



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

Mathematics

MPC1

(Specification 6360)

Pure Core 1

Final

Mark Scheme

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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
B	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	2	attempt at $y = a + bx$ or $\frac{\Delta y}{\Delta x}$ with 2 correct points
	(gradient =) $-\frac{7}{3}$	A1		condone slip in rearranging if gradient is correct
(b)(i)	$y - 3 = \text{'their grad'}(x - -1)$	M1	2	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 $y = -\frac{7}{3}x + c, \quad c = \frac{2}{3}$	A1cso		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	3	must use correct pair of equations and attempt to eliminate y (or x)
	$x = -2$	A1		
	$y = 9$	A1		
Total			9	

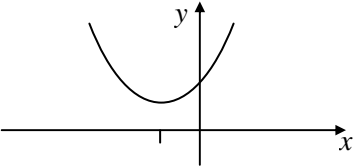
MPC1 (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$\sqrt{48} = 4\sqrt{3}$	B1	1	condone $k = 4$ stated
(ii)	$\frac{4\sqrt{3} + 6\sqrt{3}}{2\sqrt{3}}$	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 $\times \frac{\sqrt{12}}{\sqrt{12}} \left(\text{or } \times \frac{\sqrt{3}}{\sqrt{3}} \right)$ 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
				Alternative 3 $\sqrt{\frac{48}{12}} + 2\sqrt{\frac{27}{12}}$ M1
				= $2 + 2\sqrt{\frac{9}{4}}$ A1
				= 5 A1cso
				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	B1		must be seen as denominator
	giving $\frac{28 - 16\sqrt{5}}{4}$			
	(answer =) $7 - 4\sqrt{5}$	A1	4	$m = 7, n = -4$
Total			8	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$\left(\frac{dV}{dt} = \right) \frac{3t^2}{4} - 3$	M1 A1	2	one of these terms correct all correct (no + c etc)
(b)(i)	$t = 1 \Rightarrow \frac{dV}{dt} = \frac{3}{4} - 3$ $= -2\frac{1}{4}$	M1 A1cso	2	substituting $t = 1$ into their $\frac{dV}{dt}$ (-2.25 OE) BUT must have $\frac{dV}{dt}$ correct
(ii)	Volume is decreasing when $t = 1$ because $\frac{dV}{dt} < 0$	E1✓	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)	$\left(\frac{dV}{dt} = 0 \Rightarrow \right) \frac{3t^2}{4} - 3 = 0$ $\Rightarrow t^2 = 4$ $t = 2$	M1 A1✓ A1cso	3	PI by "correct" equation being solved obtaining $t'' = k$ correctly from their $\frac{dV}{dt}$ withhold if answer left as $t = \pm 2$
(ii)	$\left(\frac{d^2V}{dt^2} = \right) \frac{3t}{2}$ When $t = 2$, $\frac{d^2V}{dt^2} = 3$ or $\frac{d^2V}{dt^2} > 0$ \Rightarrow minimum	B1✓ M1 A1cso	3	(condone unsimplified) ft their $\frac{dV}{dt}$ ft their $\frac{d^2V}{dt^2}$ and value of t from (c)(i)
	Total		11	

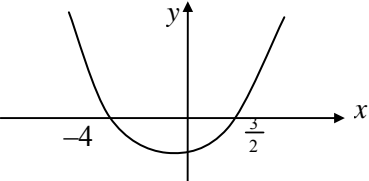
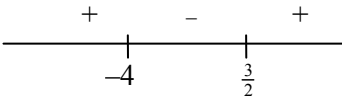
MPC1 (cont)

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

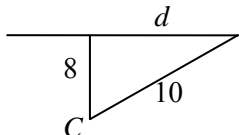
MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)	$p(3) = 3^3 - 2 \times 3^2 + 3 (= 27 - 18 + 3)$ $= 12$	M1 A1	2	p(3) attempted; not long division
(b)	$p(-1) = (-1)^3 - 2(-1)^2 + 3$ $p(-1) = -1 - 2 + 3 = 0 \Rightarrow x + 1$ is a factor	M1 A1 cso	2	p(-1) attempted; not long division correctly shown = 0 plus statement
(c)(i)	Quadratic factor $(x^2 - 3x + 3)$ $(p(x) =) (x + 1)(x^2 - 3x + 3)$	M1 A1	2	$b = -3$ or $c = 3$ by inspection or full long division attempt or comparing coefficients must see correct product
(ii)	Discriminant of quadratic $b^2 - 4ac = (-3)^2 - 4 \times 3$ $b^2 - 4ac < 0 \Rightarrow$ no real roots from quadratic \Rightarrow only one real root	M1 A1 cso	2	'their' discriminant considered possibly within quadratic equation formula
Total			8	
6(a)	$\int_{-1}^1 (x^3 - 2x^2 + 3) dx$ $= \left[\frac{x^4}{4} - \frac{2x^3}{3} + 3x \right]_{-1}^1$ $= \left(\frac{1}{4} - \frac{2}{3} + 3 \right) - \left(\frac{1}{4} + \frac{2}{3} - 3 \right)$ $= 4\frac{2}{3}$	M1 A1 A1 B1 ✓ A1 cso	5	one term correct another term correct all correct (condone + c) 'their' F(1) - F(-1) with (-1) ³ etc evaluated correctly but must have earned M1 $\frac{14}{3}$, $\frac{56}{12}$ etc but combined as single fraction
(b)	Area of $\Delta \left(= \frac{1}{2} \times 2 \times 2 \right)$ $= 2$ Shaded region has area $4\frac{2}{3} - 2$ $= 2\frac{2}{3}$	B1 M1 A1 cso	3	PI \pm their (a) \pm their Δ area $\frac{8}{3}$, $\frac{32}{12}$ etc but combined as single fraction
Total			8	

MPC1 (cont)

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

MPC1 (cont)

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