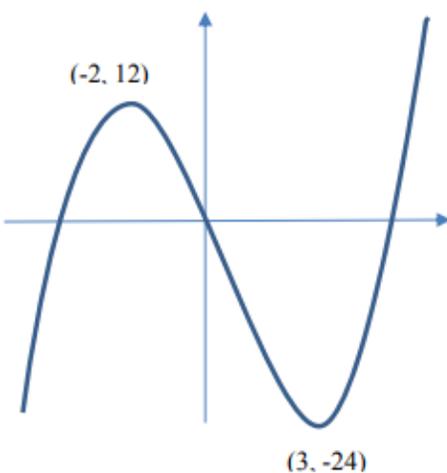


Graphs and Transformations - Answers

May 2016 Mathematics Advanced Paper 1: Pure Mathematics 1

1.

Question Number	Scheme	Notes	Marks
	Note original points are $A(-2, 4)$ and $B(3, -8)$		
4.(a)		<p>Similar shape to given figure passing through the origin. A cubic shape with a maximum in the second quadrant and a minimum in the 4th quadrant. There must be evidence of a change in at least one of the y-coordinates (inconsistent changes in the y-coordinates are acceptable) but not the x-coordinates.</p>	B1
		<p>Maximum at $(-2, 12)$ and minimum at $(3, -24)$ with coordinates written the right way round. Condone missing brackets. The coordinates may appear on the sketch, or separately in the text (not necessarily referenced as A and B). If they are on the sketch, the x and y coordinates can be positioned correctly on the axes rather than given as coordinate pairs. In cases of ambiguity, the sketch has precedence. The origin does not need to be labelled. Nor do the x and y axes.</p>	B1

(b)		A positive cubic which does not pass through the origin with a maximum to the left of the y -axis and a minimum to the right of the y -axis.	M1
		Maximum at $(-2, 0)$ and minimum at $(3, -12)$. Condone missing brackets. For the max allow just -2 or $(0, -2)$ if marked in the correct place. If the coordinates are in the text, they must appear as $(-2, 0)$ and must not contradict the sketch. The curve must touch the x -axis at $(-2, 0)$. For the min allow coordinates as shown or 3 and -12 to be marked in the correct places on the axes. In cases of ambiguity, the sketch has precedence.	A1
		Crosses y -axis at $(0, -4)$. Allow just -4 (not $+4$) and allow $(-4, 0)$ if marked in the correct place. If the coordinates are in the text, they must appear as $(0, -4)$ and must not contradict the sketch. In cases of ambiguity, the sketch has precedence.	A1
		[3]	
			5 marks

May 2014 Mathematics Advanced Paper 1: Pure Mathematics 1

2.

Question Number	Scheme	Marks
4.	<p>(a) -1 accept $(-1, 0)$</p> <p>(b)</p> <div style="display: flex; align-items: center;"> <div style="margin-left: 20px;"> <p>Shape</p> <p>Touches at $(0,0)$</p> <p>Crosses at $(2,0)$ only</p> </div> </div> <p>(c) 2 solutions as curves cross twice</p>	<p>B1 (1)</p> <p>B1</p> <p>B1</p> <p>(3)</p> <p>B1 ft (1)</p> <p>(5 marks)</p>

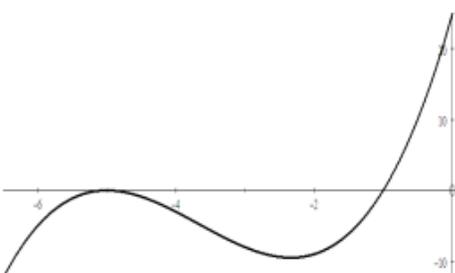
Notes

N.B. Check original diagram as answer may appear there.

- (a) B1 The x coordinate of A is -1 . Accept -1 or $(-1,0)$ on the diagram or stated with or without diagram
Allow $(0, -1)$ on the diagram if it is on the correct axis.
- (b) *If no graph is drawn then no marks are available in part (b)*
 - B1 Correct shape. The position is not important for this mark but the curve must have two clear turning points and be a $+ve x^3$ curve (with a maximum and minimum)
 - B1 The graph touches the origin. Accept touching as a maximum or minimum. There must be a sketch for this mark but sketch may be wrong and this mark is independent of previous mark. Origin is where axes cross and may not be labelled. This may be a quadratic or quartic curve for this mark.
 - B1 The graph crosses the x -axis at the point $(2,0)$ **only**. If it crosses at $(2,0)$ and $(0,0)$ this is B0. Accept $(0,2)$ or 2 marked on the correct axis. Accept $(2, 0)$ in the text of the answer provided that the curve crosses the positive x axis. There must be a sketch for this mark. Do not give credit if $(2,0)$ appears only in a table with no indication that this is the intersection point. (If in doubt send to review) Graph takes precedence over text for third B mark.
- (c) B1ft Two (solutions) **as there are two intersections (of the curves)** N.B. Just states 2 with no reason is B0
If the answer states 2 roots and two intersections – or crosses twice this is enough for B1
BUT B0 If there is any wrong **reason** given – e.g. crosses x axis twice, or crosses asymptote twice
Isw – is not used for this mark so any wrong statement listed to follow a correct statement will result in B0
Allow ft – so if their graph crosses the hyperbola once – allow “one solution as there is one intersection”
And if it crosses three times – allow “three solutions as there are three intersections” or four etc..
If it does not cross at all (e.g.negative cubic) – allow “no solutions as there are no intersections”
However in (c) if they have sketched a curve (even a fully correct one) but not extended it to intersect the hyperbola and they put "no points of intersection so no solutions" then this scores B0.
Accept “lines or curves cross over twice, or touch twice, or meet twice...etc as explanation, but need some form of words)

May 2013 Mathematics Advanced Paper 1: Pure Mathematics 1

3.

Question Number	Scheme	Marks	
<p>8</p> <p>(a)</p>		<p>Horizontal translation – does not have to cross the y-axis on the right but must at least reach the x-axis.</p>	B1
		<p>Touching at $(-5, 0)$. This could be stated anywhere or -5 could be marked on the x-axis. Or $(0, -5)$ marked in the correct place. Be fairly generous with ‘touching’ if the intention is clear.</p>	B1
		<p>The right hand tail of their cubic shape crossing at $(-1, 0)$. This could be stated anywhere or -1 could be marked on the x-axis. Or $(0, -1)$ marked in the correct place. The curve must cross the x-axis and not stop at -1.</p>	B1
		(3)	

(b)	$(x+5)^2(x+1)$	Allow $(x+3+2)^2(x-1+2)$	B1
			(1)
(c)	When $x = 0, y = 25$	M1: Substitutes $x = 0$ into their expression in part (b) which is not $f(x)$. This may be implied by their answer. Note that the question asks them to use part (b) but allow independent methods. A1: $y = 25$ (Coordinates not needed)	M1 A1
	If they expand <u>incorrectly</u> prior to substituting $x = 0$, score M1 A0 NB $f(x+2) = x^3 + 11x^2 + 35x + 25$		
			(2)
			[6]

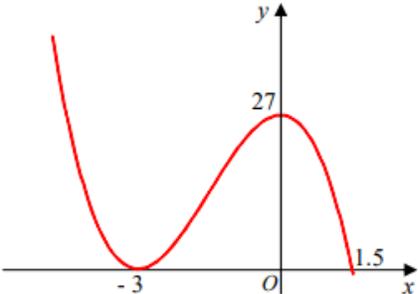
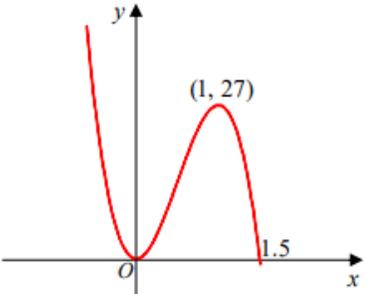
Jan 2013 Mathematics Advanced Paper 1: Pure Mathematics 1

4.

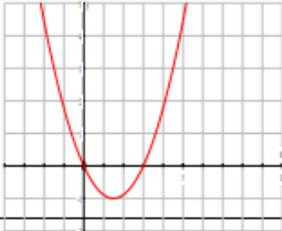
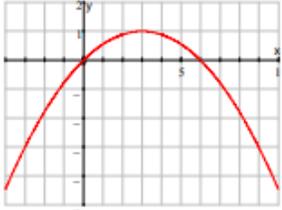
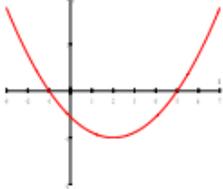
Question Number	Scheme	Marks
6. (a)	<p>Check graph in question for possible answers and space below graph for answers to part (b)</p>	<p>$y = \frac{2}{x}$ is translated up or down. M1</p> <p>$y = \frac{2}{x} - 5$ is in the correct position. A1</p> <p>Intersection with x-axis at $(\frac{2}{5}, \{0\})$ only B1 Independent mark.</p> <p>$y = 4x + 2$: attempt at straight line, with positive gradient with positive y intercept. B1</p> <p>Intersection with x-axis at $(-\frac{1}{2}, \{0\})$ and y-axis at $(\{0\}, 2)$. B1 [5]</p>
(b)	Asymptotes : $x = 0$ (or y -axis) and $y = -5$. (Lose second B mark for extra asymptotes)	An asymptote stated correctly. Independent of (a) B1 These two lines only. Not fit their graph. B1 [2]
(c)	Method 1: $\frac{2}{x} - 5 = 4x + 2$	Method 2: $\frac{y-2}{4} = \frac{2}{y+5}$ M1
	$4x^2 + 7x - 2 = 0 \Rightarrow x =$ $x = -2, \frac{1}{4}$	$y^2 + 3y - 18 = 0 \rightarrow y =$ $y = -6, 3$ dM1
	When $x = -2, y = -6$, When $x = \frac{1}{4}, y = 3$	When $y = -6, x = -2$ When $y = 3, x = \frac{1}{4}$. A1
		M1A1 [5]
		12 marks

	Notes	
	<p>(a) M1: Curve implies y axis as asymptote and does not change shape significantly. Changed curve needs horizontal asymptote (roughly) Asymptote(s) need not be shown but shape of curve should be implying asymptote(s) parallel to x axis. Curve should not remain where it was in the given figure. Both sections move in the same direction. There should be no reflection</p> <p>A1: Crosses positive x axis. Hyperbola has moved down. Both sections move by almost same amount. See sheet on page 19 for guidance.</p> <p>B1: Check diagram and text of answer. Accept $2/5$ or 0.4 shown on x-axis or $x = 2/5$, or $(2/5, 0)$ stated clearly in text or on graph. This is independent of the graph. Accept $(0, 2/5)$ if clearly on x axis. Ignore any intersection points with y axis. Do not credit work in table of values for this mark.</p> <p>B1: Must be attempt at a straight line, with positive gradient & with positive y intercept (need not cross x axis)</p> <p>B1: Accept $x = -1/2$, or -0.5 shown on x-axis or $(-1/2, 0)$ or $(-0.5, 0)$ in text or on graph and similarly accept 2 on y axis or $y = 2$ or $(0, 2)$ in text or on graph. Need not cross curve and allow on separate axes.</p> <p>(b) B1: For either correct asymptote equation. Second B1: For both correct (lose this if extras e.g. $x = \pm 1$ are given also). These asymptotes may follow correctly from equation after wrong graph in (a)</p> <p>Just $y = -5$ is B1 B0 This may be awarded if given on the graph. However for other B mark it must be clear that $x = 0$ (or the y-axis) is an asymptote. NB $x \neq 0$, $y \neq -5$ is B1B0</p> <p>(c) M1: Either of these equations is enough for the method mark (May appear labelled as part (b))</p> <p>dM1: Attempt to solve a 3 term quadratic by factorising, formula, completion of square or implied by correct answers. (see note 1) This mark depends on previous mark.</p> <p>A1: Need both correct x answers (Accept equivalents e.g. 0.25) or both correct y values (Method 2)</p> <p>M1: At least one attempt to find <i>second variable</i> (usually y) using their <i>first variable</i> (usually x) related to line meeting curve. Should not be substituting x or y values from part (a) or (b). This mark is independent of previous marks. Candidate may substitute in equation of line or equation of curve.</p> <p>A1: Need both correct <i>second variable</i> answers Need not be written as co-ordinates (allow as in the scheme)</p>	
	<p>Note: Special case: Answer only with no working in part (c) can have 5 marks if completely correct, with both points found. If co-ordinates of just one of the points is correct – with no working – this earns M0 M0 A0 M1 A0 (i.e. 1 / 5)</p>	

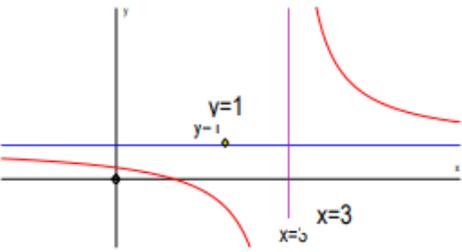
5.

Question Number	Scheme	Marks
10. (a)	{Coordinates of A are} $(4.5, 0)$ See notes below	B1
(b)(i)	 <div data-bbox="941 483 1377 636" style="border: 1px solid black; padding: 5px; margin-left: 20px;"> Horizontal translation -3 and their ft 1.5 on positive x-axis Maximum at 27 marked on the y-axis </div>	B1 [1] M1 A1 ft B1
(ii)	 <div data-bbox="941 829 1377 976" style="border: 1px solid black; padding: 5px; margin-left: 20px;"> Correct shape, minimum at $(0, 0)$ and a maximum within the first quadrant. 1.5 on x-axis Maximum at $(1, 27)$ </div>	[3] M1 A1 ft B1
(c)	{ $k =$ } -17	[3] B1 [1] 8
Notes		
(a)	B1: For stating either $x = 4.5$ or $\frac{9}{2}$ or $\frac{18}{4}$ etc. or $A = 4.5$ or $\frac{9}{2}$ or $(4.5, 0)$. Can be written on graph. Allow $(0, 4.5)$ marked on curve for B1. Otherwise $(0, 4.5)$ without reference to any of the above is B0.	
(b)(i)	M1: for any horizontal (left-right) translation where minimum is still on x -axis not at $(0, 0)$. Ignore any values. A1ft: for -3 (NOT 3) and 1.5 (or their x in part (a) - 3) evaluated and marked on the positive x -axis. Allow $(0, -3)$ and/or $(0, \text{ft } 1.5)$ rather than $(-3, 0)$ and $(\text{ft } 1.5, 0)$ if marked in the "correct" place on the x -axis. Note: Candidate cannot gain this mark if their x in part (a) is less than 3.	
(ii)	B1: Maximum at 27 marked on the y -axis. Note: the maximum must be on the y -axis for this mark. M1: for correct shape with minimum still at $(0, 0)$ and a maximum within the first quadrant. Ignore values. A1ft: for $\frac{\text{their } x \text{ in part (a)}}{3}$; as intercept on x -axis eg: $\frac{4.5}{3}$ or 1.5 or $\frac{3}{2}$ or $\frac{9}{6}$ Note: a generalised $\frac{A}{3}$ is A0. Allow $(0, \text{ft } 1.5)$ rather than $(\text{ft } 1.5, 0)$ if marked in the "correct" place on the x -axis. B1: Maximum at $(1, 27)$ or allow 1 marked on the x -axis and the corresponding 27 marked on the y -axis. Note: Be careful to look at the correct graph. The candidate may draw another graph to help them to answer part (c). Note: You can recover (b)(i) $(-3, 0)$ and $(\text{ft } 1.5, 0)$ or in (b)(ii) $(\text{ft } 1.5, 0)$ as correct coordinates only in candidate's working if these are not marked on their sketch(es).	
(c)	B1: for $(k =) -17$ only. BEWARE: This could be written in the middle or at the bottom of a page.	

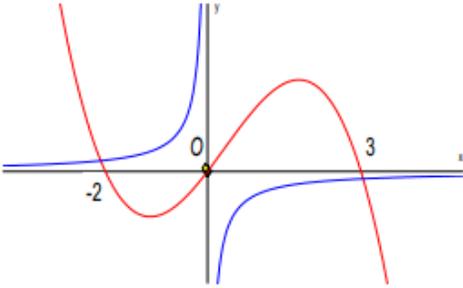
6.

Question Number	Scheme	Marks
<p>8.</p> <p>(a)</p>	 <p>Shape  through (0, 0)</p> <p>(3, 0)</p> <p>(1.5, -1)</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p>
<p>(b)</p>	 <p>Shape </p> <p>(0, 0) and (6, 0)</p> <p>(3, 1)</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p>
<p>(c)</p>	 <p>Shape  , <u>not</u> through (0, 0)</p> <p>Minimum in 4th quadrant</p> <p>(-p, 0) and (6 - p, 0)</p> <p>(3 - p, -1)</p>	<p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>(4)</p> <p>10</p>
Notes		
<p>(a) B1: U shaped parabola through origin B1: (3,0) stated or 3 labelled on x axis B1: (1.5, -1) or equivalent e.g. (3/2, -1)</p> <p>(b) B1: Cap shaped parabola in any position</p> <p>B1: through origin (may not be labelled) and (6,0) stated or 6 labelled on x - axis B1: (3,1) shown</p> <p>(c) M1: U shaped parabola not through origin A1: Minimum in 4th quadrant (depends on M mark having been given) B1: Coordinates stated or shown on x axis B1: Coordinates stated</p> <p>Note: If values are taken for p, then it is possible to give M1A1B0B0 even if there are several attempts. (In this case all minima should be in fourth quadrant)</p>		

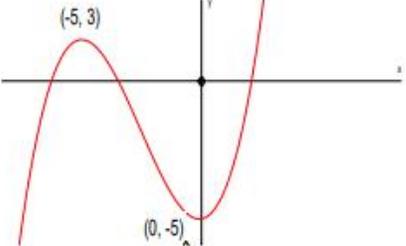
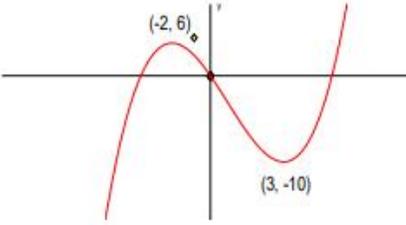
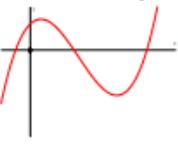
7.

Question Number	Scheme	Marks
<p>5.</p> <p>(a)</p>	 <p>Correct shape with a single crossing of each axis</p> <p>$y = 1$ labelled or stated</p> <p>$x = 3$ labelled or stated</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p>
<p>(b)</p>	<p>Horizontal translation so crosses the x-axis at $(1, 0)$</p> <p>New equation is $(y =) \frac{x \pm 1}{(x \pm 1) - 2}$</p> <p>When $x = 0$ $y =$</p> $= \frac{1}{3}$	<p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>(4)</p> <p>7</p>
Notes		
<p>(b)</p>	<p>B1 for point $(1,0)$ identified - this may be marked on the sketch as 1 on x axis. Accept $x = 1$.</p> <p>1st M1 for attempt at new equation and either numerator or denominator correct</p> <p>2nd M1 for setting $x = 0$ in their new equation and solving as far as $y = \dots$</p> <p>A1 for $\frac{1}{3}$ or exact equivalent. Must see $y = \frac{1}{3}$ or $(0, \frac{1}{3})$ or point marked on y-axis.</p> <p>Alternative</p> <p>$f(-1) = \frac{-1}{-1-2} = \frac{1}{3}$ scores M1M1A0 unless $x=0$ is seen or they write the point as $(0, \frac{1}{3})$ or give $y = 1/3$</p> <p>Answers only: $x = 1, y = 1/3$ is full marks as is $(1,0) (0, 1/3)$</p> <p>Just 1 and $1/3$ is B0 M1 M1 A0</p> <p>Special case : Translates 1 unit to left</p> <p>(a) B0, B1, B0</p> <p>(b) Mark (b) as before</p> <p>May score B0 M1 M1 A0 so $3/7$ or may ignore sketch and start again scoring full marks for this part.</p>	

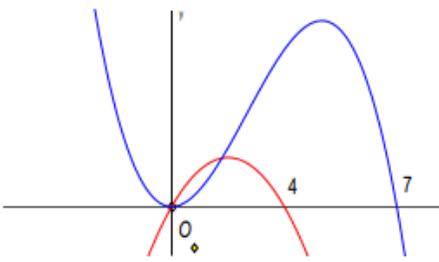
8.

Question Number	Scheme	Marks
<p>10.</p> <p>(a)</p>	 <p>(i) correct shape (-ve cubic) Crossing at (-2, 0) Through the origin Crossing at (3,0)</p> <p>(ii) 2 branches in correct quadrants not crossing axes One intersection with cubic on each branch</p>	<p>B1 B1 B1 B1</p> <p>B1</p> <p>B1</p> <p>(6)</p>
<p>(b)</p>	<p>“2” solutions</p> <p>Since only “2” intersections</p>	<p>B1ft</p> <p>dB1ft</p> <p>(2)</p> <p>8</p>
Notes		
<p>(b)</p>	<p>B1ft for a value that is compatible with their sketch dB1ft This mark is dependent on the value being compatible with their sketch. For a comment relating the number of solutions to the number of intersections.</p> <p>[Only allow 0, 2 or 4]</p>	

9.

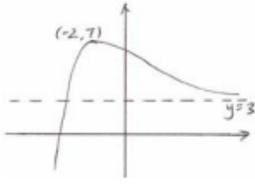
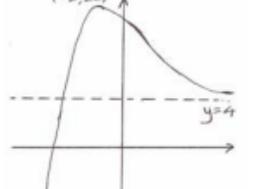
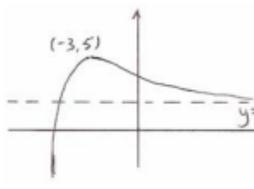
Question Number	Scheme	Marks
6.		
(a)	 <p>Horizontal translation of ± 3</p> <p>$(-5, 3)$ marked on sketch or in text</p> <p>$(0, -5)$ and min intentionally on y-axis Condone $(-5, 0)$ if correctly placed on negative y-axis</p>	<p>M1</p> <p>B1</p> <p>A1 (3)</p>
(b)	 <p>Correct shape and intentionally through $(0, 0)$ between the max and min</p> <p>$(-2, 6)$ marked on graph or in text</p> <p>$(3, -10)$ marked on graph or in text</p>	<p>B1</p> <p>B1</p> <p>B1 (3)</p>
(c)	<p>$(a =) \underline{5}$</p>	<p>B1 (1)</p>
Notes		
(a)	<p>Turning points (not on axes) should have both co-ordinates given in form (x, y). Do not accept points marked on axes e.g. -5 on x-axis and 3 on y-axis is not sufficient. For repeated offenders apply this penalty once only at first offence and condone elsewhere.</p> <p>In (a) and (b) no graphs means no marks.</p> <p>In (a) and (b) the ends of the graphs do not need to cross the axes provided max and min are clear</p>  <p>M1 for a horizontal translation of ± 3 so accept coordinates of $(1, 3)$ <u>or</u> $(6, -5)$ seen. [Horizontal translation to the left should have a min <u>on</u> the y-axis] If curve passes through $(0, 0)$ then M0 (and A0) but they could score the B1 mark.</p> <p>A1 for minimum clearly on negative y-axis and at least -5 marked on y-axis. Allow this mark if the minimum is very close and the point $(0, -5)$ clearly indicated</p>	<p>i.e max in 1st quad <u>and</u></p>
(b)	<p>1st B1 Ignore coordinates for this mark Coordinates or points on sketch override coordinates given in the text. Condone (y, x) confusion for points on axes only. So $(-5, 0)$ for $(0, -5)$ is OK if the point is marked correctly but $(3, 10)$ is B0 even if in 4th quadrant.</p>	
(c)	<p>This may be at the bottom of a page or in the question...make sure you scroll up and down!</p>	

10.

Question Number	Scheme	Marks
<p>10. (a)</p>	 <p>(i) \cap shape (anywhere on diagram)</p> <p>Passing through or stopping at (0, 0) and (4,0) only (Needn't be \cap shape)</p> <p>(ii) correct shape (-ve cubic) with a max and min drawn anywhere</p> <p>Minimum or maximum at (0,0)</p> <p>Passes through or stops at (7,0) but <u>NOT</u> touching.</p> <p>(7, 0) should be to right of (4,0) or B0</p> <p>Condone (0,4) or (0, 7) marked correctly on x-axis. Don't penalise poor overlap near origin.</p> <p>Points must be marked on the sketch...not in the text</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>(5)</p>
(b)	$x(4-x) = x^2(7-x) \quad (0=)x[7x-x^2-(4-x)]$ $(0=)x[7x-x^2-(4-x)] \quad (\text{o.e.})$ $0 = x(x^2 - 8x + 4) \quad *$	<p>M1</p> <p>B1ft</p> <p>A1 cso (3)</p>
(c)	$(0 = x^2 - 8x + 4 \Rightarrow) x = \frac{8 \pm \sqrt{64-16}}{2} \quad \text{or} \quad (x \pm 4)^2 - 4^2 + 4 (=0)$ $= \frac{8 \pm 4\sqrt{3}}{2} \quad \text{or} \quad (x-4)^2 = 12$ $x = 4 \pm 2\sqrt{3}$ <p>From sketch A is $x = 4 - 2\sqrt{3}$</p> <p>So $y = (4 - 2\sqrt{3})(4 - [4 - 2\sqrt{3}])$ (dependent on 1st M1)</p> $= -12 + 8\sqrt{3}$	<p>M1</p> <p>A1</p> <p>B1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1 (7)</p>
Notes		
(b)	<p>M1 for forming a suitable equation</p> <p>B1 for a common factor of x taken out legitimately. Can treat this as an M mark. Can fit their cubic = 0 found from an attempt at solving their equations e.g. $x^3 - 8x^2 - 4x = x(\dots)$</p> <p>A1 cso no incorrect working seen. The "= 0" is required but condone missing from some lines of working. Cancelling the x scores B0A0.</p>	
(c)	<p>1st M1 for some use of the correct formula or attempt to complete the square</p> <p>1st A1 for a fully correct expression: condone + instead of \pm or for $(x-4)^2 = 12$</p> <p>B1 for simplifying $\sqrt{48} = 4\sqrt{3}$ or $\sqrt{12} = 2\sqrt{3}$. Can be scored independently of this expression</p> <p>2nd A1 for correct solution of the form $p + q\sqrt{3}$: can be \pm or + or -</p> <p>2nd M1 for selecting their answer in the interval (0,4). If they have no value in (0,4) score M0</p> <p>3rd M1 for attempting $y = \dots$ using their x in correct equation. An expression needed for M1A0</p> <p>3rd A1 for correct answer. If 2 answers are given A0.</p>	

15

11.

Question number	Scheme	Marks
Q8	<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>(a)</p>  </div> <div style="text-align: center;"> <p>(b)</p>  </div> <div style="text-align: center;"> <p>(c)</p>  </div> </div>	
	(a) $(-2, 7), y = 3$ (Marks are dependent upon a sketch being attempted) See conditions below.	B1, B1 (2)
	(b) $(-2, 20), y = 4$ (Marks are dependent upon a sketch being attempted) See conditions below.	B1, B1 (2)
	(c) Sketch: Horizontal translation (either way)... (There must be evidence that $y = 5$ at the max and that the asymptote is still $y = 1$) $(-3, 5), y = 1$	B1 B1, B1 (3) [7]
	<p><u>Parts (a) and (b):</u></p> <p>(i) If <u>only one</u> of the B marks is scored, there is <u>no penalty</u> for a wrong sketch.</p> <p>(ii) If both the maximum and the equation of the asymptote are correct, the sketch must be “correct” to score B1 B1. If the sketch is “wrong”, award B1 B0. The (generous) conditions for a “correct” sketch are that the maximum must be in the 2nd quadrant and that the curve must not cross the positive x-axis... ignore other “errors” such as “curve appearing to cross its asymptote” and “curve appearing to have a minimum in the 1st quadrant”.</p> <p><u>Special case:</u></p> <p>(b) Stretch $\frac{1}{4}$ instead of 4: Correct shape, with $\left(-2, \frac{5}{4}\right), y = \frac{1}{4}$: B1 B0.</p> <p><u>Coordinates of maximum:</u></p> <p>If the coordinates are the wrong way round (e.g. $(7, -2)$ in part (a)), or the coordinates are just shown as values on the x and y axes, penalise <u>only once in the whole question</u>, at first occurrence.</p> <p><u>Asymptote marks:</u></p> <p>If the <u>equation</u> of the asymptote is not given, e.g. in part (a), 3 is marked on the y-axis but $y = 3$ is not seen, penalise <u>only once in the whole question</u>, at first occurrence.</p> <p><u>Ignore</u> extra asymptotes stated (such as $x = 0$).</p>	