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Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/11**

Paper 1 **October/November 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 International 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(i)	$A' \cap B$	**B1**	
1(ii)	$A \cap B \cap C$	**B1**	
1(iii)	$A \cup B$	**B1**	
2(i)	$\mathrm{p}\left(\frac{1}{2}\right)=\frac{a}{8}+\frac{b}{4}-\frac{13}{2}+4$	**M1**	attempt at $p\left(\frac{1}{2}\right)$
	$\mathrm{p}'(x)=3ax^2+2bx-13$ $\mathrm{p}'\left(\frac{1}{2}\right)=\frac{3a}{4}+b-13$	**M1**	attempt at $p'\left(\frac{1}{2}\right)$
	leading to $a+2b=20$ and $3a+4b-52=0$	**A1**	at least one correct equation
	solution of simultaneous equations	**DM1**	
	$a=12,\ b=4$	**A1**	for both
2(ii)	$p(-1)=-12+4+13+4$	**M1**	
	9	**A1**	**FT** on *their* integer values of a and b
3(a)	$Tg^{\frac{1}{2}}=2\pi l^{\frac{1}{2}}$ $T^2g=4\pi^2 l$	**B1**	multiplication/dealing with power of $\frac{1}{2}$ or squaring
	$l=\frac{T^2g}{4\pi^2}$ or $\left(\frac{Tg^{\frac{1}{2}}}{2\pi}\right)^2$	**B1**	for either
3(b)	$y^2-4y+3=0$ leading to $y=1,\ y=3$	**M1**	reduction to quadratic equation and attempt to solve
	$x^{\frac{1}{3}}=1,\ \ x^{\frac{1}{3}}=3$	**DM1**	attempt to solve $x^{\frac{1}{3}}=k$ (positive k)
	$x=1,\ x=27$	**A2**	A1 for each

Question	Answer	Marks	Guidance
4(i)	$\frac{1}{2}$	**B1**	
4(ii)	$\lg y = mx^2 + c$ $\lg y = \frac{1}{2}x^2 + 1$	**B2**	–1 for each error
4(iii)	$y = 10^{\left(\frac{x^2}{2}+1\right)}$	**B1**	dealing with lg on *their* (ii)
	$y = 10\left(10^{\frac{x^2}{2}}\right)$	**B2**	B1 for each, dependent on first B1
5(i)	(0, 20)	**B1**	
5(ii)	31.7	**B1**	
5(iii)	$2e^{2x} - 8e^{-2x} \quad (+c)$	**B2**	B1 for each correct term
5(iv)	Area of trapezium = $\frac{1}{2}(20 + 31.7)$ $= 25.86$ or 25.85	**B1**	
	$\left[2e^{2x} - 8e^{-2x}\right]_0^1 = \left(2e^2 - 8e^{-2}\right) - (-6)$	**M1**	substitution of both limits, must have come from integration of the form $ae^{2x} + be^{-2x}$.
	19.7	**A1**	
	Required area = 6.15, 6.16, 6.17	**A1**	
6(a)(i)	$f \geqslant 3$	**B1**	must be using a correct notation
6(a)(ii)	$(4x-1)^2 + 3 = 4$	**M1**	correct order
	solution of resulting quadratic equation	**DM1**	
	$x = 0,\ x = \frac{1}{2}$	**A1**	both required

Question	Answer	Marks	Guidance
6(b)(i)	$xy - 4y = 2x + 1$	**M1**	'multiplying out'
	$x(y-2) = 4y + 1$ $x = \dfrac{4y+1}{y-2}$	**M1**	collecting together like terms
	$\mathrm{h}^{-1}(x) = \dfrac{4x+1}{x-2}$	**A1**	correct answer with correct notation
	Range $\mathrm{h}^{-1} \neq 4$	**B1**	must be using a correct notation
6(b)(ii)	$\mathrm{h}^2(x) = \mathrm{h}\left(\dfrac{2x+1}{x-4}\right)$ $= \dfrac{2\left(\dfrac{2x+1}{x-4}\right)+1}{\left(\dfrac{2x+1}{x-4}\right)-4}$	**M1**	dealing with h^2 correctly
	dealing with fractions within fractions	**M1**	
	$= \dfrac{5x-2}{17-2x}$ oe	**A1**	
7(i)	$\ln(2x+1) - \ln(2x-1)$	**B1**	
7(ii)	attempt to differentiate	**M1**	
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{2}{2x+1} - \dfrac{2}{2x-1} + 4$	**A1**	all correct
	attempt to obtain in required form	**DM1**	
	$= \dfrac{16x^2-8}{4x^2-1}$	**A1**	A1 all correct
7(iii)	When $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$, $16x^2 - 8 = 0$	**M1**	setting $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$ and attempt to solve
	$x = \dfrac{1}{\sqrt{2}}$ only	**A1**	

Question	Answer	Marks	Guidance
7(iv)	$\frac{d^2y}{dx^2}=\frac{32x\left(4x^2-1\right)-8x\left(16x^2-8\right)}{\left(4x^2-1\right)^2}$	M1	attempt at second derivative and conclusion or equivalent method
	When $x=\frac{1}{\sqrt{2}}$ $\frac{d^2y}{dx^2}$ is + ve, so minimum	A1	
8(a)(i)	${}^8C_6 \times {}^6C_4$	B1	either ${}^8C_6$ or ${}^6C_4$
	420	B1	
8(a)(ii)	${}^{12}C_8 + {}^{12}C_{10}$	B2	B1 for each
	= 561	B1	
	Alternate scheme: $1001-\left(2\times {}^{12}C_9\right)$	B1 B1	
	= 561	B1	
8(b)(i)	136 080	B1	
8(b)(ii)	No of ways ending with 0 - 15 120	B1	
	No of ways ending with 5 - 13 440	B1	
	Total 28 560	B1	
8(b)(iii)	Starting with 6 or 8 - 13 440	B1	
	Starting with 7 or 9 - 16 800	B1	
	Total = 30 240	B1	
9(i)	$\tan\left(\frac{PAQ}{2}\right)=2.4$	M1	valid method
	$PAQ=2.352(01....)$ $PAQ=2.35$ correct to 3 sf	A1	must see greater than 3 sf then rounding
9(ii)	$PBQ=0.790$ or 0.792	B1	
9(iii)	$\left(2.352\times10\right)+\left(0.790\times24\right)$	M1,A1	M1 for correct attempt at an arc length A1 for one correct arc length
	= awrt 42.5	A1	

Question	Answer	Marks	Guidance
9(iv)	$\left(\left(\frac{1}{2}\times 24^2\times 0.790\right)-\left(\frac{1}{2}\times 24^2\times \sin 0.790\right)\right)$	**B1,B1**	B1 for a correct sector area allow, unsimplified B1 for a correct area of a triangle, allow unsimplified
	$+\left(\left(\frac{1}{2}\times 10^2\times 2.352\right)-\left(\frac{1}{2}\times 10^2\times \sin 2.352\right)\right)$	**B1**	correct plan, dependent on both previous B marks
	$=22.94+82.1$ $=105$	**B1**	
10(a)	$\frac{3}{4}=\sin^2 2x$	**B1**	dealing correctly with cosec
	$\sin 2x=\pm\frac{\sqrt{3}}{2}$ $2x=60,\ 120,\ 240,\ 300$	**M1**	correct method of solution including dealing with $2x$ correctly, may be implied by one correct solution.
	$x=30,\ 60,\ 120,\ 150$	**A2**	A1 for each correct pair
10(b)	$\tan\left(y-\frac{\pi}{4}\right)=\frac{1}{\sqrt{3}}$	**M1**	dealing with order of operations to obtain a first solution
	$y-\frac{\pi}{4}=\frac{\pi}{6},\ \frac{7\pi}{6}$	**M1**	M1 for attempt to obtain a second solution
	$y=\frac{5\pi}{12},\ \frac{17\pi}{12}$	**A2**	A1 for each