



**General Certificate of Education (A-level)
January 2012**

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.

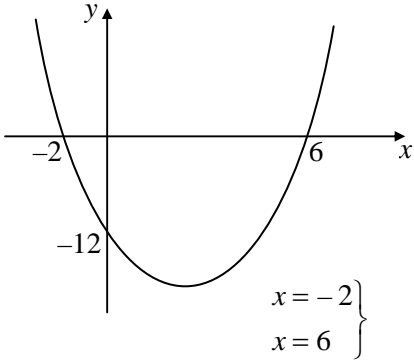
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

MPC1

Q	Solution	Marks	Total	Comments
1(a)	$(OA^2 =) 6^2 + (-4)^2 ; (OB^2 =) (-2)^2 + 7^2$	M1	3	either correct PI by 52 or 53 seen both correct values 52 or $\sqrt{52}$ and 53 or $\sqrt{53}$ seen or $OA^2 = 52$ and $OB^2 = 53$ correct working + concluding statement involving OA and/or OB
	$(OA^2 =) 52$ and $(OB^2 =) 53$ or $(OA =) \sqrt{52}$ and $(OB =) \sqrt{53}$	A1		
	$OA = \sqrt{52}$ and $OB = \sqrt{53}$ $\Rightarrow OA < OB$	A1		
(b)(i)	$\text{grad } AB = \frac{7+4}{-2-6}$	M1	2	condone one sign error
	$= -\frac{11}{8}$	A1		
(ii)	$y - 4 = \text{'their grad } AB'(x - 6)$ or $y - 7 = \text{'their grad } AB'(x - -2)$ } $y + 4 = -\frac{11}{8}(x - 6)$ OE	M1	3	or $y = \text{'their grad } AB' x + c$ and attempt to find c using $x = 6, y = -4$ or $x = -2, y = 7$ any correct form eg $y = -\frac{11}{8}x + \frac{34}{8}$ but must simplify -- to + condone $8y + 11x = 34$ or any multiple of these equations
	$\Rightarrow 11x + 8y = 34$	A1		
		A1		
(c)	$(\text{grad } AC =) \frac{8}{11}$	B1 \checkmark	3	FT $-1 / \text{'their grad } AB'$ equating gradients; LHS must be correct and RHS is "attempt" at perp grad to AB $k = 11.5$ OE
	$\frac{4}{k-6} = \text{'their } \frac{8}{11}'$ OE	M1		
	$\Rightarrow 2k - 12 = 11$ $\Rightarrow k = \frac{23}{2}$	A1cso		
Total			11	
(c) Alternative: Eqn AC : $(y + 4) = \text{'their } \frac{8}{11}'(x - 6)$ B1 \checkmark ($11y = 8x - 92$) AND must sub $y = 0$ for M1 or $(y - 0) = \text{'their } \frac{8}{11}'(x - k)$ B1 \checkmark AND must sub $x = 6, y = -4$ for M1				

MPC1 (cont)

Q	Solution	Marks	Total	Comments
2(a)	$(x-6)(x+2)$	B1	1	ISW for $x=6, x=-2$ etc
(b)	 <p> $x = -2$ $x = 6$ $y = -12$ U-shaped curve “correct” shape in all 4 quadrants with minimum to right of y-axis </p>	B1√		correct x values <i>or</i> FT ‘their’ factors (x -intercepts stated <i>or</i> marked on sketch) may be seen in (a)
		B1		(stated <i>or</i> -12 marked on sketch)
		M1		approximately
		A1	4	
(c)(i)	$(x-2)^2$	M1		$p=2$
	$(x-2)^2 - 16$	A1	2	$p=2$ and $q=16$
(ii)	(Minimum value is) -16	B1√	1	FT ‘their - q ’
(d)	Replacing each x by $x+3$ OR adding 2 to their quadratic	M1		in original equation or ‘their’ completed square or factorised form or replacing y by $y-2$
	$y = \left[(x+3)^2 - 4(x+3) - 12 \right] + 2$ $\left. \begin{array}{l} \text{or } y = (x+1)^2 - 14 \\ \text{or } y = x^2 + 2x - 13 \\ \text{or } y - 2 = (x-3)(x+5) \end{array} \right\}$	A1	2	OE any correct equation in x and y unsimplified
	Total		10	

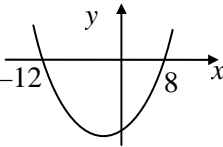
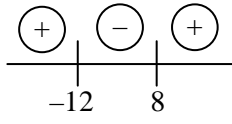
MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$(3\sqrt{2})^2 = 18$	B1	1	
(ii)	$(3\sqrt{2}-1)^2 = \text{'their } 18' - 3\sqrt{2} - 3\sqrt{2} + 1$ $= 18 - 3\sqrt{2} - 3\sqrt{2} + 1$ $(3+\sqrt{2})^2 = 9 + 3\sqrt{2} + 3\sqrt{2} + 2$ $\Rightarrow \text{Sum} = 30$	M1 A1 B1 A1cso	4	FT their $(3\sqrt{2})^2$ $(= 19 - 6\sqrt{2})$ $(= 11 + 6\sqrt{2})$
(b)	$\frac{4\sqrt{5} - 7\sqrt{2}}{2\sqrt{5} + \sqrt{2}} \times \frac{2\sqrt{5} - \sqrt{2}}{2\sqrt{5} - \sqrt{2}}$ Numerator = $8(\sqrt{5})^2 - 4\sqrt{5}\sqrt{2} - 14\sqrt{5}\sqrt{2} + 7(\sqrt{2})^2$ Denominator = $(2\sqrt{5})^2 - (\sqrt{2})^2$ $= 18$ $\Rightarrow \text{Answer} = 3 - \sqrt{10}$	M1 m1 B1 A1cso	4	correct unsimplified $(= 54 - 18\sqrt{10})$ must be seen as denominator
Total			9	

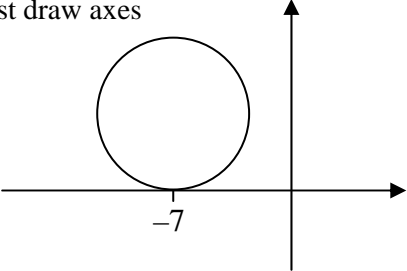
MPC1 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$\left(\frac{dy}{dx} =\right) 5x^4 - 6x + 1$	M1 A1 A1	3	one term correct another term correct all correct (no + c etc)
	(ii) $\left(\frac{d^2y}{dx^2} =\right) 20x^3 - 6$	B1✓	1	FT 'their' $\frac{dy}{dx}$
(b)	$x = -1 \Rightarrow \frac{dy}{dx} = 5(-1)^4 - 6(-1) + 1 (=12)$ $\Rightarrow y = 12(x+1)$	M1 A1cso	2	must sub $x = -1$ into 'their' $\frac{dy}{dx}$ any correct form with $(x - -1)$ simplified condone $y = 12x + c, c = 12$
	(c) $x = 1 \Rightarrow \frac{dy}{dx} = 5 - 6 + 1$ $\frac{dy}{dx} = 0 \Rightarrow$ stationary point when $x = 1, \frac{d^2y}{dx^2} = 14$ $\Rightarrow (B \text{ is a})$ minimum (point)	M1 A1cso E1	3	sub $x = 1$ into their $\frac{dy}{dx}$ shown = 0 plus correct statement or $\frac{d^2y}{dx^2} = 20 - 6 > 0$ $\Rightarrow (B \text{ is a})$ minimum (point) must have correct $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for E1
(d)(i)	$\frac{x^6}{6} - \frac{3x^3}{3} + \frac{x^2}{2} + 5x$	M1 A1 A1		one term correct another term correct all correct (may have + c)
	$\left[\frac{1}{6} - 1 + \frac{1}{2} + 5\right] - \left[\frac{1}{6} + 1 + \frac{1}{2} - 5\right]$ $= 8$	m1 A1cso	5	'their' $F(1) - F(-1)$ with powers of 1 and -1 evaluated correctly
(ii)	'their answer to part (i)' - 2	M1		
	\Rightarrow Area = 6	A1cso	2	
Total			16	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)	$p(-2) = (-2)^3 + (-2)^2c + (-2)d - 12$	M1	3	p(-2) attempted <i>or</i> long division by $x+2$ as far as remainder putting expression for remainder = -150 AG terms all on one side in any order (check that there are no errors in working)
	'their' $-8 + 4c - 2d - 12 = -150$	m1		
	$\Rightarrow 2c - d + 65 = 0$	A1cso		
(b)	$p(3) = 3^3 + 3^2c + 3d - 12$	M1	2	p(3) attempted <i>or</i> long division by $x-3$ as far as remainder any correct equation with terms collected eg $3c + d = -5$
	$9c + 3d + 15 = 0$	A1		
(c)	$\left. \begin{array}{l} 2c - d + 65 = 0 \\ 3c + d + 5 = 0 \end{array} \right\} \Rightarrow 5c = -70$	M1	3	Elimination of c or d value of c <i>or</i> d correct unsimplified both c and d correct unsimplified
	$\Rightarrow c = -14, d = 37$ OE	A1		
		A1		
Total			8	
6(a)	Sides are x and $x + 4$		1	must see this line OE AG (be convinced) condone $11 < 2x$
	$\Rightarrow x + x + x + 4 + x + 4 > 30$			
	<i>or</i> $2x + 2x + 8 > 30$			
	<i>or</i> $2(2x + 4) > 30$			
	<i>or</i> $4x + 8 > 30$			
	$(\Rightarrow 4x > 22)$			
	$\Rightarrow 2x > 11$	B1		
(b)	$x(x + 4) < 96$		1	must see this line OE AG
	$\Rightarrow x^2 + 4x - 96 < 0$			
(c)	$(x + 12)(x - 8)$	M1	4	correct factors or correct quadratic equation formula sketch or sign diagram
	Critical values $8, -12$	A1		
	 <i>or</i> 	M1		
$\Rightarrow -12 < x < 8$	A1cso		accept $x < 8$ AND $x > -12$ but not $x < 8$ OR $x > -12$ nor $x < 8, x > -12$	
(d)	$5\frac{1}{2} < x < 8$	B1	1	
Total			7	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
7(a)	$(x+7)^2 + (y-5)^2$ $(x+7)^2 + (y-5)^2 = 5^2$	M1 A1 A1cao	3	one term correct ; condone $(x--7)^2$ both terms correct with squares and plus sign between terms condone 25 for 5^2
(b)(i)	$C(-7, 5)$	B1✓		correct or FT 'their' circle equation
(ii)	$r = 5$	B1✓	2	correct or FT 'their' $r^2 > 0$ condone $\sqrt{25}$ etc but not $\pm\sqrt{25}$
(c)	must draw axes 	M1 A1	2	freehand circle with C correct or FT 'their C ' for quadrant of centre circle touching x -axis at -7 with -7 marked (need not show 5 on y -axis) but circle must not touch y -axis
(d)(i)	$x^2 + (kx+6)^2 + 14x - 10(kx+6) + 49 = 0$ $x^2 + k^2x^2 + 12kx + 36 + 14x - 10kx - 60 + 49 = 0$ $(1+k^2)x^2 + 2kx + 14x + 25 = 0$ $\Rightarrow (k^2+1)x^2 + 2(k+7)x + 25 = 0$	M1 A1cso	2	clear attempt to sub $y = kx + 6$ into original or 'their' circle equation and attempt to multiply out AG condone $x^2(1+k^2) + 2x(7+k) + \dots$ etc
(ii)	Equal roots ' $b^2 - 4ac = 0$ ' $[2(k+7)]^2 - 4 \times 25(k^2+1)$ $4\{k^2 + 14k + 49 - 25k^2 - 25\} = 0$ $-24k^2 + 14k + 24 = 0$ $\Rightarrow 12k^2 - 7k - 12 = 0$	B1 M1 A1	3	allow statement alone if discriminant in terms of k attempted discriminant (condone one slip) AG all working correct but $= 0$ must appear before last line
(iii)	$(4k+3)(3k-4)$ $\Rightarrow k = -\frac{3}{4}, k = \frac{4}{3}$ OE are values of k for which line is a tangent	M1 A1	2	correct factors or correct use of formula as far as $k = \frac{7 \pm \sqrt{49+576}}{24}$
	Total		14	
	TOTAL		75	