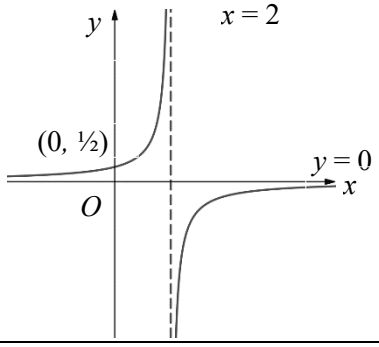
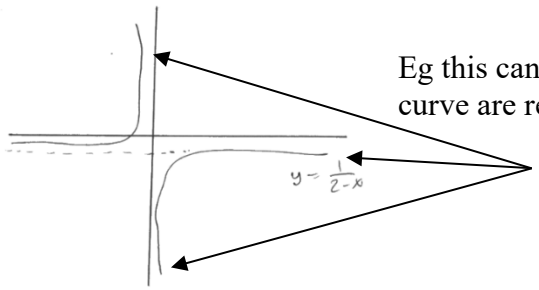
Question	Scheme		Marks
7(a)		B1 Negative reciprocal shape B1 Intercept at $\left(0, \frac{1}{2}\right)$ B1 $x=2,\ y=0$	B1B1B1
			(3)
(b)	$4x+k=\dfrac{1}{2-x}\Rightarrow(4x+k)(2-x)=1\Rightarrow 8x+2k-4x^2-kx-1(=0)$ oe $4x^2+(k-8)x+1-2k=0$ $a=4,\ b=k-8,\ c=1-2k$ or $a=-4,\ b=8-k,\ c=2k-1$ $(k-8)^2-4\times4(1-2k)(>0)$ oe $k^2-16k+64-16+32k>0\ \Rightarrow k^2+16k+48>0$*		M1 A1 M1 A1*
			(4)
(c)	$k^2+16k+48=0\Rightarrow(k+12)(k+4)=0\Rightarrow k=...$ $k=-12,\ -4$ $k<-12$ or $k>-4$		M1 A1 M1A1
			(4)
			(11 marks)

Notes

(a)

B1 Negative reciprocal shape (top left/bottom right sections) in any position on a set of axes with no clear vertical or horizontal 'overlaps'.
Condone slips of the pen as long as there is not a clear turning point, but it should not curve back on itself. If there are several attempts, then mark the last one. If there are contradictions between points stated in the text and any on the graph, then the graph takes precedence.



Eg this can score B1 for the correct shape. The ends of their curve are regarded as a slip of the pen

B1 Intercept at $\left(0, \frac{1}{2}\right)$ and no others. Allow $\frac{1}{2}$ to be marked on the y-axis and condone $\left(\frac{1}{2}, 0\right)$ if the intercept is in the correct place. Cannot be awarded without a sketch.

B1 $x = 2$ **and** $y = 0$ and no other asymptotes. Do not allow "x-axis" as an asymptote. Do not award without a sketch.

(b) **Mark (b) and (c) together**

M1 Sets line = curve, multiplies by $(2 - x)$, attempts to expand and collects terms on one side of the equation. Condone the absence of =0.

A1 Correct equation unsimplified with all terms on one side, condone the absence of =0. This may be implied by later work such as their values of a, b and c substituted in to $b^2 - 4ac$ and full marks can be awarded in this question if =0 is never seen.

M1 Attempts discriminant in terms of k using their a, b and c from their 3TQ. Sight of these terms embedded in $b^2 - 4ac$ is sufficient for this mark. Condone invisible brackets and ignore the use of $>$, $<$ or = for this mark.

A1* Correctly multiplies out their expression for the discriminant, sets > 0 and proceeds to the given answer with no errors including any omission of brackets in their work.
They must have used a correct inequality on at least the previous line before their final answer or stated $b^2 - 4ac > 0$ somewhere in their working.

(c)

M1 Solves the given quadratic to obtain 2 values for k. See guidance on solving quadratics. They may just write the roots down from their calculator which is acceptable.

A1 $-12, -4$

M1 Attempts 'outside regions' so this may include $\leq$ or $\geq$ are condoned for this mark.
$-4 < k < -12$ would imply this mark. Ignore if in terms of x for this mark. Cannot be scored from a diagram.

A1 Accept any of '$k < -12$, $k > -4$', '$k < -12$ or $k > -4$', '$\{k : k < -12 \cup k > -4\}$',
'$\{k : -\infty < k < -12 \cup -4 < k < \infty\}$' or their equivalent expressions
Must be in terms of k. (Not x or any other variable)

DO NOT ALLOW '$k < -12$ and $k > -4$' '$-12 > k > -4$', '$-4 < k < -12$'

Note: These inequalities without any working score full marks in (c)

Question	Scheme	Marks
8(a)	$y=(x-2)(x^2-8x+16) \Rightarrow y=x^3-8x^2+16x-2x^2+16x-32 \Rightarrow$ $y=x^3 \pm ...x^2 \pm ...x \pm 32$	M1
	$=x^3-10x^2+32x-32$	A1
	$\frac{dy}{dx}=3x^2-20x+32$*	M1A1*
		(4)
(b)	$x=6 \Rightarrow y=(6-2)(6-4)^2=16$	B1
	$\frac{dy}{dx}=3(6)^2-20(6)+32=20$	B1
	$y-"16"="20"(x-6)$	M1
	$y=20x-104$	A1
		(4)
(c)	$3x^2-20x+32="20" \Rightarrow 3x^2-20x+12=0$	M1
	$3x^2-20x+12=0 \Rightarrow (3x-2)(x-6)=0 \Rightarrow x=...$	dM1
	$\alpha=\frac{2}{3}$	A1
		(3)
		(11 marks)

Notes

(a)

M1 Attempts to multiply out the three brackets, condoning slips in their working.
Usually $y=(x-2)(x^2-8x+16) \Rightarrow y=x^3-8x^2+16x-2x^2+16x-32 \Rightarrow x^3 \pm ...x^2 \pm ...x \pm 32$
Score for expressions of the form $x^3 \pm ...x^2 \pm ...x \pm 32$. Middle terms do not need to be collected.

A1 $x^3-10x^2+32x-32$ If they do not collect terms together until after differentiating, A1 can be awarded by subsequent work. You would have to see the individual differentiated terms collected rather than implied by the final answer.
They must have attempted to multiply out the brackets for this mark.

M1 $x^n \to x^{n-1}$ correct on one term so either $...x^3 \to ...x^2$ $...x^2 \to ...x$ $Ax \to A$ $B \to 0$

A1* Correct proof with no errors including omission of brackets. At some point they should have had $y=...$ and their final line should finish with $\frac{dy}{dx}=3x^2-20x+32$ including the $\frac{dy}{dx}$ but the terms on the rhs can be in any order.