Question Number	Scheme	Marks
9(a)	$k=-1$	B1
		(1)
(b)(i)	$\mathrm{f}(0)=\lvert 2-4\ln(0+1)\rvert=2-0=2$	B1
(ii)	$0=2-4\ln(x+1)\Rightarrow \ln(x+1)=\dfrac{1}{2}\Rightarrow x=\mathrm{e}^{p}+q$	M1
	$x=\mathrm{e}^{\frac{1}{2}}-1$	A1
		(3)
(c)	$2-4\ln(x+1)=3\Rightarrow \ln(x+1)=...$ or $-2+4\ln(x+1)=3\Rightarrow \ln(x+1)=...$	M1
	$2-4\ln(x+1)=3\Rightarrow x=...$ and $-2+4\ln(x+1)=3\Rightarrow x=...$	dM1
	CVs $\mathrm{e}^{-\frac{1}{4}}-1,\ \mathrm{e}^{\frac{5}{4}}-1$	A1
	$"-1"<x<\mathrm{e}^{-\frac{1}{4}}-1$ or $x>\mathrm{e}^{\frac{5}{4}}-1$	ddM1A1ft
		(5)
		(9 marks)

Notes

(a)

B1: For $(k=)-1$. Accept $x=-1$ or even $x>-1$

(b) (i)

B1: For 2 seen as the *y* coordinate. May be identified as *y* or f(0) or (0, 2).

(ii)

M1: Sets $0=2-4\ln(x+1)$, rearranges and proceeds to $x=...$ of the correct form $\mathrm{e}^{p}+q,\ q\neq 0$. May be implied by awrt 0.65.

A1: $x=\mathrm{e}^{\frac{1}{2}}-1$ or accept $\sqrt{\mathrm{e}}-1$ or even $\mathrm{e}^{\frac{2}{4}}-1$ May be seen as part of a coordinate pair.

(c) Note this is M1A1A1M1A1 on epen but is being marked as M1M1A1M1A1.

M1: Forms one valid equation with the modulus signs removed and attempts to solve at least as far as ln(*x*+1) . Accept with > or < etc instead of = for the M.

dM1: Both equations attempted, allowing for "=" or any inequality used, to achieve values (may be decimals) for each via $\ln(x+1)=\ldots$ and suitable attempt to undo ln (raises to a base power, allow an error with the base). For reference the decimals are −0.221 and 2.49 to 3 s.f.

A1: Both $\mathrm{e}^{-\frac{1}{4}}-1,\ \mathrm{e}^{\frac{5}{4}}-1$ Must be exact.

ddM1: Chooses the outside region for their values. Allow with strict or non-strict inequalities. It is dependent on both previous method marks and requires two distinct critical values. The left hand bound −1 may be missing for this mark (i.e. allow for $x<\mathrm{e}^{-\frac{1}{4}}-1$ or $x>\mathrm{e}^{\frac{5}{4}}-1$) Allow with decimal values for this mark. ddM0 if the middle section is also included but isw if they choose the correct outside region but later reject the left hand portion due to confusion with $x>-1$ Watch out for $x>\ldots$ for both inequalities, which is ddM0.

A1ft: $"-1"<x<\mathrm{e}^{-\frac{1}{4}}-1$ or $x>\mathrm{e}^{\frac{5}{4}}-1$ or any equivalent form following through on their **negative** *k* from (a). Must be exact (not decimals). Allow "and" instead of "or" – ie both regions are identified as the solution. But use of $\cap$ in set notation is A0 as it is incorrect.

Question Number	Scheme	Marks
10(a)	$\frac{1}{4}=\sin^2 4y \Rightarrow y=\frac{\pi}{24}$	M1A1
		(2)
(b)	$\frac{\mathrm{d}x}{\mathrm{d}y}=\underline{\underline{8\sin 4y\cos 4y}}$	M1A1
		(2)
(c)	$\frac{\mathrm{d}x}{\mathrm{d}y}=8\sin 4y\cos 4y \rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{8\sin 4y\cos 4y}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{8\sqrt{x(1-x)}}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{\sqrt{16-64\left(x-\frac{1}{2}\right)^2}}$	A1
		(3)
(d)(i)	$x=\frac{1}{2}$	B1ft
(ii)	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{4}$	B1ft
		(2)
		(9 marks)

Notes

(a)

M1: Attempts to substitute in $x=\frac{1}{4}$ and rearranges to find an exact value for *y*. Look for $y=M\arcsin\left(\pm\frac{1}{2}\right)\rightarrow k\pi$ or $k(30°)$ allowing errors in dividing by the 4, or equivalents criteria via a double angle identity, correct up to sign error.

A1: $\frac{\pi}{24}$ Ignore extra solutions outside the domain.

(b)

M1: Attempts to differentiate achieving a form $\left(\frac{\mathrm{d}x}{\mathrm{d}y}=\right)A\sin 4y\cos 4y$ or $A\sin 8y$ oe Accept alternative forms e.g. via implicit differentiation $1=A\sin 4y\cos 4y\frac{\mathrm{d}y}{\mathrm{d}x}$. The $\frac{\mathrm{d}x}{\mathrm{d}y}$ may be missing, or labelled $\frac{\mathrm{d}y}{\mathrm{d}x}$ for this mark.

A1: $\frac{\mathrm{d}x}{\mathrm{d}y}=8\sin 4y\cos 4y$ oe eg $\frac{\mathrm{d}x}{\mathrm{d}y}=4\sin 8y$ Coefficients must be simplified. Must include the $\frac{\mathrm{d}x}{\mathrm{d}y}$

(c)

M1: Uses $\frac{\mathrm{d}y}{\mathrm{d}x}=1\div\frac{\mathrm{d}x}{\mathrm{d}y}$ (allow for the reciprocal of their answer to (b) if left hand side is omitted). Variables must be consistent.