THE SAMIA SUB-COUNTY EVALUATION TEST

MATHEMATICS PAPER 2

MARKING SCHEME

NOV/DEC, 2021

CONFIDENTIAL

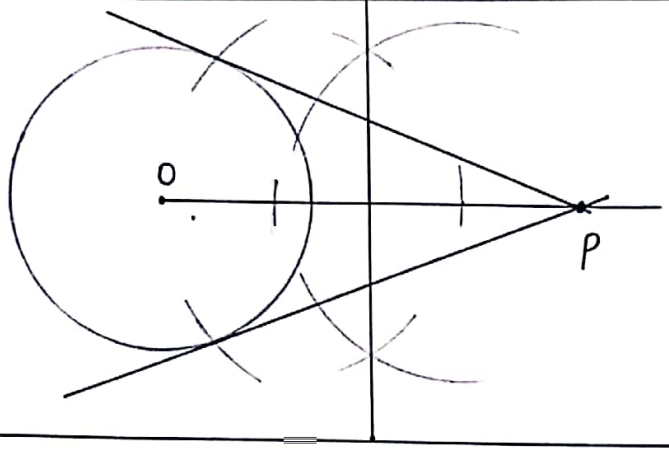
KENYA CERTIFICATE OF SECONDARY EDUCATION

MARKING SCHEME

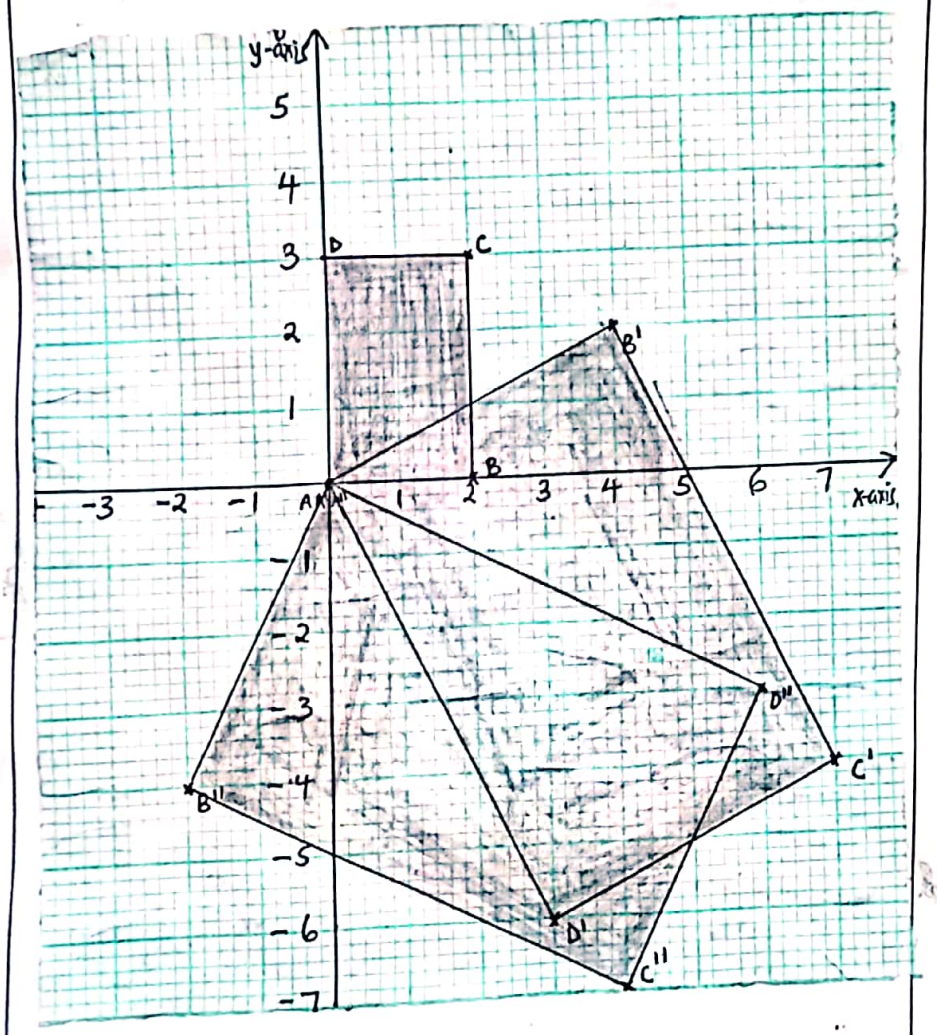
NO.	MARKING SCHEME.	MARKS	COMMENTS
1.	$\pi R^2 H_{(min)} - \pi r^2 h_{(max)}$	M_1	Both minimum and maximum volumes
	$(3\cdot142 \times 19\cdot5^2 \times \frac{139\cdot5}{3}) - (3\cdot142 \times 14\cdot5^2 \times 140\cdot5)$	M_1	correct operation
	$= 166,666\cdot9973 - 92\,815\cdot07275$		
	$= 73\,851\cdot92455$.	A_1	C.A.O (No rounding off).
		03	
2.	$2(1-\cos^2 x) + 3\cos x - 1 = 0$		
	$2 - 2\cos^2 x + 3\cos x - 1 = 0$	M_1	Correct equation
	$2\cos^2 x - 3\cos x - 1 = 0$		
	let $\cos x = y$		
	$2y^2 - 3y - 1 = 0$		
	$y = \frac{3 \pm \sqrt{9+8}}{4} = \frac{3 \pm \sqrt{17}}{4} = 1\cdot780776406$ $-0\cdot280776406$	M_1	Attempt to solve the equation
	$\cos x = 1\cdot780776406$		
	$\cos x = -0\cdot280776406$. $= 73\cdot69°$ (S A T C)	A_1	values of cosx
	$\therefore x = 180 - 73\cdot69 = 106\cdot31$.		
	$x = 180 + 73\cdot69 = 253\cdot69$		
	$x = 106\cdot31, 253\cdot69$.	B_1	All values of x.
		04	
3.	$(-2,0)$ $(3,0)$	B_1	
	$(x+2)(x-3) = 0$	M_1	Expanding.
	$x(x-3) + 2(x-3) = 0$; $x^2 - 3x + 2x - 6 = 0$		
	$\therefore x^2 - x = 6$.	A_1	formed eqn.
		03.	
4.	2^6 2^5 2^4 2^3	B_1	Correct expansion.
	$(3x)^0$ $(3x)^1$ $(3x)^2$ $(3x)^3$		
	1 6 15 20		
	$64 + 576x + 2160x^2 + 4320x^3$		
	$2 + 3x = 2\cdot09$ $x = 0\cdot03$.	M_1	Correct substitution
	$64 + 576(0\cdot03) + 2160(0\cdot03)^2 + 4320(0\cdot03)^3$		
	$= 83\cdot34064$	A_1	
		03	

NO	MARKING SCHEME	MARKS	COMMENTS.
5.	$M = kN + CN^2$. $1050 = 10K + 100C$ $2200 = 20k + 400C$ $2100 = 20k + 200C$ $2200 = 20k + 400C$ $+100 = -200C$ -200 $C = \frac{1}{2}$ $1050 = 10k + 50$ $k = 100$ $M = 100N + \frac{1}{2}N^2$.	M_1 M_1 A_1 03	Formation of Two equations Solving .
6.	A B sh. 140 160 3 5 Cost price per kg of the mixture $\frac{(140\times3)+(160\times5)}{8} = 152.50$ Profit $= 180 - 152.50 = 27.5$ $\%P = \frac{27.5}{152.50} \times 100\% = 18\frac{2}{61}\%$	M_1 M_1 A_1 03	Expression of finding Cost price per kg. Expression for % profit Allow 18.03%.
7.	$AB = B - A$ $\begin{pmatrix}-2\\-1\\2\end{pmatrix} - \begin{pmatrix}2\\-3\\4\end{pmatrix} = \begin{pmatrix}-4\\2\\-2\end{pmatrix}$ $\sqrt{(-4)^2 + 2^2 + (-2)^2} = \sqrt{24} = 4.90$.	M_1 M_1 A_1 03.	AB expressed in column vector. ~~Attempt to~~ finding the magnitude C.A.O.
8.	9, 12, 14, 16, 18, 20, 23. $Q_1 = 12$ $Q_3 = 20$ $\frac{20-12}{2} = \frac{8}{2} = 4$.	B_1 M_1 A_1	Q_1 and Q_3 correct Operation C.A.O.
9			

NO	MARKING SCHEME	MARKS	COMMENTS
9	$R = \frac{3}{4}$ Centre $(\frac{3}{4}, -\frac{1}{2})$ $(x - \frac{3}{4})^2 + (y + \frac{1}{2})^2 = (\frac{3}{4})^2$. $x^2 - \frac{6x}{4^2} + \frac{9}{16} + y^2 + y + \frac{1}{4} = \frac{9}{16}$ $x^2 - \frac{3x}{2} + y^2 + y = \frac{9}{16} - \frac{9}{16} - \frac{1}{4}$ $x^2 - \frac{3x}{2} + y^2 + y = -\frac{1}{4}$ $4x^2 + 4y^2 - 6x + 4y + 1 = 0$	M_1 M_1 A_1	Circle equation Expansion (all terms should be correct).
		03	
10.	$\log_{10} x^2 + \log_{10} 5 = \log_{10} 10 + \log_{10} 16$ $\log_{10}(5x^2) = \log_{10}(160)$ $5x^2 = 160$ $\sqrt{x^2} = \sqrt{32} = \pm 4\sqrt{2}$. $x = \pm 4\sqrt{2}$	M_1 M_1 A_1	Single logs on both sides making x^2 the subject
		03	
11.	$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6371 \cos 52 = 2400$ $\theta = 35.04°$ $37.05 - 35.04 = 2.01$ $C(52°N, 2.01°W)$	M_1 A_1 B_1	Correct substitution value of θ position of C.
		03	
12.	$\frac{2x^3}{3} - \frac{3x^2}{2} - 14x + C \Big|_{-1}^{3}$ $\left(\frac{2(3)^3}{3} - \frac{3(3)^2}{2} - 14(3)\right) - \left(\frac{2(-1)^3}{3} - \frac{3(-1)^2}{2} - 14(-1)\right)$ $(18 - 13.5 - 42) - (-\frac{2}{3} - \frac{3}{2} + 14)$ $-37.5 - 11\frac{5}{6}$ $= -49\frac{1}{3}$.	M_1 M_1 A_1	Integration operation C.A.O must be exact.
		03	

NO.	MARKING SCHEME	MARKS	COMMENTS.
13.		B1 B1 B1	Mid point of OP Identifying points on the circle. Both tangents.
		03.	
14.	$\frac{3(3-\sqrt{5})+3\sqrt{5}(3+\sqrt{5})}{(3+\sqrt{5})(3-\sqrt{5})}$ $\frac{9-3\sqrt{5}+9\sqrt{5}+15}{9-5}$ $\frac{24+6\sqrt{5}}{4} = 6+1.5\sqrt{5}$ $a=6$ and $b=1.5$ or $1\frac{1}{2}$.	M1 A1 B1	– Rationalizing the denominator and expanding the numerator – $a+b\sqrt{5}$ for expression – values of a and b
		03.	
15.	(i) $\angle BED = 37°$; angles in alternate segment. (ii) $\angle ABE = 57°$; angles in alternate segment	B1 B1 B1 B1	for the angle for the reason. " "
		04.	
16.	Det $= (1\times2)-(3\times4) = -10$ Area of $\Delta A'B'C' = 12.5\times10 = -125$ $= 125cm^2$.	M1 M1 A1	
		03.	
		50 MARKS.	

NO.	MARKING SCHEME	MARKS	COMMENTS.
17. (a)	$\begin{pmatrix}2 & 1\\ 1 & -2\end{pmatrix}\begin{pmatrix}A & B & C & D\\ 0 & 2 & 2 & 0\\ 0 & 0 & 3 & 3\end{pmatrix}=\begin{pmatrix}A' & B' & C' & D'\\ 0 & 4 & 7 & 3\\ 0 & 2 & -4 & -6\end{pmatrix}$	B_1	ABCD draw
		M_1	
		A_1	$A'B'C'D'$
	$A'(0,0)$ $B'(4,2)$ $C'(7,-4)$ $D'(3,-6)$.	B_1	$A'B'C'D'$ drawn.



(b)	$\begin{pmatrix}0 & -1\\ -1 & 0\end{pmatrix}\begin{pmatrix}A' & B' & C' & D'\\ 0 & 4 & 7 & 3\\ 0 & 2 & -4 & -6\end{pmatrix}=\begin{pmatrix}A'' & B'' & C'' & D''\\ 0 & -2 & 4 & 6\\ 0 & -4 & -7 & -3\end{pmatrix}$	M_1	
		A_1	
	$A''(0,0)$ $B''(-2,-4)$ $C''(4,-7)$ $D''(6,-3)$.	B_1	$A''B''C''D''$ drawn

(c) $\begin{pmatrix}a & b\\ c & d\end{pmatrix}\begin{pmatrix}6 & -2\\ -3 & -4\end{pmatrix}=\begin{pmatrix}0 & 2\\ 3 & 0\end{pmatrix}$

$6a-3b=0$ | $6c-3d=3$

$-2a-4b=2$ | $-2c-4d=0$

$6a=3b$

$b=2a$

$-2a-4(2a)=2$

$a=-0.2$ $b=-0.4$

$-2c=4d$

$c=-2d$

$6(-2d)-3d=3$

$d=-0.2$

$c=0.4$

$\begin{pmatrix}-0.2 & -0.4\\ 0.4 & -0.2\end{pmatrix}$

M_1 — Alternative $\begin{pmatrix}0 & 2\\ 3 & 0\end{pmatrix}$ Inverse

M_1

A_1 — Matrix.

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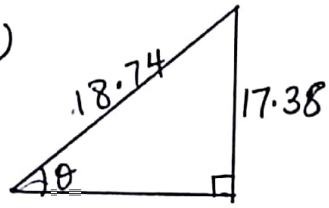
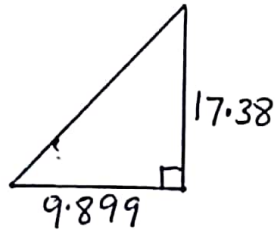
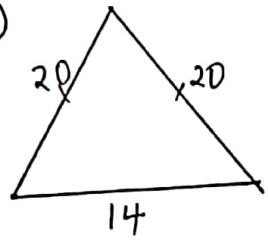
NO.	MARKING SCHEME	MARKS	COMMENTS.
18. (a)	$BO = \sqrt{\frac{14^2+14^2}{2}} = 9.899$	B_1	
	$VO = \sqrt{20^2 - 9.899^2} = 17.38$	B_1	
	$VN = \sqrt{7^2 + 17.38^2} = 18.74$	B_1	
(b)	 $\sin\theta = \frac{17.38}{18.74}$ $= 68.04^\circ$	M_1 M_1 A_1	M_1 – Angle identification M_1 – Correct substitution
(c)	 $\tan\theta = \frac{17.38}{9.899}$ $= 60.34^\circ$	M_1 A_1	
(d)	 $\sin\theta = \frac{9.899}{13.12}$ $= 48.99 \times 2$ $= 97.98^\circ$	M_1 A_1	
		10	

MARKING SCHEME.

MARKS	MARKS	COMMENTS
19.	B_1	fd column.
	B_1	c.f column
	B_1	d - column
	B_1	fd^2 column

MARKS	f	x	d^{x-57}	fd	d^2	fd^2	cf
30-34	1	32	-25	-25	625	625	1
35-39	5	37	-20	-100	400	2000	6
40-44	10	42	-15	-150	225	2250	16
45-49	10	47	-10	-100	100	1000	26
50-54	19	52	-5	-95	25	475	45
55-59	20	57	0	0	0	0	65
60-64	20	62	5	100	25	500	85
65-69	8	67	10	80	100	800	93
70-74	4	72	15	60	225	900	97
75-79	3	77	20	60	400	1200	100
	N=			Σfd =-170		Σfd^2= 9750	

(i) Actual mean.

$$\bar{X} = A + \frac{\Sigma fd}{\Sigma f}$$

$$57 + \left(\frac{-170}{100}\right) = 55.30.$$

M_1 — correct substitution

A_1 — C.A.O.

(ii) 50th percentile.

$$\frac{50}{100} \times 100 = 50.$$

$$54.5 + \left(\frac{50-45}{20}\right)5$$

$$= 55.75.$$

M_1 — correct substitution

A_1 — C.A.O.

(iii) Standard deviation.

$$\sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

$$\sqrt{\frac{9750}{100} - \left(\frac{-170}{100}\right)^2}$$

$$= \sqrt{94.61} = 9.726767192.$$

M_1 — correct substitution

A_1 — Atleast 4 s.f.

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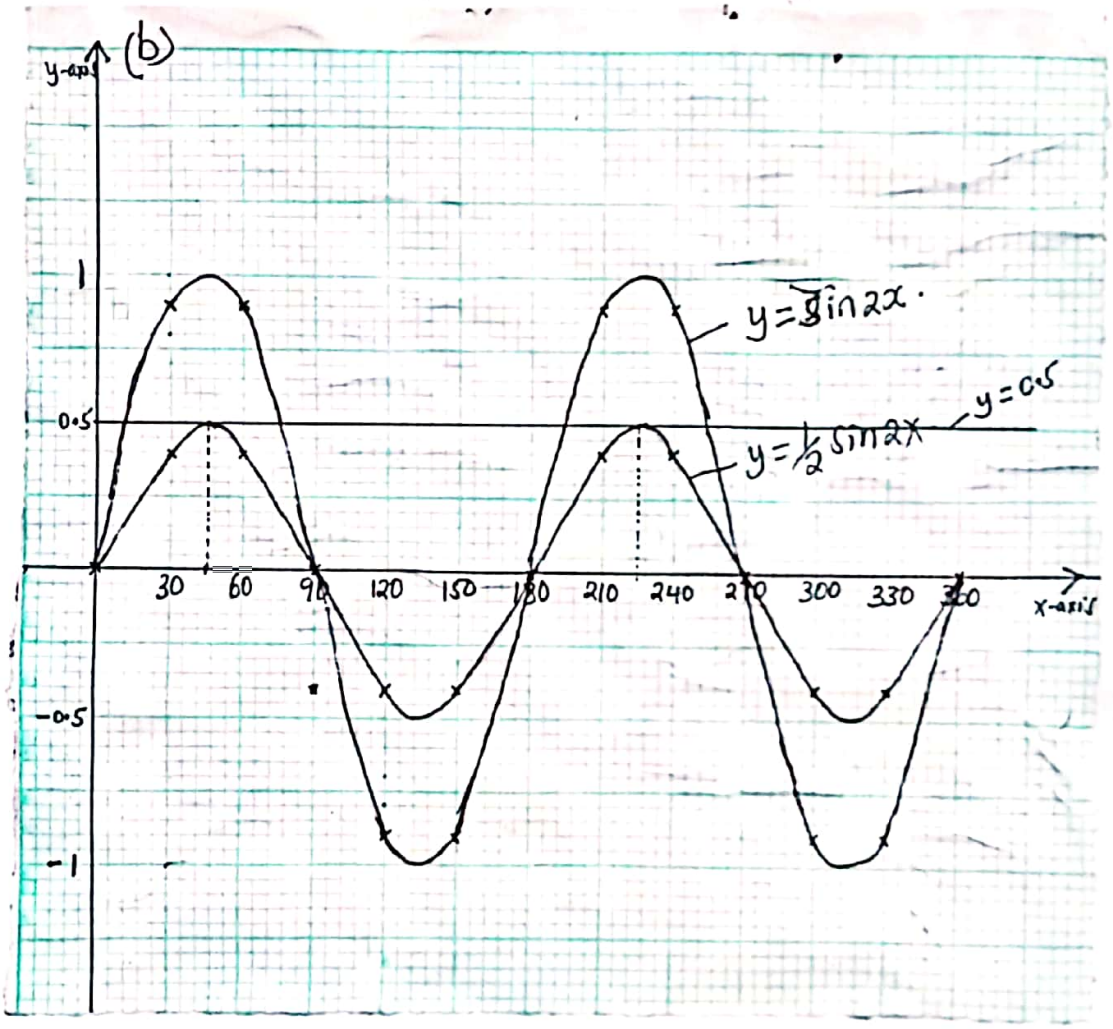
20. (a)

x	0	30	60	90	120	150	180	210	240	270	300	330	360	
$2x$	0°	60°	120°	180°	240°	300°	360°	420°	480°	540°	600°	660°	720°	B1
$y = \sin 2x$	0	0.866	0.866	0°	-0.866	-0.866	0	0.866	0.866	0	-0.866	-0.866	0	B1
$y = \frac{1}{2}\sin 2x$	0	0.433	0.433	0°	-0.433	-0.433	0	0.433	0.433	0	-0.433	-0.433	0	

(b)



P1
C1
C1

(C) Amplitude = 0.5 B1
Period = 180° B1

(d)(i) $x = 0°, 90°, 180°, 270°, 360°$ B1

(ii) $x = 45°, 225°$ B1 B1

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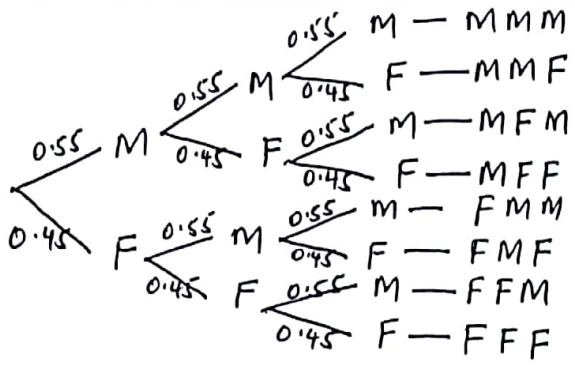
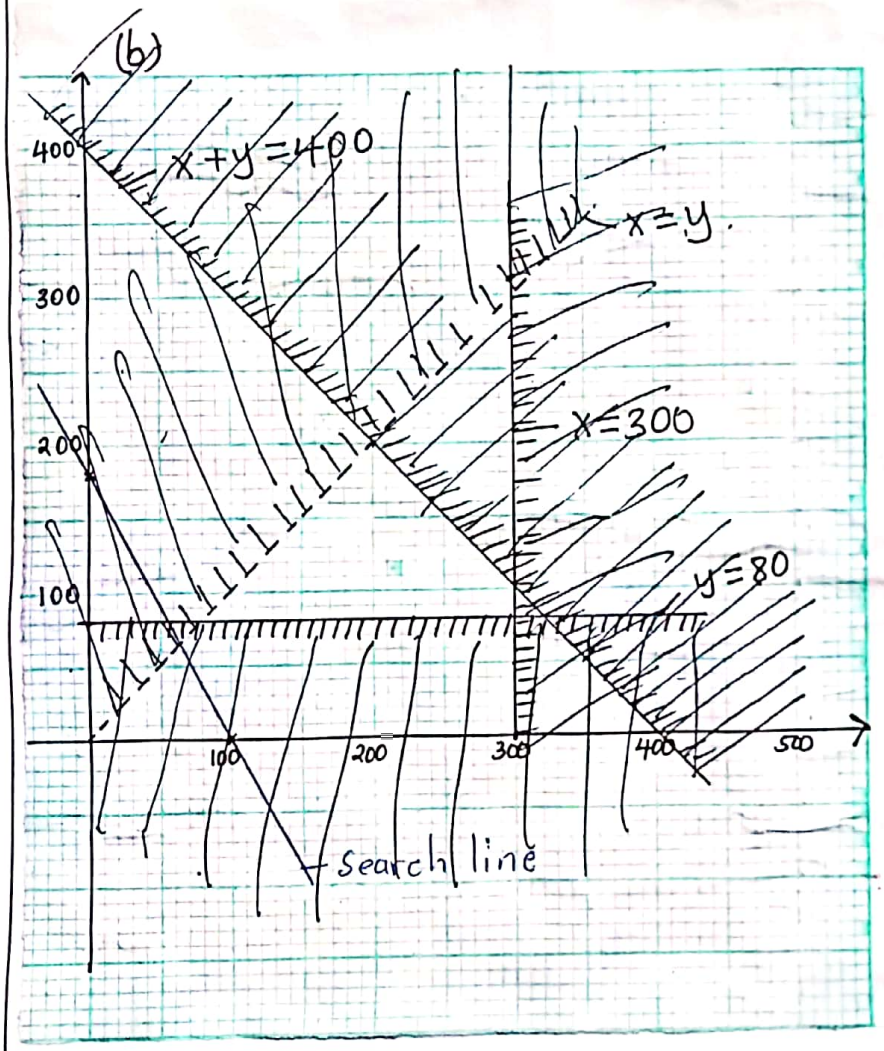
	MARKS	
21. (a) Taxable income per month. $\frac{115}{100} \times 48,000 - 3000 + 2500 + 3500$ $= 58,200.$	M1 A1	
(b) $11,180 \times \frac{10}{100} = 1118.$ $10,534 \times \frac{15}{100} = 1580.10$ $10,534 \times \frac{20}{100} = 2106.80$ $10,533 \times \frac{25}{100} = 2633.25$ $15419 \times \frac{30}{100} = 4625.70$ $1118 + 1580.10 + 2106.80 + 2633.25 + 4625.70$ $= 12,063.85$ $12063.85 - 1648 = 10,415.85.$	M1 – 1st two slabs M1 – 3rd and 4th slabs M1 – Last slab M1 – Operation A1	
(c) Total deductions $10415.85 + 1250 + 1200 + 3000$ $= 15,865.85.$ $58,200 - 15,865.85$ $= 42,334.15.$	M1 M1 A1	

NO	MARKING SCHEME	MARKS	COMMENTS
22 (a) (i)	$a = 2$ $S_8 = \frac{n}{2}(2a + (n-1)d)$ $156 = \frac{8}{2}(4 + 7d)$ $7d = 35 \quad d = 5.$	M1 A1	— correct substitution — C.A.O.
(ii)	$416 = \frac{n}{2}(4 + (n-1)5).$ $832 = 4n + 5n^2 - 5n$ $5n^2 - n - 832 = 0$ $n = \frac{1 \pm \sqrt{1 + 16640}}{10} = \frac{1 \pm 129}{10}$ $n = 13$ $n = -12.8$ $n = 13$ only.	M1 A1	— formation of quadratic eqn. — C.A.O.
(b) (i)	$a + 2d,\ a + 4d,\ a + 7d$ $\frac{a+4d}{a+2d} = \frac{a+7d}{a+4d}$ $a^2 + 8ad + 16d^2 = a^2 + 9ad + 14d^2$ $ad = 2d^2$ $a = 2d \ ; \ a = 2 \times 3 = 6.$ $a + 2d$ $6 + 2(3) = 6 + 6 = 12.$	M1 M1 A1 B1	— — — value of a —
(ii)	$\frac{a+4d}{a+2d} = \frac{6+4(3)}{12} = 1.5.$ $S_9 = \frac{a(r^n - 1)}{r - 1}$ $\frac{12(1.5^9 - 1)}{1.5 - 1} = 898.640625$ $= 898.6.$	M1 A1	— correct substitution — C.A.O
		10	

NO.	MARKING SCHEME.	MARKS	
23. (a)		B1 — correct labelling B1 — correct probabilities.	
(b) (i)	$P(FFF) = 0.45 \times 0.45 \times 0.45$ $= 0.091125$ or $\frac{729}{8000}$	M1 A1	
(ii)	$P(\text{At least a male}) = 1 - P(FFF)$ $= 1 - \frac{729}{8000} = 0.908875$ or $\frac{7271}{8000}$	M1 A1	
(iii)	$P(\text{At least 2 Females})$. $P(MFF)$ or $P(FMF)$ or $P(FFM) + P(FFF)$. $(0.55 \times 0.45 \times 0.45) + (0.45 \times 0.55 \times 0.45) +$ $(0.45 \times 0.45 \times 0.55) + (0.45 \times 0.45 \times 0.45)$ $= 0.425$	M1 M1 M1 A1 — C.A.O.	
		10	

		MARKS
24.	(a) $x+y \leq 400$.	B_1
	$X > y$.	B_1
	$x \leq 300$.	B_1
	$y \geqslant 80$.	B_1
	(b) 	B_1 B_1 B_1 B_1
	(c) $600x + 400y = P$	
	(i) $\frac{x}{100} + \frac{y}{180} = 1$	
	$x = 300 \quad y = 100$	B_1
	Type A = 300.	
	Type B = 100.	
	(ii) $600(300) + 400(100)$	
	$= 220,000$.	B_1