Question Number	Scheme	Marks
6 (a)	$2\log_4\left(x+3\right)=\log_4\left(x+3\right)^2$ or $\frac{1}{2}=\log_4 2$ o.e	B1
	Combines two terms e.g. $2\log_4\left(x+3\right)+\log_4 x=\log_4 x\left(x+3\right)^2$	M1
	e.g. $x\left(x+3\right)^2=2\left(4x+2\right)$	A1
	e.g. $x\left(x^2+6x+9\right)=8x+4\Rightarrow x^3+6x^2+x-4=0$ *	A1*
		(4)
(b) (i)	$x^3+6x^2+x-4=\left(x+1\right)\left(x^2+5x-4\right)$	M1
	$x=\frac{-5\pm\sqrt{25+16}}{2}\Rightarrow x=\frac{-5\pm\sqrt{41}}{2}$	dM1 A1
		(3)
(ii)	$x=\frac{-5+\sqrt{41}}{2}$	B1
		(1)
		(8 marks)

(a) **Do not penalise the omission of base 4 in their working provided the terms and values are consistent with base 4.**

B1: Writes (or may be implied by further work)

- $2\log_4\left(x+3\right)$ as $\log_4\left(x+3\right)^2$ **or**
- $\frac{1}{2}$ as $=\log_4 2$

M1: Correctly combines (at least) **two of the original terms**. e.g.

- $2\log_4\left(x+3\right)+\log_4 x=\log_4 x\left(x+3\right)^2$ is M1 but $2\log_4\left(x+3\right)+\log_4 x=2\log_4 x\left(x+3\right)$ is M0
- $\log_4\left(4x+2\right)-\log_4 x=\log_4\left(\frac{4x+2}{x}\right)$ is M1
- $\log_4\left(4x+2\right)+\frac{1}{2}=\log_4\left(8x+4\right)$ is M1

Do not penalise if they subsequently make errors or apply laws incorrectly. May be implied if they proceed to an equation not involving logs e.g. $x\left(x+3\right)^2=2(4x+2)$ (but not the given answer)

Beware that $2\log(x+3)+\log x=2\log x(x+3)=\log x(x+3)^2$ is B1M0A0A0

A1: A correct intermediate equation not involving logs (but not the given answer).

Must follow correct log work. e.g. $\frac{\log_4 x(x+3)^2}{\log_4(4x+2)}=\frac{1}{2}\Rightarrow\frac{x(x+3)^2}{(4x+2)}=2$ is A0

A1*: Correct proof. Expect to see

- a correct equation not involving logs which is not the final answer
- the brackets multiplied out $(x+3)^2$ or $(x^2+3x)(x+3)$ before proceeding to the given answer.

Do not allow this mark for recovery from incorrect log work but allow invisible brackets to be "recovered" or implied if the intention is clear.

(b) (i) **Answers with no working score 0 marks in (b)(i)**

M1: Divides by $(x+1)$. May be implied by a correct quadratic. May be seen as the quotient if attempting algebraic division. If via division look for $\left(x+1\right)\left(x^2 \pm 5x....\right)$ or via inspection $\left(x+1\right)\left(x^2 \pm ....x \pm 4\right)$

dM1: Attempts to find the roots of their quadratic factor (usual rules for solving a quadratic). Accept solving the quadratic via a calculator (you may need to check this). Condone decimals to 2sf for this mark. e.g. may see 0.70 or -5.7
Note that if there are multiple attempts to solve the quadratic (including via a calculator so roots may be stated) then mark the one which scores the most marks).

A1: $\left(x=\right)\dfrac{-5\pm\sqrt{41}}{2}$ or exact equivalent e.g. $-2.5\pm\sqrt{10.25}$ (Do not accept decimal answers but isw if seen after an exact answer is seen)
Ignore the presence or absence of $x=-1$

(b)(ii) **This mark can only be scored provided $\left(x=\right)\dfrac{-5+\sqrt{41}}{2}$ (or awrt 0.702) is found in (i), even if this is via solving the cubic on a calculator**

B1: $x=\dfrac{-5+\sqrt{41}}{2}$ or exact equivalent ONLY (accept awrt 0.702 if given in (b)(i)) If both answers are present then they must indicate they have chosen $x=\dfrac{-5+\sqrt{41}}{2}$ e.g circling or ticking (or putting a cross by the other one)

Question Number	Scheme	Marks
7.(a)	Attempts to use $4000 = 300 + 11d$ to find 'd'	M1
	Uses $300 + 3"d"$	M1
	Wheat production in year 4 is awrt 1310 (to the nearest 10) (tonnes)	A1
		(3)
(b)	Attempts to use $4000 = 300r^{11}$ to find 'r'	M1
	Finds $r = (1.266...)$ and MULTIPLIES this by 300	M1
	Wheat production in year 2 is awrt 380 (to the nearest 10) (tonnes)	A1
		(3)
(c)	Attempts $\frac{12}{2}\{300 + 4000\}$ or $\frac{300\left("1.266..."^{12} - 1\right)}{"1.266..." - 1}$	M1
	Finds $\frac{12}{2}\{300 + 4000\} - \frac{300\left("1.266..."^{12} - 1\right)}{"1.266..." - 1} = (25800 - 17935)$	dM1
	Difference = 7860 but allow 7870 (tonnes) (not AWRT)	A1
		(3)
		(9 marks)

Condone slips copying 300 and 4000 if they lose or gain an extra 0 in all parts

(a)

M1: Attempts to use the AP formula in an attempt to find 'd'
Accept an attempt at $4000 = 300 + 11d$ resulting in a value for d.
Accept the calculation $\frac{4000 - 300}{11}$ proceeding to a value (condoning slips)
May be implied by $\frac{3700}{11}$ or awrt 336

M1: Attempts to find the **fourth term** (do not allow a misread) by attempting $300 + 3 \times "336"$.
You may award this following an "incorrect" AP formula with $12d$ being used instead of $11d$. e.g.
$4000 = 300 + 12d$ or more likely $\frac{4000 - 300}{12}$ usually leading to an answer of 1225.
If no method seen to find d then it must be correct.

A1: awrt 1310 (**to the nearest 10**) (tonnes) isw once a correct answer is seen.

Alt (a)

M1: Forms the equation $\frac{x - 300}{4000 - 300} = \frac{4 - 1}{12 - 1}$ or may be implied by further work

M1: Rearranges the equation to $x = 300 + \frac{4 - 1}{12 - 1} \times (4000 - 300)$ or allow this mark for $x = 300 + \frac{4}{12} \times (4000 - 300)$

A1: awrt 1310 (**to the nearest 10**) (tonnes) isw once a correct answer is seen.