MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

WINTER– 2019 EXAMINATION

Subject Name: Basic Mathematics **Model Answer** **Subject Code: 22103**

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 judgment 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 FIVE of the following:**	**10**
	a)	Find the value of x if $\log_3(x+6)=2$	**02**
	Ans	$\log_3(x+6)=2$	
		$\therefore x+6=3^2$	1
		$\therefore x+6=9$	
		$\therefore x=3$	1
		--	
	b)	Find the area of triangle whose vertices are $(-3,1),(1,-3)$ and $(2,3)$.	**02**
	Ans	Let $(x_1,y_1)=(-3,1),(x_2,y_2)=(1,-3)$ and $(x_3,y_3)=(2,3)$	
		$A=\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$	
		$\therefore A=\frac{1}{2}\begin{vmatrix} -3 & 1 & 1 \\ 1 & -3 & 1 \\ 2 & 3 & 1 \end{vmatrix}$	1
		$\therefore A=\frac{1}{2}\left[-3(-3-3)-1(1-2)+1(3+6)\right]$	
		$\therefore A=14$	1
		--	
	c)	Without using calculator,find the value of $\cos(-765^0)$	**02**
	Ans	$\cos(-765^0)=\cos(765^0)$	½
		$=\cos(8\times90+45)$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	c)	$\cos\left(-765^0\right)=\cos 45^0$	1
		$=\frac{1}{\sqrt{2}}$ or 0.707	½
	d)	Find the length of the longest pole that can be placed in a room 12 m long 9 m broad and 8 m high.	**02**
	Ans	Let $L=12$ m, $B=9\ m$, $H=8\ m$	
		Longest pole = Length of diagonal	
		$=\sqrt{L^2+B^2+H^2}$	
		$=\sqrt{(12)^2+(9)^2+(8)^2}$	1
		$=17\ m$	1
	e)	Find the volume of the sphere whose surface area is 616 sq.m.	**02**
	Ans	Surface area $=616$	
		$4\pi r^2=616$	½
		$\therefore r^2=\frac{616}{4\pi}=49.02$	
		$\therefore r=7.001$	½
		Volume $=\frac{4}{3}\pi r^3$	
		$=\frac{4}{3}\pi\left(7.001\right)^3$	½
		$=1437.37$	½
	f)	If mean is 82 and standard deviation is 7, find the coefficient of variance .	**02**
	Ans	Coefficient of variation $=\frac{\sigma}{\bar{x}}\times 100$	
		Coefficient of variation $=\frac{7}{82}\times 100$	1
		$=8.537$	1
	g)	Find range and coefficient of range for the data:	**02**
		3, 7,11,2,16,17,22,20,19	
	Ans	Range $=L-S$	
		$=22-2$	½

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	g)	$\therefore$ Range $= 20$	½
		Coefficient of range $= \dfrac{L-S}{L+S}$	
		$= \dfrac{22-2}{22+2}$	½
		$= 0.833$	½
2.		**Attempt any THREE of the following :**	**12**
	a)	If A=$\begin{bmatrix} -2 & 0 & 2 \\ 3 & 4 & 5 \end{bmatrix}, B = \begin{bmatrix} 2 & 1 \\ 3 & 5 \\ 0 & 2 \end{bmatrix}$ whether AB is singular or non singular matrix	**04**
	Ans	$AB = \begin{bmatrix} -2 & 0 & 2 \\ 3 & 4 & 5 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 3 & 5 \\ 0 & 2 \end{bmatrix}$	
		$= \begin{bmatrix} -4 & 2 \\ 18 & 33 \end{bmatrix}$	2
		Consider $\lvert AB \rvert = \begin{vmatrix} -4 & 2 \\ 18 & 33 \end{vmatrix}$	
		$= -132 - 36$	
		$= -168 \neq 0$	1
		$\therefore$ AB is non singular matrix	1
	b)	Resolve into partial fraction: $\dfrac{2x+3}{x^2-2x-3}$	**04**
	Ans	$\dfrac{2x+3}{x^2-2x-3} = \dfrac{2x+3}{(x-3)(x+1)}$	
		$= \dfrac{A}{(x-3)} + \dfrac{B}{(x+1)}$	1
		$\therefore 2x+3 = A(x+1) + B(x-3)$	
		Put $x = -1$	
		$\therefore -2+3 = B(-1-3)$	
		$\therefore B = -\dfrac{1}{4}$	1

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	b)	Put $x=3$	
		$\therefore 2(3)+3=A(3+1)$	
		$\therefore A=\frac{9}{4}$	1
		$\frac{2x+3}{x^2-2x-3}=\frac{\frac{9}{4}}{(x-3)}+\frac{-\frac{1}{4}}{(x+1)}$	1
	c)	The voltages in an circuit are related by following equations:	
		$V_1+V_2+V_3=9;\ V_1-V_2+V_3=3;\ V_1+V_2-V_3=1$. Find $V_1,\ V_2$ and V_3 by using Cramer's rule	**04**
	Ans	$D=\begin{vmatrix}1 & 1 & 1\\ 1 & -1 & 1\\ 1 & 1 & -1\end{vmatrix}=1(1-1)-1(-1-1)+1(1+1)=4$	1
		$D_{V_1}=\begin{vmatrix}9 & 1 & 1\\ 3 & -1 & 1\\ 1 & 1 & -1\end{vmatrix}=9(1-1)-1(-3-1)+1(3+1)=8$	
		$\therefore V_1=\frac{D_{V_1}}{D}=\frac{8}{4}=2$	1
		$D_{V_2}=\begin{vmatrix}1 & 9 & 1\\ 1 & 3 & 1\\ 1 & 1 & -1\end{vmatrix}=1(-3-1)-9(-1-1)+1(1-3)=12$	
		$\therefore V_2=\frac{D_{V_2}}{D}=\frac{12}{4}=3$	1
		$D_{V_3}=\begin{vmatrix}1 & 1 & 9\\ 1 & -1 & 3\\ 1 & 1 & 1\end{vmatrix}=1(-1-3)-1(1-3)+9(1+1)=16$	
		$\therefore V_3=\frac{D_{V_3}}{D}=\frac{16}{4}=4$	1
	d)	Compute standard deviation for the following data:	**04**
		1 , 2 , 3 , 4 , 5 , 6 , 7	

Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	d)	$\begin{array}{|c|c|c|c|c|c|c|c|c|}\hline x_i & 1 & 2 & 3 & 4 & 5 & 6 & 7 & \sum x_i = 28 \\ \hline x_i^2 & 1 & 4 & 9 & 16 & 25 & 36 & 49 & \sum x_i^{2} = 140 \\ \hline \end{array}$	1
		Mean $\bar{x} = \frac{\sum x_i}{n} = \frac{28}{7} = 4$	1
		$S.D. = \sigma = \sqrt{\frac{\sum x_i^2}{n} - \left(\bar{x}\right)^2}$	
		$\therefore \sigma = \sqrt{\frac{140}{7} - \left(4\right)^2}$	1
		$\therefore \sigma = 2$	1
3.		**Attempt any THREE of the following:**	**12**
	a)	Simplify:	**04**
		$\frac{\cos^2\left(180^0 - \theta\right)}{\sin\left(-\theta\right)} + \frac{\cos^2\left(270^0 + \theta\right)}{\sin\left(180 + \theta\right)}$	
	Ans	$\cos^2\left(180^0 - \theta\right) = \left(-\cos\theta\right)^2 = \cos^2\theta$	½
		$\cos^2\left(270^0 + \theta\right) = \sin^2\theta$	½
		$\sin\left(-\theta\right) = -\sin\theta$	½
		$\sin\left(180 + \theta\right) = -\sin\theta$	½
		$\therefore \frac{\cos^2\left(180^0 - \theta\right)}{\sin\left(-\theta\right)} + \frac{\cos^2\left(270^0 + \theta\right)}{\sin\left(180 + \theta\right)}$	
		$= \frac{\cos^2\theta}{-\sin\theta} + \frac{\sin^2\theta}{-\sin\theta}$	½
		$= \frac{\cos^2\theta + \sin^2\theta}{-\sin\theta}$	½
		$= \frac{1}{-\sin\theta}$	½
		$= -\operatorname{cosec}\theta$	½
	b)	Prove that :	**04**
		$1 + \tan\theta.\tan 2\theta = \sec 2\theta$	

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	b)	$1+\tan\theta.\tan 2\theta$	
	Ans	$=1+\dfrac{\sin\theta}{\cos\theta}\dfrac{\sin 2\theta}{\cos 2\theta}$	
		$=\dfrac{\cos\theta\cos 2\theta+\sin\theta\sin 2\theta}{\cos\theta\cos 2\theta}$	½
		$=\dfrac{\cos(\theta-2\theta)}{\cos\theta\cos 2\theta}$	1
		$=\dfrac{\cos(-\theta)}{\cos\theta\cos 2\theta}$	½
		$=\dfrac{\cos\theta}{\cos\theta\cos 2\theta}$	
		$=\dfrac{1}{\cos 2\theta}$	1
		$=\sec 2\theta$	1
	c)	Prove that $\dfrac{\sin 4A+\sin 5A+\sin 6A}{\cos 4A+\cos 5A+\cos 6A}=\tan 5A$	**04**
	Ans	$\dfrac{\sin 4A+\sin 5A+\sin 6A}{\cos 4A+\cos 5A+\cos 6A}$	
		$=\dfrac{(\sin 4A+\sin 6A)+\sin 5A}{(\cos 4A+\cos 6A)+\cos 5A}$	
		$=\dfrac{2\sin\left(\dfrac{4A+6A}{2}\right)\cos\left(\dfrac{4A-6A}{2}\right)+\sin 5A}{2\cos\left(\dfrac{4A+6A}{2}\right)\cos\left(\dfrac{4A-6A}{2}\right)+\cos 5A}$	2
		$=\dfrac{2\sin 5A\cos(-A)+\sin 5A}{2\cos 5A\cos(-A)+\cos 5A}$	1
		$=\dfrac{\sin 5A(2\cos(-A)+1)}{\cos 5A(2\cos(-A)+1)}$	
		$=\tan 5A$	1
	d)	Prove that: $\tan^{-1}\left(\dfrac{1}{2}\right)+\tan^{-1}\left(\dfrac{1}{3}\right)=\dfrac{\pi}{4}$	**04**

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

4.		**Attempt any THREE of the following:**	**12**
	a)	If $A=\begin{bmatrix}1 & 2 & -1\\ 3 & 0 & 2\\ 4 & 5 & 0\end{bmatrix}$, $B=\begin{bmatrix}1 & 0 & 0\\ 2 & 1 & 0\\ 0 & 1 & 3\end{bmatrix}$ verify $(AB)^T=B^TA^T$	**04**
	Ans	$AB=\begin{bmatrix}1 & 2 & -1\\ 3 & 0 & 2\\ 4 & 5 & 0\end{bmatrix}\begin{bmatrix}1 & 0 & 0\\ 2 & 1 & 0\\ 0 & 1 & 3\end{bmatrix}$	
		$AB=\begin{bmatrix}1+4-0 & 0+2-1 & 0+0-3\\ 3+0+0 & 0+0+2 & 0+0+6\\ 4+10+0 & 0+5+0 & 0+0+0\end{bmatrix}$	
		$AB=\begin{bmatrix}5 & 1 & -3\\ 3 & 2 & 6\\ 14 & 5 & 0\end{bmatrix}$	1
		$\therefore (AB)^T=\begin{bmatrix}5 & 3 & 14\\ 1 & 2 & 5\\ -3 & 6 & 0\end{bmatrix}$	½
		$B^TA^T=\begin{bmatrix}1 & 2 & 0\\ 0 & 1 & 1\\ 0 & 0 & 3\end{bmatrix}\begin{bmatrix}1 & 3 & 4\\ 2 & 0 & 5\\ -1 & 2 & 0\end{bmatrix}$	1
		$\therefore B^TA^T=\begin{bmatrix}1+4-0 & 3+0+0 & 4+10+0\\ 0+2-1 & 0+0+2 & 0+5+0\\ 0+0-3 & 0+0+6 & 0+0+0\end{bmatrix}$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	a)	$\therefore B^T A^T = \begin{bmatrix} 5 & 3 & 14 \\ 1 & 2 & 5 \\ -3 & 6 & 0 \end{bmatrix}$	1
		$\therefore \left(AB\right)^T = B^T A^T$	½
		--	
	b)	Resolve in to partial fraction: $\frac{3x-2}{(x+2)(x^2+4)}$	**04**
	Ans	$\frac{3x-2}{(x+2)(x^2+4)} = \frac{A}{x+2} + \frac{Bx+C}{x^2+4}$	½
		$\therefore 3x-2 = (x^2+4)A + (x+2)(Bx+C)$ Put $x=-2$ $\therefore 3(-2)-2 = \left((-2)^2+4\right)A$ $\therefore -8 = 8A$ $\therefore A = -1$	1
		Put $x=0$ $\therefore -2 = 4A+2C$ $\therefore -2 = 4(-1)+2C$ $\therefore 2 = 2C$ $\therefore C = 1$	1
		Put $x=1$ $\therefore 3(1)-2 = \left((1)^2+4\right)A + (1+2)\left(B(1)+C\right)$ $\therefore 1 = 5A+3B+3C$ $\therefore 1 = 5(-1)+3B+3(1)$ $\therefore 3 = 3B$ $\therefore B = 1$	1
		$\therefore \frac{3x-2}{(x+2)(x^2+4)} = \frac{-1}{x+2} + \frac{x+1}{x^2+4}$	½
		--	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	c)	Without using calculator , prove that $\cos 20^0.\cos 40^0.\cos 60^0.\cos 80^0 = \frac{1}{16}$	**04**
	Ans	$\cos 20^0.\cos 40^0.\cos 60^0.\cos 80^0$	
		$=\frac{1}{2}\left(2\cos 20^\circ \cos 40^\circ\right).\left(\frac{1}{2}\right)\cos 80^\circ$	½
		$=\frac{1}{4}\left[\cos\left(20^\circ+40^\circ\right)+\cos\left(20^\circ-40^\circ\right)\right]\cos 80^\circ$	½
		$=\frac{1}{4}\left[\cos\left(60^\circ\right)+\cos\left(-20^\circ\right)\right]\cos 80^\circ$	
		$=\frac{1}{4}\left[\frac{1}{2}\cos 80^\circ+\cos 20^\circ\cos 80^\circ\right]$	½
		$=\frac{1}{4}\left[\frac{1}{2}\cos 80^\circ+\frac{1}{2}\left(2\cos 20^\circ\cos 80^\circ\right)\right]$	½
		$=\frac{1}{8}\left[\cos 80^\circ+\cos\left(20^\circ+80^\circ\right)+\cos\left(20^\circ-80^\circ\right)\right]$	½
		$=\frac{1}{8}\left[\cos 80^\circ+\cos\left(100^\circ\right)+\cos\left(-60^\circ\right)\right]$	
		$=\frac{1}{8}\left[\cos 80^\circ+\cos\left(180-80^\circ\right)+\frac{1}{2}\right]$	½
		$=\frac{1}{8}\left[\cos 80^\circ-\cos\left(80^\circ\right)+\frac{1}{2}\right]$	½
		$=\frac{1}{16}$	½
	d)	Prove that:	
		$\tan A.\tan\left(60-A\right).\tan\left(60+A\right)=\tan 3A$	**04**
	Ans	$\tan A.\tan\left(60-A\right).\tan\left(60+A\right)$	
		$=\tan A.\frac{\tan 60-\tan A}{1+\tan 60\tan A}\frac{\tan 60+\tan A}{1-\tan 60\tan A}$	1
		$=\tan A.\left(\frac{\sqrt{3}-\tan A}{1+\sqrt{3}\tan A}\right)\left(\frac{\sqrt{3}+\tan A}{1-\sqrt{3}\tan A}\right)$	1
		$=\tan A.\left(\frac{3-\tan^2 A}{1-3\tan^2 A}\right)$	1

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Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	d)	$=\left(\dfrac{3\tan A-\tan^3 A}{1-3\tan^2 A}\right)$	
		$=\tan 3A$	1
		---	
	e)	If $\angle A$ and $\angle B$ are obtuse angles and $\sin A=\dfrac{12}{13},\ \cos B=\dfrac{-4}{5}$, find $\cos\left(A+B\right)$	**04**
	Ans	$\sin A=\dfrac{12}{13},\ \cos B=\dfrac{-4}{5}$	
		$\cos^2 A=1-\sin^2 A$	
		$=1-\left(\dfrac{12}{13}\right)^2$	
		$=1-\dfrac{144}{169}=\dfrac{25}{169}$	
		$\cos A=\pm\dfrac{5}{13}$	
		$\therefore \cos A=-\dfrac{5}{13}\quad\left(\angle A \text{ is obtuse angle}\right)$	1
		$\sin^2 B=1-\cos^2 B$	
		$=1-\left(-\dfrac{4}{5}\right)^2$	
		$\sin^2 B=1-\dfrac{16}{25}=\dfrac{9}{25}$	
		$\sin B=\pm\dfrac{3}{5}$	
		$\therefore \sin B=\dfrac{3}{5}\qquad\left(\angle B \text{ is obtuse angle}\right)$	1
		$\therefore \cos\left(A+B\right)=\cos A.\cos B-\sin A.\sin B$	
		$=\left(-\dfrac{5}{13}\right)\times\left(-\dfrac{4}{5}\right)-\left(\dfrac{12}{13}\right)\times\left(\dfrac{3}{5}\right)$	1
		$=-\dfrac{16}{65}$	1

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.		**Attempt any TWO of the following:**	**12**
	a)	Attempt the following:	**06**
	(i)	Find length of perpendicular from the point $\text{P}(2,5)$ on the line $2x+3y-6=0$	**03**
	Ans	$d=\left\lvert\frac{ax_1+by_1+c}{\sqrt{a^2+b^2}}\right\rvert$	
		$p=\left\lvert\frac{2(2)+3(5)-6}{\sqrt{(2)^2+(3)^2}}\right\rvert$	2
		$p=\frac{13}{\sqrt{13}}$ or $\sqrt{13}$ or 3.61	1
		--	
	a) ii)	Find the equation of the line passing through $(2,3)$ and having slope 5 units	**03**
	Ans	Point $(x_1,y_1)=(2,3)$ and slope $m=5$	
		Equation of line is,	
		$y-y_1=m(x-x_1)$	
		$\therefore\ y-3=5(x-2)$	1
		$\therefore y-3=5x-10$	1
		$\therefore 5x-y-7=0$	1
		--	
	b)	Attempt the following:	**06**
	i)	Find the equation of the line passing through the point $(2,3)$ and perpendicular to the line $3x-5y=6$	**03**
	Ans	Point $(x_1,y_1)=(2,3)$	
		Slope of the line $3x-5y-6=0$ is,	
		$m=-\frac{a}{b}=-\frac{3}{-5}=\frac{3}{5}$	½
		$\therefore$ Slope of the required line is,	
		$m'=-\frac{1}{m}=-\frac{5}{3}$	½

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Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	b)i)	$\therefore$ equation is,	
	Ans	$y-y_1=m^{'}\left(x-x_1\right)$	
		$\therefore\ y-3=-\frac{5}{3}\left(x-2\right)$	1
		$\therefore 3y-9=-5x+10$	
		$\therefore 5x+3y-19=0$	1
	b)ii)	Find the acute angle between the lines $3x-y=4$, $2x+y=3$.	**03**
	Ans	For $3x-y=4$	
		slope $m_1=-\frac{a}{b}=-\frac{3}{-1}=3$	½
		For $2x+y=3$	
		slope $m_2=-\frac{a}{b}=-\frac{2}{1}=-2$	½
		$\therefore \tan\theta=\left\lvert\frac{m_1-m_2}{1+m_1m_2}\right\rvert$	
		$\therefore \tan\theta=\left\lvert\frac{3-\left(-2\right)}{1+3\times\left(-2\right)}\right\rvert$	1
		$\therefore \tan\theta=1$	
		$\therefore \theta=\tan^{-1}\left(1\right)$	1
		$\therefore \theta=\frac{\pi}{4}$	
	c)	Attempt the following:	**06**
	i)	A cylinder has hemispherical ends having radius 14 cm and height 50 cm. Find the total surface area	**03**
	Ans	Given $r=14$ cm and $h=50$ cm	
		Total surface area $=$ Curved Surface area of Cylinder + Surface area of two hemisphere	
		$\therefore A=2\pi rh+2\left(2\pi r^2\right)=2\pi r\left(h+2r\right)$	
		$=2\pi\left(14\right)\left[50+2\left(14\right)\right]$	2
		$=2184\pi$ or 6861.24	1

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	c)(ii)	A solid right circular cone of radius 2 m and height 27 m melted and recasted into a sphere. Find the volume and surface area of the sphere.	**03**

Ans

Volume of right circular cone $=\frac{1}{3}\pi r^2 h$

$$=\frac{1}{3}\pi(2)^2(27)$$

$$=36\pi \quad \text{or} \quad 113.04$$ 1

Volume of sphere $=$ Volume of right circular cone $=36\pi$

Volume of sphere $=\frac{4}{3}\pi r^3$

$\therefore 36\pi=\frac{4}{3}\pi r^3$

$\therefore r^3=27$ 1

$\therefore r=3$

$\therefore$ Surface area of the sphere $=4\pi r^2$

$$=4\pi(3)^2$$

$$=36\pi \quad \text{or} \quad 113.04$$ 1

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6. **Attempt any TWO of the following :** **12**

a) Find the mean, standard deviation and coefficient of variance of the following data: **06**

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

Ans

Class Interval	x_i	f_i	$f_i x_i$	$d_i=\frac{x_i-a}{h}$	$f_i d_i$	${d_i}^2$	$f_i {d_i}^2$
0-10	5	14	70	-2	-28	4	56
10-20	15	23	345	-1	-23	1	23
20-30	25	27	675	0	0	0	0
30-40	35	21	735	1	21	1	21
40-50	45	15	675	2	30	4	60
		100	2500		0		160

3

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

6. a)

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

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

$$S.D. = \sigma = \sqrt{\frac{160}{100} - \left(\frac{0}{100}\right)^2} \times 10$$

$$= 12.64$$

1

Coefficient of variance $V = \frac{\sigma}{\bar{x}} \times 100 = \frac{12.64}{25} \times 100$

$$= 50.56$$

1

OR

Class Interval	x_i	f_i	$f_i x_i$	x_i^2	$f_i x_i^2$
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

3

Mean $\bar{x} = \frac{\sum f_i x_i}{N} = \frac{2500}{1000} = 25$ 1

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

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

$$\sigma = 12.64$$

1

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

6. a)

Coefficient of variance $=\frac{\sigma}{\overline{x}}\times 100$

$$=\frac{12.64}{25}\times 100$$

$$=50.56$$

1

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b) Attempt the following: **06**

i) Calculate the range and coefficient of range from the following data: **03**

Marks	10-19	20-29	30-39	40-49	50-59	60-69
No. of students	6	10	16	14	8	4

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	6	10	16	14	8	4

1

$$\text{Range}=\text{L}-\text{S}$$

$$=69.5-9.5$$

$$=60$$

1

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

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

$$=0.76$$

1

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b)ii) The two set of observations are given below: **03**

Set I	Set II
$\overline{x}$ =82.5	$\overline{x}$ =48.75
σ =7.3	σ =8.35

Which of two set is more consistent?

Q. No.	Sub Q.N.	Answers	Marking Scheme
6.	b) ii) Ans	For Set I: Coefficient of variance $=\frac{\sigma}{x}\times 100$ $=\frac{7.3}{82.5}\times 100$ $=8.848$	1
		For Set II: Coefficient of variance $=\frac{\sigma}{x}\times 100$ $=\frac{8.35}{48.75}\times 100$ $=17.128$	1
		Set I is more consistent	1
		--	
	c)	Solve the following equations by matrix inversion method : $x+y+z=3$ $3x-2y+3z=4$ $5x+5y+z=11$	**06**
	Ans	Let $A=\begin{bmatrix}1&1&1\\3&-2&3\\5&5&1\end{bmatrix}$, $B=\begin{bmatrix}3\\4\\11\end{bmatrix}$, $X=\begin{bmatrix}x\\y\\z\end{bmatrix}$ $\lvert A\rvert=\begin{vmatrix}1&1&1\\3&-2&3\\5&5&1\end{vmatrix}$ $\lvert A\rvert=1(-2-15)-1(3-15)+1(15+10)$ $\therefore \lvert A\rvert=20\neq 0$	1
		$\therefore A^{-1}$ exists Matrix of minors $=\begin{bmatrix}\begin{vmatrix}-2&3\\5&1\end{vmatrix}&\begin{vmatrix}3&3\\5&1\end{vmatrix}&\begin{vmatrix}3&-2\\5&5\end{vmatrix}\\\begin{vmatrix}1&1\\5&1\end{vmatrix}&\begin{vmatrix}1&1\\5&1\end{vmatrix}&\begin{vmatrix}1&1\\5&5\end{vmatrix}\\\begin{vmatrix}1&1\\-2&3\end{vmatrix}&\begin{vmatrix}1&1\\3&3\end{vmatrix}&\begin{vmatrix}1&1\\3&-2\end{vmatrix}\end{bmatrix}$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
6.	c)	$\text{Matrix of minors} = \begin{bmatrix} -17 & -12 & 25 \\ -4 & -4 & 0 \\ 5 & 0 & -5 \end{bmatrix}$	1
		$\text{Matrix of cofactors} = \begin{bmatrix} -17 & 12 & 25 \\ 4 & -4 & 0 \\ 5 & 0 & -5 \end{bmatrix}$	1
		OR $C_{11} = +\begin{vmatrix} -2 & 3 \\ 5 & 1 \end{vmatrix} = -2-15 = -17,\ C_{12} = -\begin{vmatrix} 3 & 3 \\ 5 & 1 \end{vmatrix} = -\left(3-15\right) = 12\ ,\ C_{13} = +\begin{vmatrix} 3 & -2 \\ 5 & 5 \end{vmatrix} = 15+10 = 25$	
		$C_{21} = -\begin{vmatrix} 1 & 1 \\ 5 & 1 \end{vmatrix} = -\left(1-5\right) = 4\ ,\ C_{22} = +\begin{vmatrix} 1 & 1 \\ 5 & 1 \end{vmatrix} = 1-5 = -4,\ C_{23} = -\begin{vmatrix} 1 & 1 \\ 5 & 5 \end{vmatrix} = -\left(5-5\right) = 0$	1
		$C_{31} = +\begin{vmatrix} 1 & 1 \\ -2 & 3 \end{vmatrix} = 3+2 = 5,\ C_{32} = -\begin{vmatrix} 1 & 1 \\ 3 & 3 \end{vmatrix} = -\left(3-3\right) = 0\ ,\ C_{33} = \begin{vmatrix} 1 & 1 \\ 3 & -2 \end{vmatrix} = -2-3 = -5$	
		$\text{Matrix of cofactors} = \begin{bmatrix} -17 & 12 & 25 \\ 4 & -4 & 0 \\ 5 & 0 & -5 \end{bmatrix}$	1
		$\text{Adj}.A = \begin{bmatrix} -17 & 4 & 5 \\ 12 & -4 & 0 \\ 25 & 0 & -5 \end{bmatrix}$	½
		$A^{-1} = \frac{1}{\lvert A \rvert}\text{Adj}.A$	
		$\therefore A^{-1} = \frac{1}{20}\begin{bmatrix} -17 & 4 & 5 \\ 12 & -4 & 0 \\ 25 & 0 & -5 \end{bmatrix}$	1
		$\therefore X = A^{-1}B$ $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{20}\begin{bmatrix} -17 & 4 & 5 \\ 12 & -4 & 0 \\ 25 & 0 & -5 \end{bmatrix}\begin{bmatrix} 3 \\ 4 \\ 11 \end{bmatrix}$	
		$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{20}\begin{bmatrix} -51+16+55 \\ 36-16+0 \\ 75+0-55 \end{bmatrix}$	½

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.	c)	$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{20}\begin{bmatrix} 20 \\ 20 \\ 20 \end{bmatrix}$ $\therefore \quad x=1\,,\ \ y=1\,,\ \ z=1$ --- ***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.* --- --- -	 1