Version 1.0: 01.08

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Mark Scheme

2008 examination - January series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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.

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Key to mark scheme and abbreviations used in marking

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

$\surd$ or ft or F	follow through from previous incorrect result	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	or equivalent	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
$-x$ EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	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. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

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.

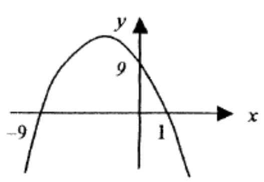
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

MPC1

Q	Solution	Marks	Total	Comments
1(a)	Mid-point of $BC = (3, -2)$	B1 B1	 2	Either coordinate correct Both cords correct. Accept $x = 3$, $y = -2$
(b)(i)	$\frac{\Delta y}{\Delta x} = \frac{3-1}{-2-4}$	M1		$\pm\frac{2}{6}$ OE implies M1
	$= -\frac{1}{3}$	A1	2	
(ii)	$y - 3 =$ "their grad"$(x + 2)$ or $y - 1 =$ "their grad"$(x - 4)$	M1		Or $y = mx + c$ and correct attempt to find c
	Hence $x + 3y = 7$	A1	2	
(iii)	$y + 5 =$ "their grad AB"$(x - 2)$	M1		Or "their $x + qy = c$" and attempt to find c
	$y+5=-\frac{1}{3}(x-2)$ or $x + 3y + 13 = 0$	A1	2	OE
(c)	Grad $BC = 3$ (from $\frac{\Delta y}{\Delta x} = \frac{1+5}{4-2}$ OE)	B1		Or 2 lengths correct: $AB = \sqrt{40}; BC = \sqrt{40}; AC = \sqrt{80}$
	$m_1 m_2 = -1$ stated **or** grad $BC = 3$ and grad $AB = -\frac{1}{3}$ **or** grad $BC \times$ grad AB $(= 3 \times -\frac{1}{3})$	M1		Or attempt at Pythagoras or Cosine Rule
	Product of gradients $= -1$ Hence AB and BC are perpendicular	A1 CSO	3	$AC^2 = AB^2 + BC^2 \Rightarrow \angle ABC = 90°$ Completing proof and statement
	Total		**11**	
2(a)	$\frac{dy}{dx} = 4x^3 - 32$	M1 A1 A1	 3	Reduce one power by 1 One term correct All correct (no + c etc)
(b)	Stationary point $\Rightarrow \frac{dy}{dx} = 0$	M1		
	$\Rightarrow x^3 = 8$	A1√		$x^n = k$ following from their $\frac{dy}{dx}$
	$\Rightarrow x = 2$	A1	3	CSO
(c)(i)	$\frac{d^2y}{dx^2} = 12x^2$	B1√	1	FT their $\frac{dy}{dx}$
(ii)	When $x = 2$, $\frac{d^2y}{dx^2}$ considered	M1		Or complete test with $2 \pm \varepsilon$ using $\frac{dy}{dx}$
	$\Rightarrow$ minimum point	E1√	2	
(d)	Putting $x = 0$ into their $\frac{dy}{dx}$ $(= -32)$	M1		
	$\frac{dy}{dx} < 0 \Rightarrow$ decreasing	A1√	2	Allow "increasing" if their $\frac{dy}{dx} > 0$
	Total		**11**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$5\sqrt{8} = 10\sqrt{2}$	B1		Or $\frac{5\sqrt{16}+6}{\sqrt{2}}$ gets B1
	$\frac{6}{\sqrt{2}} = \frac{6\sqrt{2}}{2}$ $(=3\sqrt{2})$	M1		then M1 for rationalising; and A1 answer
	Answer = $13\sqrt{2}$	A1	3	$n = 13$
(b)	$\frac{\sqrt{2}+2}{3\sqrt{2}-4} \times \frac{3\sqrt{2}+4}{3\sqrt{2}+4}$	M1		Multiplying top & bottom by $\pm\left(3\sqrt{2}+4\right)$
	Numerator = $6+6\sqrt{2}+4\sqrt{2}+8$	m1		Multiplying out (condone one slip)
	Denominator = 18 – 16 (= 2)	B1		
	Final answer = $5\sqrt{2}+7$	A1	4	
	Total		**7**	
4(a)	$x^2+(y-5)^2$	B1		$b = 5$
	RHS = 5	B1	2	$k = 5$
(b)(i)	Centre (0, 5)	B1√	1	FT their b from part (a)
(ii)	Radius = $\sqrt{5}$	B1√	1	FT their k from part (a); RHS must be > 0
(c)(i)	$x^2+4x^2-20x+20=0$	M1		May substitute into original or "their (a)"
	$\Rightarrow x^2-4x+4=0$	A1	2	CSO; AG
(ii)	$(x-2)^2=0$ or $x=2$	M1		
	Repeated root implies tangent	E1		Or b^2-4ac shown = 0 plus statement
	Point of contact is $P(2, 4)$	A1	3	
(d)	$\left(CQ^2=\right) 1^2+1^2$	M1		FT their C
	$\sqrt{2}<\sqrt{5} \Rightarrow Q$ lies inside circle	A1 CSO	2	CQ or CQ^2 OE must appear for A1
	Total		**11**	
5(a)	$(9+x)(1-x)$	M1		$\pm(9\pm x)(1\pm x)$
		A1	2	Correct factors
(b)	$25-\left(x^2+8x+16\right)=9-8x-x^2$	B1	1	AG
(c)(i)	$x=-4$ is line of symmetry	B1	1	
(ii)	Vertex is (–4, 25)	B1,B1	2	
(iii)		M1		General $\cap$ shape
		B1		–9 and 1 marked on x-axis or stated
		A1	3	9 marked on y-axis and maximum to the left of y-axis Must continue below x-axis at both ends
	Total		**9**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	p(–1) = – 1 + 7 – 6	M1		Finding p(–1)
	= 0 therefore x + 1 is a factor	A1	2	Shown to = 0 **plus statement**
(ii)	$\text{p}(x)=(x+1)(x^2-x-6)$	M1		Long division/inspection (2 terms correct)
		A1		Quadratic factor correct
	$\text{p}(x)=(x+1)(x+2)(x-3)$	A1	3	May earn M1,A1 for correct second factor then A1 for $(x+1)(x+2)(x-3)$
(b)(i)	$A(-2,0)$	B1	1	Condone x = –2
(ii)	$\dfrac{x^4}{4}-\dfrac{7x^2}{2}-6x\quad(+c)$	M1		One term correct
		A1		Another term correct
	(may have + c or not)	A1		All correct unsimplified
	$\left[\dfrac{81}{4}-\dfrac{63}{2}-18\right]-\left[\dfrac{1}{4}-\dfrac{7}{2}+6\right]$	m1		F(3) – F(–1) attempted in correct order
	= – 32	A1	5	CSO; OE
(iii)	Area of shaded region = 32	B1√	1	FT their (b)(ii) but positive value needed
(iv)	$\dfrac{\text{d}y}{\text{d}x}=3x^2-7$	M1		One term correct
		A1		All correct (no + c etc)
	When x = –1, gradient = – 4	A1	3	CSO
(v)	Gradient of normal = $\dfrac{1}{4}$	B1√		
	y = "their gradient" (x ± 1)	M1		Must be finding **normal**, not tangent
	$y=\dfrac{1}{4}(x+1)$	A1	3	CSO; any correct form eg 4y – x = 1
	Total		**18**	
7(a)	$x^2+7=k(3x+1)\Rightarrow x^2-3kx+7-k=0$	B1	1	AG
(b)	$b^2-4ac=(-3k)^2-4(7-k)$	M1		Clear attempt at b^2-4ac; Condone slip in one term of expression
	(2 distinct roots when) $b^2-4ac>0$	B1		Must involve k
	$9k^2+4k-28>0$	A1	3	CSO; AG
(c)	$(9k-14)(k+2)$	M1		Factors or formula correct unsimplified
	Critical points –2 and $\dfrac{14}{9}$	A1		
	Sketch ∪ or sign diagram correct	M1		+ve | –ve | +ve; –2, $\dfrac{14}{9}$
	$k<-2,\ k>\dfrac{14}{9}$	A1	4	
	Total		**8**	
	TOTAL		**75**	