Question	Scheme	Marks	AOs
1(a) **Way 1**	$\det \mathbf{M} = -4\times -4 - 4\sqrt{3}\times -4\sqrt{3} = ... \Rightarrow k = \sqrt{\det \mathbf{M}} = ...$	M1	3.1a
	$k = 8$	A1	1.1b
	$\Rightarrow \mathbf{Q} = \begin{pmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & -\frac{1}{2} \end{pmatrix} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \Rightarrow \cos\theta = -\frac{1}{2} \Rightarrow \theta = ...$	M1	1.1b
	$\left(\cos\theta < 0, \sin\theta > 0 \Rightarrow \text{ Quadrant 2 so}\right)\quad \theta = 120°$	A1	1.1b
		(4)	
Way 2	$\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}\begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix} = k\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} = \begin{pmatrix} -4 & -4\sqrt{3} \\ 4\sqrt{3} & -4 \end{pmatrix}$	M1	3.1a
	Achieves both the equations $k\cos\theta = -4$ and $k\sin\theta = 4\sqrt{3}$	A1	1.1b
	$\frac{k\sin\theta}{k\cos\theta} = \frac{4\sqrt{3}}{-4} \Rightarrow \tan\theta = -\sqrt{3} \Rightarrow \theta = ...$	M1	1.1b
	$\theta = 120°$ and $k = 8$	A1	1.1b
		(4)	
(b)	Area of S' = area of $S \times k^2$ (The area of the square $S = 2a^2$)	M1	1.1b
	Area of S' = $128a^2$	A1ft	2.2a
		(2)	
		(6 marks)	

Notes:

(a) Way 1

M1: A full method to find k such as attempting the square root of the determinant of **M**. It is immediately deducible so the method may be implied by $k = 8$.

A1: $k = 8$

M1: A full method to find a value of θ using their k, no need to justify quadrant. Only one equation needed for this mark. Allow if a radians answer is given. May be implied by a correct angle.

A1: Correct angle in degrees.

Way 2

M1: Multiplies the correct matrix representing transformation Q by the matrix representing transformation P and sets equal to matrix **M**. Allow for the matrices either way round as the transformations commute. No need to see the identity matrix, just multiplying through by k is sufficient.

A1: Both correct equations. Note that if a correct value of k is found, this A is scored under Way 1.

M1: Solves their simultaneous equations to find a value for θ (or k)

A1: $\theta = 120°$ and $k = 8$

(b)

M1: Complete method to find the area of S': 'their k^2' $\times$ 'their $2a^2$'. Must be an attempt at the area of S but it need not be correct.

A1ft: Deduces the correct area for S', follow through their value of k