SUMMER– 2019 EXAMINATION

Subject Name: Basic Mathematics **Model Answer** **Subject Code:** 17104

Important Instructions to Examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.		**Attempt any TEN of the following:**	**20**
	a)	Find x , if $\begin{vmatrix} x & 4 & -4 \\ 3 & -2 & 1 \\ -2 & -4 & 1 \end{vmatrix} = 0$	**02**
	Ans	$\begin{vmatrix} x & 4 & -4 \\ 3 & -2 & 1 \\ -2 & -4 & 1 \end{vmatrix} = 0$	
		$\therefore x(-2+4)-4(3+2)-4(-12-4)=0$	1
		$\therefore 2x-20+64=0$	
		$\therefore 2x+44=0$	
		$\therefore x=-22$	1
		---	
	b)	Find A if, $2A+3\begin{bmatrix} 1 & 3 \\ 2 & 5 \end{bmatrix}=\begin{bmatrix} 5 & 7 \\ 6 & 3 \end{bmatrix}$	**02**
	Ans	$2A+3\begin{bmatrix} 1 & 3 \\ 2 & 5 \end{bmatrix}=\begin{bmatrix} 5 & 7 \\ 6 & 3 \end{bmatrix}$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	b)	$\therefore 2A+\begin{bmatrix}3 & 9\\ 6 & 15\end{bmatrix}=\begin{bmatrix}5 & 7\\ 6 & 3\end{bmatrix}$	½
		$\therefore 2A=\begin{bmatrix}5 & 7\\ 6 & 3\end{bmatrix}-\begin{bmatrix}3 & 9\\ 6 & 15\end{bmatrix}$	½
		$\therefore 2A=\begin{bmatrix}2 & -2\\ 0 & -12\end{bmatrix}$	½
		$\therefore A=\frac{1}{2}\begin{bmatrix}2 & -2\\ 0 & -12\end{bmatrix}=\begin{bmatrix}1 & -1\\ 0 & -6\end{bmatrix}$	½
	c)	If $A=\begin{bmatrix}2 & 5\\ 1 & 3\end{bmatrix}$, $B=\begin{bmatrix}3 & -5\\ -1 & 2\end{bmatrix}$ show that $AB=BA=I$	**02**
	Ans	$AB=\begin{bmatrix}2 & 5\\ 1 & 3\end{bmatrix}\begin{bmatrix}3 & -5\\ -1 & 2\end{bmatrix}$	
		$\therefore AB=\begin{bmatrix}6-5 & -10+10\\ 3-3 & -5+6\end{bmatrix}$	1
		$\therefore AB=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$	
		$BA=\begin{bmatrix}3 & -5\\ -1 & 2\end{bmatrix}\begin{bmatrix}2 & 5\\ 1 & 3\end{bmatrix}$	
		$\therefore BA=\begin{bmatrix}6-5 & 15-15\\ -2+2 & -5+6\end{bmatrix}$	1
		$\therefore BA=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$	
		$\therefore AB=BA=I$	
	d)	Resolve into partial fraction $\frac{x-2}{x(x-1)}$	**02**
	Ans	$\frac{x-2}{x(x-1)}$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	d)	$\frac{x-2}{x(x-1)} = \frac{A}{x} + \frac{B}{x-1}$	½
		$\therefore x-2 = (x-1)A + xB$	
		Put $x = 0$	
		$\therefore 0-2 = A(0-1) + B(0)$	½
		$\therefore A = 2$	
		Put $x = 1$	
		$1-2 = A(1-1) + B(1)$	½
		$\therefore B = -1$	
		$\therefore \frac{x-2}{x(x-1)} = \frac{2}{x} + \frac{(-1)}{x-1}$	½
		OR	
		$\frac{x-2}{x(x-1)} = \frac{A}{x} + \frac{B}{x-1}$	½
		$\therefore x-2 = (x-1)A + xB$	
		By equating equal power coefficients	
		$A + B = 1$ and $-A = -2$	
		$\therefore A = 2$ and	½
		$B = -1$	½
		$\therefore \frac{x-2}{x(x-1)} = \frac{2}{x} + \frac{(-1)}{x-1}$	½
	e)	If $\tan A = \frac{1}{2}, \tan B = \frac{1}{3}$ find $\tan(A+B)$	**02**
	Ans	$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$	
		$= \frac{\frac{1}{2} + \frac{1}{3}}{1 - \left(\frac{1}{2}\right)\left(\frac{1}{3}\right)}$	1
		$= 1$	1

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	f)	Without using calculator find the value of $\sin\left(75^0\right)$	**02**
	Ans	$\sin\left(75^0\right)=\sin(30^0+45^0)$	
		$=\sin 30^0.\cos 45^0+\cos 30^0.\sin 45^0$	1
		$=\frac{1}{2}.\frac{1}{\sqrt{2}}+\frac{\sqrt{3}}{2}.\frac{1}{\sqrt{2}}$	
		$=\frac{1+\sqrt{3}}{2\sqrt{2}}$ or 0.966	1
	g)	Prove that $\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)=\cot^{-1}2$	**02**
	Ans	$\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)$	
		$=\tan^{-1}\left[\frac{\frac{1}{4}+\frac{2}{9}}{1-\frac{1}{4}\times\frac{2}{9}}\right]$	1
		$=\tan^{-1}\left(\frac{1}{2}\right)$	½
		$=\cot^{-1}2$	½
		$\therefore \tan^{-1}\frac{1}{4}+\tan^{-1}\frac{2}{9}=\cot^{-1}2$	
	h)	Find the principal value of $\tan^{-1}\left(\sqrt{3}\right)$	**02**
	Ans	$\tan^{-1}\left(\sqrt{3}\right)=\frac{\pi}{3}$ or 60^0	2
	i)	Find the principal value of $\sec\left[\cos^{-1}\left(\sqrt{3}/2\right)\right]$	**02**

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Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	i)	$\sec\left[\cos^{-1}\left(\sqrt{3}/2\right)\right]=\sec\left(30^0\right)$ OR $\sec\left[\sec^{-1}\left(2/\sqrt{3}\right)\right]$	1
		$=\frac{2}{\sqrt{3}}$	1
	j)	Find the distance between point $(-2,3)$ and the line $3x+2y+26=0$	**02**
	Ans	$3x+2y+26=0$	
		$d=\left\lvert\frac{ax_1+by_1+c}{\sqrt{a^2+b^2}}\right\rvert$	
		$\therefore d=\left\lvert\frac{3(-2)+2(3)+26}{\sqrt{(3)^2+(2)^2}}\right\rvert$	1
		$\therefore d=\left\lvert\frac{26}{\sqrt{13}}\right\rvert$ or $2\sqrt{13}$ or 7.21	1
	k)	Find range and coefficient of range of the following data	**02**
		5 , 7 , 9 , 13 , 11 , 5 , 3	
	Ans	Range $=L-S$	
		$=13-3$	
		$=10$	1
		Ceifficient of range $=\frac{L-S}{L+S}$	
		$=\frac{13-3}{13+3}$	
		Ceifficient of range $=\frac{10}{16}$ or $\frac{5}{8}$ or 0.625	1
	l)	Prove that the lines $3x+2y=5$ and $2x-3y=6$ are perpendicular.	**02**
	Ans	$L_1: 3x+2y=5$ $L_2: 2x-3y=6$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	l)	$L_1 : 3x+2y=5 \quad L_2 : 2x-3y=6$	
		Slope $m_1 = \frac{-a}{b} = \frac{-3}{2}$	½
		$m_2 = \frac{-2}{-3} = \frac{2}{3}$	½
		$\therefore m_1 m_2 = \frac{-3}{2} \times \frac{2}{3}$	½
		$\therefore m_1 m_2 = -1$	½
		$\therefore$ Lines are perpendicular.	

2.		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	Solve using Cramer's rule	**04**
		$x+z=4 \quad , \quad y+z=2 \quad , \quad x+y=0$	
	Ans	$x+z=4 \quad , \quad y+z=2 \quad , \quad x+y=0$	
		$D = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{vmatrix} = 1(0-1)-0(0-1)+1(0-1) = -2$	1
		$D_x = \begin{vmatrix} 4 & 0 & 1 \\ 2 & 1 & 1 \\ 0 & 1 & 0 \end{vmatrix} = 4(0-1)-0(0-0)+1(2-0) = -2$	
		$\therefore x = \frac{D_x}{D} = \frac{-2}{-2} = 1$	1
		$D_y = \begin{vmatrix} 1 & 4 & 1 \\ 0 & 2 & 1 \\ 1 & 0 & 0 \end{vmatrix} = 1(0-0)-4(0-1)+1(0-2) = 2$	
		$\therefore y = \frac{D_y}{D} = \frac{2}{-2} = -1$	1
		$D_z = \begin{vmatrix} 1 & 0 & 4 \\ 0 & 1 & 2 \\ 1 & 1 & 0 \end{vmatrix} = 1(0-2)-0(0-2)+4(0-1) = -6$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	a)	$\therefore z = \frac{D_z}{D} = \frac{-6}{-2} = 3$	1
	b)	If A $= \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$ prove that $A^2 = I$	**04**
	Ans	$A = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$	
		$A^2 = AA = \begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}\begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$	1
		$= \begin{bmatrix} 0+4-3 & 0-3+3 & 0+4-4 \\ 0-12+12 & 4+9-12 & -4-12+16 \\ 0-12+12 & 3+9-12 & -3-12+16 \end{bmatrix}$	2
		$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$	1
	c)	If A $= \begin{bmatrix} 2 & 4 & 4 \\ 4 & 2 & 4 \\ 4 & 4 & 2 \end{bmatrix}$, show that $A^2 - 8A$ is a scalar matrix	**04**
	Ans	$A = \begin{bmatrix} 2 & 4 & 4 \\ 4 & 2 & 4 \\ 4 & 4 & 2 \end{bmatrix}$	
		$A^2 = AA = \begin{bmatrix} 2 & 4 & 4 \\ 4 & 2 & 4 \\ 4 & 4 & 2 \end{bmatrix}\begin{bmatrix} 2 & 4 & 4 \\ 4 & 2 & 4 \\ 4 & 4 & 2 \end{bmatrix}$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	c)	$A^2=\begin{bmatrix}4+16+16 & 8+8+16 & 8+16+8\\ 8+8+16 & 16+4+16 & 16+8+8\\ 8+16+8 & 16+8+8 & 16+16+4\end{bmatrix}$	
		$A^2=\begin{bmatrix}36 & 32 & 32\\ 32 & 36 & 32\\ 32 & 32 & 36\end{bmatrix}$	2
		$8A=8\begin{bmatrix}2 & 4 & 4\\ 4 & 2 & 4\\ 4 & 4 & 2\end{bmatrix}=\begin{bmatrix}16 & 32 & 32\\ 32 & 16 & 32\\ 32 & 32 & 16\end{bmatrix}$	1
		$A^2-8A=\begin{bmatrix}36 & 32 & 32\\ 32 & 36 & 32\\ 32 & 32 & 36\end{bmatrix}-\begin{bmatrix}16 & 32 & 32\\ 32 & 16 & 32\\ 32 & 32 & 16\end{bmatrix}=\begin{bmatrix}20 & 0 & 0\\ 0 & 20 & 0\\ 0 & 0 & 20\end{bmatrix}$	1
		$\therefore A^2-8A$ is a scalar matrix	
		---	
	d)	If $A=\begin{bmatrix}2 & 3 & -1\\ 4 & 5 & 0\end{bmatrix}$ and $B=\begin{bmatrix}-1 & 2 & 4\\ 1 & 3 & 0\end{bmatrix}$ verify that $(A+B)'=A'+B'$	**04**
	Ans	$A=\begin{bmatrix}2 & 3 & -1\\ 4 & 5 & 0\end{bmatrix}, B=\begin{bmatrix}-1 & 2 & 4\\ 1 & 3 & 0\end{bmatrix}$	
		$\therefore A+B=\begin{bmatrix}2 & 3 & -1\\ 4 & 5 & 0\end{bmatrix}+\begin{bmatrix}-1 & 2 & 4\\ 1 & 3 & 0\end{bmatrix}$	
		$\therefore A+B=\begin{bmatrix}1 & 5 & 3\\ 5 & 8 & 0\end{bmatrix}$	1
		$\therefore (A+B)'=\begin{bmatrix}1 & 5\\ 5 & 8\\ 3 & 0\end{bmatrix}$	1
		$A'+B'=\begin{bmatrix}2 & 4\\ 3 & 5\\ -1 & 0\end{bmatrix}+\begin{bmatrix}-1 & 1\\ 2 & 3\\ 4 & 0\end{bmatrix}$	1

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Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	d)	$A'+B'=\begin{bmatrix}1 & 5\\ 5 & 8\\ 3 & 0\end{bmatrix}$ $\therefore (A+B)' = A'+B'$	1
		---	
	e)	Find A^{-1} By adjoint method if $A=\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & -1\\ 1 & -1 & 0\end{bmatrix}$	**04**
	Ans	$A=\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & -1\\ 1 & -1 & 0\end{bmatrix}$	
		$\therefore \lvert A\rvert=\begin{vmatrix}1 & 1 & 1\\ 1 & 1 & -1\\ 1 & -1 & 0\end{vmatrix}$	
		$=1(0-1)-1(0+1)+1(-1-1)$	½
		$=-4\neq 0$	
		$\therefore A^{-1}$exists	
		Matrix of minors $=\begin{bmatrix}\begin{vmatrix}1 & -1\\ -1 & 0\end{vmatrix} & \begin{vmatrix}1 & -1\\ 1 & 0\end{vmatrix} & \begin{vmatrix}1 & 1\\ 1 & -1\end{vmatrix}\\ \begin{vmatrix}1 & 1\\ -1 & 0\end{vmatrix} & \begin{vmatrix}1 & 1\\ 1 & 0\end{vmatrix} & \begin{vmatrix}1 & 1\\ 1 & -1\end{vmatrix}\\ \begin{vmatrix}1 & 1\\ 1 & -1\end{vmatrix} & \begin{vmatrix}1 & 1\\ 1 & -1\end{vmatrix} & \begin{vmatrix}1 & 1\\ 1 & 1\end{vmatrix}\end{bmatrix}$	
		$=\begin{bmatrix}-1 & 1 & -2\\ 1 & -1 & -2\\ -2 & -2 & 0\end{bmatrix}$	1
		Matrix of cofactors $=\begin{bmatrix}-1 & -1 & -2\\ -1 & -1 & 2\\ -2 & 2 & 0\end{bmatrix}$	½

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Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	e)	$\text{Adj.}A = \begin{bmatrix} -1 & -1 & -2 \\ -1 & -1 & 2 \\ -2 & 2 & 0 \end{bmatrix}$	1
		$A^{-1} = \frac{1}{\lvert A \rvert}\text{Adj.}A$	
		$A^{-1} = \frac{1}{-4}\begin{bmatrix} -1 & -1 & -2 \\ -1 & -1 & 2 \\ -2 & 2 & 0 \end{bmatrix}$	1
		---	
	f)	Resolve into the partial fractions $\frac{3x-1}{(x-4)(x+1)(x-1)}$	**04**
	Ans	$\frac{3x-1}{(x-4)(x+1)(x-1)}$	
		$\frac{3x-1}{(x-4)(x+1)(x-1)} = \frac{A}{x-4} + \frac{B}{x+1} + \frac{C}{x-1}$	½
		$\therefore 3x-1 = (x+1)(x-1)A + (x-4)(x-1)B + (x-4)(x+1)C$	
		Put $x = 4$	
		$11 = (5)(3)A$	
		$\therefore A = \frac{11}{15}$	1
		Put $x = -1$	
		$-4 = (-5)(-2)B$	
		$\therefore B = \frac{-2}{5}$	1
		Put $x = 1$	
		$2 = (-3)(2)C$	1
		$\therefore C = \frac{-1}{3}$	
		$\frac{3x-1}{(x-4)(x+1)(x-1)} = \frac{\frac{11}{15}}{x-4} + \frac{\frac{-2}{5}}{x+1} + \frac{\frac{-1}{3}}{x-1}$	½

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.		**Attempt any FOUR of the following:**	**16**
	a)	Using matrix inversion method solve the system of equation $x+y+z=3$, $x+2y+3z=4$, $x+4y+9z=6$	**04**
	Ans	$x+y+z=3$, $x+2y+3z=4$, $x+4y+9z=6$ Let $A=\begin{bmatrix}1&1&1\\1&2&3\\1&4&9\end{bmatrix}$ $\lvert A\rvert=\begin{vmatrix}1&1&1\\1&2&3\\1&4&9\end{vmatrix}$ $\therefore \lvert A\rvert=1(18-12)-1(9-3)+1(4-2)$ $\therefore \lvert A\rvert=2\neq 0$ $\therefore A^{-1}$ exists Matrix of minors $=\begin{bmatrix}\begin{vmatrix}2&3\\4&9\end{vmatrix}&\begin{vmatrix}1&3\\1&9\end{vmatrix}&\begin{vmatrix}1&2\\1&4\end{vmatrix}\\\begin{vmatrix}1&1\\4&9\end{vmatrix}&\begin{vmatrix}1&1\\1&9\end{vmatrix}&\begin{vmatrix}1&1\\1&4\end{vmatrix}\\\begin{vmatrix}1&1\\2&3\end{vmatrix}&\begin{vmatrix}1&1\\1&3\end{vmatrix}&\begin{vmatrix}1&1\\1&2\end{vmatrix}\end{bmatrix}$ $=\begin{bmatrix}6&6&2\\5&8&3\\1&2&1\end{bmatrix}$ Matrix of cofactors $=\begin{bmatrix}6&-6&2\\-5&8&-3\\1&-2&1\end{bmatrix}$ $AdjA=\begin{bmatrix}6&-5&1\\-6&8&-2\\2&-3&1\end{bmatrix}$ $A^{-1}=\frac{1}{\lvert A\rvert}\text{Adj.}A$	½ ½ ½ ½

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Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	a)	$\therefore A^{-1} = \frac{1}{2}\begin{bmatrix} 6 & -5 & 1 \\ -6 & 8 & -2 \\ 2 & -3 & 1 \end{bmatrix}$	½
		$X = A^{-1}B$	
		$\therefore \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 6 & -5 & 1 \\ -6 & 8 & -2 \\ 2 & -3 & 1 \end{bmatrix}\begin{bmatrix} 3 \\ 4 \\ 6 \end{bmatrix}$	½
		$= \frac{1}{2}\begin{bmatrix} 18-20+6 \\ -18+32-12 \\ 6-12+6 \end{bmatrix}$	½
		$= \frac{1}{2}\begin{bmatrix} 4 \\ 2 \\ 0 \end{bmatrix}$	
		$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix}$	½
		$\therefore \quad x = 2\ ,\ \ y = 1\ ,\ \ z = 0$	
		---	
	b)	Resolve into partial fractions $\frac{x^2+23x}{(x+3)(x^2+1)}$	**04**
	Ans	$\frac{x^2+23x}{(x+3)(x^2+1)} = \frac{A}{x+3} + \frac{Bx+C}{x^2+1}$	½
		$\therefore x^2+23x = (x^2+1)A + (x+3)(Bx+C)$	
		Put $x = -3$	
		$\therefore 9-69 = 10A$	
		$\therefore -60 = 10A$	1
		$\therefore A = -6$	
		Put $x = 0$	
		$0 = 1A + 3C$	
		$\therefore 0 = -6 + 3C$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	b)	$\therefore C = 2$	1
		Put $x = 1$	
		$\therefore 1 + 23 = 2A + 4(B + C)$	
		$\therefore 24 = 2(-6) + 4B + 4(2)$	
		$\therefore 28 = 4B$	1
		$\therefore B = 7$	
		$\therefore \frac{x^2 + 23x}{(x+3)(x^2+1)} = \frac{-6}{x+3} + \frac{7x+2}{x^2+1}$	½
	c)	Resolve into partial fractions $\frac{2x+1}{x^2(x+1)}$	**04**
	Ans	$\frac{2x+1}{x^2(x+1)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x+1}$	½
		$\therefore 2x+1 = A(x)(x+1) + B(x+1) + Cx^2$	
		Put $x = 0$	1
		$\therefore B = 1$	
		Put $x = -1$	
		$\therefore C = -1$	1
		Put $x = 1$	
		$\therefore 3 = 2A + 2B + C$	
		$\therefore 3 = 2A + 2 - 1$	1
		$\therefore A = 1$	
		$\therefore \frac{2x+1}{x^2(x+1)} = \frac{1}{x} + \frac{1}{x^2} + \frac{-1}{x+1}$	½
	d)	In ΔABC prove that $\tan A + \tan B + \tan C = \tan A . \tan B . \tan C$	**04**
	Ans	In any ΔABC	1
		$A + B + C = 180^0$ or π	
		$\therefore A + B = 180^0 - C$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	d)	$\therefore \tan(A+B) = \tan(180^0 - C)$	1
		$\frac{\tan A + \tan B}{1 - \tan A.\tan B} = -\tan C$	1
		$\tan A + \tan B = -\tan C(1 - \tan A.\tan B)$	
		$\tan A + \tan B = -\tan C + \tan A.\tan B.\tan C$	
		$\tan A + \tan B + \tan C = \tan A.\tan B.\tan C$	1
		---	
	e)	If $A + B = \frac{\pi}{4}$, show that $(1+\tan A)(1+\tan B) = 2$	**04**
	Ans	To show that	
		$(1+\tan A)(1+\tan B) = 2$	
		i.e. to show that $1 + \tan B + \tan A + \tan A \tan B = 2$	
		i.e. to show that $\tan B + \tan A + \tan A \tan B = 1$	1
		$\because A + B = \frac{\pi}{4}$	
		$\therefore \tan(A+B) = \tan\frac{\pi}{4}$	1
		$\therefore \frac{\tan A + \tan B}{1 - \tan A.\tan B} = 1$	1
		$\therefore \tan A + \tan B = 1 - \tan A.\tan B$	
		$\therefore \tan A + \tan B + \tan A.\tan B = 1$	1
		hence proved	
		---	
	f)	Prove that $\frac{\sin 4A + \sin 5A + \sin 6A}{\cos 4A + \cos 5A + \cos 6A} = \tan 5A$	**04**
	Ans	$LHS = \frac{\sin 4A + \sin 5A + \sin 6A}{\cos 4A + \cos 5A + \cos 6A}$	
		$= \frac{(\sin 4A + \sin 6A) + \sin 5A}{(\cos 4A + \cos 6A) + \cos 5A}$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	f)	$LHS = \dfrac{2\sin\left(\dfrac{4A+6A}{2}\right)\cos\left(\dfrac{4A-6A}{2}\right)+\sin 5A}{2\cos\left(\dfrac{4A+6A}{2}\right)\cos\left(\dfrac{4A-6A}{2}\right)+\cos 5A}$	1
		$= \dfrac{2\sin 5A\cos(-A)+\sin 5A}{2\cos 5A\cos(-A)+\cos 5A}$	1
		$= \dfrac{\sin 5A(2\cos(-A)+1)}{\cos 5A(2\cos(-A)+1)}$	1
		$= \tan 5A$	1
		$= RHS$	

4.		**Attempt any FOUR of the following:**	**16**
	a)	Prove that $\cos 2\theta = \cos^2\theta - \sin^2\theta$	**04**
	Ans	$\cos 2\theta$	
		$= \cos(\theta+\theta)$	1
		$= \cos\theta\cos\theta - \sin\theta\sin\theta$	2
		$= \cos^2\theta - \sin^2\theta$	1
		---	
	b)	Prove that $\tan^{-1}(1)+\tan^{-1}(2)+\tan^{-1}(3)=\pi$	**04**
	Ans	$\tan^{-1}(1)+\tan^{-1}(2)+\tan^{-1}(3)$	
		$= \pi + \tan^{-1}\left(\dfrac{1+2}{1-(1)(2)}\right)+\tan^{-1}(3)$	1
		$= \pi + \tan^{-1}(-3)+\tan^{-1}(3)$	1
		$= \pi - \tan^{-1}(3)+\tan^{-1}(3)$	1
		$= \pi$	1
		---	
	c)	Prove that $\dfrac{\sin A+\sin 2A+\sin 3A+\sin 4A}{\cos A+\cos 2A+\cos 3A+\cos 4A} = \tan\dfrac{5A}{2}$	**04**

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	c)	$LHS = \dfrac{\sin A+\sin 2A+\sin 3A+\sin 4A}{\cos A+\cos 2A+\cos 3A+\cos 4A}$	
		$= \dfrac{(\sin A+\sin 4A)+(\sin 2A+\sin 3A)}{(\cos A+\cos 4A)+(\cos 2A+\cos 3A)}$	
		$= \dfrac{2\sin\left(\frac{5A}{2}\right)\cos\left(\frac{-3A}{2}\right)+2\sin\left(\frac{5A}{2}\right)\cos\left(\frac{-A}{2}\right)}{2\cos\left(\frac{5A}{2}\right)\cos\left(\frac{-3A}{2}\right)+2\cos\left(\frac{5A}{2}\right)\cos\left(\frac{-A}{2}\right)}$	2
		$= \dfrac{2\sin\left(\frac{5A}{2}\right)\left[\cos\left(\frac{-3A}{2}\right)+\cos\left(\frac{-A}{2}\right)\right]}{2\cos\left(\frac{5A}{2}\right)\left[\cos\left(\frac{-3A}{2}\right)+\cos\left(\frac{-A}{2}\right)\right]}$	1
		$= \tan\dfrac{5A}{2}$	1
		$= RHS$	
		---	
	d)	If $\tan(A+B)=\dfrac{3}{4}$ and $\tan(A-B)=\dfrac{77}{36}$, Find the value of $\tan 2B$	**04**
	Ans	$\tan 2B = \tan\left[(A+B)-(A-B)\right]$	1
		$= \dfrac{\tan(A+B)-\tan(A-B)}{1+\tan(A+B)\tan(A-B)}$	1
		$= \dfrac{\frac{3}{4}-\frac{77}{36}}{1+\frac{3}{4}\times\frac{77}{36}}$	1
		$= \dfrac{-8}{15}$	1
		---	
	e)	Prove that $\cos^{-1}\left(\frac{4}{5}\right)+\cos^{-1}\left(\frac{12}{13}\right)=\cos^{-1}\left(\frac{33}{65}\right)$	**04**
	Ans	Let $\cos^{-1}\left(\frac{4}{5}\right)=A$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	e)	$\therefore \cos A = \frac{4}{5}$ $\therefore \sin^2 A = 1 - \cos^2 A$ $= 1 - \frac{16}{25}$ $= \frac{9}{25}$ $\therefore \sin A = \frac{3}{5}$ $\cos^{-1}\left(\frac{12}{13}\right) = B$ $\therefore \cos B = \frac{12}{13}$ $\therefore \sin^2 B = 1 - \cos^2 B$ $= 1 - \frac{144}{169}$ $= \frac{25}{169}$ $\therefore \sin B = \frac{5}{13}$ $\therefore \cos(A+B) = \cos A \cos B - \sin A \sin B$ $= \frac{4}{5}\frac{12}{13} - \frac{3}{5}\frac{5}{13}$ $= \frac{48}{65} - \frac{15}{65}$ $\therefore \cos(A+B) = \frac{33}{65}$ $\therefore A + B = \cos^{-1}\left(\frac{33}{65}\right)$ $\therefore \cos^{-1}\left(\frac{4}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \cos^{-1}\left(\frac{33}{65}\right)$	1 1 1 ½ ½
	f)	Prove that : $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right) = \frac{\pi}{4}$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	f)	$\tan^{-1}\left(\frac{1}{2}\right)+\tan^{-1}\left(\frac{1}{3}\right)$	**04**
	Ans	$=\tan^{-1}\left[\frac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{2}\times\frac{1}{3}}\right]$	2
		$=\tan^{-1}(1)$	1
		$=\frac{\pi}{4}$	1

5.		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	Prove that $\frac{\cos 3A}{\cos A}+\frac{\sin 3A}{\sin A}=4\cos 2A$	**04**
	Ans	$\frac{\cos 3A}{\cos A}+\frac{\sin 3A}{\sin A}$	
		$=\frac{\cos 3A\sin A+\sin 3A\cos A}{\cos A\sin A}$	½
		$=\frac{\sin(3A+A)}{\cos A\sin A}$	1
		$=\frac{\sin 4A}{\cos A\sin A}$	
		$=\frac{2\sin 2A\cos 2A}{\cos A\sin A}$	1
		$=\frac{4\sin A\cos A\cos 2A}{\cos A\sin A}$	1
		$=4\cos 2A$	½
		---	
	b)	Prove that $\sin C-\sin D=2\cos\left(\frac{C+D}{2}\right)\cdot\sin\left(\frac{C-D}{2}\right)$	**04**
	Ans	$\because\ \sin(A+B)-\sin(A-B)=2\cos A\sin B$	1
		Put $A+B=C$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	b)	$A-B=D$	
		$\therefore A=\frac{C+D}{2}$ and	1
		$B=\frac{C-D}{2}$	1
		$\therefore \sin C-\sin D=2\cos\left(\frac{C+D}{2}\right)\cdot\sin\left(\frac{C-D}{2}\right)$	1
	c)	Without using calculator prove that $\sin20^0\ \sin40^0\ \sin60^0\ \sin80^0=\frac{3}{16}$	**04**
	Ans	$\sin20^0\ \sin40^0\ \sin60^0\ \sin80^0$	
		$=\frac{\sqrt{3}}{2}\left[\sin40^0\ \sin80^0\right]\sin20^0$	½
		$=\frac{\sqrt{3}}{4}\left[\cos40^0-\cos120^0\right]\sin20^0$	
		$=\frac{\sqrt{3}}{4}\left[\cos40^0-\cos\left(180^0-60\right)\right]\sin20^0$	½
		$=\frac{\sqrt{3}}{4}\left[\cos40^0+\cos60^0\right]\sin20^0$	½
		$=\frac{\sqrt{3}}{4}\left[\cos40^0+\frac{1}{2}\right]\sin20^0$	
		$=\frac{\sqrt{3}}{4}\left[\cos40^0\sin20^0+\frac{1}{2}\sin20^0\right]$	½
		$=\frac{\sqrt{3}}{8}\left[\sin60^0+\sin\left(-20^0\right)+\sin20^0\right]$	½
		$=\frac{\sqrt{3}}{8}\left[\sin60^0+\sin20^0-\sin20^0\right]$	½
		$=\frac{\sqrt{3}}{8}\frac{\sqrt{3}}{2}$	
		$=\frac{3}{16}$	1

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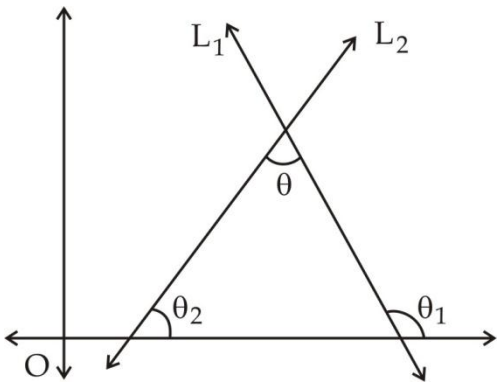
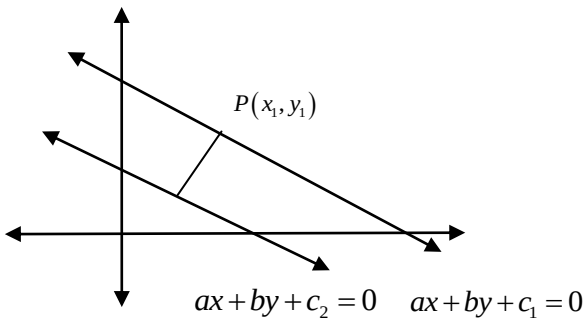
Subject Name: Basic Mathematics **Model Answer** **Subject Code:** 17104

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	d)	Find the acute angle between the lines $3x-y=4$ and $2x+y=3$	**04**
	Ans	$L_1: 3x-y=4$	
		$m_1=3$	1
		$L_2: 2x+y=3$	
		$m_2=-2$	1
		$\theta=\tan^{-1}\left\lvert\frac{m_1-m_2}{1+m_1m_2}\right\rvert$	
		$\theta=\tan^{-1}\left\lvert\frac{3+2}{1+3(-2)}\right\rvert$	1
		$\theta=\tan^{-1}(1)$	
		$\theta=\frac{\pi}{4}$	1
	e)	If m_1 and m_2 are the slope of two lines then prove that angle between two lines is $\tan\theta=\left\lvert\frac{m_1-m_2}{1+m_1m_2}\right\rvert$	**04**
	Ans		
		Let θ_1 = Angle of inclination of L_1	
		θ_2 = Angle of inclination of L_2	
		$\therefore$ Slope of L_1 is $m_1=\tan\theta_1$	
		Slope of L_2 is $m_2=\tan\theta_2$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	e)	from figure, $\theta = \theta_1 - \theta_2$	1
		$\therefore \tan\theta = \tan(\theta_1 - \theta_2)$	
		$= \dfrac{\tan(\theta_1) - \tan(\theta_2)}{1 + \tan(\theta_1)\tan(\theta_2)}$	1
		$\tan\theta = \dfrac{m_1 - m_2}{1 + m_1 \cdot m_2}$	1
		θ is acute,	
		$\therefore \tan\theta = \left\lvert \dfrac{m_1 - m_2}{1 + m_1 \cdot m_2} \right\rvert$	1
	f)	Find the equation of the line passing through the point of intersection of $2x + y + 6 = 0$ and $3x + 5y - 15 = 0$ and parallel to the line $5x + 6y + 3 = 0$	**04**
	Ans	$2x + y = -6$	
		$3x + 5y = 15$	
		$\therefore$ $10x + 5y = -30$	
		$3x + 5y = 15$	
		$- \quad - \quad -$	
		$7x = -45$	
		$y = \dfrac{-45}{7}$	
		$\therefore \quad 2x - \dfrac{45}{7} = -6$	
		$\therefore 2x = \dfrac{45}{7} - 6$	
		$\therefore x = \dfrac{3}{14}$	
		$\therefore$ Point of intersection $= \left(\dfrac{3}{14}, \dfrac{-45}{7}\right)$	1
		Slope of the line $5x + 6y + 3 = 0$ is,	
		$m = -\dfrac{a}{b} = -\dfrac{5}{6}$	1

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	f)	$\therefore$ Slope of the required line is, $m = -\frac{5}{6}$ $\therefore$ equation is, $y - y_1 = m(x - x_1)$ $\therefore\ y + \frac{45}{7} = -\frac{5}{6}\left(x - \frac{3}{14}\right)$ $\therefore\ y + \frac{45}{7} = -\frac{5x}{6} + \frac{5}{28}$ OR $\frac{7y+45}{7} = -\frac{5}{6}\left(\frac{14x-3}{14}\right)$ $\therefore \frac{5x}{6} + y + \frac{45}{7} - \frac{5}{28} = 0$ $\therefore 12(7y+45) = -5(14x-3)$ $\therefore \frac{5x}{6} + y + \frac{25}{4} = 0$ $\therefore 70x + 84y + 525 = 0$	1 1
6.		**Attempt any <u>FOUR</u> of the following:**	**16**
	a)	Show that the distance between two parallel lines $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$ is given by $d = \left\lvert \frac{c_2 - c_1}{\sqrt{a^2 + b^2}} \right\rvert$	**04**
	Ans	Considering equations as $ax + by + c_1 = 0$ *and* $ax + by + c_2 = 0$ $L_1 : ax + by + c_1 = 0$ $L_2 : ax + by + c_2 = 0$ Let $P(x_1, y_1)$ be any point on the line L_1 $\therefore ax_1 + by_1 + c_1 = 0$ 	

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Subject Name: Basic Mathematics **Model Answer** **Subject Code:** 17104

Q. No.	Sub Q.N.	Answers	Marking Scheme
6.	a)	$\therefore ax_1 + by_1 = -c_1$	1
		PM is perpendicular on the line L_2	
		$\therefore PM = \left\|\frac{ax_1 + by_1 + c_2}{\sqrt{a^2 + b^2}}\right\|$	2
		$\therefore PM = \left\|\frac{-c_1 + c_2}{\sqrt{a^2 + b^2}}\right\| = \left\|\frac{c_2 - c_1}{\sqrt{a^2 + b^2}}\right\|$	1
	b)	Find the angle between the lines $y = 5x + 6$ and $y = x$	**04**
	Ans	$L_1 : -5x + y - 6 = 0$	
		$m_1 = \frac{-a}{b} = \frac{5}{1} = 5$	1
		$L_2 : -x + y = 0$	
		$m_2 = \frac{-a}{b} = \frac{-(-1)}{1} = 1$	1
		$\theta = \tan^{-1}\left\|\frac{m_1 - m_2}{1 + m_1 m_2}\right\|$	
		$\theta = \tan^{-1}\left\|\frac{5-1}{1+(5)(1)}\right\|$	1
		$\theta = \tan^{-1}\left(\frac{2}{3}\right)$	1
	c)	In the two factories P and Q engaged in the same industries. The average weekly wages and standard deviations are as follows.Which factory P or Q has greater variability in individual wages?	**04**

Factories	Average wages	Standard deviation
P	34.5	5.0
Q	28.5	4.5

Q. No.	Sub Q.N.	Answers	Marking Scheme
6.	c)	For factory P:	
	Ans	Coefficient of variation $V_1 = \frac{S.D.}{Mean} \times 100$	
		$= \frac{5}{34.5} \times 100$	
		$= 14.49$	1
		For factory Q:	
		Coefficient of variation $V_2 = \frac{4.5}{28.5} \times 100$	1
		$= 15.79$	
		$\therefore V_1 < V_2$	1
		$\therefore$ Factory Q has greater variability	1
	d)	Find range and coefficient of range for the following data:	**04**

Marks:	10-19	20-29	30-39	40-49	50-59	60-69
No. of students	06	10	16	14	08	04

Ans

Marks:	9.5-19.5	19.5-29.5	29.5-39.5	39.5-49.5	49.5-59.5	59.5-69.5
No. of students:	06	10	16	14	08	04

Range = L – S

$= 69.5 - 9.5$ 1

$= 60$ 1

Coefficient of range $= \frac{L - S}{L + S}$

$= \frac{69.5 - 9.5}{69.5 + 9.5}$ 1

$= 0.76$ 1

	e)	Find the mean deviation for the following data:	**04**

Q. No.	Sub Q.N.	Answers	Marking Scheme

6. e)

Marks	3	4	5	6	7	8
No. of Students	1	3	7	5	2	2

Ans

x_i	f_i	$f_i x_i$	$d_i = x_i - \bar{x}$	$\lvert d_i \rvert$	$f_i \lvert d_i \rvert$
3	1	3	-2.5	2.5	2.5
4	3	12	-1.5	1.5	4.5
5	7	35	-0.5	0.5	3.5
6	5	30	0.5	0.5	2.5
7	2	14	1.5	1.5	3
8	2	16	2.5	2.5	5
	20	110			21

2

Mean $\bar{x} = \frac{\sum f_i x_i}{N} = \frac{110}{20}$

$\bar{x} = 5.5$

1

M.D. $= \frac{\sum f_i \lvert d_i \rvert}{\sum f_i}$

$= \frac{21}{20}$

$= 1.05$

1

---

f) Find the standard deviation for the following data:

04

Class Interval	0-10	10-20	20-30	30-40	40-50
Frequency	14	23	27	21	15

Q. No.	Sub Q.N.	Answers	Marking Scheme

6. f) Ans

Class	x_i	f_i	$f_i x_i$	x^2_i	$f_i x^2_i$
0-10	5	14	70	25	350
10-20	15	23	345	225	5175
20-30	25	27	675	625	16875
30-40	35	21	735	1225	25725
40-50	45	15	675	2025	30375
		100	2500		78500

2

Mean $\bar{x} = \frac{\sum f_i x_i}{N} = \frac{2500}{100} = 25$ 1

S.D.$= \sigma = \sqrt{\frac{\sum f_i x_i^2}{N} - \left(\bar{x}\right)^2}$

$= \sqrt{\frac{78500}{100} - (25)^2}$

$\sigma = 12.65$ 1

OR

Class	x_i	f_i	d_i	$f_i d_i$	d^2_i	$f_i d^2_i$
0-10	5	14	-2	-28	4	56
10-20	15	23	-1	-23	1	23
20-30	25	27	0	0	0	0
30-40	35	21	1	21	1	21
40-50	45	15	2	30	4	60
		100		00		160

2

$S.D. = \sigma = \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N}\right)^2} \times h$

$= \sqrt{\frac{160}{100} - \left(\frac{0}{100}\right)^2} \times 10$ 1

$= 12.65$ 1

Important Note

In the solution of the question paper, wherever possible all the possible alternative methods of solution are given for the sake of convenience. Still student may follow a method other than the given herein. In such case, first see whether the method falls within the scope of the curriculum, and then only give appropriate marks in accordance with the scheme of marking.