Question Number	Scheme	Notes	Marks
1	**Notes:** • Some candidates omit brackets around their matrices and vectors. This is condoned for all marks. • If a correct answer comes from no working in part (a) or part (b), please send to review. $\mathbf{M}=\begin{pmatrix}-5 & 3\\ 3 & 3\end{pmatrix}$		
(a)	$\{\det(\mathbf{M}-\lambda\mathbf{I})=\}\ \ (-5-\lambda)(3-\lambda)-(3)(3)$	Completes an attempt at $\det(\mathbf{M}-\lambda\mathbf{I})$ with one product correct	M1
	$\Rightarrow \lambda^2+2\lambda-24=0\Rightarrow(\lambda+6)(\lambda-4)=0\Rightarrow\lambda=-6,\ 4$	M1: Forms and solves 3TQ (usual rules) A1: Both correct eigenvalues	M1 A1
			(3)
(b)	$\begin{pmatrix}-5 & 3\\ 3 & 3\end{pmatrix}\begin{pmatrix}x\\ y\end{pmatrix}=\text{"}-6\text{"}\begin{pmatrix}x\\ y\end{pmatrix}\Rightarrow\begin{matrix}-5x+3y=\text{"}-6\text{"}x\\ 3x+3y=\text{"}-6\text{"}y\end{matrix}\Rightarrow x=...,\ y=...$; or $\begin{pmatrix}-5-\text{"}-6\text{"} & 3\\ 3 & 3-\text{"}-6\text{"}\end{pmatrix}\begin{pmatrix}x\\ y\end{pmatrix}=\begin{pmatrix}0\\ 0\end{pmatrix}\Rightarrow x=...,\ y=...$ Uses $\mathbf{Mx}=\lambda\mathbf{x}$ or $(\mathbf{M}-\lambda\mathbf{I})\mathbf{x}=0$ with one of their eigenvalues leading to either $x=...,y=...$ or an eigenvector. Accept any x and y values following their matrix equation. Do not be concerned with the mechanics of their solution.		M1
	$\lambda=-6\{\Rightarrow x=-3y\}\Rightarrow\begin{pmatrix}-3\\ 1\end{pmatrix}$, or $\lambda=4\{\Rightarrow 3x=y\}\Rightarrow\begin{pmatrix}1\\ 3\end{pmatrix}$	One correct eigenvector (any equivalents). Allow if a general form is given, e.g. $k\begin{pmatrix}1\\ 3\end{pmatrix}$, or if only normalised eigenvectors are given.	A1
	$\frac{1}{\sqrt{10}}\begin{pmatrix}-3\\ 1\end{pmatrix}$ and $\frac{1}{\sqrt{10}}\begin{pmatrix}1\\ 3\end{pmatrix}$ oe e.g. $\begin{pmatrix}\frac{3\sqrt{10}}{10}\\ -\frac{\sqrt{10}}{10}\end{pmatrix}$ and $\begin{pmatrix}-\frac{\sqrt{10}}{10}\\ -\frac{3\sqrt{10}}{10}\end{pmatrix}$	Both correct normalised eigenvectors (either direction). Must be numerical. The normalised eigenvectors must be seen in part (b). Do not allow for correct columns in their **P** in part (c).	A1
			(3)
(c)	$\{\mathbf{D}=\}\ \begin{pmatrix}\text{"}-6\text{"} & 0\\ 0 & \text{"}4\text{"}\end{pmatrix}$	Correct **D** ft their eigenvalues	B1ft
	$\{\mathbf{P}=\}\ \frac{1}{\sqrt{10}}\begin{pmatrix}-3 & 1\\ 1 & 3\end{pmatrix}$ or e.g., $\begin{pmatrix}\frac{3\sqrt{10}}{10} & -\frac{\sqrt{10}}{10}\\ -\frac{\sqrt{10}}{10} & -\frac{3\sqrt{10}}{10}\end{pmatrix}$	Correct **P** and **D**. The position of the two columns of **P** must correspond correctly with the position of their eigenvalues in **D**.	B1
			Total 8