Question	Scheme	Marks	AOs
6(a)	$4x^3+px^2-14x+q=0 \Rightarrow x^3+\frac{p}{4}x^2-\frac{14}{4}x+\frac{q}{4}=0$ $\alpha+\beta+\gamma=-\frac{p}{4}$ $\alpha\beta+\alpha\gamma+\beta\gamma=-\frac{14}{4}$ or $-\frac{7}{2}$	B1	3.1a
	$(\alpha+\beta+\gamma)^2=\alpha^2+\beta^2+\gamma^2+2(\alpha\beta+\alpha\gamma+\beta\gamma)$ $\left(-\frac{p}{4}\right)^2=16+2\left(-\frac{7}{2}\right)\Rightarrow p=\ldots$ or $(\alpha+\beta+\gamma)^2-2(\alpha\beta+\alpha\gamma+\beta\gamma)=\alpha^2+\beta^2+\gamma^2$ $\left(-\frac{p}{4}\right)^2-2\left(-\frac{7}{2}\right)=16\Rightarrow p=\ldots$	M1	3.1a
	$p=12$ * cso	A1*	1.1b
		(3)	
(b)	$\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}=\frac{\beta\gamma+\alpha\gamma+\alpha\beta}{\alpha\beta\gamma}$	M1	1.1b
	$\frac{\left(-\frac{7}{2}\right)}{\left(\frac{-q}{4}\right)}=\frac{14}{3}\Rightarrow q=\ldots$	M1	1.1b
	$q=3$	A1	1.1b
		(3)	
	Alternative $4(\frac{1}{w})^3+12(\frac{1}{w})^2-14(\frac{1}{w})+q\{=0\}$	M1	1.1b
	$qw^3-14w^2+12w+4=0\Rightarrow\frac{14}{3}=-\frac{-14}{q}\Rightarrow q=\ldots$	M1	1.1b
	$q=3$	A1	1.1b
		(3)	
(c)	$(\alpha-1)(\beta-1)(\gamma-1)=\ldots$ $=\alpha\beta\gamma-(\alpha\beta+\alpha\gamma+\beta\gamma)+(\alpha+\beta+\gamma)-1$	M1 A1	1.1a 1.1b
	$=\left(-\frac{\text{their } 3}{4}\right)-\left(-\frac{7}{2}\right)+\left(-\frac{12}{4}\right)-1=\ldots$	dM1	1.1b
	$=-\frac{5}{4}$	A1	1.1b
		(4)	
Alt	$4(x+1)^3+12(x+1)^2-14(x+1)+\text{'3'}\{=0\}$ or substitutes in 1	M1	1.1a
	$=\ldots4+\ldots12+\ldots-14+\text{'3'}=5$ or $4x^3+24x^2+22x+2+$ 'their q'	A1ft	1.1b

	$= -\frac{\text{'their constant'}}{4}$	dM1	1.1b
	$= -\frac{5}{4}$	A1	1.1b

(10 marks)

Notes:

(a)

B1: Identifies the correct values for the sum and pair sum. This may be implied by substituting into an equation, it must be clear

M1: Uses the correct identity and values of their sum **and** their pair sum to find a value of p

A1*: $p = 12$ cso there is no need to see a reason

(b)

M1: Establishes a correct identity

M1: Uses their identity and their pair sum and their product of roots to find a value of q. Condone a slip but the intention must be clear.

A1: $q = 3$ Allow this mark from incorrect sign of both pair sum and product

Alternative

M1: Uses $x = \frac{1}{w}$ the substitution

M1: Simplifies to an quartic equation of the form $aw^3 + bw^2 + cw + d = 0$ and uses $\frac{14}{3} = -\frac{b}{a}$to find a value for q

A1: $q = 3$

(c)

M1: Attempts to multiply out the three brackets.

A1: Correct expansion.

dM1: Dependent on previous method**.** Substitutes in the value of their sum, pair sum and the value of their product as appropriate. Condone a slip but the intention must be clear

A1: Correct value

Alternative

M1: Substitutes (x + 1) or x = 1 into the cubic with their value of q. Allow the use of different letters e.g. (w + 1)

A1ft: Correct constant terms, follow through on their value of q

dM1: Applies $-\frac{\text{'their constant'}}{4}$

A1: Correct value