Question Number	Scheme	Notes	Marks
5	$\mathbf{S}=\begin{pmatrix}1&0&p\\-1&2&3\\2&-2&0\end{pmatrix}$ $\mathbf{T}=\begin{pmatrix}2&1&-3\\0&-3&-1\\q&0&1\end{pmatrix}$		
(a)	$\det\mathbf{S}=1\big(0-(-2)(3)\big)-0+p\big((-1)(-2)-(2)(2)\big)$ $\det\mathbf{T}=2\big((-3)(1)-0\big)-1\big(0-(q)(-1)\big)-3\big(0-(q)(-3)\big)$	Recognisable attempt at either det **S** or det **T**	M1
	e.g. $\det\mathbf{S}=6+p(-2)$, $\det\mathbf{T}=2(-3)-1(q)-3(3q)$ $\det\mathbf{S}=6-2p$, $\det\mathbf{T}=-6-q-9q$	One determinant correct with minors simplified	A1
	$6-2p=-6-10q\Rightarrow p=5q+6$*	Correctly shown with no errors	A1*
			(3)
(b)	$\mathbf{U}=\mathbf{TS}=\begin{pmatrix}2&1&-3\\0&-3&-1\\q&0&1\end{pmatrix}\begin{pmatrix}1&0&p\\-1&2&3\\2&-2&0\end{pmatrix}=\begin{pmatrix}-5&8&2p+3\\1&-4&-9\\q+2&-2&pq\end{pmatrix}$ or $\begin{pmatrix}2&1&-3\\0&-3&-1\\q&0&1\end{pmatrix}\begin{pmatrix}1&0&5q+6\\-1&2&3\\2&-2&0\end{pmatrix}=\begin{pmatrix}-5&8&10q+15\\1&-4&-9\\q+2&-2&5q^2+6q\end{pmatrix}$ M1: Attempts **TS** in terms of p and q or just q A1: Six correct elements in their **TS** in terms of p and q or just q A1: Fully correct in terms of q		M1 A1 A1
			(3)
	Mark (c) and (d) together. **Note:** Full marks are possible in parts (c) and (d) if the relevant rows of their matrix **U** are correct.		
(c)	$\begin{pmatrix}-5&8&10q+15\\1&-4&-9\\q+2&-2&5q^2+6q\end{pmatrix}\begin{pmatrix}2\\-3\\1\end{pmatrix}=\begin{pmatrix}r\\5\\14\end{pmatrix}$ $\Rightarrow 2q+4+6+5q^2+6q=14$	Sets up the correct matrix equation with their **U** and multiplies out to obtain a quadratic equation in q. Attempts involving finding the inverse of **U** please send to review.	M1
	$5q^2+8q-4=0\Rightarrow(5q-2)(q+2)=0\Rightarrow q=\frac{2}{5},\ -2$	M1: Solves their 3TQ to find two values of q (usual rules including calculator solutions) A1: Both correct values	M1 A1
			(3)
(d)	$r=(-5)(2)+8(-3)+10\begin{pmatrix}2\\\frac{}{5}\end{pmatrix}+15$ $=-15$	M1: Uses the first row of their matrix equation to obtain a numerical expression for r. For the substitution of q, they must use the positive solution of their 3TQ that has two solutions of different sign. Allow slips if the intention is clear. A1: Correct value	M1 A1
			(2)
			Total 11