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Cambridge International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **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.

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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	$x^2-6x-7(>0)$	B1	
	$(x-7)(x+1)(>0)$	M1	
	Critical values 7 and –1	A1	
	$x>7$ or $x<-1$	A1	
2	$\dfrac{(1+\sin\theta)-(1-\sin\theta)}{(1-\sin\theta)(1+\sin\theta)}$	M1	Dealing with fractions
	$=\dfrac{2\sin\theta}{(1-\sin^2\theta)}$	A1	Simplification
	$=\dfrac{2\sin\theta}{\cos^2\theta}$	M1	Use of identity (seen anywhere)
	$=2\tan\theta\sec\theta$	M1	Use of $\tan\theta=\dfrac{\sin\theta}{\cos\theta}$ and $\sec\theta=\dfrac{1}{\cos\theta}$ (seen anywhere)
3	$2=\log_5 25$	B1	
	$\log_5 25+\log_5(x-7)=\log_5 25(x-7)$ $10x+5=25(x-7)$	M1	
	$180=15x$	M1	Equate, clear brackets and collect terms.
	$12=x$	A1	

Question	Answer	Marks	Guidance
4	$x-2\left(4-\sqrt{3}x\right)=5\sqrt{3}$	M1	Eliminate y
	$x=\dfrac{5\sqrt{3}+8}{2\sqrt{3}+1}$	A1	
	$x=\dfrac{\left(5\sqrt{3}+8\right)\left(2\sqrt{3}-1\right)}{\left(2\sqrt{3}+1\right)\left(2\sqrt{3}-1\right)}$	M1	Multiply by $\left(a\sqrt{b}+c\right)$ as appropriate
	$x=2+\sqrt{3}$	A1	
	$y=1-2\sqrt{3}$	A1	
	Alternative method $\sqrt{3}\left(5\sqrt{3}+2y\right)+y=4$	M1	Eliminate x
	$y=\dfrac{-11}{\left(2\sqrt{3}+1\right)}$	A1	
	$y=\dfrac{-11\left(2\sqrt{3}-1\right)}{\left(2\sqrt{3}+1\right)\left(2\sqrt{3}-1\right)}$	M1	Multiply by $\left(a\sqrt{b}+c\right)$ as appropriate
	$y=1-2\sqrt{3}$	A1	
	$x=2+\sqrt{3}$	A1	
5(i)	$\dfrac{\mathrm{d}}{\mathrm{d}x}\left(\dfrac{5}{3x+2}\right)=-5\left(3x+2\right)^{-2}\times 3$	M1	$-5\left(3x+2\right)^{-2}$
		A1	$\times 3$
5(ii)	$\int \dfrac{30}{\left(3x+2\right)^2}\,\mathrm{d}x=\left[\dfrac{-10}{\left(3x+2\right)}\right]$	M1	$\dfrac{1}{\left(3x+2\right)}$
		A1	$\times -10$
5(iii)	$\left[\dfrac{-10}{\left(3x+2\right)}\right]_1^2=-\dfrac{10}{8}+\dfrac{10}{5}$	M1	Insert limits and subtract
	$=\dfrac{3}{4}$	A1	
6(i)	$2q+3p=13$	B1	

Question	Answer	Marks	Guidance
6(ii)	Multiply matrices correctly	**M1**	
	$2p + pq = 12$	**A1**	
6(iii)	$4p + p(13 - 3p) = 24$	**M1**	Eliminate q
	$3p^2 - 17p + 24 = 0$	**A1**	
	$(3p - 8)(p - 3) = 0$	**M1**	Solve
	$p = 3,\ q = 2$	**A1**	
7	$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 - \frac{1}{x^2}(+C)$	**B2**	**B1** for $3x^2$ **B1** for $-\frac{1}{x^2}$.
	$x = 1,\ \frac{\mathrm{d}y}{\mathrm{d}x} = 1 \to C = -1$	**B1**	
	$y = x^3 + \frac{1}{x} - x + D$ $x = 1,\ y = 3 \to D = 2$	**B2**	**B1** for two correct terms in x
	$y = x^3 + \frac{1}{x} - x + 2$	**B1**	
8	$z^2 = a^2 + 3(a+3)^2 + 2a(a+3)\sqrt{3}$ $= 79 + b\sqrt{3}$	**M1**	
	$a^2 + 3(a+3)^2 = 79$ and $2a(a+3) = b$	**A1**	**FT** Equate correctly to obtain both eqns
	$a^2 + 3a^2 + 18a + 27 = 79$ $4a^2 + 18a - 52 = 0$	**M1**	Expand and simplify to obtain 3 term quadratic
	$(a - 2)(4a + 26) = 0$	**M1**	
	$a = 2, \quad b = 20$	**A2**	**A1** for each
9(i)	$1 + 4x + 6x^2 + 4x^3 + x^4$	**B1**	
9(ii)	$1296 - 864x + 216x^2 - 24x^3 + x^4$	**B2**	Minus 1 each error.
9(iii)	$1295 - 868x + 210x^2 - 28x^3 = 175$	**M1**	Subtract and equate to 1
	$28x^3 - 210x^2 + 868x - 1120 = 0$	**A1**	

Question	Answer	Marks	Guidance
9(iv)	$28(2)^3 - 210(2)^2 + 868(2) - 1120$	**M1**	Inserts $x = 2$
	$= 224 - 840 + 1736 - 1120 = 0$ $(x-2)$ is a factor	**A1**	
	$(x-2)(28x^2 - 154x + 560)$	**M1A1**	**M1** for 28 and 560 seen oe **A1** for –154
	$b^2 - 4ac < 0$ shown	**B1**	
10(i)	$\mathbf{r}_A = (2\mathbf{i} + 4\mathbf{j}) + t(\mathbf{i} + \mathbf{j})$	**B1**	
10(ii)	$\mathbf{r}_B = (10\mathbf{i} + 14\mathbf{j}) + t(-2\mathbf{i} - 3\mathbf{j})$	**B1**	
10(iii)	$\mathbf{r}_B - \mathbf{r}_A = (8\mathbf{i} + 10\mathbf{j}) + t(-3\mathbf{i} - 4\mathbf{j})$	**M1**	
	$X^2 = (8-3t)^2 + (10-4t)^2$	**M1A1**	
10(iv)	Differentiate	**M1**	
	$\frac{dX^2}{dt} = 2(8-3t)(-3) + 2(10-4t)(-4)$ oe	**A1**	
	$\frac{dX^2}{dt} = 0 \rightarrow t = 2.56$ $\rightarrow X = 0.4$	**B2**	**B1** for value of t **B1** for value of X.
11(i)	$x^2 - 2x + (kx+3)^2 = 8$	**M1**	Eliminate y
	$(1+k^2)x^2 + (6k-2)x + 1 = 0$	**A1**	
	$b^2 - 4ac = 0 \rightarrow (6k-2)^2 - 4(1+k^2) = 0$	**M1**	
	$k = \frac{3}{4}$	**A1**	Answer given
11(ii)	$x = \frac{-b}{2a} \rightarrow x = \frac{-2.5}{2 \times 1.5625}$	**M1**	
	$= -0.8$	**A1**	
	$y = 0.75 \times -0.8 + 3 = 2.4$	**A1**	**FT**

Question	Answer	Marks	Guidance
11(iii)	Eqn of PQ $\frac{y-2.4}{x+0.8} = \frac{-4}{3}$	**M1**	
	$\to 3y = 4 - 4x$	**A1**	
12(i)	$\frac{\mathrm{d}(\cos x)^{-1}}{\mathrm{d}x} = \frac{1}{\cos^2 x} \times \sin x$	**M1**	$\frac{1}{\cos^2 x}$
		A1	$\times \sin x$
12(ii)	$\frac{\mathrm{d}y}{\mathrm{d}x} = \sec^2 x + \frac{4\sin x}{\cos^2 x}$	**B1**	$\sec^2 x$
		B1	$\frac{4\sin x}{\cos^2 x}$
12(iii)	$\frac{1}{\cos^2 x} + \frac{4}{\cos x} \times \frac{\sin x}{\cos x} = 4$	**M1**	Equate *their* (i) to 4 and multiply by $\cos^2 x$
	$\to 1 + 4\sin x = 4\cos^2 x$	**M1**	Use of identity and simplify
	$4\sin^2 x + 4\sin x - 3 = 0$	**A1**	
	$(2\sin x - 1)(2\sin x + 3) = 0$	**M1**	Solve
	$x = \frac{\pi}{6}, \frac{5\pi}{6}$	**A2**	**A1** for each