Version 1.0



**General Certificate of Education (A-level) June 2011** 

**Mathematics** 

MPC1

(Specification 6360)

**Pure Core 1** 

# **Final**

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from: aga.org.uk

Copyright © 2011 AQA and its licensors. All rights reserved.

#### Copyright

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).

Registered address: AQA, Devas Street, Manchester M15 6EX.

#### Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
В	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
√or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
−x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

#### No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

# MPC1

Q	Solution	Marks	Total	Comments
1(a)	$y = \frac{13}{3} - \frac{7}{3}x$	M1		attempt at $y = a + bx$ or $\frac{\Delta y}{\Delta x}$ with 2 correct points
	(gradient =) $-\frac{7}{3}$	A1	2	condone slip in rearranging if gradient is correct
(b)(i)	y-3 = 'their grad' $(x-1)$	M1		or $7x + 3y = k$ and attempt at $k$ using $x = -1$ and $y = 3$ or $y = (\text{their } m)x + c$ and attempt at $c$ using $x = -1$ and $y = 3$
	$y-3 = -\frac{7}{3}(x+1)$ or $7x + 3y = 2$ or $y = -\frac{7}{3}x + c$ , $c = \frac{2}{3}$	A1cso	2	correct equation in any form and replacing with + sign
(ii)	(4,-5)	B1,B1	2	x = 4, $y = -5$ withhold if clearly from incorrect working
(c)	7x + 3y = 13 and $3x + 2y = 12\Rightarrow equation in x or y only$	M1		must use correct pair of equations and attempt to eliminate $y$ (or $x$ )
	x = -2	A1	2	
	y = 9 Total	A1	3 9	

MPC1 (cont)	Solution	Marks	Total	Comments
	501uti01i			
2(a)(i)	$\sqrt{48} = 4\sqrt{3}$	B1	1	condone $k = 4$ stated
( <b>ii</b> )	$\sqrt{48} = 4\sqrt{3}$ $\frac{4\sqrt{3} + 6\sqrt{3}}{2\sqrt{3}}$	M1		attempt to write each term in form $k\sqrt{3}$ with at least 2 terms correctly obtained
		A1		correct unsimplified in terms of $\sqrt{3}$ only
	= 5	A1cso	3	must simplify fraction to 5
				Alternative 1 $\times \frac{\sqrt{12}}{\sqrt{12}} \left( or \times \frac{\sqrt{3}}{\sqrt{3}} \right)$ M1
				correct with integer terms = $\frac{24+36}{12}$ A1 = 5 A1cso
				Alternative 2 $\frac{\sqrt{48} + \sqrt{108}}{\sqrt{12}}$ M1
				$= \sqrt{4} + \sqrt{9} $ A1 = 5 A1cso
				<b>Alternative 3</b> $\sqrt{\frac{48}{12}} + 2\sqrt{\frac{27}{12}}$ M1
				$= 2 + 2\sqrt{\frac{9}{4}} \qquad A1$ $= 5 \qquad A1 cso$
				if hybrid of methods used, award M1 and most appropriate first A1
				NMS (answer =) 5 scores full marks
(b)	$\frac{1 - 5\sqrt{5}}{3 + \sqrt{5}} \times \frac{3 - \sqrt{5}}{3 - \sqrt{5}}$	M1		
	(numerator =) $3 - \sqrt{5} - 15\sqrt{5} + 25$	m1		correct unsimplified but must write $5\sqrt{5}\sqrt{5} = 25$ PI by 28 seen later
	(denominator = $9 - 5 =$ ) 4 giving $\frac{28 - 16\sqrt{5}}{4}$	B1		must be seen as denominator
	$(answer =) 7 - 4\sqrt{5}$	A1	4	m = 7, $n = -4$
	Total		8	
	1 Utai			<u> </u>

Q	Solution	Marks	Total	Comments
3(a)	$\left(\frac{\mathrm{d}V}{\mathrm{d}t} = \right)\frac{3t^2}{4} - 3$	M1 A1	2	one of these terms correct all correct (no + $c$ etc)
(b)(i)	$t = 1 \Rightarrow \frac{\mathrm{d}V}{\mathrm{d}t} = \frac{3}{4} - 3$	M1		substituting $t = 1$ into their $\frac{dV}{dt}$
	$=-2\frac{1}{4}$	A1cso	2	(-2.25 OE) BUT must have $\frac{dV}{dt}$ correct
(ii)	Volume is decreasing when $t = 1$ because $\frac{dV}{dt} < 0$	<b>E</b> 1√	1	must have used $\frac{dV}{dt}$ in (b)(i) or starts again must state that $\frac{dV}{dt} < 0$ (or $-2\frac{1}{4} < 0$ etc) ft increasing plus explanation if their $\frac{dV}{dt} > 0$
(c)(i)	$\left(\frac{\mathrm{d}V}{\mathrm{d}t} = 0 \Rightarrow\right) \frac{3t^2}{4} - 3 = 0$	M1		PI by "correct" equation being solved
	$\Rightarrow t^2 = 4$	A1√		obtaining $t^n = k$ correctly from their $\frac{dV}{dt}$
	t=2	A1cso	3	withhold if answer left as $t = \pm 2$
( <b>ii</b> )	$\left(\frac{\mathrm{d}^2 V}{\mathrm{d}t^2} = \right) \frac{3t}{2}$	B1√		(condone unsimplified) ft their $\frac{dV}{dt}$
	When $t = 2$ , $\frac{d^2V}{dt^2} = 3$ or $\frac{d^2V}{dt^2} > 0$	M1		ft their $\frac{d^2V}{dt^2}$ and value of t from (c)(i)
	⇒ minimum	A1cso	3	
	Total		11	

Q	Solution	Marks	Total	Comments
<b>4</b> (a)	$(x+2.5)^{2}$ $q = 7 - 'their' p^{2}$	B1		$p = \frac{5}{2}$
	$q = 7 - \text{'their'} p^2$	M1		unsimplified attempt at $q = 7$ – 'their' $p^2$
				$q = 7 - \frac{25}{4} = \frac{3}{4}$
	$(x+2.5)^2+0.75$	A1	3	
	mark their final line as their answer			
(b)(i)	x = - 'their' $p$ or $y =$ 'their' $q$	M1		or $x = -\frac{5}{2}$ cao found using calculus
	$\left(-\frac{5}{2}, \frac{3}{4}\right)$	A1cao	2	condone correct coordinates stated $x = -2.5$ , $y = 0.75$
(ii)	$x = -\frac{5}{2}$	B1√	1	correct or ft " $x = -$ 'their' $p$ "
(iii)	y , , , , , , , , , , , , , , , , , , ,	B1		y intercept = 7 stated or seen in table as $y = 7$ when $x = 0$ or 7 marked as intercept on $y$ -axis (any graph)
	'	M1		∪ shape
		A1	3	vertex above <i>x</i> -axis in correct quadrant and parabola extending beyond <i>y</i> -axis into first quadrant
(c)	Translation	E1		and no other transformation
	through $\begin{bmatrix} -\frac{5}{2} \\ \frac{3}{4} \end{bmatrix}$	M1		ft either 'their' –p or 'their' q or one component correct for M1
		A1cao	3	both components correct for A1; may describe in words or use a vector
	Total		12	

5(a) $p(3) = 3^3 - 2 \times 3^3 + 3 = (27 - 18 + 3)$	MPC1 (cont		34 '	TD 4 3	
(b) $p(-1) = (-1)^3 - 2(-1)^2 + 3$ $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 \Rightarrow x + 1$ is a factor $p(-1) = -1 - 2 + 3 \Rightarrow x + 1 \Rightarrow x +$	Q	<b>Solution</b> (2) 23 2 22 22 12 23	Marks	Total	Comments
(b) $p(-1) = (-1)^3 - 2(-1)^2 + 3$ $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor $Alcso$ 2 correctly shown = 0 plus statement  (c)(i) Quadratic factor $(x^2 - 3x + 3)$ M1 $b = -3$ or $c = 3$ by inspection or full long division attempt or comparing coefficients must see correct product  (ii) Discriminant of quadratic $b^2 - 4ac = (-3)^2 - 4 \times 3$ M1 'their' discriminant considered possibly within quadratic equation formula $b^2 - 4ac < 0 \Rightarrow \text{no real roots from quadratic}$ Alcso 2 $b^2 - 4ac < 0 \Rightarrow \text{no real roots from quadratic}$ Alcso 2 $b^2 - 4ac < 0 \Rightarrow \text{no real roots from quadratic}$ Alcso 5 $\begin{bmatrix} \frac{1}{4} \cdot \frac{2}{3} + 3 \\ 3 \cdot \frac{3}{3} + 3x \end{bmatrix}^{\frac{1}{3}}$ One term correct another term correct all correct (condone + c) $= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ Bl. Alcso 5 $= 4\frac{2}{3}$ Alcso 5 $\begin{bmatrix} \frac{14}{3} \cdot \frac{56}{12} \text{ etc} \\ \text{but combined as single fraction} \end{bmatrix}$ (b) Area of $A = \frac{1}{2} \times 2 \times 2$ Bl $A = \frac{1}{2} \times 2 \times 2$ $a = \frac{1}{2} \times 2 \times 2 \times 2$ $a = \frac{1}{2} \times 2 \times 2 \times 2$ $a = \frac{1}{2} \times 2 \times 2 \times 2$ $a = \frac{1}{2} \times 2 \times 2 \times 2$ $a = $	5(a)			2	p(3) attempted; not long division
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		<b>= 12</b>	AI	2	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	(b)	$p(1) = (1)^3 + 2(1)^2 + 2$	M1		n(1) attempted, not long division
(c)(i) Quadratic factor $(x^2-3x+3)$	(D)				• • • • • • • • • • • • • • • • • • • •
$(p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{or full long division attempt or comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{or comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{on substance of comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{on substance of comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad$		$p(-1) = -1 - 2 + 3 = 0 \implies x + 1 \text{ is a factor}$	A1cso	2	correctly shown = $0$ plus statement
$(p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{or full long division attempt or comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{or comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{on substance of comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad 2 \qquad \text{on substance of comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad \text{other in the comparing coefficients} \\ (p(x) =)  (x+1)(x^2-3x+3) \qquad \qquad A1 \qquad \qquad 2 \qquad$					
(ii) Discriminant of quadratic $b^2 - 4ac = (-3)^2 - 4 \times 3$ M1 $b^2 - 4ac = (-3)^2 - 4 \times 3$ M1 $b^2 - 4ac = (-3)^2 - 4 \times 3$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots from quadratic} \Rightarrow \text{only one real root}$ Alcso $b^2 - 4ac = (0) \Rightarrow \text{no real roots from quadratic} \Rightarrow \text{only one real root}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ M1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$ N1 $b^2 - 4ac = (0) \Rightarrow \text{no real roots}$	(c)(i)	Quadratic factor $(x^2 - 3x + 3)$	M1		b = -3 or $c = 3$ by inspection
(ii) Discriminant of quadratic $b^2 - 4ac = (-3)^2 - 4 \times 3$					or full long division attempt
(ii) Discriminant of quadratic $b^2-4ac=(-3)^2-4\times 3$					or comparing coefficients
(ii) Discriminant of quadratic $b^2-4ac=(-3)^2-4\times 3$		$(p(x)=) (x+1)(x^2-3x+3)$	<b>A</b> 1	2	must see correct product
$b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $Alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $Alcso $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots} $ $b^{2}-4ac < 0 \Rightarrow$					-
$b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $Alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $Alcso $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $alcso $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots from quadratic} \\ \Rightarrow \text{only one real root} $ $b^{2}-4ac < 0 \Rightarrow \text{no real roots} $ $b^{2}-4ac < 0 \Rightarrow$	(ii)	Discriminant of quadratic	N.// 1		'their' discriminant considered possibly
Total  Total  Solution  Total  Total  Solution  Solution  Solution  Total  Solution  Solution  Solution  Total  Solution  Solu		$b^2 - 4ac = (-3)^2 - 4 \times 3$	IVI I		
Total  Total  Solution  Total  Total  Solution  Solution  Solution  Total  Solution  Solution  Solution  Total  Solution  Solu					
Total  Total  S  6(a) $ \int_{-1}^{1} \left(x^3 - 2x^2 + 3\right) dx $ $ = \left[\frac{x^4}{4} - \frac{2x^3}{3} + 3x\right]_{-1}^{1} $ $ = \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right) $ $ = 4\frac{2}{3} $ Alcso  Area of $\Delta$ $ A = 2$ $ = 2$ Shaded region has area $4\frac{2}{3} - 2$ $ = 2\frac{2}{3} $ Alcso  Alcso  B1  Alcso  B2  Alcso  B2  Alcso  B2  Alcso  B2  Alcso  B3  Alcso  B3  Alcso  B3  Alcso  B3  Alcso  B3  B3  B3  B4  B4  B4  B4  B4  B4  B4		$b^2 - 4ac < 0 \Rightarrow$ no real roots from quadratic	A 1 ago	2	
6(a) $\int_{-1}^{1} \left( x^3 - 2x^2 + 3 \right) dx$ $= \left[ \frac{x^4}{4} - \frac{2x^3}{3} + 3x \right]_{-1}^{1}$ $= \left( \frac{1}{4} - \frac{2}{3} + 3 \right) - \left( \frac{1}{4} + \frac{2}{3} - 3 \right)$ $= 4\frac{2}{3}$ Alcso $\int_{-1}^{1} \left( x^3 - 2x^2 + 3 \right) dx$ $= \left( \frac{1}{4} - \frac{2}{3} + 3 \right) - \left( \frac{1}{4} + \frac{2}{3} - 3 \right)$ $= 4\frac{2}{3}$ B1 \( \sigma \text{ with } (-1)^3 \text{ etc evaluated correctly but must have earned M1} \) $= 4\frac{2}{3} + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 +$		$\Rightarrow$ only one real root	Aicso	2	
6(a) $\int_{-1}^{1} \left( x^3 - 2x^2 + 3 \right) dx$ $= \left[ \frac{x^4}{4} - \frac{2x^3}{3} + 3x \right]_{-1}^{1}$ $= \left( \frac{1}{4} - \frac{2}{3} + 3 \right) - \left( \frac{1}{4} + \frac{2}{3} - 3 \right)$ $= 4\frac{2}{3}$ Alcso $\int_{-1}^{1} \left( x^3 - 2x^2 + 3 \right) dx$ $= \left( \frac{1}{4} - \frac{2}{3} + 3 \right) - \left( \frac{1}{4} + \frac{2}{3} - 3 \right)$ $= 4\frac{2}{3}$ B1 \( \sigma \text{ with } (-1)^3 \text{ etc evaluated correctly but must have earned M1} \) $= 4\frac{2}{3} + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 +$					
$= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ $= 4\frac{2}{3}$ $A1 cso$ $A1 cso$ $B1 \checkmark$ $A1 cso$		Total		8	
$= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ $= 4\frac{2}{3}$ $A1 cso$ $A1 cso$ $B1 \checkmark$ $A1 cso$		$\int_{1}^{1} \left( x^{3} - 2x^{2} + 3 \right) dx$			
$= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ $= 4\frac{2}{3}$ $A1 cso$ $A1 cso$ $B1 \checkmark$ $A1 cso$	<b>6(a)</b>	$\int_{-1}^{1} \left( x - 2x + 3 \right) dx$			
$= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ $= 4\frac{2}{3}$ $A1 cso$ $A1 cso$ $B1 \checkmark$ $A1 cso$		$\begin{bmatrix} x^4 & 2x^3 \end{bmatrix}^1$	M1		one term correct
$= \left(\frac{1}{4} - \frac{2}{3} + 3\right) - \left(\frac{1}{4} + \frac{2}{3} - 3\right)$ $= 4\frac{2}{3}$ $A1 cso$ $A1 cso$ $B1 \checkmark$ $A1 cso$		$= \left  \frac{x}{4} - \frac{2x}{2} + 3x \right $	A1		another term correct
$= \left(\frac{1}{4} - \frac{3}{3} + 3\right) - \left(\frac{1}{4} + \frac{3}{3} - 3\right)$ $= 4\frac{2}{3}$ Alcso $= 2$ B1 With $(-1)^3$ etc evaluated correctly but must have earned M1 $= \frac{14}{3} \cdot \frac{56}{12}$ etc but combined as single fraction  B1 PI  Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ B1 PI $= 2 \pm \text{their (a) } \pm \text{their } \Delta \text{ area}$ $= 2 \pm \frac{8}{3} \cdot \frac{32}{12} \text{ etc}$ but combined as single fraction		$\begin{bmatrix} 4 & 3 \end{bmatrix}_{-1}$	A1		all correct (condone $+ c$ )
$= \left(\frac{1}{4} - \frac{3}{3} + 3\right) - \left(\frac{1}{4} + \frac{3}{3} - 3\right)$ $= 4\frac{2}{3}$ Alcso $= 2$ B1 With $(-1)^3$ etc evaluated correctly but must have earned M1 $= \frac{14}{3} \cdot \frac{56}{12}$ etc but combined as single fraction  B1 PI  Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ Alcso $= 2\frac{2}{3}$ B1 PI $= 2 \pm \text{their (a) } \pm \text{their } \Delta \text{ area}$ $= 2 \pm \frac{8}{3} \cdot \frac{32}{12} \text{ etc}$ but combined as single fraction					
but must have earned M1 $= 4\frac{2}{3}$ Alcso $5 \qquad \frac{14}{3}, \frac{56}{12} \text{ etc}$ but combined as single fraction $E = 2\frac{2}{3}$ B1 PI  Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ Alcso $3 \qquad \frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction		$=\left(\frac{1}{2} - \frac{2}{2} + 3\right) - \left(\frac{1}{2} + \frac{2}{2} - 3\right)$	D1 A		
		$\begin{pmatrix} 4 & 3 \end{pmatrix} \begin{pmatrix} 4 & 3 \end{pmatrix}$	BI√		l • • • • • • • • • • • • • • • • • • •
(b) Area of $\Delta$ $\left(=\frac{1}{2}\times2\times2\right)$ $=2$ Shaded region has area $4\frac{2}{3}-2$ $=2\frac{2}{3}$ Alcso $\frac{8}{3}$ , $\frac{32}{12}$ etc but combined as single fraction		. 2			
(b) Area of $\Delta$ $\left( = \frac{1}{2} \times 2 \times 2 \right)$ $= 2$ B1  PI  Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ M1 $\pm$ their (a) $\pm$ their $\Delta$ area $= 2\frac{2}{3}$ A1cso  3 $\frac{8}{3}$ , $\frac{32}{12}$ etc  but combined as single fraction		$=4\frac{2}{3}$	A1cso	5	$\frac{11}{3}$ , $\frac{30}{12}$ etc
(b) Area of $\Delta$ $\left( = \frac{1}{2} \times 2 \times 2 \right)$ $= 2$ B1  PI  Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ M1 $\pm$ their (a) $\pm$ their $\Delta$ area $= 2\frac{2}{3}$ A1cso  3 $\frac{8}{3}$ , $\frac{32}{12}$ etc  but combined as single fraction					but combined as single fraction
Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ M1 $= 2\frac{2}{3}$ A1cso $3$ M1 $\frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction					· ·
Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$ M1 $= 2\frac{2}{3}$ A1cso $3$ M1 $\frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction	(b)	Area of $\Lambda = \frac{1}{2} \times 2 \times 2$			
Shaded region has area $4\frac{2}{3} - 2$	(0)	$2^{-2}$			
$= 2\frac{2}{3}$ A1cso $3 \qquad \frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction		= 2	B1		PI
$= 2\frac{2}{3}$ A1cso $3 \qquad \frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction		2			
$= 2\frac{2}{3}$ A1cso $3 \qquad \frac{8}{3}, \frac{32}{12} \text{ etc}$ but combined as single fraction		Shaded region has area $4\frac{2}{3} - 2$	M1		$\pm$ their (a) $\pm$ their $\Delta$ area
but combined as single fraction		3			8 32
but combined as single fraction		$=2\frac{2}{3}$	A1cso	3	$\left[\begin{array}{c} \frac{3}{3} \end{array}, \frac{32}{12} \right]$ etc
		3			2 12
		Total		8	

MPC1 (cont	)			
Q	Solution	Marks	Total	Comments
7(a)	8 - 6x > 5 - 4x - 8	M1		multiplying out correctly and > sign used
	$11 > 2x$ $x < 5\frac{1}{2} \qquad \left( \text{ or } x < \frac{11}{2} \right)$	A1cso	2	accept $5.5 > x$ OE
(b)	$2x^{2} + 5x - 12 \ge 0$ $(x+4)(2x-3)$			
	(x+4)(2x-3)	M1		correct factors
				(or roots unsimplified) $\frac{-5 \pm \sqrt{121}}{4}$
	Critical values are $-4$ and $\frac{3}{2}$	A1		both CVs correct; condone $\frac{6}{4}$ , $-\frac{16}{4}$ etc here but must be single fractions
	\ y <b>↑</b> /	M1		sketch or sign diagram including values
	$-4$ $\frac{3}{2}$ $x$			$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
	$x \leqslant -4$ , $x \geqslant \frac{3}{2}$ take their final line as their answer	A1	4	fractions must be simplified condone use of <b>OR</b> but not <b>AND</b>
	Total		6	Tondone due of Oak but not lain

Q	Solution	Marks	Total	Comments
8(a)	$(x-3)^2 + (y+8)^2$	B1		accept $(y8)^2$
	= 100	B1	2	condone RHS = $10^2$ or $k = 10^2$
(b)	$y = 0 \Rightarrow \text{'their'}(x-a)^2 + b^2 = k$ $(x-3)^2 = 36 \text{ or } x^2 - 6x - 27 (= 0) \text{ (PI)}$	M1 A1		Alternative 8 10
	$\Rightarrow x = -3, 9$	A1	3	$(d^{2} =) 10^{2} - 8^{2} $ M1 $d^{2} = 36 $ A1 or $d = 6$ $\Rightarrow x = -3, 9 $ A1
(c)	Line CA has gradient $-\frac{2}{5}$	M1		
	CA has equation $(y+8) = -\frac{2}{5}(x-3)$	A1		any form of correct equation eg $y = -\frac{2}{5}x + c$ , $c = -\frac{34}{5}$
	2x + 5y + 34 = 0	A1cso	3	integer coefficients - all terms on 1 side
(d)(i)	their $(x-3)^2 + (2x+1+8)^2$ or $x^2 + (2x+1)^2 - 6x + 16(2x+1)$ (+73)			substituting $y = 2x + 1$ correctly into LHS of "their" circle equation and
	$x^2 - 6x + 9 + 4x^2 + 36x + 81 = 100$	M1		attempt to expand in terms of <i>x</i> only
	or $x^2 + 4x^2 + 4x + 1 - 6x + 32x + 16 + 73 = 100$	A1		any correct equation (with brackets expanded)
	$\Rightarrow 5x^2 + 30x - 10 = 0$			must see this line or equivalent
	$\Rightarrow x^2 + 6x - 2 = 0$	A1cso	3	AG; all algebra must be correct
(ii)	$(x+3)^2 = 11$	M1		or correct use of formula
				must get as far as $x = \frac{-6 \pm \sqrt{44}}{2}$
	$x = -3 \pm \sqrt{11}$	A1cso	2	exactly this
	Total		13	
	TOTAL		75	