Question	Scheme	Marks	AOs
2(a)	$\lvert z_1\rvert = \sqrt{13}$ and $\arg z_1 = \tan^{-1}\left(\frac{3}{2}\right)$	B1	1.1b
	$z_1 = \sqrt{13}\left(\cos 0.9828 + \mathrm{i}\sin 0.9828\right)$	B1ft	1.1b
		(2)	
(b)	A complete method to find the modulus of z_2 e.g. $\lvert z_1\rvert = \sqrt{13}$ and uses $\lvert z_1 z_2\rvert = \lvert z_1\rvert \times \lvert z_2\rvert = 39\sqrt{2} \Rightarrow \lvert z_2\rvert = 3\sqrt{26}$ or $\sqrt{234}$	M1 A1	3.1a 1.1b
	A complete method to find the argument of z_2 e.g. $\arg(z_1 z_2) = \arg(z_1) + \arg(z_2) = \frac{\pi}{4} \Rightarrow \arg(z_2) = ...$ $\arg(z_2) = \frac{\pi}{4} - \tan^{-1}\left(\frac{3}{2}\right)$ or $\frac{\pi}{4} - 0.9828$ or $-0.1974...$	M1 A1	3.1a 1.1b
	$z_2 = 3\sqrt{26}\left(\cos('-0.1974...') + \mathrm{i}\sin('-0.1974...')\right)$ or $z_2 = a + b\mathrm{i} \Rightarrow a^2 + b^2 = 234$ and $\tan^{-1}(-0.1974) = \frac{b}{a} \Rightarrow \frac{b}{a} = -0.2$ $\Rightarrow a = ...$ and $b = ...$	ddM1	1.1b
	Deduces that $z_2 = 15 - 3\mathrm{i}$ only	A1	2.2a
	Alternative $z_1 z_2 = (a + b\mathrm{i})(2 + 3\mathrm{i}) = (2a - 3b) + (3a + 2b)\mathrm{i}$ $(2a - 3b)^2 + (3a + 2b)^2 = \left(39\sqrt{2}\right)^2$ or 3042 $\Rightarrow a^2 + b^2 = 234$ or $\lvert z_1 z_2\rvert = \lvert z_1\rvert \times \lvert z_2\rvert = 39\sqrt{2} \Rightarrow \lvert z_2\rvert = 3\sqrt{26}$ or $\sqrt{234}$ $\Rightarrow a^2 + b^2 = 234$	M1 A1	3.1a 1.1b
	$\arg\left[(2a - 3b) + (3a + 2b)\mathrm{i}\right] = \frac{\pi}{4} \Rightarrow \tan^{-1}\left(\frac{3a + 2b}{2a - 3b}\right) = \frac{\pi}{4} \Rightarrow \frac{3a + 2b}{2a - 3b} = 1$ $\Rightarrow a = -5b$	M1 A1	3.1a 1.1b
	Solves $a = -5b$ and $a^2 + b^2 = 234$ to find values for a and b	ddM1	1.1b
	Deduces that $z_2 = 15 - 3\mathrm{i}$ only	A1	2.2a
		(6)	
			(8 marks)

Notes:
(a) **B1:** Correct exact value for $\lvert z_1\rvert = \sqrt{13}$ and $\arg z_1 = \tan^{-1}\left(\frac{3}{2}\right)$. The value for $\arg z_1$ can be implied by sight of awrt 0.98 or awrt 56.3° **B1ft**: Follow through on $r = \lvert z_1\rvert$ and $\theta = \arg z_1$ and writes $z_1 = r(\cos\theta + \mathrm{i}\sin\theta)$ where *r* is exact and θ is correct to 4 s.f. do not follow through on rounding errors.
(b) **M1:** A complete method to find the modulus of z_2 **A1:** $\lvert z_2\rvert = 3\sqrt{26}$ **M1:** A complete method to find the argument of z_2 **A1:** $\arg(z_2) = \frac{\pi}{4} - \tan^{-1}\left(\frac{3}{2}\right)$ or $\frac{\pi}{4} - 0.9828$ or $-0.1974...$ **ddM1:** Writes z_2 in the form $r(\cos\theta + \mathrm{i}\sin\theta)$, dependent on both previous M marks. Alternative forms two equations involving *a* and *b* using the modulus and argument of z_2 and solve to find values for *a* and *b* **A1**: Deduces that $z_2 = 15 - 3\mathrm{i}$ only
(b) Alternative: $z_1 z_2 = (a + b\mathrm{i})(2 + 3\mathrm{i}) = (2a - 3b) + (3a + 2b)\mathrm{i}$ **M1:** A complete method to find an equation involving *a* and *b* using the modulus **A1:** Correct simplified equation $a^2 + b^2 = 234$ o.e. **M1:** A complete method to find an equation involving *a* and *b* using the argument. Note $\tan^{-1}\left(\frac{2a-3b}{3a+2b}\right) = \frac{\pi}{4}$ this would score **M0 A0 ddM0 A0** **A1:** Correct simplified equation $a = -5b$ o.e. **ddM1:** Dependent on both the previous method marks. Solves their equations to find values for *a* and *b* **A1**: Deduces that $z_2 = 15 - 3\mathrm{i}$ only