Que. No.	Sub. Que.	Model answers	Marks	Total Marks
1)	a)	$f(x)=3x^4-2x^2+\cos x$		
		$\therefore f(-x)=3(-x)^4-2(-x)^2+\cos(-x)$	½	
		$=3x^4-2x^2+\cos x$	½	
		$=f(x)$	½	
		$\therefore f(x)$ *is even.*	½	**2**
	b)	$f(x)=x^2+6x+10$		
		$\therefore f(2)=2^2+6(2)+10=26$	½	
		$f(-2)=(-2)^2+6(-2)+10=2$	½	
		$\therefore f(2)+f(-2)=28$	1	**2**
		OR		
		$f(2)+f(-2)=\left[2^2+6(2)+10\right]+\left[(-2)^2+6(-2)+10\right]$	1	
		$=28$	1	**2**
	c)	$\lim\limits_{x\to2}\dfrac{x^2-4}{x-2}=\lim\limits_{x\to2}\dfrac{(x-2)(x+2)}{x-2}$	½	
		$=\lim\limits_{x\to2}(x+2)$	½	
		$=2+2$	½	
		$=4$	½	**2**
	d)	$\lim\limits_{x\to0}\dfrac{\sin4x}{3x}=\lim\limits_{x\to0}\dfrac{\sin4x}{4x}\cdot\dfrac{4}{3}$	½	
		$=1\times\dfrac{4}{3}$	1	
		$=\dfrac{4}{3}$	½	**2**
	e)	$\lim\limits_{x\to\infty}\dfrac{6x^3+5x^2-1}{3x^3+4x^2+7}=\lim\limits_{x\to\infty}\dfrac{\frac{6x^3+5x^2-1}{x^3}}{\frac{3x^3+4x^2+7}{x^3}}$		
		$=\lim\limits_{x\to\infty}\dfrac{6+\frac{5}{x}-\frac{1}{x^3}}{3+\frac{4}{x^3}+\frac{7}{x^3}}$	½	
		$=\dfrac{6+0-0}{3+0+0}$	1	
		$=2$	½	**2**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
1)	f)	$\lim_{x\to 0}\frac{a^x+b^x+c^x-3}{x}$		
		$=\lim_{x\to 0}\left[\frac{a^x-1}{x}+\frac{b^x-1}{x}+\frac{c^x-1}{x}\right]$	½	
		$=\log a+\log b+\log c$	1	
		$=\log abc$	½	**2**
	g)	$y=e^x\tan x$		
		$\frac{dy}{dx}=e^x\frac{d}{dx}(\tan x)+\tan x\frac{d}{dx}(e^x)$	½	
		$=e^x\sec^2 x+\tan x\cdot e^x$	1	
		$=e^x\left(\sec^2 x+\tan x\right)$	½	**2**
	h)	$y=\tan(4-3x)$		
		$\frac{dy}{dx}=\sec^2(4-3x)\cdot\frac{d}{dx}(4-3x)$	1	
		$=\sec^2(4-3x)\cdot(-3)$	½	
		$=-3\sec^2(4-3x)$	½	**2**
	i)	$y=\frac{e^x+1}{e^x-1}$		
		$\therefore\frac{dy}{dx}=\frac{(e^x-1)\frac{d}{dx}(e^x+1)-(e^x+1)\frac{d}{dx}(e^x-1)}{(e^x-1)^2}$	½	
		$=\frac{(e^x-1)e^x-(e^x+1)e^x}{(e^x-1)^2}$	½	
		$=\frac{e^x\left[e^x-1-e^x-1\right]}{(e^x-1)^2}$	½	
		$=\frac{-2e^x}{(e^x-1)^2}$	½	**2**
		OR		
		$y=\frac{e^x+1}{e^x-1}=1+\frac{2}{e^x-1}$		
		$\therefore\frac{dy}{dx}=0+\frac{-2}{(e^x-1)^2}\cdot\frac{d}{dx}(e^x-1)$	1	
		$=\frac{-2e^x}{(e^x-1)^2}$	1	**2**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
1)	j)	$y=\log(x^2+2x+5)$		
		$\frac{dy}{dx}=\frac{1}{x^2+2x+5}\cdot\frac{d}{dx}\left(x^2+2x+5\right)$	1	
		$=\frac{2x+2}{x^2+2x+5}$	1	**2**
		OR		
		$y=\log(x^2+2x+5)$		
		$e^y=x^2+2x+5$		
		$\therefore e^y\frac{dy}{dx}=2x+2$	1	
		$\therefore \frac{dy}{dx}=\frac{2x+2}{e^y}$	1	**2**
	k)	Rearranging the terms:		
		3, 4, 5, 6, 6, 7, 8, 8, 9, 11		
		$\therefore Median=\frac{6+7}{2}=6.5$	1	
		$Mode=6 \quad and \quad 8$	1	**2**
	l)	(table below)	1	
		$\bar{x}=\frac{\sum f_i x_i}{N}=\frac{500}{100}=5$	1	**2**
2)	a)	$f(t)=\frac{2t+5}{3t-4}$	½	
		$=\frac{2\left(\frac{5+4x}{3x-2}\right)+5}{3\left(\frac{5+4x}{3x-2}\right)-4}$	1	
		$=\frac{\frac{2(5+4x)+5(3x-2)}{3x-2}}{\frac{3(5+4x)-4(3x-2)}{3x-2}}$		

Table for *l*):

x_i	f_i	$x_i f_i$
1	14	14
3	23	69
5	27	135
7	21	147
9	15	135
	100	**500**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
2)		$=\dfrac{10x+8x+15x-10}{15+12x-12x+8}$	1	
		$=\dfrac{23x}{23}$	1	
		$=x$	½	**4**
	b)	$f(x)=\log\left(\dfrac{1+x}{1-x}\right)$		
		$\therefore f\left(\dfrac{2x}{1+x^2}\right)=\log\left(\dfrac{1+\dfrac{2x}{1+x^2}}{1-\dfrac{2x}{1+x^2}}\right)$	1	
		$=\log\left(\dfrac{1+x^2+2x}{1+x^2-2x}\right)$	1	
		$=\log\left[\dfrac{(1+x)^2}{(1-x)^2}\right]$		
		$=\log\left(\dfrac{1+x}{1-x}\right)^2$	½	
		$=2\log\left(\dfrac{1+x}{1-x}\right)$	1	
		$=2f(x)$	½	**4**
	c)	$\lim\limits_{x\to4}\dfrac{x^4-64x}{\sqrt{x^2+9}-5}=\lim\limits_{x\to4}\dfrac{x^4-64x}{\sqrt{x^2+9}-5}\times\dfrac{\sqrt{x^2+9}+5}{\sqrt{x^2+9}+5}$		
		$=\lim\limits_{x\to4}\dfrac{\left(x^4-64x\right)}{x^2+9-25}\left(\sqrt{x^2+9}+5\right)$	1	
		$=\lim\limits_{x\to4}\dfrac{x\left(x^3-64\right)}{x^2-16}\left(\sqrt{x^2+9}+5\right)$		
		$=\lim\limits_{x\to4}\dfrac{x(x-4)\left(x^2+4x+16\right)}{(x-4)(x+4)}\left(\sqrt{x^2+9}+5\right)$	1	
		$=\lim\limits_{x\to4}\dfrac{x\left(x^2+4x+16\right)}{(x+4)}\left(\sqrt{x^2+9}+5\right)$	1	
		$=\dfrac{4\left(4^2+44+16\right)}{(4+4)}\left(\sqrt{4^2+9}+5\right)$		
		$=240$	1	**4**

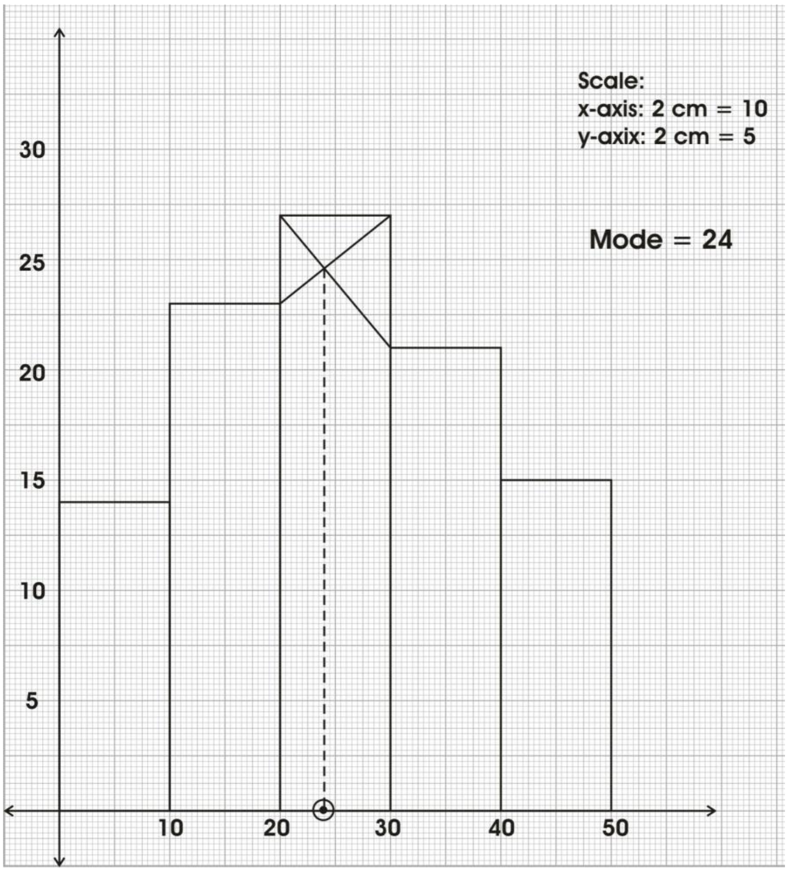
Que. No.	Sub. Que.	Model answers	Marks	Total Marks
2)	d)	$\lim_{x\to5}\left[\frac{\log x-\log 5}{x-5}\right]$ Let $x=5+h$, as $x\to5,\ h\to0$		
		$=\lim_{h\to0}\left[\frac{\log(5+h)-\log 5}{5+h-5}\right]$	1	
		$=\lim_{h\to0}\frac{1}{h}\log\left(\frac{5+h}{5}\right)$		
		$=\lim_{h\to0}\log\left(1+\frac{h}{5}\right)^{1/h}$	1	
		$=\lim_{h\to0}\log\left(1+\frac{h}{5}\right)^{5/h\times1/5}$		
		$=\lim_{h\to0}\frac{1}{5}\log\left(1+\frac{h}{5}\right)^{5/h}$		
		$=\frac{1}{5}\log e$	1	
		$=\frac{1}{5}$	1	**4**
	e)	$\lim_{x\to0}\frac{6^x-3^x-2^x+1}{x^2}=\lim_{x\to0}\frac{3^x\cdot2^x-3^x-2^x+1}{x^2}$	1	
		$=\lim_{x\to0}\frac{3^x\left(2^x-1\right)-\left(2^x-1\right)}{x^2}$		
		$=\lim_{x\to0}\frac{\left(3^x-1\right)\left(2^x-1\right)}{x^2}$ ....(*)	1	
		$=\lim_{x\to0}\frac{\left(3^x-1\right)}{x}\times\frac{\left(2^x-1\right)}{x}$	1	
		$=\log3\times\log2$	1	**4**
		Note: Students may write the step (*) directly as we do in case of factors of polynomial. So this direct step may be considered for marks.		
	f)	$\lim_{x\to0}\frac{\cos5x-\cos3x}{x^2}=\lim_{x\to0}\frac{-2\sin\left(\frac{5x+3x}{2}\right)\sin\left(\frac{5x-3x}{2}\right)}{x^2}$		
		$=\lim_{x\to0}\frac{-2\sin4x\sin x}{x^2}$	1	
		$=\lim_{x\to0}-2\times\frac{\sin4x}{4x}\times\frac{\sin x}{x}\times4$	1	
		$=-2\times1\times1\times4$	1	
		$=-8$	1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3)	a)	$x = a(\cos\theta + \theta\sin\theta)$		
		$\therefore \frac{dx}{d\theta} = a(-\sin\theta + \theta\cos\theta + \sin\theta)$		
		$= a\theta\cos\theta$	1	
		$y = a(\sin\theta - \theta\cos\theta)$		
		$\therefore \frac{dy}{d\theta} = a(\cos\theta + \theta\sin\theta - \cos\theta)$		
		$= a\theta\sin\theta$	1	
		$\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{a\theta\sin\theta}{a\theta\cos\theta}$	1	
		$= \tan\theta$	1	**4**
	b)	$y = (\sin x)\cos x$		
		$\therefore \frac{dy}{dx} = \sin x \frac{d}{dx}(\cos x) + \cos x \frac{d}{dx}(\sin x)$	1	
		$= \sin x(-\sin x) + \cos x(\cos x)$	1+1	
		$= \cos^2 x - \sin^2 x$	1	**4**
	c)	$x^3 + y^3 = 3axy$		
		$\therefore 3x^2 + 3y^2 \frac{dy}{dx} = 3a\left[x\frac{dy}{dx} + y\right]$	1+1	
		$\therefore 3y^2 \frac{dy}{dx} - 3ax\frac{dy}{dx} = 3ay - 3x^2$		
		$\therefore (3y^2 - 3ax)\frac{dy}{dx} = 3ay - 3x^2$		
		$\therefore \frac{dy}{dx} = \frac{3ay - 3x^2}{3y^2 - 3ax}$	1	
		$= \frac{3(ay - x^2)}{3(y^2 - ax)}$		
		$= \frac{ay - x^2}{y^2 - ax}$	1	**4**
	d)	$Let\ u = \tan^{-1}\left(\frac{2x}{1-x^2}\right)$		
		$Put\ \ x = \tan\theta \quad \therefore \theta = \tan^{-1} x$		
		$\therefore u = \tan^{-1}\left(\frac{2\tan\theta}{1-\tan^2\theta}\right) = \tan^{-1}(\tan 2\theta)$		

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3)		$= 2\theta$		
		$= 2\tan^{-1} x \quad \ldots\ldots\ldots\ldots (i)$	1	
		$\therefore \frac{du}{dx} = \frac{2}{1+x^2}$	½	
		$Let\ v = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$		
		$Put\ x = \tan\theta \quad \therefore \theta = \tan^{-1} x$		
		$\therefore v = \cos^{-1}\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right) = \cos^{-1}(\cos 2\theta)$		
		$= 2\theta$		
		$= 2\tan^{-1} x \quad \ldots\ldots\ldots\ldots (ii)$	1	
		$\therefore \frac{dv}{dx} = \frac{2}{1+x^2}$	½	
		$\therefore \frac{du}{dv} = \frac{\frac{du}{dx}}{\frac{dv}{dx}} = \frac{\frac{2}{1+x^2}}{\frac{2}{1+x^2}} = 1$	1	
		OR		
		$By\ (i)\ and\ (ii),\ u = v$	1	
		$\therefore \frac{du}{dv} = 1$	1	**4**
	e)	$y = \tan^{-1} x$		
		$\therefore \frac{dy}{dx} = \frac{1}{1+x^2}$	1	
		$\therefore (1+x^2)\frac{dy}{dx} = 1$	1	
		$\therefore (1+x^2)\frac{d^2y}{dx^2} + \frac{dy}{dx}(2x) = 0$	1	
		$\therefore (1+x^2)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} = 0$		
		$\therefore (1+x^2)y'' + 2xy' = 0$	1	**4**
		OR		
		$\therefore y' = \frac{1}{1+x^2}$	1	
		$y'' = \frac{-2x}{(1+x^2)^2}$	1	
		$(1+x^2)y'' + 2xy' = (1+x^2)\frac{-2x}{(1+x^2)^2} + 2x\frac{1}{1+x^2}$	1	
		$= 0$	1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3)		$y=\tan^{-1}x$		
		$\therefore \dfrac{dy}{dx}=\dfrac{1}{1+x^2}$	1	
		$\dfrac{d^2y}{dx^2}=\dfrac{-2x}{(1+x^2)^2}$	1	
		$\therefore (1+x^2)\dfrac{d^2y}{dx^2}=-2x\cdot\dfrac{1}{1+x^2}$		
		$\therefore (1+x^2)\dfrac{d^2y}{dx^2}=-2x.\dfrac{dy}{dx}$	1	
		$\therefore (1+x^2)\dfrac{d^2y}{dx^2}+2x.\dfrac{dy}{dx}=0$	1	
		$\therefore (1+x^2)y''+2xy'=0$		**4**
	f)	$y=\sin^{-1}\left[\dfrac{\cos x+\sin x}{\sqrt{2}}\right]$		
		$=\sin^{-1}\left[\dfrac{1}{\sqrt{2}}\cos x+\dfrac{1}{\sqrt{2}}\sin x\right]$		
		$=\sin^{-1}\left[\sin\dfrac{\pi}{4}\cos x+\cos\dfrac{\pi}{4}\sin x\right]$	1	
		$=\sin^{-1}\left[\sin\left(\dfrac{\pi}{4}+x\right)\right]$	1	
		$=\dfrac{\pi}{4}+x$	1	
		$\therefore \dfrac{dy}{dx}=1$	1	**4**
4)	a)	$Let\ y=2x^3-9x^2+12x+5$		
		$\therefore \dfrac{dy}{dx}=6x^2-18x+12$	½	
		$\therefore \dfrac{d^2y}{dx^2}=12x-18$	½	
		For extreme values, $\dfrac{dy}{dx}=0$		
		$\therefore 6x^2-18x+12=0$		
		$\therefore x=1,\quad 2$	1	
		$At\ x=1,\ \dfrac{d^2y}{dx^2}=-6<0$		
		$\therefore y$ is maximum at $x=1$.	½	
		$\therefore$ the maximum value is,		
		$y=2(1)^3-9(1)^2+12(1)+5=10$	½	

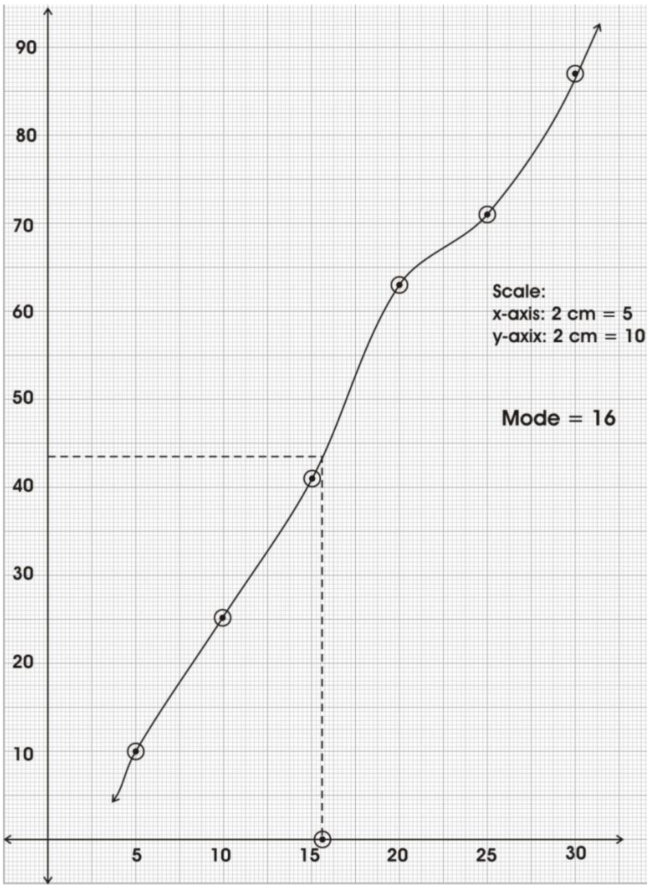
Que. No.	Sub. Que.	Model answers	Marks	Total Marks
4)		$At\ x=1,\ \frac{d^2y}{dx^2}=6>0$	½	
		$\therefore y$ is minimum at $x=2$.		
		$\therefore$ the minimum value is,		
		$y=2(2)^3-9(2)^2+12(2)+5=9$	½	**4**
	b)	$y=x^3$		
		$\therefore \frac{dy}{dx}=3x^2$	1	
		$\therefore \frac{d^2y}{dx^2}=6x$	1	
		$Radius$ of curvature, $\rho=\frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$		
		$=\frac{\left[1+\left(3x^2\right)^2\right]^{\frac{3}{2}}}{6x}$	1	
		$At\ point\ (1,1),$		
		$\rho=\frac{\left[1+(3)^2\right]^{\frac{3}{2}}}{6}=\frac{(10)^{\frac{3}{2}}}{6}\quad or\quad 5.27$	1	**4**
	c)	$Let\ length=x,\quad breadth=y$		
		$\therefore 2x+2y=100\quad or\quad x+y=50$		
		$\therefore y=50-x$		
		$Area,\ A=xy$		
		$\therefore A=x(50-x)=50x-x^2$	1	
		$\therefore \frac{dA}{dx}=50-2x$	½	
		$\therefore \frac{d^2A}{dx^2}=-2$	½	
		$Now,\ \frac{dA}{dx}=0\ gives\ \ x=25$		
		$At\ x=25,\ \ \frac{d^2A}{dx^2}=-2<0$		
		$\therefore A$ is maximum at $x=25$	1	
		$\therefore Length=25,\ \ breadth=25$	1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
4)	d)	$y=3x-x^2$ $\therefore \frac{dy}{dx}=3-2x$ $From\ given\ slope=-5$ $\therefore \frac{dy}{dx}=-5$ $\therefore 3-2x=-5$ $\therefore x=4$ $y=-4$ $\therefore$ point is $(4,-4)$	1 1 1 1	**4**
	e)	 **Marks distribution**: 1 mark for plotting points and drawing histogram correctly. 1 mark for drawing the cross lines in the modal class. 1 mark for drawing line of mode to x-axis. 1 mark for value of mode. Note the value 24 is approximate value. Difference of **+0.5 or –0.5** is acceptable in case of graph. (Note: **If the graph is too small or not clear to understand, marks can be deducted. On x-axis, instead of writing points 10, 20, 30, … etc., if class 0-10, 10-20, 20-30, … etc. are written, no marks to be given.)**	1+1+1 +1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
4)	f)			

Class	Fi	< c. f.
0-5	10	10
5-10	15	25
10-15	17	42
15-20	21	63
20-25	8	71
25-30	16	87

1



1+1+1

4

Marks distribution: 1 mark for plotting points and drawing curve correctly. 1 mark for drawing line of median to x-axis. 1 mark for value of median. Note the value 16 is approximate value. Difference of **+0.5 or –0.5** is acceptable in case of graph.

(Note: The median can also be calculated by drawing Greater than Ogive Curve and also by drawing both the ogives simultaneously. So marks to be given accordingly. If the graph is too small or not clear to understand, marks can be deducted. On x-axis, instead of writing points 0, 5, 10, 15, … etc., if class 0-5, 5-10, 10-15, … etc. are written, no marks to be given. The same is also applicable for histogram.)

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
5)	a)	$Given\ \bar{x}=40,\quad n=100$		
		$\sum x_i = n\bar{x} = 100\times 40 = 4000$	1	
		$\therefore Incorrect \sum x_i = 4000$		
		$\therefore Correct \sum x_i = Incorrect \sum x_i - 83 + 53$		
		$= 4000 - 83 + 53 = 3970$	1	
		$\therefore Correct\ mean = \dfrac{Correct \sum x_i}{n} = \dfrac{3970}{100} = 39.70$	2	**4**
	b)	$Here\quad f_1 = 18,\quad f_m = 25,\quad f_2 = 15$	1	
		$Mode = L + \dfrac{f_m - f_1}{2f_m - f_1 - f_2}\times h$	1	
		$= 25 + \dfrac{25-18}{2(25)-18-15}\times 5$	1	
		$= 27.058$	1	**4**
		Note: The formula of mode is written in the various forms such as $Mode = L + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\times h$.		
	c)	(table below)	1+1	
		$S.D. = \sqrt{\dfrac{\sum f_i x_i^2}{N} - \left(\dfrac{\sum f_i x_i}{N}\right)^2}$		
		$= \sqrt{\dfrac{110334}{750} - \left(\dfrac{8436}{750}\right)^2}$	1	
		$= 4.538$	1	**4**

Table for 5 c):

xi	f_i	$f_i x_i$	x_i^2	$f_i x_i^2$
1	7	7	1	7
4	46	184	16	736
7	165	1155	49	8085
10	195	1950	100	19500
13	189	2457	169	31941
16	89	1424	256	22784
19	28	532	361	10108
22	19	418	484	9196
25	09	225	625	5625
28	03	84	784	2352
	750	**8436**		**110334**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
5)				

xi	f_i	d_i	f_id_i	d_i^2	$f_id_i^2$
1	7	-4	-28	16	112
4	46	-3	-138	9	414
7	165	-2	330	4	660
10	195	-1	-195	1	195
13	**189**	**0**	**0**	**0**	**0**
16	89	1	89	1	89
19	28	2	56	4	112
22	19	3	57	9	171
25	09	4	36	16	144
28	03	5	15	25	75
	750		**-438**		**1972**

1+1

$A=13 \quad h=3, \quad d_i=\dfrac{x_i-A}{h}$

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

$$=3\times\sqrt{\frac{1972}{750}-\left(\frac{-438}{750}\right)^2}$$ 1

$$=4.538$$ 1

Total: **4**

Note: Students may take any another value for A in the above/ below example. So the above table and corresponding values vary accordingly. But the final answer will be the same.

d)

Class	xi	f_i	d_i	f_id_i
900-920	910	4	-3	-12
920-940	930	11	-2	-22
940-960	950	63	-1	-63
960-980	**970**	**90**	**0**	**0**
980-1000	990	73	1	73
1000-1020	1010	38	2	76
1020-1040	1030	16	3	48
1040-1060	1050	5	4	20
		300		**120**

2

$A=970, \quad h=20$

$$\therefore \bar{x}=A+\frac{\sum f_id_i}{N}\times h$$

$$=970+\left(\frac{120}{300}\right)\times 20$$ 1

$$=978$$ 1

Total: **4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
5)	e)			

Class	xi	f_i	$f_i x_i$	$D_i = \left\lvert x_i - \bar{x} \right\rvert$	$f_i D_i$
10-15	12.5	7	87.5	15.3	107.1
15-20	17.5	12	210	10.3	123.6
20-25	22.5	16	360	5.3	84.8
25-30	27.5	25	687.5	0.3	7.5
30-35	32.5	19	617.5	4.7	89.3
35-40	37.5	15	562.5	9.7	145.5
40-45	42.5	6	255	14.7	88.2
		100	2780		646

1+1

$$\bar{x} = \frac{\sum f_i x_i}{N} = \frac{2780}{100} = 27.8$$ 1

$$M.D. = \frac{\sum f_i D_i}{N}$$

$$= \frac{646}{100}$$

$$= 6.46$$ 1 **4**

f)

$$C.V.(A) = \frac{\sigma}{\bar{x}} \times 100 = \frac{6}{80} \times 100 = 7.5$$ 1

$$C.V.(B) = \frac{\sigma}{\bar{x}} \times 100 = \frac{7.2}{60} \times 100 = 12$$ 1

$$\therefore C.V.(A) < C.V.(B)$$ 1

$\therefore$ Group B is more variable. 1 **4**

6)

For Civil, Electrical and Mechanical Groups

a)

$$z_1 = -3+4i, z_2 = 5-3i$$

$$\frac{z_1}{z_2} = \frac{-3+4i}{5-3i}$$

$$= \frac{-3+4i}{5-3i} \times \frac{5+3i}{5+3i}$$ 1

$$= \frac{-15-9i+20i+12i^2}{25-9i^2}$$

$$= \frac{-15+11i-12}{25+9}$$ 1

$$= \frac{-27+11i}{34}$$ 1

$$= \frac{-27}{34} + \frac{11}{34} i$$ 1 **4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
6)	b) i)	$LHS = \sin 2\theta$		
		$= \dfrac{e^{2i\theta} - e^{-2i\theta}}{2i}$	½	
		$RHS = 2\sin\theta\cos\theta$		
		$= 2\cdot\dfrac{e^{i\theta} - e^{-i\theta}}{2i}\cdot\dfrac{e^{i\theta} + e^{-i\theta}}{2i}$	½	
		$= \dfrac{\left(e^{i\theta}\right)^2 - \left(e^{-i\theta}\right)^2}{2i}$		
		$= \dfrac{e^{2i\theta} - e^{-2i\theta}}{2i}$	½	
		$\therefore LHS = RHS$	½	
		OR		
		$2\sin\theta\cos\theta = 2\cdot\dfrac{e^{i\theta} - e^{-i\theta}}{2i}\cdot\dfrac{e^{i\theta} + e^{-i\theta}}{2i}$	½	
		$= \dfrac{\left(e^{i\theta}\right)^2 - \left(e^{-i\theta}\right)^2}{2i}$	½	
		$= \dfrac{e^{2i\theta} - e^{-2i\theta}}{2i}$	½	
		$= \sin 2\theta$	½	
	b) ii)	$\cosh^2\theta - \sinh^2\theta = \left(\dfrac{e^{\theta} + e^{-\theta}}{2}\right)^2 - \left(\dfrac{e^{\theta} - e^{-\theta}}{2}\right)^2$	½	
		$= \dfrac{e^{2\theta} + 2e^{\theta}e^{-\theta} + e^{-2\theta}}{4} - \dfrac{e^{2\theta} - 2e^{\theta}e^{-\theta} + e^{-2\theta}}{4}$	½	
		$= \dfrac{4e^{\theta}e^{-\theta}}{4}$	½	
		$= 1$	½	**4**
	c)	$\dfrac{\left[\cos 3\theta + i\sin 3\theta\right]^4 \left[\cos 4\theta - i\sin 4\theta\right]^5}{\left[\cos 4\theta + i\sin 4\theta\right]^3 \left[\cos 5\theta + i\sin 5\theta\right]^{-4}}$		
		$= \dfrac{\left[\cos\theta + i\sin\theta\right]^{3\times4} \left[\cos\theta + i\sin\theta\right]^{-4\times5}}{\left[\cos\theta + i\sin\theta\right]^{4\times3} \left[\cos\theta + i\sin\theta\right]^{5\times(-4)}}$ .... (*)	½+½+ ½+½	
		$= \dfrac{\left[\cos\theta + i\sin\theta\right]^{12} \left[\cos\theta + i\sin\theta\right]^{-20}}{\left[\cos\theta + i\sin\theta\right]^{12} \left[\cos\theta + i\sin\theta\right]^{-20}}$	1	
		$= 1$	1	**4**
		Note: Every term in the step (*) carries ½ marks.		

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
6)	d)	$\sin(x+iy)=\sin x\cos iy+\cos x\sin iy$	1	
		$=\sin x\cosh y+\cos x i\sinh y$		
		$=\sin x\cosh y+i\cos x\sinh y$	1	
		$\therefore$ Real part $=\sin x\cosh y$	1	
		Imaginary part $=\cos x\sinh y$	1	**4**
	e) i)	$z_1z_2=(4-5i)(3+7i)$		
		$=12+28i-15i-35i^2$		
		$=47+13i$	1	
		$\therefore \lvert z_1z_2\rvert=\sqrt{47^2+13^2}$		
		$=\sqrt{2378}$ *or* 48.765	1	
	e) ii)	$\dfrac{z_1}{z_2}=\dfrac{4-5i}{3+7i}$		
		$=\dfrac{4-5i}{3+7i}\times\dfrac{3-7i}{3-7i}$	½	
		$=\dfrac{12-28i-15i+35i^2}{9-49i^2}$		
		$=\dfrac{-23-43i}{58}$	½	
		$=\dfrac{-23}{58}-\dfrac{43}{58}i$		
		$\therefore \left\lvert\dfrac{z_1}{z_2}\right\rvert=\sqrt{\left(\dfrac{-23}{58}\right)^2+\left(\dfrac{-43}{58}\right)^2}$		
		$=\sqrt{\dfrac{2378}{3364}}$ *or* 0.84	1	**4**
	f)	*Let* $z=1-\cos 2+i\sin 2$		
		$\therefore z=2\sin^2 1+i\sin 1\cos 1$		
		$=2\sin 1(\sin 1+i\cos 1)$	1	
		$=2\sin 1\left[\cos\left(\dfrac{\pi}{2}-1\right)+i\sin\left(\dfrac{\pi}{2}-1\right)\right]$	1	
		$\therefore$ modulus $r=2\sin 1$	1	
		amplitude $\theta=\dfrac{\pi}{2}-1$	1	**4**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>6)</td><td></td><td>For Computer/Information Technology Group</td><td></td><td></td></tr>
<tr><td></td><td>a)</td><td>$f(x)=x^3-5x-11$
$\therefore f(2)=-13,\quad f(3)=1$
$\therefore$ the root is in $(2,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_1=\frac{2+3}{2}=2.5$
$\therefore f(2.5)=-7.875$
$\therefore$ the root is in $(2.5,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_2=\frac{2.5+3}{2}=2.75$
$\therefore f(2.75)=-3.95$
$\therefore$ the root is in $(2.75,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_3=\frac{2.75+3}{2}=2.875$</td><td>1</td><td>4</td></tr>
<tr><td></td><td></td><td>OR
$f(x)=x^3-5x-11$
$\therefore f(2)=-13,\quad f(3)=1$
$\therefore$ the root is in $(2,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td><table><tr><th>a</th><th>b</th><th>$x=\frac{a+b}{2}$</th><th>$f(x)$</th></tr><tr><td>2</td><td>3</td><td>2.5</td><td>-7.875</td></tr><tr><td>2.5</td><td>3</td><td>2.75</td><td>-3.95</td></tr><tr><td>2.75</td><td>3</td><td>2.875</td><td>---</td></tr></table></td><td>1
1
1</td><td>4</td></tr>
<tr><td></td><td>b)</td><td>$f(x)=x^3-2x-5$
$\therefore f(2)=-1$
$f(3)=16$
$\therefore$ the root is in $(2,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_1=\frac{af(b)-bf(a)}{f(b)-f(a)}=2.0588$
$\therefore f(2.0588)=-0.39$
$\therefore$ the root is in $(2.0588,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_2=2.08$
$\therefore f(2.08)=-0.16$
$\therefore$ the root is in $(2.08,\ 3)$.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>$\therefore x_3=2.089$</td><td>1</td><td>4</td></tr>
</table>

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
6)		**OR**		
		$f(x)=x^3-2x-5$		
		$\therefore f(2)=-1$		
		$f(3)=16$		
		$\therefore$ the root is in $(2,\ 3)$.	1	

a	b	$f(a)$	$f(b)$	$x=\frac{af(b)-bf(a)}{f(b)-f(a)}$	$f(x)$	Marks	Total Marks
2	3	-1	16	2.0588	-0.39	1	
2.0588	3	-0.39	16	2.08	-0.166	1	
2.08	3	-0.16	16	2.089	---	1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
	c)	$f(x)=x^3-20$		
		$f'(x)=3x^2$	½	
		$f(2)=-12$		
		$f(3)=7$	½	
		$x-\frac{f(x)}{f'(x)}=x-\frac{x^3-20}{3x^2}$		
		$=\frac{2x^3+20}{3x^2}$	1	
		Start with $x_0=3$,		
		$\therefore x_1=2.741$	1	
		$x_2=2.715$	1	**4**
		$x_3=2.714$		
		OR		
		$f(x)=x^3-20$		
		$f'(x)=3x^2$	½	
		$f(2)=-12$		
		$f(3)=7$	½	
		Start with $x_0=3$,		
		$\therefore x_1=x_0-\frac{f(x_0)}{f'(x_0)}$		
		$=3-\frac{f(3)}{f'(3)}$		
		$=3-\frac{-11}{27}$		
		$=2.741$	1	

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
6)		$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 2.741 - \frac{f(2.741)}{f'(2.741)}$ $= 2.741 - \frac{0.593}{22.539}$ $= 2.715$	1	
		$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = 2.714 - \frac{f(2.714)}{f'(2.714)}$ $= 2.714 - \frac{0.593}{22.539}$ $= 2.714$	1	**4**
	d)	$2x+3y+2z=2$ $10x+3y+4z=16$ $3x+6y+z=-6$		
		$\begin{array}{r} 2x+3y+2z=2 \\ 10x+3y+4z=16 \\ -\quad -\quad -\quad - \\ \hline -8x-2z=-14 \end{array}$ and $\begin{array}{r} 20x+6y+8z=32 \\ 3x+6y+z=-6 \\ -\quad -\quad -\quad - \\ \hline 17x+7z=38 \end{array}$	1	
		$28x+7z=49$ $\underline{17x+7z=38}$ $11x=11$ $\therefore x=1$ $z=3$ $y=-2$	1 1 1	**4**
		Note: In the above solution, first x is eliminated and then y is eliminated to find the value of z first. If in case the problem is solved by elimination of another unknown i. e., either first y or z, appropriate marks to be given as per above scheme of marking.		
	e)	$15x+2y+z=18$ $2x+20y-3z=19$ $3x-6y+25z=22$		

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
6)	e)	$\therefore x=\dfrac{18-2y-z}{15}$ $y=\dfrac{19-2x+3z}{20}$ $z=\dfrac{22-3x+6y}{25}$	1	
		Starting with $x_0=0=y_0=z_0$		
		$x_1=1.2$	½	
		$y_1=0.95$	½	
		$z_1=0.88$	½	
		$x_2=1.0146$	½	
		$y_2=0.962$	½	**4**
		$z_2=0.9864$	½	
	f)	$27x+6y-z=85$ $6x+15y+2z=72$ $x+y+54z=110$		
		$\therefore x=\dfrac{85-6y+z}{27}$ $y=\dfrac{72-6x-2z}{15}$ $z=\dfrac{110-x-y}{54}$	1	
		Starting with $x_0=0=y_0=z_0$		
		$x_1=3.148$	½	
		$y_1=3.54$	½	
		$z_1=1.91$	½	
		$x_2=2.43$	½	
		$y_2=3.57$	½	
		$z_2=1.925$	½	**4**
		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.**		