Question	Scheme	Marks
1.(a)	$\det \mathbf{M} = (2k+1)(k+4) - k(k+7)$	**M1**
	$\det \mathbf{M} = k^2 + 2k + 4 \Rightarrow b^2 - 4ac = 4 - 16$ or $\det \mathbf{M} = k^2 + 2k + 4 = (k+1)^2 + 3$ or $\frac{\mathrm{d}(\det \mathbf{M})}{\mathrm{d}k} = 2k + 2 = 0 \Rightarrow k = -1$	**M1**
	$b^2 - 4ac < 0 \Rightarrow k^2 + 2k + 4 > 0$ or $\det \mathbf{M} = (k+1)^2 + 3 \ldots 3$ or $k = -1$ at minimum so det $\mathbf{M}$ … 3 Hence $\mathbf{M}$ is non-singular for all real values of k	**A1**
		(3)
(b)	$\mathbf{M}^{-1} = \frac{1}{k^2 + 2k + 4}\begin{pmatrix} k+4 & -k \\ -k-7 & 2k+1 \end{pmatrix}$	**M1**
		A1
		(2)
		(Total 5 marks)

Notes

(a)

M1: Attempts the determinant of **M**. Must see evidence of the attempt at subtracting but allow e.g. minor sign slips inside the brackets. Must be seen in (a).

M1: Begins a correct strategy for attempting to establish that the determinant is non-zero, must follow a valid attempt at the determinant involving all four terms.. May find the discriminant, complete the square (usual rules) on the determinant, attempt to solve the quadratic via formula, or attempt a minimisation process. There must be an attempt at a calculation.

A1: Full and correct reasoning and conclusion. Must see consideration of the sign or non-zero oe, but accept e.g. … 3 (condone >3) as being sufficient to show det **M** cannot be zero for the reason. Showing the roots $(-1 \pm i\sqrt{3})$ are not real is acceptable The final deduction must refer to non-singular, but no need to mention **M** and condone det**M** is non-singular as conclusion.

(b)

M1: For applying $\mathbf{M}^{-1} = \frac{1}{\det \mathbf{M}} \times \mathrm{adj}(\mathbf{M})$ with their determinant. At least three entries in adj(**M**) must be correct initially.

A1: Correct matrix, and isw after a correct answer.