

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge Ordinary Level

MARK SCHEME for the October/November 2014 series

4037 ADDITIONAL MATHEMATICS

4037/22

Paper 2, maximum raw mark 80

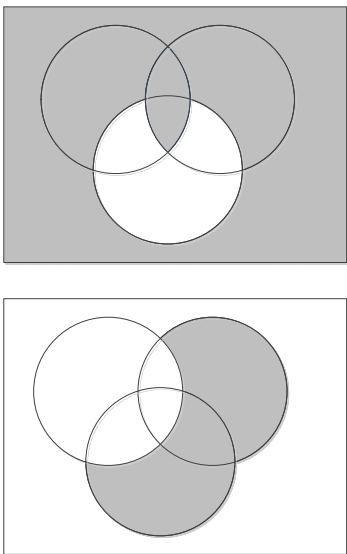
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began,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

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

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	4037	22

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

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

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6	(i)	$(x+2)^2 + x^2 = 10$ $x^2 + 2x - 3 = 0 \rightarrow (x+3)(x-1) = 0$ 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)	$m^2x^2 + 10mx + 25 + x^2 = 10$ $(m^2 + 1)x^2 + 10mx + 15 = 0$ $b^2 - 4ac = (0)^2 \rightarrow 100m^2 - 60(m^2 + 1) = 0$ $m = \pm\sqrt{\frac{3}{2}}$ 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 $\pm$ 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)	$t = \frac{2\pi}{3} \rightarrow x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\text{ m}$ $a = -2\sin t$ $t = \frac{2\pi}{3} a = -\sqrt{3} = -\frac{1.73}{4}\text{ ms}^{-2}$	B1 B1ft DB1ft	awrt ft <i>their</i> v (2 nd differential) ft using <i>their</i> 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	$\frac{1}{\text{their } k} \times$ original function

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9	$(a + 3\sqrt{5})^2 = a^2 + 3\sqrt{5}a + 3\sqrt{5}a + 45$ oe Equate: $a^2 + a + 45 = 51$ and $6a - b = 0$ $(a + 3)(a - 2) = 0$ $a = -3, 2$ $b = -18, 12$	B1 B1 B1 M1 A1 A1	anywhere Attempt to solve three term quadratic with integer coefficients obtained by equating coeffs Both <i>as</i> correct or one correct pair Both <i>bs</i> correct
10 (i)	$\sec x \csc x = \frac{1}{\cos x \sin x}$ $\cot x = \frac{\cos x}{\sin x}$ LHS = $\frac{1 - \cos^2 x}{\cos x \sin x}$ oe $= \frac{\sin^2 x}{\cos x \sin x} = \tan x$ AG	B1 B1 B1ft B1	anywhere anywhere correct addition of <i>their</i> terms use of identity and cancel
(ii)	$3 \cot x - \cot x = \tan x \rightarrow 2 \cot x = \tan x$ $\tan^2 x = 2$ oe $x = 54.7, 125.3, 234.7, 305.3$	M1 A1 A1 A1	equate and collect like terms, allow sign errors 2 values only 2 more values. awrt
11 (i)	Area of sector = $\frac{1}{2} \times x^2 \times 0.8 (= 0.4x^2 \text{ cm}^2)$ $SR = 5 \sin 0.8 (= 3.59)$ or $OR = 5 \cos 0.8 (= 3.48)$ Area of triangle = $\frac{1}{2} \times 5 \cos 0.8 \times 5 \sin 0.8 = 6.247 \text{ cm}^2$ $0.08x^2 = 6.247$ $x = 8.837 \text{ cm}$ AG	B1 B1 M1 A1 A1	anywhere SR may be seen in stated $\frac{1}{2}ab \sin C$ 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

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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)	$\int 3x - 14 + \frac{32}{x^2} dx = 1.5x^2 - 14x - \frac{32}{x} (+ c)$ 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