Question	Scheme		Marks	AOs
2	$\begin{pmatrix}4 & -2\\5 & 3\end{pmatrix}\begin{pmatrix}x\\mx+c\end{pmatrix}=\begin{pmatrix}X\\mX+c\end{pmatrix}$ leading to an equation in x, m, c and X		M1	3.1a
	$4x-2(mx+c)=X$ and $5x+3(mx+c)=mX+c$		A1	1.1b
	$5x+3(mx+c)=m\left(4x-2(mx+c)\right)+c$ leading to $5+3m=4m-2m^2$ $\quad(3c=-2mc+c)$		M1	2.1
	$2m^2-m+5=0\Rightarrow b^2-4ac=$ $(-1)^2-4(2)(5)=...$	Solves $3c=-2mc+c\Rightarrow m=...$	dM1	1.1b
	Correct expression for the discriminant = $\{-39\}<0$ therefore there are no invariant lines.	$m=-1$ and shows a contradiction in $5+3m=4m-2m^2$ therefore there are no invariant lines.	A1	2.4
	Alternative			
	$\begin{pmatrix}4 & -2\\5 & 3\end{pmatrix}\begin{pmatrix}x\\mx\end{pmatrix}=\begin{pmatrix}X\\mX\end{pmatrix}$ leading to an equation in x, m and X		M1	3.1a
	$4x-2(mx)=X$ and $5x+3(mx)=mX$		A1	1.1b
	$5x+3(mx)=m\left(4x-2(mx)\right)$ leading to $5+3m=4m-2m^2$		M1	2.1
	$2m^2-m+5=0\Rightarrow b^2-4ac=(-1)^2-4(2)(5)=...$		dM1	1.1b
	Correct expression for the discriminant = $\{-39\}<0$ therefore there are no invariant lines that pass through the origin no invariant lines.		A1	2.4
			(5)	

(5 marks)

Notes:

M1: Sets up a matrix equation in an attempt to find a fixed line and extract at least one equation.

A1: Correct equations.

M1: Eliminates X from the simultaneous equations and equates the coefficients of x leading to a quadratic equation in terms of m.

dM1: Dependent on the previous method, finds the value of the discriminant, this can be seen in an attempt to solve the quadratic using the formula.

Alternatively solves $3c=-2mc+c$ and finds a value for m

Note: If the quadratic equation in m is solved on a calculator and complex roots given this is M0 as they are not showing why there are no real roots.

A1: Correct expression for the discriminant, states < 0 and draws the required conclusion.

Alternatively, correct value for m, shows a contradiction in $5+3m=4m-2m^2$ and draws the required conclusion.

Alternative

M1: Sets up a matrix equation in an attempt to find a fixed line and extract at least one equation.

A1: Correct equations.

M1: Eliminates X from the simultaneous equations and equates the coefficients of x leading to a quadratic equation in terms of m.

dM1: Dependent on the previous method, finds the value of the discriminant.

A1: Correct expression for the discriminant, states < 0 and draws the required conclusion.