THE KENYA NATIONAL EXAMINATINOS COUNCIL

Kenya Certificate of Secondary Education

MATHEMATICS Alt. A
Paper 2

MARKING SCHEME
(CONFIDENTIAL)

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This marking scheme consists of 17 printed pages.

Turnover

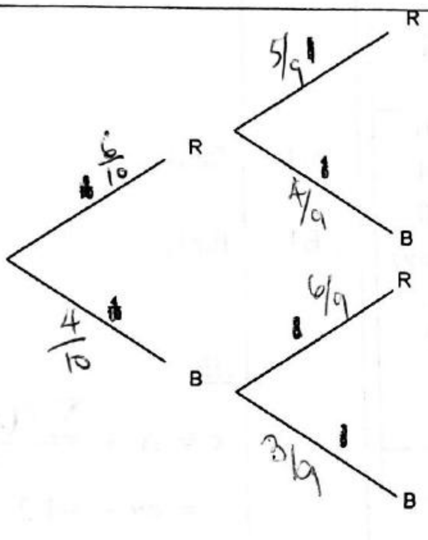
121/2 MATHEMATICS ALT. A

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

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

$x=\frac{1}{6}$ - - - A_1
$y=\frac{5}{6}$
$1:5\Rightarrow B_1$

$x:y=n:1$

4.	Angle at centre = $2\times150°$	M1	(May be implied at 300°)
	$= 300°$	A1	
		2	
5.	$x = 13 - 3y$		
	$(13-3y)^2 + 3y^2 = 43 \longrightarrow$	M1	eliminating one variable
	$169 - 78y + 12y^2 = 43$		
	$12y^2 - 78y + 126 = 0$		
	$2y^2 - 13y + 21 = 0$		
	$(2y-7)(y-3) = 0 \longrightarrow$	M1	correct attempt to solve the quadratic (When candidate substitutes in formula).
	$y = 3$ or $3.5 \longrightarrow$	A1	
	$\left.\begin{array}{l} \textit{When } y = 3,\ x = 4 \\ \textit{When } y = 3.5,\ x = 2.5 \end{array}\right\} \longrightarrow$	B1	Both (x, y) pairs √ (Award when pairing implied in substitution).
		4	
6. (a)		B1	
(b)	$\text{P}(\text{RR or BB}) = \frac{6}{10}\times\frac{5}{9} + \frac{4}{10}\times\frac{3}{9} \longrightarrow$	M1	If misses one of branches, give M1 but lose A1.
	$= \frac{1}{3} + \frac{2}{15}$		
	$= \frac{7}{15} \longrightarrow$	A1	Accept unsimplified forms. (Decimals ; A0)
		3	

3
8
11
1
+2
8
50
10

7.

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

At the turning point

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

$\Rightarrow x = 7 \longrightarrow$ A1

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

Coordinate of turning point $= (7, -39) \longrightarrow$ B1

3

8.

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

$= 2r + \frac{1}{3}\pi r \longrightarrow$ A1 (Award at earliest stage) and must be in terms of π $\frac{1}{3}$ 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 (x)	6(k-69) ($6x$)
71	7	2	14
72	4	3	12
73	2	4	8
75	1	6 ✓	6
	$\Sigma f = 30$	✓	✓
		$6x - x$	$6x - 24$

B1 for d (All correct)

B1 for fd (All correct).

$= A \mp \frac{\Sigma fd}{\Sigma f}$

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

$6k = 402$

$k = 67$ ✓ A1

Alt

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

$= 69 + -1.2 = 67.8$ B1

$\Sigma fx = 1632 + 6K$

Also,

$\bar{x} = \frac{1632 + 6k}{30}$ ✓ B1

Therefore,

$\frac{1632 + 6k}{30} = 67.8$ ✓ M1

$k = 67$ ✓ A1

4

Let $K - 69 = x$

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

$x = -2$

$K - 69 = -2$ --- M1

$K = 67$ --- A1

10.	Amplitude = 3 → Period $= \frac{360}{2} = 180°$ Or π^c →	B1 B1 **2**	Condone if units are omitted
11.	(a) $\sin\theta = \cancel{\frac{25}{50}}$ $\frac{25}{50}$ → $\theta = \sin^{-1}\left(\frac{1}{2}\right)$ $= 30°$ → (b) $BE = \sqrt{(90^2 + 50^2 + 10^2)}$ → $= \sqrt{10\,700}$ $= 103.44$ → Accept 103.48 ≃ 103.5	M1 A1 M1 A1 **4**	Condone no units
12.	Tax before relief $= \begin{cases} 10164 \times 0.1 + 9576 \times (0.15 + 0.2 + 0.25) \\ +2108 \times 0.3 \end{cases}$ → $= 7394.4$ Net tax = Ksh (7394.4 − 1162) → = Ksh 6232.4	M1 M1 A1 **3**	~~For steps~~ ✓ comp. and addition of all ✓ taxes from all slabs For subtraction of relief

$2 \times 600 = 12\cancel{0}\cancel{0}/= \times 5/1\cancel{0}\cancel{0} = 60/= \times 700{,}000 = 4{,}200{,}000$

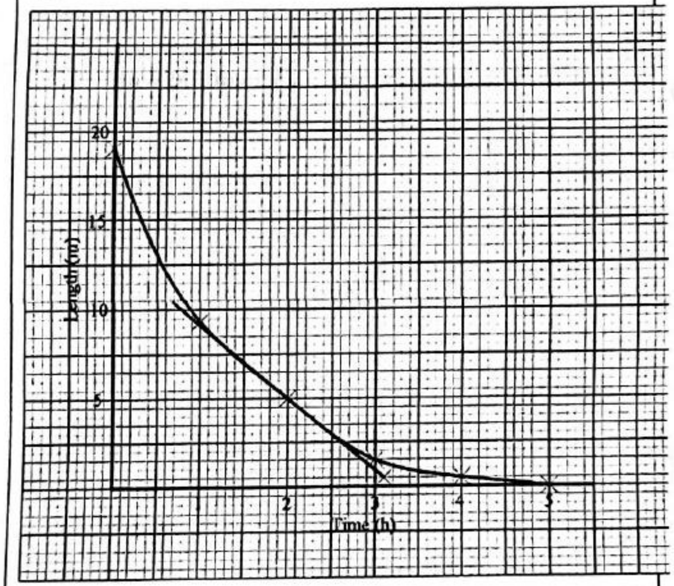
$a+b = \underset{\sim}{b} + a$

7394.40
6232.4

2 gradients ⇒ B_1
equating 2 ⇒ B_1
Statement ⇒ B_1

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
	$\begin{pmatrix}4\\-2\end{pmatrix} = k\begin{pmatrix}10\\-5\end{pmatrix}$ k must work for both Components.	~~M1~~	
	$k = 0.4$	B_1	
	Thus $\mathbf{AB} = 0.4\mathbf{AC}$ *and A is a common point.* ∴ *Points A, B and C are collinear.* $AC = 5/3BC$, $BC = 3/5AC$, $AC = 5/2AB$, $BC = 3/2AB$, $AB = 2/3BC$	~~A1~~ B_1	(Common point and parallelism must be stated)
		3	
14.	Let $M^{-1} = \begin{pmatrix}a & b\\c & d\end{pmatrix}$		Premultiplication Can use any 2 points.
	$\begin{pmatrix}a & b\\c & d\end{pmatrix}\begin{pmatrix}-7 & 2 & 4\\2 & -1 & -1\end{pmatrix} = \begin{pmatrix}-3 & 0 & 2\\2 & -1 & -1\end{pmatrix}$	M1	Or equivalent (
	$-7a + 2b = -3$ $\quad$ $-7c + 2d = 2$ $2a - b = 0$ or $b = 2a$ $\quad$ $2c - d = -1$ or $d = 2c + 1$	M1	formation of 2 pairs of eqns.
	$-7a + 2 \times 2a = -3$ $\quad$ $-7c + 2(2c + 1) = 2$ $-3a = -3$ $\quad$ $-3c = 0$ $a = 1,\ b = 2$ $\quad$ $c = 0,\ d = 1$	M1	Correct attempt to solve one pair.
	Therefore $M^{-1} = \begin{pmatrix}1 & 2\\0 & 1\end{pmatrix}$	A1	Alternatives $\begin{pmatrix}e & f\\g & h\end{pmatrix}\begin{array}{c}\begin{array}{ccc}P & Q & R\end{array}\\ \begin{pmatrix}-3 & 0 & 2\\2 & -1 & -1\end{pmatrix}\end{array} = \begin{array}{c}\begin{array}{ccc}P' & Q' & R'\end{array}\\ \begin{pmatrix}-7 & 2 & 4\\2 & -1 & -1\end{pmatrix}\end{array}$
	$M = \begin{pmatrix}1 & -2\\0 & 1\end{pmatrix}$ —	4	M_1 ⇒ Correct attempt to solve one pair. A_1 ⇒ for matrix M M_1 ⇒ for getting invers

A_1 ⇒ Accuracy.

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

⇒ Use candidate's graph.

⇒ units m/h.

⇒ Tangent (2,5) and (2.5,3.5)

a+9a

17.	(a)		
	$ar^3 = a + d$	B1	
	$ar^6 = a + 9d$	B1	
	(b)		
	From (a) above		
	$d = ar^3 - a$		
	$a+9(ar^3-a) = ar^6 \longrightarrow$	M1	Substitution for d
	$a+9ar^3-9a = ar^6$		
	$ar^6-9ar^3+8a = 0$		
	$r^6-9r^3+8 = 0 \longrightarrow$	M1	Quadratic with r^6 without a (1 unknown)
	$(r^3-1)(r^3-8) = 0 \longrightarrow$	M1	Attempt to solve
	r = 1 or r = 2		
	$r = 2 \longrightarrow$	A1	
	(c)		
	$ar^9 = 5120$		
	$a = \frac{5120}{2^9} = 10 \longrightarrow$	B1	
	$a+d = 10\times2^3 = 80$		
	$\therefore d = 80-10 = 70 \longrightarrow$	B1	
	(d)		
	$S_{20} = \frac{20}{2}\{20+19\times70\} \longrightarrow$	M1	Substitution of n, d and a in raw form.
	$=13500 \longrightarrow$	A1	$S_n = \frac{20}{2}\{2\times10-(20-1)70\}$
		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

$\cancel{a^2}+9ad=\cancel{a^2}+2ad+d^2$

$7ad=d^2$

18.	(a) Value of a plot after 2 years		
	$= 400\,000 \times 1.1^2 \longrightarrow$	M1	Can award in raw form
	$=$ Ksh. 484 000 $\longrightarrow$	A1	
	(b)		
After 2 yrs $558,400 = 484,000(1.1)^n$ ✓ M1 $n \log 1.1 = \log 1.154$ ✓ M1 $n = \frac{\log 1.154}{\log 1.1}$ $= 1.5$ $t = 1.5 + 2$ ✓ M1 $= 3.5$ ⇒ 3 yrs 6 month. ✓ A1	$558\,400 = 400\,000(1.1)^t \longrightarrow$	M1	(can score in raw form).
	$1.1^t = \frac{558\,400}{400\,000}$		
	$1.1^t = 1.396$		
	$t \log 1.1 = \log 1.396 \longrightarrow$	M1	t brought down.
	$t = \frac{\log 1.396}{\log 1.1} = 3.500 \longrightarrow$	M1	t The subject
	$= 3$ years 6 months $\longrightarrow$	A1	Accept 42 month also
	(c)		
	1) Let the number of plots bought be x		After 2 yrs
	$x \times 400\,000 \times (1.1)^4 = 2\,928\,200 \longrightarrow$	M1	$558400 = 484\,000\,(1.1)^n$
	$x = \frac{2\,928\,200}{400\,000 \times (1.1)^4} = \frac{2\,928\,200}{585\,640}$		Or equivalent $n = \frac{\log 1.154}{\log 1.1}$
	$= 5 \longrightarrow$	A1	(2) $400,000\,(1.1)^4$ ✓ M1 $= 585,640.$
	Profit $= 2\,928\,200 - 5 \times 400\,000$		$P = 585,640 - 400,000$
	$= 928\,200$		$= 185,640$ ✓ A1
	% profit $= \left(\frac{928\,200}{2\,000\,000}\right) \times 100 \longrightarrow$	M1	$P\% = \frac{185,640}{400,000} \times 100$ ✓ M1
	$= 46.41\% \longrightarrow$	A1	$= 46.41\%.$ ✓ A1
		10	

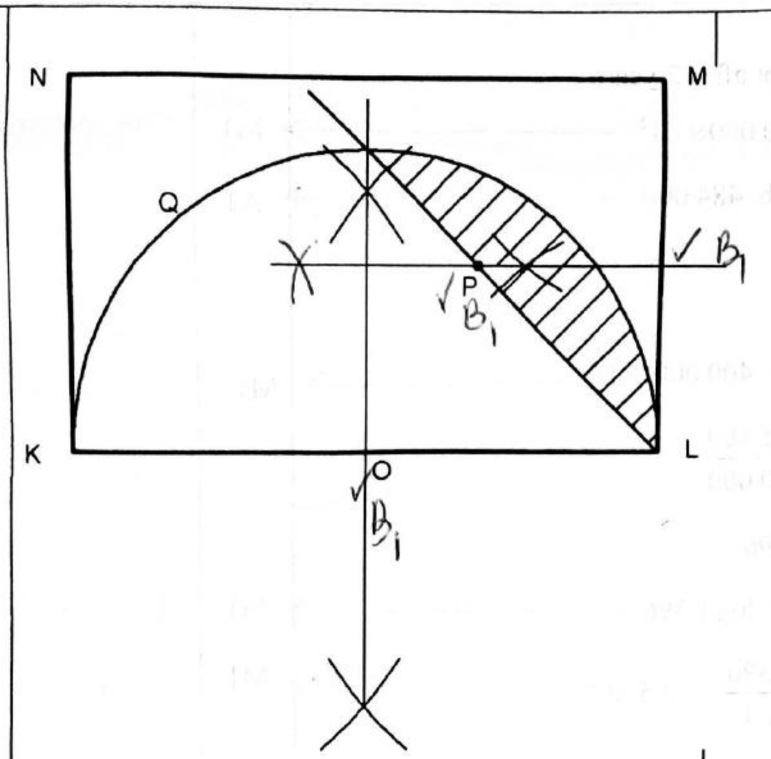
(3) $2928200 = P(1.1)^4$ ✓ M1

$P = 2,000,000$

Profit $= 2,928,200$ ✓ A1

Profit $= \frac{2928200}{2000000} \times 100$ ✓ M1

$= 46.41\%$ ✓ A1

19.			
	(a) (i) ⊥ bisector to line LM Bisector to ∠KLM Position of P correctly ~~identified~~ labeled	B1 B1 B1	. bisector of $L\hat{M}N$
	(ii) ⊥ bisector to line KL → Correct identification of centre and used → Locus of Q correctly drawn →	B1 B1 B1	
	(b) (i) Correct region R shaded ~~and labelled~~ →	B1	
	(ii) ~~r=4 cm~~ r = 40m → Area of region R $= \frac{90}{360} \times 3.142 \times 4^2 - \frac{1}{2} \times 4 \times 4$ → = ~~12.568 – 9~~ 1256·8 – 800 = ~~4.568cm²~~ 456·8m² → ~~If~~	B1 M1 A1	Can be implied in the formular. ~~On search line~~
		10	

If the students works in cm, the marking will be B_0, M_1, A_0.
If he converts back to m^2, B_1, M_1 A_1

20.	(a)(i) Distance in nm $= 24 \times 90$ $= 2160$ nm	B1	
	(a)(ii) Distance Km $= 2160 \times 1.853$ $= 4002.48$ km	B1	CAD
	(b) Position of R $1^\circ = 60\cos 10\,\text{nm}$ = 2160	B1	$60\cos 10^\circ$ seen.
	$\theta = \angle PO_1R$	M_1	for expression
	$\theta = \dfrac{2160}{60\cos 10}$	M1	θ subject formula.
	$= 36.56^\circ$ in km (36.55). (36.54)	~~A1~~	In Km, 6370 cos 10 B_1
	Position of R $= \left(10^\circ\text{S}, (40 + 36.56)^\circ\text{E}\right)$	M1	
	$= \left(10^\circ\text{S}, 76.56^\circ\text{E}\right)$ ⇒ (10°S, 76.55°E)	A1	
	(c) Local time at R Longitude difference between P and R = 36.56		
	Time difference = $\dfrac{36.56 \times 4}{60}$	M1	Time diff in hrs.
	=2hrs 26mins	~~A1~~	
	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.

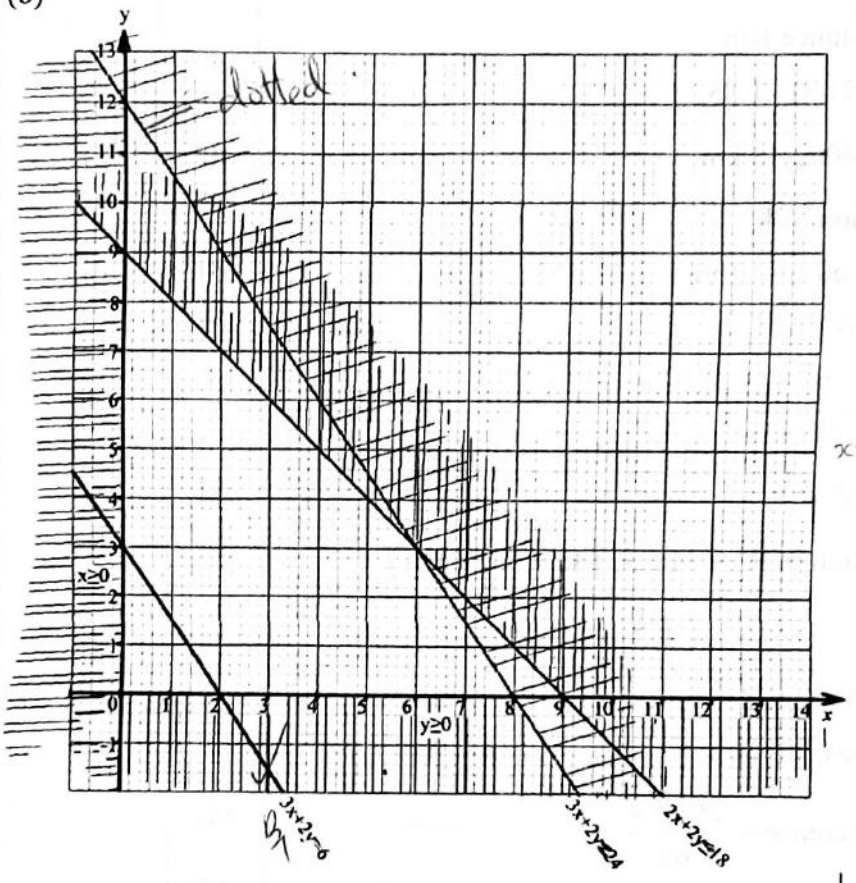
21. (a)

$x \geq 0, \quad y \geq 0$ ✓ — 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 ~~31600~~ 46,000 ✓ A1

B1 – Searchline drawn.

B1 – isolated point.

M1 Or two feasible

A1 points inspected (atleast 2 points inspected)

10

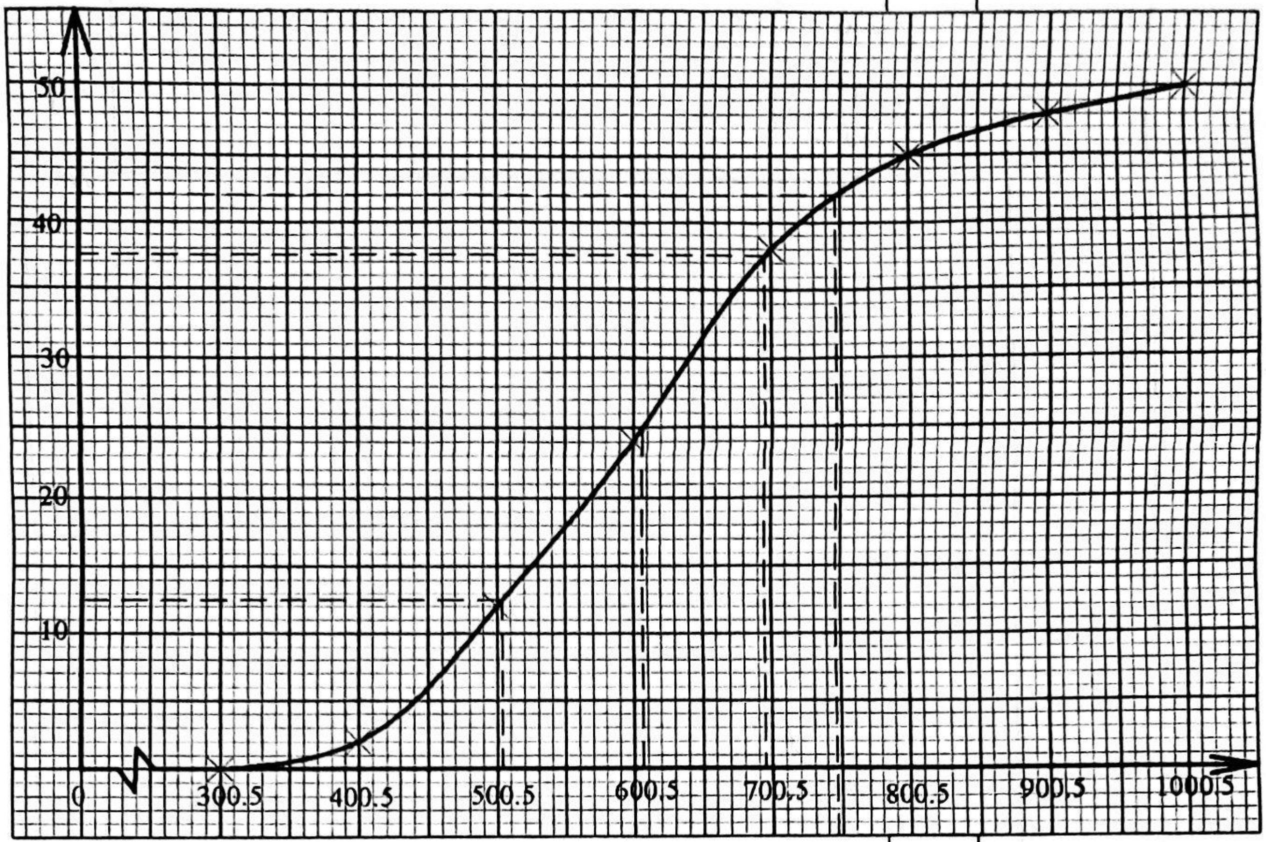
B1 for inspected points (atleast 2 points (5,4), (7,1))

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

P = 6000×7 + 4000×1 ✓ M1

= ~~316000~~ ✓ A1

46,000

22.			
	(a) c.f. 2, 12, 24,38,45,48,50 ⟶	B1	
		S1 P1 C1	linear is sufficient
	(b) (i) Median = Contribution of 25th student = ~~[illegible]~~ 605.5 ⟶	~~[illegible]~~ B_1	Use student's reading.
	(b) (ii)Quartile deviation		
	Q_3 = Contribution of 37.5 student = ~~700.5~~ 695.5 Q_1 = Contribution of 12.5 student = ~~500.5~~ 505.5 ⟶	B1	
	$\frac{Q_3 - Q_1}{2} = \frac{\cancel{700.5 - 500.5}}{2}$ $\frac{695.5 - 505.5}{2}$ ⟶ = ~~100~~	M1	Allow if 1 of Qs ✓
	= 95 ⟶	A1	

	(b) (iii) No of ~~people~~ students who contributed ~~more than~~ at least 750·50		
	$= 9 \quad \frac{(50-42)+1}{50} \times 100$	M1	
	$\% = \frac{9}{50} \times 100$	[illegible]	
	$= 18\%$	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	$OY = \underset{\sim}{b} + \frac{1}{4}(-\underset{\sim}{b} + \underset{\sim}{a})$ - M$_1$ $= \frac{3}{4}\underset{\sim}{b} + \frac{1}{4}\underset{\sim}{a}$.
	(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 equivalent twice.
	$h\left(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}\right) = \mathbf{b} + k\left(\frac{1}{2}\mathbf{a} - \mathbf{b}\right)$	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$_1$	
	$\frac{1}{4}h = \frac{1}{2}k \Rightarrow \{h = 2k\}$ ← Ignore (*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).

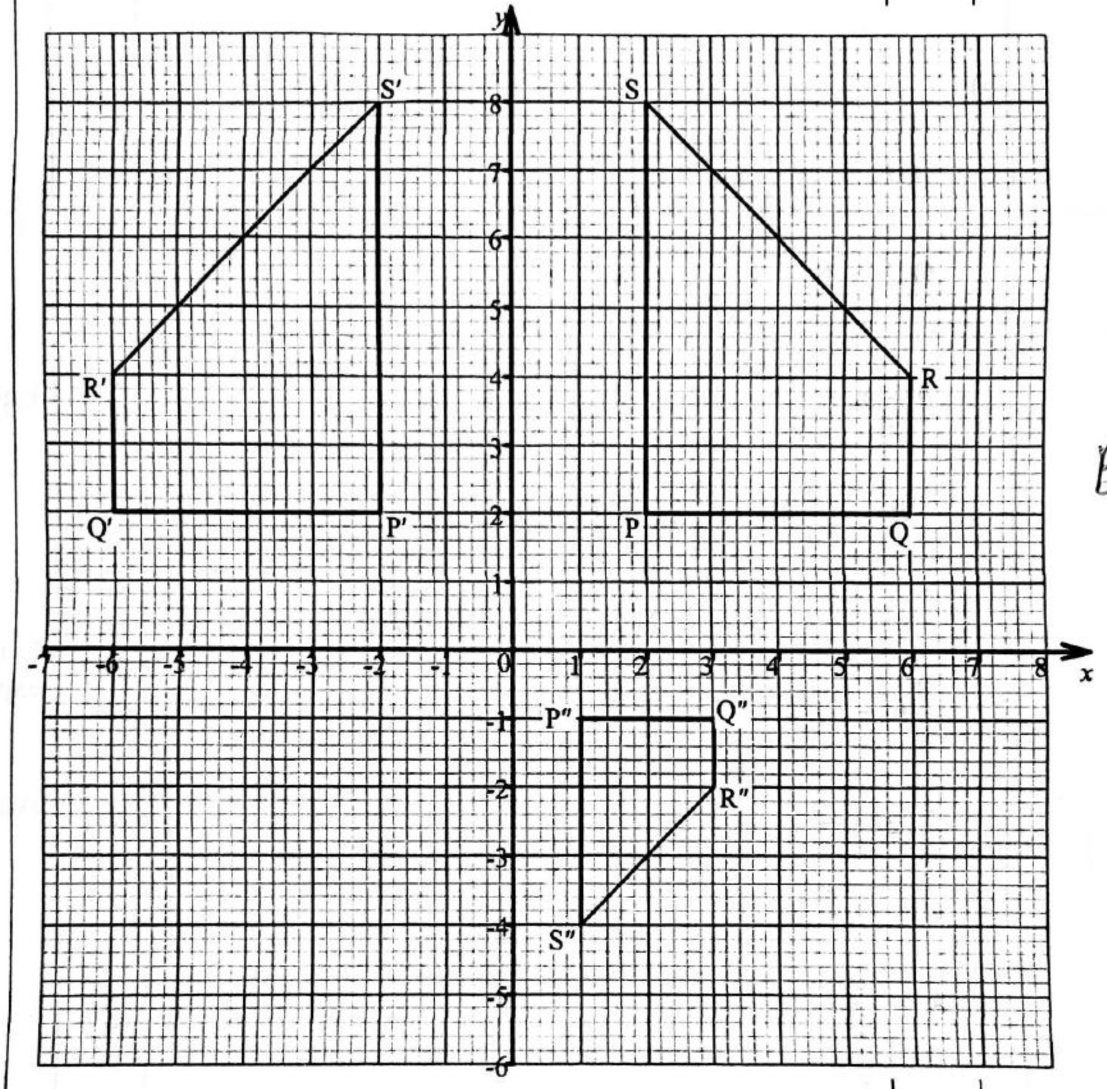
24. (a)

$$\begin{pmatrix}-1 & 0\\ 0 & 1\end{pmatrix}\begin{array}{c}\begin{array}{cccc}P & Q & R & S\end{array}\\ \begin{pmatrix}2 & 6 & 6 & 2\\ 2 & 2 & 4 & 8\end{pmatrix}\end{array} = \begin{array}{c}\begin{array}{cccc}P' & Q' & R' & S'\end{array}\\ \begin{pmatrix}-2 & -6 & -6 & -2\\ 2 & 2 & 4 & 8\end{pmatrix}\end{array} \longrightarrow$$

~~M1~~ M1 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) $\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix} \begin{array}{c} \begin{matrix} \text{P} & \text{Q} & \text{R} & \text{S} \end{matrix} \\ \begin{pmatrix} -2 & -6 & -6 & -2 \\ 2 & 2 & 4 & 8 \end{pmatrix} \end{array} = \begin{array}{c} \begin{matrix} \text{P}'' & \text{Q}'' & \text{R}'' & \text{S}'' \end{matrix} \\ \begin{pmatrix} 1 & 3 & 3 & 1 \\ -1 & -1 & -2 & -4 \end{pmatrix} \end{array}$	B1	
(c) (ii) Trapezium P″Q″R″S″ correctly drawn	B1	
(d) (i) The matrix is N^{-1} Det $= -\frac{1}{2} \times -\frac{1}{2} - 0 \times 0$ $= \frac{1}{4}$ forming eqns and ✓ attempt to solve one pair		← $\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$
~~finding inverse~~ $N^{-1} = 4 \begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix} \longrightarrow$	M1	✓ Process of getting N^{-1}
$= \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix} \longrightarrow$	A1	(even if matrix is stated)
(d)(ii) Enlargement centre O(0, 0)	B1	
S.F = -2	B1	
	10	