ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Mark Scheme

2008 examination - June 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		
√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.

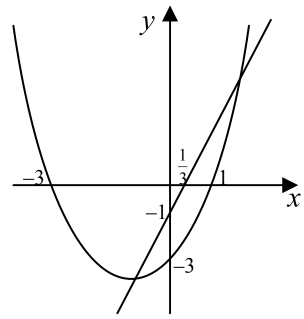
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn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

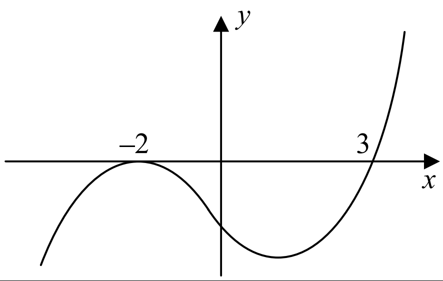
MPC1

Q	Solution	Marks	Total	Comments
1(a)	L: straight line with positive gradient and negative intercept on y-axis	B1		Line must cross both axes but need not reach the curve
	cutting at $\left(\frac{1}{3},0\right)$ and $(0,-1)$ (intercepts **stated** or marked on sketch)	B1		Condone 0.33 or better for $\frac{1}{3}$
	C: **attempt at parabola** $\cup$ or $\cap$ through $(-3,0)$ and $(1,0)$ or values –3 and 1 stated as intercepts on x-axis	B1		
	$\cup$ shaped graph – vertex below x-axis and cutting x-axis twice	M1		
	through $(0,-3)$ and minimum point to left of y-axis	A1	5	(y-intercept or coordinates marked)
(b)	$(x+3)(x-1)=3x-1$	M1		
	$x^2+3x-x-3-3x+1=0$			
	$\Rightarrow x^2-x-2=0$	A1	2	AG; must have "= 0" and no errors
(c)	$(x-2)(x+1)=0$	M1		$(x\pm1)(x\pm2)$ or use of formula (one slip)
	$\Rightarrow x=2,\ -1$	A1		correct values imply M1A1
	Substitute one value of x to find y	m1		
	Points of intersection (2, 5) and (–1,–4)	A1	4	May say $x=2, y=5$ etc SC: (2, 5) $\Rightarrow$ B2 $(-1,-4)\Rightarrow$ B2 without working
	Total		**11**	
2(a)	$xy=6$	B1	1	B0 for $\sqrt{36}$ or ± 6
(b)	$\frac{y}{x}=\frac{2\sqrt{3}}{\sqrt{3}}$ or $\sqrt{\frac{12}{3}}$ or $\sqrt{\frac{4}{1}}$ or $\frac{\sqrt{12}}{\sqrt{3}}\times\frac{\sqrt{3}}{\sqrt{3}}$	M1		Allow M1 for ± 2
	$=2$	A1	2	
(c)	$x^2+2xy+y^2$ or $(\sqrt{3}+2\sqrt{3})^2$ correct	M1		or $\left(\sqrt{3}+\sqrt{12}\right)\left(\sqrt{3}+\sqrt{12}\right)$ expanded as 4 terms – no more than one slip
	Correct with 2 of $x^2, y^2, 2xy$ simplified $3+2\sqrt{36}+12$ or $3^2\times 3$ or $\left(3\sqrt{3}\right)^2$	A1		Correct but unsimplified – one more step
	$=27$	A1	3	
	Total		**6**	

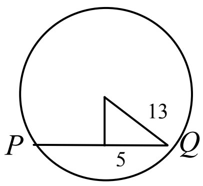
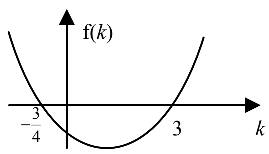
MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$V = x(9-3x)^2$	M1		Attempt at V in terms of x (condone slip when rearranging formula for $y = 9 - 3x$) or $(9-3x)^2 = 81 - 54x + 9x^2$
	$V = x(81 - 54x + 9x^2)$ $= 81x - 54x^2 + 9x^3$	A1	2	AG; no errors in algebra
(b)(i)	$\frac{dV}{dx} = 81 - 108x + 27x^2$	M1 A1 A1		One term correct Another correct All correct (no + c etc)
	$= 27(x^2 - 4x + 3)$	A1	4	CSO; all algebra and differentiation correct
(ii)	$(x-3)(x-1)$ or $(27x-81)(x-1)$ etc $\Rightarrow x = 1, 3$	M1 A1	2	"Correct" factors or correct use of formula SC: B1,B1 for $x = 1$, $x = 3$ found by inspection (provided no other values)
(c)	$\frac{d^2V}{dx^2} = -108 + 54x$ (condone one slip)	M1		ft their $\frac{dV}{dx}$ (may have cancelled 27 etc)
		A1	2	CSO; all differentiation correct
(d)(i)	$x = 3 \Rightarrow \frac{d^2V}{dx^2} = 54$; $x = 1 \Rightarrow \frac{d^2V}{dx^2} = -54$	B1$\surd$	1	ft their $\frac{d^2V}{dx^2}$ and their **two** x-values
(ii)	$(x =)$ 1 (gives maximum value)	E1	1	Provided their $\frac{d^2V}{dx^2} < 0$
(iii)	$V_{max} = 36$	B1	1	CAO
	Total		**13**	
4(a)	$\left(x - \frac{3}{2}\right)^2$	B1		Must have $(\ )^2$ $p = 1.5$
	$+\frac{7}{4}$	B1	2	$q = 1.75$
(b)	Minimum value is $\frac{7}{4}$	B1$\surd$	1	ft their q or correct value
(c)	**Translation** (and **no other** transformation stated)	E1		(**not** shift, move, transformation etc)
	through $\begin{bmatrix} \frac{3}{2} \\ \frac{7}{4} \end{bmatrix}$ (or equivalent in words)	M1 A1	 3	M1 for one component correct or ft their p or q values CSO; condone 1.5 right and 1.75 up etc
	Total		**6**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)	Grad $AC = \frac{15}{3} = 5$	B1		OE
	Equation of AC: $y = m(x+2)$ or $(y-15) = m(x-1)$	M1		Or use of $y = mx + c$ with (–2, 0) or (1, 15) correctly substituted for x and y
	$y = 5x + 10$	A1	3	OE eg $y - 15 = 5(x-1)$, $y = 5(x+2)$
(b)(i)	$\left[16x - \frac{x^5}{5}\right]$	M1 A1 A1		Raise one power by 1 One term correct All correct
	$\left(16 - \frac{1}{5}\right) - \left(-32 + \frac{32}{5}\right)$	m1		$\text{F}(1) - \text{F}(-2)$ attempted
	$= 41\frac{2}{5}$ (or 41.4, $\frac{207}{5}$ etc)	A1	5	CSO; withhold if $+c$ added
(ii)	Area $\Delta = \frac{1}{2} \times 3 \times 15$ or $22\frac{1}{2}$ or 22.5	B1		Or $\int_{-2}^{1} (5x+10)\,\text{d}x = 22.5$
	Shaded area = "their (b)(i) answer" – correct triangle	M1		Condone "difference" if $\Delta > \int$
	$\Rightarrow$ shaded area $= 18\frac{9}{10}$	A1	3	CSO; OE (18.9 etc)
	Total		**11**	
6(a)	Remainder $= \text{p}(1) = 1 + 1 - 8 - 12$ $= -18$	M1 A1	2	Use of p(1) NOT long division
(b)(i)	$\text{p}(-2) = -8 + 4 + 16 - 12$ $= 0 \Rightarrow (x+2)$ is factor	M1 A1	2	NOT long division $\text{p}(-2)$ shown $= 0$ **and** statement
(ii)	Quad factor by comparing coefficients or $(x^2 + kx \pm 6)$ by inspection	M1		Or full long division or attempt at Factor Theorem using $\text{f}(\pm 3)$
	$\text{p}(x) = (x+2)(x^2 - x - 6)$	A1		Correct quadratic factor or $(x-3)$ shown to be factor by Factor Theorem
	$\text{p}(x) = (x+2)^2(x-3)$ or $(x+2)(x+2)(x-3)$	A1	3	CSO; SC: B1 for $(x+2)(x***)(x-3)$ by inspection or without working
(c)(i)	$(k =)\ -12$	B1	1	Condone $y = -12$ or $(0, -12)$
(ii)		M1 A1 A1	3	Cubic shape (one max and one min) Maximum at $(-2, 0)$ and through (3, 0) – at least one of these values marked "correct" graph as shown (touching smoothly at –2, 3 marked and minimum to right of y-axis)
	Total		**11**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
7(a)	$(x-8)^2+(y-13)^2$	B1		**Exactly this** with + and squares
	$=13^2$	B1	2	Condone 169
(b)(i)	grad $PC=\dfrac{12}{5}$	B1	1	Must simplify $\dfrac{-12}{-5}$
(ii)	grad of tangent $=\dfrac{-1}{\text{grad } PC}=-\dfrac{5}{12}$	B1√		Condone $-\dfrac{1}{2.4}$ etc
	tangent has equation $y-1=-\dfrac{5}{12}(x-3)$	M1 A1		ft gradient but M0 if using grad PC Correct – but not in required final form
	$5x+12y=27$ OE	A1	4	MUST have integer coefficients
(iii)	half chord $=5$	B1		Seen or stated
	 $d^2=(\text{their } r)^2-5^2$ (provided $r>5$)	M1		Pythagoras used correctly $d^2=13^2-5^2$
	Distance = 12	A1	3	CSO
	Total		**10**	
8(a)	$b^2-4ac=16k^2-36(k+1)$	M1		Condone one slip
	Real roots: discriminant $\geqslant 0$	B1		
	$\Rightarrow 16k^2-36k-36\geqslant 0$			
	$\Rightarrow 4k^2-9k-9\geqslant 0$	A1	3	AG (watch signs)
(b)	$(4k+3)(k-3)$	M1		Or correct use of formula (unsimplified)
	critical points $(k=)\ -\dfrac{3}{4}$, 3	A1		Not in a form involving surds Values may be seen in inequalities etc
	 sketch	M1		Or sign diagram
	$k\geqslant 3,\quad k\leqslant -\dfrac{3}{4}$	A1	4	NMS full marks Condone use of word "and" but final answer in a form such as $3\leqslant k\leqslant -\dfrac{3}{4}$ scores A0
	Total		**7**	
	TOTAL		**75**	