ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Mark Scheme

2007 examination - June 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.

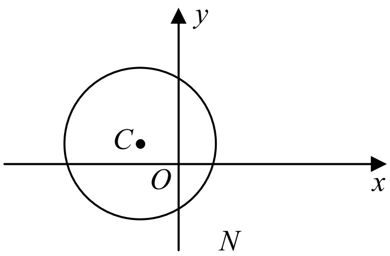
MPC1

Q	Solution	Marks	Total	Comments
1(a)(i)	Gradient $AB = \frac{-1-5}{6-2}$ or $\frac{5--1}{2-6}$	M1		$\pm\frac{6}{4}$ implies M1
	$= \frac{-6}{4} = -\frac{3}{2}$	A1	2	AG
(ii)	$\left.\begin{matrix} y-5 \\ y+1 \end{matrix}\right\} = -\frac{3}{2}\left\{\begin{matrix} (x-2) \\ (x-6) \end{matrix}\right.$	M1		or $y = -\frac{3}{2}x + c$ and attempt to find c
	$\Rightarrow 3x + 2y = 16$	A1	2	OE; must have integer coefficients
(b)(i)	Gradient of perpendicular $= \frac{2}{3}$	M1		or use of $m_1 m_2 = -1$
	$\Rightarrow y - 5 = \frac{2}{3}(x-2)$	A1	2	$3y - 2x = 11$ (no misreads permitted)
(ii)	Substitute $x = k,\ y = 7$ into their (b)(i)	M1		or grads $\frac{7-5}{k-2} \times \frac{-3}{2} = -1$
	$\Rightarrow 2 = \frac{2}{3}(k-2) \Rightarrow k = 5$	A1	2	or Pythagoras $(k-2)^2 = (k-6)^2 + 8$
	Total		**8**	
2(a)	$\frac{\sqrt{63}}{3} = \sqrt{7}$ or $\frac{3\sqrt{7}}{3}$	B1		or $\frac{\left(\sqrt{7}\sqrt{63} + 14 \times 3\right)}{3\sqrt{7}}$
	$\frac{14}{\sqrt{7}} = 2\sqrt{7}$ or $\frac{14\sqrt{7}}{7}$	B1		or $\frac{\sqrt{7}}{\sqrt{7}}(\quad)$ M1
	$\Rightarrow$ sum $= 3\sqrt{7}$	B1	3	$\Rightarrow$ correct answer with all working correct A2
(b)	Multiply by $\frac{\sqrt{7}+2}{\sqrt{7}+2}$	M1		
	Denominator = 7 − 4 = 3	A1		
	Numerator $= \left(\sqrt{7}\right)^2 + \sqrt{7} + 2\sqrt{7} + 2$	m1		multiplied out (allow one slip) $9 + 3\sqrt{7}$
	Answer $= \sqrt{7} + 3$	A1	4	
	Total		**7**	

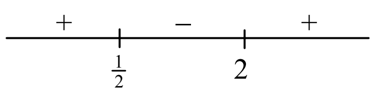
MPC1 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$(x+5)^2$	B1		$p=5$
	-6	B1	2	$q=-6$
(ii)	$x_{\text{vertex}}=-5$ (or their $-p$)	B1√		may differentiate but must have $x=-5$
	$y_{\text{vertex}}=-6$ (or their q)	B1√	2	and $y=-6$. Vertex $(-5,-6)$
(iii)	$x=-5$	B1	1	
(iv)	Translation (not shift, move etc)	E1		and NO other transformation stated
	through $\begin{bmatrix}-5\\-6\end{bmatrix}$ (or 5 left, 6 down)	M1		either component correct
		A1	3	M1, A1 independent of E mark
(b)	$x+11=x^2+10x+19$			quadratic with all terms on one side of equation
	$\Rightarrow x^2+9x+8=0$ or $y^2-13y+30=0$	M1		
	$(x+8)(x+1)=0$ or $(y-3)(y-10)=0$	m1		attempt at formula (1 slip) or to factorise
	$\left.\begin{matrix}x=-1\\y=10\end{matrix}\right\}$ or $\left.\begin{matrix}x=-8\\y=3\end{matrix}\right\}$	A1		both x values correct
		A1	4	both y values correct and linked
				SC $(-1,10)$ B2, $(-8,3)$ B2 no working
	Total		**12**	
4(a)(i)	$t^3-52t+96$	M1		one term correct
		A1		another term correct
		A1	3	all correct (no + c etc)
(ii)	$3t^2-52$	M1		ft one term correct
		A1√	2	ft all "correct"
(b)	$\frac{dy}{dt}=8-104+96$	M1		substitute $t=2$ into their $\frac{dy}{dt}$
	$=0 \Rightarrow$ stationary value	A1		CSO; shown = 0 + statement
	Substitute $t=2$ into $\frac{d^2y}{dt^2}$ $(=-40)$	M1		any appropriate test, e.g. $y'(1)$ and $y'(3)$
	$\frac{d^2y}{dt^2}<0 \Rightarrow$ max value	A1	4	all values (if stated) must be correct
(c)	Substitute $t=1$ into their $\frac{dy}{dt}$	M1		must be their $\frac{dy}{dt}$ NOT $\frac{d^2y}{dt^2}$
	Rate of change = 45 (cm s^{-1})	A1√	2	ft their $y'(1)$
(d)	Substitute $t=3$ into their $\frac{dy}{dt}$	M1		interpreting their value of $\frac{dy}{dt}$
	$(27-156+96=-33<0)$			
	$\Rightarrow$ decreasing when $t=3$	E1√	2	allow increasing if their $\frac{dy}{dt}>0$
	Total		**13**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	Centre $(-3, 2)$	M1 A1	 2	± 3 or ± 2 correct
(ii)	Radius $= 5$	B1	1	accept $\sqrt{25}$ but not $\pm\sqrt{25}$
(b)(i)	$3^2 + (-4)^2 = 9 + 16 = 25$ $\Rightarrow N$ lies on circle	B1	1	must have $9 + 16 = 25$ or a statement
(ii)		M1 A1	 2	must draw axes; ft their centre in correct quadrant correct (reasonable freehand circle enclosing origin)
(iii)	Attempt at gradient of CN grad $CN = -\frac{4}{3}$ $y = -\frac{4}{3}x - 2$ (or equivalent)	M1 A1 A1√	 3	withhold if subsequently finds tangent CSO ft their grad CN
(c)(i)	$P(2,6)$ Hence $PC^2 = 5^2 + 4^2$ $\Rightarrow PC = \sqrt{41}$	M1 A1	 2	"their" PC^2
(ii)	Use of Pythagoras correctly $PT^2 = PC^2 - r^2 = 41 - 25$, where T is a point of contact of tangent $\Rightarrow PT = 4$	M1 A1√ A1	 3	 ft their PC^2 and r^2 **Alternative** sketch with vertical tangent M1 showing that tangent touches circle at point (2, 2) A1 hence $PT = 4$ A1
	Total		**14**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$\mathrm{f}(1) = 1 + 4 - 5$	M1		must find $\mathrm{f}(1)$ NOT long division
	$\Rightarrow \mathrm{f}(1) = 0 \Rightarrow (x-1)$ is factor	A1	2	shown $= 0$ plus a statement
(ii)	Attempt at $x^2 + x + 5$	M1		long division leading to $x^2 \pm x + ...$ or equating coefficients
	$\mathrm{f}(x) = (x-1)(x^2 + x + 5)$	A1	2	$p = 1,\ q = 5$ by inspection scores B1, B1
(iii)	$(x =)\ 1$ is real root	B1		
	Consider $b^2 - 4ac$ for their $x^2 + x + 5$	M1		not the cubic!
	$b^2 - 4ac = 1^2 - 4 \times 5 = -19 < 0$			
	Hence no real roots (or only real root is 1)	A1	3	CSO; all values correct plus a statement
(b)(i)	$\int ...\,\mathrm{d}x = \frac{x^4}{4} + 2x^2 - 5x\ (+c)$	M1 A1 A1	3	one term correct unsimplified second term correct unsimplified all correct unsimplified
(ii)	$[4 + 8 - 10] - \left[\frac{1}{4} + 2 - 5\right]$	M1		correct use of limits 1 and 2; $\mathrm{F}(2) - \mathrm{F}(1)$ attempted
	$= 4\frac{3}{4}$	A1		
	Area of $\Delta = \frac{1}{2} \times 11 = 5\frac{1}{2}$	B1		correct unsimplified
	$\Rightarrow$ shaded area $= 5\frac{1}{2} - 4\frac{3}{4}$			combined integral of $7x - 6 - x^3$ scores M1 for limits correctly used then
	$= \frac{3}{4}$	A1	4	A3 correct answer with all working correct
	Total		**14**	
7(a)	$b^2 - 4ac = 4 - 4(k-1)(2k-3)$	M1		(or seen in formula) condone one slip
	Real roots when $b^2 - 4ac \geqslant 0$	E1		must involve $\mathrm{f}(k) \geqslant 0$ (usually M1 must be earned)
	$4 - 4(2k^2 - 5k + 3) \geqslant 0$			
	$\Rightarrow -2k^2 + 5k - 3 + 1 \geqslant 0$			at least one step of working justifying $\leqslant 0$
	$\Rightarrow 2k^2 - 5k + 2 \leqslant 0$	A1	3	AG
(b)(i)	$(2k-1)(k-2)$	B1	1	
(ii)	(Critical values) $\frac{1}{2}$ and 2	B1√		ft their factors or correct values seen on diagram, sketch or inequality or stated
		M1		use of sketch / sign diagram
	$\Rightarrow 0.5 \leqslant k \leqslant 2$	A1	3	M1A0 for $0.5 < k < 2$ or $k \geqslant 0.5,\ k \leqslant 2$
	Total		**7**	
	TOTAL		**75**	