

Question	Scheme	Marks
10(i)	$\vec{AB} = \vec{OB} - \vec{OA} = [(3a+2)\mathbf{i} + b\mathbf{j}] - [(b+1)\mathbf{i} + b\mathbf{j}]$ $\vec{AB} = [(3a+2) - (b+1)]\mathbf{i} = 3\mathbf{i}$ $(3a+2) - (b+1) = 3 \Rightarrow 3a - b = 2 \text{ or } b = 3a - 2$ $\frac{\sqrt{17}}{34} = \frac{1}{\sqrt{68}}$ $68 = (3a+2)^2 + b^2$ $\Rightarrow 68 = (3a+2)^2 + (3a-2)^2 \Rightarrow 68 = 18a^2 + 8$ $\Rightarrow 60 = 18a^2 \Rightarrow a = \frac{\sqrt{30}}{3} \text{ oe}$ $b = \frac{3\sqrt{30}}{3} - 2 = \sqrt{30} - 2$	M1 A1 M1A1  B1  M1 M1 A1
(ii)	$b = \frac{3\sqrt{30}}{3} - 2 = \sqrt{30} - 2$	M1A1 [10]
Total 10 marks		

Part	Mark	Notes
	M1	For the vector equation $\vec{AB} = \vec{OB} - \vec{OA}$ This can be implied by the next correct step.
	A1	For the correct unsimplified vector $\vec{AB} = [(3a+2)\mathbf{i} + b\mathbf{j}] - [(b+1)\mathbf{i} + b\mathbf{j}]$
	M1	For setting their vector $\vec{AB} = 3\mathbf{i}$ and attempting to find an expression in terms of $a$ and $b$ only
	A1	For a correct expression in any form. e.g. $3a - b = 2$ or $b = 3a - 2$ or equivalent
	ALT	
	M1	For the vector equation $\vec{OB} = \vec{AB} + \vec{OA}$
	A1	For the correct unsimplified vector $\vec{OB} = [(b+1)\mathbf{i} + b\mathbf{j}] + 3\mathbf{i} = \{(b+4)\mathbf{i} + b\mathbf{j}\}$
	M1	For setting their $\vec{OB}$ equal to $(3a+2)\mathbf{i} + b\mathbf{j}$ and equating coefficients of $\mathbf{i}$ and $\mathbf{j}$ $(b+4)\mathbf{i} + b\mathbf{j} = (3a+2)\mathbf{i} + b\mathbf{j} \Rightarrow b+4 = 3a+2$
	A1	For a correct expression in any form.

(i)		e.g. $3a - b = 2$ or $b = 3a - 2$ or equivalent
	<b>B1</b>	For simplifying $\frac{\sqrt{17}}{34}$ into $\frac{1}{\sqrt{68}}$ or any equivalent. For example, $\left(\frac{\sqrt{17}}{34}\right)^2 = \frac{1}{68}$ Accept seen anywhere in their working. If this step is not explicitly, correct $a$ or $b$ implies correct work.
	<b>Way 1</b>	
	<b>M1</b>	For using Pythagoras to form an equation with their $\sqrt{68}$ or 68 and $(3a+2)\mathbf{i} + b\mathbf{j}$ and forming an expression in terms of $a$ and $b$ [ These values must be applied correctly. Do not accept $\frac{1}{68} = (3a+2)^2 + b^2$ for this mark]
	<b>M1</b>	For eliminating $b$ from their equation <b>and</b> solving the resulting equation to find a value for $a$ or $a^2$ .
	<b>A1</b>	For $a = \frac{\sqrt{30}}{3}$ oe This does not have to be simplified.
	<b>(ii)</b>	
	<b>M1</b>	For finding the value of $b$ using their expression in terms of $a$ and $b$ and their $a$ <b>provided their <math>a &gt; 0</math></b>
	<b>A1</b>	For $b = \sqrt{30} - 2$ o.e. This does not have to be simplified.
	<b>Way 2</b>	
(ii)	<b>M1</b>	For using Pythagoras to form an equation with their $\vec{OB} = (b+4)\mathbf{i} + b\mathbf{j}$ $\sqrt{68}$ or 68 and forming an expression in terms of $b$ [This must be applied correctly. Do not accept $\frac{1}{68} = (b+4)^2 + b^2$ for this mark]
	<b>M1</b>	For finding a value for $b$ or $b^2$ by solving their 3TQ by any valid method. E.g., by completing the square. $68 = (b+4)^2 + b^2$ $\Rightarrow 68 = 2b^2 + 8b + 16 \Rightarrow b^2 + 4b - 26 = 0$ $\Rightarrow b^2 + 4b - 26 = (b+2)^2 - 30 = 0$ $\Rightarrow b = \sqrt{30} - 2$
	<b>A1</b>	For $b = \sqrt{30} - 2$ o.e. This does not have to be simplified.
	<b>(i)</b>	
(i)	<b>M1</b>	For finding the value of $a$ using their expression in terms of $a$ and $b$ and their $b$ <b>provided their <math>b &gt; 0</math>.</b>
	<b>A1</b>	For $a = \frac{\sqrt{30}}{3}$ oe This does not have to be simplified.

Question	Scheme	Marks
<b>11(a)</b>	$f(x) = 10 + 6x - x^2 = -(x^2 - 6x) + 10 \Rightarrow A = -1$ $f(x) = -[(x-3)^2 - 9] + 10 = -(x-3)^2 + 19$ $B = -3, C = 19$	B1 M1 A1A1 [4]
<b>(b)</b>	(i) $x = 3$ (ii) $f(x)_{\text{greatest}} = 19$	B1ft B1ft [2]
<b>(c)</b>	$x^2 - x + 13 = 10 + 6x - x^2 \Rightarrow 2x^2 - 7x + 3 = 0$ $\Rightarrow (2x-1)(x-3) = 0 \Rightarrow x = \frac{1}{2}, 3$	M1 M1A1 [3]
<b>(d)</b>	$A = \int_{\frac{1}{2}}^3 (10 + 6x - x^2) dx - \int_{\frac{1}{2}}^3 (x^2 - x + 13) dx = \left[ \int_{\frac{1}{2}}^3 -2x^2 + 7x - 3 dx \right]$ $A = \left[ -\frac{2x^3}{3} + \frac{7x^2}{2} - 3x \right]_{\frac{1}{2}}^3$ $A = \left[ \left( -\frac{2 \times 3^3}{3} + \frac{7 \times 3^2}{2} - 3 \times 3 \right) - \left( -\frac{2 \times 0.5^3}{3} + \frac{7 \times 0.5^2}{2} - 3 \times 0.5 \right) \right]$ $A = \frac{125}{24} \text{ oe}$	M1 M1A1 M1 A1 [5]
<b>Total 14 marks</b>		

Part	Mark	Notes
<b>(a)</b>	<b>B1</b>	For factorising – 1 and finding $A = -1$
	<b>M1</b>	For an attempt to complete the square – (See general guidance)
	<b>A1</b>	For either $B = -3$ or $C = 19$
	<b>A1</b>	For both $B = -3$ and $C = 19$ Accept all values embedded.
	<b>NB:</b> Correct values following no working – Award full marks in this part.	

(b)(i)	<b>B1ft</b>	$x = 3$ ft their $B$ You may see differentiation to find a maximum $x$ . Allow a correct value of $x$ here even if it does not follow from their working.
(b)(ii)	<b>B1ft</b>	$f(x) = 19$ ft their $C$ You may see differentiation to find a maximum $x$ . Allow a correct value of $f(x)$ here even if it does not follow from their working. Allow $y = 19$ .
(c)	<b>M1</b>	Sets the equation of curve $C$ equal to the equation of curve $S$ and forms a 3TQ
	<b>M1</b>	Attempts to solve their 3TQ using any correct method to find <b>two</b> values of $x$ If their 3TQ is incorrect and no working is seen to solve it, withhold this mark.
	<b>A1</b>	For both $x = \frac{1}{2}$ , 3 correct Accept coordinates – ignore $y$ values.
	<b>NB:</b> Both correct values following no working – Award full marks in this part.	
(d)	<b>M1</b>	For a correct statement with their values of $x$ in the correct position of the intent to integrate the two expressions and <b>subtract</b> the result, or to integrate $2x^2 - 7x + 3$ Ft their limits for this mark, the correct way around, but allow recovery at a later stage. If they deal with the two expressions separately, look for subtraction at the end of their solution.
	<b>M1</b>	For an attempt to integrate their combined expression or <b>two</b> separate expressions. They must achieve as a minimum $\pm Px^3 \pm Qx^2 \pm Rx$ for their integration whether they integrate two expressions separately (each) or one combined expression. Ignore limits for this mark.
	<b>A1</b>	For the correct integrated expression(s)– ignore limits for this mark Allow $\frac{2x^3}{3} - \frac{7x^2}{2} + 3x$
	<b>M1</b>	For substituting their limits into their integrated expression and subtracting the results of lower limit from upper limit. <b>Note carefully:</b> If they have the correct limits and correct integration allow this mark if the <b>correct</b> area is obtained without seeing explicit substitution. $\left(\pm \frac{125}{24}, \pm 5.208\ldots\right)$ If their limits are incorrect or the integration is incorrect or the final area is incorrect then explicit substitution <b>must</b> be seen for the award of this mark.
	<b>A1</b>	For the correct area $A = \frac{125}{24}$ oe

