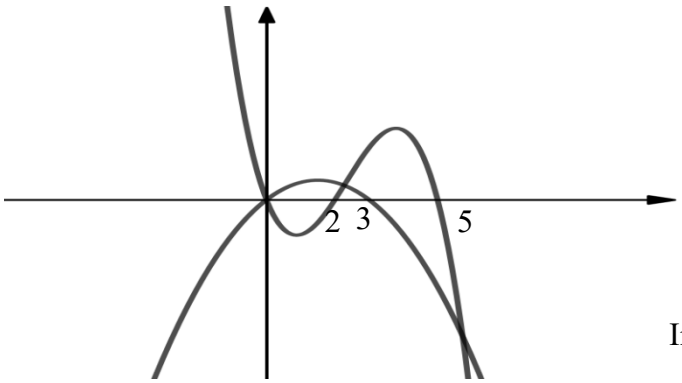
Question Number	Scheme	Marks
11. (a)	 $\cap$ shaped quadratic Intercepts at O and 3 -ve cubic Intercepts at O, 2 and 5	B1 B1 B1 B1 (4)
(b)	Sets $x(x-2)(5-x)=x(3-x)$ $3x-x^2=-x^3+7x^2-10x \Rightarrow \pm(x^3-8x^2+13x)$ $(=0)$ OR $\pm x\{(x-2)(5-x)-(3-x)\}$ $(=0)$ Proceeds to $x(x^2-8x+13)=0$ *	M1 dM1 A1* (3)
(c)	Solves $x^2-8x+13=0 \Rightarrow x=4\pm\sqrt{3}$ Substitutes $x="4-\sqrt{3}"$ into $y=x(3-x)$ oe $y=(4-\sqrt{3})(-1+\sqrt{3})=-4+4\sqrt{3}+\sqrt{3}-3=\ldots$ $y=-7+5\sqrt{3}$	M1 A1 M1 M1 A1 (5) (12 marks)

(a) **For both parts they must have a graph**

(i)

B1 $\cap$ shaped quadratic appearing anywhere on the graph. This is for the general shape so do not be concerned with any parts which appear linear.

B1 A quadratic which crosses the x-axis at O and 3. Accept a mark of 3 on the x-axis. The origin does not need to be labelled as a point of intersection.

(ii)

B1 -ve cubic appearing anywhere on the graph with a maximum and a minimum. This is for the general shape so do not be concerned with any parts which appear linear.

B1 A cubic which crosses the *x*-axis at *O*, 2 and 5. Accept 2 and 5 marked on the *x*-axis. The origin does not need to be labelled as a point of intersection.

It is not a requirement that the curves meet in quadrant 4. The relative heights of the maximum points are not important either. Points of intersection with the coordinate axes may be listed separately. Condone the lack of brackets but the *x* and *y* coordinates must be the correct way round. They cannot simply state eg $x = 2, x = 5$

(b)

M1 Sets the equations equal to each other

dM1 Multiples out and collects terms on one side (unsimplified). Condone errors in multiplying out and slips in collecting like terms but *x* must be a factor of each term. Condone invisible brackets for this mark and condone the absence of "=0"

Alternatively takes the factorised forms to one side and factors out the *x* term.

A1* Proceeds to $x\left(x^2 - 8x + 13\right) = 0$ with no errors including brackets. As a minimum you must see $(x-2)(5-x)$ being multiplied out, terms being collected on one side and a factor of *x* being taken out.

(c)

M1 Solves $x^2 - 8x + 13 = 0$ by completing the square or formula. Apply general marking principles for quadratics for this mark. Their solutions do not need to be exact for this mark.

A1 Either (or both) of $(x =)\ 4 \pm \sqrt{3}$ (oe but must be of the form $\frac{a \pm \sqrt{b}}{c}$ or simplified further)

M1 Substitutes $x = 4 - \sqrt{3}$ or their **lower** value of *x* into either equation to find *y*. This mark can be awarded if they had rounded decimal solutions to their quadratic. If they substitute both values in then this mark can still be awarded. You may need to check their *y* value on a calculator to imply this method mark if their *x* value is incorrect.

M1 Evidence of using the rules of surds to form a *y* coordinate that is exact and simplified. They must show evidence of working with surds before simplifying to two terms of the form $d + f\sqrt{g}$. Eg one of the bold terms from $y = (a - \sqrt{b})(c + \sqrt{b}) = ac + \mathbf{a\sqrt{b} - c\sqrt{b} - b}$ would be sufficient. If no working shown then M0 and A0 will follow this.

A1 $(4 - \sqrt{3}, -7 + 5\sqrt{3})$ or exact equivalent. This must be the only coordinate stated as their final answer.

Note that the question stated using algebra and showing your working. If they simply state the solutions of the quadratic then they can only get M0A0M1M1A0.

If they simply state the solutions of the quadratic and show no surd work then the maximum they may be able to get is M0A0M1M0A0.

Question Number	Scheme	Marks
12.(a)	Substitutes $x=4$ in $\frac{dy}{dx}=3x\sqrt{x}-10x^{-\frac{1}{2}}=3\times4\times2-\frac{10}{2}=19$	M1A1
	Attempts $(y-(-2))="19"\times(x-4)\Rightarrow y=19x-78$	M1A1 cao
		(4)
(b)	$f'(x)=3x^{\frac{3}{2}}-10x^{-\frac{1}{2}}\Rightarrow f(x)=\frac{6}{5}x^{\frac{5}{2}}-20x^{\frac{1}{2}}+c$	M1 A1 A1
	$x=4, f(x)=-2\Rightarrow$	
	$-2=38.4-40+c\Rightarrow c=...(-0.4)$	M1
	$[f(x)=]\ \frac{6}{5}x^{\frac{5}{2}}-20x^{\frac{1}{2}}-0.4$	A1 cso
		(5) **(9 marks)**

(a)

M1 Substitutes $x=4$ into $\frac{dy}{dx}=3x\sqrt{x}-10x^{-\frac{1}{2}}$. Do not award this mark if they attempt to differentiate the expression first (look at the $-10x^{-\frac{1}{2}}$ for evidence of the power decreasing) but do condone an error made on the power of the first *x* term if they try to write it as a single power of x .

A1 Gradient = 19

M1 Attempts an equation of a tangent using their $f'(4)$ and $(4,-2)$. If they attempt $(y+2)="19"(x-4)$ at least one of the brackets must be correct. If the form $y=mx+c$ is used they must proceed as far as finding *c*. They must either have shown their gradient and $(4,-2)$ substituted into $y=mx+c$ and rearrange (maybe with errors) to find *c* or if they show no working then their *c* must be correct.

A1 $y=19x-78$ cao

(b)

M1 Raises the power of any term by one $x^{-\frac{1}{2}}\to x^{\frac{1}{2}}, x^{\frac{3}{2}}\to x^{\frac{5}{2}}$ Accept eg $x^{\frac{3}{2}}\to x^{\frac{3}{2}+1}$

A1 Any term correct (may be un-simplified) with or without +*c*

A1 Both terms correct (may be un-simplified) with or without +*c*

M1 Substitutes $x=4, y=-2$ into their $f(x)$ containing +*c* to obtain *c*. Condone errors in evaluating and rearranging

A1 $[f(x)=]\ \frac{6}{5}x^{\frac{5}{2}}-20x^{\frac{1}{2}}-0.4$ or equivalent including $(y=)$ ... cso