Question number	Scheme	Marks
9 (a)	$x^2 - \text{sum} \times x + \text{product} = 0$	
	$x^2 + \frac{5}{2}x - 5 = 0$	
	$2x^2 + 5x - 10 = 0$ or integer multiples	M1A1 (2)
(b) (i)	$\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta = \left(\frac{25}{4}\right) + 10 = \frac{65}{4}$	M1A1
(ii)	$(\alpha+\beta)^3 = \alpha^3 + 3\alpha^2\beta + 3\alpha\beta^2 + \beta^3$	
	$\Rightarrow \alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta) = -\frac{125}{8} + 15\left(-\frac{5}{2}\right) = -\frac{425}{8}$	M1A1A1
	ALT	(5)
	$\alpha^3 + \beta^3 = (\alpha+\beta)(\alpha^2 - \alpha\beta + \beta^2) = \left(-\frac{5}{2}\right)\left(\frac{73}{4} + 5\right) = -\frac{425}{8}$	{M1A1A1}
	Product	
(c)	$\left(\alpha - \frac{1}{\alpha^2}\right) \times \left(\beta - \frac{1}{\beta^2}\right) = \left(\frac{\alpha^3 - 1}{\alpha^2}\right)\left(\frac{\beta^3 - 1}{\beta^2}\right) = \frac{\alpha^3\beta^3 - (\alpha^3 + \beta^3) + 1}{\alpha^2\beta^2}$	M1
	$= \frac{-125 - -\frac{425}{8} + 1}{36} = -\frac{567}{200}$	A1
	Sum	
	$\left(\alpha - \frac{1}{\alpha^2}\right) + \left(\beta - \frac{1}{\beta^2}\right) = \left(\frac{\alpha^3 - 1}{\alpha^2}\right) + \left(\frac{\beta^3 - 1}{\beta^2}\right)$	
	$= \frac{\alpha^3\beta^2 - \beta^2 + \alpha^2\beta^3 - \alpha^2}{\alpha^2\beta^2} = \frac{\alpha^2\beta^2(\alpha+\beta) - (\alpha^2 + \beta^2)}{\alpha^2\beta^2}$	M1
	$= \frac{25\left(-\frac{5}{2}\right) - \frac{65}{4}}{25} = -\frac{63}{20}$ oe	A1
	Equation	

	Sum $= -\frac{63}{20}$, Product $= -\frac{567}{200}$ $\Rightarrow x^2 + \frac{63}{20}x - \frac{567}{200} \ (=0)$ $x^2 + \frac{314}{100}x - \frac{567}{200} \ (=0)$ M1 $200x^2 + 630x - 567 = 0$ A1	M1A1 (6) [13]

Additional Notes			
Part	**M**	**Guidance**	
(a)	M1	Forms a quadratic equation with the given product and sum $\left(x^2 + \frac{5}{2}x - 5\right)$ = 0 not required for this mark. Allow y =... for this mark	
	A1	For $2x^2 + 5x - 10 = 0$ or equivalent equation with integer coefficients only. Look out for = 0 which must be present.	
(b) (i)	M1	Uses the **correct** algebra to form $\alpha^2 + \beta^2$ **and** substitutes the given values of the sum and product.	
	A1	For $\alpha^2 + \beta^2 = \frac{65}{4}$	
(ii)	M1	Uses the **correct** algebra to form an expression for $\alpha^3 + \beta^3$ For example; $\alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$ or $\alpha^3 + \beta^3 = (\alpha+\beta)(\alpha^2 - \alpha\beta + \beta^2)$	Their algebraic expansion must be sufficiently arranged to allow substitution of $\alpha^2 + \beta^2$, $\alpha + \beta$ and $\alpha\beta$
	A1	Substitutes the given values for the sum and product into their form of $\alpha^3 + \beta^3$	
	A1	For $\alpha^3 + \beta^3 = -\frac{425}{8}$ oe	
(c)	M1	**Product** For the **correct** algebra to achieve $\frac{\alpha^3\beta^3 - (\alpha^3+\beta^3) + 1}{\alpha^2\beta^2}$ or $\alpha\beta - \left(\frac{\alpha^3+\beta^3}{\alpha^2\beta^2}\right) + \frac{1}{\alpha^2\beta^2}$ and substitutes their $(\text{product})^3$, $(\text{product})^2$ and their $\alpha^3 + \beta^3$ Their algebra must be sufficient to substitute $\alpha\beta$, $\alpha^3 + \beta^3$ and $\alpha^2\beta^2$ in directly.	
	A1	Product $= -\frac{567}{200}$ oe	
	M1	**Sum** For the **correct** algebra to achieve $\frac{\alpha^2\beta^2(\alpha+\beta) - (\alpha^2+\beta^2)}{\alpha^2\beta^2}$ or $\alpha + \beta - \left(\frac{\alpha^2+\beta^2}{\alpha^2\beta^2}\right)$ (but in a from where the sum and product can be substituted) and substitutes their $(\text{product})^2$ and their $\alpha^2 + \beta^2$	