Question Number	Scheme	Marks
5(a)	$(\alpha+\beta)(\alpha^2-\alpha\beta+\beta^2)=\alpha^3-\alpha^2\beta+\alpha\beta^2+\beta\alpha^2-\beta^2\alpha+\beta^3=\alpha^3+\beta^3$	B1 (1)
(b)	$\alpha+\beta=\frac{-6}{2}=-3\ \alpha\beta=-\frac{7}{2}$	B1
	$\alpha^3+\beta^3=(\alpha+\beta)\left((\alpha+\beta)^2-3\alpha\beta\right)$	M1
	$=(-3)\left((-3)^2-3\times\frac{-7}{2}\right),=-\frac{117}{2}$	A1ft,A1 (4)
(c)	$(\alpha-\beta)^2=\alpha^2-2\alpha\beta+\beta^2=(\alpha+\beta)^2-4\alpha\beta=(-3)^2-4\times\frac{-7}{2}=23$	M1
	$\alpha-\beta=\sqrt{23}$	A1 (2)
(d)	$(\alpha^3-\beta^3)=(\alpha-\beta)(\alpha^2+\alpha\beta+\beta^2)=(\alpha-\beta)\left((\alpha+\beta)^2-\alpha\beta\right)$	M1
	$=\sqrt{23}\left((-3)^2+\frac{7}{2}\right)=\frac{25}{2}\sqrt{23}$	A1 (2) **[9]**
	ALT: $2\alpha^3+6\alpha^2-7\alpha=0$ and $2\beta^3+6\beta^2-7\beta=0$ Subtract and substitute Correct answer	 M1 A1

Notes

NOTE: If they use the quadratic formula to answer any part of the question, award zero marks in that part.

(a) B1 for simplification as shown cso. This is a show question so multiplication, ie., $\alpha^3-\alpha^2\beta+\alpha\beta^2+\beta\alpha^2-\beta^2\alpha+\beta^3$ must be seen.

(b)

B1 for both sum and product (the sum need not be simplified to −3)

M1 If they use the given answer in part (a) , they must achieve an expansion that is as a minimum $(\alpha+\beta)\{(\alpha+\beta)^2+A\alpha\beta\}$ where $A\neq 0$

For an fresh attempt at an expansion and simplification of $(\alpha+\beta)^3$. Minimally acceptable attempt; $\alpha^3+\beta^3=(\alpha+\beta)^3-A\alpha\beta(\beta+\alpha)$ where $A\neq 0$

{Note: $\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$ is the correct expansion}

Note: Their attempt must have been sufficiently simplified in order to substitute their sum in terms of $(\alpha+\beta)$ and $\alpha\beta$

A1ft for substituting their values for the Sum and Product into their $\alpha^3+\beta^3$.

A1 for the correct answer $\left\{-\frac{117}{2}\right\}$ oe

(c)

M1 for expanding $(\alpha-\beta)^2=(\alpha+\beta)^2-B\alpha\beta$, where $B\neq 2$ or 0 **AND** for substituting **their** values for the Sum and Product **OR** for $(\alpha-\beta)^2=\alpha^2+\beta^2-2\alpha\beta$

A1 for answer as shown $\alpha-\beta=\sqrt{23}$

(d)

M1 for the **correct algebra** on the expansion of $(\alpha-\beta)^3$ to give either;

$(\alpha-\beta)\left((\alpha+\beta)^2-\alpha\beta\right)$ or $(\alpha-\beta)^3-3\alpha\beta(\alpha+\beta)$ or $(\alpha-\beta)(\alpha^2+\alpha\beta+\beta^2)$

A1 final answer as shown

ALT

M1 uses the given equation and substitutes *α* and *β,* and subtracts to give $\alpha^3-\beta^3=\frac{7(\alpha-\beta)-6(\alpha^2-\beta^2)}{2}$ and substitutes their values of $(\alpha-\beta)$ and $(\alpha^2-\beta^2)$ leading to a value for $\alpha^3-\beta^3$

A1 for the correct answer as shown.