Question	Scheme	Marks	AOs
9(a)	$2p$	B1	1.1b
		(1)	
(b)	$\log_a 100 = \log_a 4 + \log_a 25$	M1	1.2
	$\log_a 16^{\frac{1}{2}} + \log_a 25 = \frac{1}{2}p + q$	A1	1.1b
		(2)	
(c)	e.g. $\log_a 80 \times \log_a 3.2 = (\log_a 16 + \log_a 5) \times (\log_a 16 - \log_a 5)$	M1	3.1a
	$\left(p + \frac{1}{2}q\right) \times \left(p - \frac{1}{2}q\right)$ or $p^2 - \frac{1}{4}q^2$	A1	1.1b
		(2)	
			(5 marks)

Notes

(a)

B1: $2p$ o.e.

(b)

M1: Uses the laws of logs to write $\log_a 100$ correctly as a sum of logs

e.g. $\log_a 100 = \log_a 4 + \log_a 25$ e.g. $\log_a 100 = \log_a 4 + \log_a a^q$

e.g. $\log_a 100 = 2\log_a 2 + 2\log_a 5$

e.g. $\log_a 100 = \frac{1}{2}\log_a 16 + \frac{1}{2}\log_a 625$

e.g. $\log_a 100 = \log_a 50 + \log_a 2$

May also be implied by expressions in p or q or a mixture of both

e.g.

$(p + q =) \log_a 16 + \log_a 25 = \log_a 400 = \log_a 4 + \log_a 100 \Rightarrow p + q - \log_a 4 = \log_a 100$

Look out for more complex versions of above e.g. e.g. $\log_a 100 = \log_a 4 + \log_a a^q$ which are acceptable.

Do not penalise the omission of base a

A1: $\frac{1}{2}p + q$ o.e. Correct answer scores full marks but withhold this mark if incorrect log work is seen e.g. $\log_a 100 = \log_a 4 \times \log_a 25$ or $\log_a 100 = 4\log_a 25$

(c)

M1: Uses both the addition and subtraction laws of logs to write the **full expression** of $\log_a 80 \times \log_a 3.2$ correctly in terms of any of the following:

- $\log_a 16 \ (= p)$
- $\log_a 4 \left(= \frac{p}{2}\right)$
- $\log_a 2 \left(= \frac{p}{4}\right)$
- $\log_a 5 \left(= \frac{q}{2}\right)$
- $\log_a 25 \ (= q)$

e.g. $\log_a 80 \times \log_a 3.2 = (2\log_a 4 + \log_a 5) \times (\log_a 16 - \log_a 5)$

You may see other viable solutions using e.g. $\log_a \frac{1}{5}$, $\log_a \frac{1}{4}$ but they will need to proceed to either e.g. $\log_a 5$ (an integer value) or proceed to an expression in terms of p or q

Do not penalise the omission of base a.

May be implied by equivalent expressions in p or q or a mixture of both.

A1: $\left(p + \frac{1}{2}q\right) \times \left(p - \frac{1}{2}q\right)$ or $p^2 - \frac{1}{4}q^2$ o.e. (does not need to be simplified)

Correct answer scores full marks but withhold this mark if incorrect log work is seen in their solution. isw once a correct answer in terms of p and q is seen.