Question Number	Scheme	Marks
4.(a)	$x^2+0x+1\overline{)3x^3-5x^2+7x-5}$ $\quad 3x-5$ $3x^3+0x^2+3x$ $-5x^2+4x$ $-5x^2+0x-5$ $4x$	M1
	$\underline{A=3}, \quad B=-5, C=4$	<u>B1</u>, A1
	$D=0$ *	A1*
		(4)
(b)	$\int 3x-5+\frac{4x}{x^2+1}\,\mathrm{d}x=\frac{3x^2}{2}-5x+2\ln(x^2+1)+c$	M1, A1ft
	$\text{Area}=\left(\frac{3\times3^2}{2}-5\times3+2\ln(3^2+1)\right)-\left(\frac{3\times2^2}{2}-5\times2+2\ln(2^2+1)\right)$	
	$=\frac{5}{2}+\ln 4$	dM1, A1
		(4) **(8 marks)**

(a) **Method via division**

M1: Full attempt to divide producing a linear quotient $(...x+...)$ and linear remainder $(...x+...)$

B1: States $A = 3$ which may be awarded from the quotient line in the division sum $3x...$

This is an independent mark and can be awarded without sight of method

A1: $B = -5$ and $C = 4$ following the award of the M mark. May be awarded from within the division sum.

A1*: Requires

- fully correct division (see main scheme) with no constant within the remainder which proves that $D = 0$
- all previous marks to have been scored
- all constants stated or correct expression seen in (a) or (b)

If the candidates don't put in the $'0'x$ you would need to see something like the following work

$x^2+1\overline{)3x^3-5x^2+7x-5}$ $\quad 3x-5$

$3x^3\quad\quad+3x$

$-5x^2+4x-5$

$-5x^2\quad\quad-5$

$4x$

The remainder should be $4x$ and not $4x \pm 5$

To score the A1* line it must be fully correct division

(a) **Alternative method via identity**

M1: Sets $3x^3 - 5x^2 + 7x - 5 \equiv (Ax + B)\left(x^2 + 1\right) + Cx + D$ and finds values for A, B, and C

B1: States $A = 3$

This is an independent mark and can be awarded without sight of method

A1: $B = -5$ and $C = 4$ following the award of the M mark

A1*: This must be proven/shown and not just stated

For example:

Comparing terms in x^2, $\quad -5 = B \quad$ I

Comparing constant terms $\quad -5 = B + D \quad$ II

So $D = 0$

Look for a pair of relevant and correct equations which are correctly solved

All previous marks must have been scored

……

(b)

M1: $\int \frac{Cx}{x^2+1}\,\mathrm{d}x = k\ln(x^2+1)$ where k is a constant. You may see $k\ln u$ where $u = x^2 + 1$

Allow this to be scored from

$\int \frac{Cx+D}{x^2+1}\,\mathrm{d}x = \int \frac{Cx}{x^2+1}\,\mathrm{d}x + \int \frac{D}{x^2+1}\,\mathrm{d}x == k\ln(x^2+1) + \ldots$ where … is not $= m\ln(x^2+1)$

A1ft: $\int 3x - 5 + \frac{4x}{x^2+1}\,\mathrm{d}x = \frac{3x^2}{2} - 5x + 2\ln(x^2+1)$ but follow through on their A, B and C (with D =0)

Also accept versions such as $\frac{(3x-5)^2}{6} + 2\ln(u)$ where $u = x^2 + 1$

dM1: Substitutes 3 and 2 (o.e) into their integrated function (either way around) and correctly combines the two log terms. The limits must be consistent with their variable, so 3 and 2 for x and 10 and 5 for u. It is dependent upon having integrated to a form $\mathrm{f}(x) + \delta\ln(x^2+1)$ where $\mathrm{f}(x)$ is a quadratic expression

A1: CSO $\frac{5}{2} + \ln 4$ Note that $\frac{5}{2} + 2\ln 2$ is A0 as the form of the answer has to be $\alpha + \ln\beta$

Question Number	Scheme	Marks
5.(a)	$\frac{dy}{dx} = -10\sin 2x - 24\cos 2x$	M1, A1
	$\left.\frac{dy}{dx}\right\|_{x=\frac{\pi}{3}} = -10\sin\left(\frac{2\pi}{3}\right) - 24\cos\left(\frac{2\pi}{3}\right) = -5\sqrt{3} + 12$	A1
		(3)
(b)	$R = 13$	B1
	$\tan\alpha = \frac{12}{5} \Rightarrow \alpha =$ awrt 1.176	M1A1
		(3)
(c)	Sets $-26\sin(2x + 1.176) = 6$	M1
	$\sin(2x + "1.176") = -\frac{3}{13}$	A1 ft
	$x = \frac{\arcsin\left(-\frac{3}{13}\right) - 1.176}{2} =$ awrt 2.44	dM1, A1
		(4)
		(10 marks)

(a)

M1: Correct attempt at differentiation. Score for $\frac{dy}{dx} = p\sin 2x + q\cos 2x$

There may be attempts in which the double angle formulae have been used.

For example, $y = 5\cos 2x - 12\sin 2x = 5(\pm 2\cos^2 x \pm 1) - 24\sin x\cos x$

In such cases look for applications of the chain rule and product rules condoning slips in sign and loss of coefficients.

A1: $\frac{dy}{dx} = -10\sin 2x - 24\cos 2x$ which may be left un-simplified

If the double angle is used you should see $\frac{dy}{dx} = -20\sin x\cos x + 24\sin^2 x - 24\cos^2 x$

A1: Substitutes $x = \frac{\pi}{3}$ into a correct $\frac{dy}{dx}$ and achieves $-5\sqrt{3} + 12$ o.e.

It must follow the award of M1, A1. ISW after a correct answer

(b)

B1: $R = 13$. Allow for example 13.000 but not 12.99 followed by 13

Note that $\sqrt{169}$ or ± 13 is A0 unless followed by 13

M1: $\tan\alpha = \pm\frac{12}{5}, \tan\alpha = \pm\frac{5}{12} \Rightarrow \alpha = ...$ (Condone $\sin\alpha = 12, \cos\alpha = 5$ in the working)

If R is used to find α accept $\sin\alpha = \pm\frac{12}{R}$ or $\cos\alpha = \pm\frac{5}{R} \Rightarrow \alpha = ...$

A1: $\alpha =$ awrt 1.176 ISW after a correct answer so don't penalise if they then write $\sqrt{13}\cos(2x - 1.176)$