

Question	Scheme	Marks	AOs
1(i)	$\alpha + \beta + \gamma = 8, \quad \alpha\beta + \beta\gamma + \gamma\alpha = 28, \quad \alpha\beta\gamma = 32$	B1	3.1a
	$\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} = \frac{\beta\gamma + \alpha\gamma + \alpha\beta}{\alpha\beta\gamma}$	M1	1.1b
	$= \frac{7}{8}$	A1ft	1.1b
		(3)	
(ii)	$(\alpha + 2)(\beta + 2)(\gamma + 2) = (\alpha\beta + 2\alpha + 2\beta + 4)(\gamma + 2)$	M1	1.1b
	$= \alpha\beta\gamma + 2(\alpha\beta + \alpha\gamma + \beta\gamma) + 4(\alpha + \beta + \gamma) + 8$	A1	1.1b
	$= 32 + 2(28) + 4(8) + 8 = 128$	A1	1.1b
		(3)	
	Alternative:		
	$(x - 2)^3 - 8(x - 2)^2 + 28(x - 2) - 32 = 0$	M1	1.1b
	$= \dots - 8 + \dots - 32 + \dots - 56 - 32 = -128$	A1	1.1b
	$\therefore (\alpha + 2)(\beta + 2)(\gamma + 2) = 128$	A1	1.1b
	(3)		
(iii)	$\alpha^2 + \beta^2 + \gamma^2 = (\alpha + \beta + \gamma)^2 - 2(\alpha\beta + \alpha\gamma + \beta\gamma)$	M1	3.1a
	$= 8^2 - 2(28) = 8$	A1ft	1.1b
		(2)	

(8 marks)

Notes:

(i)

B1: Identifies the correct values for all 3 expressions (can score anywhere)

M1: Uses a correct identity

A1ft: Correct value (follow through their 8, 28 and 32)

(ii)

M1: Attempts to expand

A1: Correct expansion

A1: Correct value

Alternative:

M1: Substitutes $x - 2$ for x in the given cubic

A1: Calculates the correct constant term

A1: Changes sign and so obtains the correct value

(iii)

M1: Establishes the correct identity

A1ft: Correct value (follow through their 8, 28 and 32)