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General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Mark Scheme

2007 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

√ 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

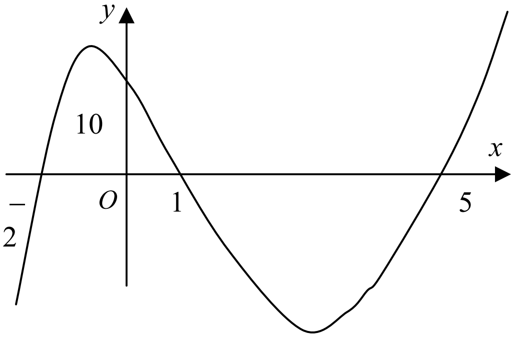
Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal 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.

Q	Solution	Marks	Total	Comments
1(a)(i)	p(–2) = –8 –16 +14 + *k*	M1		or long division or $(x+2)(x^2-6x+5)$
	p(–2) = 0 $\Rightarrow -10+k=0 \quad \Rightarrow k=10$	A1	2	**AG** likely withhold if p(–2) = 0 not seen
	Must have statement if *k*=10 substitute			
(ii)	$\text{p}(x)=(x+2)(x^2+\text{....}\quad 5)$	M1		Attempt at quadratic or second linear
	$\text{p}(x)=(x+2)(x^2-6x+5)$	A1		factor $(x-1)$ or $(x-5)$ from factor theorem
	$\Rightarrow \text{p}(x)=(x+2)(x-1)(x-5)$	A1	3	Must be written as product
(b)	p(3) = 27 –36 –21 + *k*	M1		long division scores M0
	(Remainder) = $k-30$ = –20	A1	2	Condone $k-30$
(c)		B1		Curve thro' 10 marked on *y*-axis
		B1√		**FT** their 3 roots marked on *x*-axis
		M1		Cubic shape with a max and min
		A1	4	Correct graph (roughly as on left) going beyond –2 and 5 (condone max anywhere between *x* = –2 and 1 and min between 1 and 5)
	Total		**11**	
2(a)(i)	$y=-\frac{3}{5}x+...;\qquad$ Gradient *AB* = $-\frac{3}{5}$	M1		**Attempt** to find $y=$ or $\Delta y/\Delta x$ or $\frac{3}{5}$ or 3*x*/5
		A1	2	Gradient correct – condone slip in *y* = ...
(ii)	$m_1m_2=-1$	M1		Stated or used correctly
	Gradient of perpendicular = $\frac{5}{3}$	A1√		**ft** gradient of *AB*
	$\Rightarrow y+2=\frac{5}{3}(x-6)$	A1	3	**CSO** Any correct form eg $y=\frac{5}{3}x-12$, $5x-3y=36$ etc
(b)	Eliminating *x* or *y* (unsimplified)	M1		Must use $3x+5y=8;\ 2x+3y=3$
	$x=-9$	A1		
	$y=7$	A1	3	*B* (–9,7)
(c)	$4^2+(k+2)^2\quad(=25)$ or $16+d^2=25$	M1		Diagram with 3,4, 5 triangle
	$k=1$	A1		Condone slip in one term (or $k+2=3$)
	or $k=-5$	A1	3	**SC1** with no working for spotting one correct value of *k*. Full marks if both values spotted with no contradictory work
	Total		**11**	

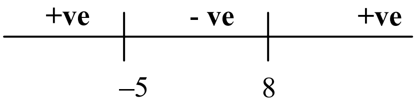
MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$\frac{\sqrt{5}+3}{\sqrt{5}-2}\times\frac{\sqrt{5}+2}{\sqrt{5}+2}$	M1		Multiplying top & bottom by $\pm\left(\sqrt{5}+2\right)$
	Numerator = $5+3\sqrt{5}+2\sqrt{5}+6$	M1		Multiplying out (condone one slip) $\pm\left(\sqrt{5}+3\right)\left(\sqrt{5}+2\right)$
	$= 5\sqrt{5}+11$	A1		
	Final answer = $5\sqrt{5}+11$	A1	4	With clear evidence that denominator =1
(b)(i)	$\sqrt{45}=3\sqrt{5}$	B1	1	
(ii)	$\sqrt{20}=\sqrt{4}\sqrt{5}$ or $4\sqrt{5}=\sqrt{4}\times\sqrt{20}$ or attempt to have equation with $\sqrt{5}$ or $\sqrt{20}$ only	M1		Both sides
	$\left[x\ 2\sqrt{5}=7\sqrt{5}-3\sqrt{5}\right]$ **or** $x\sqrt{20}=2\sqrt{20}$	A1		or $x=\sqrt{4}$
	$x=2$	A1	3	**CSO**
	Total		**8**	
4(a)	$(x+1)^2+(y-6)^2$	B2		B1 for one term correct or missing + sign
	$(1+36-12=25)$ RHS $=5^2$	B1	3	Condone 25
(b)(i)	Centre (–1 , 6)	B1√	1	**FT** their a and b from part (a) or correct
(ii)	Radius = 5	B1√	1	**FT** their r from part (a) RHS must be > 0
(c)	Attempt to solve "their" $x^2+2x+12=0$	M1		Or comparing "their" $y_c=6$ and their $r=5$ may use a diagram with values shown
	(all working correct) so no real roots or statement that does not intersect	A1	2	$r<y_c$ so does not intersect condone ± 1 or ± 6 in centre for A1
(d)(i)	$(4-x)^2=16-8x+x^2$	B1		Or $(-2-x)^2=4+4x+x^2$
	$x^2+(4-x)^2+2x-12(4-x)+12=0$ or $(x+1)^2+(-2-x)^2=25$	M1		Sub $y=4-x$ in circle eqn (condone slip) or "their" circle equation
	$\Rightarrow 2x^2+6x-20=0 \quad \Rightarrow x^2+3x-10=0$	A1	3	**AG CSO** (must have = 0)
(ii)	$(x+5)(x-2)=0 \quad \Rightarrow x=-5, x=2$	M1		Correct factors or unsimplified solution to quadratic
	Q has coordinates (–5, 9)	A1	2	(give credit if factorised in part (i)) SC2 if Q correct. Allow x = –5 $y=9$
(iii)	Mid point of 'their' (–5, 9) and (2,2)	M1		Arithmetic mean of **either** x or y coords
	$\left(-1\frac{1}{2},5\frac{1}{2}\right)$	A1	2	Must follow from correct value in (ii)
	Total		**14**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$2x^2 + 2xh + 4xh \quad (= 54)$ $\Rightarrow x^2 + 3xh = 27$	M1 A1	 2	Attempt at surface area (one slip) **AG CSO**
(ii)	$h = \dfrac{27 - x^2}{3x}$ or $h = \dfrac{9}{x} - \dfrac{x}{3}$ etc	B1	1	Any correct form
(iii)	$V = 2x^2h \quad = 18x - \dfrac{2x^3}{3}$	B1	1	**AG** (watch fudging) condone omission of brackets
(b)(i)	$\dfrac{dV}{dx} = 18 - 2x^2$	M1 A1	 2	One term correct "their" V All correct unsimplified $18 - 6x^2/3$
(ii)	Sub $x = 3$ into their $\dfrac{dV}{dx}$	M1		Or attempt to solve their $\dfrac{dV}{dx}$ =0
	Shown to equal 0 plus **statement** that this implies a stationary point if verifying	A1	2	**CSO** Condone $x = \pm 3$ or $x = 3$ if solving
(c)	$\dfrac{d^2V}{dx^2} = -4x$ $(= -12)$	B1√		**FT** their $\dfrac{dV}{dx}$
	$\dfrac{d^2V}{dx^2} < 0$ at stationary point $\Rightarrow$ maximum	E1√	2	**FT** their second derivative conclusion If "their" $\dfrac{d^2y}{dx^2} > 0 \Rightarrow$ minimum etc
	Total		**10**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	B (0,5)	B1		
	Area $AOB = \frac{1}{2}\times 1\times 5$	M1		Condone slip in number or a minus sign
	$= 2\frac{1}{2}$	A1	3	
(ii)	$\frac{3x^6}{6}+\frac{2x^2}{2}+5x$ or $\frac{x^6}{2}+x^2+5x$	M1		Raise one power by 1
		A1		One term correct
	(may have + c or not)	A1	3	All correct unsimplified
(iii)	Area under curve = $\int_{-1}^{0} \mathrm{f}(x)\,\mathrm{d}x$	B1		Correctly written or F(0) – F(–1) correct
	$[0]-\left[\frac{1}{2}+1-5\right]$	M1		Attempt to sub limit(s) of –1 (and 0) Must have integrated
	Area under curve = $3\frac{1}{2}$	A1		**CSO** (no fudging)
	Area of shaded region = $3\frac{1}{2}-2\frac{1}{2}=1$	B1√	4	**FT** their integral and triangle (very generous)
(b)(i)	$\frac{\mathrm{d}y}{\mathrm{d}x}=15x^4+2$	M1		One term correct
		A1		All correct (no +c etc)
	when $x=-1$, gradient = 17	A1	3	**cso**
(ii)	$y=$"their gradient"$(x+1)$	B1√	1	Must be finding **tangent** – not normal any form e.g. $y=17x+17$
	Total		**14**	
7(a)	$b^2-4ac = 144-4(k+1)(k-4)$	M1		Clear attempt at b^2-4ac Condone slip in one term of expression
	Real roots when $b^2-4ac \geqslant 0$	B1		Not just a statement, must involve k
	$36-(k^2-3k-4)\geqslant 0$ $\Rightarrow k^2-3k-40\leqslant 0$	A1	3	**AG** (watch signs carefully)
(b)	$(k-8)(k+5)$	M1		Factors attempt or formula
	Critical points 8 and –5	A1		
	Sketch or sign diagram **correct,** must have 8 and –5	M1		
	$-5\leqslant k\leqslant 8$	A1	4	
	A0 for –5 < k < 8 or two separate inequalities unless word AND used			
	Total		**7**	
	TOTAL		**75**	