June 2025
WFM02 Further Pure Mathematics F2
Mark Scheme

Question Number	Scheme	Notes	Marks
1(a)	$r = 4\sqrt{2}$	Correct r Accept $\pm 4\sqrt{2}$ or $\pm\sqrt{32}$ or other processed equivalents.	B1
	$\theta = -\pi + \arctan\left(\frac{2\sqrt{6}}{2\sqrt{2}}\right) = -\pi + \frac{\pi}{3} = -\frac{2\pi}{3}$	Complete method to find an argument in the correct quadrant for their r	M1
	$\Rightarrow -2\sqrt{2} - \left(2\sqrt{6}\right)\mathrm{i} = 4\sqrt{2}\mathrm{e}^{-\frac{2\pi}{3}\mathrm{i}}$	Correct answer in the form specified. Accept with $\sqrt{32}$	A1
			(3)
(b)	$z^5 = -2\sqrt{2} - \left(2\sqrt{6}\right)\mathrm{i}$		
	$z = \left(4\sqrt{2}\right)^{\frac{1}{5}} \mathrm{e}^{\frac{-\frac{2\pi}{3}+2k\pi}{5}\mathrm{i}}$	Attempts De Moivre correctly with either all roots indicated or simplified r with one argument. See additional notes.	M1
	$\sqrt{2}\mathrm{e}^{-\frac{2\pi}{15}\mathrm{i}}$, $\sqrt{2}\mathrm{e}^{\frac{4\pi}{15}\mathrm{i}}$, $\sqrt{2}\mathrm{e}^{\frac{2\pi}{3}\mathrm{i}}$, $\sqrt{2}\mathrm{e}^{-\frac{8\pi}{15}\mathrm{i}}$, $\sqrt{2}\mathrm{e}^{-\frac{14\pi}{15}\mathrm{i}}$	Three correct roots provided coefficients of π for θ are single fractions, allow for $0 < \theta < 2\pi$ Allow $\left(4\sqrt{2}\right)^{\frac{1}{5}}$ oe for $\sqrt{2}$ and correct roots in trig form	A1
		All five correct roots and no extra. Must have $-\pi < \theta \leqslant \pi$. Allow e.g., $\sqrt{2}\mathrm{e}^{\frac{10\pi}{15}\mathrm{i}}$ for $\sqrt{2}\mathrm{e}^{\frac{2\pi}{3}\mathrm{i}}$	A1
			(3)
			Total 6

Additional Notes:

(a)

B1: Accept positive or negative root. Allow if seen in part (b).

M1: Requires a method to achieve an argument in the correct quadrant for their r. Accept attempts at $\arctan\left(\frac{2\sqrt{6}}{2\sqrt{2}}\right) \pm \pi$ or $\arctan\left(\frac{2\sqrt{2}}{2\sqrt{6}}\right) \pm \pi$ for attempts where $r > 0$, or equivalent methods via arccos or arcsin (must use r as the denominator). May be implied by sight of any of $-\frac{2\pi}{3}$, $\frac{4\pi}{3}$, $\frac{7\pi}{6}$ or $-\frac{5\pi}{6}$ if no method is shown.

In cases where a negative r is given, accept attempts at just $\arctan\left(\frac{2\sqrt{6}}{2\sqrt{2}}\right)$ or $\arctan\left(\frac{2\sqrt{2}}{2\sqrt{6}}\right)$ provided they do not subsequently adjust to a different quadrant.

A1: Correct answer in the form specified, with $-\pi < \theta < \pi$. Must be given in correct form, but accept answer with negative r, i.e. $-4\sqrt{2}\mathrm{e}^{\frac{\pi}{3}\mathrm{i}}$ Accept with exact processed equivalents for r.

Note: Correct answer with no working shown will score B1M1(implied)A1.

(b)

M1: Applies de Moivre correctly with their answer to (a) which could be in trig form, to reach either simplified modulus with one correct argument for their (a), or multiple arguments with unsimplified modulus.

Condone missing "i" for the M.

Note: If $\pm 2k\pi$ is not used or is used incorrectly this mean you can score M1A0A0 for just $\sqrt{2}e^{-\frac{2\pi}{15}i}$

A1: Accept for three correct distinct roots allowing arguments in the range $-\pi < \theta < \pi$ or $0 < \theta < 2\pi$ for this mark. The modulus need not be simplified for this mark.

A1: All 5 correct roots in the form specified.