Important Instructions to STUDENTS

1) The model answer given here are prepared from the answers from the previously uploaded model answers by Board.
2) These model answers are not uploaded by the MSBTE official site but MSBTE study resources website prepared it for students. This model answer has question paper also inbuilt in it, no need to download it separate.
3) Please remembter that answers are not checked word to word but based on keywords which must be present in your answer
4) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate
5) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn bycandidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn
6) For programming language papers, credit may be given to any other program based on equivalentconcept
7) Students are advised to prepare all the syllabus from recommended book and use these model answers for the purpose of tests.

Q.NO	SUB Q N	ANSWER	Marking Scheme

1. Attempt any five.

a) Find Value of $\log\left(\frac{2}{3}\right)+\log\left(\frac{4}{5}\right)-\log\left(\frac{8}{15}\right)$

→ $\log\left(\frac{2}{3}\right)+\log\left(\frac{4}{5}\right)-\log\left(\frac{8}{15}\right)$.

$$= \log\left[\frac{\frac{2}{3}\times\frac{4}{5}}{8/15}\right]$$

$$= \log\left[\frac{8/15}{8/15}\right]$$

$$= \log[1]$$

$$\boxed{= 0 \text{.......... Answer.}}$$

b) Without using calculator find value of $\cos(135°)$.

→ $\cos(135°) = \cos(90°+45°)$

using; $\cos(A+B) = \cos A\cdot\cos B - \sin A\cdot\sin B$.

$\therefore \cos[90°+45°] = \cos 90°\cdot\cos 45° - \sin 90°\cdot\sin 45°$

$$= (0)\left(\frac{1}{\sqrt{2}}\right) - (1)\left(\frac{1}{\sqrt{2}}\right)$$

$$\therefore \boxed{\cos[135°] = \frac{-1}{\sqrt{2}}}.$$

c) If $f(x) = x^3 - \frac{1}{x^3}$

show that; $f(x) + f(\frac{1}{x}) = 0.$

$\rightarrow$ $L.H.S. = f(x) + f(\frac{1}{x})$

$$= x^3 - \frac{1}{x^3} + (\frac{1}{x})^3 - \frac{1}{(\frac{1}{x})^3}$$

$$= x^3 - \frac{1}{x^3} + \frac{1}{x^3} - x^3$$

$$= 0.$$

$\therefore \boxed{L.H.S. = R.H.S.}$

d) State whether function is even or odd;

$$f(x) = \frac{e^x + e^{-x}}{2}.$$

$\rightarrow$
$$f(x) = \frac{e^x + e^{-x}}{2}$$

$$f(-x) = \frac{e^{-x} + e^{-(-x)}}{2}$$

$$f(-x) = \frac{e^{-x} + e^{x}}{2}$$

$$f(-x) = \frac{e^x + e^{-x}}{2}$$

$\therefore$ $\boxed{f(x) = f(-x) \text{.... function is } \underline{\underline{\text{even}}}}$

e) Find $\frac{dy}{dx}$ if $y = x^2 \cdot e^x$.

$\rightarrow$ $y = x^2 \cdot e^x$

Diff. w.r.t. x, using product rule;

$$\frac{dy}{dx} = x^2 \cdot \frac{d}{dx}(e^x) + e^x \cdot \frac{d}{dx}(x^2)$$

Q.NO	SUB Q.N	ANSWER	Marking Scheme

$$\therefore \frac{dy}{dx} = x^2 \cdot e^x + e^x \cdot 2x$$

$$\therefore \boxed{\frac{dy}{dx} = e^x \cdot [x^2 + 2x].}$$

F.) Find range & coeff. of range for runs scored by cricket player in eight innings: 45, 42, 39, 40, 48, 41, 45, 44.

→ Given numbers are :-

45, 42, 39, 40, 48, 41, 45, 44.

$39 \downarrow L$, $48 \downarrow H$

Highest Number = 48.
Lowest Number = 39.

$$\text{Range} = H - L$$
$$= 48 - 39$$

$$\therefore \boxed{\text{Range} = 9.}$$

$$\text{coeff. of Range} = \frac{H - L}{H + L} = \frac{48 - 39}{48 + 39}$$

$$\therefore \boxed{\text{Coeff. of Range} = 0.103.}$$

g] If mean is "34.5" & S.D. (σ) is "5" Find coefficient of variance.

→ $$C.V. = \frac{\sigma}{\bar{x}} \times 100$$

$$= \frac{5}{34.5} \times 100$$

$$= 14.492\%$$

$$\therefore \boxed{\text{coefficient of variance} = 14.492\%}$$

2 Solve any three.

a] If $P = \begin{bmatrix} 1 & 2 & -3 \\ 3 & -1 & 2 \\ -2 & 1 & 3 \end{bmatrix}$ & $Q = \begin{bmatrix} 2 & 3 & 1 \\ 3 & 1 & 2 \\ 1 & 2 & 3 \end{bmatrix}$

then find matrix "R" such that, $P+Q+R=0$.

→ $P+Q+R=0$.

$\therefore R = 0 - P - Q$.

$$\therefore R = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 2 & -3 \\ 3 & -1 & 2 \\ -2 & 1 & 3 \end{bmatrix} - \begin{bmatrix} 2 & 3 & 1 \\ 3 & 1 & 2 \\ 1 & 2 & 3 \end{bmatrix}$$

$$\therefore R = \begin{bmatrix} 0-1-2 & 0-2-3 & 0-(-3)-1 \\ 0-3-3 & 0-(-1)-1 & 0-2-2 \\ --(-2)-1 & 0-1-2 & 0-3-3 \end{bmatrix}$$

$$\boxed{\therefore R = \begin{bmatrix} -3 & -5 & 2 \\ -6 & 0 & -4 \\ 1 & -3 & -6 \end{bmatrix}.}$$

b] Resolve into Partial fractions, $\dfrac{x^2-2x+3}{(x+2)(x^2+1)}$.

→ let us put it into three terms,

$$\frac{x^2-2x+3}{(x+2)(x^2+1)} = \frac{A}{(x+2)} + \frac{Bx}{(x^2+1)} + \frac{C}{(x^2+1)}.$$

or $$= \frac{A}{(x+2)} + \frac{Bx+C}{(x^2+1)}.$$

$$\therefore x^2-2x+3 = (x+2)(x^2+1)\cdot\left[\frac{A}{(x+2)} + \frac{Bx}{(x^2+1)} + \frac{C}{(x^2+1)}\right]$$

$$\boxed{x^2-2x+3 = A(x^2+1) + Bx(x+2) + C(x+2)}$$

---- eq.^{n} 1

Now, using this eq.^{n}, we can evaluate constants A, B & C.

Put $x+2=0 \therefore x=-2$ in eq.^{n} 1

$\therefore (-2)^2 - 2(-2) + 3 = A[(-2)^2+1] + 0 + 0$

$\therefore 11 = A(5)$

$\therefore \boxed{A = \frac{11}{5}}$

Put $x=0$ & $A = {}^{11}/_{5}$ ---- in eq^n ①

$$\therefore 0-0+3 = \frac{11}{5}(0+1)+0+C(0+2).$$

$$\therefore 3 = \frac{11}{5}+2C$$

$$\therefore 3-\frac{11}{5} = 2C$$

$$\therefore \frac{15-11}{5} = 2C$$

$$\therefore \frac{4}{5} = 2C$$

$$\therefore \frac{\cancel{4}^{2}}{5}\times\frac{1}{\cancel{2}_{1}} = C. \quad \therefore \boxed{C=\frac{2}{5}}$$

Put $x=1$, $A=\frac{11}{5}$ & $C=\frac{2}{5}$ in eq^n ①

$$\therefore (1)^2-2(1)+3 = \frac{11}{5}(1^2+1)+B(1)(1+2)+\frac{2}{5}(1+2)$$

$$\therefore 2 = \frac{11}{5}(2)+3B+\frac{6}{5}$$

$$\therefore 2 = \frac{22}{5}+3B+\frac{6}{5}$$

$$\therefore 2 = 3B+\frac{28}{5}$$

$$\therefore 2-\frac{28}{5} = 3B$$

$$\therefore -\frac{18}{5} = 3B$$

$$\therefore -\frac{18}{5}\times\frac{1}{3} = B \qquad \therefore \boxed{B=\frac{-6}{5}}$$

$$\therefore \frac{x^2-2x+3}{(x+2)(x^2+1)} = \frac{({}^{11}/_{5})}{(x+2)}+\frac{({}^{-6}/_{5})x}{(x^2+1)}+\frac{({}^{2}/_{5})}{(x^2+1)}$$

$$\therefore \boxed{\frac{x^2-2x+3}{(x+2)(x^2+1)} = \frac{11}{5(x+2)}-\frac{6x}{5(x^2+1)}+\frac{2}{5(x^2+1)}}$$

2. c) Without using calculator, find value of

$\sin 150^\circ + \cos 300^\circ - \tan 315^\circ + \sec^2 360^\circ$.

→ $\sin 150^\circ = \sin(90^\circ + 60^\circ) = \cos 60^\circ = \left(\frac{1}{2}\right)$.

$\cos 300^\circ = \cos[(3 \times 90^\circ) + 30^\circ] = \sin 30^\circ = (1/2)$.

$\tan 315^\circ = \tan[(3 \times 90^\circ) + 45^\circ] = -\cot 45^\circ = (-1)$

$\sec^2 360^\circ = \frac{1}{\cos^2(360^\circ)} = (1)$.

Now, $\sin 150^\circ + \cos 300^\circ - \tan 315^\circ + \sec^2 360^\circ$

$= \left(\frac{1}{2}\right) + \left(\frac{1}{2}\right) - (-1) + (1)$

$\boxed{= 3 \text{ ---------- Answer.}}$

d) Calculate mean deviation about mean :-

17, 15, 18, 23, 25, 22, 11, 5.

→ Step I) To calculate mean,

$$\bar{x} = \frac{17+15+18+23+25+22+11+5}{8}$$

$\bar{x} = \frac{136}{8}$ $\therefore \boxed{\bar{x} = 17.}$

Step II) To Calculate mean deviation,

x_i	$d_i = \lvert \bar{x} - x_i \rvert$
17	$= \lvert 17 - 17 \rvert = 0$
15	$= \lvert 17 - 15 \rvert = 2$
18	$= \lvert 17 - 18 \rvert = 1$
23	$= \lvert 17 - 23 \rvert = 6$
25	$= \lvert 17 - 25 \rvert = 8$
22	$= \lvert 17 - 22 \rvert = 5$
11	$= \lvert 17 - 11 \rvert = 6$
5	$= \lvert 17 - 5 \rvert = 12$
	$\Sigma d_i = 40.$

$M.D. = \frac{\Sigma d_i}{N}$

$M.D. = \frac{40}{8}$

$\therefore \boxed{M.D. = 5.}$

$\boxed{\text{Mean deviation} = M.D. = 5.}$

Que No.	Sub Que	ANSWER	Marking Scheme

3. Attempt any three.

a] Prove that; $\dfrac{\sin 4A + \sin 5A + \sin 6A}{\cos 4A + \cos 5A + \cos 6A} = \tan 5A$

→ Rearranging the terms;

$$L.H.S. = \frac{\sin 4A + \sin 6A + \sin 5A}{\cos 4A + \cos 6A + \cos 5A}$$

we know;

$$\boxed{\begin{aligned} &\sin C + \sin D = 2\cdot\sin\left[\frac{C+D}{2}\right]\cdot\cos\left[\frac{C-D}{2}\right] \\ \& &\cos C + \cos D = 2\cdot\cos\left[\frac{C+D}{2}\right]\cdot\cos\left[\frac{C-D}{2}\right]. \end{aligned}}$$

$$\therefore L.H.S. = \frac{2\cdot\sin\left[\frac{4A+6A}{2}\right]\cdot\cos\left[\frac{4A-6A}{2}\right] + \sin(5A)}{2\cdot\cos\left[\frac{4A+6A}{2}\right]\cdot\cos\left[\frac{4A-6A}{2}\right] + \cos(5A)}.$$

$$L.H.S. = \frac{2\cdot\sin\left(\frac{10A}{2}\right)\cdot\cos\left(\frac{-2A}{2}\right) + \sin(5A)}{2\cdot\cos\left(\frac{10A}{2}\right)\cdot\cos\left(\frac{-2A}{2}\right) + \cos(5A)}.$$

$$L.H.S. = \frac{2\cdot[\sin(5A)]\cdot[\cos(-A)] + [\sin(5A)]}{2\cdot[\cos(5A)]\cdot[\cos(-A)] + [\cos(5A)]}.$$

Taking $[\sin(5A)]$ common from numerator & $[\cos(5A)]$ common from denominator.

$$L.H.S. = \frac{[\sin(5A)]\cdot\cancel{[2\cos(A)+1]}}{[\cos(5A)]\cdot\cancel{[2\cos(A)+1]}}$$

$$\because \boxed{\cos(-\theta) = \cos(\theta)}$$

$$L.H.S. = \frac{\sin(5A)}{\cos(5A)} = \tan(5A) = \underline{\underline{R.H.S.}}$$

$$\boxed{\therefore \frac{\sin 4A + \sin 5A + \sin 6A}{\cos 4A + \cos 5A + \cos 6A} = \tan 5A \quad \text{Proved.}}$$

3 b) Prove that, $\sqrt{2+\sqrt{2+2\cos(4\theta)}} = 2\cos\theta$.

$$L.H.S. = \sqrt{2+\sqrt{2+2\cos(4\theta)}}$$

$$= \sqrt{2+\sqrt{2[1+\cos(4\theta)}}$$

we know,

$$\boxed{\begin{aligned} 1+\cos 2\theta &= 2\cos^2\theta \\ \therefore\ 1+\cos 4\theta &= 2\cos^2 2\theta \end{aligned}}$$

$$\therefore L.H.S. = \sqrt{2+\sqrt{2\cdot(2\cos^2 2\theta)}}$$

$$\therefore L.H.S. = \sqrt{2+\sqrt{4\cdot\cos^2 2\theta}}$$

$$\therefore L.H.S. = \sqrt{2+2\cos 2\theta}$$

$$\therefore L.H.S. = \sqrt{2[1+\cos 2\theta]}$$

$$\therefore L.H.S. = \sqrt{2(2\cos^2\theta)}$$

$$\therefore L.H.S. = \sqrt{4\cdot\cos^2\theta}$$

$$\therefore L.H.S. = 2\cdot\cos\theta = \underline{\underline{R.H.S.}}$$

$$\therefore \boxed{\sqrt{2+\sqrt{2+2\cos(4\theta)}} = 2\cdot\cos\theta \quad \text{Proved.}}$$

c) Show that; $\tan^{-1}\left[\frac{1}{8}\right] + \tan^{-1}\left[\frac{1}{5}\right] = \tan^{-1}\left[\frac{1}{3}\right]$.

$$L.H.S. = \tan^{-1}\left[\frac{1}{8}\right] + \tan^{-1}\left[\frac{1}{5}\right]$$

$$L.H.S. = \tan^{-1}\left[\frac{(1/8)+(1/5)}{1-[(1/8)\times(1/5)]}\right]$$

$$L.H.S. = \tan^{-1}\left[\frac{\left(\frac{5+8}{40}\right)}{\left(\frac{40-1}{40}\right)}\right] = \tan^{-1}\left[\frac{\left(\frac{13}{40}\right)}{\left(\frac{39}{40}\right)}\right]$$

$$\therefore L.H.S. = \tan^{-1}\left[\frac{13}{40}\times\frac{40}{39}\right] = \tan^{-1}\left[\frac{13}{39}\right] = \tan^{-1}\left(\frac{1}{3}\right) = \underline{\underline{R.H.S.}}$$

$$\therefore \boxed{\tan^{-1}\left[\frac{1}{8}\right] + \tan^{-1}\left[\frac{1}{5}\right] = \tan^{-1}\left[\frac{1}{3}\right] \text{ — Proved.}}$$

3. d) If, $x=a[\theta-\sin\theta]$, $y=a[1-\cos\theta]$ find $\frac{dy}{dx}$ at $\theta=\left(\frac{\pi}{4}\right)$.

$\rightarrow$ $x=a(\theta-\sin\theta)$

$$\frac{dx}{d\theta}=a[1-\cos\theta]$$

& $y=a[1-\cos\theta]$

$$\therefore \frac{dy}{d\theta}=a[0-(-\sin\theta)]$$

$$\therefore \frac{dy}{d\theta}=a\cdot\sin\theta.$$

Now; $$\frac{dy}{dx}=\frac{(dy/d\theta)}{(dx/d\theta)}=\frac{\cancel{a}[\sin\theta]}{\cancel{a}[1-\cos\theta]}$$

$$\therefore \frac{dy}{dx}=\frac{2\cdot\sin\left[\frac{\theta}{2}\right]\cdot\cos\left[\frac{\theta}{2}\right]}{2\cdot\sin^2\left[\frac{\theta}{2}\right]}$$

$$\therefore \frac{dy}{dx}=\frac{\cos(\theta/2)}{\sin(\theta/2)}=\cot\left(\frac{\theta}{2}\right)$$

$$\therefore \left(\frac{dy}{dx}\right)_{\theta=\frac{\pi}{4}}=\cot\left[\frac{\left(\frac{\pi}{4}\right)}{2}\right]$$

$$\therefore \boxed{\left(\frac{dy}{dx}\right)_{\theta=\frac{\pi}{4}}=\cot\left[\frac{\pi}{8}\right].}$$

4. Attempt any Four.

a] If $A=\begin{bmatrix}2 & 1\\ 0 & 3\end{bmatrix}$ & $B=\begin{bmatrix}1 & 2\\ 3 & -2\end{bmatrix}$ show that $A\cdot B$ is singular or non-singular Matrix.

$\rightarrow$ $$A\cdot B=\begin{bmatrix}2 & 1\\ 0 & 3\end{bmatrix}\cdot\begin{bmatrix}1 & 2\\ 3 & -2\end{bmatrix}$$

$$\therefore AB=\begin{bmatrix}(2\times1)+(1\times3) & (2\times2)+(1\times-2)\\ (0\times1)+(3\times3) & (0\times2)+(3\times-2)\end{bmatrix}$$

$$\therefore AB=\begin{bmatrix}5 & 2\\ 9 & -6\end{bmatrix}=[(5\times-6)-(9\times2)]$$

$\therefore AB=[-48]$ i.e. $\boxed{A\cdot B\neq0}$

$\therefore$ $\boxed{AB \text{ is non-singular Matrix.}}$

Q.NO	SUB Q.N	ANSWER	Marking Scheme

4. b) find $\frac{dy}{dx}$ if $y = (\sin x)^x$.

→ $y = (\sin x)^x$, taking log of both sides,

$\log y = \log[(\sin x)^x]$

$\therefore \log y = x \cdot \log(\sin x)$

Diff. w.r.t. x ;

$\left(\frac{1}{y}\right) \cdot \frac{dy}{dx} = x \cdot \frac{d}{dx}[\log(\sin x)] + \log(\sin x) \cdot \frac{d}{dx}[x]$

$\left(\frac{1}{y}\right) \frac{dy}{dx} = (x)\left(\frac{1}{\sin x} \cdot \cos x\right) + \log(\sin x)$.

$\left(\frac{1}{y}\right) \frac{dy}{dx} = \left[\frac{x \cdot \cos x}{\sin x}\right] + \log(\sin x)$.

$$\therefore \boxed{\frac{dy}{dx} = (\sin x)^x \cdot \left[\frac{x \cdot \cos x}{\sin x} + \log(\sin x)\right]}$$

c) find $\frac{dy}{dx}$, if, $x^2 + y^2 = 4x \cdot y$.

→ $x^2 + y^2 = 4xy$ Diff. w.r.t. x.

$2x + 2y\frac{dy}{dx} = 4\left[x \cdot \frac{dy}{dx} + y(1)\right]$

Dividing both sides by "2", we get,

$x + y\frac{dy}{dx} = 2 \cdot x\frac{dy}{dx} + 2y$.

$\therefore y \cdot \frac{dy}{dx} - 2x\frac{dy}{dx} = 2y - x$

$\therefore (y - 2x)\frac{dy}{dx} = 2y - x$

$$\therefore \boxed{\frac{dy}{dx} = \frac{(2y - x)}{(y - 2x)}}.$$

d] Find $\frac{dy}{dx}$ if, $y = \tan^{-1}\left[\frac{a+x}{1-ax}\right]$.

→ $y = \tan^{-1}\left[\frac{a+x}{1-(ax)}\right]$

using formula:- $\tan^{-1}(A)+\tan^{-1}(B) = \tan^{-1}\left[\frac{A+B}{1-AB}\right]$

we get;

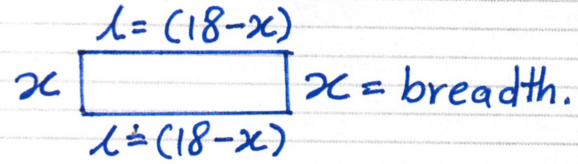
$y = \tan^{-1}(a)+\tan^{-1}(x)$.

Diff. w.r.t. x.,

$\frac{dy}{dx} = 0 + \frac{1}{1+x^2}$ $\therefore$ $\boxed{\frac{dy}{dx} = \frac{1}{1+x^2}}$

e] A metal wire 36 cm long is bent to form a rectangle. Find it's dimensions when it's area is maximum.

→



Area of rectangle = Length × breadth

$\therefore A = (18-x)\cdot x$

$\therefore A = 18x - x^2$ Diff. "A." w.r.t. x, we get,

$\therefore \frac{dA}{dx} = 18-2x$ ——— eq^n ①

For maximum area, $\frac{dA}{dx} = 0$.

$\therefore 0 = 18-2x$

$\therefore 2x = 18$ $\therefore x = 9$

Diff. eq^n ① again w.r.t. x.

$\frac{dA}{dx} = 18-2x$

$\therefore \frac{d^2A}{dx^2} = 0-2(1)$ But $(-2)<0$.

$\therefore x = 9$ certainly gives max. area of rectangle.

When $x=9$; length $= 18-x = 18-9 = 9$ cm.

Dimensions of rectangle = length = breadth = 9 cm
$\therefore$ It is a square for maximum area.

5 Solve any two.

A

(i) Find equation of straight line passing through points $(-4, 6)$ & $(8, -3)$.

→ Given Points :- $(-4, 6)$ & $(8, -3)$.

(x_1, y_1) & (x_2, y_2).

$$\frac{y-y_1}{y_1-y_2} = \frac{x-x_1}{x_1-x_2}$$ ---using two point form.

$$\therefore \frac{y-6}{6-(-3)} = \frac{x-(-4)}{(-4)-(8)}$$

$$\therefore \frac{y-6}{9} = \frac{x+4}{-12}$$

$$\therefore -12(y-6) = 9(x+4)$$

$$\therefore -12y+72 = 9x+36$$

$$\therefore 0 = 9x+36+12y-72$$

$$\therefore 0 = 9x+12y-36$$

i.e. $9x+12y-36=0$

Dividing each term by "3";

$$\boxed{3x+4y-12=0}$$

is the required eq^n of line.

(ii) Find equation of line passing through $(2,5)$ & through intersection of line $x+y=0$, $2x-y=9$.

→ step ① To find point of intersection by solving equations;

$$\begin{array}{r} x+y=0 \\ +\ 2x-y=9 \\ \hline 3x\ \ \ =9 \end{array} \quad \therefore \boxed{x=3}.$$

Now, we have;

$x+y=0$

$\therefore 3+y=0$ $\qquad \therefore \boxed{y=-3}$.

Point of intersection $=(3,-3)$.

Using two point form; $(2, 5)$ & $(3,-3)$

$$\frac{y-y_1}{y_1-y_2} = \frac{x-x_1}{x_1-x_2}$$

$$\therefore \frac{y-5}{5-(-3)} = \frac{x-2}{(2)-(3)}$$

$$\therefore \frac{y-5}{8} = \frac{x-2}{-1}$$

$$\therefore -1(y-5) = 8(x-2)$$

$-1(y-5) = 8(x-2)$

$\therefore -y+5 = 8x-16$

$\therefore 0 = 8x-16+y-5$

$\therefore 0 = 8x+y-21$

$\therefore \boxed{8x+y-21=0}$ is the required sol^n.

5. (B)

(i) Find angle between lines, $x+5y=11$ & $5x-y=11$.

→ step ① To find slopes of given line,

slope of $x+5y=11$

$\therefore x+5y-11=0$

std. eq^n $ax+by+c=0$ $\therefore a=1$ & $b=5$.

slope $m_1 = -\frac{a}{b} = \frac{-1}{5}$ $\boxed{m_1 = \frac{-1}{5}}$

slope of line, $5x-y=11$

$\therefore 5x-y-11=0$

std. eq^n $ax+by+c=0$ $\therefore a=5$ & $b=-1$.

slope $m_2 = -\frac{a}{b} = \frac{-5}{-1} = 5.$ $\boxed{m_2 = 5}$

step ② To find angle between lines,

$$\tan\theta = \left|\frac{m_1-m_2}{1+m_1 \cdot m_2}\right|$$

$$\therefore \theta = \tan^{-1}\left|\frac{(-1/5)-(5)}{1+[(-1/5)\times(5)}\right|$$

$$\therefore \theta = \tan^{-1}\left|\frac{(-1/5)-(5)}{1+(-1)}\right|$$

$$\therefore \theta = \tan^{-1}\left|\frac{(-1/5)-(5)}{0}\right|$$

$$\therefore \theta = \tan^{-1}|\infty|$$

$$\therefore \theta = 90°. \quad \boxed{\theta = 90°}.$$

$\because$ Angle bet^n lines is 90°,

$\therefore$ Lines are perpendicular to each-other.

5. (b)
(ii) Find perpendicular distance of point $(-3, 4)$ from line $4(x+2) = 3(y-4)$.

→ Point : $(-3, 4)$

line : $4(x+2) = 3(y-4)$.

$$4(x+2) = 3(y-4)$$
$$\therefore 4x + 8 = 3y - 12.$$
$$\therefore 4x - 3y + 8 + 12 = 0$$
$$\therefore 4x - 3y + 20 = 0$$

std. eq^n. $ax + by + c = 0$ $\therefore a = 4, b = -3, c = 20.$

Distance between point & line;

$$d_{pl} = \left| \frac{ax_1 + by_1 + c}{\sqrt{a^2 + b^2}} \right|$$
$$= \left| \frac{4(-3) + (-3)(4) + (20)}{\sqrt{(4)^2 + (-3)^2}} \right|$$
$$= \left| \frac{-12 - 12 + 20}{\sqrt{(16) + (9)}} \right|$$
$$= \left| \frac{-24 + 20}{\sqrt{25}} \right|$$
$$d_{pl} = \left| \frac{-4}{5} \right|$$
$$\boxed{d_{pl} = \left(\frac{4}{5}\right) \text{units}}$$

5. C.
(i) A beam is bent in form of curve $y = 2\sin x - \sin 2x$. find radius of curvature of beam at $x = \pi/2$.

→ $y = 2\sin x - \sin 2x$

Differenciate w.r.t. x;

$$\frac{dy}{dx} = 2\cos x - \cos(2x)\frac{d}{dx}(2x)$$
$$\therefore \frac{dy}{dx} = 2\cos x - 2\cos(2x) \text{ —— } (1)$$
$$\left.\frac{dy}{dx}\right|_{x=\frac{\pi}{2}} = 2\cos\left(\frac{\pi}{2}\right) - 2\cos\left(2 \times \frac{\pi}{2}\right)$$

$$\therefore \boxed{\left.\frac{dy}{dx}\right|_{x=\frac{\pi}{2}} = 2.}$$

We have eq^n. 1

$$\frac{dy}{dx} = 2\cos x - 2\cos(2x) \quad \text{—— eq}^n \text{ (1)}$$

Again Differenciate w.r.t. x, we get;

$$\frac{d^2y}{dx^2} = 2[-\sin(x)] - 2[-\sin(2x)]\frac{d}{dx}(2x)$$

$$\therefore \frac{d^2y}{dx^2} = -2\sin(x) + 4\sin(2x)$$

Now, $\left.\frac{d^2y}{dx^2}\right|_{x=\frac{\pi}{2}} = -2\sin\left(\frac{\pi}{2}\right) + 4\sin\left(2\times\frac{\pi}{2}\right)$

$$\therefore \boxed{\left.\frac{d^2y}{dx^2}\right|_{x=\frac{\pi}{2}} = -2.}$$

Radius of curvature :- (ρ);

$$\rho = \frac{[1+(dy/dx)^2]^{3/2}}{(d^2y/dx^2)}$$

$$\therefore \rho = \frac{[1+(2)^2]^{\frac{3}{2}}}{(-2)} = -5.59 \text{ units}$$

$$\therefore \boxed{\text{Radius of Curvature} = \rho = 5.59 \text{ units.}}$$

5 C. (ii) Find equation of tangent to curve, $4x^2 + 9y^2 = 40$ at $(1, 2)$.

→ step (1) To find Slope ;

$$4x^2 + 9y^2 = 40 \quad \text{Diff. w.r.t. } x,$$

$$4(2x) + 9(2y)\frac{dy}{dx} = 0.$$

$$\therefore 8x + 18y\frac{dy}{dx} = 0$$

$$\therefore 18y\frac{dy}{dx} = -8x$$

$$\therefore \frac{dy}{dx} = \frac{-8x}{18y} = \frac{-2x}{9y}.$$

$$\therefore \boxed{\frac{dy}{dx} = -\frac{2x}{9y}.}$$

Q.NO	SUB Q.N	ANSWER	Marking Scheme

$$\frac{dy}{dx} = \frac{-2x}{9y}$$

Now, slope $m = \left.\frac{dy}{dx}\right|_{(1,2)} = \frac{-2(1)}{9(2)} = \frac{-1}{9}$.

$$\therefore \boxed{\text{Slope} = m = \left.\frac{dy}{dx}\right|_{(1,2)} = \frac{-1}{9}.}$$

step ② Equation of Tangent,

at point $(1,2)$ & slope $= \frac{-1}{9}$.

slope point form $(y-y_1) = m(x-x_1)$.

$$\therefore y-2 = \frac{-1}{9}(x-1)$$

$$\therefore 9(y-2) = -1(x-1)$$

$$\therefore 9y-18 = -x+1.$$

$$\therefore x+9y-18-1 = 0$$

$\therefore \boxed{x+9y-19=0.}$ — is the eqn. of tangent.

Q.NO	SUB Q.N	ANSWER	Marking Scheme

6. Attempt any two.

a. Using Matrix-inversion method solve

$x+y+z=6$, $3x-y+3z=10$; $5x+5y-4z=3$.

→ Step I] Write in Matrix Form :-

$$\begin{bmatrix} 1 & 1 & 1 \\ 3 & -1 & 3 \\ 5 & 5 & -4 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 10 \\ 3 \end{bmatrix}$$

$$A \quad X = D$$

Step II] To find $|A|$

$$|A| = 1[(4)-(15)] - 1[(-12)-(15)] + 1[(15)-(-5)]$$

$$|A| = 1[-11] - 1[-27] + 1[20]$$

$$|A| = -11 + 27 + 20$$

$$\therefore |A| = 36 \qquad \text{so } A^{-1} \text{ exists.}$$

Step III] To find Adj A

$$P = \begin{bmatrix} +\begin{vmatrix} -1 & 3 \\ 5 & -4 \end{vmatrix} & -\begin{vmatrix} 3 & 3 \\ 5 & -4 \end{vmatrix} & +\begin{vmatrix} 3 & -1 \\ 5 & 5 \end{vmatrix} \\ -\begin{vmatrix} 1 & 1 \\ 5 & -4 \end{vmatrix} & +\begin{vmatrix} 1 & 1 \\ 5 & -4 \end{vmatrix} & -\begin{vmatrix} 1 & 1 \\ 5 & 5 \end{vmatrix} \\ +\begin{vmatrix} 1 & 1 \\ -1 & 3 \end{vmatrix} & -\begin{vmatrix} 1 & 1 \\ 3 & 3 \end{vmatrix} & +\begin{vmatrix} 1 & 1 \\ 3 & -1 \end{vmatrix} \end{bmatrix}$$

$$P = \begin{bmatrix} +[(4)-(15)] & -[(-12)-(15)] & +[(15)-(-5)] \\ -[(-4)-(5)] & +[(-4)-(5)] & -[(5)-(5)] \\ +[(3)-(-1)] & -[(3)-(3)] & +[(-1)-(3)] \end{bmatrix}$$

$$P = \begin{bmatrix} -11 & 27 & 20 \\ 9 & -9 & 0 \\ 4 & 0 & -4 \end{bmatrix} \qquad \text{Adj}A = P^T = \begin{bmatrix} -11 & 9 & 4 \\ 27 & -9 & 0 \\ 20 & 0 & -4 \end{bmatrix}.$$

$$A^{-1} = \frac{1}{|A|} \cdot \text{Adj}A$$

Q.NO	SUB Q.N	ANSWER	Marking Scheme

$$A^{-1} = \frac{1}{|A|} \cdot \text{Adj } A$$

$$A^{-1} = \frac{1}{36} \cdot \begin{bmatrix} -11 & 9 & 4 \\ 27 & -9 & 0 \\ 20 & 0 & -4 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} -\frac{11}{36} & \frac{9}{36} & \frac{4}{36} \\ \frac{27}{36} & \frac{-9}{36} & 0 \\ \frac{20}{36} & 0 & \frac{-4}{36} \end{bmatrix}$$

Step IV] Find x, y, z.

$$X = A^{-1} \cdot D$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \frac{-11}{36} & \frac{9}{36} & \frac{4}{36} \\ \frac{27}{36} & \frac{-9}{36} & 0 \\ \frac{20}{36} & 0 & \frac{-4}{36} \end{bmatrix} \cdot \begin{bmatrix} 6 \\ 10 \\ 3 \end{bmatrix}$$

$$\therefore x = \left[\frac{-11}{36} \times 6\right] + \left[\frac{9}{36} \times 10\right] + \left[\frac{4}{36} \times 3\right] = 1.$$

$$y = \left[\frac{27}{36} \times 6\right] + \left[\frac{-9}{36} \times 10\right] + \left[0 \times 3\right] = 2.$$

$$z = \left[\frac{20}{36} \times 6\right] + \left[0 \times 10\right] + \left[\frac{-4}{36} \times 3\right] = 3.$$

$$\therefore \{x = 1, \quad y = 2, \quad z = 3\}$$ Answer.

Q.NO	SUB Q.N	ANSWER	Marking Scheme

6 b. Find Mean of following distribution.

(i)

Marks	0-10	10-20	20-30	30-40	40-50
No. of students	5	8	15	16	6

→

Marks	Class Marks (x_i)	f_i	$x_i.f_i$
0-10	5	5	25
10-20	15	8	120
20-30	25	15	375
30-40	35	16	560
40-50	45	6	270
		$\Sigma f_i = 50$	$\Sigma x_i f_i = 1350$

$$\text{Mean} = \bar{x} = \frac{\Sigma x_i f_i}{\Sigma f_i} = \frac{1350}{50} = 27 \quad \therefore \boxed{\bar{x} = 27}$$

(ii) An analysis of monthly wages paid to workers in two firms A & B. which firm is more consistent?

	Firm A	Firm B
Avarage wages in (₹) =	186	175
Variance of distribution of wages(₹) =	81	100

→

	Firm A	Firm B
$\bar{x}$	186	175
variance	81	100
$\sigma = \sqrt{\text{variance}}$	$\sqrt{81} = 9$	$\sqrt{100} = 10.$

$$(C.V.)_A = \frac{\sigma}{\bar{x}} \times 100 = \frac{9}{186} \times 100 = 4.838.$$

$$(C.V.)_B = \frac{\sigma}{\bar{x}} \times 100 = \frac{10}{175} \times 100 = 5.71.$$

$\therefore (C.V.)_A < (C.V.)_B$

$\therefore$ Firm "A" is more consistent.

Q.NO	SUB Q N	ANSWER	Marking Scheme

6. C. Calculate mean, S.D. & coeff. of variation of given:-

C.I.	0-10	10-20	20-30	30-40	40-50
frequency	14	23	27	21	15

C.I.	Class Marks (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
		$\Sigma f_i = 100$	$\Sigma f_i x_i = 2500$	—	$\Sigma f_i x_i^2 = 78500$

Mean $\bar{x} = \frac{\Sigma f_i x_i}{N} = \frac{2500}{100}$ $\boxed{\bar{x} = 25}$

Standard Deviation (S.D.)

Variance $= \sigma^2 = \frac{\Sigma f_i x_i^2}{N} - \left[\frac{\Sigma f_i x_i}{N}\right]^2$

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

$\sigma^2 = 160$

$\therefore$ Standard Deviation $=$ S.D. $= \sigma = \sqrt{160}$

$\therefore \boxed{S.D. = 12.65}$

Coeff. of variance $= \frac{\sigma}{\bar{x}} \times 100$

$= \frac{12.65}{25} \times 100$

$\therefore \boxed{\text{Coeff. of Variance} = 50.6}$