Question	Scheme	Marks	AOs
5 (a)(i)	$\mathrm{f}(x) = x^3 + ax^2 - ax + 48,\ x \in \mathbb{R}$		
	$\mathrm{f}(-6) = (-6)^3 + a(-6)^2 - a(-6) + 48$	M1	1.1b
	$= -216 + 36a + 6a + 48 = 0 \Rightarrow 42a = 168 \Rightarrow a = 4$ *	A1*	1.1b
(a)(ii)	Hence, $\mathrm{f}(x) = (x+6)(x^2 - 2x + 8)$	M1	2.2a
		A1	1.1b
		(4)	
(b)	$2\log_2(x+2) + \log_2 x - \log_2(x-6) = 3$		
	E.g. • $\log_2(x+2)^2 + \log_2 x - \log_2(x-6) = 3$ • $2\log_2(x+2) + \log_2\left(\dfrac{x}{x-6}\right) = 3$	M1	1.2
	$\log_2\left(\dfrac{x(x+2)^2}{(x-6)}\right) = 3$ $\left[\text{or } \log_2\left(x(x+2)^2\right) = \log_2\left(8(x-6)\right)\right]$	M1	1.1b
	$\left(\dfrac{x(x+2)^2}{(x-6)}\right) = 2^3$ $\left\{\text{i.e. } \log_2 a = 3 \Rightarrow a = 2^3 \text{ or } 8\right\}$	B1	1.1b
	$x(x+2)^2 = 8(x-6) \Rightarrow x(x^2 + 4x + 4) = 8x - 48$		
	$\Rightarrow x^3 + 4x^3 + 4x = 8x - 48 \Rightarrow x^3 + 4x^3 - 4x + 48 = 0$ *	A1 *	2.1
		(4)	
(c)	$2\log_2(x+2) + \log_2 x - \log_2(x-6) = 3 \Rightarrow x^3 + 4x^3 - 4x + 48 = 0$		
	$\Rightarrow (x+6)(x^2 - 2x + 8) = 0$		
	Reason 1: E.g. • $\log_2 x$ is not defined when $x = -6$ • $\log_2(x-6)$ is not defined when $x = -6$ • $x = -6$, but $\log_2 x$ is only defined for $x > 0$ Reason 2: • $b^2 - 4ac = -28 < 0$, so $(x^2 - 2x + 8) = 0$ has no (real) roots		
	At least one of Reason 1 or Reason 2	B1	2.4
	Both Reason 1 and Reason 2	B1	2.1
		(2)	
			(10 marks)

Question 5 Notes:

(a)(i)	
M1:	Applies $\mathbf{f(-6)}$
A1*:	Applies $\mathbf{f(-6)=0}$ to show that $\boldsymbol{a=4}$
(a)(ii)	
M1:	Deduces $\mathbf{(x+6)}$ is a factor of $\mathbf{f(x)}$ and attempts to find a quadratic factor of $\mathbf{f(x)}$ by either equating coefficients or by algebraic long division
A1:	$(x+6)(x^2-2x+8)$
(b)	
M1:	Evidence of applying a correct law of logarithms
M1:	Uses correct laws of logarithms to give either • an expression of the form $\log_2(\mathrm{h}(x))=k$, where *k* is a constant • an expression of the form $\log_2(\mathrm{g}(x))=\log_2(\mathrm{h}(x))$
B1:	Evidence in their working of $\log_2 a=3 \Rightarrow a=2^3$ or 8
A1*:	Correctly proves $x^3+4x^3-4x+48=0$ with no errors seen
(c)	
B1:	See scheme
B1:	See scheme