Strictly Confidential: (For Internal and Restricted use only)

Senior Secondary School Term II Examination, 2022

Marking Scheme – MATHEMATICS (SUBJECT CODE – 041)

(PAPER CODE – 65/2/1)

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 (√) 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 totalled 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

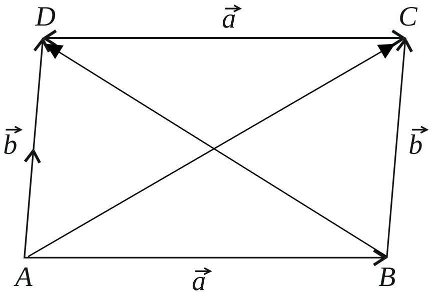
MATHEMATICS (Subject Code–041)

[Paper Code: 65/2/1]

Maximum Marks: 40

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION – A	
1.	Find the product of the order and the degree of the differential equation $\left[\frac{d}{dx}(xy^2)\right] \cdot \frac{dy}{dx} + y = 0$.	2
Sol.	Given differential equation can be written as $2xy\left(\frac{dy}{dx}\right)^2 + y^2\frac{dy}{dx} + y = 0$ Order = 1, Degree = 2 Order × degree = 1 × 2 = 2	1 1 2
2. (a)	Find : $\int \frac{\sin 3x}{\sin x}\, dx$	2
Sol.	$\int \frac{\sin 3x}{\sin x} dx = \int \frac{3\sin x - 4\sin^3 x}{\sin x} dx$ $= \int [3 - 4\frac{(1-\cos 2x)}{2}]dx$ $= \int (1 + 2\cos 2x)dx$ $= x + \sin 2x + C$	½ ½ 1 2
	Or	
2. (b)	Evaluate : $\int_0^{\frac{1}{2}\log 3} \frac{e^x}{e^{2x}+1}\, dx$	2
Sol.	Let $e^x = t,\ e^x dx = dt$	½

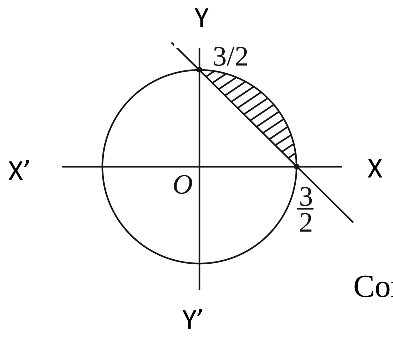
	$\therefore \int_0^{\frac{1}{2}\log 3} \frac{e^x}{e^{2x}+1}dx = \int_1^{\sqrt{3}} \frac{dt}{t^2+1}$ $= \tan^{-1} t\Big\vert_1^{\sqrt{3}}$ $= \frac{\pi}{3} - \frac{\pi}{4} = \frac{\pi}{12}$	½ ½ ½ 2
3.	$\vec{a}$ and $\vec{b}$ are two unit vectors such that $\lvert 2\vec{a} + 3\vec{b} \rvert = \lvert 3\vec{a} - 2\vec{b} \rvert$. Find the angle between $\vec{a}$ and $\vec{b}$.	2
Sol.	$\lvert 2\vec{a} + 3\vec{b}\rvert = \lvert 3\vec{a} - 2\vec{b}\rvert$ $\Rightarrow \lvert 2\vec{a} + 3\vec{b}\rvert^2 = \lvert 3\vec{a} - 2\vec{b}\rvert^2$ $\Rightarrow 4\lvert\vec{a}\rvert^2 + 12\,\vec{a}.\vec{b} + 9\lvert\vec{b}\rvert^2 = 9\lvert\vec{a}\rvert^2 - 12\,\vec{a}.\vec{b} + 4\lvert\vec{b}\rvert^2$ As $\lvert\vec{a}\rvert = \lvert\vec{b}\rvert = 1$ $\therefore 24\,\vec{a}.\vec{b} = 5\lvert\vec{a}\rvert^2 - 5\lvert\vec{b}\rvert^2 = 0 \Rightarrow \vec{a}.\vec{b} = 0$ So, $\vec{a} \perp \vec{b}$ or Angle between them is $\frac{\pi}{2}$	1 ½ ½ 2
4.	A pair of dice is thrown. It is given that the sum of numbers appearing on both dice is an even number. Find the probability that the number appearing on at least one die is 3.	2
Sol.	A: number appearing on at least one die is 3 B: sum of numbers appearing on both dice is even Clearly, $A \cap B = \{(3,1), (3,5), (1,3), (5,3), (3,3)\}$ $P\left(\frac{A}{B}\right) = \frac{P(A\cap B)}{P(B)} = \frac{5/36}{18/36}$ $= \frac{5}{18}$	½ 1 ½ 2
5.	Probabilities of A and B solving a specific problem are $\frac{2}{3}$ and $\frac{3}{5}$, respectively. If both of them try independently to solve the problem, then find the probability that the problem is solved.	2
Sol.	P (Problem is solved)=1 – P (Problem not solved) $= 1 - P(\bar{A})P(\bar{B})$	1

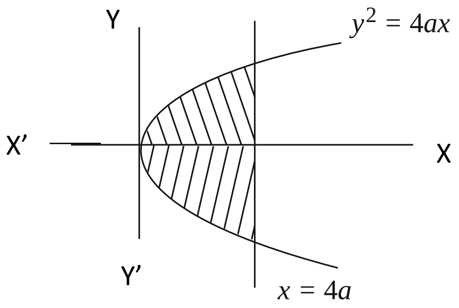
	$=1-\frac{1}{3}\cdot\frac{2}{5}$ $=\frac{13}{15}$	1
		2
6.	Write the cartesian equation of the line PQ passing through point P(2, 2, 1) and Q(5, 1, – 2). Hence, find the y-coordinate of the point on the line PQ whose z-coordinate is – 2.	2
Sol.	Required equation of line is given by $$\frac{x-2}{3}=\frac{y-2}{-1}=\frac{z-1}{-3}$$ putting $z=-2$, we get $\frac{y-2}{-1}=\frac{-3}{-3}=1$ $y-2=-1 \Rightarrow y=1$	1 ½ ½
		2
	SECTION – B	
7.	ABCD is a parallelogram such that $\overrightarrow{AC}=\hat{i}+\hat{j}$ and $\overrightarrow{BD}=2\hat{i}+\hat{j}+\hat{k}$. Find $\overrightarrow{AB}$ and $\overrightarrow{AD}$. Also, find the area of the parallelogram ABCD.	3
Sol.	Let $\overrightarrow{AB}=\vec{a}$ and $\overrightarrow{AD}=\vec{b}$ $\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC}=\vec{a}+\vec{b}=\hat{\imath}+\hat{\jmath}$ $\overrightarrow{BD}=\overrightarrow{BC}+\overrightarrow{CD}=\vec{b}-\vec{a}=2\hat{\imath}+\hat{\jmath}+\hat{k}$  Adding we get, $2\overrightarrow{AD}=\overrightarrow{AC}+\overrightarrow{BD}=3\hat{\imath}+2\hat{\jmath}+\hat{k}$ $\Rightarrow \overrightarrow{AD}=\frac{3}{2}\hat{\imath}+\hat{\jmath}+\frac{1}{2}\hat{k}$ Subtracting, we get $2\overrightarrow{AB}=\overrightarrow{AC}-\overrightarrow{BD}=-\hat{\imath}-\hat{k} \Rightarrow \overrightarrow{AB}=-\frac{1}{2}\hat{\imath}-\frac{1}{2}\hat{k}$ $\left\lvert\overrightarrow{AC}\times\overrightarrow{BD}\right\rvert=\begin{vmatrix}\hat{\imath} & \hat{\jmath} & \hat{k}\\ 1 & 1 & 0\\ 2 & 1 & 1\end{vmatrix}=\hat{\imath}-\hat{\jmath}-\hat{k}$ Area $=\frac{1}{2}\left\lvert\overrightarrow{AC}\times\overrightarrow{BD}\right\rvert$ $=\frac{\sqrt{3}}{2}$	1 1 1

		3
8.(a)	Evaluate : $$\int_0^1 \tan^{-1} x\, dx$$	3
Sol.	Consider $\int (\tan^{-1} x)\, dx = \tan^{-1} x \cdot x - \int \frac{1}{1+x^2} \cdot x\, dx$ $= x\tan^{-1}x - \frac{1}{2}\log(1+x^2)$ $\int_0^1 (tan^{-1} x)dx = x\, tan^{-1} x - \frac{1}{2} log(1+x^2)\Big]_0^1$ $= \frac{\pi}{4} - \frac{1}{2}\log 2$	1 1 1 3
	Or	
8.(b)	Find : $$\int \frac{2x}{x^2 + 3x + 2}\, dx$$	3
Sol.	$I = \int \frac{2x \cdot dx}{x^2+3x+2} = \int \frac{2x}{(x+1)(x+2)} dx$ $= \int \left(\frac{-2}{x+1} + \frac{4}{x+2} \right) dx$ using partial fraction $= -2\log\lvert x+1\rvert + 4\log\lvert x+2\rvert + C$	½ 1½ 1 3
9.	Find the particular solution of the differential equation $(y + 3x^2)\frac{dx}{dy} = x$, given that y = 1, when x = 1.	3
Sol.	Given differential equation can be written as $x\frac{dy}{dx} - y = 3x^2$ or $\frac{dy}{dx} - \frac{1}{x} y = 3x$ I.F $= e^{\int -\frac{1}{x}dx} = e^{-\log x} = -x^{-1} = \frac{1}{x}$ Solution is $y \cdot \frac{1}{x} = \int 3x \frac{1}{x} dx + C$ $\frac{y}{x} = 3x + C$	 ½ 1 ½ ½

	$x=1,\ y=1$ gives $C=-2$ Particular solution is $\frac{y}{x}=3x-2$ or $y=3x^2-2x$	½ 3
10.(a)	Find the equation of the plane passing through points $(2, 1, 0)$, $(3, -2, -2)$ and $(1, 1, -7)$. Also, obtain its distance from the origin.	3
Sol.	Equation of plane is given by $\begin{vmatrix} x-2 & y-1 & z \\ 1 & -3 & -2 \\ -1 & 0 & -7 \end{vmatrix}=0$ $21(x-2)+9(y-1)-3z=0$ i.e., $7x+3y-z=17$ Distance of plane from origin is $d=\frac{\lvert 0+0-0-17\rvert}{\sqrt{59}}=\frac{17}{\sqrt{59}}$	1½ 1 ½ 3
	Or	
10.(b)	Find the distance between the lines $x=\frac{y-1}{2}=\frac{z-2}{3}$ and $x+1=\frac{y+2}{2}=\frac{z-1}{3}$.	3
Sol.	For lines $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ and $\frac{x+1}{1}=\frac{y+2}{2}=\frac{z-1}{3}$ Let $\vec{a_1}=\hat{j}+2\hat{k}, \vec{b}=\hat{i}+2\hat{j}+3\hat{k}$ $\vec{a_2}=-\hat{i}-2\hat{j}+\hat{k}, \vec{b}=\hat{i}+2\hat{j}+3\hat{k}$ Clearly lines are parallel Hence, Shortest distance or distance is given by $\frac{\lvert(\vec{a_2}-\vec{a_1})\times\vec{b}\rvert}{\lvert\vec{b}\rvert}$ $\vec{a_2}-\vec{a_1}=-\hat{i}-3\hat{j}-\hat{k}$ $(\vec{a_2}-\vec{a_1})\times\vec{b}=\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -3 & -1 \\ 1 & 2 & 3 \end{vmatrix}$	 ½ ½

	$= -7\hat{i} + 2\hat{j} + \hat{k}$	1
	Required distance = $\frac{\sqrt{49+4+1}}{\sqrt{1+4+9}} = \frac{\sqrt{27}}{\sqrt{7}}$ or $\frac{3\sqrt{21}}{7}$	1
		3
	SECTION – C	
11.	Find the distance of the point $(-1, -5, -10)$ from the point of intersection of the line $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$ and the plane $x - y + z = 5$.	4
Sol.	General point of the line is $(3\lambda+2,\ 4\lambda-1,\ 12\lambda+2)$	1
	This will be the point of intersection with the plane, if $(3\lambda+2)-(4\lambda-1)+(12\lambda+2)=5$ $\Rightarrow 11\lambda+5=5,\ \Rightarrow \lambda=0$	1
	Thus, the point of intersection is (2, –1, 2)	1
	Distance = $\sqrt{(2+1)^2+(-1+5)^2+(2+10)^2}$ $=\sqrt{9+16+144}$ $=\sqrt{169}=13$	1
		4
12.	Evaluate : $\int_0^1 x\,(1-x)^n\,dx$	4

Sol.	$I = \int_0^1 x(1-x)^n\,dx$ $= \int_0^1 (1-x)[1-(1-x)]^n\,dx$ [using property] $= \int_0^1 x^n(1-x)\,dx$ $= \int_0^1 x^n dx - \int_0^1 x^{n+1} dx$ $= \left[\frac{x^{n+1}}{n+1}\right]_0^1 - \left[\frac{x^{n+2}}{n+2}\right]_0^1$ $= \frac{1}{n+1} - \frac{1}{n+2}$ Or $\frac{1}{(n+1)(n+2)}$	1 1 1 1 4
13.(a)	Using integration, find the area of the smaller region enclosed by the curve $4x^2 + 4y^2 = 9$ and the line $2x + 2y = 3$.	4
Sol.	Clearly point of intersection are $\left(\frac{3}{2}, 0\right)$ & $\left(0, \frac{3}{2}\right)$  Correct Figure Required area $= \int_0^{3/2} \sqrt{\frac{9}{4} - x^2}\,dx - \int_0^{3/2} \left(\frac{3}{2} - x\right) dx$ $= \left[\frac{x}{2}\sqrt{\frac{9}{4} - x^2} + \frac{9}{8}\sin^{-1}\frac{2x}{3}\right]_0^{3/2} + \left[\frac{\left(\frac{3}{2} - x\right)^2}{2}\right]_0^{3/2}$ $= \frac{9\pi}{16} - \frac{9}{8}$	½ 1 1 1 ½ 4
	Or	

13.(b)	If the area of the region bounded by the curve $y^2 = 4ax$ and the line $x = 4a$ is $\frac{256}{3}$ sq. units, then using integration, find the value of a, where $a > 0$.	4
Sol.	Given area = $\frac{256}{3}$  Correct Figure	1
	Area of Shaded region = $2\int_0^{4a} \sqrt{4ax}\, dx$	1
	$= 8\sqrt{a} \left. \frac{x^{3/2}}{3} \right\|_0^{4a}$	1
	$= \frac{64a^2}{3}$	½
	$\frac{64a^2}{3} = \frac{256}{3}$ $\Rightarrow a^2 = 4$ gives $a = 2$ (as $a > 0$)	½
		4

14.

Case-Study Based Question

At the start of a cricket match, a coin is tossed and the team winning the toss has the opportunity to choose to bat or bowl. Such a coin is unbiased with equal probabilities of getting head and tail.

Based on the above information, answer the following questions :

(a) If such a coin is tossed 2 times, then find the probability distribution of number of tails. **2**

(b) Find the probability of getting at least one head in three tosses of such a coin. **2**

Sol.

(a) Let X denote the number of tails: ½

X	0	1	2
$P(X)$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

1½

(b) S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}

P (at least one head) = 1–P (no head) 1

$$= 1-\frac{1}{8}$$

$$=\frac{7}{8}$$ 1

2+2

* * *