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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics and Statistics 6320
Specification B

MBP4 Pure 4

Mark Scheme

2005 examination - June 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.

Key to Mark Scheme

M	mark is for	method
m	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	accuracy
E	mark is for	explanation
$\surd$ or ft or F		follow through from previous incorrect result
cao		correct answer only
cso		correct solution only
awfw		anything which falls within
awrt		anything which rounds to
acf		any correct form
ag		answer given
sc		special case
oe		or equivalent
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
$-x$ ee		deduct x marks for each error
pi		possibly implied
sca		substantially correct approach

Abbreviations used in Marking

MC – x	deducted x marks for mis-copy
MR – x	deducted x marks for mis-read
isw	ignored subsequent working
bod	given benefit of doubt
wr	work replaced by candidate
fb	formulae book

Application of Mark Scheme

No method shown:	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
More than one method / choice of solution:	
2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only
Crossed out work	do not mark unless it has not been replaced
Alternative solution using a correct or partially correct method	award method and accuracy marks as appropriate

Mathematics and Statistics B Pure 4 MBP4 June 2005

Q	Solution	Marks	Total	Comments
1	$\frac{A}{x-5}+\frac{B}{x+2}$	M1		Split as shown
	$A=4$	A1		
	$B=1$	A1	3	$\frac{4}{x-5}+\frac{1}{x+2}$
	Total		**3**	
2(a)(i)	$\frac{dy}{dx}=12(1+2x)^5$	M1		$k(1+2x)^5$
		A1	2	correct unsimplified
(ii)	$\frac{dy}{dx}=(1+2x)^6+12x(1+2x)^5$	M1		Product rule used
		A1√	2	ft their part (i) unsimplified
				M0 for $\delta V \approx \ldots$
(b)	$\frac{dV}{dt}=\frac{dV}{dx}\times\frac{dx}{dt}$	M1		Any correct form stated and used
	$= 2.56\ (\mathrm{m^3 s^{-1}})$	A1	2	Condone missing or incorrect units
				sc B1 for 2.56 without rate of change
(c)	$1 + 12x$	B1		correct unsimplified
	$+ 60x^2$	B1		correct unsimplified
	$+ 160x^3$	B1	3	last 3 terms correctly simplified
	Total		**9**	
3(a)	$f'(x)=5x^4+10x$	B1	1	
(b)(i)	$\frac{1}{5}\ln(x^5+5x^2+2)\quad (+c)$	M1		$k\ln(x^5+5x^2+2)$
		A1	2	correct
(ii)	$\frac{1}{5}\ln 8-\frac{1}{5}\ln 2$	M1		Sub limits into "ln expression" correctly
	(Correctly shown to equal) $=\frac{2}{5}\ln 2$	A1	2	cso ($k=$ 0.4)
(c)	$-2-\frac{f(-2)}{f'(-2)}=-2+\frac{10}{60}$	M1		Newton - Raphson used
	$=-1.83$ (to 3SF)	A1	2	Condone $-1.83333...$ or $-1\frac{5}{6}$
				Ans only without working M0
	Total		**7**	

MBP4 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$u_2 = 2;\quad u_3 = -1;\quad u_4 = \frac{1}{2};\quad u_5 = 2$	M1 A1	 2	Correct use of iterative formula All 4 values correct
(ii)	Pattern starts to repeat Period = 3	E1 B1	 2	
(b)(i)	$t_2 = \dfrac{9.5}{5.5} \approx 1.72727\ldots;\ t_3 \approx 1.85714\ldots$	M1		Correct use of iterative formula once
	$t_2 = 1.73;\quad t_3 = 1.86$ (to 3 SF)	A1	2	Must be these values
(ii)	$L = \dfrac{5L+2}{4+L}$ hence $L(4+L) = 5L+2$	M1		Setting up equation $(t_n \to L;\quad t_{n+1} \to L)$
	$\Rightarrow L^2 - L - 2 = 0$	A1		**ag** be convinced
	$(L-2)(L+1) = 0 \Rightarrow L = 2;\ L = -1$	M1		Correct factors or **both** values correct
	$L > 0 \qquad \Rightarrow L = 2$	A1	4	cso rejecting negative value **sc** B1 for L=2 with no working
	Total		**10**	
5(a)(i)	$(x-2)^2 + (y+9)^2 \quad \{= 4 + 81 - k\}$ Centre (2, –9)	M1 A1	 2	Attempt to complete square or one coordinate of centre correct
(ii)	$85 - k = 49$ $\Rightarrow k = 36$	M1 A1	 2	f(k) = 49 may sub (2, -2); (9, -9) cso working must be correct
(b)(i)	$\dfrac{\lvert(3\times2)+(4\times-9)+5d\rvert}{\sqrt{3^2+4^2}} = \dfrac{\lvert 5d-30\rvert}{5}$	M1 A1√		Condone one slip in distance formula Simplified f(d) /5 ft their centre (2, –9)
	$= \lvert d-6\rvert$	A1	3	**ag** (all working correct)
(ii)	$\lvert d-6\rvert = 7$ or $d-6=7$	M1		Or –1 and 13 as end points of inequality
	Hence $d = 13$, $d = -1$	A1	2	Both values of d correct and no extras, eg. inequality
(iii)	grad $l_1 = -\dfrac{3}{4}$; grad $l_2 = 1$;	B1		Both gradients correct
	Use of $\tan^{-1}\left\lvert\dfrac{m_1-m_2}{1+m_1m_2}\right\rvert = \tan^{-1}\left\lvert\dfrac{7/4}{1/4}\right\rvert$	M1		Condone omission of modulus signs and minus signs for M1 but $\tan^{-1}(-7)$ not acceptable for A1 unless acute angle
	$= \tan^{-1} 7$	A1	3	Accept $\tan\theta = 7$; but $\tan^{-1}(-7)$ not OK -acute angle needed
	Total		**12**	

MBP4 (cont)

Q	Solution	Marks	Total	Comments
6(a)	$\operatorname{cosec}^2\theta = 1+\cot^2\theta = 1+x^2$ $\Rightarrow 1+x^2+x=7 \quad \Rightarrow x^2+x-6=0$	B1	1	**ag** accept $\cot^2\theta+\cot\theta-6=0$
(b)	$(x+3)(x-2)=0 \qquad \Rightarrow x=2,\ -3$	B1		
	$\tan\theta = 1/\text{their } x$ (any value of x)	M1		Correct interpretation of cot
	$\tan\theta=0.5 \qquad \theta=26.6°$	A1		
	$\theta=206.6°$	A1√		their $26.6°+180°$ but no extras
	$\tan\theta=-0.333... \qquad \theta=161.6°$	A1		
	$\theta=341.6°$	A1√	6	their $161.6°+180°$ but no extras
	accept more SF awrt to these values			Withhold last A mark for radians
	Total		**7**	
7(a)(i)	$f'(x)=3\sec^2 3x$	M1		$k\sec^2 mx$
		A1	2	correct
(ii)	y-coordinate = 3	B1		
	Gradient of tangent = 6	M1		Using $f'(\pi/12)$ for grad of tangent
	$y-3=6(x-\pi/12)$	A1	3	**cso** exact values
(b)(i)	$\frac{4}{3}\ln\sec 3x+\frac{1}{3}\tan 3x \quad (+c)$	M1		p ln sec3x or q tan3x
		A1		one term correct
		A1	3	other term correct
(ii)	Use of $\sec^2 3x = 1+\tan^2 3x$ to prove $(2+\tan 3x)^2=3+4\tan 3x+\sec^2 3x$	B1	1	**ag** be convinced
(iii)	$\pi\int_0^{\frac{\pi}{9}}(2+\tan 3x)^2\,dx$	B1		Correct expression for volume generated
	$=(\pi)\left[3x+\textit{their answer to}(b)(i)\right]$ $(\pi)\left[\frac{3\pi}{9}+\frac{4}{3}\ln\sec\frac{\pi}{3}+\frac{1}{3}\tan\frac{\pi}{3}\right]$	M1		Attempting to sub $x=\frac{\pi}{9}$ (and possibly 0) Must have 3x term condone missing π
	$=\frac{\pi}{3}\left(\sqrt{3}+\pi+4\ln 2\right)$	A1	3	**ag** be convinced (no calculator values)
	Total		**12**	
	TOTAL		**60**	