## MARK SCHEME for the May/June 2015 series

## **0606 ADDITIONAL MATHEMATICS**

0606/11

Paper 1, maximum raw mark 80

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## Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied
WWW	without wrong working

1 (i)	180° or $\pi$ radians or 3.14 radians ( or better)	B1	
(ii)	2	<b>B</b> 1	
(iii) (a)		<b>B</b> 1	$y = \sin 2x$ all correct
(b)		B1 B1	for either $\uparrow \downarrow \uparrow$ starting at their highest value and ending at their lowest value Or a curve with highest value at $y = 3$ and lowest value at $y = -1$ completely correct graph
(iv)	3	<b>B</b> 1	
2 (i)	$\tan \theta = \frac{(8+5\sqrt{2})(4-3\sqrt{2})}{(4+3\sqrt{2})(4-3\sqrt{2})}$ $= \frac{32-24\sqrt{2}+20\sqrt{2}-30}{16-18}$ $= 1+2\sqrt{2}  \text{cao}$	M1 A1	attempt to obtain $\tan \theta$ and rationalise. Must be convinced that no calculators are being used

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(ii)	$\sec^2 \theta = 1 + \tan^2 \theta$		
	$=1+(-1+2\sqrt{2})^{2}$	M1	attempt to use $\sec^2 \theta = 1 + \tan^2 \theta$ , with <i>their</i> answer to (i)
	$=1+1-4\sqrt{2}+8$	DM1	attempt to simplify, must be convinced no calculators are being used.
	$=10-4\sqrt{2}$	A1	Need to expand $(-1+2\sqrt{2})^2$ as 3 terms
	Alternative solution:		
	$AC^{2} = \left(4 + 3\sqrt{2}\right)^{2} + \left(8 + 5\sqrt{2}\right)^{2}$		
	$=148+104\sqrt{2}$		
	$\sec^2 \theta = \frac{148 + 104\sqrt{2}}{\left(4 + 3\sqrt{2}\right)^2}$	M1	
	$=\frac{148+104\sqrt{2}}{\left(4+3\sqrt{2}\right)^2}\times\frac{34-24\sqrt{2}}{34-24\sqrt{2}}$	DM1	
	$=10-4\sqrt{2}$	A1	
3 (i)	$64 + 192x^2 + 240x^4 + 160x^6$	B3,2,1,0	-1 each error
(ii)	$(64+192x^2+240x^4)\left(1-\frac{6}{x^2}+\frac{9}{x^4}\right)$	B1	expansion of $\left(1-\frac{3}{x^2}\right)^2$
	Terms needed $64 - (192 \times 6) + (240 \times 9)$	M1	attempt to obtain 2 or 3 terms using <i>their</i> (i)
	= 1072	A1	

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4	(a)	$\mathbf{X}^2 = \begin{pmatrix} 4 - 4k & -8\\ 2k & -4k \end{pmatrix}$	B2,1,0	-1 each incorrect element		
	(b)	Use of $\mathbf{A}\mathbf{A}^{-1} = \mathbf{I}$ $\begin{pmatrix} a & 1 \\ b & 5 \end{pmatrix} \begin{pmatrix} \frac{5}{6} & -\frac{1}{6} \\ -\frac{2}{3} & \frac{1}{3} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	M1	use of $AA^{-1} = I$ and an attempt to obtain at least one equation.		
		Any 2 equations will give $a = 2, b = 4$	A1,A1			
		Alternative method 1: $1  (5  -1)  \left( \begin{array}{c} \frac{5}{6} & -\frac{1}{6} \end{array} \right)$				
		$\frac{1}{5a-b} \begin{pmatrix} 5 & -1 \\ b & a \end{pmatrix} = \begin{pmatrix} \frac{5}{6} & -\frac{1}{6} \\ -\frac{2}{3} & \frac{1}{3} \end{pmatrix}$	M1	correct attempt to obtain $A^{-1}$ and comparison of at least one term.		
		Compare any 2 terms to give $a = 2, b = 4$	A1,A1			
		Alternative method 2:				
		Inverse of $\frac{1}{6} \begin{pmatrix} 5 & -1 \\ -4 & 2 \end{pmatrix} = \begin{pmatrix} 2 & 1 \\ 4 & 5 \end{pmatrix}$	M1 A1,A1	reasoning and attempt at inverse		
5		$3x-1 = x(3x-1) + x^{2} - 4 \text{ or}$ $y = \left(\frac{y+1}{3}\right)y + \left(\frac{y+1}{3}\right)^{2} - 4$				
		$4x^2 - 4x - 3 = 0$ or $4y^2 - 4y - 35 = 0$	M1	equate and attempt to obtain an		
		(2x-3)(2x+1)=0 or $(2y-7)(2y+5)=0$	DM1	equation in 1 variable forming a 3 term quadratic equation and attempt to solve		
		leading to $x = \frac{3}{2}, x = -\frac{1}{2}$ and	A1	x values		
		$y = \frac{7}{2}, y = -\frac{5}{2}$	A1	<i>y</i> values		
		Midpoint $\left(\frac{1}{2}, \frac{1}{2}\right)$	B1	for midpoint, allow anywhere		
		Perpendicular gradient = $-\frac{1}{3}$	M1	correct attempt to obtain the gradient of the perpendicular, using AB		
		Perp bisector: $y - \frac{1}{2} = -\frac{1}{3}\left(x - \frac{1}{2}\right)$	M1	straight line equation through the midpoint; must be convinced it is a		
		(3y+x-2=0)	A1	perpendicular gradient. allow unsimplified		

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6	(i)	$f\left(\frac{1}{2}\right) = \frac{a}{8} - \frac{15}{4} + \frac{b}{2} - 2 = 0$	M1	correct use of either $f\left(\frac{1}{2}\right)$ or $f(1)$		
		leading to $a + 4b = 46$ f(1) = $a - 15 + b - 2 = 5$		paired correctly		
		leading to $a + b = 22$	A1	both equations correct (allow unsimplified)		
		giving $b = 8$ (AG), $a = 14$	M1,A1	M1 for solution of equations A1 for both <i>a</i> and <i>b</i> . <b>AG</b> for <i>b</i> .		
	(ii)	$(2x-1)(7x^2-4x+2)$	M1,A1	M1 for valid attempt to obtain $g(x)$ , by either observation or by algebraic long division.		
	(iii)	$7x^2 - 4x + 2 = 0$ has no real solutions as	M1	use of $b^2 - 4ac$		
		$b^2 < 4ac$ $16 < 56$	A1	correct conclusion; must be from a correct $g(x)$ or $2g(x)$ www		
		$\frac{dy}{dt} = \frac{(x-1)\frac{8x}{(4x^2+2)} - \ln(4x^2+3)}{(x-1)^2}$	M1	differentiation of a quotient (or product)		
7	(i)	$\frac{dy}{dx} = \frac{(4x + 2)}{(x - 1)^2}$	B1 A1	correct differentiation of $\ln(4x^2 + 3)$ all else correct		
		When $x = 0$ , $y = -\ln 3$ oe	B1	for <i>y</i> value		
		$\frac{dy}{dx} = -\ln 3$ so gradient of normal is $\frac{1}{\ln 3}$ (allow numerical equivalent)	M1	valid attempt to obtain gradient of the normal		
		normal equation $y + \ln 3 = \frac{1}{\ln 3}x$	M1	attempt at normal equation must be using a perpendicular		
		or $y = 0.910x - 1.10$ , or $y = \frac{10}{11}x - \frac{11}{10}$ cao (Allow $y = 0.91x - 1.1$ )	A1	6 - F - F		
	(ii)	when $x = 0$ , $y = -\ln 3$ when $y = 0$ , $x = (\ln 3)^2$	M1	valid attempt at area		
		Area = $\pm 0.66$ or $\pm 0.67$ or awrt these or $\frac{1}{2}(\ln 3)^3$	A1			

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8 (i)	Range for f: $y \ge 3$ Range for g: $y \ge 9$	B1 B1			
(ii)	$x = -2 + \sqrt{y - 5}$ g <sup>-1</sup> (x) = -2 + \sqrt{x - 5}	M1 A1	attempt to obtain the inverse function Must be correct form		
	Domain of $g^{-1}$ : $x \ge 9$	B1	for domain		
	Alternative method: $y^2 + 4y + 9 - x = 0$	M1	attempt to use quadratic formula and		
	$y = \frac{-4 + \sqrt{16 - 4(9 - x)}}{2}$	A1	find inverse must have + not $\pm$		
(iii)	Need $g(3e^{2x})$	M1	correct order		
	$(3e^{2x} + 2)^{2} + 5 = 41$ or $9e^{4x} + 12e^{2x} - 32 = 0$ $(3e^{2x} - 4)(3e^{2x} + 8) = 0$	DM1	correct attempt to solve the equation		
	leading to $3e^{2x} + 2 = \pm 6$ so $x = \frac{1}{2} \ln \frac{4}{3}$	M1	dealing with the exponential correctly in order to reach a solution for $x$		
	or $e^{2x} = \frac{4}{3}$ so $x = \frac{1}{2} \ln \frac{4}{3}$	A1	Allow equivalent logarithmic forms		
	Alternative method:				
	Using $f(x) = g^{-1}(41)$ , $g^{-1}(41) = 4$	M1	correct use of $g^{-1}$		
	leading to $3e^{2x} = 4$ , so $x = \frac{1}{2} \ln \frac{4}{3}$	DM1	dealing with $g^{-1}(41)$ to obtain an equation in terms of $e^{2x}$		
		M1 A1	dealing with the exponential correctly in order to reach a solution for $x$ Allow equivalent logarithmic forms		
(iv)	$g'(x) = 6e^{2x}$ $g'(\ln 4) = 96$	B1 B1	B1 for each		

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(ii) (ii) (ii) (ii) (i) (		dy.		
gradient of line also 3 solution is a tangent.A1comparing both gradientsAlternate method: $3x+10 = x^3 - 5x^2 + 3x + 10$ leading to $x^2 = 0$ , so tangent at $x = 0$ M1attempt to deal with simultaneous equations obtaining $x = 0$ (ii)When $\frac{dy}{dx} = 0$ , $(3x-1)(x-3) = 0$ $x = \frac{1}{3}$ , $x = 3$ M1equating gradient to zero and valid attempt to solve(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ B1area of the trapezium(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ B1area of the trapezium(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{45}{3} + \frac{27}{2} + 30\right)$ B1area of the trapezium(iii)Area = $\int_0^3 (3x+10) - (x^3 - 5x^2 + 3x + 10)dx$ $= 2^4.7$ or 24.8B1attempt to obtain the area enclosed by integration all correct correct application of limits (must be using <i>their</i> 3 from (ii) and 0)Alternative method: $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ B1correct use of 'Y-y' attempt to integrate integration all correct correct application of limits $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ DM1correct application of limits	9 (i)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 - 10x + 3$	M1	for differentiation
gradient of line also 3 solution is a tangent.A1comparing both gradientsAlternate method: $3x+10 = x^3 - 5x^2 + 3x + 10$ leading to $x^2 = 0$ , so tangent at $x = 0$ M1attempt to deal with simultaneous equations obtaining $x = 0$ (ii)When $\frac{dy}{dx} = 0$ , $(3x-1)(x-3) = 0$ $x = \frac{1}{3}$ , $x = 3$ M1equating gradient to zero and valid attempt to solve(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ B1area of the trapezium(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ B1area of the trapezium(iii)Area = $\frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{45}{3} + \frac{27}{2} + 30\right)$ B1area of the trapezium(iii)Area = $\int_0^3 (3x+10) - (x^3 - 5x^2 + 3x + 10)dx$ $= 2^4.7$ or 24.8B1attempt to obtain the area enclosed by integration all correct correct application of limits (must be using <i>their</i> 3 from (ii) and 0)Alternative method: $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ B1correct use of 'Y-y' attempt to integrate integration all correct correct application of limits $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ DM1correct application of limits		When $x = 0$ , for curve $\frac{dy}{dx} = 3$ ,		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$		ů.	A1	comparing both gradients
(ii) leading to $x^2 = 0$ , so tangent at $x = 0$ (ii) When $\frac{dy}{dx} = 0$ , $(3x-1)(x-3) = 0$ $x = \frac{1}{3}$ , $x = 3$ (iii) Area $= \frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ $= \frac{87}{2} - \left[\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$ = 24.7  or  24.8 Alternative method: Area $= \int_0^3 (3x+10) - (x^3 - 5x^2 + 3x + 10) dx$ $= \int_0^3 - x^3 + 5x^2 dx$ $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ And the correct application of limits of limits and the correct integration and correct integration of limits integration integratin integration integration inte		Alternate method:		
(ii) $\begin{aligned} \text{leading to } x^2 = 0 \text{, so tangent at } x = 0 \\ \text{(ii)} \\ \text{When } \frac{dy}{dx} = 0, (3x-1)(x-3) = 0 \\ x = \frac{1}{3}, x = 3 \end{aligned}$ (iii) $\begin{aligned} \text{Area} = \frac{1}{2}(10+19)3 - \int_0^3 x^3 - 5x^2 + 3x + 10dx \\ &= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3 \\ &= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3 \end{aligned}$ $\begin{aligned} \text{B1} \\ \text{area of the trapezium} \\ \text{attempt to obtain the area enclosed by the curve and the coordinate axes, by integration integration all correct correct application of limits (must be using their 3 from (ii) and 0) \\ \text{A1} \\ \text{A1} \\ \text{A1} \\ \text{A1} \\ \text{A2} \\ \text{A2} \\ \text{A2} \\ \text{A3} \\ \text{A3} \\ \text{A3} \\ \text{A3} \\ \text{A4} \\ \text{A5} \\ \text{A5} \\ \text{A5} \\ \text{A5} \\ \text{A5} \\ \text{A6} \\ \text{A6} \\ \text{A7} \\ \text{A8} \\ \text{A8} \\ \text{A9} \\ \text{A1} \\ A1$		$3x + 10 = x^3 - 5x^2 + 3x + 10$	M1	-
(iii) $x = \frac{1}{3}, x = 3$ (iii) $Area = \frac{1}{2}(10+19)3 - \int_{0}^{3} x^{3} - 5x^{2} + 3x + 10dx$ $= \frac{87}{2} - \left[\frac{x^{4}}{4} - \frac{5x^{3}}{3} + \frac{3x^{2}}{2} + 10x\right]_{0}^{3}$ $= \frac{87}{2} - \left[\frac{x^{4}}{4} - \frac{5x^{3}}{3} + \frac{3x^{2}}{2} + 10x\right]_{0}^{3}$ $= \frac{87}{2} - \left(\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$ $= 24.7 \text{ or } 24.8$ Alternative method: Area = $\int_{0}^{3}(3x+10) - (x^{3} - 5x^{2} + 3x + 10)dx$ $= \int_{0}^{3} -x^{3} + 5x^{2}dx$ $= \left[-\frac{x^{4}}{4} + \frac{5x^{3}}{3}\right]_{0}^{3} = \frac{99}{4}$ A1,A1 A1 area of the trapezium A1 attempt to obtain the area enclosed by the curve and the coordinate axes, by integration integration all correct correct application of limits (must be using <i>their</i> 3 from (ii) and 0) A1 attempt to integrate integration all correct correct use of 'Y-y' attempt to integrate integration all correct correct application of limits (must be using <i>their</i> 3 from (ii) and 0)		leading to $x^2 = 0$ , so tangent at $x = 0$	A1	-
(iii) $x = \frac{1}{3}, x = 3$ A1,A1 A1 for each area of the trapezium $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ B1 area of the trapezium $= \frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$ M1 attempt to obtain the area enclosed by the curve and the coordinate axes, by integration integration all correct correct application of limits (must be using <i>their</i> 3 from (ii) and 0) Alternative method: Area = $\int_0^3 (3x+10) - (x^3 - 5x^2 + 3x + 10) dx$ $= \int_0^3 -x^3 + 5x^2 dx$ $= \left[-\frac{x^4}{4} + \frac{5x^3}{3}\right]_0^3 = \frac{99}{4}$ B1 correct use of 'Y-y' attempt to integrate integration all correct $= (x^4 + \frac{5x^3}{3})_0^3 = \frac{99}{4}$ B1 correct application of limits	(ii)	When $\frac{dy}{dx} = 0$ , $(3x-1)(x-3) = 0$	M1	
Area = $\frac{1}{2}(10+19)3 - \int_{0}^{1} x^{3} - 5x^{2} + 3x + 10dx$ = $\frac{87}{2} - \left[\frac{x^{4}}{4} - \frac{5x^{3}}{3} + \frac{3x^{2}}{2} + 10x\right]_{0}^{3}$ = $\frac{87}{2} - \left(\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$ = 24.7 or 24.8 Alternative method: Area = $\int_{0}^{3}(3x+10) - (x^{3} - 5x^{2} + 3x + 10)dx$ = $\int_{0}^{3} -x^{3} + 5x^{2}dx$ = $\left[-\frac{x^{4}}{4} + \frac{5x^{3}}{3}\right]_{0}^{3} = \frac{99}{4}$ BI A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 Correct use of 'Y-y' attempt to integrate integration all correct correct application of limits		$x = \frac{1}{3}, x = 3$	A1,A1	-
Area = $\frac{1}{2}(10+19)3 - \int_{0}^{1} x^{3} - 5x^{2} + 3x + 10dx$ = $\frac{87}{2} - \left[\frac{x^{4}}{4} - \frac{5x^{3}}{3} + \frac{3x^{2}}{2} + 10x\right]_{0}^{3}$ = $\frac{87}{2} - \left(\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$ = 24.7 or 24.8 Alternative method: Area = $\int_{0}^{3}(3x+10) - (x^{3} - 5x^{2} + 3x + 10)dx$ = $\int_{0}^{3} -x^{3} + 5x^{2}dx$ = $\left[-\frac{x^{4}}{4} + \frac{5x^{3}}{3}\right]_{0}^{3} = \frac{99}{4}$ BI A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 B1 A1 Correct use of 'Y-y' attempt to integrate integration all correct correct application of limits	(iiii)	1 3		
$=\frac{87}{2} - \left(\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$ $= 24.7 \text{ or } 24.8$ Alternative method: Area $= \int_{0}^{3} (3x+10) - (x^{3} - 5x^{2} + 3x + 10) dx$ $= \int_{0}^{3} -x^{3} + 5x^{2} dx$ $= \left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ And the coordinate axes, by integration integration integration integration of limits (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (ii) and 0) (must be using <i>their</i> 3 from (iii) and 0) (must be using <i>their</i> 3 from (iii) and 0) (must be using <i>their</i> 3 from (iii) and 0) (must be using <i>their</i> 3 from (iii) and 0) (must be using <i>their</i> 3 from (iii) and 0) (must be using <i>their</i> 3 from (iii) (must be using <i>their</i> 3 from (must be using <i>their</i> 3 fro	()	Area = $\frac{1}{2}(10+19)3 - \int_0^5 x^3 - 5x^2 + 3x + 10dx$	<b>B</b> 1	area of the trapezium
$=\frac{3}{2} - \left(\frac{34}{4} - 45 + \frac{21}{2} + 30\right)$ $= 24.7 \text{ or } 24.8$ Alternative method: Area $= \int_{0}^{3} (3x+10) - (x^{3} - 5x^{2} + 3x + 10) dx$ $= \int_{0}^{3} -x^{3} + 5x^{2} dx$ $= \left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ Alternative method: Area $= \int_{0}^{3} -x^{3} + 5x^{2} dx$ $= \left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ Antipute the second of t		$=\frac{87}{2} - \left[\frac{x^4}{4} - \frac{5x^3}{3} + \frac{3x^2}{2} + 10x\right]_0^3$	M1	
= 24.7  or  24.8 Alternative method: Area $= \int_0^3 (3x+10) - (x^3 - 5x^2 + 3x + 10) dx$ $= \int_0^3 -x^3 + 5x^2 dx$ $= \left[ -\frac{x^4}{4} + \frac{5x^3}{3} \right]_0^3 = \frac{99}{4}$ And the method is the initial of		$=\frac{87}{2} - \left(\frac{81}{4} - 45 + \frac{27}{2} + 30\right)$		integration all correct
Area = $\int_{0}^{3} (3x+10) - (x^{3}-5x^{2}+3x+10) dx$ = $\int_{0}^{3} -x^{3} + 5x^{2} dx$ = $\left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ B1 M1 A1 B1 M1 A1 Correct use of ' <i>Y</i> - <i>y</i> ' attempt to integrate integration all correct DM1 A1 Correct application of limits		= 24.7 or 24.8		(must be using <i>their</i> 3 from <b>(ii)</b> and 0)
$= \int_{0}^{3} -x^{3} + 5x^{2} dx$ $= \left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ $M1$ attempt to integrate integration all correct DM1 A1 correct application of limits		Alternative method:		
$= \int_{0}^{5} -x^{3} + 5x^{2} dx$ $= \left[ -\frac{x^{4}}{4} + \frac{5x^{3}}{3} \right]_{0}^{3} = \frac{99}{4}$ A1 integration all correct DM1 correct application of limits 10 (a)		Area = $\int_{0}^{3} (3x+10) - (x^{3}-5x^{2}+3x+10) dx$		
		$=\int_{0}^{3}-x^{3}+5x^{2}dx$		
10 (a) $\sin^2 x = \frac{1}{4}$		$= \left[ -\frac{x^4}{4} + \frac{5x^3}{3} \right]_0^3 = \frac{99}{4}$		correct application of limits
	10 (a)	$\sin^2 x = \frac{1}{4}$		
$\sin x = (\pm)\frac{1}{2}$ M1 using $\operatorname{cosec} x = \frac{1}{\sin x}$ and obtaining		$\sin x = (\pm)\frac{1}{2}$	M1	5111 A
$x = 30^{\circ}, 150^{\circ}, 210^{\circ}, 330^{\circ}$ A1,A1 $\begin{cases} \sin x = \dots \\ A1 \text{ for one correct pair, A1 for another correct pair with no extra solutions} \end{cases}$		x = 30°, 150°, 210°, 330°	A1,A1	A1 for one correct pair, A1 for another

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(b)	$(\sec^2 3y - 1) - 2\sec 3y - 2 = 0$	M1	use of the correct identity
	$\sec^2 3y - 2\sec 3y - 3 = 0$ (sec 3y + 1)(sec 3y - 3) = 0	M1	attempt to obtain a 3 term quadratic equation in sec 3 <i>y</i> and attempt to solve
	leading to $\cos 3y = -1$ , $\cos 3y = \frac{1}{3}$	M1	dealing with sec and 3y correctly
	$3y = 180^{\circ}, 540^{\circ}$ $3y = 70.5^{\circ}, 289.5^{\circ}, 430.5^{\circ}$ $y = 60^{\circ}, 180^{\circ}, 23.5^{\circ}, 96.5^{\circ}, 143.5^{\circ}$	A1,A1 A1	A1 for a correct pair, A1 for a second correct pair, A1 for correct 5 <sup>th</sup> solution and no other within the range
	Alternative 1: $\sec^2 3y - 2\sec 3y - 3 = 0$	M1	use of the correct identity
	leading to $3\cos^2 3y + 2\cos 3y - 1$	M1	attempt to obtain a quadratic equation in cos 3y and attempt to solve
	$(3\cos y - 1)(\cos y + 1) = 0$	M1	dealing with 3 <i>y</i> correctly A marks as above
	Alternative 2: $\frac{\sin^2 y}{\cos^2 y} - \frac{2}{\cos y} - 2 = 0$ $(1 - \cos^2 x) - 2\cos x - 2\cos^2 x = 0$	M1	use of the correct identity, $\tan y = \frac{\sin y}{\cos y}$ and $\sec y = \frac{1}{\cos y}$ , then as before
(c)	$z-\frac{\pi}{3}=\frac{\pi}{3},\frac{4\pi}{3}$	M1	correct order of operations
	$z = \frac{2\pi}{3}, \frac{5\pi}{3}$ or 2.09 or 2.1, 5.24	A1,A1	A1 for a correct solution A1 for a second correct solution and no other within the range