

THE SAMIA SUB-COUNTY EVALUATION TEST

MATHEMATICS PAPER 2

MARKING SCHEME

NOV/DEC, 2021

CONFIDENTIAL

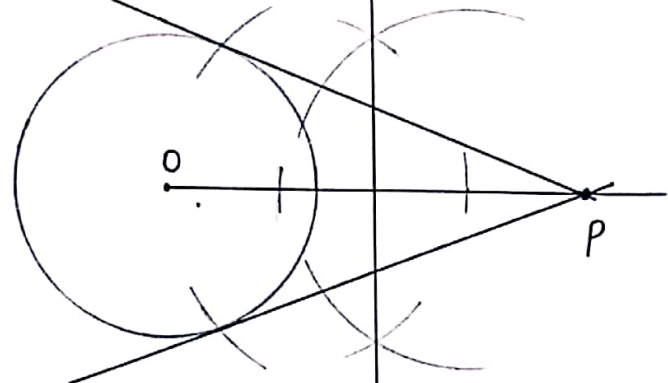
KENYA CERTIFICATE OF SECONDARY EDUCATION

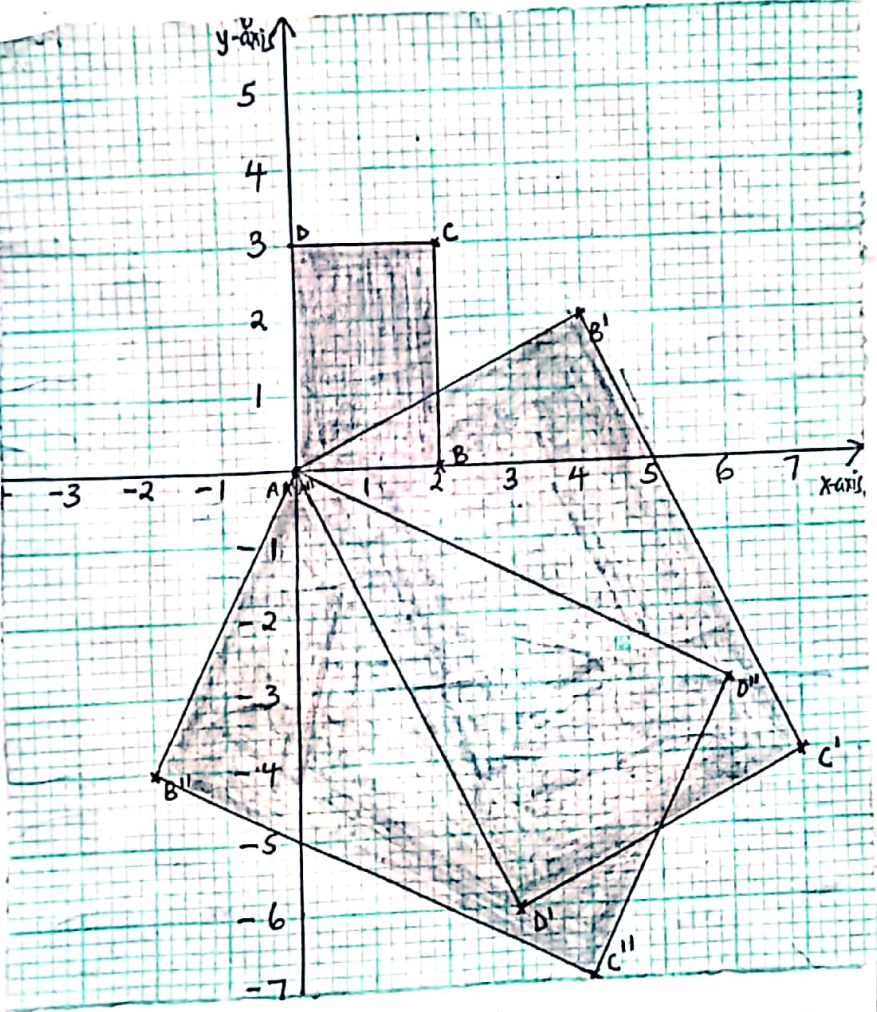
MARKING SCHEME

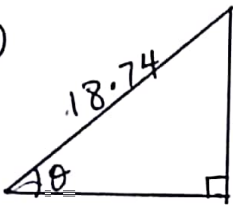
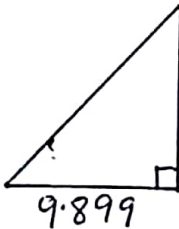
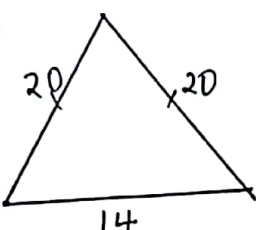
NO.	MARKING SCHEME.	MARKS	COMMENTS
1.	$\pi R^2 h_{\min} - \pi r^2 h_{\max}$ $(3.142 \times 19.5^2 \times 139.5) - (3.142 \times 14.5^2 \times 140.5)$ $= 166,666.9973 - 92,815.07275$ $= 73,851.92455.$	M ₁ M ₁ A ₁	Both minimum and maximum volumes Correct operation C.A.O (No rounding off).
		03	
2.	$2(1 - \cos^2 x) + 3 \cos x - 1 = 0$ $2 - 2 \cos^2 x + 3 \cos x - 1 = 0$ $2 \cos^2 x - 3 \cos x - 1 = 0$ let $\cos x = y$ $2y^2 - 3y - 1 = 0$ $y = \frac{3 \pm \sqrt{9+8}}{4} = \frac{3 \pm \sqrt{17}}{4} = 1.780776406, -0.280776406$ $\cos x = 1.780776406$ $\cos x = -0.280776406 = 73.69^\circ$ $\therefore x = 180 - 73.69 = 106.31$ $x = 180 + 73.69 = 253.69$ $x = 106.31, 253.69.$	M ₁ M ₁ A ₁ B ₁	Correct equation Attempt to solve the equation values of $\cos x$ All values of x .
		04	
3.	$(-2, 0) (3, 0)$ $(x+2)(x-3) = 0$ $x(x-3) + 2(x-3) = 0; x^2 - 3x + 2x - 6 = 0$ $x^2 - x - 6 = 0.$	B ₁ M ₁ A ₁	Expanding. formed eqn.
		03.	
4.	$\begin{array}{cccc} 2^6 & 2^5 & 2^4 & 2^3 \\ (3x)^0 & (3x)^1 & (3x)^2 & (3x)^3 \\ 1 & 6 & 15 & 20 \\ \hline 64 & + 576x & + 2160x^2 & + 4320x^3 \end{array}$ $2 + 3x = 2.09 \quad x = 0.03.$ $64 + 576(0.03) + 2160(0.03)^2 + 4320(0.03)^3$ $= 83.34064$	B ₁ M ₁ A ₁	Correct expansion. Correct substitution
		03	

NO	MARKING SCHEME	MARKS	COMMENTS.						
5.	$M = kN + cN^2$ $1050 = 10k + 100c$ $2200 = 20k + 400c$ $2100 = 20k + 200c$ $2200 = 20k + 400c$ $\frac{+100}{-200} = \frac{-200c}{-200}$ $c = \frac{1}{2}$ $1050 = 10k + 50$ $k = 100$ $M = 100N + \frac{1}{2}N^2$	M_1 M_1 A_1	Formation of Two equations Solving .						
6.	<table border="0"> <tr> <td>A</td> <td>B</td> </tr> <tr> <td>st. 140</td> <td>160</td> </tr> <tr> <td>3</td> <td>5</td> </tr> </table> Cost price per kg of the mixture $\frac{(140 \times 3) + (160 \times 5)}{8} = 152.50$ Profit = $180 - 152.50 = 27.5$ $\% P = \frac{27.5}{152.50} \times 100\% = 18\frac{2}{61}\%$	A	B	st. 140	160	3	5	M_1 M_1 A_1	Expression of finds Cost price per kg. Expression for % profit Allow 18.03%.
A	B								
st. 140	160								
3	5								
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	AB expressed in column vector Attempt to find 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.						
0									

NO	MARKING SCHEME	MARKS	COMMENTS
9	$R = \frac{3}{4}$ Centre $(\frac{3}{4}, -\frac{1}{2})$ $(x - \frac{3}{4})^2 + (y + \frac{1}{2})^2 = (\frac{3}{4})^2$ $x^2 - \frac{6x}{4} + \frac{9}{16} + y^2 + y + \frac{1}{4} = \frac{9}{16}$ $x^2 - \frac{3x}{2} + y^2 + y = \frac{9}{16} - \frac{9}{16} - \frac{1}{4}$ $x^2 - \frac{3x}{2} + y^2 + y = -\frac{1}{4}$ $4x^2 + 4y^2 - 6x + 4y + 1 = 0$	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.	$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6371 \cos 52 = 2400$ $\theta = 35.04^\circ$ $37.05 - 35.04 = 2.01$ $C (52^\circ N, 2.01^\circ W)$	M_1 A_1 B_1	Correct substitution value of θ position of C.
		03	
12.	$\left. \frac{2x^3}{3} - \frac{3x^2}{2} - 14x + c \right _{-1}^3$ $\left(\frac{2(3)^3}{3} - \frac{3(3)^2}{2} - 14(3) \right) - \left(\frac{2(-1)^3}{3} - \frac{3(-1)^2}{2} - 14(-1) \right)$ $(18 - 13.5 - 42) - (-\frac{2}{3} - \frac{3}{2} + 14)$ $-37.5 - 11\frac{5}{6}$ $= -49\frac{1}{3}$	M_1 M_1 A_1	Integration operation C.A.O must be exact.
		03	

NO.	MARKING SCHEME	MARKS	COMMENTS.
13.		B ₁ B ₁ B ₁	mid point of OP Identifying points on the circle. Both tangents.
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 $1\frac{1}{2}$.	03. M ₁ A₁ A₁	Rationalizing the denominator and expanding the numerator $a + b\sqrt{5}$ for expression values of a and b
15.	(i) $\angle BED = 37^\circ$; angles in alternate segment. (ii) $\angle ABE = 57^\circ$; angles in alternate segment	03. B ₁ B ₁ B ₁	for the angle for the reason. //
16.	$\text{Det} = (1 \times 2) - (3 \times 4) = -10$ $\text{Area of } \triangle A'B'C' = 12.5 \times 10 = -125$ $= 125 \text{ cm}^2.$	04. M ₁ M ₁ A ₁	
		03. 50 MARKS.	

No.	MARKING SCHEME	MARKS	COMMENTS.
17.	(a) $\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} A & B & C & D \\ 0 & 2 & 2 & 0 \\ 0 & 0 & 3 & 3 \end{pmatrix} = \begin{pmatrix} A' & B' & C' & D' \\ 0 & 4 & 7 & 3 \\ 0 & 2 & -4 & -6 \end{pmatrix}$ $A'(0,0) \quad B'(4,2) \quad C'(7,-4) \quad D'(3,-6).$ 	B₁ — ABCD draw M₁ A₁ — A'B'C'D' B₁ — A'B'C'D' drawn.	
	(b) $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} A' & B' & C' & D' \\ 0 & 4 & 7 & 3 \\ 0 & 2 & -4 & -6 \end{pmatrix} = \begin{pmatrix} A'' & B'' & C'' & D'' \\ 0 & -2 & 4 & 6 \\ 0 & -4 & -7 & -3 \end{pmatrix}$ $A''(0,0) \quad B''(-2,-4) \quad C''(4,-7) \quad D''(6,-3).$	M₁ A₁ B₁ — A''B''C''D'' drawn	
	(c) $\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} 6 & -2 \\ -3 & -4 \end{pmatrix} = \begin{pmatrix} 0 & 2 \\ 0 & 3 \end{pmatrix}$ $\begin{array}{l l} 6a - 3b = 0 & 6c - 3d = 3 \\ -2a - 4b = 2 & -2c - 4d = 0 \end{array} \quad \left \begin{pmatrix} -0.2 & -0.4 \\ 0.4 & -0.2 \end{pmatrix} \right.$ $\begin{array}{l l} 6a = 3b & -2c = 4d \\ b = 2a & c = -2d \\ -2a - 4(2a) = 2 & 6(-2d) - 3d = 3 \\ a = -0.2 & d = -0.2 \\ b = -0.4 & c = 0.4 \end{array}$	M₁ — Alternative $\begin{pmatrix} 0 & 2 \\ 3 & 0 \end{pmatrix}$ inv M₁ A₁ — matrix.	
		10	

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 — Angle identification M ₁ — Correct substitution A ₁	
	(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 COMMENTS

19.

MARKS	f	x	$\frac{x-57}{d}$	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	

B₁ - fd column.

B₁ - c.f column

B₁ - d - column

B₁ - fd^2 column

(i) Actual mean.

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

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

M₁ - correct substitution

A₁ - C.A.O.

(ii) 50th percentile.

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

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

$$= 55.75.$$

M₁ - correct substitution

A₁ - C.A.O.

(iii) Standard deviation.

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

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

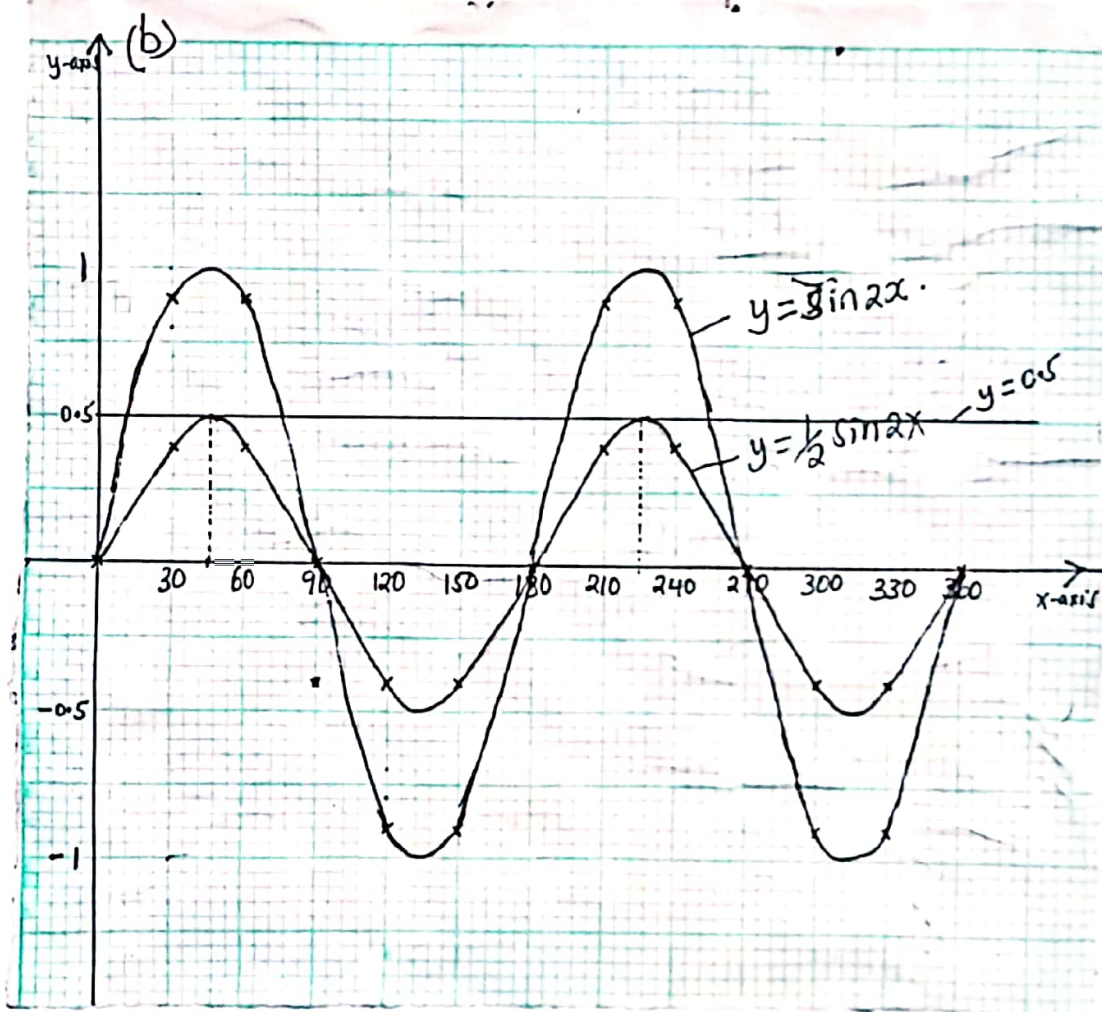
$$= \sqrt{94.61} = 9.726767192.$$

M₁ - correct substitution

A₁ - Atleast 4 s.f.

10

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	B_1
	$y = \sin 2x$	0	0.866	0.866	0	-0.866	-0.866	0	0.866	0.866	0	-0.866	-0.866	0	B_1
	$y = \frac{1}{2} \sin 2x$	0	0.433	0.433	0	-0.433	-0.433	0	0.433	0.433	0	-0.433	-0.433	0	



P_1
 C_1
 C_1

(c) Amplitude = 0.5
 Period = 180°

B_1

B_1

(d) (i) $x = 0^\circ, 90^\circ, 180^\circ, 270^\circ, 360^\circ$

B_1

(ii) $x = 45^\circ, 225^\circ$

$B_1 B_1$

10

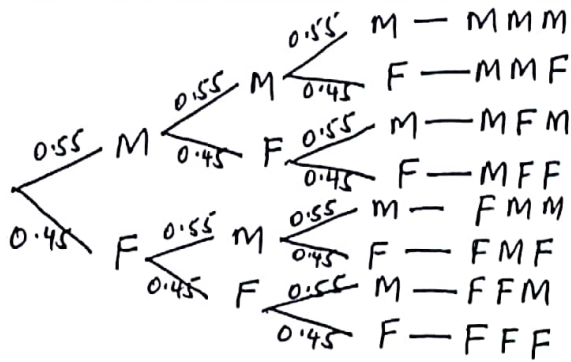
	MARKS	
21. (a) Taxable income per month. $\frac{115}{100} \times 48,000 - 3000 + 2500 + 3500$ $= 58,200.$	M, A7	
(b) $11,184 \times \frac{10}{100} = 1118.$ $10,534 \times \frac{15}{100} = 1580.10$ $10,534 \times \frac{20}{100} = 2106.80$ $10,533 \times \frac{25}{100} = 2633.25$ $15419 \times \frac{30}{100} = 4625.70$ $1118 + 1580.10 + 2106.80 + 2633.25 + 4625.70$ $= 12,063.85$ $12,063.85 - 1648 = 10,415.85.$	M, — 1 st two slabs M, — 3 rd and 4 th slabs, M, — Last slab M, — Operation A1	
(c) Total deductions $10,415.85 + 1250 + 1200 + 3000$ $= 15,865.85.$ $58,200 - 15,865.85$ $= 42,334.15.$	M, M, A7	

NO	MARKING SCHEME	MARKS	COMMENTS
22	(a) (i) $a = 2$ $S_8 = \frac{n}{2}(2a + (n-1)d)$ $156 = \frac{8}{2}(4 + 7d)$ $7d = 35 \quad d = 5.$	M_1 — correct substitution A_1 — C.A.O.	
	(ii) $416 = \frac{n}{2}(4 + (n-1)5)$ $832 = 4n + 5n^2 - 5n$ $5n^2 - n - 832 = 0$ $n = \frac{1 \pm \sqrt{1 + 16640}}{10} = \frac{1 \pm 129}{10} \quad n = 13$ $n = -12.8$ $n = 13$ only.	M_1 — formation of quadratic eqn. A_1 — C.A.O.	
	(b) (i) $a + 2d, a + 4d, a + 7d$ $\frac{a + 4d}{a + 2d} = \frac{a + 7d}{a + 4d}$ $a^2 + 8ad + 16d^2 = a^2 + 9ad + 14d^2$ $ad = 2d^2$ $a = 2d; a = 2 \times 3 = 6.$ $a + 2d$ $6 + 2(3) = 6 + 6 = 12.$	M_1 — M_1 — A_1 — value of a B_1 —	
	(ii) $\frac{a + 4d}{a + 2d} = \frac{6 + 4(3)}{12} = 1.5.$ $S_9 = \frac{a(r^n - 1)}{r - 1}$ $\frac{12(1.5^9 - 1)}{1.5 - 1} = 898.640625$ $= 898.6.$	M_1 — correct substitution A_1 — 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) $P(\text{At least 2 Females})$.
 $P(MFE) \text{ or } P(FMf) \text{ or } P(FFm) + P(FFF)$.
 $(0.55 \times 0.45 \times 0.45) + (0.45 \times 0.55 \times 0.45) +$
 $(0.45 \times 0.45 \times 0.55) + (0.45 \times 0.45 \times 0.45)$
 $= 0.425$

M₁

M₁

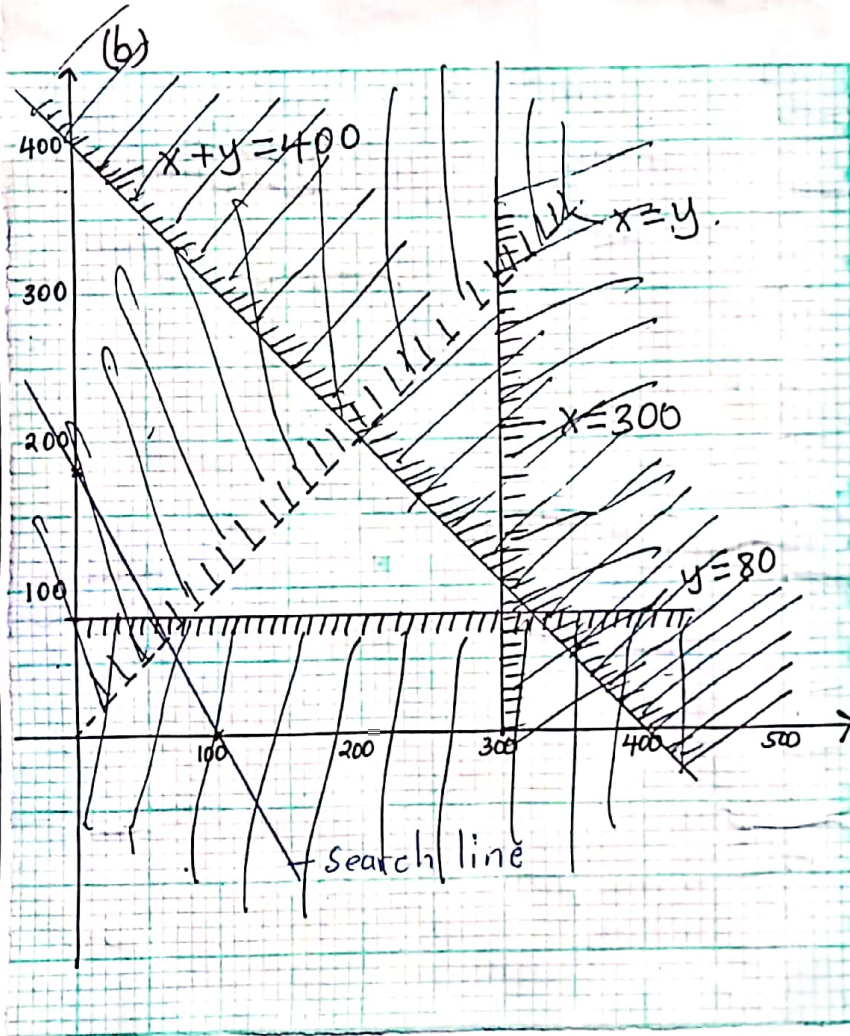
M₁

A₁ — C.A.O.

10

24. (a) $x + y \leq 400$.
 $x > y$.
 $x \leq 300$.
 $y \geq 80$.

B₁
 B₁
 B₁
 B₁



B₁
 B₁
 B₁
 B₁

c) $600x + 400y = P$

(i) $\frac{x}{100} + \frac{y}{120} = 1$

$x = 300$ $y = 100$

Type A = 300.

Type B = 100.

B₁

(ii) $600(300) + 400(100)$
 $= 220,000$.

B₁