Version 1.0: 0107

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC3 Pure Core 3

Mark Scheme

2007 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.

Jan 07

MPC3

Q	Solution	Marks	Total	Comments
1	$x = 1.5, 2.5, 3.5, 4.5$	M1		Method
		A1		x values
	$y_1 = 0.7115 \quad 0.712$ $y_2 = 0.5218 \quad 0.522$ $y_3 = 0.4439 \quad 0.444$ $y_4 = 0.3993 \quad 0.399$ AWRT	A1		3 correct y's
	$A = 1 \times (y_1 + y_2 + y_3 + y_4)$			
	$= 2.08$	A1	4	
	Total		**4**	
2	Stretch (I)			
	SF $\frac{1}{3}$ (II)	M1		For I + (II or III)
	Parallel to x – axis (III)	A1		All correct
	Translate	E1		Allow translation
	$\begin{pmatrix} 0 \\ 1 \end{pmatrix}$	B1	4	Correct vector or description
	Total		**4**	
3(a)	$\mathrm{f}(x) \le 3$	M1A1	2	M1 for $\mathrm{f} < 3$, $x \le 3$ Condone y, f, range
(b)(i)	$y = \frac{2}{x+1}$			
	$x + 1 = \frac{2}{y}$	M1		Attempt to obtain x as a function of y or y as a function of x
	$x = \frac{2}{y} - 1$	M1		$x \leftrightarrow y$ at any stage
	$y/\mathrm{g}^{-1}(x) = \frac{2}{x} - 1 = \frac{2-x}{x}$	A1	3	Any correct form
(ii)	$\left(\mathrm{g}^{-1}(x)\right) \neq -1$	B1	1	
(c)(i)	$\mathrm{h}(x) = \frac{2}{3 - x^2 + 1}$	M1		
	$= \frac{2}{4 - x^2} = \frac{2}{(2-x)(2+x)}$	A1	2	
(ii)	$(x \in \mathbb{R})$, $x \neq +2$, $x \neq -2$	B1	1	Condone omit 'x is real' Allow $x^2 \neq 4$
	Total		**9**	

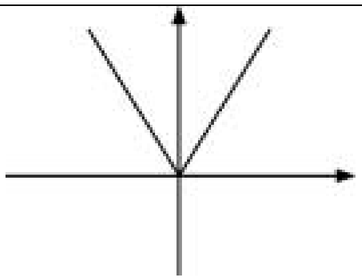
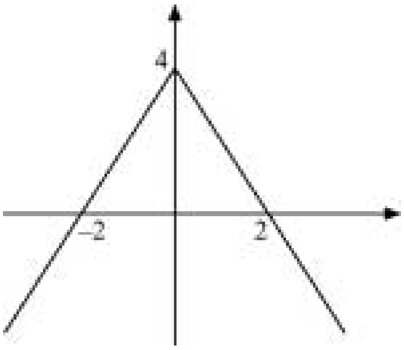
MPC3 (cont)

Q	Solution	Marks	Total	Comments
4(a)	$\int x\sin x\,dx \quad u=x$			
	$\frac{dv}{dx}=\sin x$	M1		For differentiating one term and integrating other
	$\frac{du}{dx}=1 \quad v=-\cos x$			
	$\int = -x\cos x-\int -\cos x(dx)$	m1		For correctly substituting their terms into parts formula
		A1		
	$=-x\cos x+\sin x\ (+c)$	A1	4	CSO
(b)	$u=x^2+5$			
	$du=2x\,dx$			
	$\int = \int \frac{1}{2}u^{\frac{1}{2}}(du)$	M1		$\int ku^{\frac{1}{2}}(du)$ condone omission of du but M0 if dx
		A1		$k=\frac{1}{2}$ OE
	$=\frac{u^{\frac{3}{2}}}{3}$	A1√		Ft $\int ku^{\frac{1}{2}}du$
	$=\frac{1}{3}\sqrt{(x^2+5)^3}\ (+c)$	A1	4	CSO **SC** $\frac{2}{6}\sqrt{(x^2+5)^3}$ with no working B3
(c)	$y=x^2-9$			
	$x^2=y+9$			
	$V=\pi\int x^2\,dy$	B1		Must have π and x^2, condone omission of dy, but B0 if dx
	$=\pi\int(y+9)\,dy$			
	$=(\pi)\left[\frac{y^2}{2}+9y\right]_1^2$ or $(\pi)\left[\frac{(y+9)^2}{2}\right]_1^2$	M1		$\int$"their x^2"dy integrated; Limits 2 and 1 substituted in correct order including – sign; π not necessary
	$=(\pi)\left[20-9\frac{1}{2}\right]$	m1		
	$=10\frac{1}{2}\pi$	A1	4	CSO
	Total		**12**	

MPC3 (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$2(\text{cosec}^2 x - 1) + 5\ \text{cosec}\, x = 10$	M1		
	$2\,\text{cosec}^2 x - 2 + 5\,\text{cosec}\, x - 10 = 0$			
	$2\ \text{cosec}^2 x + 5\ \text{cosec}\ x - 12 = 0$	A1	2	**AG**
(ii)	$(2\,\text{cosec}\, x - 3)(\text{cosec}\, x + 4) = 0$	M1		Attempt to solve
	$\text{cosec}\, x = \frac{3}{2}$ or -4	A1		Condone answers with no method shown
	$\sin x = \frac{2}{3}$ or $-\frac{1}{4}$	A1	3	**AG**
(b)	$(\theta - 0.1) = 0.73, 2.41, -0.25, -2.89$ AWRT	B1		2 correct values, may be implied later $(41.8, 138.2, -165.5, -14.5)$
	$\theta = 0.83, 2.51, -0.15, -2.79$ AWRT	B1		2 correct answers
		B1	3	+ 2 correct answers and no extra within range
	Total		**8**	
6(a)(i)	$y = (4x^2 + 3x + 2)^{10}$			
	$\frac{dy}{dx} = 10\,(4x^2 + 3x + 2)^9\,(8x + 3)$	M1 A1	 2	For $f(x)(\ \ )^9$ where $f(x) \neq k$ and is linear
(ii)	$y = x^2 \tan x$	M1		Product rule
	$\frac{dy}{dx} = x^2 \sec^2 x + 2x \tan x$	A1	2	
(b)(i)	$x = 2y^3 + \ln y$			
	$\frac{dx}{dy} = 6y^2 + \frac{1}{y}$	B1	1	
(ii)	At $(2,1)$			
	$\frac{dx}{dy} = 6 + 1 = 7$	M1		
	$\frac{dy}{dx} = \frac{1}{7}$	A1$\surd$		May be implied
	$(y - 1) = \frac{1}{7}(x - 2)$	A1	3	OE
	Total		**8**	

MPC3 (cont)

Q	Solution	Marks	Total	Comments
7(a)		B1	1	
(b)		M1 A1 A1	 3	Shape inverted V in all four quadrants Symmetrical about y axis Coordinates
(c)	$4-\lvert 2x\rvert = x$			
	$4-2x=x \qquad x=\frac{4}{3}$	M1 A1		Attempt to solve
	$4+2x=x \qquad x=-4$	A1	3	And no others
(d)	$-4<x<\frac{4}{3}$	M1 A1	 2	Either correct Other solution and no extras **SC** $-4\le x\le\frac{4}{3}$ B1
	Total		**9**	
8(a)	$A(-1,\pi)$	B1		
	$B\left(0,\frac{\pi}{2}\right)$	B1	2	
(b)	$\cos^{-1}x-3x-1=0$			
	$f(0.1)=0.17$ allow 0.2, 0.1	M1		Or comparing 'sides'
	$f(0.2)=-0.23$ allow -0.2			
	Change of sign $\therefore$ root	A1	2	
(c)	$x_1=0.1$	M1		
	$x_2=0.1569=0.157$	A1		
	$x_3=0.1378=0.138$			
	$x_4=0.144$	A1	3	
	Total		**7**	

MPC3 (cont)

Q	Solution	Marks	Total	Comments
9(a)(i)	$\int\left(4-e^{2x}\right)dx$			
	$=4x-\frac{1}{2}e^{2x}\ (+c)$	B1 B1	 2	$4x$ $-\frac{1}{2}e^{2x}$
(ii)	$\int_0^{\ln 2}=\left[4x-\frac{1}{2}e^{2x}\right]_0^{\ln 2}$			
	$=\left[4\ln 2-\frac{1}{2}e^{2\ln 2}\right]-\left[(0)-\frac{1}{2}\left(e^0\right)\right]$	M1		Substitute both ln 2 and 0 correctly into an integrated expression
	$=4\ln 2-2+\frac{1}{2}$			Convincing
	$=4\ln 2-\frac{3}{2}$	A1	2	**AG**
(b)(i)	$x=0$			
	$y=4-1=\underline{\underline{3}}$	B1	1	
(ii)	At B, $y=0$			
	$4-e^{2x}=0$	M1		Or reverse argument
	$e^{2x}=4$			
	$x=\ln 2$	A1	2	**AG**
(c)	$\frac{dy}{dx}=-2e^{2x}$	B1		
	$x=\ln 2$, Gradient $=-2e^{2\ln 2}$ $=-8$	M1		$x=\ln 2$ into ke^{2x}
	Gradient normal $=\frac{1}{8}=\frac{1}{2e^{2\ln 2}}$	A1		OE
	Equation $y=\frac{1}{8}x-\frac{1}{8}\ln 2$	A1	4	OE
(d)	When $x=0$			
	$y=-\frac{1}{8}\ln 2$	M1		Attempt to integrate their line and substitute $x=0, \ln 2$
	Area Δ $=\frac{1}{16}(\ln 2)^2$ condone – ve sign $=0.03$	A1$\surd$		$\frac{1}{2}(\text{their } y)\times\ln 2$
	Total area $=4\ln 2-\frac{3}{2}+\frac{1}{16}(\ln 2)^2=1.30$ AWRT	A1	3	CSO
	Total		**14**	
	Total		**75**	