Question Number	Scheme	Marks
3.(a)	Implies equation of line is of the form $\log_{10} y = \pm\frac{2}{3}\log_{10} x + 4$	M1
	States $\log_{10} y = -\frac{2}{3}\log_{10} x + 4$ o.e.	A1
		(2)
(b)	Applies one correct log law E.g $\log_{10} y = -\frac{2}{3}\log_{10} x + 4 \rightarrow \log_{10} y = \log_{10} x^{-\frac{2}{3}} + 4$	M1
	Full attempt to undo the logs $\log_{10} y = \log_{10} x^{-\frac{2}{3}} + \log_{10} 10^4 \rightarrow y = x^{-\frac{2}{3}} \times 10^4$	dM1
	$\rightarrow y = 10\,000x^{-\frac{2}{3}}$ o.e.	A1
		(3)
		5 marks

Note that other versions of $\log_{10}$ are acceptable. So allow $\log_{10} \leftrightarrow \log$ and $\log_{10} \leftrightarrow \lg$

(a)

M1 Implies equation of line is of the form $\log_{10} y = \pm\frac{2}{3}\log_{10} x + 4$ oe

(Eg allow for M1 A0 $\log_{10} y = \pm 0.67\log_{10} x + 4$) Condone $"y" = \pm\frac{2}{3}"x" + 4$ here

A1 $\log_{10} y = -\frac{2}{3}\log_{10} x + 4$ oe such as $3\log_{10} y + 2\log_{10} x = 12$

Allow unsimplified equations such as $\log_{10} y = -\frac{4}{6}\log_{10} x + 4$

This may be implied by the constants if the full equation is used in part (b).
So marks in (a) can be awarded from work in (b).

(b) **Main Method: Starting from $\log_{10} y = a\log_{10} x + b$ and working towards $y = px^q$**

M1 Uses one correct log law. Look for either

$\log_{10} y = a\log_{10} x + b \rightarrow \log_{10} y = \log_{10} x^a + b$

$\log_{10} y = a\log_{10} x + b \rightarrow \log_{10} y = a\log_{10} x + \log_{10} 10^b$

$\log_{10} y = a\log_{10} x + b \rightarrow y = 10^{a\log_{10} x + b}$

dM1 A full attempt to get y in terms of x or values of p and q
Cannot be awarded from easier equations, e.g. where $b = 0$

Look for $\log_{10} y = a\log_{10} x + b \rightarrow y = x^a \times 10^b$

A1 $y = 10\,000x^{-\frac{2}{3}}$ but condone $y = 10^4 x^{-\frac{2}{3}}$

This requires the equation and not just the values of p and q
It is acceptable to just write down the answer, but it must follow a correct part (a)

.....

Method Two: Starting from $y = px^q$ **and working towards** $\log_{10} y = a\log_{10} x + b$**.**

M1 Takes $\log_{10}$ of both sides and uses one correct log law

E.g. proceeds to $\log_{10} y = \log_{10} p + \log_{10} x^q$

dM1 Proceeds to $\log_{10} y = \log_{10} p + q\log_{10} x$ and finds p and q using $\log_{10} p = '4'$ and $q = '-\frac{2}{3}'$

A1 $y = 10\,000x^{-\frac{2}{3}}$ or $y = 10^4 x^{-\frac{2}{3}}$

Condone $\log_{10} \leftrightarrow \log$ throughout

This requires the equation and not just the values of p and q

.....

Alt (b) using the alternative equation in (a)

Method Three: Starting from $a\log_{10} y + b\log_{10} x = c$ **and working towards** $y = px^q$

M1 Uses correct log laws to combine the two terms on the lhs

Eg: $3\log_{10} y + 2\log_{10} x = 12 \Rightarrow \log_{10} y^3 x^2 = 12$

dM1 Undoes the logs and makes y the subject $\Rightarrow y^3 x^2 = 10^{12} \Rightarrow y^3 x^2 = 10^{12} \Rightarrow y = \sqrt[3]{\frac{10^{12}}{x^2}}$

A1 $y = 10\,000x^{-\frac{2}{3}}$ or $y = 10^4 x^{-\frac{2}{3}}$

.....

Method 4: Using the coordinates

M1: Finds either p or q using one of the coordinates.

Look for either

using $(\log_{10} x, \log_{10} y) = (0,4) \Rightarrow x = 1, y = 10000$ and then substituting into $y = px^q \Rightarrow p = 10^4$

Condone slips here for the method mark

Or using $(\log_{10} x, \log_{10} y) = (6,0) \Rightarrow x = 10^6, y = 1$ and the substituting into

$y = 10^4 \times x^q \Rightarrow 1 = 10^4 \times 10^{6q} \Rightarrow q = ...$ **C**ondone slips here for the method mark

dM1 Finds both p and q using both coordinates. (See above)

A1 $y = 10\,000x^{-\frac{2}{3}}$

.....

Partially correct answers without any work

If you see any partially correct answers, e.g. $y = 4x^{-\frac{2}{3}}$, without working, award SC 100.

Question Number	Scheme	Marks
4. (i) (a)	$f'(x)=\dfrac{4(x-3)(2x+5)-(2x+5)^2}{(x-3)^2}$ or $\dfrac{(x-3)(8x+20)-(4x^2+20x+25)}{(x-3)^2}$	M1 A1
	$=\dfrac{(2x+5)(2x-17)}{(x-3)^2}$	M1 A1
(b)	Attempts both critical values or finds one "correct" end	M1
	$x<-2.5,\ x>8.5$ (accept $x\leqslant -2.5,\ x\geqslant 8.5$)	A1
		(6)
(ii)	Attempts the chain rule on $(\sin 4x)^{\frac{1}{2}}\rightarrow A(\sin 4x)^{-\frac{1}{2}}\times\cos 4x$	M1
	$g(x)=x(\sin 4x)^{\frac{1}{2}}\Rightarrow g'(x)=(\sin 4x)^{\frac{1}{2}}+x\times\dfrac{1}{2}(\sin 4x)^{-\frac{1}{2}}4\cos 4x$	M1 A1
	Sets $g'(x)=0\rightarrow(\sin 4x)^{\frac{1}{2}}+x\times\dfrac{2\cos 4x}{(\sin 4x)^{\frac{1}{2}}}=0$ and $\times\dfrac{(\sin 4x)^{\frac{1}{2}}}{\cos 4x}$ oe	M1
	$\rightarrow\tan 4x+2x=0$	A1
		(5)
		11 marks

(i)(a)

M1 Attempts the quotient rule and achieves

$$f'(x)=\frac{A(x-3)(2x+5)-B(2x+5)^2}{(x-3)^2}\quad A,B>0 \text{ condoning slips}$$

Alternatively uses the product rule and achieves

$$\frac{d}{dx}\left\{(x-3)^{-1}(2x+5)^2\right\}=\pm A(2x+5)^2(x-3)^{-2}+B(x-3)^{-1}(2x+5)\quad A,B>0$$

They may attempt to multiply out the $(2x+5)^2$ first which is fine as long as they reach a 3TQ.

A1 Score for correct unsimplified $f'(x)$

M1 Attempts to take out a factor of $(2x+5)$ or multiplies out and attempts to factorise the numerator.

The method must be seen $\dfrac{(x-3)4(2x+5)\pm(2x+5)^2}{...}=\dfrac{(2x+5)\{(x-3)4\pm(2x+5)\}}{...}$ condoning slips.

If the method is not seen it may be implied by a correct result for their fraction

This can be achieved from an incorrect quotient or product rule. E.g. $\dfrac{vu'+uv'}{v^2}$ or $\dfrac{vu'-uv'}{v}$

It can be scored by candidates who multiply out their numerators and then factorise by taking out a factor of $(2x+5)$

If the product rule is used it would be for writing as a single fraction and taking out, from the numerator, a common factor of $(2x+5)$.

A1 $\dfrac{(2x+5)(2x-17)}{(x-3)^2}$ but accept expressions such as $\dfrac{4(x+2.5)(x-8.5)}{(x-3)^2}$ or $\dfrac{(2x+5)(2x-17)}{(x-3)(x-3)}$

Note the final two marks in (i)(a) may be scored in (i)(b), ONLY IF the correct work is done on the complete fraction, not just the numerator

(i)(b)