Question	Scheme	Marks	AOs
2	$w = 2z + 1 \Rightarrow z = \frac{w-1}{2}$	B1	3.1a
	$\left(\frac{w-1}{2}\right)^3 - 3\left(\frac{w-1}{2}\right)^2 + \left(\frac{w-1}{2}\right) + 5 = 0$	M1	3.1a
	$\frac{1}{8}\left(w^3 - 3w^2 + 3w - 1\right) - \frac{3}{4}\left(w^2 - 2w + 1\right) + \frac{w-1}{2} + 5 = 0$		
	$w^3 - 9w^2 + 19w + 29 = 0$	M1 A1 A1	1.1b 1.1b 1.1b
		(5)	
ALT 1	$\alpha + \beta + \gamma = 3, \alpha\beta + \beta\gamma + \alpha\gamma = 1, \alpha\beta\gamma = -5$	B1	3.1a
	New sum = $2(\alpha + \beta + \gamma) + 3 = 9$	M1	3.1a
	New pair sum = $4(\alpha\beta + \beta\gamma + \gamma\alpha) + 4(\alpha + \beta + \gamma) + 3 = 19$		
	New product = $8\alpha\beta\gamma + 4(\alpha\beta + \beta\gamma + \gamma\alpha) + 2(\alpha + \beta + \gamma) + 1 = -29$		
	$w^3 - 9w^2 + 19w + 29 = 0$	M1 A1 A1	1.1b 1.1b 1.1b
		(5)	
		(5 marks)	

Notes

B1: Selects the method of making a connection between *z* and *w* by writing $z = \frac{w-1}{2}$

M1: Applies the process of substituting their $z = \frac{w-1}{2}$ into $z^3 - 3z^2 + z + 5 = 0$

(Allow *z* = 2*w* + 1)

M1: Manipulates their equation into the form $w^3 + pw^2 + qw + r (= 0)$ having substituted their *z* in terms of *w*. Note that the "= 0" can be missing for this mark.

A1: At least two of *p*, *q*, *r* correct. Note that the "= 0" can be missing for this mark.

A1: Fully correct equation including "= 0"

The first 4 marks are available if another letter is used instead of *w* but the final answer must be in terms of *w*.

ALT1

B1: Selects the method of giving three correct equations containing α, β and γ

M1: Applies the process of finding the new sum, new pair sum, new product

M1: Applies $w^3 - (\text{new sum})w^2 + (\text{new pair sum})w - (\text{new product})(= 0)$

or identifies *p* as –(new sum) *q* as (new pair sum) and *r* as –(new product)

A1: At least two of *p*, *q*, *r* correct.

A1: Fully correct equation including "= 0"

The first 4 marks are available if another letter is used instead of *w* but the final answer must be in terms of *w*.