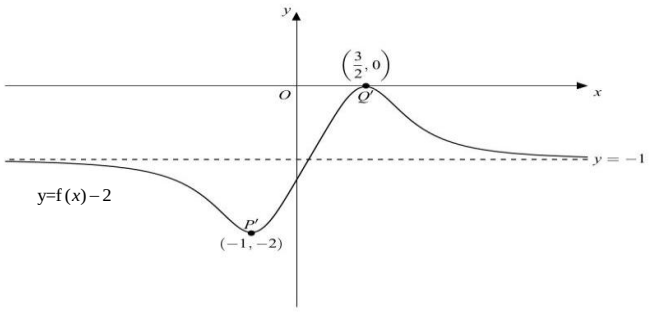
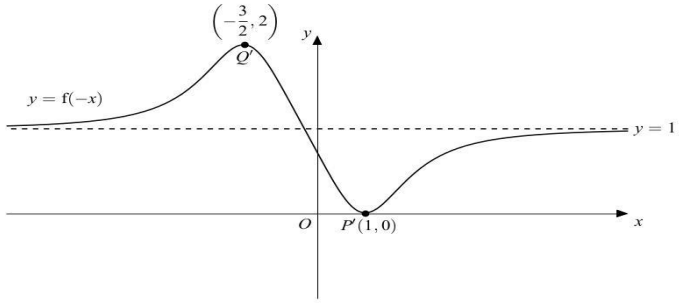
Question	Scheme		Marks
4(i)		Correct shape, translated down.	**B1**
		Correct horizontal asymptote labelled	**B1**
		Correct **maximum** and **minimum** points labelled	**B1**
			(3)
(ii)		Correct shape, reflected in *y* axis	**B1**
		Correct horizontal asymptote labelled	**B1**
		Correct **maximum** and **minimum** points labelled.	**B1**
			(3)
			(6 marks)
Notes:			

In both parts be tolerant with "pen slips" for the asymptotes. Judge the intent of the shape.

(i) There is no MR for sketching $y = \mathrm{f}(x-2)$. These marks are independent of each other

B1: Same shape as the original graph but translated vertically downwards.

Do not consider any coordinates here.

Look for a minimum to the left of the *y* axis and a maximum to the right

Be tolerant of the asymptote not being **exactly** at the same level at either end of the curve but withhold the mark if it is intentionally different. Condone slight upturns at either end

B1: For $y = -1$ labelled as the horizontal asymptote. It must be below the *x* axis and the intention must be for ends to be at the same height/level. The intention must be for the curve to be asymptotic here (at both ends)

B1: For the coordinates of the maximum and minimum points in the correct positions. E.g. $\left(\frac{3}{2}, 0\right)$ must be on the positive *x*-axis and $\left(-1, -2\right)$ is in quadrant 3. Note that *P* and *Q* don't need to be seen, just their coordinates. Coordinates may be given in the body of the script but must match with maximum and minimum points marked in some way on the graph

(ii) There is no MR for sketching $y = -\mathrm{f}(x)$ These marks are independent of each other

B1: For the correct shape, a reflection in the *y*-axis. The intention should be for the asymptotes to be at the same level but be tolerant of slips. Look for the image *Q*' a maximum being to the left of *y*-axis in quadrant two and *P*' a minimum on the positive *x*- axis.

B1: For $y = 1$ labelled as the horizontal asymptote. It must be above the *x* axis and the intention must be for ends to be at the same height/level. The curve must be asymptotic here (at both ends)

B1: For the coordinates of the maximum and minimum points in correct positions. E.g. *P*' must be on the *x*-axis although *P* and *Q* don't need to be seen, just their coordinates. Coordinates may be given in the body of the script but must match with maximum and minimum points marked in some way on the graph.

Question	Scheme	Marks
5(a)	E.g. $12-a(x+2)^2$ or $a(x-1)(x+5)$ or $y=ax^2+bx+c \Rightarrow 4a-2b+c=12$ and $25a-5b+c=0$	**M1A1**
	E.g. $0=12-a(-5+2)^2 \Rightarrow a=...$ or $12=a(-2-1)(-2+5) \Rightarrow a=...$ or $2a(-2)+b=0, 25a-5b+c=0, 4a-2b+c=12 \Rightarrow a=..., b=..., c=...$	**dM1**
	$12-\frac{4}{3}(x+2)^2$ or $-\frac{4}{3}(x-1)(x+5)$ or $-\frac{4}{3}x^2-\frac{16}{3}x+\frac{20}{3}$ oe	**A1**
		(4)
(b)	Gradient of l_2 is $\frac{-5}{4}$ o.e.	**M1**
	Equation of l_2 is $y="-\frac{5}{4}"(x+5)$	**M1**
	$y=-\frac{5}{4}x-\frac{25}{4}$	**A1**
		(3)
(c)	For two of $y \geqslant "-\frac{5}{4}x-\frac{25}{4}"$; $y \geqslant \frac{4}{5}x$; $y \leqslant "-\frac{4}{3}x^2-\frac{16}{3}x+\frac{20}{3}"$ Or with strict inequalities	**M1**
	For all three of $y \geqslant "-\frac{5}{4}x-\frac{25}{4}"$; $y \geqslant \frac{4}{5}x$; $y \leqslant "-\frac{4}{3}x^2-\frac{16}{3}x+\frac{20}{3}"$ Or with strict inequalities	**A1ft**
		(2)
		(9 marks)
Notes:		

(a) Just the expression for f (*x*) is required but you may see *y* = ... or f(*x*) =.. . which is fine

M1: For knowing a quadratic form and using two correct pieces of information. This can be scored by

- using the maximum value occurs at (−2,12) to state the form $12 \pm a(x \pm 2)^2$
- use symmetry, usually with roots of -5 and 1 to state the form $a(x \pm 1)(x \pm 5)$
- using the general form $y=ax^2+bx+c$ and substituting in two points, usually $\left(-2,12\right)$ and $\left(-5,0\right)$. An alternative is using just one point and setting $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ at $x=-2 \Rightarrow -4a+b=0$