Question Number	Scheme	Marks
6(a)	$\frac{\mathrm{d}u}{\mathrm{d}x}=2$ or $\frac{\mathrm{d}x}{\mathrm{d}u}=\frac{1}{2}$	B1
	$\int \frac{(3x+2)^2}{2x-1}\mathrm{d}x=\int \frac{\left(3\frac{u+1}{2}+2\right)^2}{u}\frac{1}{2}\mathrm{d}u$	M1
	$=\frac{1}{8}\int\left(9u+42+\frac{49}{u}\right)\mathrm{d}u$	dM1
	$=\frac{1}{8}\left[\frac{9u^2}{2}+42u+49\ln u\right]$	A1
	$=\frac{1}{8}\left[\frac{9(9)^2}{2}+42(9)+49\ln(9)-\left(\frac{9(3)^2}{2}+42(3)+49\ln(3)\right)\right]$	M1
	$72+\frac{49}{8}\ln 3$ *	A1*
		(6)
(b)	$V=\pi\int\left(\frac{3x+2}{2\sqrt{2x-1}}\right)^2\mathrm{d}x=\frac{\pi}{4}\int\frac{(3x+2)^2}{2x-1}\mathrm{d}x$	M1
	$=\pi\left(18+\frac{49}{32}\ln 3\right)$	A1
		(2)
		Total 8

(a) Note if no algebraic integration is seen then max score B1M1dM1A0M0A0*
Correct answer with no working scores 0 marks

You may see other credit-worth methods e.g. partial fractions followed by substitution – send to review

B1: $\frac{\mathrm{d}u}{\mathrm{d}x}=2$ o.e such as $\frac{\mathrm{d}x}{\mathrm{d}u}=\frac{1}{2}$ or $\mathrm{d}u=2\mathrm{d}x$

M1: An attempt at a complete substitution in terms of u Look for $A\int\frac{(\text{linear expression in } u)^2}{u}(\mathrm{d}u)$ $A\neq 0$

Condone slips. The du may be implied by further work.

dM1: Proceeds to the form $\int\left(\alpha u+\beta+\frac{\gamma}{u}\right)(\mathrm{d}u)$ oe which may be unsimplified $\alpha,\ \beta,\ \gamma\neq 0$. It is dependent on the previous method mark.

A1: $\frac{1}{8}\left[\frac{9u^2}{2}+42u+49\ln u\right]$ oe (note may see e.g. $\frac{49}{8}\ln 8u$ for $\frac{49}{8}\ln u$) May be unsimplified

M1: Correct use of changed limits (3 and 9) within their integrand in 'u' of the form $pu^2+qu+r\ln ku$ or $x=2$ and $x=5$ within the integral of this form where 'u' has been changed back to $2x-1$

It cannot be for proceeding directly to the given answer which is M0 – must see some evidence of the use of limits.

A1*: Obtains the given answer with no errors seen and all previous marks scored. Condone invisible brackets to be recovered provided it is before the final answer. Do not penalise incorrect limits on the integral in their working, provided the correct values were substituted in to their integrand.

Note $= \frac{1}{8}\left[\frac{9u^2}{2} + 42u + 49\ln u\right]_3^9$ = given answer then M0A0*

(b)

M1: $V = K\pi \times$ answer to (a). Condone $K = 1$ Implied by $K\pi \times \left(72 + \frac{49}{8}\ln 3\right)$

A1: Correct exact answer (allow equivalent exact forms) e.g. $\frac{\pi}{4}\left(72 + \frac{49}{8}\ln 3\right)$ isw

Question Number	Scheme	Marks
7 (a)	$(1, 4.5)$	B1B1 **(2)**
(b)	Attempts $\dfrac{dy}{dx} = \dfrac{dy/d\theta}{dx/d\theta} = \dfrac{12\sin\theta\cos\theta}{-24\cos^2\theta\sin\theta} = \left(-\dfrac{1}{2\cos\theta}\right)$	M1A1
	Subs $\theta = \dfrac{\pi}{3}$ into $\dfrac{dy}{dx} \Rightarrow \dfrac{dy}{dx} = ...(=-1)$	dM1
	Uses gradient of normal with $(1, 4.5) \Rightarrow (y-4.5) = 1(x-1)$	ddM1
	$y = x + 3.5$	A1 **(5)**
(c)	Attempts $\int y\dfrac{dx}{d\theta}\,d\theta = \int 6\sin^2\theta \times -24\cos^2\theta\sin\theta\,d\theta$	M1A1
	Uses $\sin^2\theta = 1-\cos^2\theta \Rightarrow \int y\dfrac{dx}{d\theta}\,d\theta = \int A\left(\cos^2\theta\sin\theta - \cos^4\theta\sin\theta\right)d\theta$	dM1
	Area of trapezium= $\dfrac{1}{2}(3.5+4.5) = 4$	B1ft
	Attempts trapezium + area under curve $= \dfrac{1}{2}(3.5+4.5) - 144\int_{\frac{\pi}{3}}^{0} \sin^3\theta\cos^2\theta\,d\theta$	dM1
	Area $= 4 + 144\int_0^{\frac{\pi}{3}} \left(\sin\theta\cos^2\theta - \sin\theta\cos^4\theta\right)d\theta$ *	A1* **(6)**
(d)	Area $= 4 + 144\left[-\dfrac{\cos^3\theta}{3} + \dfrac{\cos^5\theta}{5}\right]_0^{\frac{\pi}{3}} = 4 + 144\left(\left(-\dfrac{1}{24} + \dfrac{1}{160}\right) - \left(-\dfrac{1}{3} + \dfrac{1}{5}\right)\right) = \dfrac{181}{10}$	M1A1A1 **(3)**
		(16 marks)

(a)

B1: Either of $(1, 4.5)$ Accept any exact equivalent for 4.5 (May be seen on a diagram) May be written separately e.g. $x = 1,\ y = 4.5$ Condone coordinates without brackets

B1: Both $(1, 4.5)$ Accept any exact equivalent for 4.5 (May be seen on a diagram) May be written separately e.g. $x = 1,\ y = 4.5$ Condone coordinates without brackets. isw once a correct pair is seen

Note for parts (b), (c) and (d) do not penalise incorrect notation provided the intention is clear or notation is recovered. E.g. $\sin\theta^2$ **for** $\sin^2\theta$**.**

(b)

M1: Attempts $\left(\dfrac{dy}{dx} =\right) \dfrac{dy/d\theta}{dx/d\theta}$ Allow e.g. $"12\sin\theta\cos\theta" \times \dfrac{1}{-24\cos^2\theta\sin\theta}$ or e.g. $"6\sin 2\theta" \times \dfrac{1}{-12\sin 2\theta\cos\theta}$ Condone poor differentiation on y and/or x provided the functions are both "changed". If the attempts at $\dfrac{dy}{d\theta}$ and $\dfrac{dx}{d\theta}$ are not seen separately then look for the formula stated or a