HARYANA STATE OPEN BOARD OF SCHOOLING

(2026-27)

Marking Scheme

Model Question Paper -MATHEMATICS

CODE: 835

⇨ Important Instructions: ● All answers provided in the Marking scheme are SUGGESTIVE.
● Examiners are requested to accept all possible alternative correct answer(s).

Q. No.	SECTION – A (1Mark × 24Q) EXPECTED ANSWERS	Marks
Q1.	(C) $(6, 8) \in R$	1
Q2.	(A) $\frac{\pi}{3}$	1
Q3.	(D) $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$	1
Q4.	(C) a square matrix	1
Q5.	(D) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	1
Q6.	(C) 1	1
Q7.	(B) f is continuous at x = a	1
Q8.	(C) $\frac{-1}{x^2}$	1
Q9.	(B) $2x. \cos(x^2 + 5)$	1
Q10.	(B) 12π	1
Q11.	(C) $-\cos x + \sin x + c$	1
Q12.	(A) $\frac{1}{3} e^{x^3} + C$	1
Q13.	(C) 0	1
Q14.	(A) 2	1
Q15.	1 sq. unit	1
Q16.	3 arbitrary constants	1
Q17.	Direction Cosines are 2/3, -1/3, -2/3	1
Q18.	$P(A\|B) = P(A \cap B) / P(B) \Rightarrow \frac{0.32}{0.50} \Rightarrow \frac{16}{25}$	1
Q19.	5	1
Q20.	P (A.B) = P(A) . P(B)	1
Q21.	B(4, 2)	1
Q22.	$P(A \cup B) = P(A) + P(B) \Rightarrow P(B) = P(A \cup B) - P(A) \Rightarrow \frac{3}{5} - \frac{1}{2} = \frac{1}{10}$	1

Q23.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	**1**
Q24.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A)	**1**
	SECTION - B	
Q25.	f = {(1, 4), (2, 5), (3, 6)} Since, $1 \rightarrow 4, 2 \rightarrow 5, 3 \rightarrow 6$ $\therefore$ Every element of A has unique image. Therefore, f is one to one function.	 **1** **1**
OR Q25.	$\cos^{-1}(\frac{1}{2}) + 2\sin^{-1}(\frac{1}{2})$ $= \frac{\pi}{3} + 2\,(\frac{\pi}{2})$ $= \frac{4\pi}{3}$	 **1** **1**
Q26.	$a_{ij} = \frac{(i+j)^2}{2}$ $a_{11} = \frac{(1+1)^2}{2} = 2$ $\qquad a_{12} = \frac{(1+2)^2}{2} = \frac{9}{2}$ $a_{21} = \frac{(2+1)^2}{2} = \frac{9}{2}$ $\qquad a_{22} = \frac{(2+2)^2}{2} = 8$ $\therefore A = \begin{bmatrix} 2 & \frac{9}{2} \\ \frac{9}{2} & 8 \end{bmatrix}$	**$1\frac{1}{2}$** **$\frac{1}{2}$**
OR Q26.	Vertices of triangle are (1, 0), (6, 0) and (4, 3). Area of a triangle $\Delta = \frac{1}{2}\begin{bmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{bmatrix}$ $\therefore \quad \Delta = \frac{1}{2}\begin{bmatrix} 1 & 0 & 1 \\ 6 & 0 & 1 \\ 4 & 3 & 1 \end{bmatrix} =$ $\Delta = \frac{1}{2}\{1(0-3) - 0(6-4) + 1(18-0)\}$ $\Delta = \frac{15}{2}$	 **1** **1**
Q27.	$x = \sin t,$ $\qquad y = \cos 2t$ $\frac{dx}{dt} = \cos t$ $\qquad \frac{dy}{dt} = -2\sin 2t$	 **1**

	$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-2\sin 2t}{\cos t}$	**1**
Q28.	$\int(1-x)\sqrt{x}\ .\ dx$ $= \int(1-x).\ x^{1/2}\ .\ dx$ $= \int\left(x^{1/2} - x^{3/2}\right).\ dx$ $= \frac{x^{3/2}}{3/2}$ - $\frac{x^{5/2}}{5/2} + c$	 **1** **1**
Q29.	Let $\vec{a}$ = $\hat{\imath}$ - 2$\hat{\jmath}$ +3$\hat{k}$ and $\vec{b}$ = 3$\hat{\imath}$ -2$\hat{\jmath}$ +$\hat{k}$ Angle between two vectors = $\cos\theta = \frac{\vec{a}.\vec{b}}{\lvert\vec{a}\rvert.\lvert\vec{b}\rvert}$ $\vec{a}.\vec{b}$ = ($\hat{\imath}$ - 2$\hat{\jmath}$ +3$\hat{k}$). ($\vec{b}$ = 3$\hat{\imath}$ -2$\hat{\jmath}$ +$\hat{k}$) $\vec{a}.\vec{b} = 1 - 4 + 3 = 0$ $\lvert\vec{a}\rvert = \sqrt{1+4+9} = \sqrt{13}$ $\lvert\vec{b}\rvert = \sqrt{9+4+1} = \sqrt{13}$ $\cos\theta = \frac{\vec{a}.\vec{b}}{\lvert\vec{a}\rvert.\lvert\vec{b}\rvert} = \frac{0}{\sqrt{13}.\sqrt{13}} = 0$ ⇨ $\theta = \frac{\pi}{2}$	 **1** **1**
Q30.	The lines $\frac{X-5}{7} = \frac{Y+2}{-5} = \frac{Z}{1}$ and $\frac{X}{1} = \frac{Y}{2} = \frac{Z}{3}$ Now the lines will be perpendicular if the product of their D.R.'s is 0. D.R. of given lines are < 7, -5, 1 > and <1, 2, 3 > Product = (7).(1) + (-5).(2) + (1).(3) = 7 – 10 + 3 = 0	 **1** **1**
Q31.	A and B be independent events with P(A) = 0.3 and P(B) = 0.4. (i) P (A ∩ B) For independent events P (A ∩ B) = P(A). P(B) = (0.3).(0.4) P (A ∩ B) = 0.12 (ii) Now P(A|B) = $\frac{P(A \cap B)}{P(B)}$	 **1**

$$= \frac{0.12}{0.4}$$
$$= \frac{3}{10}$$

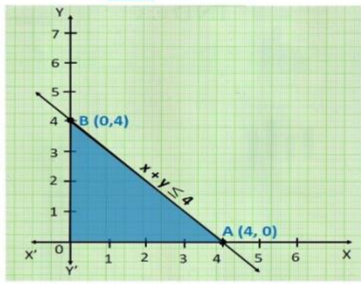
1

Q32.

Given Data:
Z = 3x + 4y
x + y ≤ 4
x ≥ 0, y ≥ 0
Feasible Region:
The boundary line is x + y = 4.
Corner points are (0, 0), (4, 0), (0, 4).

x + y ≤ 4

x	0	4
y	4	0



1

Corner-Point Table:

Corner Point	Z = 3x + 4y
(0, 0)	0
(4, 0)	12
(0, 4)	16

Final Result:
Maximum Z = 16 at (0, 4).

1

SECTION - C

Q33.

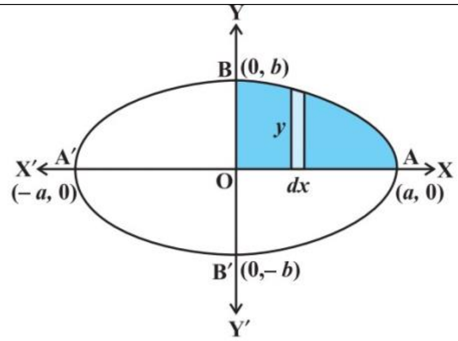
1. **Reflexive:**
For any line $L_1 \in L$, a line is always parallel to itself.
Therefore, $(L_1, L_1) \in R$. This satisfies the reflexive property. 1

2. Symmetric:
If $(L_1, L_2) \in R$, then L_1 is parallel to L_2. By the definition of parallel lines, L_2 is also parallel to L_1. Hence, $(L_2, L_1) \in R$, satisfying symmetry. 1

	3. Transitive: If $(L_1, L_2) \in R$ and $(L_2, L_3) \in R$, then L_1 is parallel to L_2 and L_2 is parallel to L_3. Parallel lines have the same slope, so L_1 and L_3 have the same slope, implying L_1 is parallel to L_3. Therefore, $(L_1, L_3) \in R$, satisfying transitivity. Since all three properties hold, R is an **equivalence relation**.	**1**
Q34.	We have $X + Y = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix}$ and $X - Y = \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$ Now $(X + Y) + (X - Y) = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix} + \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$ ⇨ $2X = \begin{bmatrix} 8 & 8 \\ 0 & 8 \end{bmatrix}$ ⇨ $X = \begin{bmatrix} 4 & 4 \\ 0 & 4 \end{bmatrix}$ Now $(X + Y) - (X - Y) = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix} - \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$ ⇨ $2Y = \begin{bmatrix} 2 & -4 \\ 0 & 10 \end{bmatrix}$ ⇨ $Y = \begin{bmatrix} 1 & -2 \\ 0 & 5 \end{bmatrix}$	$1\frac{1}{2}$ $1\frac{1}{2}$
OR Q34.	Area of triangle = 4 sq. units Again, area of triangle = $\frac{1}{2} \cdot \begin{vmatrix} k & 0 & 1 \\ 4 & 0 & 1 \\ 0 & 2 & 1 \end{vmatrix}$ $\Delta = \frac{1}{2}$ | k(0 – 2) – 0 (4 – 0) + 1(8 – 0) | $4 = \left\| \frac{-2k+8}{2} \right\|$ $\pm 4 = \frac{-2k+8}{2}$ ± 8 = -2k + 8 $-2k + 8 = 8$ or $-2k + 8 = -8$ ⇨ - 2k = 0 or -2 k = - 16	$1\frac{1}{2}$

	⇨ k = 0 or k = 8 ⇨ k = 0, 8	$1\frac{1}{2}$
Q35.	$$y = (\tan^{-1} x)^2$$ $$\Rightarrow y_1 = 2\ \tan^{-1} x \frac{d}{dx}(\tan^{-1} x)$$ $$y_1 = 2\ \tan^{-1} x . \frac{1}{1+x^2}$$ $(1+x^2).y_1 = 2\ \tan^{-1} x$ Diff. again we get: $$2x.y_1 + (1+x^2).y_2 = 2.\frac{1}{1+x^2}$$ So $$(x^2+1)^2 y_2 + 2x(x^2+1)y_1 = 2$$ Hence the result.	**0.5** **0.5** **1.5** **0.5**
OR Q35.	y = log ($\frac{1-x^2}{1+x^2}$) = log (1-x) $+ \log(1+x) - \log(1+x^2)$ $\frac{dy}{dx} = \frac{-1}{1-x} + \frac{1}{1+x} - \frac{2x}{1+x^2}$ $= \frac{-4x}{1-x^4}$	**1** **1.5** **0.5**
Q36.	Put $x^4 = y$ रखने पर Differentiating w.r.t. x: xके सापेक्ष अवकलन करने पर: $$4x^3 dx = dy$$ $$x^3 dx = \frac{dy}{4}$$ $$I = \int \frac{x^3}{\sqrt{1-x^8}}\, dx = \int \frac{dy}{4\sqrt{1-y^2}}$$ Using $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\frac{x}{a} + c$ (का उपयोग करते हुए) : then (तब): $$I = \frac{1}{4}\sin^{-1} y$$	**1** **1**

	Put $x^4 = y$ रखने पर: $$I = \frac{1}{4}\sin^{-1}(x^4) + C$$	1
Q37.	$y = a\ \cos x + b\sin x$ $\Rightarrow \frac{dy}{dx} = -a\sin x + b\cos x$ $\Rightarrow \frac{d^2x}{dy^2} = -a\cos x - b\sin x$ $\Rightarrow \frac{d^2x}{dy^2} = -y$ $\Rightarrow \frac{d^2x}{dy^2} + y = 0$	1 1 1
	SECTION - D	
Q38.	We note that $x^3 - x \geq 0$ on $[-1,0]$, $x^3 - x \leq 0$ on $[0,1]$ and that $x^3 - x \geq 0$ on $[1,2]$, So $\int_{-1}^{2}\lvert x^3 - x\rvert dx = \int_{-1}^{0}(x^3 - x)dx - \int_{0}^{1}(x^3 - x)dx + \int_{1}^{2}(x^3 - x)dx$ I=$\left[\frac{x^4}{4} - \frac{x^2}{2}\right]_{-1}^{0} + \left[\frac{x^2}{2} - \frac{x^4}{4}\right]_{0}^{1} + \left[\frac{x^4}{4} - \frac{x^2}{2}\right]_{1}^{2}$ I= $\left(-\frac{1}{4} + \frac{1}{2}\right) + \left(\frac{1}{2} - \frac{1}{4}\right) + (4-2) - \left(\frac{1}{4} - \frac{1}{2}\right)$ I= $\frac{11}{4}$	1.5 1 1.5 1
OR Q38.	Given ellipse is : $$\frac{x^2}{5^2} + \frac{y^2}{\sqrt{3}^2} = 1$$ $$\Rightarrow y = \sqrt{3}.\sqrt{1 - \frac{x^2}{5^2}} = \frac{\sqrt{3}}{5}\sqrt{5^2 - x^2}$$ (in figure) : $a = \pm 5 , b = \pm\sqrt{3}$	1

	 Required Area = $A = 4.\int_0^a y.dx$ $A = 4\int_0^5 \frac{\sqrt{3}}{5}\sqrt{5^2 - x^2}dx = \frac{4\sqrt{3}}{5}\int_0^5 \sqrt{5^2 - x^2}\ dx$ $\Rightarrow A = \frac{4\sqrt{3}}{5}\left[\frac{x}{2}\sqrt{25 - x^2} + \frac{25}{2}\sin^{-1}\frac{x}{5}\right]_0^5$ $A = \frac{4\sqrt{3}}{5}\left[\frac{25}{2} \times \frac{\pi}{2}\right] = 5\sqrt{3}\pi\ square\ units$	**1.5** **0.5** **1** **1**
Q39.	We have $A^2 = A.A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}$ $= \begin{bmatrix} 19 & 4 & 8 \\ 1 & 12 & 8 \\ 14 & 6 & 15 \end{bmatrix}$ $A^3 = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}\begin{bmatrix} 19 & 4 & 8 \\ 1 & 12 & 8 \\ 14 & 6 & 15 \end{bmatrix} = \begin{bmatrix} 63 & 46 & 69 \\ 69 & -6 & 23 \\ 92 & 46 & 63 \end{bmatrix}$ $A^3 - 23A - 40I = \begin{bmatrix} 63 & 46 & 69 \\ 69 & -6 & 23 \\ 92 & 46 & 63 \end{bmatrix} - 23\begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix} - 40\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 63 - 23 - 40 & 46 - 46 + 0 & 69 - 69 + 0 \\ 69 - 69 + 0 & -6 + 46 - 40 & 23 - 23 + 0 \\ 92 - 92 + 0 & 46 - 46 + 0 & 63 - 23 - 40 \end{bmatrix}$	**1** **1** **2** **1**

	$= \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} = O$, Hence Proved.	
OR Q39.	This system of equations can be written as: $$AX = B, where \text{ जहाँ}$$ $$A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$$ $$\Rightarrow \lvert A \rvert = 10 \neq 0$$ (Now): $$A_{11} = 4, A_{12} = -5, A_{13} = 1$$ $$A_{21} = 2, A_{22} = 0, A_{23} = -2$$ $$A_{31} = 2, A_{32} = 5, A_{33} = 3$$ $$adj\ A = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$$ (Thus): $$A^{-1} = \frac{1}{\lvert A \rvert}.adj\ A = \frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$$ (Since): $$X = A^{-1}B = \frac{1}{10}\begin{bmatrix} 16+0+4 \\ -20+0+10 \\ 4-0+6 \end{bmatrix}$$ $$X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$	**1** **1.5** **0.5** **0.5** **1.5**
Q40.	Comparing with $\vec{r} = \vec{a} + \lambda\vec{b}$ we get $\vec{a}_1$, $\vec{a}_2$, $\vec{b}_1$, $\overrightarrow{b_2}$ Now $\vec{a}_2 - \vec{a}_1 = -10\hat{\imath} - 2\hat{\jmath} - 3\hat{k}$ And $\vec{b}_1 \times \overrightarrow{b_2} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 1 & -2 & 2 \\ 3 & -2 & -2 \end{vmatrix} = 8\hat{\imath} + 8\hat{\jmath} + 4\hat{k}$	**1** **1** **1**

<table>
<tr><td></td><td>Shortest Distance = $\left|\frac{(\vec{b}_1 \times \vec{b_2}).(\vec{a}_2 - \vec{a}_1)}{|\vec{b}_1 \times \vec{b_2}|}\right|$

$= \left|\frac{-108}{12}\right| = 9\,units$</td><td>1

1</td></tr>
<tr><td>OR
Q40</td><td>We have $\vec{a} + \vec{b} = 2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$
And $\vec{a} - \vec{b} = -\hat{\jmath} - 2\hat{k}$

A vector which is perpendicular to both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ is given by

$$(\vec{a} + \vec{b}) \times (\vec{a} - \vec{b}) = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 2 & 3 & 4 \\ 0 & -1 & -2 \end{vmatrix}$$
$$= -2\hat{\imath} + 4\hat{\jmath} - 2\hat{k} (= \hat{c}, say)$$
$|\hat{C}| = \sqrt{4 + 16 + 4} = \sqrt{24} = 2\sqrt{6}$
Now the required unit vector is

$$\frac{\hat{c}}{|\hat{C}|} = -\frac{1}{\sqrt{6}}\hat{\imath} + \frac{2}{\sqrt{6}}\hat{\jmath} - \frac{1}{\sqrt{6}}\hat{k}$$</td><td>0.5
0.5

2

1

1</td></tr>
<tr><td>Q41.</td><td>Objective function : $Z = -x + 2y$
Given constraints are:
$$x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0$$
Consider the system of lines according to given constraints:

$x = 3$
<table><tr><td>x</td><td>3</td><td>3</td></tr><tr><td>y</td><td>0</td><td>1</td></tr></table>
$x + y = 5$
<table><tr><td>x</td><td>5</td><td>0</td></tr><tr><td>y</td><td>0</td><td>5</td></tr></table></td><td>

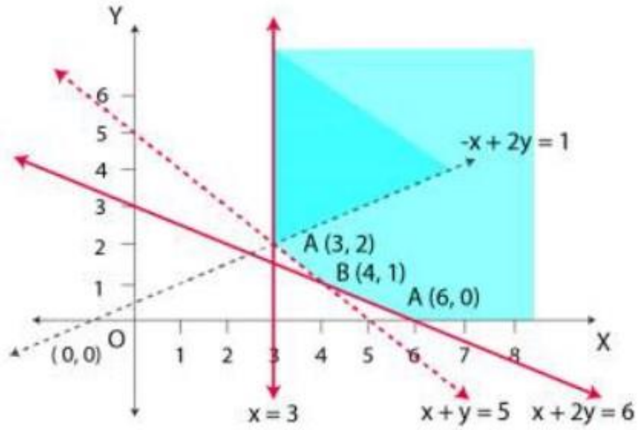
0.5

0.5</td></tr>
</table>

$x + 2y = 6$

x	6	0
y	0	3

0.5



1.5

Corner Point	$Z = -x + 2y$ (Value of Z)
(6,0)	-6
(4,1)	-2
(3,2)	1

1

Since feasible region is unbounded so we have to graph the inequality $Z > 1$ from which we find that resulting region has points in common with U.F.R. So Z has no maximum value. **1**

OR
Q41.

Let E= the chosen coin is two headed
F= the chosen coin is biased
G = the chosen coin is unbiased
Then E,F,G are mutually exclusive and exhaustive events. **1**
P(E)=P(F)=P(G)=$\frac{1}{3}$ **1**
Let A = the tossed coin shows head
Then P(A/E)=1 , P(A/F) = ¾ , P(A/G)=1/2 **1.5**
Using Bayes' Theorem :

	P(E/A) = $\frac{P(E).P(\frac{A}{E})}{P(E).P\left(\frac{A}{E}\right)+P(F).P\left(\frac{A}{F}\right)+P(G).P(\frac{A}{G})} = \frac{4}{9}$	**1.5**
Q42.	If $y = 3e^{2x} + 2e^{3x}$ Then $\frac{dy}{dx} = 6e^{2x} + 6e^{3x}$ And $\frac{d^2y}{dx^2} = 12e^{2x} + 18e^{3x}$ So $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y =$ = $12e^{2x} + 18e^{3x} -$ $30e^{2x} - 30e^{3x} + 18e^{2x} + 12e^{3x}$ = 0	**1.5** **1.5** **2**
OR Q42.	Here $f(x) = 4x^3 - 6x^2 - 72x + 30$ So $f'(x) = 12x^2 - 12x - 72$ = $12(x^2 - x - 6)$ = $12(x-3) + (x+2)$ Put $f'(x) = 0$ gives $x = 3, x = -2$ -∞ -2 3 ∞	**1** **1**

INTERVAL	SIGN OF $f'(x)$	Nature of $f(x)$	
$(-\infty, -2)$	> 0	f *is strictly increasing*	**1**
$(-2,3)$	< 0	f *is strictly decreasing*	**1**
$(3, \infty)$	> 0	f *is strictly increasing*	**1**