Question	Scheme	Marks	AOs
1(i)	$\alpha+\beta+\gamma=\frac{3}{2},\ \alpha\beta+\alpha\gamma+\beta\gamma=\frac{5}{2}$	B1	3.1a
	$\alpha^2+\beta^2+\gamma^2=(\alpha+\beta+\gamma)^2-2(\alpha\beta+\alpha\gamma+\beta\gamma)=\left(\frac{3}{2}\right)^2-2\left(\frac{5}{2}\right)=...$	M1	1.1b
	$=-\frac{11}{4}=-2.75$ cso	A1	1.1b
		(3)	
(ii)	$\alpha\beta\gamma=-\frac{7}{2}$ or $x=\frac{3}{w}$ used in the equation	B1	2.2a
	$\frac{3}{\alpha}+\frac{3}{\beta}+\frac{3}{\gamma}=\frac{3(\alpha\beta+\alpha\gamma+\beta\gamma)}{\alpha\beta\gamma}=\frac{3\left(\frac{5}{2}\right)}{\left(-\frac{7}{2}\right)}$ or $2\left(\frac{3}{w}\right)^3-3\left(\frac{3}{w}\right)^2+5\left(\frac{3}{w}\right)+7=0\Rightarrow 7w^3+15w^2-27w+54\{=0\}$ $\Rightarrow\ -\frac{'15'}{'7'}$	M1	1.1b
	$=-\frac{15}{7}$ cso	A1	1.1b
		(3)	
(iii)	$(5-\alpha)(5-\beta)(5-\gamma)=A\pm B(\alpha+\beta+\gamma)\pm C(\alpha\beta+\alpha\gamma+\beta\gamma)\pm(\alpha\beta\gamma)$ $=\{5^3-5^2(\alpha+\beta+\gamma)+5(\alpha\beta+\alpha\gamma+\beta\gamma)-\alpha\beta\gamma\}$ or $2(5-w)^3-3(5-w)^2+5(5-w)+7\{=0\}$ or $f(x)=A(x-\alpha)(x-\beta)(x-\gamma)\Rightarrow A=2$	M1	3.1a
	$(5-\alpha)(5-\beta)(5-\gamma)=125-25\left(\frac{3}{2}\right)+5\left(\frac{5}{2}\right)+\frac{7}{2}$ or $(5-\alpha)(5-\beta)(5-\gamma)=-\left(\frac{2\times125-3\times25+25+7}{-2}\right)$ Or $-2w^3+27w^2-125w+207\{=0\}\Rightarrow-\frac{'207'}{'-2'}$ Or $f(5)=2(5-\alpha)(5-\beta)(5-\gamma)$ $\Rightarrow(5-\alpha)(5-\beta)(5-\gamma)=\frac{f(5)}{2}$	M1	1.1b

	$= \dfrac{207}{2} = 103.5$ cso	A1	1.1b
		(3)	
			(9 marks)

Notes

(i)
B1: Correct sum and pair sum, they may be seen anywhere in the candidates working.
M1: Uses a correct identity and substitutes in their sum and pair sum to find a value.
A1: Correct value following B1, if uses $\alpha + \beta + \gamma = -\dfrac{3}{2}$ this can score B0 M1 A0 cso

(ii)
B1: Correct value for the product (may be seen anywhere in the candidates working) or for using $x = \dfrac{3}{w}$ in the given equation.
M1: Uses a correct identity and substitutes in their pair sum and product to obtain a value or multiplies through by w^3 to identify at least the required terms and finds their new sum.
A1: Correct value from correct pair sum and product cso
(iii)
M1: Correct strategy for obtaining the required value by expanding, must reach an expression for the form $A \pm B(\alpha + \beta + \gamma) \pm C(\alpha\beta + \alpha\gamma + \beta\gamma) \pm (\alpha\beta\gamma)$ may not be factorised for example.

$$A \pm B\alpha \pm B\beta \pm B\gamma \pm C\alpha\beta \pm C\alpha\gamma \pm C\beta\gamma \pm (\alpha\beta\gamma)$$

or
Attempts the correct linear transformation of the given equation and expands.
or
Uses $\mathrm{f}(x) = A(x-\alpha)(x-\beta)(x-\gamma)$ to find a value for A

M1: Uses their sum, pair sum and product to obtain a value. Allow recovery from a sign slip as long as substituting into an expression of the form $A \pm B(\alpha + \beta + \gamma) \pm C(\alpha\beta + \alpha\gamma + \beta\gamma) \pm (\alpha\beta\gamma)$.
This would be A0 even if the correct answer is achieved.
or
Simplifies to obtain at least the required terms to find a value for the new product. Ignore the other terms whether correct or not.
Or
Uses $\dfrac{\mathrm{f}(5)}{2}$

A1: Correct value with no errors seen cso