Question	Scheme	Marks
2(a)	$\frac{2x}{x^2+1}=\frac{1}{x+4} \Rightarrow 2x(x+4)=x^2+1$ **OR** $\frac{2x}{x^2+1}-\frac{1}{x+4}=0 \Rightarrow \frac{2x(x+4)-(x^2+1)}{(x^2+1)(x+4)}=0$	**M1**
	$(\Rightarrow x^2+8x-1=0) \Rightarrow x=\frac{-8\pm\sqrt{64-4\times1\times-1}}{2}=...$	**dM1**
	$x=-4\pm\sqrt{17}$	**A1**
		(3)
(b)	$x<-4-\sqrt{17}$ **or** $-4<x<-4+\sqrt{17}$	**M1**
	Both $x<-4-\sqrt{17}, -4<x<-4+\sqrt{17}$	**A1**
		(2)
(c)	$x<-4+\sqrt{17}, x\neq-4$ **OR** $x<-4\ \ , -4<x<-4+\sqrt{17}$ **OR** $x\in(-\infty,-4)\cup\left(-4,-4+\sqrt{17}\right)$	**M1** **A1**
		(2)
		(7 marks)

Notes:

(a)

M1: Sets equal and cross multiplies to reach an unsimplified quadratic equation, OR takes terms to one side, combines together with common denominator to reach an unsimplified quadratic on their numerator.

dM1: Solves the quadratic. Usual rules. May use a calculator. **Dependent on the previous M Mark.**

Note: If the answer given is incorrect, and no QF is quoted then M0. But if the correct formula is quoted and there are errors in the substitution of values or incorrect answer given after formula quoted then the M mark can still be scored.

A1: Correct roots. Must be exact.

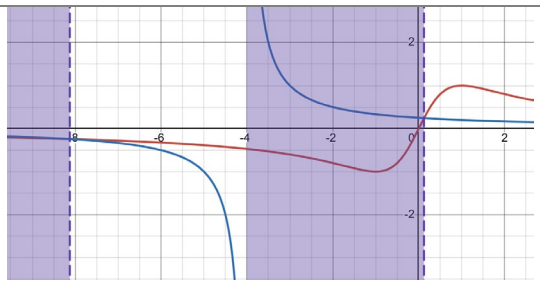
(b)

NOTE: decimal answers can score M marks only in parts (b) and (c)

M1: For $x<\alpha$ **OR** $-4<x<\beta$ for their roots α,β, where $\alpha<\beta$ and their $\alpha<-4$, their $\beta>-4$ (their roots need to be on opposite sides of the asymptote)

Selects a solution set from one of those above with their critical values (provided their CVs are within the parameters allowed). Allow if any non-strict inequalities are used for this mark.

A1: Correct answer. **Must be exact**.



Useful graph of solution

(c)

M1: Deduces partially correct range by including all the values less than −4 in their answer (with possible exception of their negative root α). May also include the −4 and boundary value(s) for this mark. **i.e. allow boundary values to be included/excluded as long as the reflected part of the reciprocal graph is included in the solution.**

e.g. $x \leq -4$ **M1A0** (values less than -4 included, boundary allowed, but incomplete solution)

$x < -4$ **M1A0** (values less than -4 included, but incomplete solution)

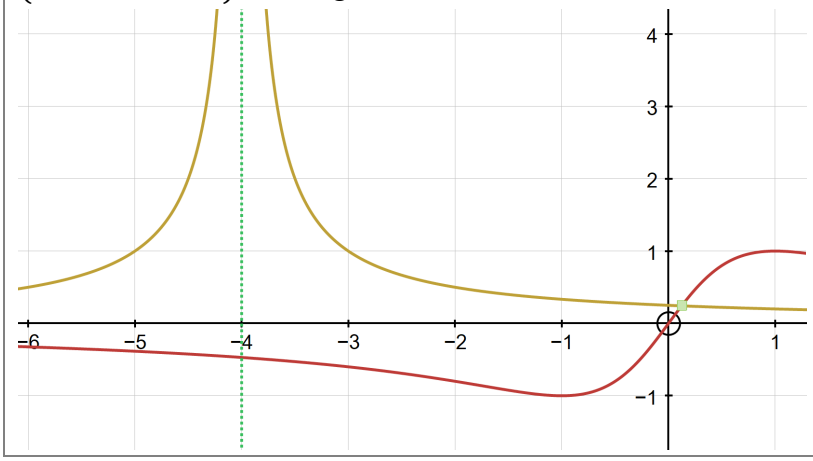
$-4 - \sqrt{17} < x < -4$ and $x < -4 - \sqrt{17}$ **M1A0** (values less than -4 included, excluding the negative root)

$-4 - \sqrt{17} < x < -4$ **M0A0** (values less than -4 not included in the solution set)

$x \leq -4 + \sqrt{17}$, $x \neq -4$ **M1A0** (values less than -4 included, but includes end point)

$x \leq -4 + \sqrt{17}$ **M1A0** (values less than -4 included, but incomplete solution)

A1: Deduces fully correct range. Allow equivalent notations such as $x \in (-\infty, -4) \cup (-4, -4 + \sqrt{17})$ with e.g. 'or/and' between the brackets, but not $\cap$. **Values must be exact.**



Useful graph of solution