

1.

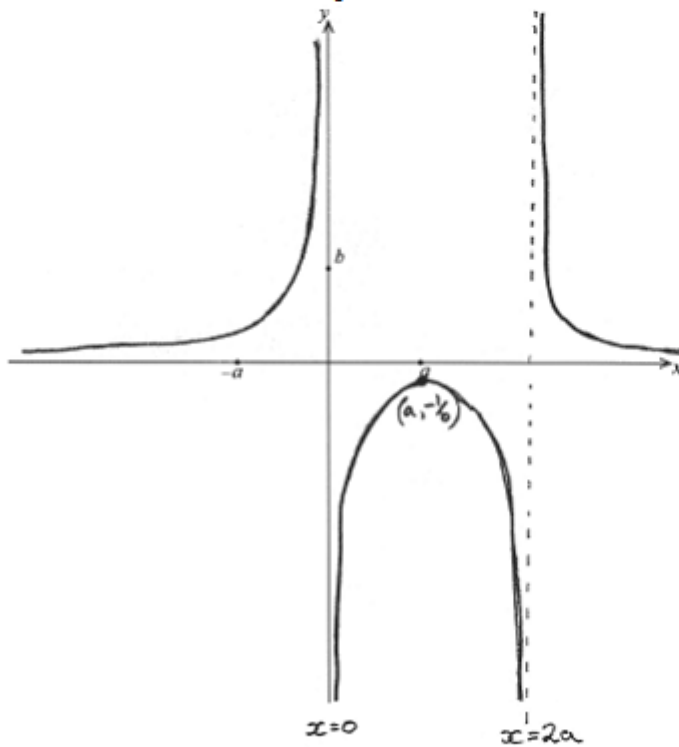
- (a) $f(x-a) \neq b$ (M1)
 $x \neq 0$ and $x \neq 2a$ (or equivalent) A1
- (b) vertical asymptotes $x = 0, x = 2a$ A1
horizontal asymptote $y = 0$ A1

Note: Equations must be seen to award these marks.

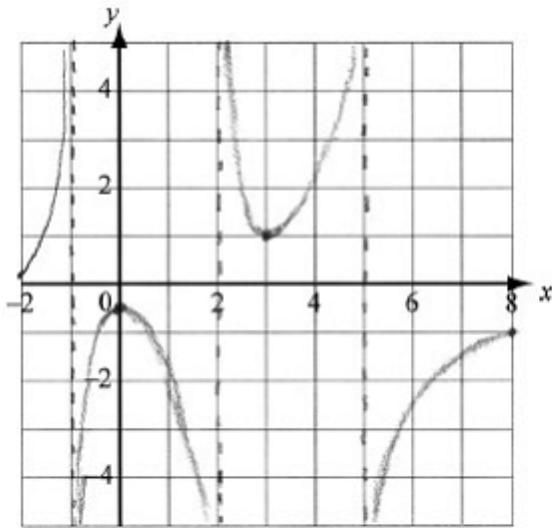
maximum $\left(a, -\frac{1}{b}\right)$ A1A1

Note: Award A1 for correct x -coordinate and A1 for correct y -coordinate.

- one branch correct shape A1
other 2 branches correct shape A1



2.



A1A1A1A1A1

Notes: Award A1 for vertical asymptotes at $x = -1$, $x = 2$ and $x = 5$.

A1 for $x \rightarrow -2$, $\frac{1}{f(x)} \rightarrow 0^+$

A1 for $x \rightarrow 8$, $\frac{1}{f(x)} \rightarrow -1$

A1 for local maximum at $\left(0, -\frac{1}{2}\right)$ (branch containing local max. must be present)

A1 for local minimum at $(3, 1)$ (branch containing local min. must be present)

In each branch, correct asymptotic behaviour must be displayed to obtain the A1.

Disregard any stated horizontal asymptotes such as $y = 0$ or $y = -1$.

[5]

3.

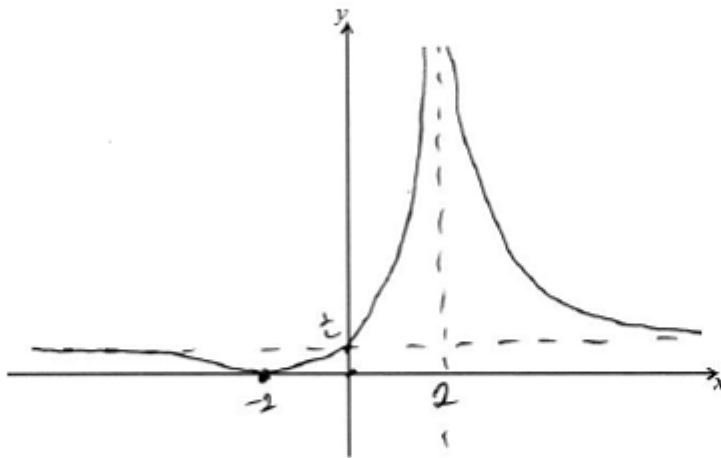
(a) an attempt to use either asymptotes or intercepts

(M1)

$$a = -2, b = 1, c = \frac{1}{2}$$

A1A1A1

(b)

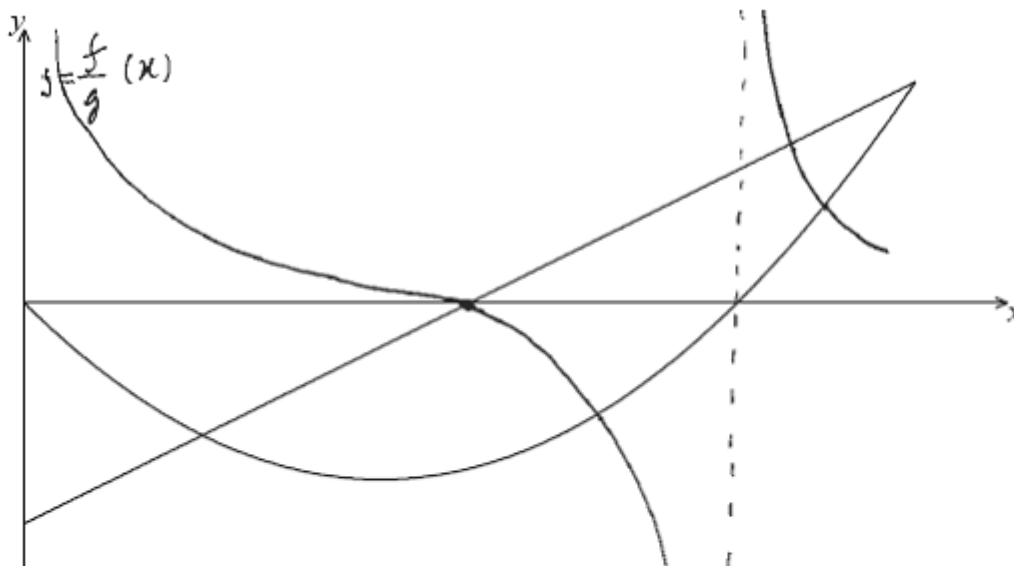


A4

Note: Award A1 for both asymptotes,
 A1 for both intercepts,
 A1, A1 for the shape of each branch, ignoring shape at $(x = -2)$.

[8]

4.



correct concavities

A1A1

Note: Award A1 for concavity of each branch of the curve.

correct x -intercept of $\frac{f}{g}$ (which is EXACTLY the x -intercept of f)

A1

correct vertical asymptotes of $\frac{f}{g}$ (which ONLY occur when x equals the

x -intercepts of g)

A1A1

[5]