Marking Scheme

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Senior School Certificate Examination, 2024 (Comptt.)

MATHEMATICS PAPER CODE 65(B)/S

General Instructions: -

1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc. may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them.**
4	The Marking scheme carries only suggested value points for the answers. These are Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after deliberation and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark (√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓) while evaluating which gives the impression that answer is correct, and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totalled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	**In Q1-Q20, if a candidate attempts the question more than once (without canceling the previous attempt), marks shall be awarded for the first attempt only and the other answer scored out with a note "Extra Question".**
10	**In Q21-Q38, if a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note**

	“Extra Question”.
11	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
12	A full scale of marks __________ (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) must be used. Please do not hesitate to award full marks if the answer deserves it.
13	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.

14	Ensure that you do not make the following common types of errors committed by the Examiner in the past: - ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totalling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totalling on the title page. ● Wrong totalling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
15	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0) Marks.
16	Any unassessed portion, non-carrying over of marks to the title page, or totalling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
17	The Examiners should acquaint themselves with the guidelines given in the “**Guidelines for spot Evaluation**” before starting the actual evaluation.
18	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totalled and written in figures and words.
19	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

EXPECTED ANSWER/VALUE POINTS

SECTION A

Q.No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A (Question nos. 1 to 18 are Multiple Choice Questions carrying 1 mark each)	
1	If $y = (\sin x)^x$, then $\frac{dy}{dx}$ at $x = \frac{\pi}{2}$ is : (A) 1 (B) 0 (C) -1 (D) 2	
Ans	(B) 0	**1**
2.	If $A \begin{bmatrix} 5 & 4 \\ 6 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then the matrix A is : (A) $\begin{bmatrix} 7 & -6 \\ 9 & -8 \end{bmatrix}$ (B) $\begin{bmatrix} -7 & 6 \\ 9 & -8 \end{bmatrix}$ (C) $\begin{bmatrix} -7 & -9 \\ 6 & 8 \end{bmatrix}$ (D) $\begin{bmatrix} -7 & 6 \\ -9 & 8 \end{bmatrix}$	
Ans	(D) $\begin{bmatrix} -7 & 6 \\ -9 & 8 \end{bmatrix}$	**1**
3.	If $\begin{vmatrix} 2 & 4 & y \\ 3 & 9 & y \\ 2 & 1 & y \end{vmatrix} + 3 = 0$, then the value of y is : (A) 0 (B) 1 (C) -1 (D) 3	
Ans	(B) 1	**1**
4.	If B is a non-singular matrix of order 3 such that $B^2 = 2B$, then the value of $\lvert B \rvert$ is : (A) -2 (B) 2 (C) 4 (D) 8	
Ans	(D) 8	**1**
5.	If $\begin{bmatrix} 5 & 2x+3 \\ 3x-1 & x \end{bmatrix}$ is a symmetric matrix, then the value of x is : **(A) 4** **(B) 3** **(C) 2** **(D) 1**	
Ans	(A) 4	**1**

6.	The integrating factor of the differential equation $1+x^2 \frac{dy}{dx} + xy = \frac{1}{1+x^2}$ is : (A) $\log(1+x^2)$ (B) $(1+x^2)$ (C) $\sqrt{1+x^2}$ (D) $\frac{1}{1+x^2}$	
Ans	**Note: Due to printing error in question paper, one mark to be awarded for attempting the question**	**1**
7.	The order of the differential equation : $x\left(\frac{dy}{dx}\right)^4 + y\sin\left(\frac{d^2y}{dx^2}\right)^3 + y^4 = 0$ is : (A) 1 (B) 2 (C) 3 (D) not defined	
Ans	(B) 2	**1**
8.	$\int \frac{\sin(\cot^{-1}x)}{1+x^2}\, dx$ is equal to : (A) $\cos(\cot^{-1}x) + C$ (B) $-\cos(\cot^{-1}x) + C$ (C) $\sin(\tan^{-1}x) + C$ (D) $\cos(\tan^{-1}x) + C$	
Ans	(A) $\cos(\cot^{-1}x) + C$	**1**
9.	$\int \frac{x-2}{x+1^{\,4}} e^x\, dx$ is equal to : (A) $\frac{1}{x+1^{\,4}} e^x + C$ (B) $\frac{1}{x+1^{\,3}} e^x + C$ (C) $\frac{1}{x+1^{\,2}} e^x + C$ (D) $\frac{x}{x+1^{\,3}} e^x + C$	
Ans	**Note: Due to printing error in question paper, one mark to be awarded for attempting the question**	**1**
10.	If $P(E) = \frac{6}{11}$, $P(F) = \frac{5}{11}$ and $P(E \cup F) = \frac{7}{11}$, then $P(E/F)$ is : (A) $\frac{4}{7}$ (B) $\frac{4}{11}$ (C) $\frac{2}{3}$ (D) $\frac{4}{5}$	
Ans	(D) $\frac{4}{5}$	**1**
11.	Of all the points of the feasible region for maximum or minimum values of objective function in an LPP, the point lies (A) inside the feasible region (B) at the boundary line of the feasible region (C) at the corner point(s) of the feasible region (D) outside the feasible region	

Ans	(C) at the corner point(s) of feasible region	**1**
12.	The feasible region, for the constraints $x \geq 0$, $y \geq 0$ and $x + y \leq 2$ lies in : (A) IV quadrant (B) III quadrant (C) II quadrant (D) I quadrant	
Ans	(D) I quadrant	**1**
13.	The vector equation of a line passing through two points A (1, 2, 3) and B (2, – 2, –1) is : (A) $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(2\hat{i} - 2\hat{j} - \hat{k})$ (B) $\vec{r} = 2\hat{i} - 2\hat{j} - \hat{k} + \lambda(\hat{i} + 2\hat{j} + 3\hat{k})$ (C) $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - 4\hat{j} - 4\hat{k})$ (D) $\vec{r} = 2\hat{i} - 2\hat{j} - \hat{k} + \lambda(\hat{i} - 2\hat{j} - 3\hat{k})$	
Ans	(C) $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - 4\hat{j} - 4\hat{k})$	**1**
14.	If the points with position vectors $10\hat{i} + 3\hat{j}$, $12\hat{i} - 5\hat{j}$ and $a\hat{i} + 11\hat{j}$ are collinear, then 'a' is equal to : (A) – 8 (B) 4 (C) 8 (D) 12	
Ans	(c) 8	**1**
15.	A unit vector perpendicular to the two vectors $\vec{a} = -2\hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ is given by : (A) $\hat{i} + \hat{j}$ (B) $\hat{i} + \hat{k}$ (C) $-\frac{\hat{i}}{\sqrt{2}} - \frac{\hat{j}}{\sqrt{2}}$ (D) $\frac{\hat{i}}{\sqrt{2}} - \frac{\hat{j}}{\sqrt{2}}$	
Ans	(C) $-\frac{\hat{i}}{\sqrt{2}} - \frac{\hat{j}}{\sqrt{2}}$	**1**
16.	The area of a parallelogram, whose adjacent sides are represented by the vectors $\vec{a} = 5\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j} + 2\hat{k}$, is (in sq. units) : (A) $5\sqrt{7}$ (B) $7\sqrt{5}$ (C) $2\sqrt{65}$ (D) $49\sqrt{5}$	
Ans	**(B) $7\sqrt{5}$**	**1**

17.	The direction cosines of the line $\frac{4-x}{2} = \frac{y}{6} = \frac{z-1}{3}$ are (A) $\left\langle \frac{-2}{7}, \frac{6}{7}, \frac{-3}{7} \right\rangle$ (B) $\left\langle \frac{2}{7}, \frac{-6}{7}, \frac{3}{7} \right\rangle$ (C) $\left\langle \frac{-2}{7}, \frac{-6}{7}, \frac{-3}{7} \right\rangle$ (D) $\left\langle \frac{-2}{7}, \frac{6}{7}, \frac{3}{7} \right\rangle$	
Ans	(D) $< \frac{-2}{7}, \frac{6}{7}, \frac{3}{7} >$	**1**
18.	The number of all possible matrices of order 2×2 with each entry 0, 1 or 2 is : (A) 27 (B) 9 (C) 512 (D) 81	
Ans	(D) 81	**1**
	(Question Nos. 19 & 20 are Assertion-Reason based questions of 1 mark each)	
19.	**19.** *Assertion (A) :* The principal value of $\tan^{-1} \sqrt{3}$ is $\frac{\pi}{3}$. *Reason (R) :* $\tan \frac{\pi}{3} = \sqrt{3}$.	
Ans	(A) **Both (A) and (R) are true and (R) is correct explanation of (A)**	**1**
20.	*Assertion (A) :* $f(x) = \lvert x-5 \rvert$ is differentiable for all $x \in$ ¡ $- \{5\}$. *Reason (R) :* A differentiable function in ¡ is always continuous in ¡ .	
Ans	**Note: Due to printing error in question paper, one mark to be awarded for attempting the question**	**1**
	SECTION-B **(Question nos. 21 to 25 are very short Answer type questions carrying 2 marks each)**	
21.	(a) If the function $f(x) = \begin{cases} \frac{1-\cos 4x}{x^2}, & x < 0 \\ k, & x \leq 0 \end{cases}$ is continuous at $x = 0$, find the value of k. **OR** (b) If $\sin^2 x + \cos^2 y = 1$, find $\frac{dy}{dx}$.	
Ans	(a) LHL = $\lim_{x \to 0-} \frac{2\sin^2 2x}{x^2} = 2.4 = 8$ f(0) = k k = 8 **OR** (b) Differentiating both sides we get $2\sin x \cos x - 2\sin y \cos y \frac{dy}{dx} = 0$	**1** **½** ½ **$1\frac{1}{2}$**

	$\frac{dy}{dx} = \frac{sin2x}{sin2y}$ OR $\frac{sinxcosx}{sinycosy}$	$\frac{1}{2}$
22.	(a) Find the principal value of $\cos^{-1}\left(\cos\frac{2\pi}{3}\right) + \sin^{-1}\left(\sin\frac{2\pi}{3}\right)$. **OR** (b) Find the domain of $\cos^{-1}(3x - 2)$.	
Ans	(a) Required value $= \frac{2\pi}{3} + \frac{\pi}{3}$ $= \pi$ OR (b) $-1 \leq 3x-2 \leq 1$ Gives $\frac{1}{3} \leq x \leq 1$ or [1/3, 1]	$\frac{1}{2} + 1$ $\frac{1}{2}$ 1 1
23.	Volume of a spherical balloon is increasing at the rate of 25 cm^3/s. Find the rate of change of its surface area when the radius is 4 cm.	
Ans	$V = \frac{4\pi}{3}r^3$ $\frac{dv}{dt} = \frac{4\pi}{3}3r^2\frac{dr}{dt} \Rightarrow \frac{dr}{dt} = \frac{25}{4\pi r^2}$ $S = 4\pi r^2 \Rightarrow \frac{dS}{dt} = 4\pi.2r\frac{dr}{dt}$ $\frac{dS}{dt}(at\ r = 4) = \frac{25}{2}\ cm^2/s$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
24.	Find : $\int \frac{1}{\sqrt{5-6x-x^2}}dx$.	
Ans	Given integral $= \int \left(\frac{dx}{\sqrt{14-(x+3)^2}}\right)$ $= sin^{-1}\frac{x+3}{\sqrt{14}} + C$	1 1
25.	Prove that $f(x) = \sin x + \sqrt{3}\cos x$ has maximum value at $x = \frac{\pi}{6}$.	
Ans	f '(x) = cosx - $\sqrt{3}$ sinx Clearly f '($\frac{\pi}{6}$) = 0 f ''(x) = -sinx - $\sqrt{3}$ cosx Clearly f ''($\frac{\pi}{6}$) < 0	½ ½ ½

	Hence f(x) is maximum at x = $\frac{\pi}{6}$	½
SECTION-C **(Question nos. 26 to 31 are short Answer type questions carrying 3 marks each)**		
26.	Find : $\int \frac{3x-2}{(x+1)^2(x+3)}\,dx$.	
Ans	Let I = $\int \frac{3x-2}{(x+1)^2(x+3)}dx$ Let $\frac{3x-2}{(x+1)^2(x+3)} = \frac{A}{(x+3)} + \frac{B}{(x+1)} + \frac{C}{(x+1)^2}$ Solving we get A = -11/4 B = 11/4 and C = -5/2 $\frac{3x-2}{(x+1)^2(x+3)} = \frac{-11}{4(x+3)} + \frac{11}{4(x+1)} + \frac{-5}{2(x+1)^2}$ Integrating to get ∴ I = $\frac{-11}{4}\log\|x+3\| + \frac{11}{4}\log\|x+1\| + \frac{5}{2(x+1)} + C$	½ 1 1 ½
27.	(a) Evaluate : $\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\cot x}}$. **OR** (b) Evaluate : $\int_0^{\pi/4} \sin 2x \sin 3x\,dx$	
Ans	Let I = $\int_{\pi/6}^{\pi/3} \frac{1}{1+\sqrt{cotx}}dx = \int_{\pi/6}^{\pi/3} \frac{\sqrt{sinx}}{\sqrt{sinx}+\sqrt{cosx}}dx$ Using property = $\int_a^b f(x)dx = = \int_a^b f(a+b-x)dx$ we get I = $\int_{\pi/6}^{\pi/3} \frac{\sqrt{cosx}}{\sqrt{cosx}+\sqrt{sinx}}dx$ **Adding we get** **2I** = $\int_{\pi/6}^{\pi/3} \frac{\sqrt{sinx}+\sqrt{cosx}}{\sqrt{sinx}+\sqrt{cosx}}dx = \int_{\pi/6}^{\pi/3} 1dx$ $= x\Big\|_{\frac{\pi}{6}}^{\frac{\pi}{3}} = \frac{\pi}{6}$ I = $\frac{\pi}{12}$ **OR** Given integral = $\int_0^{\pi/4} \frac{cosx-cos5x}{2}dx$ $= \frac{5sinx-sin5x}{10}\Big\|_0^{\frac{\pi}{4}}$ $= \frac{3\sqrt{2}}{10}$	½ 1 ½ ½ ½ 1 1 1
28.	(a) If y = tan x + sec x, prove that $\frac{d^2y}{dx^2} = \frac{\cos x}{(1-\sin x)^2}$	

Ans	$\frac{dy}{dx} = \sec^2 x + secx\ tanx$ $= \frac{1+\text{sinx}}{(\cos x)^2}$ $= \frac{1+\text{sinx}}{1-\sin^2 x}$ $= \frac{1}{1-sinx}$ getting $\boldsymbol{\frac{d^2y}{dx^2}}$	**1** ½ ½ ½ ½
29.	(a) Find the general solution of the differential equation $x^2 \frac{dy}{dx} = 2xy + y^2$. **OR** (b) Find the particular solution of the differential equation $\frac{dy}{dx} - 3y \cot x = \sin 2x$; given that $y = 2$ when $x = \frac{\pi}{2}$.	
Ans	(a) Given differential equation can be written as $\frac{dy}{dx} = \frac{2xy+y^2}{x^2}$ --------- (i) Let y = vx $\Rightarrow \frac{dv}{dx}$ = v + x$\frac{dv}{dx}$ substituting in (i) We get v + x$\frac{dv}{dx}$ = v^2 + 2v $\Rightarrow \frac{dv}{v+v^2} = \frac{dx}{x}$ Integrating both sides, we get $\int \frac{dv}{v\,(v+1)} = \log\lvert x\rvert + C$ $\int \frac{dv}{v} - \int \frac{dv}{(v+1)} = \log\lvert x\rvert + C$ logv – log (v+ 1) = log│x│+ C $log\frac{v}{v+1} = \log\lvert x\rvert + \log K$ $\frac{y}{y+x} = kx$ **OR** **(b)** Integrating factor = $e^{\int -3cotxdx} = e^{-3logsinx} = cosec^3x$ Solution is y.$cosec^3x$ = $\int 2sinxcosx.cosec^3xdx + C$ $= \int \frac{2cosx}{\sin^2 x} dx + C$	 ½ ½ ½ ½ ½ ½ ½ ½

	Let sin x = t cosx dx = dt $\therefore \int \frac{2cosx}{\sin^2 x}$ dx = $\int \frac{2dt}{t^2}$ dx = $\frac{-2}{t} = \frac{-2}{sinx}$ $\therefore$ ycosec^{3}x = $\frac{-2}{sinx} + C$ y($\frac{\pi}{2}$) = 2 gives C = 4 **Particular solution is y.cosec^{3}x = $\frac{-2}{sinx}$ + 4** or y = -2sin^{2}x + 4 sin^{3}x	½ ½ ½ ½
30.	(a) Bag I contains 4 red and 5 black balls while Bag II contains 3 red and 6 black balls. One ball is drawn at random from one of the bags and is found to be red. Find the probability that it was drawn from Bag I. **OR** (b) A coin is biased so that the head is three times as likely to occur as tail. If the coin is tossed twice, find the probability distribution of number of tails. Also, find the mean of the distribution.	
Ans	(a) E_1 = Bag I is chosen E_2 = Bag II is chosen A = Red ball is drawn $P(E_1) = P(E_2) = ½$ $P(A/E_1) = 4/9$ and $P(A/E_2) = 3/9$ $P(E_1/A) = \frac{P(E1)P(A/E1)}{P(E1)P(A/E1)+P(E2)P(A/E2)}$ $= \frac{\frac{1}{2}\cdot\frac{4}{9}}{\frac{1}{2}\cdot\frac{4}{9}+\frac{1}{2}\cdot\frac{3}{9}}$ $= \frac{4}{7}$ OR (b) P(Head) = ¾ and P(T) = ¼	½ 1 1 ½ ½

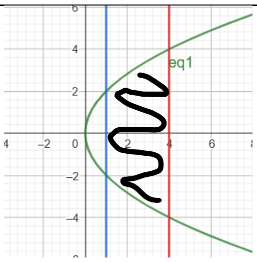
X	0	1	2
P(X)	9/16	6/16	1/16
XP(X)	0	6/16	2/16

(marks: ½, 1, ½)

Mean = 8/16 or ½ — ½

31.	The corner points of the feasible region determined by the system of linear constraints in an LPP are (0, 10), (5, 5), (15, 15) and (0, 20). Let z = px + q, p, q > 0, be the objective function, then find the relation between p and q so that the maximum of z occurs at both the points (15, 15) and (0, 20).	
Ans	Value of z at (15, 15) = 15p + q Value of z at (0, 20) = q 15p + q = q or p = 0	**1** **1** **1**
	SECTION-D **(Question nos. 32 to 35 are Long Answer type questions carrying 5 marks each)**	
32.	(a) If R is the relation defined on set A = {1, 2, 3, ..., 12} by R = {(x, y) : $\|x - y\|$ is divisible by 2}, show that R is an equivalence relation. Also, find [2]. **OR** (b) Show that the function f in A = $\mathbb{R} - \left\{\frac{2}{3}\right\}$ defined as $f(x) = \frac{4x+3}{6x-4}$ is one-one and onto.	
Ans	For reflexive |x-x| = 0 is divisible by 2 ∴ (x, x) ∈R for all x ∈A	 **1**
	∴ R is reflexive	**½**
	For symmetric Let (x, y) ∈R ∴ |x – y| is divisible by 2 ∴ |y – x| is divisible by 2	 **1**
	∴ (y, x) ∈ R ∴ R is symmetric	 **½**
	For Transitive Let (x, y) ∈ R and (y, z) ∈ R ∴ |x – y| is divisible by 2 and |y – z| is divisible by 2 x – y = ±2p and y – z = ±2q	 **1**
	x – z = ±2p ± 2q ∴ |x – z| is divisible by 2 ∴ (x, z) ∈R R is transitive	**½**
	Hence R is an equivalence relation **[2] = {2, 4, 6, 8, 10, 12}**	 **½**
	OR	
	For one- one **Let f(x) = f(y)** $\frac{4x+3}{6x-4} = \frac{4y+3}{6y-4}$ (4x + 3)(6y-4) = (4y+3)(6x-4)	 **1**

	24xy – 16x + 18y -12 = 24xy – 16y + 18x -12 -34x = -34y x = y ∴ f is one-one **For Onto** **Let y = f(x)** y = $\frac{4x+3}{6x-4}$ gives x = $\frac{4y+3}{6y-4}$ Range = Co-domain Hence f is onto	**1** ½ ½ **2**
33.	(a) Solve the following system of equations, using matrices : 3x – y + z = 5 2x – 2y + 3z = 7 x + y – z = – 1 **OR** (b) If $A^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$, find $(AB)^{-1}$.	
Ans	(a) Given system is $\begin{bmatrix} 3 & -1 & 1 \\ 2 & -2 & 3 \\ 1 & 1 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 7 \\ -1 \end{bmatrix}$ A . X = B ⇒ X = A^{-1}B |A| = -4 ≠ 0 A_{11} = -1 A_{12} = 5 A_{13} = 4 A_{21} = 0 A_{22} = –4 A_{23} = -4 A_{31} = -1 A_{32} = -7 A_{33} = – 4 ∴ $A^{-1} = \frac{1}{-4}\begin{bmatrix} -1 & 0 & -1 \\ 5 & -4 & -7 \\ 4 & -4 & -4 \end{bmatrix}$ ⇒ $X = \frac{1}{-4}\begin{bmatrix} -1 & 0 & -1 \\ 5 & -4 & -7 \\ 4 & -4 & -4 \end{bmatrix}\begin{bmatrix} 5 \\ 7 \\ -1 \end{bmatrix} = \frac{1}{-4}\begin{bmatrix} -4 \\ 4 \\ -4 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$ ∴ x = 1 y = -1 z = 1 (b) $B = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$, $A^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$ $(AB)^{-1} = B^{-1}A^{-1}$ |B| = 1(3) – 2(– 1) – 2(2) = 3 + 2 – 4 = 1 ≠ 0 **adj(B)** = $\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$ $B^{-1} = \frac{1}{1}\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$	½ 1 2 ½ 1 1 1 1 ½ ½

	$\therefore B^{-1}A^{-1} = \begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix} \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$ $= \begin{bmatrix} 9 & -3 & 5 \\ -2 & 1 & 0 \\ 1 & 0 & 2 \end{bmatrix}$	1
34.	Find the area of the region bounded by $y^2 = 4x$, $x = 1$ and $x = 4$, using integration.	
Ans	 Required area $= 2\int_1^4 2\sqrt{x}\,dx$ $= \frac{8}{3} x^{3/2}\Big\vert_1^4$ $= \frac{56}{3}$	**2** **2** **1**
35.	Show that the lines $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ intersect. Also, find their point of intersection.	
Ans	Any point on line 1 is $(3\lambda-1, 5\lambda-3, 7\lambda-5)$ Any point on line 2 is $(\mu + 2, 3\mu + 4, 5\mu + 6)$ For point of intersection, Let $3\lambda-1 = \mu + 2$, $5\lambda-3 = 3\mu + 4$ Solving we get $\lambda = 1/2$ and $\mu = -3/2$ These values satisfy $7\lambda-5 = 5\mu + 6$ Therefore, lines intersect each other Required point is (1/2, -1/2, -3/2)	**1** **1** **1** **1** ½ ½

SECTION-E

(Question nos. 36 to 38 are source based/case based/passage based/integrated units of assessment questions carrying 4 marks each)

36.	**Case Study – 1** (a) A magazine company circulates its magazine on a monthly basis to its readers. It has 5000 readers on its list and charges a fixed amount of ₹ 2000 per reader annually. Before going for increase in subscription, the company had an online survey which predicted that for every increase of ₹ 2, one reader will discontinue the service of this company.	

	Based on the above information, answer the following questions : (i) Suppose the company increases ₹ 2x of each reader, then find the earnings of the company R(x) represented in terms of x. *1* (ii) Find $\frac{d}{dx}$ (R(x)). *1* (iii) (a) What increase of each reader will bring maximum earning for the company ? Verify your answer. *2* **OR** (b) Find the increase per reader for maximum R(x). Find maximum R(x). *2*	
Ans	(i) R(x) = (2000 + 2x) (5000 – x) (ii) $\frac{d(R(x))}{dx}$ = 2(5000-x) + (2000 +2x)(-1) OR 8000 -4x (iii) (a) For maximum earning, R'(x) = 0, i.e., 8000-4x = 0 x = 2000 R''(x) = -4 < 0 hence R(x) is maximum for x = 2000 OR (iv) (b) For maximum earning, R'(x) = 0, i.e., 8000-4x = 0 x = 2000 R''(x) = -4 < 0 hence R(x) is maximum for x = 2000 Increase per Reader = 4000 and Maximum R(x) = Rs 1,80,00,000	1 1 **1** ½ ½ 1 ½ ½
37.	**Case Study – 2** (a) A mobile tower standing vertically at the top of a hill is such that the coordinates of its top point is P (3, 5, 4) and it is tied with 3 cables from the points A (2, 2, 5) B (4, 1, 4) and C (2, 4, 4) on the ground surface. Based on the above information, answer the following questions : (i) Find $\lvert \overrightarrow{AP} \rvert$. *1* (ii) Find $\lvert \overrightarrow{BP} \rvert$. *1* (iii) (a) Find the direction ratios of vector $\overrightarrow{CP}$. *2* **OR** (b) Find a unit vector along the vector $\overrightarrow{BP}$. *2*	
Ans	(i) $\overrightarrow{AP} = \hat{i} + 3\hat{j} - \hat{k}$ and $\lvert\overrightarrow{AP}\rvert = \sqrt{11}$	**½ + ½**

	(ii) $\overrightarrow{BP} = -\hat{i} + 4\hat{j}$ and $\lvert\overrightarrow{BP}\rvert = \sqrt{17}$	½ + ½
	(iii) (a) $\overrightarrow{CP} = \hat{i} + \hat{j}$ drs are 1, 1, 0	**1** **1**
	OR (b) $\overrightarrow{BP} = -\hat{i} + 4\hat{j}$ and $\lvert\overrightarrow{BP}\rvert = \sqrt{17}$ Unit vector along $\overrightarrow{BP} = \frac{-1}{\sqrt{17}}\hat{i} + \frac{4}{\sqrt{17}}\hat{j}$	**1** 1
38.	**Case Study – 3** (a) In your school, on the sports day, X denotes the number of sports events you take part in and P(X = x) denotes your probability of winning in x number of events. It is given that : $P(X) = \begin{cases} 3k, & x=0 \\ 2k, & x=1 \\ k, & x=2 \text{ or } 3 \\ 0, & \text{otherwise} \end{cases}$ Based on the above, answer the following questions : (i) Find the value of k. *1* (ii) Find the probability of winning in at most one game. *1* (iii) (a) Find the probability of winning in at least one game. *2* **OR** (b) Find the mean number of games you win. *2*	
Ans	(i) 3k + 2k + k + k = 1 gives k = 1/7	½ + ½
	(ii) P(X< 2) = 5k = 5/7	**1**
	(iii) (a) P(X > 0) = 2k + k + k = 4/7	**1** **1**
	OR (c) Mean = ∑pi.xi = 0 + 2k + 2k + 3k = 7k = 1	**1** **1**