

Strictly Confidential: (For Internal and Restricted use only)
Senior Secondary School Term II Examination, 2022
Marking Scheme – MATHEMATICS (SUBJECT CODE — 041)
(PAPER CODE — 65/3/3)

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 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 marks be awarded to them. In class-XII, while evaluating two competency based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, marks should be awarded.**
4. 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. 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.
5. Evaluators will mark(\checkmark) wherever answer is correct. For wrong answer ‘X’ be marked. Evaluators will not put right kind of mark while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
6. 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 totaled up and written in the left-hand margin and encircled. This may be followed strictly.
7. 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.
8. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
9. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

10. A full scale of marks _____ 0 to 40 _____ (example 0-40 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
11. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 30 answer books per day in main subjects and 35 answer books per day in other subjects (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.
12. 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 a reply.
 - 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.
 - 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.
13. 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.
14. 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, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
15. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.
16. 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.
17. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

MATHEMATICS (Subject Code — 041)

[Paper Code — 65/3/3]

Maximum Marks: 40

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
SECTION—A		
1.	If the distance of the point (1, 1, 1) from the plane $x - y + z + \lambda = 0$ is $\frac{5}{\sqrt{3}}$, find the value(s) of λ .	2
Sol.	Distance of point (1, 1, 1) from $x - y + z + \lambda = 0$ is	$\frac{1}{2}$
	$\frac{ 1+\lambda }{\sqrt{3}}$	1
	$\frac{ 1+\lambda }{\sqrt{3}} = \frac{5}{\sqrt{3}} \Rightarrow 1 + \lambda = \pm 5$	$\frac{1}{2}$
	$\lambda = -6$ or $+4$	2
2.	Write the projection of the vector $(\vec{b} + \vec{c})$ on the vector \vec{a} , where $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$.	2
Sol.	$\vec{b} + \vec{c} = 3\hat{i} + \hat{j} + 2\hat{k}$	$\frac{1}{2}$
	Projection of $\vec{b} + \vec{c}$ on $\vec{a} = \frac{(\vec{b}+\vec{c}) \cdot \vec{a}}{ \vec{a} }$	1
	$= \frac{(3\hat{i} + \hat{j} + 2\hat{k}) \cdot (2\hat{i} - 2\hat{j} + \hat{k})}{\sqrt{9}}$	$\frac{1}{2}$
	$= \frac{6 - 2 + 2}{3} = \frac{6}{3} = 2$	2
3.	Find the general solution of the differential equation : $\frac{dy}{dx} = \frac{3e^{2x} + 3e^{4x}}{e^x + e^{-x}}$	2
Sol.	$\frac{dy}{dx} = \frac{3e^{2x} + 3e^{4x}}{e^x + e^{-x}}$ $\frac{dy}{dx} = \frac{3e^{2x}(1 + e^{2x})}{e^x + \frac{1}{e^x}}$	

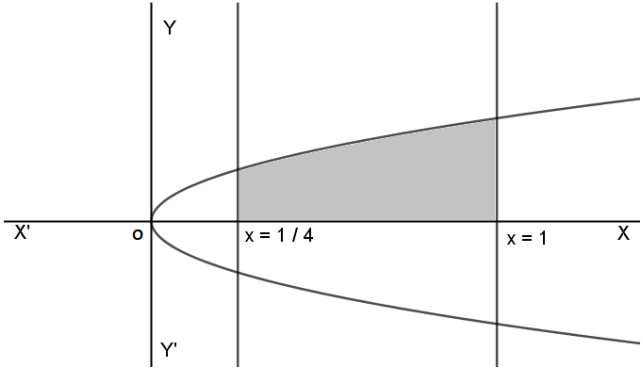
	$= \frac{3e^{2x}(1+e^{2x})}{e^{2x}+1} \times e^x$ $\frac{dy}{dx} = 3e^{3x}$ $\int dy = \int 3e^{3x} dx$ $y = e^{3x} + C$	1								
		1								
		2								
4.	Two cards are drawn successively with replacement from a well shuffled pack of 52 cards. Find the probability distribution of the number of spade cards.	2								
Sol.	Let X denotes the number of spades $p = \frac{13}{52} = \frac{1}{4}, q = \frac{3}{4}$ <table><tr><td>X</td><td>0</td><td>1</td><td>2</td></tr><tr><td>P(X)</td><td>$\frac{3}{4} \cdot \frac{3}{4} = \frac{9}{16}$</td><td>$2 \cdot \frac{3}{4} \cdot \frac{1}{4} = \frac{6}{16}$</td><td>$\frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$</td></tr></table>	X	0	1	2	P(X)	$\frac{3}{4} \cdot \frac{3}{4} = \frac{9}{16}$	$2 \cdot \frac{3}{4} \cdot \frac{1}{4} = \frac{6}{16}$	$\frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$	$\frac{1}{2}$ $1\frac{1}{2}$
X	0	1	2							
P(X)	$\frac{3}{4} \cdot \frac{3}{4} = \frac{9}{16}$	$2 \cdot \frac{3}{4} \cdot \frac{1}{4} = \frac{6}{16}$	$\frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$							
		2								
5.	Find : $\int \frac{dx}{x^2 - 6x + 13}$	2								
Sol.	$\int \frac{dx}{x^2 - 6x + 13}$ $= \int \frac{dx}{(x-3)^2 + (2)^2}$ $= \frac{1}{2} \tan^{-1} \frac{(x-3)}{2} + C$	1 1 2								
6.(a)	A pair of dice is thrown and the sum of the numbers appearing on the dice is observed to be 7. Find the probability that the number 5 has appeared on atleast one die.	2								
Sol.	A: sum is 7 B: 5 has appeared at least on one die $A \cap B = \{(2,5), (5,2)\}$ $P\left(\frac{B}{A}\right) = \frac{P(A \cap B)}{P(A)} = \frac{2/36}{6/36} = \frac{1}{3}$	$\frac{1}{2}$ $\frac{1}{2}$ 1 2								
	OR									


6.(b)	The probability that A hits the target is $\frac{1}{3}$ and the probability that B hits it, is $\frac{2}{5}$. If both try to hit the target independently, find the probability that the target is hit.	3
Sol.	$E_1 = A$ hits the target $E_2 = B$ hits the target $P(\text{target is hit}) = 1 - P(\text{target is not hit})$ $= 1 - \left(\frac{2}{3} \cdot \frac{3}{5}\right) = \frac{3}{5}$	1 1 2
SECTION—B		
7.	Find the shortest distance between the following lines : $\vec{r} = 3\hat{i} + 5\hat{j} + 7\hat{k} + \lambda(\hat{i} - 2\hat{j} + \hat{k})$ and $\vec{r} = (-\hat{i} - \hat{j} - \hat{k}) + \mu(7\hat{i} - 6\hat{j} + \hat{k})$.	3
Sol.	$\vec{a}_1 = 3\hat{i} + 5\hat{j} + 7\hat{k}$ $\vec{b}_1 = (\hat{i} - 2\hat{j} + \hat{k})$ $\vec{a}_2 = -\hat{i} - \hat{j} - \hat{k}$ $\vec{b}_2 = 7\hat{i} - 6\hat{j} + \hat{k}$ $(\vec{a}_2 - \vec{a}_1) = -4\hat{i} - 6\hat{j} - 8\hat{k}$, $\vec{b}_1 \times \vec{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 1 \\ 7 & -6 & 1 \end{vmatrix} = 4\hat{i} + 6\hat{j} + 8\hat{k}$ $(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2) = -16 - 36 - 64 = -116$ $ \vec{b}_1 \times \vec{b}_2 = \sqrt{16 + 36 + 64} = \sqrt{116}$ $\text{S.D.} = \frac{ -116 }{\sqrt{116}} = \sqrt{116}$	$\frac{1}{2}+1$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 3
8.(a)	The two adjacent sides of a parallelogram are represented by vectors $2\hat{i} - 4\hat{j} + 5\hat{k}$ and $\hat{i} - 2\hat{j} - 3\hat{k}$. Find the unit vector parallel to one of its diagonals. Also, find the area of the parallelogram.	3
Sol.	One diagonal of the parallelogram $= (2\hat{i} - 4\hat{j} + 5\hat{k}) + (\hat{i} - 2\hat{j} - 3\hat{k})$ $= 3\hat{i} - 6\hat{j} + 2\hat{k}$ Unit vector parallel to the diagonal $= \frac{3\hat{i} - 6\hat{j} + 2\hat{k}}{\sqrt{9 + 36 + 4}}$ $= \frac{3}{7}\hat{i} - \frac{6}{7}\hat{j} + \frac{2}{7}\hat{k}$	1 1

	<p>Vector area of parallelogram $= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -4 & 5 \\ 1 & -2 & -3 \end{vmatrix}$</p> <p>$= \hat{i}(22) - \hat{j}(-11) + \hat{k}(0)$</p> <p>$= 22\hat{i} + 11\hat{j}$</p> <p>Area $= \sqrt{484 + 121} = \sqrt{605} = 11\sqrt{5}$</p>	1
		3
	OR	
8.(b)	<p>If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are such that the vector $(\vec{a} + \lambda\vec{b})$ is perpendicular to vector \vec{c}, then find the value of λ.</p>	3
Sol.	<p>$(\vec{a} + \lambda\vec{b}) \cdot \vec{c} = 0 \Rightarrow [(2 - \lambda)\hat{i} + (2 + 2\lambda)\hat{j} + (3 + \lambda)\hat{k}] \cdot (3\hat{i} + \hat{j}) = 0$</p> <p>$\Rightarrow 3(2 - \lambda) + (2 + 2\lambda) \cdot 1 = 0$</p> <p>$\Rightarrow -3\lambda + 2\lambda + 6 + 2 = 0$</p> <p>$\Rightarrow \lambda = 8$</p>	$\frac{1}{2} + 1$ 1 $\frac{1}{2}$
		3
9.(a)	<p>Find the particular solution of the differential equation $x \frac{dy}{dx} - y = x^2 \cdot e^x$, given $y(1) = 0$.</p>	3
Sol.	<p>$\frac{dy}{dx} - \frac{y}{x} = \left(\frac{x^2}{x}\right)e^x = xe^x$</p> <p>$I \cdot F = e^{\int -\frac{1}{x} dx} = e^{-\log x} = e^{\log x^{-1}} = \frac{1}{x}$</p> <p>Solution is $y \times \frac{1}{x} = \int e^x dx$</p> <p>$\frac{y}{x} = e^x + C$</p> <p>$y = xe^x + Cx$</p> <p>$C = -e$</p> <p>Particular solution is</p> <p>$y = xe^x - ex$</p>	$\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
		3
	OR	

9.(b)	Find the general solution of the differential equation $x \frac{dy}{dx} = y(\log y - \log x + 1)$.	3
Sol.	$x \frac{dy}{dx} = y[\log y - \log x + 1]$ $\frac{dy}{dx} = \frac{y}{x} \left[\log \frac{y}{x} + 1 \right]$ $y = vx$ $\frac{dy}{dx} = v + x \frac{dv}{dx}$ $v + x \frac{dv}{dx} = v[\log v + 1]$ $x \frac{dv}{dx} = v \log v$ $\int \frac{dv}{v \log v} = \int \frac{1}{x} dx$ $\log \log v = \log x + \log C$ $\log \left(\frac{y}{x} \right) = Cx$	<div>1/2</div> <div>1/2</div> <div>1/2</div> <div>1/2</div> <div>1/2</div> <div>1/2</div> <div>3</div>
10.	Evaluate : $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (\sin x + \cos x) dx$	3
Sol.	$I = \int_{-\pi/2}^{\pi/2} (\sin x + \cos x) dx$ $f(x) = \sin x + \cos x $ $f(x) \text{ is an even function}$ $I = 2 \int_0^{\pi/2} (\sin x + \cos x) dx$ $= 2 \int_0^{\pi/2} (\sin x + \cos x) dx$ $= 2[-\cos x]_0^{\pi/2} + [\sin x]_0^{\pi/2}$ $= 2[1 + 1]$ $= 4$	<div>1/2</div> <div>1/2</div> <div>1/2</div> <div>1</div> <div>1/2</div> <div>3</div>
SECTION—C		

11.	Find the distance of the point (1, -2, 9) from the point of intersection of the line $\vec{r} = 4\hat{i} + 2\hat{j} + 7\hat{k} + \lambda(3\hat{i} + 4\hat{j} + 2\hat{k})$ and the plane $\vec{r} \cdot (\hat{i} - \hat{j} + \hat{k}) = 10$.	4
Sol.	<p>Given line is $\vec{r} = (4\hat{i} + 2\hat{j} + 7\hat{k}) + \lambda(3\hat{i} + 4\hat{j} + 2\hat{k})$</p> <p>Any point on the line is $(4 + 3\lambda, 2 + 4\lambda, 7 + 2\lambda)$</p> <p>This point lies on the plane $\vec{r} \cdot (\hat{i} - \hat{j} + \hat{k}) = 10$ $\Rightarrow 4 + 3\lambda - 2 - 4\lambda + 7 + 2\lambda = 10$ $\Rightarrow \lambda + 9 = 10 \Rightarrow \lambda = 1$ \therefore Point of intersection is (7, 6, 9) Distance of (7, 6, 9) from (1, -2, 9) is $d = \sqrt{(7-1)^2 + (6+2)^2 + 0}$ $= \sqrt{36 + 64} = 10$</p>	1 1 4
12.(a)	Find : $\int \frac{x^2}{(x^2 + 1)(3x^2 + 4)} dx$	4
Sol.	$\int \frac{x^2 dx}{(x^2 + 1)(3x^2 + 4)}$ <p>Let $x^2 = t$ $\frac{t}{(t+1)(3t+4)} = \frac{-1}{t+1} + \frac{4}{3t+4}$ (by Partial fraction)</p> $\int \frac{x^2}{(x^2 + 1)(3x^2 + 4)} dx = \int -\frac{1}{x^2 + 1} dx + \int \frac{4}{3x^2 + 4} dx$ $= -\tan^{-1} x + \frac{4}{3} \times \frac{\sqrt{3}}{2} \tan^{-1} \frac{\sqrt{3}x}{2} + C$ $= -\tan^{-1} x + \frac{2}{\sqrt{3}} \tan^{-1} \frac{\sqrt{3}x}{2} + C$	½ 1 ½ 1½ ½ 4
	OR	
12.(b)	Evaluate : $\int_{-2}^1 \sqrt{5 - 4x - x^2} dx$	4
Sol.		

	$\int_{-2}^1 \sqrt{5-4x-x^2} dx$ $= \int_{-2}^1 \sqrt{9-(x+2)^2} dx$ $= \left[\frac{x+2}{2} \sqrt{9-(x+2)^2} + \frac{9}{2} \sin^{-1} \frac{x+2}{3} \right]_{-2}^1$ $= 0 + \frac{9}{2} \cdot \frac{\pi}{2} - 0$ $= \frac{9\pi}{4}$	<div>1½</div> <div>1½</div> <div>1</div> <div>4</div>
13.	Find the area of the region enclosed by the curves $y^2 = x$, $x = \frac{1}{4}$, $y = 0$ and $x = 1$. using integration.	4
Sol.	 <p style="text-align: right;">Correct Figure</p> $I = \int_{1/4}^1 \sqrt{x} dx$ $= \left[\frac{2}{3} x^{3/2} \right]_{1/4}^1$ $= \frac{2}{3} \left[1 - \frac{1}{8} \right] = \frac{7}{12}$	<div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>4</div>

14.	<p>Case Study Problem :</p> <p>A shopkeeper sells three types of flower seeds A₁, A₂, A₃. They are sold in the form of a mixture, where the proportions of these seeds are 4 : 4 : 2, respectively. The germination rates of the three types of seeds are 45%, 60% and 35% respectively.</p>  <p>Based on the above information :</p> <p>(a) Calculate the probability that a randomly chosen seed will germinate;</p> <p>(b) Calculate the probability that the seed is of type A₂, given that a randomly chosen seed germinates.</p>	<p>2</p> <p>2</p>
Sol.	<p> E_1 : Seed is of type A_1 E_2 : Seed is of type A_2 E_3 : Seed is of type A_3 A : Seed germinates </p> <p> $P(E_1) = \frac{4}{10}, P(E_2) = \frac{4}{10}, P(E_3) = \frac{2}{10}$ $P(A E_1) = \frac{45}{100}, P(A E_2) = \frac{60}{100}, P(A E_3) = \frac{35}{100}$ </p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>
	<p>(a) $P(A) = P(E_1)P(A E_1) + P(E_2)P(A E_2) + P(E_3)P(A E_3)$</p> $= \frac{4}{10} \times \frac{45}{100} + \frac{4}{10} \times \frac{60}{100} + \frac{2}{10} \times \frac{35}{100}$ $= \frac{180 + 240 + 70}{1000}$ $= \frac{490}{1000} = \frac{49}{100}$	<p>1</p> <p>$\frac{1}{2}$</p>
	<p>(b) $P\left(\frac{E_2}{A}\right) = \frac{P(E_2)P(A E_2)}{P(A)}$</p>	

	$= \frac{\frac{4 \times 60}{10 \times 100}}{\frac{490}{1000}} = \frac{24}{49}$	$\frac{1}{2} + \frac{1}{2}$
		4

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