CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0606 ADDITIONAL MATHEMATICS

0606/21 Paper 2, maximum raw mark 80

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.

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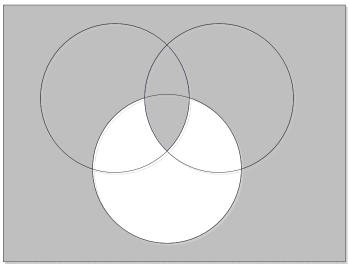
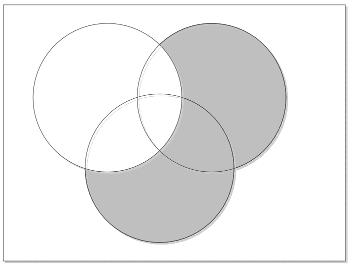
CAMBRIDGE
International Examinations

1 (a)		**B1**	
		**B1**	
(b)	No.in H only $= 50 - x$; No in F only $= 60 - x$	**B1**	Both written or on diagram
	Sum: $50 - x + 60 - x + x + 30 - 2x = 98$	**M1**	Add at least 3 terms each with x involved and equate to 98 soi
	$x = 14$	**A1**	
2	$9x^2 + 2x - 1 < (x+1)^2$	**M1**	Expand and collect terms
	$8x^2 < 2$ oe isw	**A1**	
	$-\frac{1}{2} < x < \frac{1}{2}$	**A1**	
3	$\log_2(x+3) = \log_2 y + 2 \quad \rightarrow \quad x + 3 = 4y$	**B1**	
	$\log_2(x+y) = 3 \quad \rightarrow \quad x + y = 8$	**B1**	
	$x + 3 = 4(8 - x)$	**M1**	Eliminate y or x from two linear three term equations
	$5x = 29 \quad \rightarrow \quad x = 5.8$, oe	**A1**	
	$y = 2.2$ oe	**A1**	

4 (i)	$\mathrm{f}(37)=3$ or $\mathrm{gf}(x)=\dfrac{\sqrt{x-1}-3-2}{2\left(\sqrt{x-1}-3\right)-3}$	**B1**	
	$\mathrm{gf}(37)=\dfrac{3-2}{6-3}=\dfrac{1}{3}$	**B1**	
(ii)	$y=\sqrt{x-1}-3 \quad\rightarrow\quad (y+3)^2=x-1$	**M1**	Rearrange and square in any order
	$(x+3)^2+1=\mathrm{f}^{-1}(x)$ oe isw	**A1**	Interchange x and y and complete
(iii)	$y=\dfrac{x-2}{2x-3}$		
	$2xy-3y=x-2 \quad\rightarrow\quad 2xy-x=3y-2$	**M1**	Multiply and collect like terms
	$\dfrac{3x-2}{2x-1}=\mathrm{g}^{-1}(x)$ oe	**A1**	Interchange and complete Mark final answer
5 (i)	$B=900$	**B1**	
(ii)	$B = 500 + 400\mathrm{e}^2 = 3455$ or 3456 or 3460	**B1**	3455.6 scores **B0**
(iii)	$\left(\dfrac{\mathrm{d}B}{\mathrm{d}t}=\right)80\mathrm{e}^{0.2t}$	**B1**	
	$t=10 \quad\rightarrow\quad \dfrac{\mathrm{d}B}{\mathrm{d}t}=80\mathrm{e}^2=591\,(\text{/day})$	**B1**	awrt
(iv)	$10000=500+400\mathrm{e}^{0.2t} \quad\rightarrow\quad \mathrm{e}^{0.2t}=(23.75)$	**M1**	$\mathrm{e}^{0.2t}=k$
	$0.2t=\ln 23.75$	**DM1**	take logs: $0.2t=\ln k$
	$t=15.8\,(\text{days})$	**A1**	awrt

6 (i)	$(x+2)^2 + x^2 = 10$ $x^2 + 2x - 3 = 0 \quad \rightarrow \quad (x+3)(x-1) = 0$ Points (1, 3), (–3, –1) isw or elimination of x leads to $y^2 - 2y - 3 = 0$, then as above	**B1** **M1** **A1** **A1**	 3 term quadratic with attempt to solve both x or a pair both y or second pair
(ii)	$m^2x^2 + 10mx + 25 + x^2 = 10$ $(m^2+1)x^2 + 10mx + 15 = 0$ $b^2 - 4ac = (0) \quad \rightarrow \quad 100m^2 - 60(m^2+1) = 0$ $m = \pm\sqrt{\frac{3}{2}}$ oe isw Alternative solution: $\frac{dy}{dx} = \frac{-x}{\sqrt{10-x^2}}$ or $\frac{dy}{dx} = -\frac{x}{y}$ Result: $y^2 = x^2 + 5y$ after inserted in $y = mx + 5$ Attempt to solve with $x^2 + y^2 = 10$ $y = 2, x = \pm\sqrt{6}$ $m = \pm\frac{3}{\sqrt{6}}$ oe	**B1** **M1** **A1** **A1** **B1** **M1** **A1** **A1**	 attempt to use discriminant on three term quadratic. Allow unsimplified cao ± is required allow unsimplified Eliminate x or y both
7 (i)	$v = 2\cos t + 1$	**B1**	mark final answer
(ii)	$2\cos t + 1 = 0$ $t = \frac{2\pi}{3}$ or 2.09	**M1** **A1**	equate their v to zero (must be a differential) and attempt to solve to find an **angle** awrt
(iii)	$t = \frac{2\pi}{3} \quad \rightarrow \quad x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\,\text{m}$ $a = -2\sin t$ $t = \frac{2\pi}{3} a = -\sqrt{3} = -\frac{1.73}{4}\,\text{ms}^{-2}$	**B1** **B1ft** **DB1ft**	awrt ft *their* v (2nd differential) ft using *their* **angle** t in correct a awrt
8 (i)	$\frac{dy}{dx} = \frac{(2+x^2) \times 2x - x^2 \times 2x}{(2+x^2)^2} = \frac{4x}{(2+x^2)^2}$ $k = 4$	**M1** **A1** **A1**	apply quotient or product rule unsimplified k=4 does not need to be specifically identified
(ii)	$\int \frac{x}{(2+x^2)^2} dx = \frac{1}{4} \times \frac{x^2}{2+x^2} + (c)$ isw	**B1** **B1**	$\frac{1}{\textit{their } k} \times$ original function

9	$\left(a+3\sqrt{5}\right)^2 = a^2 + 3\sqrt{5}a + 3\sqrt{5}a + 45$ oe	**B1**	anywhere
	Equate: $a^2 + a + 45 = 51$ and $6a - b = 0$	**B1** **B1**	
	$(a+3)(a-2) = 0$	**M1**	Attempt to solve three term quadratic with integer coefficients obtained by equating coeffs
	$a = -3, 2$ $b = -18, 12$	**A1** **A1**	Both *a*s correct or one correct pair Both *b*s correct
10 (i)	sec*x*cosec*x* = $\dfrac{1}{\cos x \sin x}$	**B1**	anywhere
	$\cot x = \dfrac{\cos x}{\sin x}$	**B1**	anywhere
	LHS = $\dfrac{1-\cos^2 x}{\cos x \sin x}$ oe	**B1ft**	correct addition of *their* terms
	$= \dfrac{\sin^2 x}{\cos x \sin x} = \tan x$ AG	**B1**	use of identity and cancel
(ii)	$3\cot x - \cot x = \tan x \rightarrow 2\cot x = \tan x$	**M1**	equate and collect like terms, allow sign errors
	$\tan^2 x = 2$ oe x = 54.7, 125.3, 234.7, 305.3	**A1** **A1** **A1**	 2 values only 2 more values. awrt
11 (i)	Area of sector = $\dfrac{1}{2} \times x^2 \times 0.8 \left(= 0.4x^2 \text{ cm}^2\right)$	**B1**	anywhere
	$SR = 5\sin 0.8\,(= 3.59)$ or $OR = 5\cos 0.8\,(= 3.48)$	**B1**	*SR* may be seen in stated $\dfrac{1}{2}ab\sin C$
	Area of triangle = $\dfrac{1}{2} 5\cos 0.8 \times 5\sin 0.8 = 6.247\,\text{cm}^2$ $0.08x^2 = 6.247$ $x = 8.837\,\text{cm}$ AG	**M1** **A1** **A1**	insert correct terms into correct area formulae
(ii)	$SQ = 8.84 - 5\,(= 3.84\,\text{cm})$ $PR = 8.84 - 5\cos 0.8\,(= 5.35 \text{ or } 5.36\,\text{cm})$ $PQ = 8.84 \times 0.8\,(= 7.07\,\text{cm})$ Perimeter = 19.84 to 19.86 cm or rounded to 19.8 or 19.9	**B1** **B1** **B1**	two lengths from *SQ, PR, PQ* awrt third length awrt sum
(iii)	Area $PQSR = 4 \times 6.247$ $= 25\,\text{cm}^2$	**M1** **A1**	 24.95 to 25

12 (i)	$f(2)=3(2^3)-14(2^2)+32=0$ Or complete long division	**B1**	
(ii)	$f(x)=(x-2)(3x^2-8x-16)$ $f(x)=(x-2)(x-4)(3x+4)$	**M1** **A1** **M1** **A1**	$3x^2$ and 16 $8x$ and correct signs Factorise three term quadratic
(iii)	$x = 2, 4$	**B1**	
(iv)	$\int 3x-14+\frac{32}{x^2}\,\mathrm{d}x=1.5x^2-14x-\frac{32}{x}(+\mathrm{c})$ Area = $\left[1.5x^2-14x-\frac{32}{x}\right]_2^4$ = (–) 2	**B1** **B1** **M1** **A1**	first 2 terms third term correct unsimplified Limits of 2 and 4 and subtract