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General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Mark Scheme

2009 examination - January series

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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.

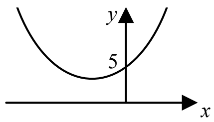
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

MPC1

Q	Solution	Marks	Total	Comments
1(a)	$M\,(3, 2)$	B1 B1	2	B1 for each coordinate
(b)	Gradient $AB = \dfrac{-2-6}{5-1} = \left(\dfrac{-8}{4}\right)$	M1		May use coords of M instead of A or B - condone one slip
	$= -2$	A1	2	CSO Answer must be simplified to –2
(c) (i)	Gradient of perpendicular = $\dfrac{1}{2}$	B1√		ft "their" –1/gradient AB
	$\Rightarrow\ y-2=\dfrac{1}{2}(x-3)$	M1		attempt at perp to AB; ft their M coords
	$\Rightarrow\ 2y-4=x-3\ \Rightarrow\ x-2y+1=0$ **AG**	A1	3	CSO Must write down the printed answer
(ii)	$k-2(k+5)+1=0$ or $\dfrac{(k+5)-2}{k-3}=\dfrac{1}{2}$	M1		Sub into given line equation or correct expression involving gradients Condone omission of brackets or use of x
	$\Rightarrow k=-9$	A1	2	Condone $x=-9$ *(Full marks for correct answer without working)*
	Total		**9**	
2(a)	$(x-1)(2x-3)$	B1	1	$(1-x)(3-2x)$ or $2(x-1)(x-1.5)$ etc
(b)	Critical values are 1, $1\frac{1}{2}$	B1√		Correct or ft their factors from (a)
	Sign diagram or sketch	M1		+	–	+ (1, $1\frac{1}{2}$)
	$\Rightarrow 1<x<1\frac{1}{2}$	A1	3	*Full marks for correct inequality without working*
	Total		**4**	
3(a)	$\dfrac{7+\sqrt{5}}{3+\sqrt{5}}\times\dfrac{3-\sqrt{5}}{3-\sqrt{5}}$	M1		Multiply by $\dfrac{3-\sqrt{5}}{3-\sqrt{5}}$ or $\dfrac{\sqrt{5}-3}{\sqrt{5}-3}$
	Numerator $= 21+3\sqrt{5}-7\sqrt{5}-\left(\sqrt{5}\right)^2$	m1		Condone one slip $16-4\sqrt{5}$
	Denominator = 9 – 5 = 4	B1		(Or 5 – 9 = – 4 from other conjugate)
	Answer $= 4-\sqrt{5}$	A1	4	CSO
(b)	$\sqrt{45}=3\sqrt{5}$	B1		
	$\dfrac{20}{\sqrt{5}}=\dfrac{20\sqrt{5}}{5}$	M1		May score if combined as one expression Must have 5 in denominator
	Sum $= 7\sqrt{5}$	A1	3	
	Total		**7**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$(x+1)^2$	B1		$p = 1$
	$+\ 4$	B1	2	$q = 4$
(ii)	$(x+1)^2 \geqslant 0 \Rightarrow (x+1)^2 + 4 > 0$	E1	1	Condone if they say $(x+1)^2$ *positive*
	$(\Rightarrow x^2 + 2x + 5 > 0$ for all values of $x)$			and adding 4 so always positive
(b)(i)	$x = -1$ **or** $y = 4$	M1		ft their $x = -p$ or $y = q$
	Minimum point is (–1, 4)	A1	2	
(ii)		B1		Sketch roughly as shown
		B1	2	y-intercept 5 or (0, 5) marked or stated
(c)	Translation (not shift, move etc)	E1		and NO other transformation stated
	through $\begin{bmatrix} -1 \\ 4 \end{bmatrix}$ (or 1 left, 4 up etc)	M1		either component correct or ft their $-p$, q
		A1	3	correct translation M1, A1 independent of E mark
	Total		**10**	
5(a)(i)	$\dfrac{dx}{dt} = 2t^3 - 40t + 66$	M1		one term correct
		A1 A1	3	another term correct all correct unsimplified (no + c etc)
(ii)	$\dfrac{d^2x}{d\,t^2} = 6t^2 - 40$	M1		ft one term correct
		A1√	2	ft all "correct", 2 terms equivalent
(b)	$\dfrac{dx}{dt} = 54 - 120 + 66$	M1		substitute $t = 3$ into their $\dfrac{dx}{dt}$
	$= 0 \Rightarrow$ stationary value	A1		CSO shown = 0 (54 or 2×27 seen) and statement
	Substitute $t = 3$ into $\dfrac{d^2x}{dt^2}$ (= 14)	M1		
	$\dfrac{d^2x}{dt^2} > 0 \Rightarrow$ minimum value	A1	4	CSO; all values (if stated) must be correct
(c)	Substitute $t = 1$ into their $\dfrac{dx}{dt}$	M1		must be their $\dfrac{dx}{d\,t}$ NOT $\dfrac{d^2x}{dt^2}$ etc
	$\dfrac{dx}{dt} = 28$	A1√	2	ft their $\dfrac{dx}{dt}$ when $t = 1$
(d)	Substitute $t = 2$ into their $\dfrac{dx}{dt}$	M1		must be their $\dfrac{dx}{d\,t}$ NOT $\dfrac{d^2x}{dt^2}$ or x
	$= 16 - 80 + 66 = 2$ (> 0)			Interpreting their value of $\dfrac{dx}{dt}$
	$\Rightarrow$ increasing when $t = 2$	E1√	2	Allow decreasing if their $\dfrac{dx}{dt} < 0$
	Total		**13**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$\text{p}(2) = 8 + 2 - 10$	M1		Must find p(2) NOT long division
	$\Rightarrow \text{p}(2) = 0 \Rightarrow (x-2)$ is factor	A1	2	Shown = 0 plus a statement
(ii)	Attempt at long division (generous)	M1		Obtaining a quotient $x^2 + cx + d$ or equating coefficients (full method)
	$\text{p}(x) = (x-2)(x^2 + 2x + 5)$	A1	2	$a = 2$, $b = 5$ by inspection B1, B1
(b)(i)	$\frac{\text{d}y}{\text{d}x} = 3x^2 + 1$	M1 A1		One term correct All correct – no +*c* etc
	When $x = 2$ $\frac{\text{d}y}{\text{d}x} = 3 \times 4 + 1$	m1		Sub $x = 2$ into their $\frac{\text{d}y}{\text{d}x}$
	Therefore gradient at *Q* is 13	A1	4	CSO
(ii)	$y = 13(x-2)$	M1		Tangent (NOT normal) attempted ft their gradient answer from (b)(i)
		A1	2	CSO; correct in any form
(iii)	$\int \ldots \,\text{d}x = \frac{x^4}{4} + \frac{x^2}{2} - 10x \; (+c)$	M1 A1 A1	3	one term correct second term correct all correct (condone no +c)
(iv)	$[4 + 2 - 20] - [0] = -14$	M1		$\text{F}(2)$ attempted and possibly F(0) Must have earned M1 in (b)(iii)
	Area of shaded region = 14	A1	2	CSO; separate statement following correct evaluation of limits
	Total		**15**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	$(x-3)^2+(y+5)^2$	B1		One term correct
		B1		LHS correct with + and squares
	$=25-9+9=25\quad(=5^2)$	B1	3	Condone RHS = 25
(b)(i)	$C\ (3,-5)$	B1√		
(ii)	Radius = 5	B1√	2	Correct or ft their RHS provided > 0
(c)(i)	$(7-3)^2+(-2+5)^2=16+9=25$ $\Rightarrow D$ lies on circle *Must see statement*	B1	1	Or sub'n of (7, –2) in original equation $7^2+(-2)^2-42-20+9=0$ Or sub x=7 into eqn & showing $y=-2$ etc
(ii)	Attempt at gradient of CD as normal grad $CD=\dfrac{-2-(-5)}{7-3}=\dfrac{3}{4}$	M1		withhold if subsequently uses $m_1m_2=-1$ $\dfrac{\Delta y}{\Delta x}$ (condone one slip) FT their centre C
	$y+2=\dfrac{3}{4}(x-7)$ or $y+5=\dfrac{3}{4}(x-3)$	A1		Correct equation in any form $y=\frac{3}{4}x-\frac{29}{4}$
	$\Rightarrow 3x-4y=29$	A1	3	CSO ***Integer*** coefficients Condone $4y-3x+29=0$ etc
(d)(i)	$y=kx$ sub'd into original circle equation $x^2+(kx)^2-6x+10kx+9=0$	M1		or using their completed square form and multiplying out
	$\Rightarrow(k^2+1)x^2+2(5k-3)x+9=0$ **AG**	A1	2	CSO must see at least previous line for A1 any error such as $kx^2=\ldots=k^2x^2$ gets A0
(ii)	$4(5k-3)^2-36(k^2+1)$	M1		Discriminant in k (can be seen in quad formula) Condone one slip
	$=64k^2-120k$	A1		or $8k^2-15k=0$ OE
	Equal roots: $4(5k-3)^2-36(k^2+1)=0$	B1		$b^2-4ac=0$ clearly stated or evident by an equation in k with at most 2 slips.
	$8k^2-15k=0$	m1		Attempt to solve ***their*** quadratic or linear equation if k has been cancelled
	$\Rightarrow k=0,\quad k=\dfrac{15}{8}$	A1	5	OE but must have k=0 If "=0" is not seen but correct values of k are found, candidate will lose B1 mark but may earn all other marks
(iii)	(Line is a) **tangent** (to the circle)	E1	1	Line **touches** circle at one point
	Total		**17**	
	TOTAL		**75**	