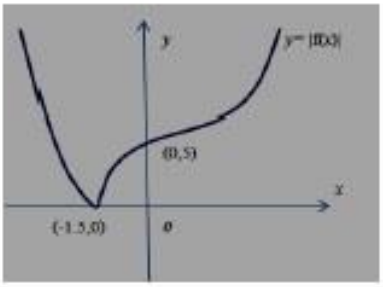
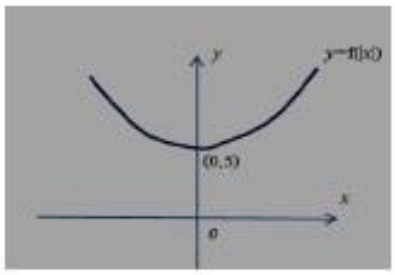
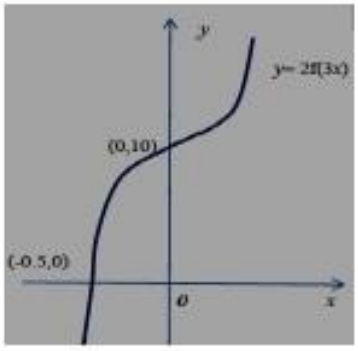
Multiple Transformations of Functions Exam Questions (Sheet 2) Mark Scheme

Q1.

Question Number	Scheme		Marks
(a)		Shape including cusp	B1
		(-1.5, 0) **and** (0, 5)	B1
			(2)
(b)		Shape	B1
		(0,5)	B1
			(2)
(c)		Shape	B1
		(0,10)	B1
		(-0.5, 0)	B1
			(3) **(7 marks)**

(a) **Note that this appears as M1A1 on EPEN**

B1 Shape (inc cusp) with graph in just quadrants 1 and 2. Do not be overly concerned about relative gradients, but the left hand section of the curve should not bend back beyond the cusp

B1 This is independent, and for the curve touching the x-axis at (-1.5, 0) **and** crossing the y-axis at (0,5)

(b) **Note that this appears as M1A1 on EPEN**

B1 For a U shaped curve symmetrical about the y- axis

B1 (0,5) lies on the curve

(c) **Note that this appears as M1B1B1 on EPEN**

B1 Correct shape- do not be overly concerned about relative gradients. Look for a similar shape to f(x)

B1 Curve **crosses** the y axis at (0, 10). The curve must appear in both quadrants 1 and 2

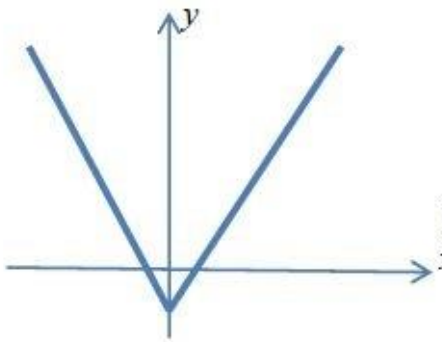
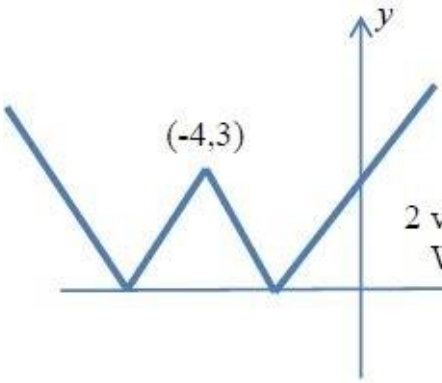
B1 Curve **crosses** the x axis at (-0.5, 0). The curve must appear in quadrants 3 and 2.

In all parts accept the following for any co-ordinate. Using (0,3) as an example, accept both (3,0) or 3 written on the y axis (as long as the curve passes through the point)

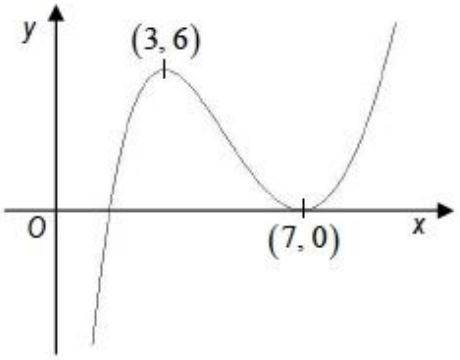
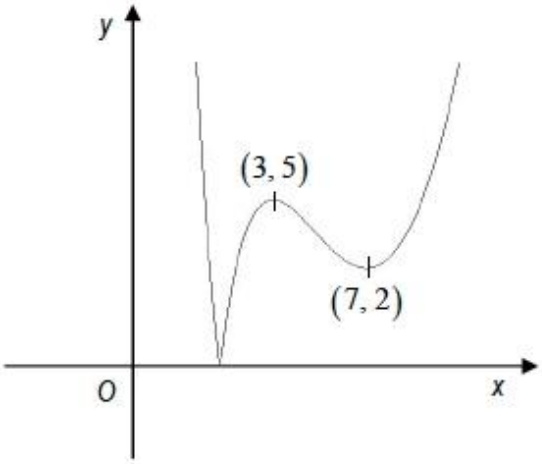
Special case with (a) and (b) completely correct but the wrong way around mark - SC(a) 0,1 SC(b) 0,1

Otherwise follow scheme

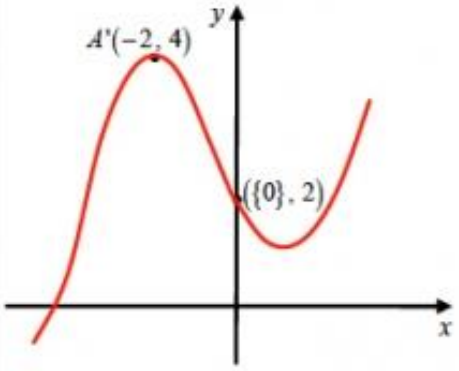
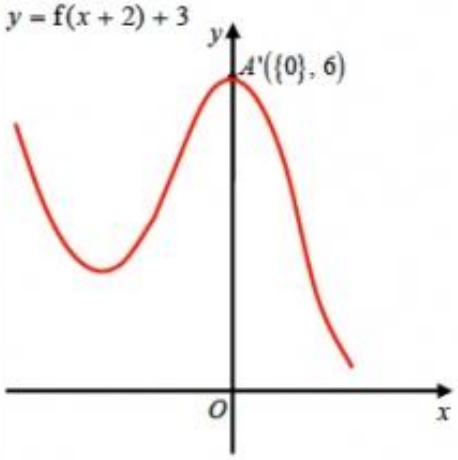
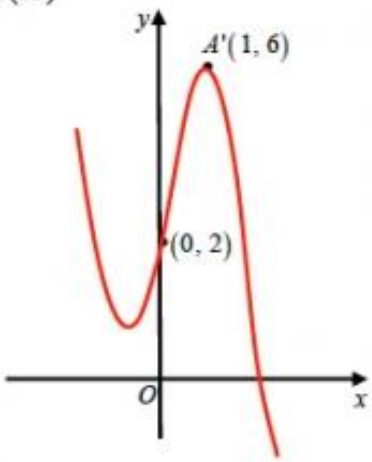
Q2.

Question Number	Scheme	Marks
(a)	 V shape	B1
	vertex on y axis &both branches of graph cross x axis	B1
	'y' co-ordinate of R is -6	B1
	(0,-6)	(3)
(b)	 W shape	B1
	2 vertices on the negative x axis. W in both quad 1 & quad 2.	B1dep
	R'=(-4,3)	B1
		(3)
		6 Marks

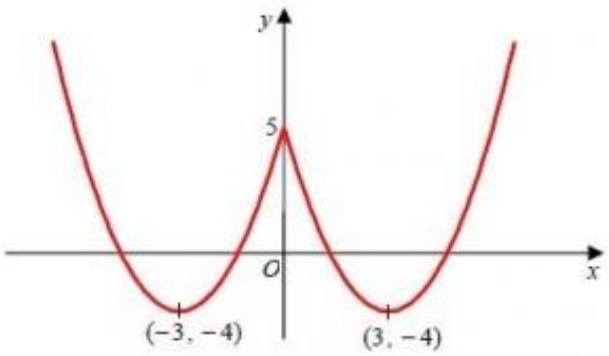
Q3.

Question Number	Scheme		Marks	
(a)		Shape (3, 6) (7, 0)	B1 B1 B1	(3)
(b)		Shape (3, 5) (7, 2)	B1 B1 B1	(3) **[6]**

Q4.

Question Number	Scheme	Marks
(i)	$y = f(-x) + 1$ 	Shape of  and must have a maximum in quadrant 2 and a minimum in quadrant 1 or on the positive y-axis. B1 Either $(\{0\}, 2)$ or $A'(-2, 4)$ B1 Both $(\{0\}, 2)$ and $A'(-2, 4)$ B1 (3)
(ii)	$y = f(x + 2) + 3$ 	Any translation of the original curve.  B1 The *translated maximum* has either x-coordinate of 0 (can be implied) or y-coordinate of 6. B1 The translated curve has maximum $(\{0\}, 6)$ and is in the correct position on the Cartesian axes. B1 (3)
(iii)	$y = 2f(2x)$ 	Shape of  with a minimum in quadrant 2 and a maximum in quadrant 1. B1 Either $(\{0\}, 2)$ or $A'(1, 6)$ B1 Both $(\{0\}, 2)$ and $A'(1, 6)$ B1 (3) **[9]**

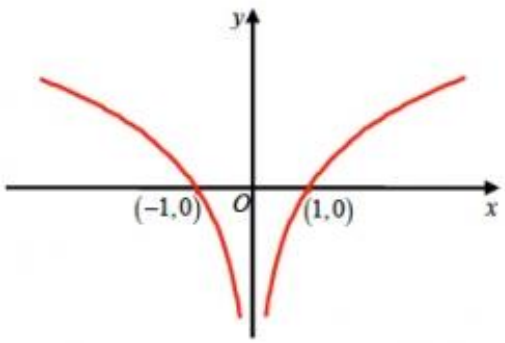
Q5.

Question Number	Scheme	Marks
(a) (i)	$(3, 4)$	B1 B1
(ii)	$(6, -8)$	B1 B1
		(4)
(b)		B1 B1 B1
		(3)
(c)	$f(x) = (x-3)^2 - 4$ or $f(x) = x^2 - 6x + 5$	M1A1
		(2)
(d)	Either: The function f is a many-one {mapping}. Or: The function f is not a one-one {mapping}.	B1
		(1)
		[10]
	(b) B1: Correct shape for $x \geqslant 0$, with the curve meeting the positive y-axis and the turning point is found below the x-axis. (providing candidate does not copy the whole of the original curve and adds nothing else to their sketch.). B1: Curve is symmetrical about the y-axis or correct shape of curve for $x < 0$. **Note:** The first two B1B1 can only be awarded if the curve has the correct shape, with a cusp on the positive y-axis and with both turning points located in the correct quadrants. Otherwise award B1B0. B1: Correct turning points of $(-3, -4)$ and $(3, -4)$. Also, $(\{0\}, 5)$ is marked where the graph cuts through the y-axis. Allow $(5, 0)$ rather than $(0, 5)$ if marked in the "correct" place on the y-axis. (c) M1: Either states $f(x)$ in the form $(x \pm \alpha)^2 \pm \beta$; $\alpha, \beta \neq 0$ Or uses a complete method on $f(x) = x^2 + ax + b$, with $f(0) = 5$ and $f(3) = -4$ to find both a and b. A1: Either $(x-3)^2 - 4$ or $x^2 - 6x + 5$ (d) B1: Or: The inverse is a one-many {mapping and not a function}. Or: Because $f(0) = 5$ and also $f(6) = 5$. Or: One y-coordinate has 2 corresponding x-coordinates {and therefore cannot have an inverse}.	

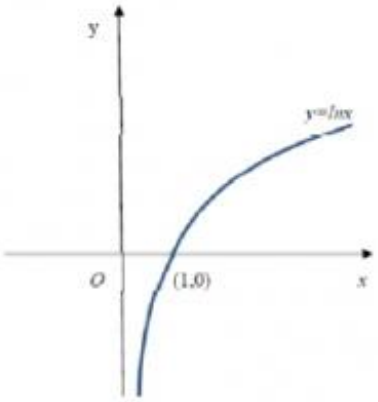
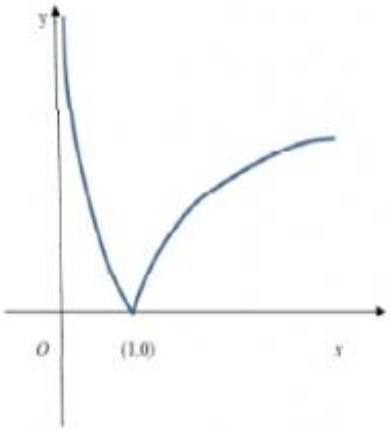
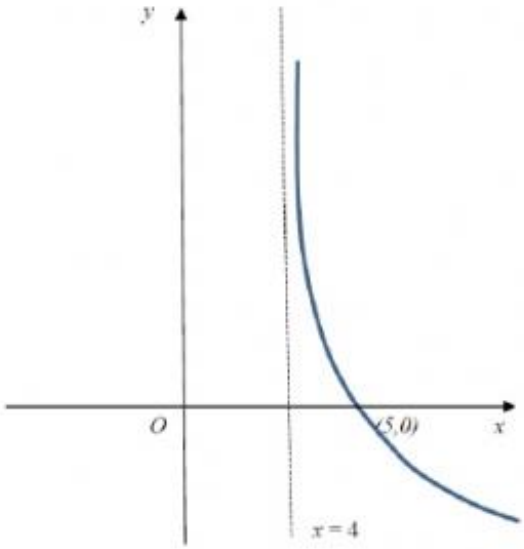
Q6.

Question	Scheme	Marks	AOs
(a)	$(-2, -3)$	B1	1.1b
		(1)	
(b)	$(-2, 5)$	B1	1.1b
		(1)	
(c)	Either $x = 0$ or $y = -13$	M1	1.1b
	$(0, -13)$	A1	1.1b
		(2)	
			(4 marks)
Notes:			

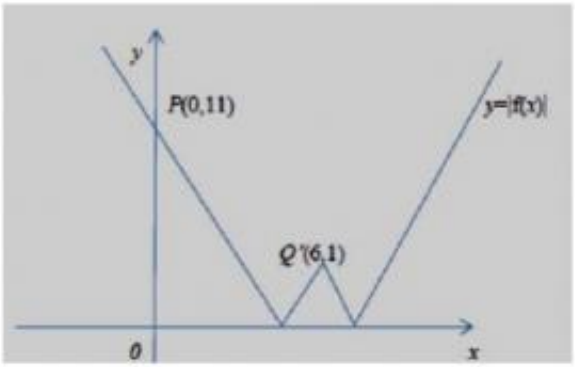
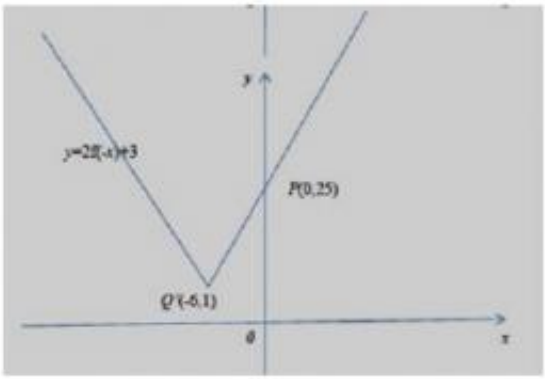
Q7.

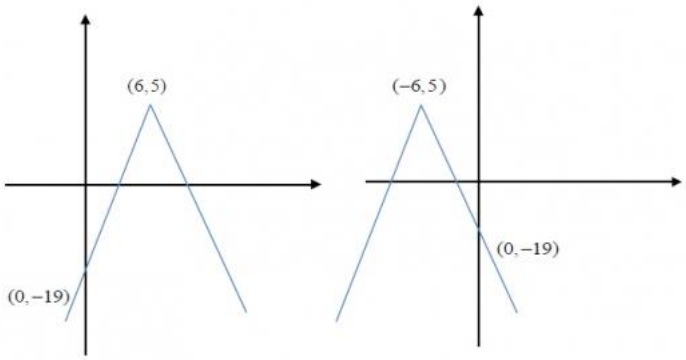
Question Number	Scheme	Marks
	$y = \ln\lvert x\rvert$  Right-hand branch in quadrants 4 and 1. Correct shape.	B1
	Left-hand branch in quadrants 2 and 3. Correct shape.	B1
	Completely correct sketch and both $(-1,\{0\})$ and $(1,\{0\})$	B1
		(3)
		[3]

Q8.

Question Number	Scheme	Marks
(i)	 *ln* graph crossing x axis at (1,0) and asymptote at x=0	B1
(ii)	 Shape including cusp Touches or crosses the x axis at (1,0) Asymptote given as x=0	B1ft B1ft B1
(iii)	 Shape Crosses at (5, 0) Asymptote given as x=4	B1 B1ft B1 (7 marks)

Q9.

Question Number	Scheme		Marks
(a)		'W' Shape (0, 11) and (6, 1)	B1 B1 (2)
(b)		'V' shape (-6,1) (0,25)	B1 B1 B1 (3)
(c)	One of $a = 2$ or $b = 6$ $a = 2$ and $b = 6$		B1 B1 (2) **(7 marks)**



(c)

B1 Either states $a = 2$ **or** $b = 6$.
This can be implied (if there are no stated answers given) by the candidate writing that $y = ..|x-6|-1$ or $y = 2|x-..|-1$. If they are both stated and written, the stated answer takes precedence.

B1 States both $a = 2$ **and** $b = 6$
This can be implied by the candidate stating that $y = 2|x-6|-1$
If they are both stated and written, the stated answer takes precedence.