GCE 2005

January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics

MPC1

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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

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	OE	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)

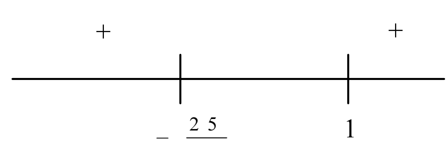
MPC1

Q	Solution	Marks	Total	Comments
1(a)(i)	Attempt at $\Delta y/\Delta x$ (used with numbers)	M1		Not x over y
	$=\dfrac{3}{12}=\dfrac{1}{4}$	A1	2	0.25 etc any correct equivalent
(ii)	$y-2=m(x-11)$ or $y+1=m(x+1)$	M1		or $y=mx+c$ and attempt to find c (or sub both points into given equation)
	$4y-x=-3$ etc leading to $x-4y=3$	A1	2	AG (be convinced)
(b)	Attempt to eliminate x or y	M1		$17y=17$ etc
	$y=1$	A1		
	$x=7$	A1	3	C is point (7,1)
	Total		**7**	
2(a)	$\dfrac{dy}{dx}=5x^4-18x^2-3$	M1		Decrease one power by 1
		A1		One term correct
		A1	3	All correct
(b)(i)	Sub $x=2$ into their $\dfrac{dy}{dx}$	M1		$80-72-3$
	Shown to equal 5	A1	2	AG (be convinced)
(ii)	Gradient of normal $=-\dfrac{1}{5}\,(\,y+\dfrac{1}{5}x+\ldots)$	B1		Or $m_1m_2=-1$ used or stated
	$y-3=-\dfrac{1}{5}(x-2)$	M1		Trying normal NOT tangent or $y=mx+c$ and attempt to find c
	$x+5y=17$ (integer coefficients)	A1	3	Or integer multiple of coefficients
(c)	Sub $x=1$ into their $\dfrac{dy}{dx}$ $(=-16<0)$	M1		$(5-18-3=-16)$ (Watch $\dfrac{d^2y}{dx^2}=-16$!)
	Negative value $\Rightarrow$ DECREASING	E1$\sqrt{}$	2	Correct interpretation of sign of $\dfrac{dy}{dx}$
	Total		**10**	
3(a)	$(x-6)^2+(y-3)^2$	B1		
	$=36+9-20$	M1		Generous with sign errors
	$=5^2$	A1	3	Condone 25
(b)	(i) Centre (6,3)	B1$\sqrt{}$		ft their a and b
	(ii) Radius = 5	B1$\sqrt{}$	2	Correct or ft $\sqrt{RHS}$ if $RHS>0$
(c)(i)	$x^2+(x+4)^2-12x-6(x+4)+20=0$	M1		Or their $(x-a)^2+(x+4-b)^2=r^2$
	$(2x^2-10x+12=0)\Rightarrow x^2-5x+6=0$	A1	2	AG (be convinced)
(ii)	$(x-3)(x-2)=0$	M1		Attempt at factors or use of formula
	$x=2,\ \ x=3$	A1		Both correct
		m1		Substituting for one y value
	P, Q are (2,6) and (3,7)	A1	4	Both points correct
	Total		**11**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$f(-1) = -1 - 3 + 6 + 8$ (Remainder) = 10	M1 A1	 2	Or long division up to remainder term
(ii)	$x-1$ is a factor $x+2$ is a factor	B1 B1	 2	May be earned retrospectively From part (iii)
(iii)	Attempt at third factor $f(x) = (x-1)(x+2)(x-4)$	M1 A1	 2	Multiplying/ dividing/factor theorem $(x+4) \Rightarrow$ M1, A0
(b)(i)	At A, $y = 8$	B1	1	Or (0,8)
(ii)	At B, $x = 4$	B1	1	Or (4,0) NO ft of wrong factor
(c)(i)	$\frac{x^4}{4} - x^3 - 3x^2 + 8x \quad (+c)$	M1 A1 A1 A1	 4	Increase one power by 1 One term correct (unsimplified) Two other terms correct (unsimplified) All correct (unsimplified) (condone missing + c)
(ii)	Realisation that limits are –2 and 1 Area = $\left[\frac{1}{4} - 1 - 3 + 8\right] - [4 + 8 - 12 - 16]$ $= 20\frac{1}{4}$	B1 M1 A1	 3	Condone wrong way round Attempt to sub their limits into their (c)(i) CSO. Must use F(1) – F(–2) correctly
	Total		**15**	
5(a)	$\left(\sqrt{12}\right)^2 - 2^2$ attempt to multiply out $(= 12 - 4) \quad = 8$	M1 A1	 2	May have $\sqrt{12}$ terms
(b)	$2\sqrt{3}$	B1	1	
(c)	Multiplying top and bottom by $\sqrt{12} + 2$ Numerator $= 12 + 4\sqrt{12} + 4$ Expression $= \frac{16 + 4\sqrt{12}}{8}$ or $\frac{16 + 8\sqrt{3}}{8}$ $= 2 + \sqrt{3}$	B1 M1 A1√ A1	 4	Or $\sqrt{3} + 1$ etc At least 3 terms multiplied out on top OE in $\sqrt{3}$ ft denominator from (a); or correct but numerator correct (unsimplified)
	Total		**7**	

MPC1 (cont)

Q	Solution	Marks	Total	Comments
6(a)	Sides $24-2x$, $9-2x$ $V = x(24-2x)(9-2x)$ $= 4x^3 - 66x^2 + 216x$	B1 M1 A1	 3	Either correct 3 sides involving x multiplied together AG (be convinced)
(b)(i)	$\dfrac{dV}{dx} = 12x^2 - 132x + 216$	M1 A1 A1	 3	Power decreased by 1 One term correct All correct (no $+C$ etc)
(ii)	Putting their $\dfrac{dV}{dx} = 0$ (must see this first) $\Rightarrow x^2 - 11x + 18 = 0$	M1 A1	 2	Or their $12x^2 - 132x + 216 = 0$ Or $12(x^2 - 11x + 18) = 0$ or statement AG (be convinced)
(iii)	$(x-2)(x-9) = 0$ $\Rightarrow x = 2, \quad x = 9$	M1 A1	2	Factors, comp sq or formulae used (1 slip)
(iv)	Reject $x = 9$, since $9 - 2x < 0$	E1	1	$x = 2$ is only possible value
(c)(i)	$\dfrac{d^2V}{dx^2} = 24x - 132$	M1 A1	 2	Differentiating their $\dfrac{dV}{dx}$ (eg $2x-11$) Correct
(ii)	$x = 2$ only $\Rightarrow \dfrac{d^2V}{dx^2} = -84$ (or < 0) Maximum value	B1 E1$\checkmark$	 2	Correct $\dfrac{d^2V}{dx^2}$ value OE full test. ft if their test implies minimum
	Total		**15**	
7(a)	$k^2 + 10k + 25 - 12k^2 - 24k$ $= -11k^2 - 14k + 25$	M1 A1	 2	Condone one slip No ISW here
(b)(i)	Real roots when "$b^2 - 4ac$" $\geqslant 0$ $(k+5)^2 - 12k(k+2)$ $(k-1)(11k+25)$ attempted to be shown equal to $11k^2 + 14k - 25$ $-11k^2 - 14k + 25 \geqslant 0$ $\Rightarrow (k-1)(11k+25) \leqslant 0$	B1 M1 m1 A1 A1	 5	Non-negative discriminant (stated / used) Finding $b^2 - 4ac$ in terms of k Or factorisation attempt Real roots condition correct and ... AG (be convinced about inequality)
(ii)	(Critical values) 1 and $-\dfrac{25}{11}$ seen Sketch or sign diagram $\Rightarrow -\dfrac{25}{11} \leqslant k \leqslant 1$	B1 M1 A1	 3	
	Total		**10**	
	TOTAL		**75**	