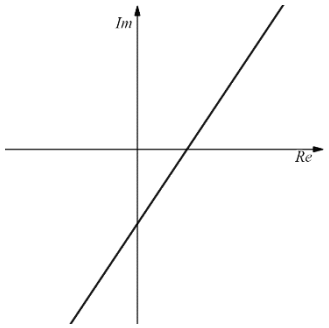
Question Number	Scheme	Notes	Marks
6(a)		A straight line anywhere that is not vertical or horizontal which does not pass through the origin. It may be solid or dotted. Clear "V" shapes score M0.	M1
		A straight line in the correct position. Must have a positive gradient and lie in quadrants 1, 3 and 4. Ignore any intercepts correct or incorrect. If there are other lines that are clearly "construction" lines e.g. a line from 2i to 3 they can be ignored. The line may be solid or dotted. However, if there are clearly several lines then score A0.	A1
			(2)

Part (b)

The approaches below are the ones that have been seen most often.
Apply the mark scheme to the overall method the candidate has chosen.
There may be several attempts:

- **If none are crossed out, mark all attempts and score the best single complete attempt**
- **If some attempts are crossed out, mark the uncrossed out work**
- **If everything is crossed out, mark all the work and score the best single complete attempt**

Note that the question does not specify the variables the candidates should work in so they may use: e.g. $z = x + iy$ and $w = u + iv$ or $w = x + iy$ and $z = u + iv$ or any other letters so please check the work carefully.

Note that the M marks are all dependent on each other.

(b) **Way 1**	$w=\dfrac{\mathrm{i}z}{z-2\mathrm{i}}\Rightarrow z=\dfrac{2w\mathrm{i}}{w-\mathrm{i}}$	Attempts to make z the subject. Must obtain the form $\dfrac{aw\mathrm{i}}{bw+c\mathrm{i}}$, a, b, c real and non-zero.	M1
	$z=\dfrac{2(u+\mathrm{i}v)\mathrm{i}}{u+\mathrm{i}v-\mathrm{i}}$ or e.g. $z=\dfrac{2(x+\mathrm{i}y)\mathrm{i}}{x+\mathrm{i}y-\mathrm{i}}$ $z=\dfrac{2(u+\mathrm{i}v)\mathrm{i}}{u+(v-1)\mathrm{i}}\times\dfrac{u-(v-1)\mathrm{i}}{u-(v-1)\mathrm{i}}$ or equivalent Introduces $w=u+\mathrm{i}v$ or e.g. $w=x+\mathrm{i}y$ and attempts to multiply numerator and denominator by the complex conjugate of the denominator. The above statement would be sufficient e.g. no expansion is needed for this mark.		**d**M1
	$z=\dfrac{-2u}{u^2+(v-1)^2}+\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}\mathrm{i}$ or e.g. $z=\dfrac{-2x}{x^2+(y-1)^2}+\dfrac{2x^2+2y(y-1)}{x^2+(y-1)^2}\mathrm{i}$ or $z=\dfrac{-2uv+2u(v-1)+\left(2u^2+2v(v-1)\right)\mathrm{i}}{u^2+(v-1)^2}$ or e.g. $z=\dfrac{-2xy+2x(y-1)+\left(2x^2+2y(y-1)\right)\mathrm{i}}{x^2+(y-1)^2}$ Correct expression for z in terms of their variables with real and imaginary parts identified. May be embedded as above or stated explicitly.		A1
	$\lvert z-2\mathrm{i}\rvert=\lvert z-3\rvert\Rightarrow y-1=\dfrac{3}{2}\left(x-\dfrac{3}{2}\right)\left(y=\dfrac{3}{2}x-\dfrac{5}{4},\ 6x-4y=5\right)$ $\Rightarrow\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}-1=\dfrac{3}{2}\left(\dfrac{-2u}{u^2+(v-1)^2}-\dfrac{3}{2}\right)$ Attempts the Cartesian equation of the locus of z and substitutes for x and y or equivalent using their variables to obtain an equation in u and v (or their variables). Condone slips with the locus of z but must be a linear equation in any form but with a non-zero constant term. **or** $\lvert z-2\mathrm{i}\rvert=\lvert z-3\rvert\Rightarrow\left\lvert\dfrac{-2u}{u^2+(v-1)^2}+\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}\mathrm{i}-2\mathrm{i}\right\rvert=\left\lvert\dfrac{-2u}{u^2+(v-1)^2}+\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}\mathrm{i}-3\right\rvert$ $\Rightarrow\left(\dfrac{-2u}{u^2+(v-1)^2}\right)^2+\left(\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}-2\right)^2=\left(\dfrac{-2u}{u^2+(v-1)^2}-3\right)^2+\left(\dfrac{2u^2+2v(v-1)}{u^2+(v-1)^2}\right)^2$ Substitutes their z into the locus of z and applies Pythagoras correctly to obtain an equation in u and v (or their variables). Note that here, further progress is unlikely.		**dd**M1
	$13u^2+13v^2+12u-18v+5=0\Rightarrow u^2+v^2+\dfrac{12}{13}u-\dfrac{18}{13}v+\dfrac{9}{13}=\dfrac{4}{13}$ $\Rightarrow\left(u+\dfrac{6}{13}\right)^2+\left(v-\dfrac{9}{13}\right)^2=\dfrac{4}{13}$ Attempts to complete the square on their equation in u and v where u^2 and v^2 have the same coefficient. Award for e.g. $u^2+v^2+\alpha u+\beta v+\ldots=\left(u+\dfrac{\alpha}{2}\right)^2+\left(v+\dfrac{\beta}{2}\right)^2+\ldots=\ldots$		**ddd**M1

	Attempts using the form $u^2+v^2+2gu+2fv+c=0$ send to review.		
	$\left\|w-\left(-\frac{6}{13}+\frac{9}{13}\mathrm{i}\right)\right\|=\frac{2}{\sqrt{13}}$	Correct equation in the required form	A1
			Total 8

(b) **Way 2**	$w=\frac{\mathrm{i}z}{z-2\mathrm{i}}\Rightarrow z=\frac{2w\mathrm{i}}{w-\mathrm{i}}$	Attempts to make z the subject. Must obtain the form $\frac{aw\mathrm{i}}{bw+c\mathrm{i}}$, a, b, c real and non-zero.	M1
	$\|z-2\mathrm{i}\|=\|z-3\|\Rightarrow\left\|\frac{2w\mathrm{i}}{w-\mathrm{i}}-2\mathrm{i}\right\|=\left\|\frac{2w\mathrm{i}}{w-\mathrm{i}}-3\right\|$ $\Rightarrow\left\|\frac{2w\mathrm{i}-2w\mathrm{i}-2}{w-\mathrm{i}}\right\|=\left\|\frac{2w\mathrm{i}-3w+3\mathrm{i}}{w-\mathrm{i}}\right\|$ Introduces z in terms of w into the given locus and attempts to combine terms		**d**M1
	$\left\|\frac{-2}{w-\mathrm{i}}\right\|=\left\|\frac{2w\mathrm{i}-3w+3\mathrm{i}}{w-\mathrm{i}}\right\|\Rightarrow\|-2\|=\|2w\mathrm{i}-3w+3\mathrm{i}\|$ Correct equation with fractions removed		A1
	$\|2(u+\mathrm{i}v)\mathrm{i}-3(u+\mathrm{i}v)+3\mathrm{i}\|=2\Rightarrow(3u+2v)^2+(3v-2u-3)^2=4$ Introduces e.g. $w = u + \mathrm{i}v$ and applies Pythagoras correctly		**dd**M1
	$13u^2+13v^2+12u-18v+9=4\Rightarrow u^2+v^2+\frac{12}{13}u-\frac{18}{13}v+\frac{9}{13}=\frac{4}{13}$ $\Rightarrow\left(u+\frac{6}{13}\right)^2+\left(v-\frac{9}{13}\right)^2=\frac{4}{13}$ Attempts to complete the square on their equation in u and v where u^2 and v^2 have the same coefficient. Award for e.g. $u^2+v^2+\alpha u+\beta v+\ldots=\left(u+\frac{\alpha}{2}\right)^2+\left(v+\frac{\beta}{2}\right)^2+\ldots=\ldots$ Attempts using the form $u^2+v^2+2gu+2fv+c=0$ send to review.		**ddd**M1
	$\left\|w-\left(-\frac{6}{13}+\frac{9}{13}\mathrm{i}\right)\right\|=\frac{2}{\sqrt{13}}$	Correct equation in the required form	A1
			Total 8

(b) **Way 3**	$w=\dfrac{\mathrm{i}z}{z-2\mathrm{i}}\Rightarrow z=\dfrac{2w\mathrm{i}}{w-\mathrm{i}}$	Attempts to make z the subject. Must obtain the form $\dfrac{aw\mathrm{i}}{bw+c\mathrm{i}}$, a, b, c real and non-zero.	M1
	$\lvert z-2\mathrm{i}\rvert=\lvert z-3\rvert\Rightarrow\left\lvert\dfrac{2w\mathrm{i}}{w-\mathrm{i}}-2\mathrm{i}\right\rvert=\left\lvert\dfrac{2w\mathrm{i}}{w-\mathrm{i}}-3\right\rvert$ $\Rightarrow\left\lvert\dfrac{2w\mathrm{i}-2w\mathrm{i}-2}{w-\mathrm{i}}\right\rvert=\left\lvert\dfrac{2w\mathrm{i}-3w+3\mathrm{i}}{w-\mathrm{i}}\right\rvert$ Introduces z and attempts to combine terms		**d**M1
	$\left\lvert\dfrac{-2}{w-\mathrm{i}}\right\rvert=\left\lvert\dfrac{2w\mathrm{i}-3w+3\mathrm{i}}{w-\mathrm{i}}\right\rvert\Rightarrow\lvert-2\rvert=\lvert 2w\mathrm{i}-3w+3\mathrm{i}\rvert$ Correct equation with fractions removed		A1
	$\lvert w(2\mathrm{i}-3)+3\mathrm{i}\rvert=\left\lvert(2\mathrm{i}-3)\left(w+\dfrac{3\mathrm{i}}{2\mathrm{i}-3}\right)\right\rvert=\lvert 2\mathrm{i}-3\rvert\left\lvert w+\dfrac{6-9\mathrm{i}}{13}\right\rvert=2$ Attempts to isolate w and rationalise denominator of other term		**dd**M1
	$\sqrt{13}\left\lvert w-\left(-\dfrac{6}{13}+\dfrac{9}{13}\mathrm{i}\right)\right\rvert=2\Rightarrow\left\lvert w-\left(-\dfrac{6}{13}+\dfrac{9}{13}\mathrm{i}\right)\right\rvert=\dfrac{2}{\sqrt{13}}$ M1: Completes the process by dividing by their $\lvert 2\mathrm{i}-3\rvert$ A1: Correct equation in the required form		**ddd**M1A1
			(6)