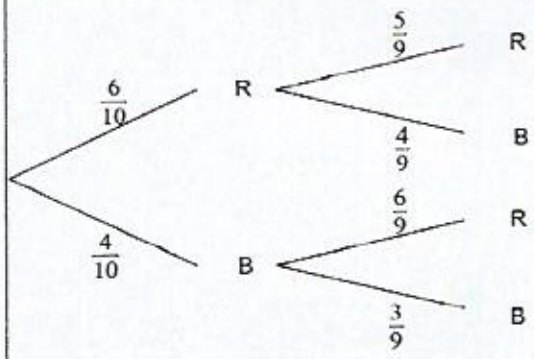
5.1.2 Mathematics Alternative A Paper 2 (121/2)

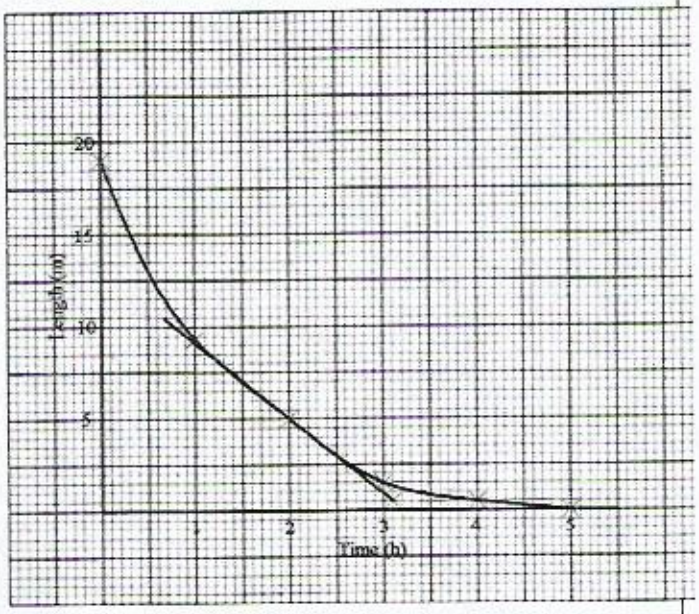
No.	Marking scheme	marks	comments
1.	$\frac{\sqrt{5}+3}{\sqrt{5}-2} = \frac{(\sqrt{5}+3)}{(\sqrt{5}-2)} \times \frac{(\sqrt{5}+2)}{(\sqrt{5}+2)}$ $= \frac{5+2\sqrt{5}+3\sqrt{5}+6}{5-4}$ $= 11 + 5\sqrt{5}$	M1 A1 **2**	
2.	Let the ratio of X to Y $= x : y$ $\frac{60x + 72y}{x + y} = 70$ $60x + 72y = 70x + 70y$ $10x = 2y$ $\frac{x}{y} = \frac{2}{10}$ or $\frac{1}{5}$ $\therefore$ Ratio $x : y = 1:5$	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 $\therefore$ Ratio $x : y = 1:5$ B1
3.	$P \alpha \frac{1}{L^2}$ $P = \frac{K}{L^2}$ $0.625 = \frac{K}{16}$ $K = 10$ When L = 0.2 $P = \frac{10}{0.2^2}$ $= 250$	M1 M1 A1 **3**	

No.	Marking scheme	marks	comments
4.	Angle at centre $= 2\times150°$ $= 300°$	M1 A1 **2**	May be implied
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 √
6.	(a)  (b) $P(\text{RR or BB}) = \frac{6}{10}\times\frac{5}{9} + \frac{4}{10}\times\frac{3}{9}$ $= \frac{1}{3} + \frac{2}{15}$ $= \frac{7}{15}$	B1 M1 A1 **3**	 (or equivalent)

<table>
<tr><th>No.</th><th>Marking scheme</th><th>marks</th><th>comments</th></tr>
<tr><td>7.</td><td>$\frac{dy}{dx} = 2x - 14$
At the turning point
$\frac{dy}{dx} = 2x - 14 = 0$
$\Rightarrow x = 7$
$y = 49 - 98 + 10 = -39$
Coordinate of turning point $= (7, -39)$</td><td>M1
A1
B1
3</td><td></td></tr>
<tr><td>8.</td><td>Perimeter of sector $= \frac{60}{360} \times 2\pi r + 2r$
$= 2r + \frac{1}{3}\pi r$</td><td>M1
A1
2</td><td></td></tr>
<tr><td>9.</td><td>
<table>
<tr><th>Score x</th><th>No. of students</th><th>$d = x - 69$</th><th>fd</th></tr>
<tr><td>59</td><td>2</td><td>-10</td><td>-20</td></tr>
<tr><td>61</td><td>3</td><td>-8</td><td>-24</td></tr>
<tr><td>65</td><td>5</td><td>-4</td><td>-20</td></tr>
<tr><td>k</td><td>6</td><td>k -69</td><td>6(k-69)</td></tr>
<tr><td>71</td><td>7</td><td>2</td><td>14</td></tr>
<tr><td>72</td><td>4</td><td>3</td><td>12</td></tr>
<tr><td>73</td><td>2</td><td>4</td><td>8</td></tr>
<tr><td>75</td><td>1</td><td>6</td><td>6</td></tr>
<tr><td></td><td>$\Sigma f = 30$</td><td></td><td></td></tr>
</table>
$\frac{\Sigma fd}{\Sigma f} = \frac{6k - 438}{30} = -1.2$
$6k = 402$
$k = 67$</td><td>B1
B1
M1
A1
4</td><td>for d
for fd
<u>Alt</u>
$\bar{x} = A + \frac{\sum f(x - A)}{N}$
$= 69 + -1.2 = 67.8$ B1
Also,
$\bar{x} = \frac{1632 + 6k}{30}$ B1
Therefore,
$\frac{1632 + 6k}{30} = 67.8$ M1
$k = 67$ A1</td></tr>
</table>

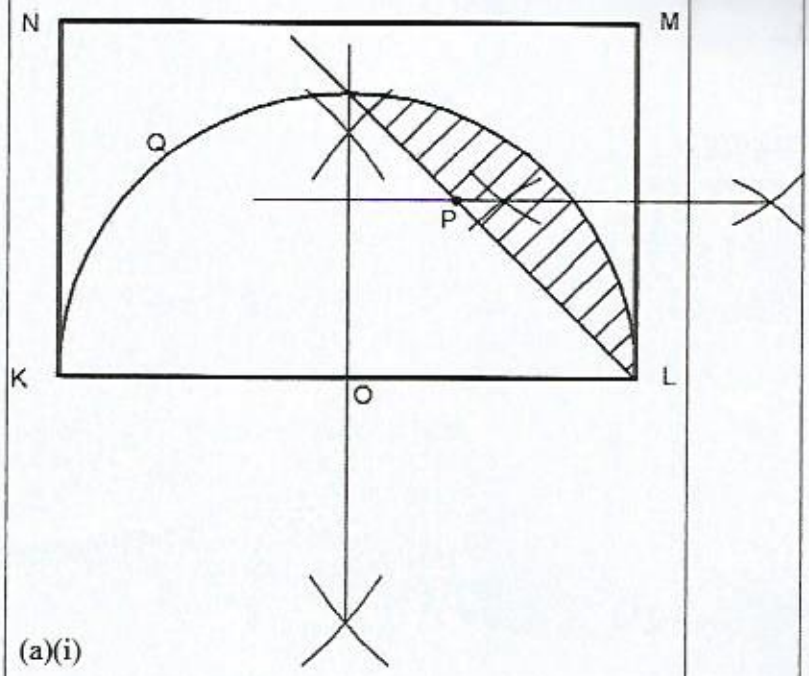
No.	Marking scheme	marks	comments
10.	Amplitude = 3	B1	
	Period $= \frac{360}{2} = 180°$	B1	
		2	
11.	(a)		
	$\text{Sin}\,\theta = \frac{25}{50}$	M1	
	$\theta = \text{Sin}^{-1}\left(\frac{1}{2}\right)$		
	$= 30°$	A1	
	(b)		
	$BE = \sqrt{(90^2 + 50^2 + 10^2)}$	M1	
	$= \sqrt{10700}$		
	$= 103.44$	A1	
		4	
12.	Tax before rclief		
	$= \begin{Bmatrix} 10164 \times 0.1 + 9576 \times (0.15 + 0.2 + 0.25) \\ +2108 \times 0.3 \end{Bmatrix}$	M1	For steps
	$= 7394.4$		
	Nct tax = Ksh $(7394.4 - 1162)$	M1	For subtraction of relief
	= Ksh 6232.4	A1	
		3	

No.	Marking scheme	marks	comments
13.	$\mathbf{AB} = \begin{pmatrix}1\\2\end{pmatrix} - \begin{pmatrix}-3\\4\end{pmatrix} = \begin{pmatrix}4\\-2\end{pmatrix}$ $\mathbf{AC} = \begin{pmatrix}7\\-1\end{pmatrix} - \begin{pmatrix}-3\\4\end{pmatrix} = \begin{pmatrix}10\\-5\end{pmatrix}$ $\begin{pmatrix}4\\-2\end{pmatrix} = k\begin{pmatrix}10\\-5\end{pmatrix}$ $k = 0.4$ *Thus* **AB** // **AC** *and A is a common point.* $\therefore$ *Points A, B and C are collinear.*	B1 B1 B1 **3**	
14.	Let $\mathrm{M}^{-1} = \begin{pmatrix}a & b\\c & d\end{pmatrix}$ $\begin{pmatrix}a & b\\c & d\end{pmatrix}\begin{pmatrix}-7 & 2 & 4\\2 & -1 & -1\end{pmatrix} = \begin{pmatrix}-3 & 0 & 2\\2 & -1 & -1\end{pmatrix}$ $-7a + 2b = -3$, $2a - b = 0$ *or* $b = 2a$ $-7a + 2\times 2a = -3$ $-3a = -3$ $a = 1,\ b = 2$ $-7c + 2d = 2$, $2c - d = -1$ *or* $d = 2c + 1$ $-7c + 2(2c + 1) = 2$ $-3c = 0$ $c = 0,\ d = 1$ Therefore $\mathrm{M}^{-1} = \begin{pmatrix}1 & 2\\0 & 1\end{pmatrix}$	M1 M1 M1 A1 **4**	Or equivalent

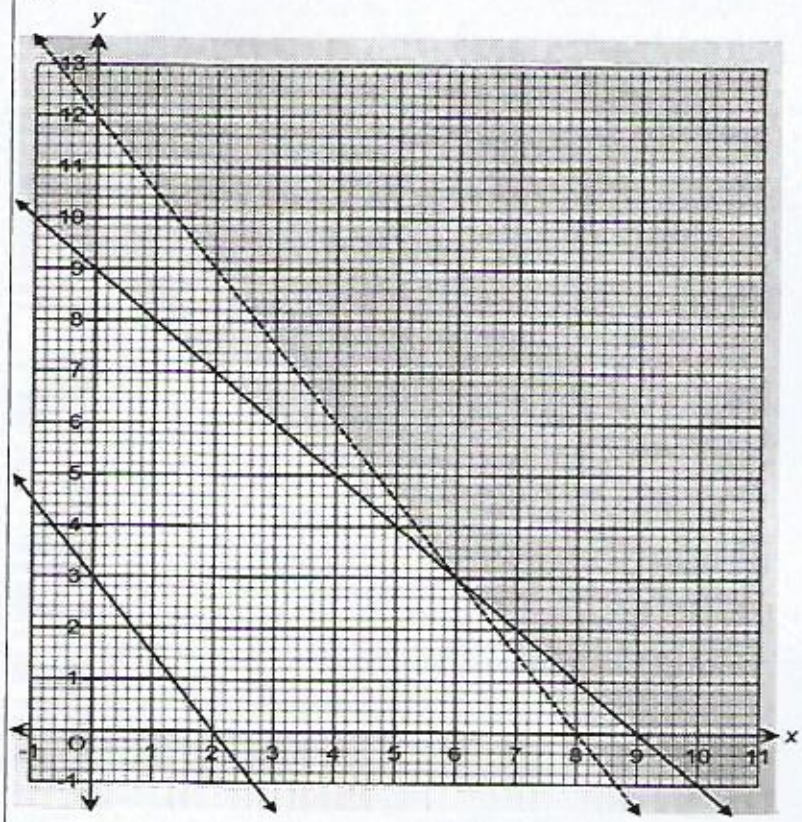
No.	Marking scheme	marks	comments
15.	$2 = \log 100$	B1	For Log100
	$\log(7x-3) + \log 5^2 = \log 100 + \log(x+3)$		
	$\log\{25(7x-3)\} = \log\{100(x+3)\}$	M1	
	$25(7x-3) = 100(x+3)$	M1	
	$7x-3 = 4x+12$		
	$3x = 15$		
	$x = 5$	A1	
		4	
16.	(a) 	P1 C1	
	(b) Acceptable tangent drawn at $t = 2$ Tangent passes through points $(2, 5)$ and $(2.5, 3.5)$	B1	
	$\frac{\Delta L}{\Delta t} = \frac{3.5-5}{2.5-2} = \frac{-1.5}{0.5}$ $= -3.0$ m/s	B1	
		4	

No.	Marking scheme	marks	comments
17.	(a)		
	$ar^3 = a + d$	B1	
	$ar^6 = a + 9d$	B1	
	(b)		
	From (a) above		
	$d = ar^3 - a$		Alt
	$a + 9(ar^3 - a) = ar^6$	M1	$\frac{a+d}{a} = \frac{a+9d}{a+d}$ M1
	$a + 9ar^3 - 9a = ar^6$		$a^2 - 7ad = 0$
	$ar^6 - 9ar^3 + 8a = 0$		$d = 7a$
	$r^6 - 9r^3 + 8 = 0$	M1	$a + 7a = ar^3$ M1
	$(r^3 - 1)(r^3 - 8) = 0$	M1	$8a = ar^3$
	r = 1 or r = 2		$8 = r^3$ M1
	r = 2	A1	$r = 2$ 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	
	$= 13500$	A1	
		10	

No.	Marking scheme	marks	comments
18.	(a) Value of a plot after 2 years		
	$= 400\,000 \times 1.1^2$	M1	
	= Ksh. 484 000	A1	
	(b)		
	$558\,400 = 400\,000(1.1)^t$	M1	
	$1.1^t = \frac{558\,400}{400\,000}$		
	$1.1^t = 1.396$		
	$t \log 1.1 = \log 1.396$	M1	
	$t = \frac{\log 1.396}{\log 1.1} = 3.500$	M1	
	= 3 years 6 months (or 42 months)	A1	
	(c)		
	Let the number of plots bought be x		
	$x \times 400\,000 \times (1.1)^4 = 2\,928\,200$	M1	Alt Let V_4 = Value of each plot after 4yrs
	$x = \frac{2\,928\,200}{400\,000 \times (1.1)^4} = \frac{2\,928\,200}{585\,640}$		$V_4 = 400000 \times 1.1^4$ M1 $= 585640$
	$= 5$	A1	Profit $= 585640 - 400000$ $= 185640$ A1
	Profit $= 2\,928\,200 - 5 \times 400\,000$		$\%\text{ profit} = \frac{185640}{400000} \times 100$ M1
	$= 928\,200$		$= 46.41\%$ A1
	$\%\text{ profit} = \left(\frac{928\,200}{2\,000\,000}\right) \times 100\%$	M1	
	$= 46.41\%$	A1	
		10	

No.	Marking scheme	marks	comments
19.			
	(a)(i)		
	⊥ bisector to line LM	B1	
	Bisector to ∠KLM	B1	
	Position of P correctly identified	B1	
	(ii)		
	⊥ bisector to line KL	B1	
	Correct centre used	B1	
	Locus of Q correctly drawn	B1	
	(b) (i) Correct region R shaded and labelled	B1	
	(ii)		
	r = 40 m	B1	
	Area of region R		
	$= \frac{90}{360} \times 3.142 \times 40^2 - \frac{1}{2} \times 40 \times 40$	M1	
	$= 1256.8 - 800$		
	$= 456.8 m^2$	A1	
		10	

No.	Marking scheme	marks	comments
20.	(a)(i) Distance in nm $= 24 \times 90$ $= 2160$ nm	B1	
	(a)(ii) Distance Km $= 2160 \times 1.853$ $= 4002.48$ km	B1	
	(b) Position of R $1° = 60\cos 10$ nm	B1	
	$\theta = \angle PO_1R$ $\theta = \frac{2160}{60\cos 10}$	M1	
	$= 36.56°$	A1	
	Position of R $= (10°S, (40 + 36.56)°E)$	M1	
	$= (10°S, 76.56°E)$	A1	
	(c) Local time at R Longitude difference between P and R = 36.56°		
	Time difference $= \frac{36.56 \times 4}{60}$	M1	
	=2hrs 26mins	A1	
	Local time at R = 1100h + 2h 26min = 1326h = 1.26 pm	B1	
		10	

21.	(a) $x \geq 0, \quad y \geq 0$ $2x + 2y \leq 18$ or $x + y \leq 9$ $3x + 2y < 24$	B1 B1 B1	
	(b)  	B1 B1 B1	Line & ✓ shading Line & ✓ shading Line & ✓ shading
	(c) Objective function $6000x + 4000y = P$ $6000x + 4000y = 12000$ *or* $3x + 2y = 6$ $x = 5, y = 4$ and $x = 7, y = 1$ Profit = sh $(6000 \times 5 + 4000 \times 4)$ or $(6000 \times 7 + 4000 \times 1)$ = sh 31600	B1 B1 M1 A1 **10**	Or two feasible points inspected

22.

(a) c.f. 2, 12, 24,38,45,48,50 — B1

S1
P1
C1

(b) (i) Median = Contribution of 25th student — B1

= 605.5

(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

= 95 — A1

(b) (iii) No of people who contributed at least Ksh 750.5

= 9

% = $\frac{9}{50} \times 100$ — M1

= 18% — A1

10

23.	(a)		
	(i) $\mathbf{BA} = \mathbf{a} - \mathbf{b}$	B1	
	(ii) $\mathbf{OY} = \mathbf{b} + \frac{1}{4}(\mathbf{a} - \mathbf{b})$	M1	Accept ratio thm $\mathbf{OY} = \frac{3}{4}\mathbf{b} + \frac{1}{4}\mathbf{a}$
	$= \frac{3}{4}\mathbf{b} + \frac{1}{4}\mathbf{a}$	A1	
	(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	
	$h\left(\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}\right) = \mathbf{b} + k\left(\frac{1}{2}\mathbf{a} - \mathbf{b}\right)$		
	$\frac{1}{4}h\mathbf{a} + \frac{3}{4}h\mathbf{b} = \frac{1}{2}k\mathbf{a} + (1-k)\mathbf{b}$	M1	Equating
	$\frac{1}{4}h = \frac{1}{2}k \Rightarrow h = 2k$ (iii) $\frac{3}{4}h = 1-k$ (iv)	M1	Extracting expressions in h & k
	$\frac{3}{4}(2k) = 1-k$	M1	Attempt to solve
	$10k = 4$		
	$k = \frac{2}{5}$	A1	OW-1 if vector sign omitted
	$h = \frac{4}{5}$	B1	
		10	

24. (a)

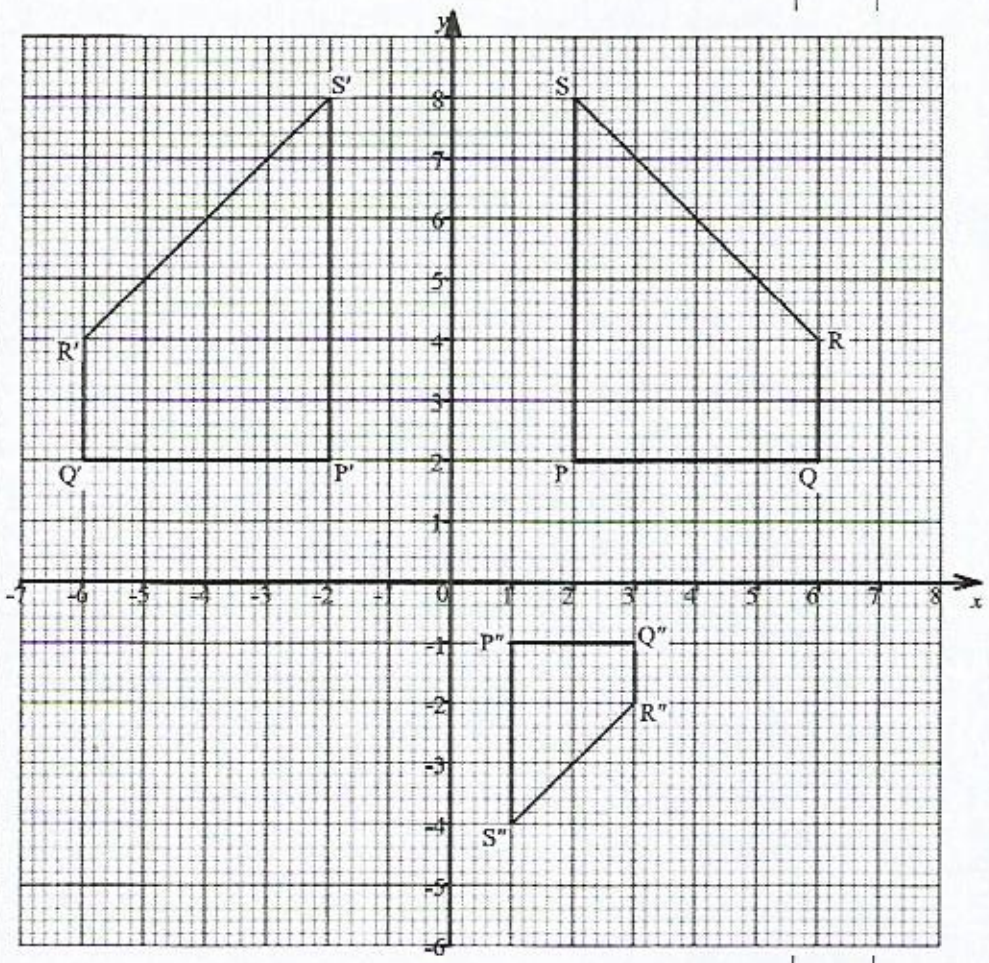
$$\begin{matrix} & P & Q & R & S & & P' & Q' & R' & S' \end{matrix}$$
$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 2 & 6 & 6 & 2 \\ 2 & 2 & 4 & 8 \end{pmatrix} = \begin{pmatrix} -2 & -6 & -6 & -2 \\ 2 & 2 & 4 & 8 \end{pmatrix}$$

M1

Coordinates:

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

A1



(b) Trapezium PQRS correctly drawn

B1

Trapezium P'Q'R'S' correctly drawn

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

(c) (ii) Trapezium P″Q″R″S″ correctly drawn B1

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

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

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

$$N^{-1} = 4\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$$ M1

$$= \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$$ A1

(d)(ii) Enlargement centre O(0, 0) B1

S.F = -2 B1

10