Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2017**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method marks, awarded for a valid method applied to the problem.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Guidance
1(a)	$\log_7 2.5 = 2x + 5$ or $\log_7\left(\frac{2.5}{7^5}\right) = 2x$ or $(2x+5)\log 7 = \log 2.5$	**M1**	correct first anti-logging step
	$[x =]\frac{\log_7 2.5 - 5}{2}$ or $\frac{1}{2}\log_7\left(\frac{2.5}{7^5}\right) = x$ or $x = \frac{1}{2}\left(\frac{\log 2.5}{\log 7} - 5\right)$	**M1**	isolates x
	–2.26(4...)	**A1**	
1(b)	$5^2 p^{-3} q^{\frac{5}{4}}$ oe	**B3**	**B1** for each term If B0 then allow **M1** for numerator of $125q^{\frac{3}{2}}$ or denominator of $5p^3q^{\frac{1}{4}}$
2(i)	*B* and *C* with valid reason	**B2**	**B1** for one graph and valid reason or both graphs and no reason
2(ii)	*B* only with valid reason	**B2**	**B1** for graph *B* or valid reason
3	$[m =]\frac{13-5}{1-0.2}$ or 10 soi	**M1**	or $13 = m + c$ and $5 = 0.2m + c$ and subtracting/substituting to solve for *m* or *c,* condone one error
	$Y - 13 = \textit{their}\ 10(X-1)$ or $Y - 5 = \textit{their}\ 10(X-0.2)$ or $13 = \textit{their}\ 10 + c$ or $5 = \textit{their}\ 10 \times 0.2 + c$	**M1**	or using *their m* or *their c* to find *their c* or *their m*, without further error
	$\sqrt[3]{y} = (\textit{their}\ m)\frac{1}{x} + (\textit{their}\ c)$ or $\sqrt[3]{y} = (\textit{their}\ m)\left(\frac{1}{x} - 1\right) + 13$ or $\sqrt[3]{y} = (\textit{their}\ m)\left(\frac{1}{x} - 0.2\right) + 5$	**M1**	*their m* and *c* must be validly obtained
	$y = \left(\frac{10}{x} + 3\right)^3$ or $y = \left(10\left(\frac{1}{x} - 1\right) + 13\right)^3$ or $y = \left(10\left(\frac{1}{x} - 0.2\right) + 5\right)^3$ cao, isw	**A1**	

Question	Answer	Marks	Guidance
4(a)(i)	$\begin{pmatrix}-4\\3\end{pmatrix}$	B1	
4(a)(ii)	$\sqrt{11^2+(-15)^2}$ or better	M1	
	$\frac{1}{\sqrt{346}}\begin{pmatrix}11\\-15\end{pmatrix}$	A1	
4(b)	$\overrightarrow{OR}=\overrightarrow{OP}+\frac{3}{4}\overrightarrow{PQ}$ soi	M1	or $\overrightarrow{OR}=\overrightarrow{OQ}-\frac{1}{4}\overrightarrow{PQ}$ soi
	$\left[\overrightarrow{OR}=\right]\mathbf{p}+\frac{3}{4}(\mathbf{q}-\mathbf{p})$	M1	or $\left[\overrightarrow{OR}=\right]\mathbf{q}-\frac{1}{4}(\mathbf{q}-\mathbf{p})$
	$\left[\overrightarrow{OR}=\right]\frac{1}{4}\mathbf{p}+\frac{3}{4}\mathbf{q}$ oe	A1	
5(a)	$(9\times8\times7\times6\times1)+(8\times8\times7\times6\times1)$ soi	M2	**M1** for one correct product of the sum
	5712	A1	
5(b)	${}^9C_4\times{}^5C_4+{}^9C_3\times{}^5C_5$ oe	M2	**M1** for one correct product of the sum
	[630 + 84 =] 714	A1	
6	$64=2^n$	M1	
	$n=6$	A1	
	$their\,6(2)^{their(6-1)}\times(-a)=-16b$ oe	M1	
	$their\,\frac{6\times(6-1)}{2}(2)^{their(6-2)}\times(-a)^2=100b$ oe	M1	
	attempts to solve	DM1	dep on both M1 marks being awarded; must have correctly or correct FT eliminated one unknown
	$a=5$	A1	
	$b=60$	A1	

Question	Answer	Marks	Guidance
7(i)	$k\left(1+4x\right)^9$	M1	
	$4\times10\left(1+4x\right)^9$ or better	A1	
	$(1+4x)^{10}(\textit{their}-\sin x)+\cos x\left(\textit{their}\left(4\times10\times\left(1+4x\right)^9\right)\right)$	M1	clearly applies product rule
	$(1+4x)^{10}(-\sin x)+\cos x\left(4\times10\times\left(1+4x\right)^9\right)$	A1	all correct
7(ii)	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\mathrm{e}^{4x-5}\right)=4\mathrm{e}^{4x-5}$ soi	B1	
	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\tan x\right)=\sec^2 x$ soi	B1	
	clearly applies correct form of quotient rule $\frac{\tan x\left(\textit{their}\ 4\mathrm{e}^{4x-5}\right)-\mathrm{e}^{4x-5}\left(\textit{their}\sec^2 x\right)}{\left(\tan x\right)^2}$	M1	or correct form of product rule to $\mathrm{e}^{4x-5}(\tan x)^{-1}$ $4\mathrm{e}^{4x-5}(\tan x)^{-1}+\mathrm{e}^{4x-5}(\tan x)^{-2}\times\sec^2 x$
	$\frac{\tan x\left(4\mathrm{e}^{4x-5}\right)-\mathrm{e}^{4x-5}\left(\sec^2 x\right)}{\left(\tan x\right)^2}$ isw	A1	all correct
8(i)	$\frac{\pi}{3}$	B1	
	6 [cm]	B1	
8(ii)	[major arc =]$\left(2\pi-\textit{their}\frac{\pi}{3}\right)\textit{their } r$	M1	
	$10\pi + 6$ cao	A1	
8(iii)	$\frac{1}{2}(\textit{their}6)^2\left(2\pi-\textit{their}\frac{\pi}{3}\right)$	M1	$\frac{1}{2}(\textit{their}6)^2\left(\textit{their}\frac{\pi}{3}\right)$
	$\frac{1}{2}(\textit{their}6)^2\sin\left(\textit{their}\frac{\pi}{3}\right)$	M1	$\frac{1}{2}(\textit{their}6)^2\sin\left(\textit{their}\frac{\pi}{3}\right)$
	Sector + triangle	M1	$\pi\times\textit{their}6^2$ – (Sector – triangle)
	$30\pi + 9\sqrt{3}$	A1	

Question	Answer	Marks	Guidance
9(i)	$\frac{y}{9}=\sqrt{x-1}$ with attempt to swop x and y at some point or $\frac{x}{9}=\sqrt{y-1}$	**M1**	attempt to swop; may be in later work that contains an error
	$\left[f^{-1}(x)=\right]\left(\frac{x}{9}\right)^2+1$ oe	**A1**	condone $y=$ ... etc; must be a function of x
	$x>0$	**B1**	
9(ii)	f(51)	**M1**	or $fg(x)=9\sqrt{x^2+1}$
	$9\sqrt{50}$ oe	**A1**	
9(iii)	$\left[gf(x)=\right]\left(9\sqrt{x-1}\right)^2+2$	**M1**	
	$\left[gf(x)=\right]81(x-1)+2$ or better	**A1**	
	$their\left(81x-79\right)=5x^2+83x-95\rightarrow$ $their\left(5x^2+2x-16\,[=0]\right)$	**M1**	provided $their(81x-79)$ of the form $ax+b$ for non-zero a and b
	1.6 oe only	**A1**	must disregard other solution
10(a)	$\sin x=0.5$, $\sin x=-0.5$	**M1**	
	$\frac{\pi}{6}, -\frac{\pi}{6}, \frac{5\pi}{6}, -\frac{5\pi}{6}$ oe	**A2**	**A1** for any correct pair of angles if M0 then **SC1** for a correct pair of angles
10(b)	$2y+15=\tan^{-1}\left(\frac{1}{3}\right)$ soi	**M1**	
	18.43(49...) and 198.43(49...)	**M1**	
	1.7, 91.7	**A2**	**A1** for each

Question	Answer	Marks	Guidance
10(c)	Uses $\cot^2 z = \operatorname{cosec}^2 z - 1$ oe	M1	for using correct identity or identities to obtain an equation in terms of a single trigonometric ratio
	$2\operatorname{cosec}^2 z + 7\operatorname{cosec} z - 4 = 0 \Rightarrow$ $(2\operatorname{cosec} z - 1)(\operatorname{cosec} z + 4)$	DM1	for dealing with quadratic
	$[\sin z = 2\ ]\ \sin z = -\frac{1}{4}$	M1	
	194.5, 345.5	A2	**A1** for each
11(i)	$5 + \sqrt{10x} = \frac{5x+20}{4} \to \cancel{20} + 4\sqrt{10x} = 5x + \cancel{20}$	M1	or better; equates and solves as far as clearing the fraction
	$\left[\frac{x}{\sqrt{x}} =\right] \sqrt{x} = \frac{4\sqrt{10}}{5}$ oe	M1	Simplifies as far as $\sqrt{x} = \cdots$
	$x = 6.4$ cao	A1	squares and simplifies to 6.4
	$[y =]13$	B1	
11(ii)	(area of trapezium =) *their* 57.6	B1	**FT** $x = \textit{their}\ 6.4$, $y = \textit{their}\ 13$ using any valid method
	$\int_0^{6.4} \left(5 + \sqrt{10x}\right) dx$	M1	
	$\int (10x)^{\frac{1}{2}}\, dx = k\,(10x)^{\frac{3}{2}}$ or	M1	or $\int \sqrt{10}x^{\frac{1}{2}}\, dx = k\,\sqrt{10}\,(x)^{\frac{3}{2}}$
	$\left[5x + \frac{2(10x)^{\frac{3}{2}}}{3 \times 10}\right]$	A1	or $\left[5x + \frac{2(10)^{\frac{1}{2}}(x)^{\frac{3}{2}}}{3}\right]$
	$\textit{their}\left[5(6.4) + \frac{2(10 \times 6.4)^{\frac{3}{2}}}{3 \times 10}\right] - \textit{their}\,57.6$ oe	M1	limits used correctly or correct **FT** and subtraction of trapezium; $\textit{their}\,\frac{992}{15} - \textit{their}\,57.6$
	$\frac{128}{15}$ or 8.53 oe	A1	allow 8.5333333.... rot to 4 or more sf