Question Number	Scheme	Marks
4(a)	e.g. $5+17x-10x^2 = A(2x+1)(1-x)+Bx(2x+1)+Cx(1-x)$ $\Rightarrow A=..., \ B=...., \ C=....$	M1
	$A=5, \ B=4, \ C=8 \Rightarrow \mathrm{f}(x)=\dfrac{5}{x}+\dfrac{4}{(1-x)}+\dfrac{8}{(2x+1)}$	A1A1
		(3)
(b)	$\displaystyle\int \frac{5}{x}+\frac{4}{(1-x)}+\frac{8}{(2x+1)}\,\mathrm{d}x = 5\ln\lvert x\rvert - 4\ln\lvert 1-x\rvert + 4\ln\lvert 2x+1\rvert \ (+c)$	M1A1ftA1
	$\left[5\ln\lvert x\rvert - 4\ln\lvert 1-x\rvert + 4\ln\lvert 2x+1\rvert\right]_2^4$ $=(5\ln 4 - 4\ln 3 + 4\ln 9)-(5\ln 2 - 4\ln 1 + 4\ln 5) = 5\ln 2 + 4\ln\left(\dfrac{3}{5}\right)$	dM1A1
		(5)
		(8 marks)

(a)

M1: Sets $5+17x-10x^2 = A(2x+1)(1-x)+Bx(2x+1)+Cx(1-x)$ condoning slips on the coefficients of $5+17x-10x^2$ only and finds values for *A*, *B* and *C*. The right-hand side must be correct. Do not be concerned how the values are formed, e.g. via substitution or simultaneous equations. Just look for a suitable identity followed by values for *A*, *B* and *C*.

A1: Two (out of three) correct values of $A=5, \ B=4, \ C=8$

A1: Accept either $A=5, \ B=4, \ C=8$ or $\dfrac{5}{x}+\dfrac{4}{(1-x)}+\dfrac{8}{(2x+1)}$ but condone $\dfrac{5}{x}-\dfrac{4}{(x-1)}+\dfrac{8}{(2x+1)}$ which is also correct (but not in the form requested).

(b)

M1: Attempts to integrate their $\dfrac{"5"}{x}+\dfrac{"4"}{(1-x)}+\dfrac{"8"}{(2x+1)}$.

Score for any one $\dfrac{"5"}{x}\to\alpha\ln\lvert x\rvert$ $\dfrac{"4"}{(1-x)}\to\beta\ln\lvert 1-x\rvert$ $\dfrac{"8"}{(2x+1)}\to\delta\ln\lvert 2x+1\rvert$

(Condone invisible modulus signs or invisible brackets if subsequent work implies them)

Condone $\beta\ln\lvert 1-x\rvert\to\beta\ln\lvert x-1\rvert$ **throughout (b)**

Be aware that if they incorrectly find *C*, e.g. $C=\dfrac{7}{2}$, then $\dfrac{7}{(4x+2)}\to\dfrac{7}{4}\ln(4x+2)$ is a correct follow through

A1ft: Two of $5\ln\lvert x\rvert - 4\ln\lvert 1-x\rvert + 4\ln\lvert 2x+1\rvert$ follow through their *A*, *B* and *C*.

Allow use of brackets instead of modulus signs or allow further work to imply them.

A1: $5\ln\lvert x\rvert - 4\ln\lvert 1-x\rvert + 4\ln\lvert 2x+1\rvert$ with or without the $+c$

Allow use of brackets instead of modulus signs or allow further work to imply them.

dM1: Substitutes in the limits, subtracts either way round and applies laws of logs correctly to achieve either an $p\ln 2$ term or a $q\ln\frac{3}{5}$ term.

It is dependent on the previous M and having integrated to a form $\alpha\ln|x|+\beta\ln|1-x|+\delta\ln|2x+1|$ or $\alpha\ln|x|+\beta\ln|x-1|+\delta\ln|2x+1|$

This is most likely going to be scored via the ln2 term.

The term in ln2 must be found from $\alpha\ln 4-\alpha\ln 2=\alpha\ln 2$ so the value of *p* and α must be the same

The term in $\ln\left(\frac{3}{5}\right)$ must be found from $\beta\ln 3+2\delta\ln 3-\delta\ln 5$

Condone calculations such as $\ln(-3)-\ln(-5)=\ln\frac{3}{5}$

A1: CSO: $5\ln 2+4\ln\left(\frac{3}{5}\right)$

It cannot be scored following incorrect integration. ISW after sight of this

Question Number	Scheme	Marks
5(a)	$\frac{dx}{dt} = \frac{2(1-t)-(-1)(3+2t)}{(1-t)^2} = \frac{5}{(1-t)^2}$ and $\frac{dy}{dt} = -2t$	
	At $t=2 \Rightarrow \frac{dy}{dx} = \frac{(-1)^2}{5} \times (-2(2)) = -\frac{4}{5}$	M1A1
	$(-7, -3)$	B1
	$y+3 = \frac{5}{4}(x+7)$	M1
	$5x-4y+23=0$	A1
		(5)
(b)	$x = \frac{3+2t}{1-t} \rightarrow t = \frac{x-3}{x+2}$	M1
	$y = 1-\left(\frac{x-3}{x+2}\right)^2 = \frac{(x+2)^2-(x-3)^2}{(x+2)^2} = \frac{10x-5}{(x+2)^2}$	dM1A1
	$x \neq -2$	B1
		(4)
		(9 marks)

FYI $x = \frac{3+2t}{1-t} = \frac{5}{1-t} - 2$

(a) Note: A cartesian approach in (a) can score a maximum of 1 mark (the B1) as it does not satisfy the demand of the question.

M1: Attempts to find $\frac{dy}{dx}$ at $t=2$ by finding $\frac{dy}{dt} \div \frac{dx}{dt}$.

Condone slips when differentiating $\frac{dx}{dt}$ and $\frac{dy}{dt}$ but look for a minimum of

- $\frac{dx}{dt} = \frac{\alpha(1-t) \pm \beta(3+2t)}{(1-t)^2}$ with $\alpha > 0$ or equivalent using the product rule or division and chain rule
- $\frac{dy}{dt} = \pm \varpi t$
- Substitution of $t=2$ into $\frac{dy}{dt} \div \frac{dx}{dt}$ which may have been simplified incorrectly. Note that a simplified $\frac{dy}{dx} = \frac{-2t(1-t)^2}{5}$

Note that using the quotient rule the wrong way around $\frac{uv'-vu'}{v^2}$ would be M0

A1: $-\frac{4}{5}$ following M1. It may be implied by a normal gradient of $\frac{5}{4}$

B1: $(-7, -3)$ which may be implied from terms within an attempt at the equation of the normal