Question Number	Scheme	Notes	Marks
7(i)(a)	A rotation of $240°/\frac{4\pi}{3}$ (anti/counter clockwise) about/around/at centre (0, 0)/origin/O M1: Any rotation. Condone "rotate" for all marks A1: Fully correct description. Condone missing degrees symbol. If direction is not mentioned assume anticlockwise so allow rotation of $120°/\frac{2\pi}{3}$ **clockwise** about O. $-120°/-\frac{2\pi}{3}$ (anticlockwise) or $-240°/-\frac{4\pi}{3}$ **clockwise** are also acceptable. Must be a single transformation.		M1A1
			(2)
(b)	$\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$	Correct matrix. Allow if they omit (b) and this matrix is seen in (c).	B1
			(1)
(c)	$\{\mathbf{C}=\mathbf{AB}=\}\begin{pmatrix} -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & -\frac{1}{2} \end{pmatrix}"\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}"$	Forms a correct product of matrices with their **B** Condone a clear miscopy of **A**	M1
	$\begin{pmatrix} -1 & \frac{\sqrt{3}}{2} \\ -\sqrt{3} & -\frac{1}{2} \end{pmatrix}$	Correct matrix. Any equivalent. No evidence of incorrect method for product or any incorrect matrices.	A1
			(2)

Question Number	Scheme	Notes	Marks
7(ii)(a)	$\begin{pmatrix} k & -2 \\ -1 & 2k \end{pmatrix}\begin{pmatrix} k \\ k \end{pmatrix} = \begin{pmatrix} k^2-2k \\ -k+2k^2 \end{pmatrix} \left\{= \begin{pmatrix} 35 \\ 91 \end{pmatrix}\right\}$	Multiplies to obtain one correct element. May just see e.g., $\begin{pmatrix} k & -2 \end{pmatrix}\begin{pmatrix} k \\ k \end{pmatrix} = \left(k^2-2k\right)$	M1
	$k^2-2k-35=0 \Rightarrow k=...$ **or** $2k^2-k-91=0 \Rightarrow k=...$ Attempts to solve one correct quadratic equation. Usual rules. One root correct if no working. This mark can also be awarded if they solve a correct 3TQ following combining correct equations e.g., $3k^2-3k-126\left\{=k^2-k-42=0\right\}=0 \Rightarrow k=...\ \{7,-6\}$ If they eliminate to a correct equation that isn't a 3TQ then one solution must be correct e.g., $3k^2-147=0 \Rightarrow k^2=49 \Rightarrow k=\{\pm\}7$ or $-3k+21=0 \Rightarrow k=7$ **If reduced to a linear equation allow all marks** otherwise 1100 max if the evidence is that only one quadratic has been solved (e.g., 2 solutions from one equation offered even if one is "rejected" etc. rather than crossed out - ignore all crossed out work)		M1
	$k^2-2k-35=0 \Rightarrow k=...\{-5,\ 7\}$ **and** $2k^2-k-91=0 \Rightarrow k=...\left\{-\frac{13}{2},\ 7\right\}$ **Or** one of the above with one of $3k^2-3k-126=0\ \{\Rightarrow k^2-k-42=0\} \Rightarrow k=...\{7,-6\}$ or $3k^2-147=0\left\{\Rightarrow k^2=49\right\} \Rightarrow k=...\{7,-7\}$ **Or** $\Rightarrow -3k+21=0 \Rightarrow k=7$ Factorisations shown below	Attempts to solve two correct quadratic equations (or one correct linear). Usual rules. One root correct if no working. Allow if they obtain 7 from one equation and verify correctly that it works in the second equation (or shows that the other root doesn't work). It is valid to solve one of the equations with a combined equation. Allow if equations not "extracted" from matrices e.g., $\begin{pmatrix} k^2-2k \\ -k+2k^2 \end{pmatrix} = \begin{pmatrix} 35 \\ 91 \end{pmatrix}$	M1
	$k^2-2k-35=(k+5)(k-7),\ 2k^2-k-91 \Rightarrow (2k+13)(k-7),\ \ k^2-k-42 \Rightarrow (k+6)(k-7),\ k^2-49 \Rightarrow (k+7)(k-7)$		
	$k=7$ following use of 2 correct equations. No incorrect values of k or incorrect factorisations etc seen. No other values offered. **Two correct equations (which could be "unextracted") followed by 7 <u>only</u> is sufficient.** Condone poor matrix work such as using (k, k) or matrix multiplications written the wrong way around provided correct elements/equations are obtained.		A1
			(4)
	Alternative using inverse: $\mathbf{M}\begin{pmatrix} k \\ k \end{pmatrix} = \begin{pmatrix} 35 \\ 91 \end{pmatrix} \Rightarrow \begin{pmatrix} k \\ k \end{pmatrix} = \mathbf{M}^{-1}\begin{pmatrix} 35 \\ 91 \end{pmatrix}$ and $\mathbf{M}^{-1} = \frac{1}{2k^2-2}\begin{pmatrix} 2k & 2 \\ 1 & k \end{pmatrix} \Rightarrow \begin{pmatrix} k \\ k \end{pmatrix} = \frac{1}{2k^2-2}\begin{pmatrix} 70k+182 \\ 35+91k \end{pmatrix}$ M1: For $70k+182$ or $35+91k$ $k\left(2k^2-2\right)=70k+182 \Rightarrow k^3-36k-91\left\{=(k-7)\left(k^2+7k+13\right)\right\}=0 \Rightarrow k=7\ \left\{\text{or } \frac{-7\pm\sqrt{3}\mathrm{i}}{2}\right\}$ $k\left(2k^2-2\right)=35+91k \Rightarrow 2k^3-93k-35\left\{=(k-7)\left(2k^2+14k+5\right)\right\}=0$ $\Rightarrow k=7\ \left\{\text{or } \frac{-7\pm\sqrt{39}}{2} \text{ or awrt} -0.38 \text{ or } -6.6\right\}$ M1: Obtains a correct root from a correct equation M1: Obtains a correct root from two correct equations or verifies as mentioned above **OR** $70k+182=35+91k \Rightarrow k=7$ M1 M1: Obtains $k=7$ from this linear equation A1: $k=7$ and no incorrect values/factorisations etc. Condone poor matrix work such as using (k, k) or matrix multiplications written the wrong way around provided correct elements/equations are obtained.		

Question Number	Scheme	Notes	Marks
7(ii)(b)	$\left\{\begin{vmatrix} "7" & -2 \\ -1 & 2\times"7" \end{vmatrix} \Rightarrow\right\}$ $"7"\times 2\times"7"-(-1)(-2)$ $\{=96\}$	Correct numerical expression for det **M** correct for any of their values of k. May be implied by sight of $"96"\times 336$ (or e.g. 32256). Allow an invented **value** of k	M1
	$\Rightarrow \frac{7}{2}$ $\left\{\text{or } 3.5,\ 3\frac{1}{2}, \frac{336}{96}\right\}$	Correct value and no others. Any equivalent	A1
	If points and transformed points are used a correct numerical expression for the area scale factor or its reciprocal must be achieved for the M mark		**(2)**
			Total 11