THE KENYA NATIONAL EXAMINATINOS COUNCIL

Kenya Certificate of Secondary Education

MATHEMATICS Alt. A
Paper 2

MARKING SCHEME
(CONFIDENTIAL)

THIS MARKING SCHEME IS THE PROPERTY OF THE KENYA NATIONAL EXAMINATIONS COUNCIL AND MUST BE RETURNED TO THE KENYA NATIONAL EXAMINATIONS COUNCIL AT THE END OFMARKING.

This marking scheme consists of 17 printed pages.

Turnover

121/2 MATHEMATICS ALT. A

No.	Marking scheme	marks	comments
1.	$\frac{\sqrt{5}+3}{\sqrt{5}-2} = \frac{(\sqrt{5}+3)}{(\sqrt{5}-2)} \times \frac{(\sqrt{5}+2)}{(\sqrt{5}+2)}$ $= \frac{5+2\sqrt{5}+3\sqrt{5}+6}{5-4}$ ✓ $= 11 + 5\sqrt{5}$ ✓	M1 A1 2	Expanded numerator Denominator rationalised } Combined
2.	Let the ratio of X to Y = $x : y$ $\frac{60x + 72y}{x + y} = 70$ ✓ M_1 $60x + 72y = 70x + 70y$ $10x = 2y$ $\frac{x}{y} = \frac{1}{5}$ ✓ A_1 (Accept $\frac{2}{10}$) ∴ Ratio $x : y$ = 1:5 ✓ B_1	M1 A1 B1 3	Let the ratio of X to Y = $1 : n$ $\frac{60 + 72n}{1 + n} = 70$ M1 $60 + 72n = 70 + 70n$ $2n = 10$ $n = 5$ A1 ∴ Ratio $x : y$ = 1:5 B1
3.	$P \propto \frac{1}{L^2}$ $P = \frac{K}{L^2}$ $0.625 = \frac{K}{16}$ → M_1 $K = 10$ When L = 0.2 $P = \frac{10}{0.2^2} = 250$ ✓M_1 ✓A_1	M_1 A 3	Correct substitution $(0.625 = \frac{k}{4^2})$. for $P = \frac{10}{0.2^2}$ for 250.

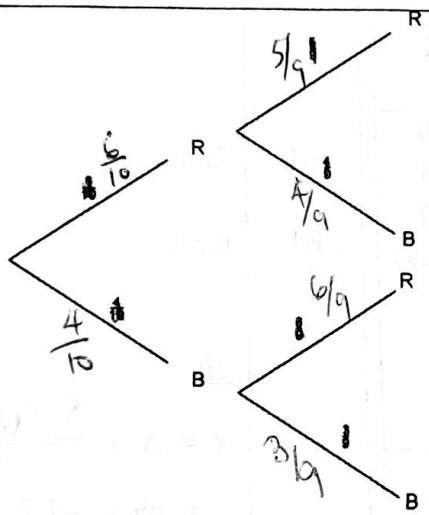
60 72 70 M_1 2 10 A_1 1:5 B_1 B1 correct

121/2 MS

(2) $x + y = 1$
$60x + 72y = 70$ } M_1 formation of eqn 2

$x = \frac{1}{6}$ — A_1
$y = \frac{5}{6}$
1:5 ⇒ B_1

$x : y = n : 1$

4.	Angle at centre $= 2\times150°$ $= 300°$	M1 A1 **2**	(May be implied at 300°)
5.	$x = 13 - 3y$ $(13-3y)^2 + 3y^2 = 43$ ⟶ $169 - 78y + 12y^2 = 43$ $12y^2 - 78y + 126 = 0$ $2y^2 - 13y + 21 = 0$ $(2y-7)(y-3) = 0$ ⟶ $y = 3$ or 3.5 ⟶ *When* $y = 3$, $x = 4$ *When* $y = 3.5$, $x = 2.5$ ⟶	M1 M1 A1 B1 **4**	eliminating one variable correct attempt to solve the quadratic Both (x, y) pairs √ (When candidate substitutes in formula). (Award when pairing implied in substitution).
6. (a)		B1	
(b)	$P(\text{RR or BB}) = \frac{6}{10}\times\frac{5}{9} + \frac{4}{10}\times\frac{3}{9}$ ⟶ $= \frac{1}{3} + \frac{2}{15}$ $= \frac{7}{15}$ ⟶	M1 A1 **3**	If misses one of branches, give M_1 but lose A_1. Accept unsimplified forms. (Decimals ; A_0)

7.

$\frac{dy}{dx} = 2x - 14$

At the turning point

$\frac{dy}{dx} = 2x - 14 = 0$ → M1 (Correct dif'n and equated to zero)

$\Rightarrow x = 7$ → A1

$y = 49 - 98 + 10 = -39$

Coordinate of turning point $= (7, -39)$ → B1B1

3

8.

Perimeter of sector $= \frac{60}{360} \times 2\pi r + 2r$ → M1

$= 2r + \frac{1}{3}\pi r$ → A1 (Award at earliest stage and must be in terms of π & r.)

$= \frac{6r + \pi r}{3} = r\left(\frac{\pi}{3} + 2\right)$

2

9.

Score x	No. of students	$d = x - 69$	fd
59	2	-10	-20
61	3	-8	-24
65	5	-4	-20
k	6	k -69 (3x)	6(k-69) (6x)
71	7	2	14
72	4	3	12
73	2	4	8
75	1	6	6
	$\Sigma f = 30$	✓	✓

6x-24 6x-24

B1 for d (All Correct)

B1 for fd (All Correct).

$\frac{\Sigma fd}{\Sigma f} = \frac{6k - 438}{30} = -1.2$ ✓ M1

$6k = 402$

$k = 67$ ✓ A1

4

Alt

$\bar{x} = A + \frac{\sum f(x - A)}{N}$ ✓

$= 69 + -1.2 = 67.8$ B1

Also, $\Sigma fx = 1632 + 6K$

$\bar{x} = \frac{1632 + 6k}{30}$ ✓ B1

Therefore,

$\frac{1632 + 6k}{30} = 67.8$ M1

$k = 67$ ✓ A1

Let $k - 69 = x$

$\frac{-24 + 6x}{30} = -1.2$

$x = -2$

$k - 69 = -2$ --- M_1

$k = 67$ --- A_1

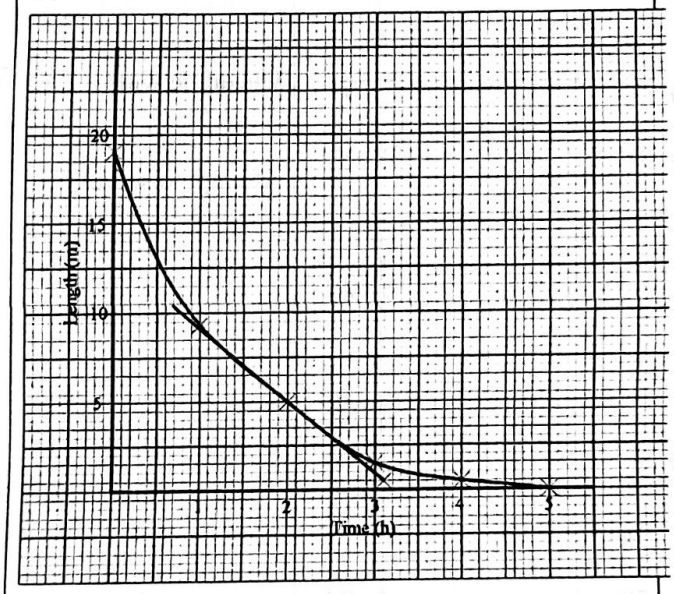
10.	Amplitude = 3 →	B1	
	Period = $\frac{360}{2} = 180°$ Or π^c →	B1	Condone if units are omitted
		2	
11.	(a)		
	$\sin\theta = \frac{25}{50}$ →	M1	
	$\theta = \sin^{-1}\left(\frac{1}{2}\right)$		
	$= 30°$ →	A1	
	(b)		
	$BE = \sqrt{(90^2 + 50^2 + 10^2)}$ →	M1	
	$= \sqrt{10700}$		
	$= 103.44$ →	A1	Condone no units
	Accept $103.48 \approx 103$	4	
12.	Tax before relief		
	$= \begin{cases} 10164 \times 0.1 + 9576 \times (0.15 + 0.2 + 0.25) \\ +2108 \times 0.3 \end{cases}$ →	M1	✓ comp. and addition of all taxes from all steps ✓
	$= 7394.4$		
	Net tax = Ksh $(7394.4 - 1162)$ →	M1	For subtraction of relief
	= Ksh 6232.4	A1	
		3	

$2 \times 600 = 1200$ ×5/100 = 60/= ×700,000 = 4,200,000

$a+b = b+a$

7394.40
6232.4

13.	$\mathbf{AB} = \begin{pmatrix}1\\2\end{pmatrix} - \begin{pmatrix}-3\\4\end{pmatrix} = \begin{pmatrix}4\\-2\end{pmatrix}$ $\mathbf{AC} = \begin{pmatrix}7\\-1\end{pmatrix} - \begin{pmatrix}-3\\4\end{pmatrix} = \begin{pmatrix}10\\-5\end{pmatrix}$	B1	for $\begin{pmatrix}4\\-2\end{pmatrix}$ and $\begin{pmatrix}10\\-5\end{pmatrix}$ or equivalents
2 gradients ⇒ B_1 equating 2 ⇒ B_1 Statement ⇒ B_1	$\begin{pmatrix}4\\-2\end{pmatrix} = k\begin{pmatrix}10\\-5\end{pmatrix}$ | k must work for both components. $k = 0.4$ *Thus* $\mathbf{AB} = 0.4\mathbf{AC}$ *and A is a common point.* *∴ Points A, B and C are collinear.* $AC = \frac{5}{3}BC$, $BC = \frac{3}{5}AC$, $AC = \frac{5}{2}AB$, $BC = \frac{3}{2}AB$, $AB = \frac{2}{3}BC$	M1 B_1 B_1 3	(Common point and parallelism must be stated)
14.	Let $M^{-1} = \begin{pmatrix}a & b\\c & d\end{pmatrix}$ $\begin{pmatrix}a & b\\c & d\end{pmatrix}\begin{pmatrix}-7 & 2 & 4\\2 & -1 & -1\end{pmatrix} = \begin{pmatrix}-3 & 0 & 2\\2 & -1 & -1\end{pmatrix}$ $-7a + 2b = -3$ | $-7c + 2d = 2$ $2a - b = 0$ *or* $b = 2a$ | $2c - d = -1$ *or* $d = 2c+1$ $-7a + 2\times 2a = -3$ | $-7c + 2(2c+1) = 2$ $-3a = -3$ | $-3c = 0$ $a = 1,\ b = 2$ | $c = 0,\ d = 1$ Therefore $M^{-1} = \begin{pmatrix}1 & 2\\0 & 1\end{pmatrix}$ $M = \begin{pmatrix}1 & -2\\0 & 1\end{pmatrix}$	M1 M1 M1 A1 4	Pre-multiplication Can use any 2 points. Or equivalent formation of 2 pairs of eqns. Correct attempt to solve one pair. Alternative $\begin{pmatrix}p & q & r\\s & t & u\end{pmatrix}\begin{pmatrix}-3 & 0 & 2\\2 & -1 & -1\end{pmatrix} = \begin{pmatrix}p' & q' & r'\\-7 & 2 & 4\\2 & -1 & -1\end{pmatrix}$ M_1 ⇒ Correct attempt to solve one pair. A_1 ⇒ for matrix M M_1 ⇒ for getting inverse A_1 ⇒ Accuracy.

15.	$2 = \log 100$ ✓ $\log(7x-3) + \log 5^2 = \log 100 + \log(x+3)$ $\log\{25(7x-3)\} = \log\{100(x+3)\}$ ⟶ $25(7x-3) = 100(x+3)$ ⟶ $7x - 3 = 4x + 12$ $3x = 15$ $x = 5$ ⟶	~~M1~~ B1 M1 M1 A1 3 04	For Log100 ⇒ 2 Log10 ⇒ $\text{Log}10^2$ (single logs on both sides). Dropping logs from expression.
16.	(a)  	P1 C1	(All points correct) (smooth curve).
	(b) At t=2, $\frac{\Delta L}{\Delta t} = \frac{6-2}{1.2-3} = \frac{4}{-1.8}$ $= -2.22\ m/s$	~~M1~~ B1 ~~A1~~ 4 B1	Correct acceptable tangent drawn touching the curve at (2,5) follow through

⇒ use candidate's graph.
⇒ units m/h.
⇒ Tangent (2,5) and (2·5, 3·5) 7

17.	(a)		
	$ar^3 = a + d$	B1	
	$ar^6 = a + 9d$	B1	
	(b)		
	From (a) above		
	$d = ar^3 - a$		
	$a + 9(ar^3 - a) = ar^6$	M1	Substitution for d
	$a + 9ar^3 - 9a = ar^6$		
	$ar^6 - 9ar^3 + 8a = 0$		
	$r^6 - 9r^3 + 8 = 0$	M1	Quadratic with r^6 without a (1 unknown)
	$(r^3 - 1)(r^3 - 8) = 0$	M1	Attempt to solve
	$r = 1$ or $r = 2$		
	$r = 2$	A1	
	(c)		
	$ar^9 = 5120$		
	$a = \frac{5120}{2^9} = 10$	B1	
	$a + d = 10 \times 2^3 = 80$		
	$\therefore d = 80 - 10 = 70$	B1	
	(d)		
	$S_{20} = \frac{20}{2}\{20 + 19 \times 70\}$	M1	Substitution of n, d and a in raw form.
	$= 13500$	A1	
		10	

Alternative (b)

$\frac{a+d}{a} = \frac{a+9d}{a+d}$ ✓ – M_1

$d^2 - 7ad = 0$

$d = 0$ or $d = 7a$

$a + 7a = ar^3$ ✓ – M_1

$8a = ar^3$

$8 = r^3$ – M_1

$r = 2$ – A_1

$a + 9d$

$a^2 + 9ad = a^2 + 2ad + d^2$

$7ad = d^2$

18.

(a) Value of a plot after 2 years

$= 400\,000 \times 1.1^2$ → M1 Can award in raw form

$=$ Ksh. 484 000 → A1

(b)

$558\,400 = 400\,000(1.1)^t$ → M1 (can score in raw form).

$1.1^t = \frac{558\,400}{400\,000}$

$1.1^t = 1.396$

$t \log 1.1 = \log 1.396$ → M1 t brought down.

$t = \frac{\log 1.396}{\log 1.1} = 3.500$ → M1 t The subject

$=$ 3 years 6 months → A1 Accept 42 month also

After 2 yrs

$558,400 = 484,000(1.1)^n$ ✓ M_1

$n \log 1.1 = \log 1.154$ ✓ M_1

$n = \frac{\log 1.154}{\log 1.1}$

$= 1.5$

$t = 1.5 + 2$ ✓ M_1

$= 3.5$

$\geq$ 3 yrs 6 month. ✓ A_1

(c)

Let the number of plots bought be x

$x \times 400\,000 \times (1.1)^4 = 2\,928\,200$ → M1

$x = \frac{2\,928\,200}{400\,000 \times (1.1)^4} = \frac{2\,928\,200}{585\,640}$

$= 5$ → A1

Profit $= 2\,928\,200 - 5 \times 400\,000$

$= 928\,200$

% profit $= \left(\frac{928\,200}{2\,000\,000}\right) \times 100$ → M1

$= 46.41\%$ → A1

10

After 2 yrs

$558\,400 = 484\,000(1.1)^n$

$n = \frac{\log 1.154}{\log 1.1}$

Or equivalent

(2) $400,000(1.1)^4$ ✓ M_1

$= 585,640.$

$P = 585,640 - 400,000$

$= 185,640$ ✓ A_1

$P\% = \frac{185,640}{400,000} \times 100$ ✓ M_1

$= 46.41\%$ ✓ A_1

(3) $2928200 = P(1.1)^4$ ✓ M_1

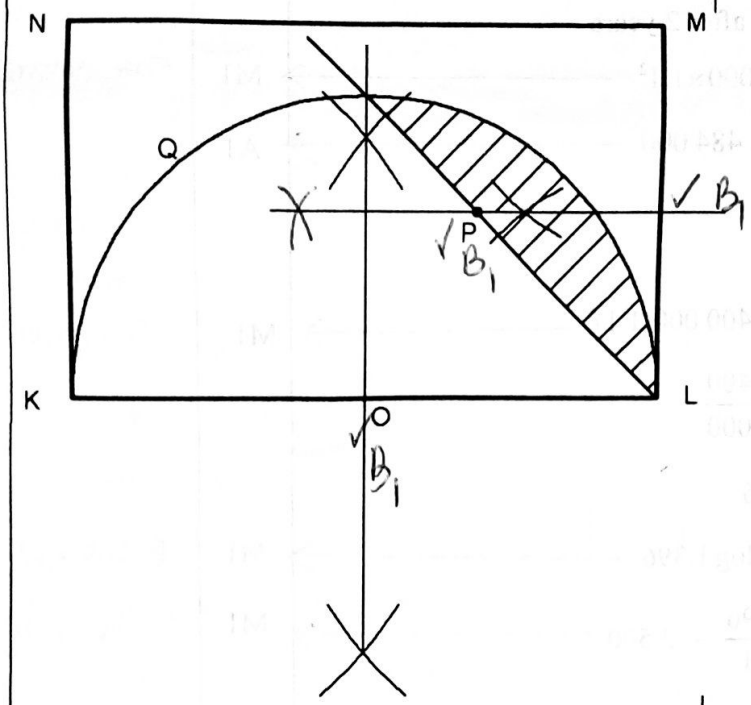
$P = 2,000,000$

Profit $= 928,200$ ✓ A_1

$\text{Profit} = \frac{928200}{2000000} \times 100$ ✓ M_1

$= 46.41\%$ ✓ A_1

19.



(a) (i) ⊥ bisector to line LM	B1	. bisector of $L\hat{M}N$
Bisector to ∠KLM	B1	
Position of P correctly ~~identified~~ labeled	B1	
(ii) ⊥ bisector to line KL	B1	
Correct identification of centre and used	B1	
Locus of Q correctly drawn	B1	
(b) (i) Correct region R shaded ~~and labelled~~	B1	
(ii) ~~r = 4 cm~~ r = 40m	B1	(can be implied in the formular.
Area of region R		
$= \frac{90}{360} \times 3.142 \times 4^2 - \frac{1}{2} \times 4 \times 4$	M1	
= ~~12.568 – 9~~ 1256·8 – 800	A1	
= ~~4.568cm²~~ 456·8m²		
~~If~~	10	

121/2 MS If the students works in cm, the marking will be B_{10}, M_1, A_0.
If he converts back to m^2, B_1, M_1, A_1

20.	(a)(i) Distance in nm = 24×90 = 2160 nm →	B1	
	(a)(ii) Distance Km = 2160 × 1.853 = 4002.48 km →	B1	CAD
	(b) Position of R 1° = 60 cos10 nm = 2160	B1	60 cos 10° seen.
	$\theta = \angle PO_1R$	M_1	for expression
	$\theta = \frac{2160}{60\cos 10}$ →	M1	θ subject formula.
	= 36.56° in km (36.55). (36.54)	A0	In km,
	Position of R = (10°S, (40 + 36.56)°E) →	M1	6370 cos 10 B_1
	= (10°S, 76.56°E) ≡ (10°S, 76.55°E)	A1	
	(c) Local time at R Longitude difference between P and R = 36.56		
	Time difference = $\frac{36.56 \times 4}{60}$ →	M1	Time diff in hrs.
	=2hrs 26mins	A0	
	Local time at R = 1100h + 2h 26min →	M_1	
	= 1326h or = 1.26 pm →	A1	(Units must be specified).
		10	If wrong value of θ is used, A_0.

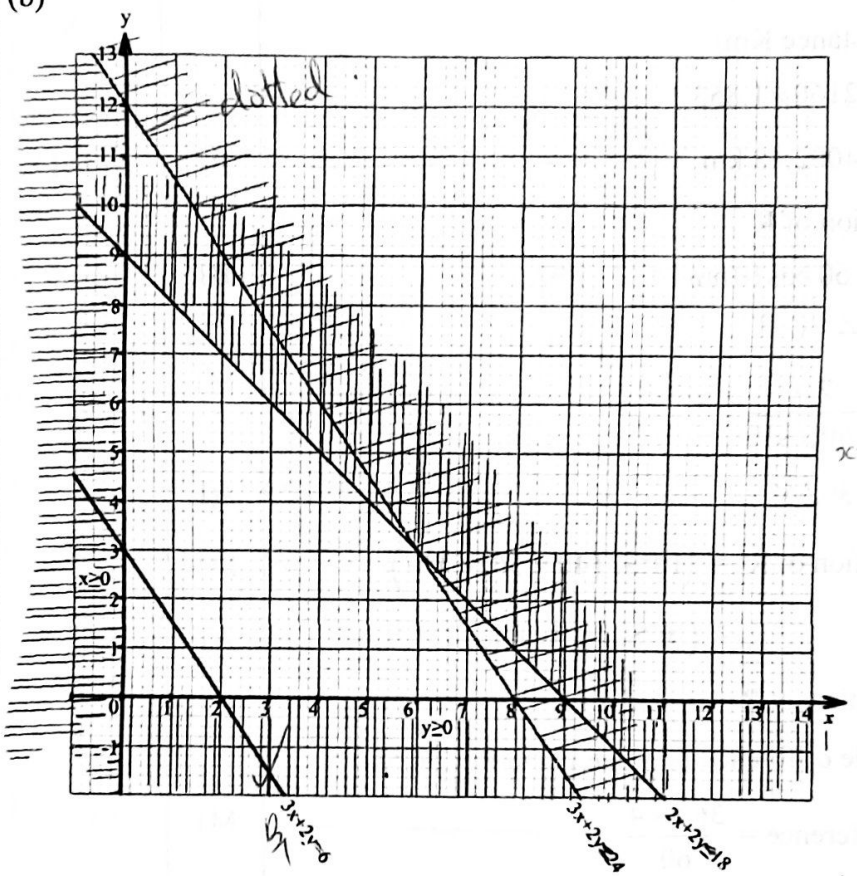
21. (a)

$x \geq 0, \quad y \geq 0$ ✓ B1

$2x + 2y \leq 18$ or $x + y \leq 9$ ✓ B1

$3x + 2y < 24$ ✓ B1

(b)



$x \geq 0, y \geq 0$

B1 Line & ✓ shading ($x+y \leq 9$)

B1 Line & ✓ shading

B1 Line & ✓ shading ($3x+2y < 24$)

(c) (c) Objective function

$6000x + 4000y = P$

$6000x + 4000y = 12000$ *or* $3x + 2y = 6$

$x = 5, y = 4$ ✓B1

Profit = sh $(6000 \times 5 + 4000 \times 4)$ ✓M1

= sh ~~37000~~ 46,000 ✓A1

B1 – Searchline drawn.

B1 – Isolated point.

M1 Or two feasible

A1 points inspected (atleast 2 points inspected)

10

121/2 MS

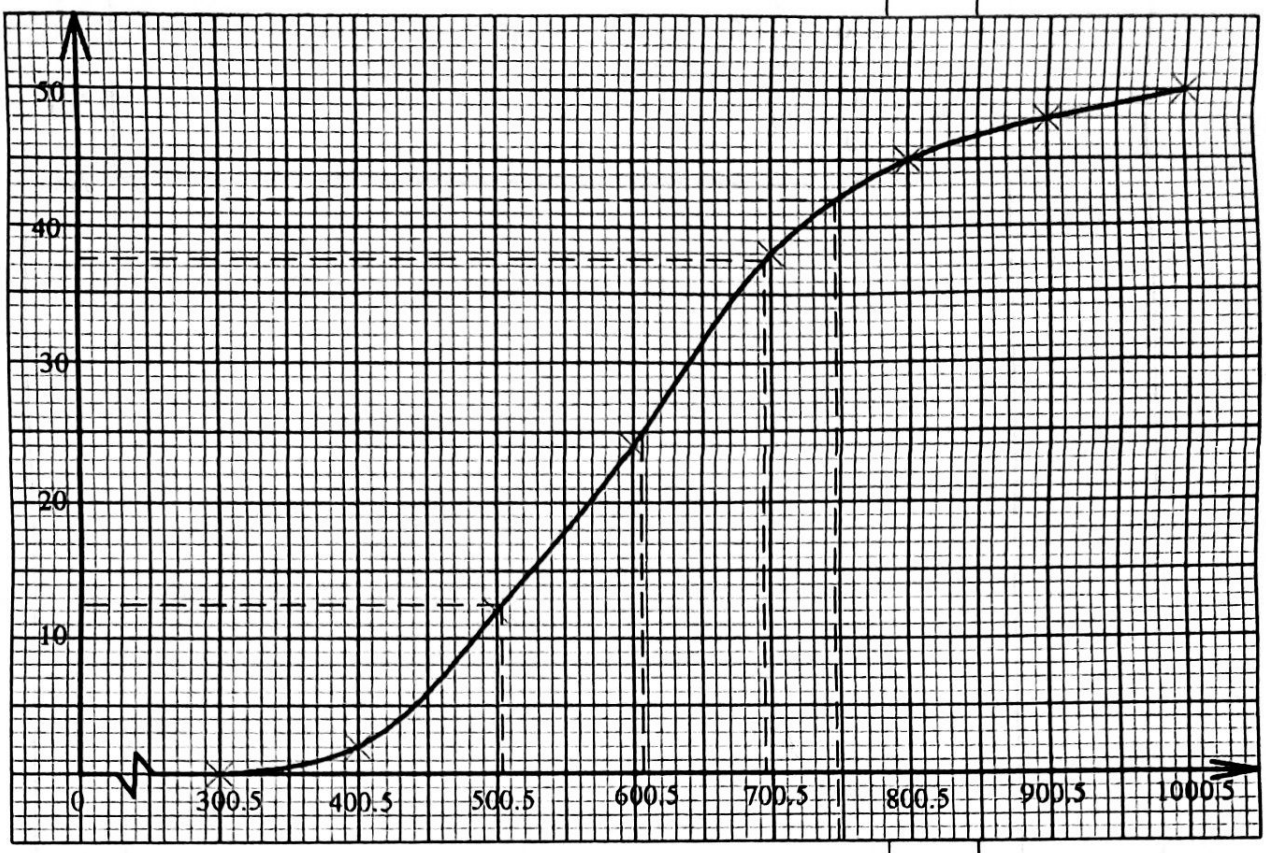
B1 for inspected points (atleast 2 points (5,4),(7,1))

B1 for isolating the points, $x=5, y=4$ or $x=7, y=1$. 12

$P = 6000 \times 7 + 4000 \times 1$ ✓M1

= ~~36000~~ 46,000 ✓A1

22.



(a) c.f. 2, 12, 24, 38, 45, 48, 50 → B1

S1 P1 C1 — linear & sufficient

(b) (i) Median = Contribution of 25th student

= 605.5 → B_1 — Use student's reading.

(b) (ii) Quartile deviation

Q_3 = Contribution of 37.5 student
= 695.5

Q_1 = Contribution of 12.5 student
= 505.5

→ B1

$\frac{Q_3 - Q_1}{2} = \frac{695.5 - 505.5}{2}$ → M1 — Allow if 1 of Qs ✓

= 95 → A1

(b) (iii) No of ~~people~~ students who contributed ~~more than~~ at least 750·50

= 9 $\frac{(50-42)+1}{50} \times 100$ → M1

$\% = \frac{9}{50} \times 100$

$= 18\%$ → A1

10

23. (a)

(i) $\mathbf{BA} = \mathbf{a} - \mathbf{b}$ OR $-\underset{\sim}{b} - \underset{\sim}{a}$. ✓1 → B1

(ii) $\mathbf{OY} = \frac{3}{4}\mathbf{b} + \frac{1}{4}\mathbf{a}$ ✓1 ✓1 → M1 A1

$\overrightarrow{OY} = \underset{\sim}{b} + \frac{1}{4}(-\underset{\sim}{b} + \underset{\sim}{a})$ - M1

$= \frac{3}{4}\underset{\sim}{b} + \frac{1}{4}\underset{\sim}{a}$.

(iii) $\mathbf{BX} = -\mathbf{b} + \frac{1}{2}\mathbf{a}$ → B1

(b)

$\mathbf{OC} = h\left(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}\right)$ (*i*)

$\mathbf{OC} = \mathbf{b} + k\left(\frac{1}{2}\mathbf{a} - \mathbf{b}\right)$ (*ii*)

→ B1 ✓OC expressed or twice. or equivalent

$h\left(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}\right) = \mathbf{b} + k\left(\frac{1}{2}\mathbf{a} - \mathbf{b}\right)$ M1 Equating 2 ✓ OC's eqns, expanded and b factored out.

$\frac{1}{4}h\mathbf{a} + \frac{3}{4}h\mathbf{b} = \frac{1}{2}k\mathbf{a} + (1-k)\mathbf{b}$ → M_1

← Ignore

$\frac{1}{4}h = \frac{1}{2}k \Rightarrow \{h = 2k\}$ (*iii*)

$\frac{3}{4}h = 1-k$ (*iv*)

→ M1 Extracting both expressions in h & k

$\frac{3}{4}(2k) = 1-k$ → M1 Attempt to solve simultaneous eqn.

$10k = 4$

$k = \frac{2}{5}$ → A1

$h = \frac{4}{5}$ → B1

10

OW − 1 (vector sign missing applied once).

24. (a)

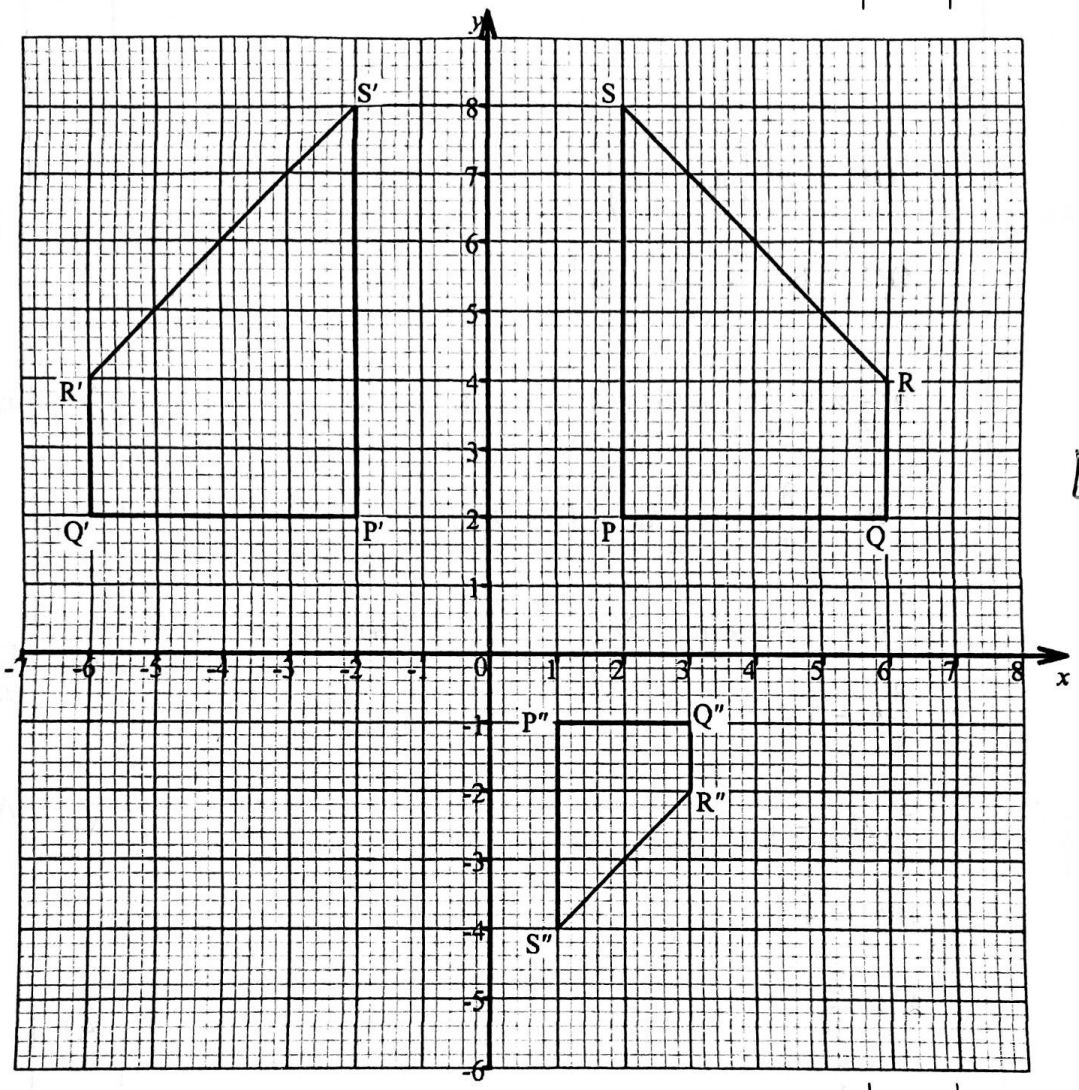
$$\begin{matrix} & P & Q & R & S \end{matrix} \qquad \begin{matrix} & P' & Q' & R' & S' \end{matrix}$$

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 2 & 6 & 6 & 2 \\ 2 & 2 & 4 & 8 \end{pmatrix} = \begin{pmatrix} -2 & -6 & -6 & -2 \\ 2 & 2 & 4 & 8 \end{pmatrix} \longrightarrow M_1$$

Correct attempt to pre multiply matrix with object. If no working, M1 can be implied.

Coordinates:

$P'(-2, 2), Q'(-6, 2), R'(-6, 4), S'(-2, 8)$ → A1



B1 (PQRS labeled)

B1 (P'Q'R'S' ")

B1 (P''Q''R''S'' & labeled)

(b) Trapezium PQRS correctly drawn and labeled — B1

Trapezium P′Q′R′S′ correctly drawn and labeled. — B1

(c) (i)

$$\begin{matrix} & & & & & P & Q & R & S & & P'' & Q'' & R'' & S'' \end{matrix}$$

$$\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}\begin{pmatrix} -2 & -6 & -6 & -2 \\ 2 & 2 & 4 & 8 \end{pmatrix} = \begin{pmatrix} 1 & 3 & 3 & 1 \\ -1 & -1 & -2 & -4 \end{pmatrix}$$

B1

B1

(c) (ii) Trapezium P″Q″R″S″ correctly drawn

(d) (i) The matrix is N^{-1}

$$\text{Det} = -\frac{1}{2}\times -\frac{1}{2} - 0\times 0$$

$$= \frac{1}{4}$$

$$N^{-1} = 4\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$$

$$= \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$$

forming eqns and attempt to solve one pair ✓

finding inverse of N

M1

✓ Process of getting N^{-1}

A1

(even if matrix is stated)

B1

(d)(ii) Enlargement centre O(0, 0)

B1

S.F = -2

10