



General Certificate of Education (A-level)
January 2013

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 students' 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 students' 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 students' 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: aqa.org.uk

Copyright © 2013 AQA and its licensors. All rights reserved.

Copyright

AQA retains the copyright on all its publications. However, registered schools/colleges 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 schools/colleges 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.

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) (i)	$21 + 5k = 1$ $\Rightarrow k = -4$	B1	1	condone $3 \times 7 + 5k = 1$ AG condone $y = -4$
(ii)	$(x =) 2$ $(y =) -1$	B1 B1	2	midpoint coords are $(2, -1)$
(b)	$y = \frac{1}{5} - \frac{3}{5}x$ $(\text{Gradient } AB =) -\frac{3}{5}$	M1 A1	2	obtaining $y = a \pm \frac{3}{5}x$ or $\frac{\Delta y}{\Delta x} = \frac{-4-2}{7--3}$ or $\frac{-1-2}{2--3}$ or $\frac{-4--1}{7-2}$ condone one sign error in expression allow -0.6 , $\frac{6}{-10}$ etc for A1 & condone error in rearranging if gradient is correct.
(c)	Perp grad = $\frac{5}{3}$ $y - 2 = \frac{5}{3}(x + 3)$ or $y = \frac{5}{3}x + c, \quad c = 7 \quad \text{etc}$	M1 A1		-1/ "their" grad AB correct equation in any form (must simplify $x - -3$ to $x+3$ or c to a single term equivalent to 7)
	$5x - 3y + 21 = 0$	A1	3	or any multiple of this with integer coefficients –terms in any order but all terms on one side of equation
(d)	$3x + 5y = 1 \quad \text{and} \quad 5x + 8y = 4$ $\Rightarrow P \ x = Q \quad \text{or} \quad R \ y = S$ $x = 12$ $y = -7$	M1 A1 A1	3	must use correct pair of equations and attempt to eliminate y (or x) (generous) $(12, -7)$
Total			11	

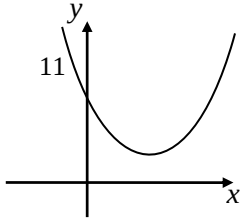
MPC1 (cont)

Q	Solution	Marks	Total	Comments
2(a)	$\left(\frac{dy}{dt} = \right) \frac{4t^3}{8} - 2t$	M1 A1	2	one of these terms correct all correct (no + c etc)
(b)(i)	$t = 1 \Rightarrow \frac{dy}{dt} = \frac{4}{8} - 2$ $= -1\frac{1}{2}$	M1 A1cso	2	Correctly sub $t = 1$ into their $\frac{dy}{dt}$ must have $\frac{dy}{dt}$ correct (watch for t^3 etc)
(ii)	$\frac{dy}{dt} < 0$ $\Rightarrow$ (height is) decreasing (when $t = 1$)	 E1✓	1	must have used $\frac{dy}{dt}$ in part (b)(i) must state that “ $\frac{dy}{dt} < 0$ ” or “ $-1.5 < 0$ ” or the equivalent in words FT their value of $\frac{dy}{dt}$ with appropriate explanation and conclusion
(c)(i)	$\left(\frac{d^2y}{dt^2} = \right) \frac{4}{8} \times 3t^2 - 2$ $\left(t = 2, \frac{d^2y}{dt^2} = \right) 4$	M1 A1cso	2	Correctly differentiating their $\frac{dy}{dt}$ even if wrongly simplified Both derivatives correct and simplified to 4
(ii)	$\Rightarrow$ minimum	E1✓	1	FT their numerical value of $\frac{d^2y}{dt^2}$ from part (c) (i)
	Total		8	

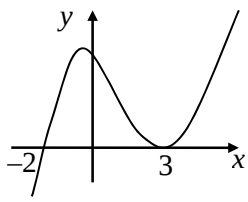
MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$\sqrt{18} = 3\sqrt{2}$	B1	1	Condone $k = 3$
(ii)	$\frac{2\sqrt{2}}{3\sqrt{2} + 4\sqrt{2}}$	M1	3	attempt to write each term in form $n\sqrt{2}$ with at least 2 terms correct
		A1		correct unsimplified
	$= \frac{2}{7}$	A1		or $\times \frac{\sqrt{2}}{\sqrt{2}}$ M1
				integer terms $= \frac{4}{6+8}$ A1
(b)	$\frac{7\sqrt{2} - \sqrt{3}}{2\sqrt{2} - \sqrt{3}} \times \frac{2\sqrt{2} + \sqrt{3}}{2\sqrt{2} + \sqrt{3}}$	M1	4	
	(numerator =) $14 \times 2 - 2\sqrt{6} + 7\sqrt{6} - 3$	m1		correct unsimplified but must simplify $(\sqrt{2})^2$, $(\sqrt{3})^2$ and $\sqrt{2} \times \sqrt{3}$ correctly
	(denominator = $8 - 3 =$) 5	B1		must be seen or identified as denominator giving $\frac{25 + 5\sqrt{6}}{5}$
	(Answer =) $5 + \sqrt{6}$	A1cso		$m = 5, n = 6$
Total			8	

MPC1 (cont)

M1C1 (cont)				
Q	Solution	Marks	Total	Comments
4(a)(i)	$(x-3)^2$	M1	2	or $p = 3$ seen
	$(x-3)^2 + 2$	A1		
(ii)	$(x-3)^2 = -2$	M1	2	FT their positive value of q not use of discriminant for graphical approach see below to see if SC1 can be awarded
	No (real) square root of -2 therefore equation has no real solutions	A1cso		
(b)(i)	$x = \text{'their' } p$ or $y = \text{'their' } q$ Vertex is at $(3, 2)$	M1 A1cao	2	or $x = 3$ found using calculus
	(ii)	B1		
(iii)		M1	3	y intercept = 11 stated or marked on y-axis (as y intercept of any graph) ∪ shape (generous) above x-axis , vertex in first quadrant crossing y-axis into second quadrant
		A1		
		E1		
		M1		
		A1		
(iii)	Translation through $\begin{bmatrix} -3 \\ -2 \end{bmatrix}$	E1	3	and no other transformation FT negative of BOTH 'their' vertex coords both components correct for A1; may describe in words or use a column vector
		M1		
		A1		
Total			12	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)	$p(-1) = (-1)^3 - 4 \times (-1)^2 - 3(-1) + 18$ $(= -1 - 4 + 3 + 18) = 16$	M1 A1	2	p(-1) attempted not long division
(b)(i)	$p(3) = 3^3 - 4 \times 3^2 - 3 \times 3 + 18$ $p(3) = 27 - 36 - 9 + 18 = 0 \Rightarrow x - 3$ is a factor	M1 A1	2	p(3) attempted not long division shown = 0 plus statement
(ii)	Quadratic factor $(x^2 - x + c)$ or $(x^2 + bx - 6)$ Quadratic factor $(x^2 - x - 6)$ $[p(x) =] (x - 3)(x - 3)(x + 2)$	M1 A1 A1	 3	-x or -6 term by inspection or full long division by $x - 3$ or comparing coefficients or p(-2) attempted correct quadratic factor (or x+2 shown to be factor by Factor Theorem) or $[p(x) =] (x - 3)^2(x + 2)$ must see product of factors
(c)		M1 A1	 3	cubic curve with one maximum and one minimum meeting x-axis at -2 and touching x-axis at 3
	Final A1 is dependent on previous A1 and can be withheld if curve has very poor curvature beyond $x = 3$, V shape at $x = 3$ etc	A1	3	graph as shown, going beyond $x = -2$ but condone max on or to right of y-axis
Total			10	

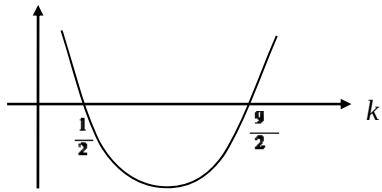
MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)	(Gradient = $10 - 6 + 5$) = 9	B1	3	correct gradient from sub $x=1$ into $\frac{dy}{dx}$
	$y - 4 = \text{"their 9"}(x - 1)$ or $y = \text{"their 9"}x + c$ and attempt to find c using $x=1$ and $y=4$	M1		must attempt to use given expression for $\frac{dy}{dx}$ and must be attempting tangent and not normal and coordinates must be correct
	$y = 9x - 5$	A1		condone $y = 9x + c, \dots c = -5$
(b)	$(y =) \frac{10}{5}x^5 - \frac{6}{3}x^3 + 5x + C$	M1	5	one term correct
		A1		another term correct
		A1		all integration correct including $+ C$
	$4 = 2 - 2 + 5 + C$ $\Rightarrow C = -1$	m1	5	substituting both $x=1$ and $y=4$ and attempting to find C
	$y = 2x^5 - 2x^3 + 5x - 1$	A1cso		must have $y = \dots$ and coefficients simplified
	Total		8	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
7(a)	$x=0 \Rightarrow y^2 - 4y - 12 (=0)$	M1		sub $x = 0$ & correct quadratic in y
	$(y-6)(y+2) (=0)$	A1		or $(y-2)^2 = 16$ or $(y-2)^2 - 16 = 0$ correct factors
	$\Rightarrow y = -2, 6$	A1	3	or formula as far as $\frac{4 \pm \sqrt{64}}{2}$ or $y - 2 = \pm\sqrt{16}$ condone $(0, -2)$ & $(0, 6)$
(b)	$(x+3)^2 - 9 + (y-2)^2 - 4 (=12)$	M1		correct sum of square terms and attempt to complete squares (or multiply out) PI by next line
	$(r^2 =) 9 + 4 + 12$	A1		$(r^2 =) 25$ seen on RHS
	$(\Rightarrow r =) 5$	A1	3	$r = \sqrt{25}$ or $r = \pm 5$ scores A0
(c)(i)	$(CP^2 =) (2 - -3)^2 + (5 - 2)^2$	M1		condone one sign slip within one bracket
	$\Rightarrow (CP =) \sqrt{34}$	A1	2	$n = 34$
(ii)	$PQ^2 = CP^2 - r^2 = 34 - 25$	M1		Pythagoras used correctly with values
	$(\Rightarrow PQ =) 3$	A1	2	FT “their” r and CP
	Total		10	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
8(a)	$2x^2 - x - 1 = 2kx - 3k$ $2x^2 - x - 1 - 2kx + 3k = 0$ OE $\Rightarrow 2x^2 - (2k+1)x + 3k - 1 = 0$	B1	1	equated and multiplied out and all 5 terms on one side and = 0 AG (correct with no trailing = signs etc)
(b)(i)	$(2k+1)^2 - 4 \times 2(3k-1)$	M1	3	clear attempt at $b^2 - 4ac$
	$(2k+1)^2 - 4 \times 2(3k-1) > 0$	B1		discriminant > 0 which must appear before the printed answer
	$4k^2 + 4k + 1 - 24k + 8 > 0$ $\Rightarrow 4k^2 - 20k + 9 > 0$	A1cso		AG (all working correct with no missing brackets etc)
(ii)	$4k^2 - 20k + 9 = (2k-9)(2k-1)$	M1	4	correct factors or correct use of formula as far as $\frac{20 \pm \sqrt{256}}{8}$
	critical values are $\frac{1}{2}$ and $\frac{9}{2}$	A1		condone $\frac{4}{8}$, $\frac{36}{8}$ etc here but must combine sums of fractions
		M1		sketch or sign diagram including values
	$k < \frac{1}{2}, k > \frac{9}{2}$ Take their final line as their answer	A1		fractions must be simplified condone use of OR but not AND
	Total		8	
	TOTAL		75	