Question Number	Scheme	Marks
2 (a) (i)	$\log_6 T = 4 - 2\log_6 x$	B1
(ii)	E.g. $\log_6 T = 4 - 2\log_6 216 \Rightarrow \log_6 T = 4 - 2\times 3 = -2 \Rightarrow T = ...$	M1
	$\Rightarrow T = 6^{-2} = \frac{1}{36}$	A1
		(3)
(b)	$\log_6 T = 4 - 2\log_6 x \Rightarrow T = 6^{4-2\log_6 x}$	M1
	$\Rightarrow T = 6^4 \times 6^{\log_6 x^{-2}}$	dM1
	$\Rightarrow T = \frac{1296}{x^2}$	A1
		(3)
		(6 marks)

Notes

Mark the question as a whole. Do not be concerned about part labelling.

(a)(i)

B1 Correct linear equation $\log_6 T = 4 - 2\log_6 x$ (oe) The 4 may be written as $\log_6 1296$

(ii)

M1 Substitutes $x = 216$ into an equation linking *T* and *x* arising from a linear equation in the logarithms and proceeds to make *T* the subject. They may have answered (b) first. Do not be concerned about the process for this mark. May be implied by awrt 0.028 following a correct equation.

A1 Correct value $T = \frac{1}{36}$. Do not accept 6^{-2}.

(b)

M1 Makes a first step towards achieving an answer. Use of a correct log rule or law **applied** at some stage in their attempt to eliminate logs from the equation.
As a rule of thumb this can be awarded for e.g.

- application of a power rule $-"2"\log_6 x = -\log_6 x^{"2"}$ or $"4" = \log_6 6^{"4"}$ or $4 \to 6^4$ (note that e.g. $\log_6 T = -2\log_6 x + 4 \to x^{-2} + 6^4$ implies this mark)
- an attempt to make *T* the subject. E.g. $\log_6 T = "4" - "2"\log_6 x \Rightarrow T = 6^{"4"-"2"\log_6 x}$

dM1 Full and complete method in proceeding from an equation of form $\log_6 T = a + b\log_6 x \ \left(a, b \neq 0\right)$ to an equation of form $T = k \times x^{\pm n}$ or equivalent. All log work must be correct but allow slips on coefficients.

A1 Achieves $T = \frac{1296}{x^2}$ or equivalent such as $Tx^2 = 1296$ and isw after a correct answer. Allow 6^4 for 1296.

Note: Allow the M marks if a different letter than *T* is used, e.g. *y*. But must be correct in terms of *T* and *x* for the A mark.

Question Number	Scheme	Marks
3 (i)	$\frac{\mathrm{d}}{\mathrm{d}x}\ln\left(\sin^2 3x\right)=\frac{1}{\sin^2 3x}\times 2\cancel{\sin 3x}\times 3\cos 3x=6\cot 3x$	M1 A1 **(2)**
(ii) (a)	$\frac{\mathrm{d}}{\mathrm{d}x}\left(3x^2-4\right)^6=36x\left(3x^2-4\right)^5$	M1 A1 **(2)**
(b)	$\int x\left(3x^2-4\right)^5\mathrm{d}x=\frac{1}{36}\left(3x^2-4\right)^6$	B1ft
	$\int_0^{\sqrt{2}} x\left(3x^2-4\right)^5\mathrm{d}x=\left[\frac{1}{36}\left(3x^2-4\right)^6\right]_0^{\sqrt{2}}=\frac{1}{36}(2)^6-\frac{1}{36}(-4)^6=-112$	M1 A1cso **(3)** **(7 marks)**

Notes

(i)

M1 Attempts to differentiate a ln function. Award for $\frac{\mathrm{d}}{\mathrm{d}x}\ln\left(\sin^2 3x\right)=\frac{1}{\sin^2 3x}\times\ldots$ where ... could be 1

An alternative could be $\frac{\mathrm{d}}{\mathrm{d}x}\ln\left(\sin^2 3x\right)=\frac{\mathrm{d}}{\mathrm{d}x}2\ln\left(\sin 3x\right)=(2\times)\frac{1}{\sin 3x}\times\ldots$ or

$\frac{\mathrm{d}}{\mathrm{d}x}\ln\left(\frac{1-\cos 6x}{2}\right)=\frac{2}{1-\cos 6x}\times\ldots$

A1 $6\cot 3x$ o.e. such as $\frac{6\cos 3x}{\sin 3x}$ or $\frac{6}{\tan 3x}$ or $6(\tan 3x)^{-1}$ but not $6\tan^{-1}3x$ Accept also $\frac{6\sin 6x}{1-\cos 6x}$ or $\frac{3\sin 6x}{\sin^2 3x}$ and isw after a suitably simplified answer.

Constant terms must be gathered and no uncancelled common factors in numerator and denominator.

(ii) (a)

M1 Achieves $\frac{\mathrm{d}}{\mathrm{d}x}\left(3x^2-4\right)^6=Ax\left(3x^2-4\right)^5$ where A is a constant which may be 1.

A1 $\frac{\mathrm{d}}{\mathrm{d}x}\left(3x^2-4\right)^6=36x\left(3x^2-4\right)^5$ oe. Need not be simplified. Isw after a correct answer.

(ii) (b)

B1ft $\int x\left(3x^2-4\right)^5\mathrm{d}x=\frac{1}{36}\left(3x^2-4\right)^6$ or $\frac{1}{A}\left(3x^2-4\right)^6$ following through on their (a) provided it is of the form $\frac{\mathrm{d}}{\mathrm{d}x}\left(3x^2-4\right)^6=Ax\left(3x^2-4\right)^5$ This may arise from attempts via substitution and can be scored from a restart if (ii)(a) was incorrect. Need not be simplified and isw if simplified incorrectly. Condone notation errors such as unneeded integral signs - mark the expression that is their attempt at the integration.

M1 Substitutes in both limits and subtracts (either way round) into an expression of the form $D\left(3x^2-4\right)^6$ where D is a constant but allow slips such as a missing power if the intention is clear.

Sight of the subtraction is sufficient. Implied by the correct answer for their integral if substitution not seen. If using integration by substitution they must be substituting the **correct** limits for their variable.