38 (80)**

 # No. of questions (Marks)   * Internal Choice Questions,   AS-R = Assertion-Reason

SAMPLE QUESTION PAPER-03 (2024-25)

SUBJECT: MATHEMATICS (041)

Time: - 3 Hours   CLASS: XII   Max Marks: - 80

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 (VSA)-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 calculator is not allowed.

Q No	**SECTION A** (This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18):	**Ms**
1	Set A has 3 elements and Set B has 5 elements. Then the number of injective functions that can be defined from set A to set B are (a) 15 (b) 64 (c) 60 (d) 20	1
2	The degree of the differential equation:$\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^2 = xsin\left(\frac{d^2y}{dx^2}\right)$ (a)1 (b)2 (c)3 (d)Not defined	1
3	The unit vector perpendicular to the vectors $\hat{\imath} + \hat{\jmath}$ and $\hat{\imath} - \hat{\jmath}$ forming a right-handed system is : (a) $\hat{k}$ (b) $-\hat{k}$ (c) $\frac{\hat{k}}{2}$ (d) $-\frac{\hat{k}}{2}$	1
4	The point which does not lie in the half plane $x - 2y - 1 \leq 0$ is (a) (1,2) (b) (4,1) (c) (0,2) (d) (-3,2)	1

5	The angle between the lines passing through the points of first line $(6,7,8),(4,3,4)$ and points of second line $(-2,-2,1),(0,2,5)$ is (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) 0° (d) $\frac{\pi}{6}$	1
6	$\int_0^{\frac{1}{\sqrt{2}}} \frac{dx}{\sqrt{2-x^2}}$ *is equal to* $(a)\frac{\pi}{3}$ $(b)\frac{\pi}{6}$ $(c)\frac{\pi}{2}$ $(d)\frac{\pi}{4}$	1
7	If the matrix A is both symmetric and skew symmetric, then (a) A is a diagonal matrix (b) A is a zero matrix (c) A is a scalar matrix (d) None of these	1
8	If P(B)=$\frac{3}{5}, P\left(\frac{A}{B}\right)=\frac{1}{2} and\ P(AUB)=\frac{4}{5}$,then P$(A\cap B)'$= (a) 3/10 (b) 7/10 (c)2/5 (d) None of these	1
9	The difference between Max. Z and Min. Z, where Z = 5x – 3y and corner points of feasible solution region are $(5,5),(0,10),(0,20),(15,15)$: (a) - 30 (b) 10 (c) 90 (d) 30	1
10	The solution of the differential equation $\frac{dy}{dx}=\frac{x+y}{x}$ satisfying the condition is (a) $y = xlogx + Cx$ (b) $y = logx + x + C$ (c) $y = xlogx + x^2 + C$ (d) $y = xe^{x-1} + C$	1
11	Find the area of a parallelogram whose diagonals are given by $2\hat{i}$ and $5\hat{j}$ (a) 5 (b) 10 (c)20 (d)2.5	1
12	If lines $\frac{x-2}{3}=\frac{y-4}{-8}=\frac{z-6}{3k}$ and $\frac{x-1}{k}=\frac{y-3}{3}=\frac{z-5}{5}$ are mutually perpendicular then k is equal to (a) $\frac{-3}{4}$ (b)$\frac{4}{3}$ (c) $\frac{3}{4}$ (d) $\frac{-4}{3}$	1
13	The point(s) on the curve y=x^2,at which y- coordinate is changing 5 times as fast as x-coordinate is/are $(a)(5,25)$ $(b)\left(\frac{5}{2},\frac{25}{4}\right)$ $(c)\left(\frac{3}{2},\frac{9}{4}\right)$ $(d)(3,9)$	1
14	*The value of* $\int \frac{\sqrt{tanx}}{sinxcosx}dx$ *is* $(a)\ 2\sqrt{tanx} + C$ $(b)\ 2\sqrt{sinx} + C$ $(c)2\sqrt{secx} + C$ $(d)2tanx + C$	1
15	The equation of line passing through (–7, 8) and (5, 2) is (a) $x + 2y - 9 = 0$ (b) $5x - y - 27 = 0$ (c) $x - 2y + 9 = 0$ (d) $5x + y - 27 = 0$	1
16	*The interval on which the function* $f(x) = 2x^3 + 9x^2 + 12x - 1$ *decreasing is* $(a)\ [-2,-1]$ $(b)\ [-1,\infty]$ $(c)[-\infty,-2]$ $(d)[-1,1]$	1
17	If $f(x) = \log(\log x)$, then derivative of *f(x)* at *x* = *e* is: (a) 1 (b) *e* (c) 0 (d) *1/e*	1

18	If $f(x)=\begin{cases}\frac{sinx}{2x}, x\neq 0\\ k, x=0\end{cases}$ is continuous at x = 0, then the value of k is : (a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) 0	1

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

® A is true but R is false.

(d) A is false but R is true.

19	**Assertion (A) :** If a line makes an angle of $30^\circ, 60^\circ, 90^\circ$ with the positive direction of x, y, z axes respectively , then its direction cosines are $< \frac{\sqrt{3}}{2}, \frac{1}{2}, 0 >$. **Reason (R) :** Angle between the two lines $\frac{x-2}{3}=\frac{y+1}{-2}, z=2$ and $\frac{x-1}{1}=\frac{y+3}{3}=\frac{z+5}{3}$ is $\mathbf{90^\circ}$**.**	1
20	**Assertion(A)** : The matrix $\begin{bmatrix}8 & -1 & -1\\ 3 & 1 & 2\\ 1 & 4 & 7\end{bmatrix}$ is singular. **Reason(R)** : The value of determinant of matrix A is zero.	1

SECTION B

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	Find: $\int \frac{xe^x - e^x}{x^2}$ dx	2
22	Find The value of $cos^{-1}(cos\ \frac{5\pi}{3}) + sin^{-1}(sin\ \frac{5\pi}{3})$. **OR** Find the domain of $cos^{-1}[x]$. Where $[x]$ denotes the greatest integer function.	2
23	On the occasion of Deepawali a child lightens the rocket which is moving in a straight line in such a way that its distance in meter from a fixed point on the line after t second is given by $3t^3 + 2t + 7$.Find the velocity at the end of 5 seconds.	2
24	If the function $f(x) = \begin{cases}\frac{x^2}{a}, & 0 \le x < 1\\ -1, & 1 \le x < \sqrt{2}\\ \frac{2b^2-4b}{x^2}, & \sqrt{2} \le x < \infty\end{cases}$ is continuous in[0,∞), then find the value of a and b **OR** Differentiate $log_7(log_e x)$ with respect to x	2
25	$If\ A = \begin{bmatrix}2 & -2\\ -2 & 2\end{bmatrix}\ and\ A^2 = kA\ then\ write\ the\ value\ of\ k$	2

	SECTION C **(This section comprises of 6 short answer type questions (SA) of 3 marks each)**	
26	Find the general solution of differential equation: $(x + 2y^{3)}\frac{dy}{dx} = y$ OR Solve the differential equation: x dy – y dx = $\sqrt{x^2 - y^2}$ dx.	3
27	A die is thrown twice and the sum of the numbers appearing is observed to be 6. what is the conditional probability that the number 4 has appeared at least once.	3
28	Maximize $Z=8x+9y$ subject to the constraints given below: $2x+3y \leq 6,\ 3x - 2y \leq 6,\ y \leq 1$ and $x, y \geq 0$	3
29	$Evaluate \int \frac{x}{\sqrt{x}+1} dx$ OR Evaluate: $\int \frac{dx}{\sqrt{3x^2+6x+12}}$	3
30	If $x = ae^{\theta}(sin\theta + \cos\theta)$ and $y = ae^{\theta}(sin\theta - \cos\theta)$, prove that $\frac{dy}{dx} = \frac{x+y}{x-y}$.	3
31	$Evaluate \int \frac{cos5x + cos4x}{1 - 2cos3x} dx$ **OR** $Evaluate \int_0^{\pi} xlogsinx\, dx$	3
	SECTION D **(This section comprises of 4 long answer (LA) type questions of 5 marks each**	
32	Find the area of the region included between the parabola $2y = 3x^2$ and the line $x - 2y + 10 = 0$	5
33	An insect is crawling along the line $\vec{r} = 6\hat{i} + 2\hat{j} + 2\hat{k} + \lambda(\hat{i} -2\hat{j} +2\hat{k})$ and another insect is crawling along the line $\vec{r} = -4\hat{i} - \hat{k} + \mu(3\hat{i} -2\hat{j} +2\hat{k})$. At what points on the lines should they reach so that the distance between them is the shortest? Find the shortest possible distance between them. **OR** The equations of motion of a rocket are : $x = 2t, y = -4t, z = 4t$, where the time t is given in seconds, and the coordinates of a moving point in km. What is the path of the rocket? At what distances will the rocket be from the starting point $O(0, 0, 0)$ and from the following line in 10 seconds? $\vec{r} = 20\hat{i} - 10\hat{j} + 40\hat{k} + \mu(10\hat{i} -20\hat{j} +10\hat{k})$.	5
34	Prove that the function f(x) = $\frac{x}{x^2+1}$ *such that* f: R→ $[\frac{-1}{2}, \frac{1}{2}]$ is one- one and onto function. Find the images of 3 and 4 and pre-image of -1 . **OR** Show that the relation R defined in the set of natural numbers is defined by (a,b) R(c,d) $if\ \frac{1}{c} + \frac{1}{b} = \frac{1}{d} + \frac{1}{a}$.Show that R is and equivalence relation .Also find the equivalence class of (3,4) .	5

35	If A=$\begin{bmatrix}1 & -1 & 1\\ 2 & 1 & -3\\ 1 & 1 & 1\end{bmatrix}$ and B=$\begin{bmatrix}4 & 2 & 2\\ -5 & 0 & 5\\ 1 & -2 & 3\end{bmatrix}$,find AB Hence, solve the system of equations: $\frac{1}{x}$ - $\frac{1}{y}$ + $\frac{1}{z}$ =4, $\frac{2}{x}$ + $\frac{1}{y}$ - $\frac{3}{z}$ =0 and $\frac{1}{x}$ + $\frac{1}{y}$ + $\frac{1}{z}$ = 2	5
	SECTION E (This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)	
36	Solar Panels have to be installed carefully so that the tilt of the roof, and the direction to the sun, produce the largest possible electrical power in the solar panels. A surveyor uses his instrument to determine the coordinates of the four corners of a roof where solar panels are to be mounted. In the picture, suppose the points are labelled the roof corner nearest to the camera in units of meters P_1 (6,8,4), P_2 (21,8,4), P_3 (21,16,10) and P_4 (6,16,10).  (i) What are the components to the two edge vectors defined by $\vec{A}$ = PV of P_2 – PV of P_1 and position vector $\vec{B}$ = PV of P_4 – PV of P_1? (where PV stands for position vector) (ii) What are the magnitudes of the vectors $\overrightarrow{A}$ and $\vec{B}$. (iii) What are the components to the vector $\vec{N}$ $\left(where\ \lvert\vec{N}\rvert = 150\right)$, perpendicular to $\vec{A}$ and $\overrightarrow{B}$ and the surface of the roof? **OR** The sun is located along the unit vector $\vec{S} = \tfrac{1}{2}\,\hat{\imath} - 6/7\hat{\jmath} + 1/7\,\hat{k}$. If the flow of solar energy is given by the vector $\vec{F}$ = 910 $\vec{S}$ in units of watts/meter ^{2}, what is the dot product of vectors $\vec{F}\ with\ \overrightarrow{N}$.	1 1 2
37	P(x) = $-5x^2 + 125x + 37500$ is the total profit function of a company, where x is the production of the company.  **Based on given information, answer the following questions:** (i) What will be the production when the profit is maximum? **OR** What will be the maximum profit? (ii) When the production is 2 units, what will be the profit of the company (iii) What will be production of the company when the profit is Rs. 38250	1 1 2

38	Aditya, Bhaskar & Ravi graduated from IIM and the chances of being selected as the, manager of a firm is 4:1:2 respectively. The respective probability for them to introduce a change in marketing strategy are 0.3, 0.8 & 0.5 respectively. Let E1, E2 & E3 be the event that Aditya, Bhaskar & Ravi be selected and A be the event change does takes place. Based on above information, answer the following:  (1) Write the probability of selection of Aditya. (2) Write the probability that the change took place due to appointment of Bhaskar.	2 2

Sample Paper 03

Marking scheme 2024-25

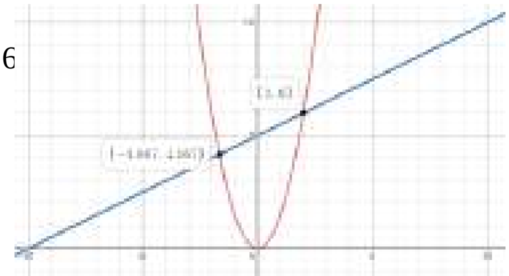
Class: XII **Subject: Mathematics**

Section: A (MCQs of 1 Mark each)							
1	(c)	6	(c)	11	(b)	16	(a)
2	(d)	7	(b)	12	(b)	17	(d)
3	(a)	8	(b)	13	(b)	18	(b)
4	(b)	9	(c)	14	(a)	19	(b)
5	(c)	10	(a)	15	(a)	20	(a)

Section: B (VSA of 2 Marks each)		
21	$\int \frac{xe^x-e^x}{x^2}$ dx = $\int e^x(\frac{1}{x}-\frac{1}{x^2})$dx $=\frac{1}{x}e^x$	1 1
22	$= cos^{-1}(\cos(2\pi-\frac{5\pi}{3}) + sin^{-1}(\sin(2\pi-\frac{5\pi}{3})$ $= cos^{-1}(\cos(\frac{\pi}{3}) + sin^{-1}(-\sin(\frac{\pi}{3})$ $=\frac{\pi}{3}-\frac{\pi}{3}=0$ **OR** $-1 \le [x] \le 1 \;\Rightarrow -1 \le x < 2 \;\Rightarrow x\, \epsilon\, [-1,2)$.	½ 1 ½ 1+1
23	$y = 3t^3 + 2t + 7$ Velocity, v = $\frac{dy}{dt}$ = $9t^2 + 2$ Velocity after 5 seconds 227 metre/sec	½ 1 ½
24	Since f(x) is continuous in [0,∞), the $\lim_{x\to 1}\frac{x^2}{a}$ =-1 .⇒ a=-1	1

	And $\lim_{x\to\sqrt{2}} \frac{2b^2-4b}{x^2}$ =-1 .⇒ $\lim_{x\to\sqrt{2}} \frac{2b^2-4b}{2}$ =-1 .⇒ $2b^2-4b=-2$.⇒ $2b^2-4b+2$=0 .⇒ $2(b-1)^2$=0 .⇒ $b=1$ **OR** Y=$log_7(log_e x)$ y=$\frac{\log_e(log_e x)}{\log_e 7}$.$\frac{dy}{dx}=\frac{1}{(\mathbf{log_e\ 7})\boldsymbol{x}(\mathbf{log_e}\ \boldsymbol{x})}=\frac{1}{xlog_e(7x)}$	1 1 1
25	A^2=$\begin{bmatrix} 8 & -8 \\ -8 & 8 \end{bmatrix}$ =4$\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$ =4A K=4	**1** **1**
	Section: C (SA of 3 Marks each)	
26	$\frac{dx}{dy}-\frac{x}{y}=2y^3$ (L.D.E.) I.F. = $e^{\int -\frac{1}{y}dy}=\frac{1}{y}$ Solution is: $x\frac{1}{y}=\int 2y^3.\frac{1}{y}dy$ $\frac{x}{y}=\frac{2}{3}y^3+C$ **OR** $\frac{dy}{dx}=\frac{y+\sqrt{x^2-y^2}}{x}$ Homogeneous diff. Equation Let y = vx then $v+x\frac{dv}{dx}=v+\sqrt{1-v^2}$ $\frac{dv}{\sqrt{1-v^2}}=\frac{dx}{x}$ $\sin^{-1}v=\log x+C$ $\sin^{-1}\frac{y}{x}=\log x+C$	1 1 1 1 ½ ½ 1
27	Total events =36 E=getting sum of numbers on both dice is 6	

	F= number 4 had appeared at least once E={(1,5)(5,1)(2,4)(4,2)(3,3)} F= {(1,4)(2,4)(3.4)(4,1)(4,2)(4.3)(4,4)(4,5)(4,6)(5,4)(6,4)} E∩F={(2,4)(4,2)} P(E∩F)=2/36;P(E)=11/36 P($\frac{E}{F}$)=$\frac{P(E)}{P(E\cap F)}$=2/11	2 1
28	Correct feasible region Solving equations and correct corner points	1.5 1.5
29	Let $\sqrt{x}+1=t$ => $\sqrt{x}=t-1$ =>x=$(t-1)^2$ =>dx=2(t-1) => $\int\frac{x}{\sqrt{x}+1}dx \quad = \int\frac{2(t-1)^3}{t}dt$ =$\int 2(t^2-\frac{1}{t}-3t+3)dt$ =2($\frac{t^3}{3}$ -logt- $\frac{3t^2}{2}$ +3t) +C =2[$\frac{(\sqrt{x}-1)^3}{3}$ - log($\sqrt{x}-1$) - $\frac{3(\sqrt{x}-1)^2}{2}$ +3($\sqrt{x}-1$)] +C **OR** Sol. I= $\frac{1}{\sqrt{3}}\int\frac{dx}{\sqrt{x^2+2x+4}}=\frac{1}{\sqrt{3}}\int\frac{dx}{\sqrt{(x+1)^2+(\sqrt{3})^2}}=\frac{1}{\sqrt{3}}\int\frac{dx}{\sqrt{(t)^2+(\sqrt{3})^2}}$ (put x+1=t => dx=dt) = $\frac{1}{\sqrt{3}}\log\lvert t+\sqrt{t^2+3}\rvert+c$ = $\frac{1}{\sqrt{3}}\log\lvert (x+1)+\sqrt{x^2+2x+4}\rvert+c$	1 1 1
30	$x=ae^{\theta}(sin\theta+\cos\theta) \Rightarrow \frac{dx}{d\theta}=2ae^{\theta}\cos\theta$ and $y=ae^{\theta}(sin\theta-\cos\theta) \Rightarrow \frac{dy}{d\theta}=2ae^{\theta}\sin\theta$ $\frac{dy}{dx}=\frac{2ae^{\theta}\sin\theta}{2ae^{\theta}\cos\theta} \Rightarrow \frac{dy}{dx}=tan\theta \quad ----(1)$ and $\frac{x+y}{x-y}=\frac{ae^{\theta}(sin\theta+\cos\theta)+ae^{\theta}(sin\theta-\cos\theta)}{ae^{\theta}(sin\theta+\cos\theta)-ae^{\theta}(sin\theta-\cos\theta)}=tan\theta ------(2)$ From (1) & (2) $\frac{d\,y}{dx}=\frac{x+y}{x-y}$.	1 1 1
31	I=$\int\frac{cos5x+cos4x}{1-2cos3x}\,dx$	1

	$=\int \frac{2cos\frac{9x}{2}cos\frac{x}{2}}{3-4cos^2(\frac{3x}{2})}\ dx$ Divide and multiply by cos$\frac{3x}{2}$ I=$\int \frac{2cos\frac{9x}{2}cos\frac{x}{2}\cos\frac{3x}{2}}{3\cos\frac{3x}{2}-4cos^3(\frac{3x}{2})}\ dx$ $=-\int \frac{2cos\frac{9x}{2}cos\frac{x}{2}\cos\frac{3x}{2}}{cos\frac{9x}{2}}\ dx$ $=-\int(cos2x+cosx)dx$ $=-\frac{sin2x}{2}$ – sinx +C **OR** Let I=$\int_0^{\pi} xlogsinx\ dx$……(1) Using P4 I=$\int_0^{\pi}(\pi-x))logsinx\ dx$…..(2) Adding 1 and 2 2I=$\pi\int_0^{\pi} logsinx\ dx$ Using P6 I=2.$\frac{\pi}{2}\int_0^{\frac{\pi}{2}} logsinx\ dx$ I=$\pi\int_0^{\frac{\pi}{2}} logsinx\ dx$ I=$\pi(-\frac{\pi}{2}$ log2) I=$-\frac{\pi^2}{2}$ log2	1 1 1 1 1
Section: D (LA of 5 Marks each)		
32	Graph of curve and line Intersecting points (-5/3 , 25/6) and (2,6 Correct integral and limit Solving integral Actual answer  	1.5 0.5 1 1.5 0.5
33	$\mu-3\lambda=4$ and $17\mu-3\lambda=20 \Rightarrow\ \mu=1\ and\ \lambda=-1$ PV of the points at which they meet so that the distance between them is the shortest are $5\hat{\imath}+4\hat{\jmath}$ and -$\hat{\imath}-2\hat{\jmath}-3\hat{k}$ $\overrightarrow{PQ}=-\widehat{6\iota}-6\hat{\jmath}-3\hat{k}$ SD = 9 units **OR** Equation of Path $\frac{x}{2}=\frac{y}{-4}=\frac{z}{4}$ d.r.s. 2,-4,4 When t=10 sec ,$x=20\ ,y=-40\ ,z=40$ So the rocket will be at the point P(20,-40,40) , OP = 60 km	2.5 1 1 0.5 1.5 1

	Distance = $10\sqrt{3}$	1 1.5
34	For one-one Let f(x_1)=f(x_2) .$\frac{x_1}{{x_1}^2+1} = \frac{x_2}{{x_2}^2+1}$ ($x_1 - x_2$)(1 − x_1x_2)=0 .$x_1 = x_2$ Therefore f(x) is one-one For onto Let y=$\frac{x}{x^2+1}$.⇒ $y(x^2+1)$=x .⇒ $yx^2 - x + 1$=0 For real roots D≥ 0 1-4$y^2 \geq 0$ y∈ [$-\frac{1}{2}$,$\frac{1}{2}$] =Codomain. Therefore, function is onto also Images of 3 are f(3)=3/10 and f(4)=4/17 Preimage of -1 -1=$\frac{x}{x^2+1}$ x^2+x+1=0 which gives non-real roots. Therefore, no preimage of -1 exists **OR** (a,b) R(c,d) $if\ \frac{1}{c}+\frac{1}{b}=\frac{1}{d}+\frac{1}{a}$ For reflexive (a,b) R(a,b) .$\frac{1}{a}+\frac{1}{b}=\frac{1}{a}+\frac{1}{b}$ For symmetric (c,d) R(a,b) . $\frac{1}{a}+\frac{1}{d}=\frac{1}{c}+\frac{1}{b}$ For transitive (a,b) R(c,d) $if\ \frac{1}{c}+\frac{1}{b}=\frac{1}{d}+\frac{1}{a}$…………..(1) Let (c,d)$R(e,f)\ if\ \frac{1}{e}+\frac{1}{d}=\frac{1}{c}+\frac{1}{f}$……(2) Adding (1) and (2) we get $\frac{1}{e}+\frac{1}{b}=\frac{1}{a}+\frac{1}{f}\ldots$ Which implies (a,b) R (e,f) Therefore, transitive also Above relation is a n equivalence relation Equivalence class of (3,4) is (4,3)	1 2 1 1 1 1 2 1
35	AB=$\begin{bmatrix}1&-1&1\\2&1&-3\\1&1&1\end{bmatrix}\begin{bmatrix}4&2&2\\-5&0&5\\1&-2&3\end{bmatrix}$.⇒AB= 10 I .⇒ A($\frac{B}{10}$)=I .⇒A($\frac{B}{10}$)=I	2

	.⇒AA^{-1}=I .⇒ $A^{-1} = \frac{B}{10}$.⇒ $A^{-1} = \frac{1}{10}\begin{bmatrix}4 & 2 & 2\\-5 & 0 & 5\\1 & -2 & 3\end{bmatrix}$.⇒ $\begin{bmatrix}1 & -1 & 1\\2 & 1 & -3\\1 & 1 & 1\end{bmatrix}\begin{bmatrix}\frac{1}{x}\\\frac{1}{y}\\\frac{1}{z}\end{bmatrix}=\begin{bmatrix}4\\0\\2\end{bmatrix}$.⇒ $x = 1/2\ ; y = -1\ and\ z = 1$	1.5 1.5
Section: E (CS Based of 4Marks each)		
36	(i) 15, 0, 0 ; 0, 8, 6 (ii) Answer : 00$\sqrt{15^2}$ = 15 unit , & $\sqrt{8^2 + 6^2} = \sqrt{64 + 36} = \sqrt{100}$ = 10 unit (iii) $\vec{N} = A \times \vec{B} \Rightarrow \vec{N} = \begin{vmatrix}i & j & k\\15 & 0 & 0\\0 & 8 & 6\end{vmatrix}$ = -15(6j-8k) = -90j+120k ; 0, -90 , 120 & Here $\lvert\vec{N}\rvert$ = $\sqrt{90^2 + 120^2}$ = $\sqrt{22500}$ = 150 **OR** $\vec{F} = 910\ (1/2\hat{\imath} - 6/7\hat{\jmath} + 1/7\hat{k}) = 455\hat{\imath} - 780\hat{\jmath} + 130\hat{k}$. The dot product is just $\vec{F} \cdot \vec{N}$ = $455 \times (0) - 780 \times (-90) + 130 \times 120$ = 85,800 watts. From the definition of dot product: $\vec{F} \cdot \vec{N} = \lvert\vec{F}\rvert\lvert\vec{N}\rvert$cosθ Then since $\lvert\vec{F}\rvert$ = 910 and $\lvert\vec{N}\rvert$ = 150 and $\vec{F} \cdot \vec{N}$ = 85,800.	1 1 2 1 1 2
37	(i) $P'(x) = -10x + 125 = 0$ $x = 12.5$ **OR** P(12.5) = Rs. 38281.25 (ii) P(2) = 37730 (iii) 38250 = $-5x^2 + 125x + 37500$ $5x^2 - 125x + 750 = 0$ x=15 or x=10	1 1 2
38	(1) 4/7 (2) 4/15	2 2

SAMPLE QESTION PAPER -04 (2024-25)

SUBJECT: MATHEMATICS (041)

Time: - 3 Hours **CLASS: XII** **Max Marks: - 80**

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 (VSA)-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.

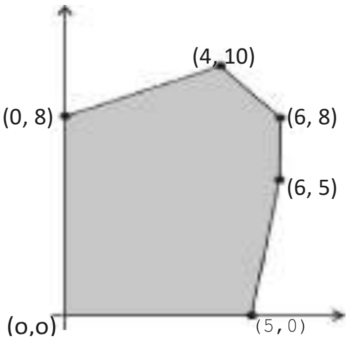
(vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.

(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 calculator is not allowed.

Q. No.	**SECTION A** (This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18):	**Marks**
1	The number of all possible matrices of order 3 × 3 with each entry 0 or 1 is: (a) 27 (b) 18 (c) 81 (d) 512	1
2	If A = [a_{ij}] is a symmetric matrix of order n, then (a) $a_{ij} = 1/a_{ij}$ for all i,j (b) $a_{ij} \neq 0$ for all i,j (c) $a_{ij} = a_{ji}$ for all i,j (d) $a_{ij} = 0$ for all i, j	1
3	Let A be a nonsingular square matrix of order 3 × 3. Then |*adj* A| is equal to (a) |A| (b) $\|A\|^2$ (c) $\| A\|^3$ (d) 3|A|	1
4	The area of a triangle with vertices (–3, 0), (3, 0) and (0, *k*) is 9 sq. units. The value of *k* will be (a) 9 (b) 3 (c) – 9 (d) 6	1
5	If A and B are invertible matrices, then which of the following is not correct? (a) *adj* A = |A|. A^{-1} (b) $\det(A)^{-1} = [\det (A)]^{-1}$ (c) $(AB)^{-1} = B^{-1} A^{-1}$ (d) $(A + B)^{-1} = B^{-1} + A^{-1}$	1
6	The function *f* (*x*) = [*x*], where [*x*] denotes the greatest integer function, is continuous at (a) 4 (b) – 2 (c) 1 (d) 1.5	1
7	Differential coefficient of sec ($\tan^{-1}x$) w.r.t. *x* is (a) $\frac{x}{\sqrt{1+x^2}}$ (b) $\frac{x}{1+x^2}$(c) $x\sqrt{1+x^2}$ (d) $\frac{1}{\sqrt{1+x^2}}$	1
8	The rate of change of the area of a circle with respect to its radius *r* at *r* = 6 cm is (a) 10 π (b) 12 π (c) 8 π (d) 11 π	1

9	On which of the following intervals is the function f given by $f(x) = x^{100} + \sin x - 1$ decreasing? (a) (0,1) (b) $(\frac{\pi}{2}, \pi)$ (c) $(0, \frac{\pi}{2})$ (d) None of these	1
10	$\int \frac{dx}{sin^2xcos^2x}$ $is\ equal\ to$ (a) $\tan x + \cot x + c$ (b) $\sin x + \cos x + c$ (c) $\tan x - \cot x + c$ (d) $\sin x - \cos x + c$	1
11	The value of $\int_a^{-a} \sin^3 x \, dx$ is (a) a (b) a/3 (c) 1 (d) 0	1
12	The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0\ is$ (a) 3 (b) 2 (c) 1 (d) not defined	1
13	A homogeneous differential equation of the from $\frac{dy}{dx} = h\left(\frac{x}{y}\right)x$ can be solved by making the substitution. (a) $y = vx$ (b) $v = yx$ (c) $x = vy$ (d) $x = v$	1
14	If is $\vec{a}$ nonzero vector of magnitude 'a' and λ a nonzero scalar, then $\lambda\vec{a}$ is unit vector if (a) $\lambda = 1$ (b) $\lambda = -1$ (c) $a = \lvert \lambda \rvert$ (d) $a = \frac{1}{\lvert\lambda\rvert}$	1
15	The coordinates of the foot of the perpendicular drawn from the point (2, 5, 7) on the x-axis are given by (a) (2, 0, 0) (b) (0, 5, 0) (c) (0, 0, 7) (d) (0, 5, 7)	1
16	The feasible solution for a LPP is shown in given figure. Let Z=3x-4y be the objective function. Minimum of Z occurs at e) (0,0) f) (0,8) g) (5,0) h) (4,10)  	1
17	Region represented by $x \geq 0, y \geq 0$ is: (a) First quadrant (b) Second quadrant (c) Third quadrant (d) Fourth quadrant	1
18	If A and B are two events such that P(A)+P(B)- P(A and B)=P(A), then (b) P(B/A) =1 (b) P(A/B) =1 (c) P(A/B) =0 (d) P(B/A) =0	1

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(d) **Both A and R are true and R is the correct explanation of A.**
(e) **Both A and R are true but R is not the correct explanation of A.**
(f) **A is true but R is false.**
(g) **A is false but R is true.**

19	A: The Principal value of $\cos^{-1}\left(-\frac{1}{\sqrt{2}}\right) + 2\ \sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ is equal to $\frac{5\pi}{4}$ R: If domain of $\cos^{-1} x$ and $\sin^{-1} x$ are respectively $(0, \pi)$ and $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$	1
20	A: The following straight lines are perpendicular to each other. $\frac{x+1}{2} = \frac{y-2}{5} = \frac{z+3}{4}\ and\ \frac{1-x}{-1} = \frac{y+2}{2} = \frac{3-z}{3}$ R: Let line L-l passes through the point $(x_1, y_1, z_1,)$ and parallel to the vector whose direction ratios are a_1, b_1, and c_1, and let line L- 2 passes through the point $(x_2, y_2, z_2,)$ and parallel to the vector whose direction ratios are a_2, b_2, and c_2, · Then the lines L-1 and L-2 are perpendicular if $a_1 . a_2 + b_1 . b_2 + c_1 . c_2 = 0$	1

SECTION B

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21	Check whether the relation R in the set **R** of real numbers, defined as R = $\{(a, b): a \le b^2\}$ is transitive.	2
22	Find $\frac{dy}{dx}$ of the function $y^x = x^y$ OR Find the values of *k* so that the function *f* is continuous at the indicated point $f(x) = \begin{cases} kx+1, & if\ x \le \pi \\ \cos x, & if\ x > \pi \end{cases} \qquad at\ x = \pi$	2
23	Evaluate: $\int \frac{x}{(x+1)(x+2)} dx$	2
24	Find the area of the region in the first quadrant enclosed by the circle $x^2 + y^2 = 16$. OR Find the area of the region in the first quadrant enclosed by the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$.	2
25	If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, find the value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$	2

SECTION C

(This section comprises of 6 short answer type questions (SA) of 3 marks each)

26	If *y* = 3 cos (log *x*) + 4 sin (log *x*), show that $x^2 y_2 + x y_1 + y = 0$	3
27	Evaluate: $\int \sqrt{1 + 3x - x^2}\, dx$	3

	OR Evaluate: $\int_0^1 (xe^x + \sin\frac{\pi x}{4})\, dx$	
28	Find the area of the region bounded by the parabola $y = x^2$ and $y = \lvert x \rvert$.	3
29	Solve the differential equation $\frac{\mathrm{dy}}{\mathrm{dx}} = \frac{x+y}{x}$ OR Solve the differential equation $x\frac{\mathrm{dy}}{\mathrm{dx}} + 2y = x^2 \quad ; (x \neq 0)$	3
30	Solve the following Linear Programming Problem graphically: Maximize Z = 5x + 2y subject to the constraints: $x - 2y \leq 2$, $3x + 2y \leq 12$, $-3x + 2y \leq 3$, $x \geq 0$, $y \geq 0$.	3
31	Two numbers are selected at random (without replacement) from the first six positive integers. Let X denote the larger of the two numbers obtained. Find E(X). OR The random variable X has a probability distribution P(X) of the following form, where *k* is some number: $P(X)=\begin{cases} k, & if \;\; x = 0 \\ 2k, & if \;\; x = 1 \\ 3k, & if \;\; x = 2 \\ 0, & otherwise \end{cases}$ (a) Determine the value of *k*. (b) Find P (X < 2), (c) Find P (X≥2),	3
	SECTION D **(This section comprises of 4 long answer (LA) type questions of 5 marks each)**	
32	Show that the function f : R→R defined by f(x) =$\frac{x}{x^2+1}$, ∀x∈R is neither one-one nor onto. OR Let f: W → W be defined by : f(n) = $\begin{cases} \mathrm{n-1, if\ n\ is\ odd} \\ \mathrm{n+1, if\ n\ is\ even} \end{cases}$. Show that f is one-one and onto .	5
33	Solve the following system of equations by matrix method. $3x - 2y + 3z = 8$ $2x + y - z = 1$ $4x - 3y + 2z = 4$	5
34	Evaluate $\int \frac{\sqrt{x^2+1}\,[\log(x^2+1) - 2\log x]}{x^4}$ dx OR Evaluate $\int_0^{\frac{\pi}{2}} \log\sin x \; dx$	5
35	Prove that the lines *x* = *py* + *q*, *z* = *ry* + *s* and *x* = *p'y* + *q'*, *z* = *r'y* + *s*' are perpendicular if *pp'* + *rr*'+ 1 = 0. OR Find the angle between the lines whose direction cosines are given by the	5

equations $l + m + n = 0$, $l^2 + m^2 - n^2 = 0$.

SECTION E

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)

36 Read the following text and answer the following questions, on the basis of the same:

The relation between the heights of the plant (y in cm) with respect to exposure to sunlight is governed by the equation $y = 4x - \frac{1}{2}x^2$ where x is the number of days exposed to sunlight.

(i) Find the rate of growth of the plant with respect to sunlight. 1

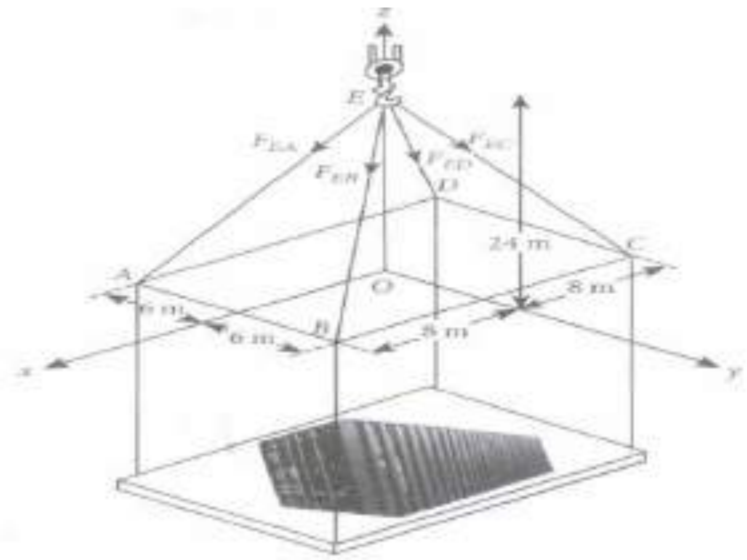
(ii) Is this function satisfy the condition of second order derivative? 1

(iii) What is the number of days it will take for the plant to grow to the maximum height? 2

OR

What is the maximum height of the plant?

37 Consider the following diagram, where the forces in the cable are given.



Based on the above information, answer the following questions.

(i) Find The vector of Direction Ratios of a Line $\overrightarrow{ED}$

(ii) The length of the cable $\overrightarrow{EB}$ is

(iii) Find The sum of all vectors of Direction Ratios along the cables.

OR

Find The cartesian equation of line along $\overrightarrow{EA}$

1
1
2

38 One day, a sangeet mahotsav is to be organised in an open area of Rajasthan. In recent years, it has rained only 6 days each year. Also, it is given that when it actually rains, the weatherman correctly forecasts rain 80% of the time. When it doesn't rain, he incorrectly forecasts rain 20% of the time. If leap year is considered, then answer the following questions.

(i) Find the probability that the weatherman predict rain.

(ii) Find The probability that it will rain on the chosen day, if weatherman predict rain for that day,

2
2

SAMPLE PAPER-04 (2024-25)
CLASS XII MATHEMATICS
BLUE PRINT

	Name of the Chapter	1 M (MCQ) **Section A**	2 M(VSA) **Section B**	3 M(SA) **Section C**	5 M(LA) **Section D**	4 M(Case Based) **Section E**	Total
Unit- I	Relation and Function				1(5)		3(8)
	Inverse Trigonometric Functions	1(1) AR	1(2)				
Unit - II	Matrices	2(2)					6(10)
	Determinant	3(3)			1(5)		
Unit - III	Continuity and Differentiability	2(2)	1(2)				15(35)
	Application of Derivative		1(2)			2(8)	
	Integrals	2(2)		3(9)			
	Application of Integrals				1(5)		
	Differential Equations	2(2)		1(3)			
Unit - IV	Vector Algebra	3(3)	1(2)				8(14)
	3-Dimensional Geometry	1(1) 1(1)AR	1(2)		1(5)		
Unit – V	Linear Programming Problems	2(2)		1(3)			3(5)
Unit -VI	Probability	1(1)		1(3)		1(4)	3(8)
	Total	20(20)	5(10)	6(18)	4(20)	3(12)	38(80)

Note: Numeral outside the bracket denote the number of questions and numeral inside the bracket denotes the marks.
AR: Assertive Reasoning Based.

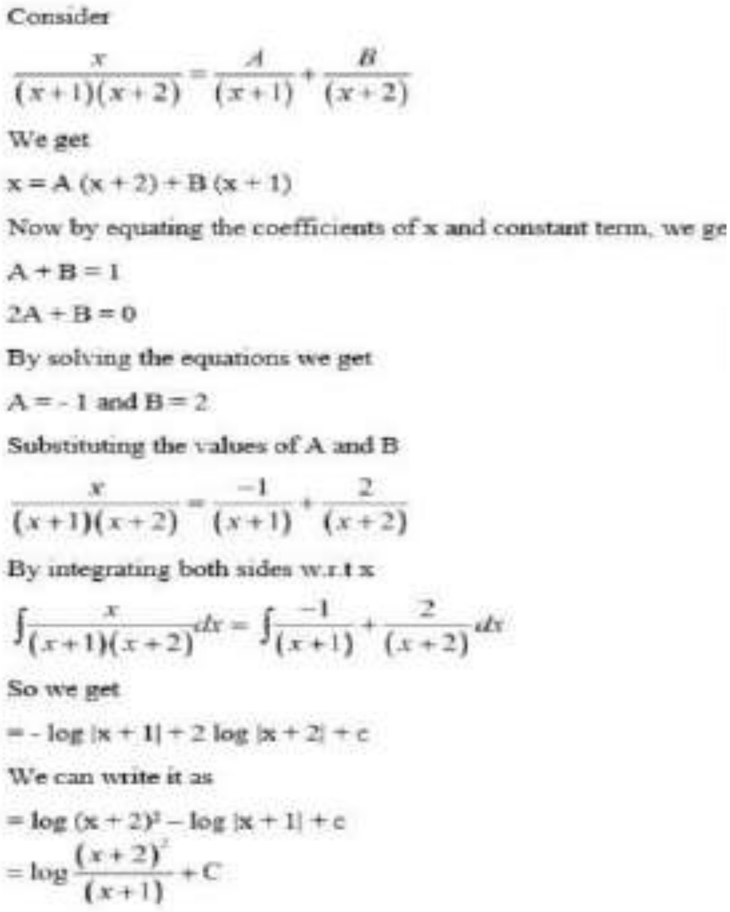
SAMPLE PAPER- 04 (2024-25)

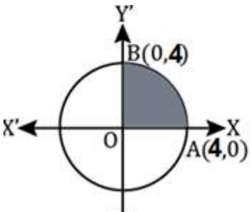
SUBJECT: MATHEMATICS (041)

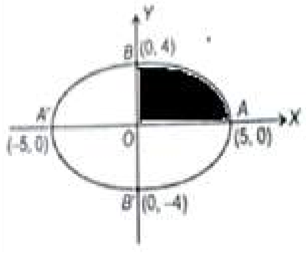
Time: - 3 Hours **CLASS: XII** **Max Marks: - 80**

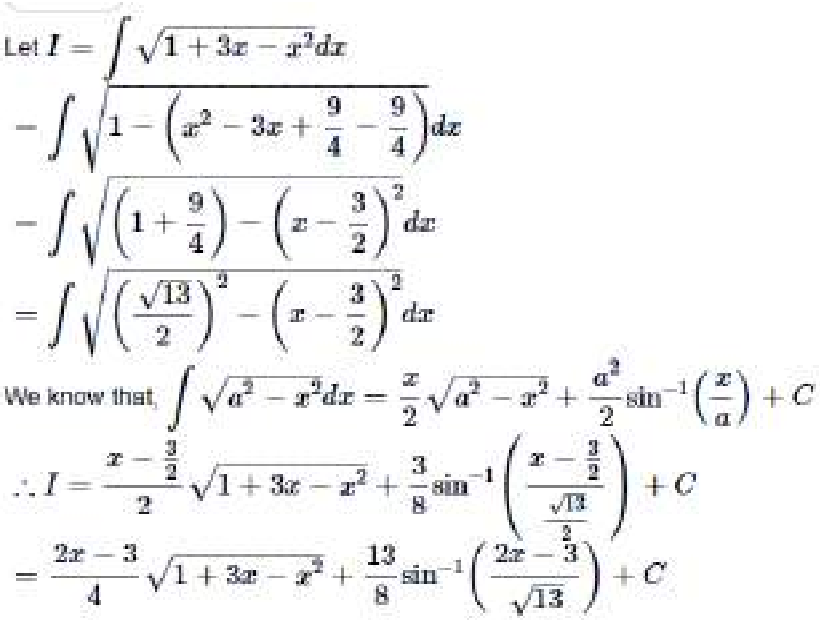
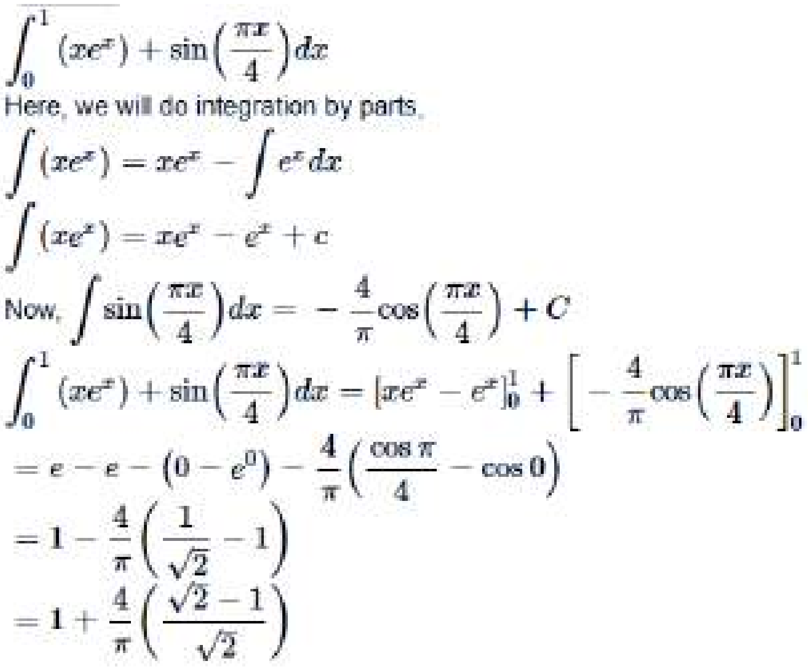
MARKING SCHEME

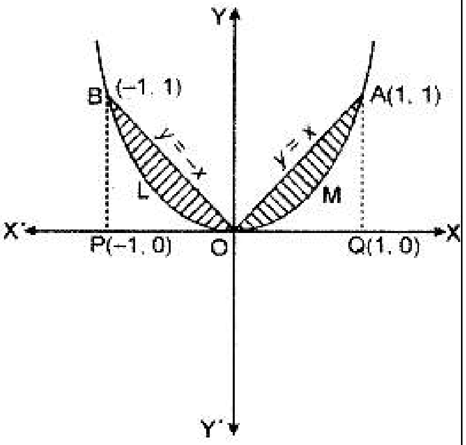
Q. No.	**SECTION – A**	**Marks**
1	(d) 512	1
2	(c) $a_{ij} = a_{ji}$ for all i,j	1
3	(b) $\|A\|^2$	1
4	(b) 3	1
5	(d) $(A + B)^{-1} = B^{-1} + A^{-1}$	1
6	(d) 1.5	1
7	(a) $\frac{x}{\sqrt{1+x^2}}$	1
8	(b) $12\,\pi$	1
9	(d) None of these	1
10	(c) $\tan x - \cot x + c$	1
11	(d) 0	1
12	(d) not defined	1
13	(c) $x = vy$	1
14	(d) $a = \frac{1}{\|\lambda\|}$	1
15	(a) (2, 0, 0)	1
16	(b) (0,8)	1
17	(a) First quadrant	1
18	(b) P(A/B) =1	1
19	(c) **A is true but R is false.**	1
20	(a) **Both A and R are true and R is the correct explanation of A.**	1
	SECTION – B This section comprises of very short answer type-questions (VSA) of 2 marks each.	
21	**(3, 2), (2, 1.5) $\in$ R** **(as $3 < 2^2 = 4$ and $2 < (1.5)^2 = 2.25$)** **But, $3 > (1.5)^2 = 2.25$, $\therefore$(3, 1.5) $\notin$ R** **$\therefore$ R is not transitive.**	1 1
22	**Taking logarithm on both sides** **x log y = y log x** **Differentiating both sides with respect to x** $\frac{x}{y}\frac{dy}{dx} + \log y = \frac{y}{x} + \log x \frac{dy}{dx}$ $\left(\frac{x}{y} - \log x\right)\frac{dy}{dx} = \left(\frac{y}{x} - \log y\right)$	1

	So $\frac{\mathrm{dy}}{\mathrm{dx}} = \frac{y(y-x\log y)}{x(x-y\log x)}$ ***OR*** $\boldsymbol{f(x)\ is\ continous\ at\ x = \pi}$ $\boldsymbol{\lim_{x\to\pi} f(x) \ = f(\pi)}$ $\boldsymbol{\lim_{x\to\pi^+} \ f(x) \ = \lim_{x\to\pi^-} \ f(x) = k\pi + 1}$ $\boldsymbol{\lim_{x\to\pi} \ cos\ x \ = \lim_{x\to\pi} \ (kx + 1) = k\pi + 1}$ $\boldsymbol{-1 = k\pi + 1}$ $\boldsymbol{k \ = \ \frac{-2}{\pi}}$	1 1 1
23	 Consider $\frac{x}{(x+1)(x+2)} = \frac{A}{(x+1)} + \frac{B}{(x+2)}$ We get x = A (x + 2) + B (x + 1) Now by equating the coefficients of x and constant term, we ge A + B = 1 2A + B = 0 By solving the equations we get A = - 1 and B = 2 Substituting the values of A and B $\frac{x}{(x+1)(x+2)} = \frac{-1}{(x+1)} + \frac{2}{(x+2)}$ By integrating both sides w.r.t x $\int \frac{x}{(x+1)(x+2)} dx = \int \frac{-1}{(x+1)} + \frac{2}{(x+2)} dx$ So we get = - log |x + 1| + 2 log |x + 2| + c We can write it as = log $(x + 2)^2$ – log |x + 1| + c $= \log \frac{(x+2)^2}{(x+1)} + C$	1 1
24	the circle equation $x^2 + y^2 = 16$.--------(i) From equation (i) $x^2 + y^2 = 4^2$ $\Rightarrow y = \pm\sqrt{4^2 - x^2}$ Since sector AOBA lies in 1st Quadrant, the value of y is positive $y = \sqrt{4^2 - x^2}$ Area of Region AOBA $= \int_0^4 y\, dx \ = \int_0^4 \sqrt{4^2 - x^2}\, dx$	1



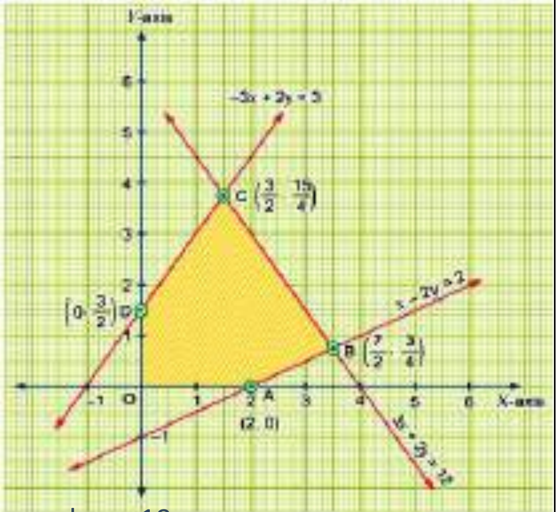
	$\left[x^2\sqrt{4^2-x^2}+\frac{4^2}{2}\sin^{-1}\frac{x}{4}\right]_0^4$ =$[0+8\sin^{-1}1-0-0]$ $=8\frac{\pi}{2}$ =4π Final answer: Therefore, required area =4π square units. OR the ellipse Equation $\frac{x^2}{25}+\frac{y^2}{16}=1$------(i) from equation –(i)  $y=\frac{4}{5}\sqrt{5^2-x^2}$ Area of Region AOBA =$\int_0^5 y\,dx$ =$\frac{4}{5}\int_0^4\sqrt{5^2-x^2}\,dx$ $\frac{4}{5}\left[x^2\sqrt{5^2-x^2}+\frac{5^2}{2}\sin^{-1}\frac{x}{5}\right]_0^5$ =$\frac{4}{5}\left[0+\frac{25}{2}\sin^{-1}1-0-0\right]$ = $\frac{4}{5}\;\frac{25}{2}\;\frac{\pi}{2}$ =5π Final answer: Therefore, required area =5π square units.	1 1 1
25	a,b,c are unit vectors ∴$\lvert\vec{a}\rvert=\lvert\vec{b}\rvert=\lvert\vec{c}\rvert=1$ $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ (given) ∴$\left(\vec{a}+\vec{b}+\vec{c}\right)^2=0$ ∴$\lvert\vec{a}\rvert^2+\lvert\vec{b}\rvert^2+\lvert\vec{c}\rvert^2$ +2 $\left(\vec{a}.\vec{b}+\vec{b},\vec{c}+\vec{c}\vec{a}\right)=0$ **1+1+1**+2 $\left(\vec{a}.\vec{b}+\vec{b},\vec{c}+\vec{c}\vec{a}\right)=0$ ∴$\vec{a}.\vec{b}+\vec{b},\vec{c}+\vec{c}\vec{a}=-\frac{3}{2}$	1 1
	SECTION C **(This section comprises of short answer type questions (SA) of 3 marks each)**	
26	y = 3 cos (log x) + 4 sin (log x) $\frac{\mathrm{dy}}{\mathrm{dx}}=-3\sin(\log x)\frac{1}{x}+4\cos(\log x)\frac{1}{x}$ $x\frac{\mathrm{dy}}{\mathrm{dx}}=-3\sin(\log x)+4\cos(\log x)$ $x\frac{d^2y}{dx^2}+\frac{\mathrm{dy}}{\mathrm{dx}}=-3\cos(\log x)\frac{1}{x}-4\sin(\log x)\frac{1}{x}$ $x^2\frac{d^2y}{dx^2}+x\frac{\mathrm{dy}}{\mathrm{dx}}=-\{3\cos(\log x)+4\sin(\log x)\}$	1 1

	$x^2y_2+xy_1+y=0$	1
27	 Let $I=\int\sqrt{1+3x-x^2}dx$ $=\int\sqrt{1-\left(x^2-3x+\frac{9}{4}-\frac{9}{4}\right)}dx$ $=\int\sqrt{\left(1+\frac{9}{4}\right)-\left(x-\frac{3}{2}\right)^2}dx$ $=\int\sqrt{\left(\frac{\sqrt{13}}{2}\right)^2-\left(x-\frac{3}{2}\right)^2}dx$ We know that, $\int\sqrt{a^2-x^2}dx=\frac{x}{2}\sqrt{a^2-x^2}+\frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)+C$ $\therefore I=\frac{x-\frac{3}{2}}{2}\sqrt{1+3x-x^2}+\frac{3}{8}\sin^{-1}\left(\frac{x-\frac{3}{2}}{\frac{\sqrt{13}}{2}}\right)+C$ $=\frac{2x-3}{4}\sqrt{1+3x-x^2}+\frac{13}{8}\sin^{-1}\left(\frac{2x-3}{\sqrt{13}}\right)+C$ **OR**  $\int_0^1(xe^x)+\sin\left(\frac{\pi x}{4}\right)dx$ Here, we will do integration by parts. $\int(xe^x)=xe^x-\int e^x dx$ $\int(xe^x)=xe^x-e^x+c$ Now, $\int\sin\left(\frac{\pi x}{4}\right)dx=-\frac{4}{\pi}\cos\left(\frac{\pi x}{4}\right)+C$ $\int_0^1(xe^x)+\sin\left(\frac{\pi x}{4}\right)dx=[xe^x-e^x]_0^1+\left[-\frac{4}{\pi}\cos\left(\frac{\pi x}{4}\right)\right]_0^1$ $=e-e-(0-e^0)-\frac{4}{\pi}\left(\frac{\cos\pi}{4}-\cos 0\right)$ $=1-\frac{4}{\pi}\left(\frac{1}{\sqrt{2}}-1\right)$ $=1+\frac{4}{\pi}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$	1 1 1 1 1 1
28	Curve y = x^2 is a parabola whose vertex is (0, 0) and is symmetric about y-axis. Equation y = | x | represents two lines When x > 0, then y = x When x < 0, then y = -x Intersection points of y = x and parabola y = x^2 are O (0, 0) and A (1, 1). Intersection points of y = – x and parabola y = x^2 and O (0, 0) and B (- 1, 1).	

	The region bounded by lines y = x and y = – x and parabola y = x^2 is shown in the following figure. Required area = Area of BLOMA $= 2 \times \text{Area of } OMA$ $= 2 \text{ Area of } (\Delta OQA - \text{Area of } OMAQO)$ $= \int y \text{ (for line } y = x) \, dx$ $- \int y \left(\text{for parabola } y = x^2\right) dx$ $= 2 \int_0^1 x \, dx - 2\int_0^1 x^2 \, dx$ $= 2\left[\frac{x^2}{2}\right]_0^1 - 2\left[\frac{x^3}{3}\right]_0^1$ $= 2\left[\frac{1}{2} - 0\right] - 2\left[\frac{1}{3} - 0\right]$ $= 2 \times \frac{1}{2} - 2 \times \frac{1}{3} = 1 - \frac{2}{3}$ $= \frac{1}{3}$ sq. unit.  	1 1 1
29	$\frac{dy}{dx} = \frac{x+y}{x}$ It is a homogenous differential equation, Put $y = vx$ and $\frac{dy}{dx} = v + x\frac{dv}{dx}$ ∴ the equation becomes, $v + x\frac{dv}{dx} = \frac{x + vx}{x} = \frac{(1+v)x}{x}$ $= 1 + v$ $x\frac{dv}{dx} = 1 + v - v = 1$	1 1

	$dv = \frac{dx}{x}$ On integration $\int dv = \int \frac{dx}{x}$ $v = \log x + \log c$ Now, replace $v = \frac{y}{x}$ $\Rightarrow \frac{y}{x} = \log x + \log c$ $\frac{y}{x} = \log cx$ (or) $cx = e^{\frac{y}{x}}$ $x = \frac{1}{c} e^{\frac{y}{x}}$ $x = k e^{\frac{y}{x}}, k = \frac{1}{c}$ **OR** We are given $x\frac{dy}{dx} + 2y - x^2$ $\Rightarrow \frac{dy}{dx} + 2\frac{y}{x} = x$ This is of the form $\frac{dy}{dx} + Py = Q$ $\therefore$ I.F. $= e^{\int \frac{2}{x} dx} = e^{2 \log x} = e^{\log x^2} = x^2$ General solution is: $yx^2 = \int x \cdot x^2 dx + c$ $\Rightarrow yx^2 = \frac{x^4}{4} + c$	1 1 1 1
30		1

CORNER POINTS	Z =5x+ 2y
(0,0)	0
(2,0)	10
$\left(\frac{7}{2},\frac{3}{4}\right)$	19 (MAXIMUM)
$\left(\frac{3}{2},\frac{15}{4}\right)$	15
$(0,\frac{3}{2})$	3



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1

Hence, Z is maximum at x = $\frac{7}{2}$, y = $\frac{3}{4}$ and maximum value = 19

31 X can take values 2, 3, 4, 5, 6 1

(∵1 cannot be greater than the other selected number)

X	2	3	4	5	6
P(X)	$\frac{2}{30}$	$\frac{4}{30}$	$\frac{6}{30}$	$\frac{8}{30}$	$\frac{10}{30}$
X.P(X)	$\frac{4}{30}$	$\frac{12}{30}$	$\frac{24}{30}$	$\frac{40}{30}$	$\frac{60}{30}$

1

Mean of X=E(X)=∑X P(X) = $\frac{4+12+24+40+60}{30} = \frac{140}{30} = \frac{14}{3}$ 1

OR

The random variable X has a probability distribution P(X) of the following form, where *k* is some number:

X	0	1	2	OTHERWISE	
P(X)	K	2K	3K	0	

(a) As Sum of all probabilities should be

⇒k+2k+3k=1 ⇒k=1/6 1

(b) P(x<2) =p(x=0) + p(x=1)=k+2k=3($\frac{1}{6}$)=$\frac{1}{2}$ 1

(c) P(x≥2) =3k+0=3($\frac{1}{6}$)+0 = $\frac{1}{2}$ 1

SECTION D

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

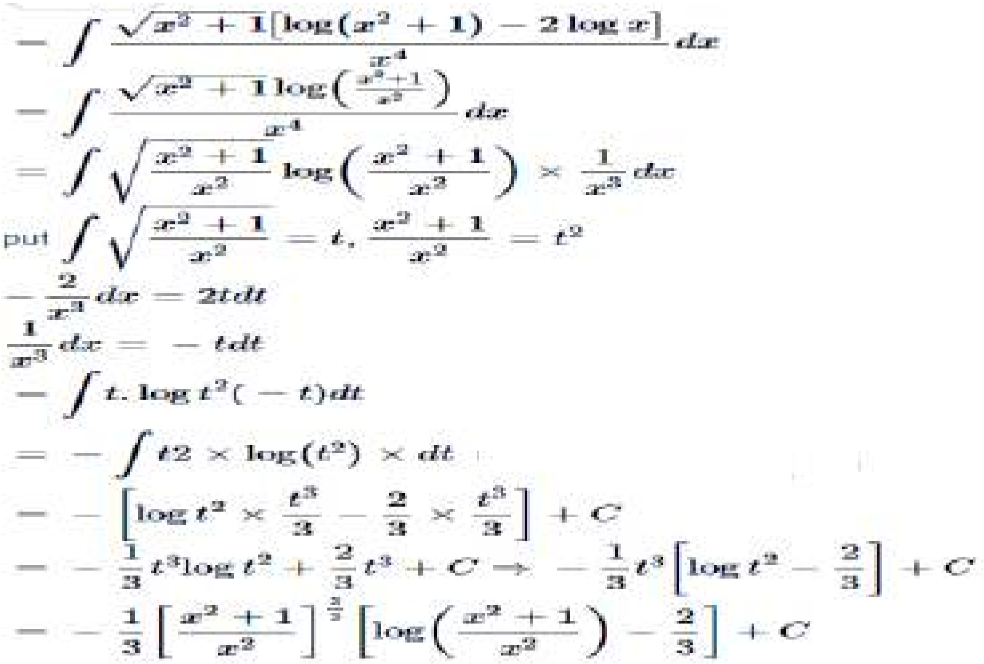
32 ONE -ONE

For $x_1, x_2 \epsilon$ R, consider

f (x_1) = f (x_2)

$$\Rightarrow \frac{x_1}{x_1^2+1} = \frac{x_2}{x_2^2+1}$$

	$\Rightarrow x_1x_2^2 + x_1 = x_2x_1^2 + x_2$ $\Rightarrow x_1x_2^2 + x_1 - x_2x_1^2 - x_2 = 0$ $\Rightarrow x_1x_2(x_2 - x_1) - 1(x_2 - x_1) = 0$ $\Rightarrow (x_1x_2 - 1)(x_2 - x_1) = 0$ $\Rightarrow (x_1x_2 = 1)\ \ or\ (x_2 = x_1)$ We note that there are point, x_1 and $x_{2.}$ with $x_1 \neq x_{2.}$ and f (x_1) = f (x_2), for instance, if we take x_1 = 2 and $x_2 = \frac{1}{2}$, then we have f (x_1) = $\frac{2}{5}$ and f x_2) =$\frac{2}{5}$ But 2 $\neq \frac{1}{2}$. Hence f is not one-one. Onto: Also, f is not onto for if so then for 1 ϵ R $\exists\ x \in R$ such that f (x) = 1 which gives $\frac{x}{x^2+1} = 1$. But there is no such *x* in the domain **R**, since the equation $x^2 - x + 1 = 0$ does not give any real value of *x*. **OR** The given function f:W→W is defined by, f(n) = $\begin{cases} n - 1, \text{if n is odd} \\ n + 1, \text{if n is even} \end{cases}$ one one :- Consider that f(n)=f(m). Case -1 If n is odd and m is even, then, n−1=m+1 ⇒n−m=2 This cannot be possible. Case :- 2 If both n and m are odd, then, n−1=m−1 ⇒n=m Case-3 If both n and m are even, then, n+1=m+1 ⇒n=m Thus, f is one-one. Onto It can be observed that any odd number 2k+1 in the co-domain W is the image of 2k in domain W. Also, any even number 2k in the co-domain W is the image of 2k+1 in domain W. SO Range = co-domain Thus, f is onto.	2.5 2.5 2.5 2.5
33	$3x - 2y + 3z = 8$ $2x + y - z = 1$ $4x - 3y + 2z = 4$	

	The system of equations can be written in the form AX = B, where $A = \begin{bmatrix} 3 & -2 & 3 \\ 2 & 1 & -1 \\ 4 & -3 & 2 \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \quad and \quad B = \begin{bmatrix} 8 \\ 1 \\ 4 \end{bmatrix}$ We see that $\|A\|$ = 3 (2 – 3) + 2(4 + 4) + 3 (– 6 – 4) = – 17 ≠ 0 Hence, A is non-singular and so its inverse exists. Now $A_{11} = -1$, $A_{12} = -8$, $A_{13} = -10$ $A_{21} = -5$, $A_{22} = -6$, $A_{23} = 1$ $A_{31} = -1$, $A_{32} = 9$, $A_{33} = 7$ Therefore $A^{-1} = -\frac{1}{17}\begin{bmatrix} -1 & -5 & -1 \\ -8 & -6 & 9 \\ -10 & 1 & 7 \end{bmatrix}$ So $X = A^{-1}B = -\frac{1}{17}\begin{bmatrix} -1 & -5 & -1 \\ -8 & -6 & 9 \\ -10 & 1 & 7 \end{bmatrix}\begin{bmatrix} 8 \\ 1 \\ 4 \end{bmatrix}$ $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = -\frac{1}{17}\begin{bmatrix} -17 \\ -34 \\ -51 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ Hence $x = 1$, $y = 2$ and $z = 3$.	1 3 1 1
34	$\int \frac{\sqrt{x^2+1}\,[\log(x^2+1)-2\log x]}{x^4}$  $- \int \frac{\sqrt{x^2+1}[\log(x^2+1) - 2\log x]}{x^4} dx$ $- \int \frac{\sqrt{x^2+1}\log\left(\frac{x^2+1}{x^2}\right)}{x^4} dx$ $= \int \sqrt{\frac{x^2+1}{x^2}} \log\left(\frac{x^2+1}{x^2}\right) \times \frac{1}{x^3} dx$ put $\int \sqrt{\frac{x^2+1}{x^2}} = t, \frac{x^2+1}{x^2} = t^2$ $- \frac{2}{x^3} dx = 2tdt$ $\frac{1}{x^3} dx = - tdt$ $- \int t.\log t^2(-t)dt$ $= - \int t2 \times \log(t^2) \times dt$ $= - \left[\log t^2 \times \frac{t^3}{3} - \frac{2}{3} \times \frac{t^3}{3}\right] + C$ $= - \frac{1}{3}t^3\log t^2 + \frac{2}{3}t^3 + C \rightarrow - \frac{1}{3}t^3\left[\log t^2 - \frac{2}{3}\right] + C$ $= - \frac{1}{3}\left[\frac{x^2+1}{x^2}\right]^{\frac{3}{2}}\left[\log\left(\frac{x^2+1}{x^2}\right) - \frac{2}{3}\right] + C$ **OR** Let I = $\int_0^{\frac{\pi}{2}} \log\sin x\ dx$ ---(i) Then, using P-4	1 1 1 1

	I = $\int_0^{\frac{\pi}{2}} \log\sin(\frac{\pi}{2}-x)\ dx = \int_0^{\frac{\pi}{2}} \log\cos x\ dx$ ---(ii) Adding the two values of I, we get 2I = $\int_0^{\frac{\pi}{2}} (\log\sin x + \log\cos x)\ dx$ 2I = $\int_0^{\frac{\pi}{2}} (\log\frac{\sin 2x}{2})\ dx$ $2I = \int_0^{\frac{\pi}{2}} \log\sin 2x\ dx - \int_0^{\frac{\pi}{2}} \log 2\ dx$ Put 2*x* = *t* in the first integral. Then 2 *dx* = *dt*, when *x* = 0, *t* = 0 and when $x = \frac{\pi}{2}$, *t* = π Therefore $2I = \frac{1}{2}\int_0^{\pi} \log\sin t\ dt - \frac{\pi}{2}\log 2$ Now in the first integral we use P-6 $2I = \frac{2}{2}\int_0^{\frac{\pi}{2}} \log\sin t\ dt - \frac{\pi}{2}\log 2$ Now in the first integral we use P-0 $2I = \int_0^{\frac{\pi}{2}} \log\sin x\ dx - \frac{\pi}{2}\log 2$ $2I = \mathrm{I} - \frac{\pi}{2}\log 2$ I = $-\frac{\pi}{2}\log 2$	1 1 1 1 1 1
35	We have, x = py+q ⇒ y=$\frac{x-q}{p}$ ...(i) And z = ry+s ⇒ y = $\frac{z-s}{r}$ ...(ii) [Using Eqs. (i) and (ii)] **⇒ $\frac{x-q}{p} = \frac{y}{1} = \frac{z-s}{r}$ ….(iii)** *Similarly,* ⇒ $\frac{x-q'}{p'} = \frac{y}{1} = \frac{z-s'}{r'}$ ….(iv) if these given lines are perpendicular to each other, then ⇒ $a_1a_2 + b_1b_2 + c_1c_2 = 0$ ⇒pp′+1+rr′=0 **⇒ *pp′* + *rr′* + 1 = 0** **Which is the required condition.** **OR** Given eqs. *l* + *m* + *n* = 0 ...(i)	1.5 1.5 1 1

	$l^2 + m^2 - n^2 = 0$ ....(ii) Eliminating n from both the equations, we have ⇒ $l^2 + m^2 - (-l - m)^2 = 0$ ⇒ $l^2 + m^2 - l^2 - m^2 + 2lm = 0$ ⇒ $2lm = 0$ ⇒ $l=0$ or $m = 0$ **Now when l**=0 **Then by eq. (i)** $m + n = 0$ ⇒ **l**=0 or $m = -n$ **⇒ so dr of 1st line (0,** $-n, n$**)** **Now when** $m = 0$ **Then by eq. (i) l** + $n = 0$ ⇒ $m = 0$ or $l = -n$ **⇒ so dr of 2nd line (**$-n, 0, n$**)** Thus, Dr's two lines are proportional to (0, −n, n) and (−n,0, n) i.e., (0, −1,1) and (−1,0,1). So, the vectors parallel to these given lines are $\vec{a} = -\hat{\jmath} + \hat{k}$ and $\vec{b} = -\hat{\imath} + \hat{k}$ $now \cos\theta = \frac{\vec{a}\vec{b}}{\vert\vec{a}\vert\vert\vec{b}\vert}$ ⇒ $\cos\theta = \frac{1}{\vert\sqrt{2}\vert\vert\sqrt{2}\vert} = \frac{1}{2} \Rightarrow \theta = = \pi/3$	1 1 1 2
	SECTION E	
36	(iv)$y = 4x - \frac{1}{2}x^2$ $= \frac{dy}{dx} = 4 - x$ (iv) yes (v) 4 OR 8	1 1 2
37	(i) D is (-8, -6, 0) and that of E is (0, 0, 24) ∴ Vector $\overrightarrow{ED}$ is $(-8-0)\hat{\imath}+(-6-0)\hat{\jmath}+(0-24)\hat{k}$ i.e., $-8\hat{\imath}-6\hat{\jmath}-24\hat{k}$ (ii) B is (8, 6, 0) and that of E are (0, 0, 24), therefore length of cable EB = $\sqrt{(8-0)^2 + (6-0)^2 + (0-24)^2}$ = √676= √26 units (iii) A is (8, -6, 0), B is (8, 6, 0) C is (-8,6,0) , D is (-8, -6, 0) and that of E are (0, 0, 24). SO $\overrightarrow{EA} + \overrightarrow{EB} + \overrightarrow{EC} + \overrightarrow{ED} = (8\hat{\imath}-6\hat{\jmath}-24\hat{k}) + (8\hat{\imath}+6\hat{\jmath}-24\hat{k}) + (-8\hat{\imath}+6\hat{\jmath}-24\hat{k}) + (-8\hat{\imath}-6\hat{\jmath}-24\hat{k})$ $\overrightarrow{EA} + \overrightarrow{EB} + \overrightarrow{EC} + \overrightarrow{ED} = -96\hat{k}$ OR The coordinates of A are (8, -6, 0) and that of E are (0, 0, 24). So cartesian equation of line along $\overrightarrow{EA}$= $\frac{x-0}{8-0} = \frac{y-0}{-6-0} = \frac{z-24}{0-24} \Rightarrow \frac{x}{-4} = \frac{y}{3} = \frac{z-24}{12}$	1 1 2
38	Let E be the event that it rains on chosen day, F be the event that it does not rain on chosen	

	day and A be the event the weatherman predict rain. Then we have, $P(E) = \frac{6}{366}$, $P(F) = \frac{360}{366}$, $P(A \mid E) = \frac{8}{10}$ and $P(A \mid F) = \frac{2}{10}$ (i) $\mathrm{P(A)} = \mathrm{P}(E)\, P(A \mid E) + P(F)\, P(A \mid F)$ $= \frac{6}{366} \times \frac{8}{10} + \frac{360}{366} \times \frac{2}{10} = \frac{768}{3660} = \frac{64}{305}$ (ii) $P\left(\frac{E}{A}\right) = \frac{P(E)\, P(A \mid E)}{P(E)\, P(A \mid E) + P(F)\, P(A \mid F)}$ $= \dfrac{\frac{6}{366} \times \frac{8}{10}}{\frac{6}{366} \times \frac{8}{10} + \frac{360}{366} \times \frac{2}{10}} = \dfrac{1}{16}$	2 2

SAMPLE QUESTION PAPER -05 (2024-25)

SUBJECT: MATHEMATICS (041)

Time: - 3 Hours **CLASS: XII** **Max Marks: - 80**

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 (VSA)-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 calculator is not allowed.

SECTION A

(This section comprises of multiple choice questions (MCQs) of 1 mark each) Select the correct option (Question 1 - Question 18):

1.	If A is matrix of order m × n and B is a matrix such that AB' and $B'A$ are both defined, then order of matrix B is (a) m × m (b) n × n (c) n × m (d) m × n	1

2.	If A is any square matrix of order 3×3 such that $\lvert A \rvert = 3$, Then the value of $\lvert adjA \rvert$ is (a) 3 (b) $\frac{1}{3}$ (c) 9 (d) 27	1
3.	If $\lvert\vec{a}\rvert = 10$, $\lvert\vec{b}\rvert = 2$ and $\vec{a}.\vec{b} = 12$, then the value of $\lvert\vec{a} \times \vec{b}\rvert$ is (a) 5 (b) 10 (c) 14 (d) 16	1
4.	The function f(x) = $\frac{4 - x^2}{4x - x^3}$ is (a) Discontinuous at only one point (b) Discontinuous at exactly two points (c) Discontinuous at exactly three points (d) None of these	1
5.	$\int log\ x\ \ dx$ is equal to (a) $\mathrm{xlog\,x} + \mathrm{x} + \mathrm{C}$ (b) $\mathrm{xlogx} - x + \mathrm{C}$ (c) $xlogx - 1$ + C (d) $1/x$ + C	1
6.	The integrating factor of differential equation $\cos x \frac{dy}{dx}$ + y sin x = 1 is (a) $\cos x$ (b) tan x (c) sec x (d) sin x	
7.	The point which does not lie in the half plane $2x + 3y - 12 \leq 0$ is (a) (1,2) (b) (2,1) (c) (2,3) (d) $(-3, 2)$	1
8.	If θ is the angle between any two vectors $\vec{a}$ and $\vec{\mathrm{b}}$, then $\lvert\vec{a} . \vec{b}\rvert = \lvert\vec{a} \times \vec{b}\rvert$ when θ is equal to (a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) π	1

<table>
<tr><td>9.</td><td>$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{1+\cos 2x}$ is equal to
(a) 1 (b) 2 (c) 3 (d) 4</td><td>1</td></tr>
<tr><td>10.</td><td>Let A be singular matrix then find the value of x where A= $\begin{bmatrix} x & 2 \\ x-2 & 4 \end{bmatrix}$
(a). 2 (b) 4 (c) -2 (d) 0</td><td>1</td></tr>
<tr><td>11.</td><td>The corner points of the feasible region determined by the system of linear constraints are (0,0), (0,40), (20,40), (60,20),(60,0). The objective function is
$Z = 4x + 3y$. Compare the quantity in Column A and Column B
<table>
<tr><th>Column A</th><th>Column B</th></tr>
<tr><td>Maximum of Z</td><td>325</td></tr>
</table>
(a) The quantity in Column A is greater.
(b) The quantity in Column B is greater.
(c) The two quantities are equal
(d) The relationship cannot be determined on the basis of the information supplied.</td><td>1</td></tr>
<tr><td>12.</td><td>If A is a square matrix such that $|A|$ = 5 , Then the value of $|A\ A^T|$ is
(a) 25 (b) ± 25 (c) ± 5 (d) 5</td><td>1</td></tr>
<tr><td>13.</td><td>If A is a 3 × 3 skew symmetric matrix, then the value of $|A|$ is
(a) Any real number (b) positive real number
(c) 0 (d) negative real number</td><td>1</td></tr>
<tr><td>14.</td><td>If P(A) = $\frac{1}{2}$, P(B) = 0 , then $P(A|B)$ is</td><td>1</td></tr>
</table>

	(a) 0 (b) $\frac{1}{2}$ (c) not defined (d) 1	
15.	The general solution of $e^x cos\, y\, dx - e^x sin\, y\, dy = 0$ is (a) $e^x cos\, y = k$ (b) $e^x sin\, y = k$ (c) $e^x = k\, cos\, y$ (d) $e^x = k\, sin\, y$	1
16.	If $x = t^2$ and $y = t^3$ then $\frac{d^2y}{dx^2}$ (a). $\frac{3}{2}$ (b) $\frac{3}{4t}$ (c) $\frac{3}{2t}$ (d) $\frac{3}{4}$	1
17.	The magnitude of projection $(2\hat{\imath} - \hat{\jmath} + \hat{k})$ on $(\hat{\imath} - 2\hat{\jmath} + 2\hat{k})$ is (a) 1 unit (b) 2 units (c) 3 units (d) 4 unit	1
18.	If a line makes angles α, β, γ with the positive direction of co – ordinate axes, then the value of $sin^2 \alpha + sin^2 \beta + sin^2 \gamma$ is. (a) . 0 (b) 1 (c) 2 (d) 3	1
	(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.) (a) Both (A) and (R) are true and (R) is the correct explanation of (A). (b) Both (A) and (R) are true but (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)**: Range of $cot^{-1} x$ is $(0,\pi)$ **Reason (R)**: Domain of $tan^{-1} x$ is R.	1
20.	**Assertion (A)**: The acute angle between the line $\vec{r} = \hat{\imath} + \hat{\jmath} + 2\hat{k} + \lambda(\hat{\imath} - \hat{\jmath})$ and the x– axis is $\pi/4$ **Reason (R)**: The acute angle θ between the lines $\vec{r} = x_1\hat{\imath} + y_1\hat{\jmath} + z_1\hat{k} + \lambda(a_1\hat{\imath} + b_1\hat{\jmath} + c_1\hat{k})$ and $\vec{r} = x_2\hat{\imath} + y_2\hat{\jmath} + z_2\hat{k} + \mu(a_2\hat{\imath} + b_2\hat{\jmath} + c_2\hat{k})$ is given by $\cos\theta = \frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2}.\sqrt{a_2^2 + b_2^2 + c_2^2}}$	1

SECTION B

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21.	Write the principal value of $\tan^{-1}(\sqrt{3}) + \cot^{-1}(-\sqrt{3})$. **OR** If A = {1,2,3}, B = {4,5,6,7} and f = {(1,4), (2,5), (3,6)} is a function from A to B. State whether f is one – one or not.	2
22.	The radius of a ccircle is increasing at the rate of 5 cm/min. Find the rate of increasing of its area when its radius is 10 cm.	2
23.	Find a vector in the direction of $\vec{a} = \hat{\imath} - 2\hat{\jmath} + 3\hat{k}$ that has magnitude 10 units. **OR** If a line makes angles 90^0, 60^0 and θ with x, y and z axis respectively, where θ is acute, then find θ	2
24.	Write the derivative of sin x with respect to cos x.	2
25.	Find the area of triangle with vertices A (0,1,-1), B(1,0,-1) and C(0,1,2)	2
Section C **(This section comprises of 6 short answer (SA) type questions of 3 marks each.)**		
26.	Find: $\int \sin^{-1}(2x)\, dx$.	3
27.	Find: $\int \frac{x}{(x^2+1)(x-1)}$ dx	3
28.	A and B throw a pair of dice alternately. A wins the game if he gets a total of 9 and B wins if he gets a total of 7. If A starts the game, find the probability of winning the game by B. **OR** A problem in Mathematics is given to 4 students A, B, C. Their chances of solving the problem are $\frac{1}{3}, \frac{1}{4}$ and $\frac{2}{3}$ respectively. What is the probability that the problem will be solved?	3
29.	Evaluate : $\int_0^{\frac{\pi}{4}} log[1 + tanx]dx$ **OR** Evaluate : $\int_1^3 \lvert x^2 - 2x\rvert\, dx$	
30.	Solve the differential equation: $x\,\frac{dy}{dx} = y - x\,tan\left(\frac{y}{x}\right)$ **OR** Find the particular solution of the differential equation $(1+x^2)\frac{dy}{dx} + 2xy = \frac{1}{1+x^2}$ given that y = 0 when x = 1.	3
31.	Solve the following Linear Programming Problem graphically: Minimize: Z = 5 x + 10 y subject to	

	$x + y \geq 60$, x -2 y ≥ 0, x + 2 y ≤ 120, x ≥ 0, y ≥ 0	

SECTION D

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32.	Let A = { x ∈ Z : 0 ≤ x ≤ 12} . Show that R = {(a, b) : a, b ∈ A , $\|a - b\|$ is divisible by 4 } Is an equivalence relation . Also write the equivalence class [2]. **OR** Let f: $R - \left\{-\frac{4}{3}\right\} \rightarrow R - \{\frac{4}{3}\}$ 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	5
33.	Find the shortest distance between the lines : $\vec{r}$ = (t + 1) $\hat{\imath}$ + (2 – t) $\hat{\jmath}$ + (1 + t) $\hat{k}$ $\vec{r}$ = (2s + 2) $\hat{\imath}$ – (1 – s) $\hat{\jmath}$ + (2 s – 1) $\hat{k}$. **OR** Find the co-ordinates of the foot of perpendicular drawn from the point A (1, 8, 4) to the line joining the points B (0, –1, 3) and C (2, –3, –1).	5
34.	If A = $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix}$, find A^{-1}. Use A^{-1} to solve the following system of equations $x + y + z = 6, \; x + 2z = 7 , 3x + y + z = 12$	5
35.	Using method of integration, find the area of the region $x^2 + y^2 = 4$ *and* $x = \sqrt{3}y$ with x-axis in first quadrant	5

SECTION E

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)

36.	Read the following passage and answer the questions given below.	1+1 +2

Sonam wants to prepare a sweet box for Diwali at home. For making lower part of box, she takes a square piece of card board of side 18cm.

(i) If x cm be the length of each side of the square cardboard which is to be cut off from corner of the square piece of side 18 cm, then x must lie in which interval ?

(ii) What would be the volume of the box (in terms of x) ?

(iii) (a)The values of x for which $\frac{dV}{dx} = 0$, are

OR

(b). What is the value of maximum volume ?

37. Read the following passage and answer the questions given below. 1+1 +2

In a group activity class, there are 10 students whose ages are 16, 17, 15, 14, 19, 17, 16, 19, 16 and 15 years. One student is selected at random such that each has equal chance of being chosen and age of the student is recorded.

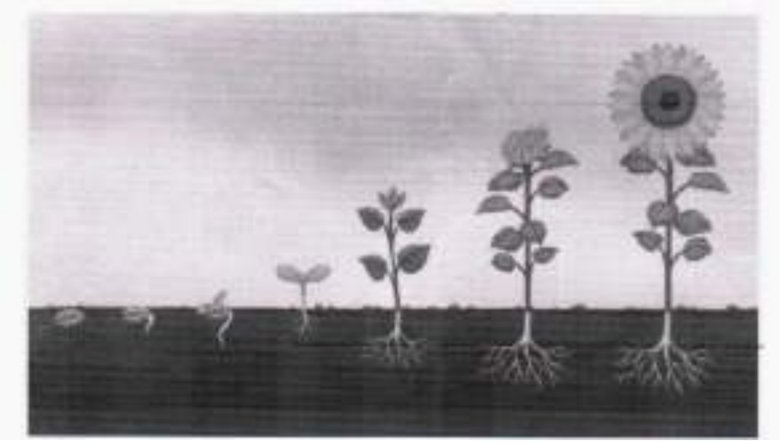
(i)Find the probability that the age of the selected student is a composite number.

(ii) Let X be the age of the selected student. What can be the value of X ?

(iii) (a) Find the probability distribution of random variable X and hence find the mean age.

OR

(iii) (b) A student was selected at random and his age was found to be greater than 15 years. Find the probability that his age is a prime number.

38.	In an agricultural institute, scientists do experiments with varieties of seeds to grow them in different environments to produce healthy plants and get more yield. A scientist observed that a particular seed grew very fast after germination. He had recorded growth of plant since germination and he said that its growth can be defined by the function $f(x) = \frac{1}{3}x^3 - 4x^2 + 15x + 2, 0 \le x \le 10$ where x is the number of days the plant is exposed to sunlight.  On the basis of the above information, answer the following questions : (i) What are the critical points of the function f(x) ? (ii) Using second derivative test, find the minimum value of the function.	2+2

SAMPLE QUESTION PAPER -05, 2024-25
BLUEPRINT
CLASS: XII MATHEMATICS (Code-041)

UNITS	**NAME OF CHAPTERS**	**SECTION A (Objective Type) (1 MARK EACH)**		**SECTION B (VSA) (2 MARKS EACH)**	**SECTION C (SA) (3 MARKS EACH)**	**SECTION D (LA) (5 MARKS EACH)**	**SECTION E (CBQ) (4 MARKS EACH)**	**TOTAL**
		MCQ	ARQ					
UNIT-I (Relations & Functions)	RELATIONS AND FUNCTIONS			2(1)		5*(1)		8(3)
	INVERSE TRIGONOMETRY FUNCTION		1(1)					
UNIT-II (Algebra)	MATRICES	2(2)						10(6)
	DETERMINANT	3(3)				5(1)		
UNIT-III (calculus)	CONTINUITY & DIFFERENTIABILITY	2(2)		2*(1)	3(1)			35(17)
	APPLICATION OF DERIVATIVE	2(2)					4*(1)	

	INTEGRATION	2(2)		2(1)	3*(1)	5*(1)		
	APPLICATION OF INTEGRATION			2*(1)	3(1)			
	DIFFERENTIAL EQUATION	2(2)			3*(1)			
UNIT-IV (Vectors & 3D)	VECTORS	1(1)		2(1)				14(6)
	THREE-DIMENSIONAL GEOMETRY	1(1)	1(1)			5(1)	4*(1)	
UNIT-V (LPP)	LPP	2(2)			3(1)			5(3)
UNIT-VI (Probability)	PROBABILITY	1(1)			3*(1)		4(1)	8(3)
	TOTAL	**18(18)**	**2(2)**	**10(5)**	**18(6)**	**20(4)**	**12(3)**	**80(38)**

(*) represents question with internal choice. Marks are mentioned outside brackets. No. of questions - within the brackets.

SAMPLE PAPER-05

MATHEMATICS CLASS XII 2024-25

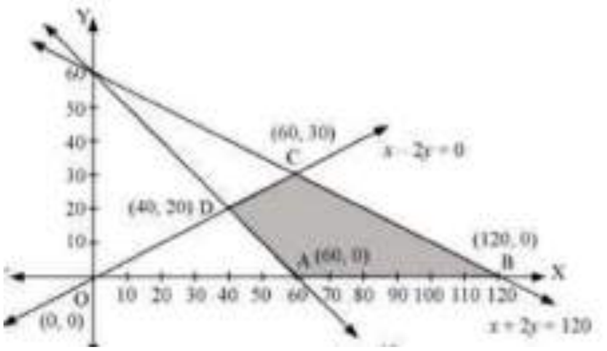
MARKING SCHEME

Class XII **Sub: Mathematics**

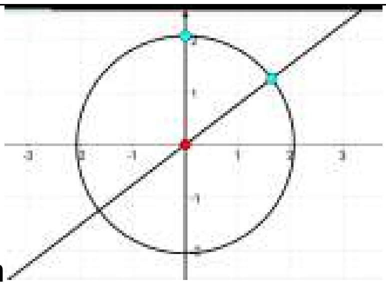
Sr. No.	**Answers and steps**	Marks
1	(d) m × n	1
2.	(c) 9	1
3	(d) 16	1
4	(a) Discontinuous at exactly three points	1
5.	(e) xlog x + x + C	1
6.	(c) sec x	1
7.	(c) (2,3)	1
8.	(b) $\frac{\pi}{4}$	1
9.	(a) 1	1
10.	(c) -2	1
11	(b)The quantity in Column B is greater	1
12.	(a)25	1
13.	(c) 0	1
14.	(c) not defined	1
15	$(a)\ e^x \cos y = k$	1

16.	(b) $\frac{3}{4t}$	1
17.	(b) 2 units	1
18	(c) 2	
19	(b) Both (A) and (R) are true but (R) is not the correct explanation of(A).	1
20	(a) Both (A) and (R) are true and (R) is the correct explanation of (A)	1
21	$\frac{\pi}{3}+\frac{5\pi}{6}=$ $\frac{7\pi}{6}$ **OR** **1,2,3 have different images in B** There is no element left which has image in B	1½ ½ 1 1
22	$\frac{dr}{dt} = 5cm/min$ $A = \pi r^2$ $\frac{dA}{dt} = 2\pi r\frac{dr}{dt}$ 2π 10 .5 = 20π sq cm/ min	 ½ 1 ½
23	Unit vector in direction of $\vec{a} = \widehat{6\imath} - 2\hat{\jmath} + 3\hat{k}$ is $\frac{6\hat{\imath}-2\hat{\jmath}+3\hat{k}}{\sqrt{36+4+9}}$ Required vector is $\frac{10(6\hat{\imath}-2\hat{\jmath}+\widehat{3k)}}{7}$ **OR** $cos^2\alpha + cos^2\beta + cos^2\gamma = 1$ $cos^2 90 + cos^2 60 + cos^2\theta = 1$ $0+\frac{1}{4}+cos^2\theta=1$ $\cos\theta=\pm\sqrt{3}/2$ $\theta = \frac{\pi}{6}, \frac{5\pi}{6}$	1½ ½ ½ ½ ½ ½
24	y=sinx, y = cos x $\frac{d(sinx)}{dx} = cos\ x$, $\frac{d(cosx)}{dx} = -sinx$ $\frac{dy}{dz}=\frac{cos\ x}{-sin\ x} = -cot\ x$	½ +½ 1
25.	$\overrightarrow{AB} = (\hat{\imath} - \hat{\jmath}), \overrightarrow{AC} = 3\hat{k}$ $\overrightarrow{AB} \times \overrightarrow{AC} = \frac{1}{2}\begin{vmatrix} i & j & k \\ 1 & -1 & 0 \\ 0 & 0 & 3 \end{vmatrix} = \frac{1}{2}(3\hat{\imath} - 3\hat{\jmath})$ Area = $\sqrt{(\frac{3}{2})^2 + (\frac{3}{2})^2} = \frac{3}{2}\sqrt{2}$ sq units.	½ 1 ½
26	Applying correct formula $\int uv\,dx = u\int\{v\,dx - \int(\frac{du}{dx}\int vdx)\}dx$ $\sin^{-1}(2x)\int 1\,dx - \int\frac{2x}{\sqrt{1-4x^2}}dx$	 1½ 1½

	$\sin^{-1}(2x) . \mathrm{x} - \sqrt{1 - 4x^2}$ +c	
27.	$\frac{x}{(x^2+1)(x-1)} = \frac{Ax+B}{(x^2+1)} + \frac{C}{(x-1)}$ Finding A, B and C A= $\frac{-1}{2}$, B= $\frac{1}{2}$,C =$\frac{1}{2}$ $\int \frac{x}{(x^2+1)(x-1)}$ dx =$\int \frac{-x+1}{2(x^2+1)} dx + \int \frac{dx}{2(x-1)}$ = $\frac{-1}{2} log(x^1 + 1) + \frac{1}{2} \tan^{-1} x + \frac{1}{2} log(x-1) + c$	1 ½ 1½
28.	P(A) =1/36, P(B) = 1/36 P(A')= 35/36 , P(B')= 35/36 P(winning of A) =P(A)+P($\overline{AB}A$) +P$(\overline{ABAB}A)$+………. $\frac{1}{36}+\frac{1}{36}(\frac{35}{36})^2+\ldots\ldots = \frac{\frac{1}{36}}{1-\frac{35}{36}^2} = 36/71$ P(winning of B) =P($\bar{A}B$)+P$(\overline{ABA}B)$ +P$(\overline{ABABA}B)$ +…… $\frac{1}{36}(\frac{35}{36})^{1+} \frac{1}{36}(\frac{35}{36})^3 + - - - - -$= 35/71 OR P(A) =$\frac{1}{3}$, P(B)=$\frac{1}{4}$ P(C) =$\frac{2}{3}$ P$(\overline{A})$ =$\frac{2}{3}$, P($\bar{B}$)=$\frac{3}{4}$ P($\bar{C}$) =$\frac{1}{3}$ Problem will be if anyone of these three solve the problem P(atleast one of them) = 1-P($\overline{ABC}$) 1- $\frac{2}{3}.\frac{3}{4} . \frac{1}{3}$= 5/6	1 1 ½ ½ ½ 1 ½
29	Applying property$\int_0^a f(x)\, \boldsymbol{dx} \int_0^a f(a-x)\, \boldsymbol{dx}$ $I = \int_0^{\frac{\pi}{4}} \log(1 + \frac{1 - tanx}{1 + tanx})\, dx$ $I = \int_0^{\frac{\pi}{4}} \log 2\, dx - \int_0^{\frac{\pi}{4}} \log(1 + tanx)\, dx$ $I = log\ 2 . \frac{\pi}{8}$ OR Redefining the function $\lvert x^2 - 2x \rvert = \{ \begin{matrix} -(x^2 - 2x)\ if\ 1 \le x \le 2 \\ (x^2 - 2x)\ \ if\ 2 \le x \le 3 \end{matrix}$	½ 1 ½ 1 1 1 1

	$\int_1^3 \lvert x^2 \ - 2x \rvert \, dx = \int_1^2 -(x^2 \ - 2x)dx \ + \int_2^3 (x^2 \ - 2x)dx$ $\left[x^2 - \frac{x^3}{3}\right]_1^2 + \left[-x^2 + \frac{x^3}{3}\right]_2^3$= 2	
30	Put y =vx $\frac{dy}{dx} = v + x\frac{dv}{dx}$ $x(\ v + x\frac{dv}{dx}$)= vx $- \ x \ tan \ v$ $\frac{dv}{tanv}$ = $\frac{-dx}{x}$ $\int \frac{dv}{tanv} = \int \frac{-dx}{x}$ $\mathrm{logsinv} \ = \mathrm{logc/x}$ $\sin\frac{\mathrm{y}}{\mathrm{x}} = \mathrm{c/x}$ OR compare with $\frac{dy}{dx} + Py \ = Q$ P(x)=$\frac{2x}{1+x^2}$ Q(x) =($\frac{1}{1+x^2}$)^2 I. F =$e^{\int \frac{2x}{1+x^2}dx}$= $1 + x^2$ Solution of equations is Y. IF = $\int Q \ \times IF \ dx$ $\mathrm{y.(1+x^2)} = \int \frac{1}{1+x^2} \mathrm{dx}$ $\mathrm{y.(1+x^2)} = \tan^{-1}\mathrm{x}$ +c Using condition x=0, y =1 , c=$\frac{-\pi}{4}$ $\mathrm{y.(1+x^2)} = \tan^{-1}\mathrm{x} \ -\frac{\pi}{4}$	½ ½ ½ 1 ½ 1 1 1
31	 Coorect image	2 1

	Z(60,0)=300 Z(120,0)=600 Z(60,30)= 600 Z(40,20) = 400 MAXIMUM AT LINE X+2Y=120	
32	Let A = { x ∈ Z : 0 ≤ x ≤ 12} . Show that R = {(a, b) : a, b ∈ A , $\|a - b\|$ is divisible by 4 } Is an equivalence relation . Also write the equivalence class [2]. R is reflexive relation iff $\|a - a\| = 0$ is divisible by 4 which is true R is symmetric : Let aRb ⇔ $\|a - b\|$ is divisible by 4 ⇔ $\|b - a\|$ is divisible by 4⇔bRa R is transitive : Let aRb⇔ $\|a - b\|$ is divisible by 4 = $a - b = \pm 4m$ bRc ⇔ $\|b - c\|$ is divisible by 4 ⇔ $b - c = \pm 4n$ $a - c = \pm 4m \pm 4n$ aRc Equivalance class of [1]={1,5,9} OR To prove one one by taking $f(x_1)=f(x_2)$ $\Rightarrow \frac{4x_1}{3x_1+4}=\frac{4x_2}{3x_2+4} \quad \Rightarrow x_1=x_2$ $f(x) = \frac{4x}{3x+4} = y$ 3xy+4y =4x X(3y-4) =-4y $x = \frac{-4y}{3y-4}$ f is not onto as every element of y has preimage in x such that f(x) =y	1 1 1 2 1 2 1 2
33.	(a) $\overrightarrow{a_1} = \hat{\imath} + 2\hat{\jmath} + \hat{k} \quad \overrightarrow{a_2} = 2\hat{\imath} - \hat{\jmath} - \hat{k}$ $\overrightarrow{b_1} = \hat{\imath} - \hat{\jmath} + \hat{k} \quad b_2 = 2\hat{\imath} + \hat{\jmath} + 2\hat{k}$ $\overrightarrow{a_2} - \overrightarrow{a_1} = \hat{\imath} - 3\hat{\jmath} - 2\hat{k}$ $\overrightarrow{b_1} \times b_2 = -3\hat{\imath} + 0\,\hat{\jmath} + 3\hat{k}$ $I\overrightarrow{b_1} \times b_2 I = 3\sqrt{2}$ SD=$\frac{I\overrightarrow{(a_2 - \overrightarrow{a_1})}.\overrightarrow{(b_1} \times b_2)I}{\|\overrightarrow{(b_1} \times \overrightarrow{b_2}\|} = \frac{9}{3\sqrt{2}}$	1 1 1 1

	(b). Equation of line $\frac{x}{2}=\frac{y+1}{-2}=\frac{z-3}{4}$ put$\frac{x}{2}=\frac{y+1}{-2}=\frac{z-3}{4}$ =k find co ordinates of any poin on line BC (2k,-2k-1,4k+3) find the dr's of perpendicular from A ((2k-1,-2k-1-8,4k+3-4) Condition of perpendicular 2(2k-1)-2(-2k-9)+4(4k-1))=0 Value of k=1 Point (2,-3,7)	2 1 1
34	Find IAI = 4 Find adj(A)=$\begin{bmatrix}-2 & 0 & 2\\ 5 & -2 & -1\\ 1 & 2 & -1\end{bmatrix}$ Find A^{-1}=$\frac{1}{4}\begin{bmatrix}-2 & 0 & 2\\ 5 & -2 & -1\\ 1 & 2 & -1\end{bmatrix}$ The solution of system of equation is X = $(A^{-1})B$ X =$\frac{1}{4}\begin{bmatrix}-2 & 0 & 2\\ 5 & -2 & -1\\ 1 & 2 & -1\end{bmatrix}\begin{bmatrix}6\\ 7\\ 12\end{bmatrix}$ $\begin{bmatrix}x\\ y\\ z\end{bmatrix}$=$\begin{bmatrix}3\\ 1\\ 2\end{bmatrix}$ $x = 3, y = 1\ and\ z = 2$	1 1 ½ 1 1 ½
35	 Rough sketch Point of intersection in 1st quadrant by putting y =x in equation of circle , we have $(1\sqrt{3},)$ $\int_0^{\sqrt{3}}\frac{x}{\sqrt{3}}dx + \int_{\sqrt{3}}^{2}\sqrt{4-x^2}\,dx =$ $\frac{x^2}{2\sqrt{3}_0}^{\sqrt{3}} + \frac{x\sqrt{4-x^2}}{2} + \frac{4\sin^{-1}\frac{x^2}{2}}{2}_{\sqrt{3}}$ On solving	1 ½ 1 2 ½

<table>
<tr><td></td><td>$\sqrt{3}/2 + 2\frac{\pi}{2} - \sqrt{3}/2 \ + 2\sin^{-1}\frac{\sqrt{3}}{2}$
$\pi - \frac{\pi}{3} = 2\pi/3$</td><td></td></tr>
<tr><td>36</td><td>(i) (0,9)
(ii) $v = x(18 - 2x)^2$
(iii) (a)Find dv/dx ,
X=3
OR
(iii) Check maximum by second derivative testy or first derivative test on v
Maximum volume= 432 cube cm</td><td>1
1
2</td></tr>
<tr><td>37</td><td>(i) 3/5
(ii) X=14,15,16,17,19
(iii) (a).
<table>
<tr><td>x</td><td>14</td><td>15</td><td>16</td><td>17</td></tr>
<tr><td>P(x)</td><td>0.1</td><td>0.2</td><td>0.3</td><td>0.2</td></tr>
</table>
Mean =1.4+3.0+4.8+3.4+3.8=16.4
OR
(iii)(b) P(greater than 15)= 7/10
P(number greater than 15 which are composite)= 3/10
Reqiured probablity = 3/7</td><td>1
1
2</td></tr>
<tr><td>38</td><td>(1) F’(x)= $x^2 - 8x + 15$
Critical points 3,5
(i) F”(x)= 2x-8, minimum value exist at x=5
(ii) Minimum value 56/3 cm @ F</td><td>2
2</td></tr>
</table>

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