Question	Scheme	Marks	AOs
1(a)	$\mathbf{M}=\mathbf{QP}=\begin{pmatrix}-1 & 0\\ 0 & 1\end{pmatrix}\times\frac{1}{2}\begin{pmatrix}1 & \sqrt{3}\\ -\sqrt{3} & 1\end{pmatrix}$	M1	1.1a
	$=\begin{pmatrix}-\frac{1}{2} & -\frac{\sqrt{3}}{2}\\ -\frac{\sqrt{3}}{2} & \frac{1}{2}\end{pmatrix}$ or $\frac{1}{2}\begin{pmatrix}-1 & -\sqrt{3}\\ -\sqrt{3} & 1\end{pmatrix}$	A1	1.1b
		(2)	
(b)	$\begin{pmatrix}-\frac{1}{2} & -\frac{\sqrt{3}}{2}\\ -\frac{\sqrt{3}}{2} & \frac{1}{2}\end{pmatrix}\begin{pmatrix}x\\ y\end{pmatrix}=\begin{pmatrix}x\\ y\end{pmatrix}\Rightarrow -\frac{1}{2}x-\frac{\sqrt{3}}{2}y=x$ and $-\frac{\sqrt{3}}{2}x+\frac{1}{2}y=y$	M1	3.1a
	$\Rightarrow -y\sqrt{3}=3x$ and $y=-x\sqrt{3}$	M1	1.1b
	First equation gives $y=-\frac{3x}{\sqrt{3}}=-x\sqrt{3}$, so equations are the same, hence M fixes all points on the line $y=-x\sqrt{3}$.	A1ft	2.1
		(3)	
			(5 marks)

Notes:

(a)

M1: Attempts the multiplication of the matrices the correct way round. If no working shown, needs correct answer to imply the method.

A1: Correct matrix.

(b)

M1: Extracts simultaneous equations using their matrix $\mathbf{M}$, or using $\mathbf{M}^{-1}$ from $\mathbf{x}=\mathbf{M}^{-1}\mathbf{x}$.

M1: Gathers terms from their two equations.

A1ft: Shows the equations are consistent and deduces the correct line. Accept equivalent equations as long as both have been shown to be the same. Follow through only on an incorrect order of matrices from part (a). If wrong order of matrices is used in (a) the equation will end up being $y=x\sqrt{3}$.

ALT (b)

M1: Identifies P is a rotation (through $\frac{\pi}{3}$ clockwise) AND Q is a reflection (in the y-axis).

M1: Hence deduce s M is a reflection (through line at angle $-\frac{\pi}{3}$ to the x-axis) and so has a line of fixed points.

A1ft: All reasoning correct (including correct reflections/rotations if stated) and identifies the equation of the line. Follow through as above.