

**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

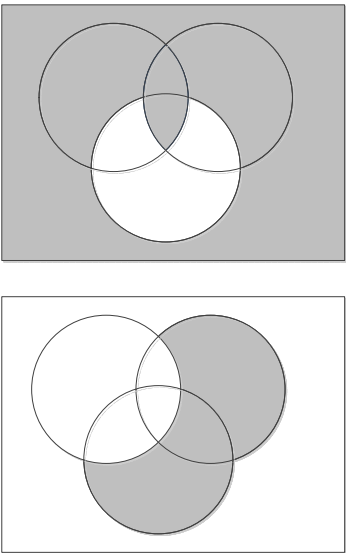
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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Page 2	Mark Scheme	Syllabus	Paper
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1	(a)		B1	
	(b)	<p>No. in <math>H</math> only = <math>50 - x</math>; No in <math>F</math> only = <math>60 - x</math>  Sum: <math>50 - x + 60 - x + x + 30 - 2x = 98</math>  <math>x = 14</math></p>	B1 M1 A1	Both written or on diagram Add at least 3 terms each with $x$ involved and equate to 98 so
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		$\log_2(x + 3) = \log_2 y + 2 \rightarrow x + 3 = 4y$ $\log_2(x + y) = 3 \rightarrow x + y = 8$ $x + 3 = 4(8 - x)$ $5x = 29 \rightarrow x = 5.8$ , oe $y = 2.2$ 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 <b>B0</b>
	(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	<b>B1</b>  <b>M1</b> <b>A1</b> <b>A1</b>	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	<b>B1</b>          <b>M1</b> <b>A1</b> <b>A1</b>       <b>B1</b>       <b>M1</b> <b>A1</b> <b>A1</b>	attempt to use discriminant on three term quadratic. Allow unsimplified   cao $\pm$ is required      allow unsimplified    Eliminate $x$ or $y$ both
7	(i)	$v = 2\cos t + 1$	<b>B1</b>	mark final answer
	(ii)	$2\cos t + 1 = 0$  $t = \frac{2\pi}{3}$ or 2.09	<b>M1</b>  <b>A1</b>	equate their $v$ to zero (must be a differential) and attempt to solve to find an <b>angle</b> awrt
	(iii)	$t = \frac{2\pi}{3} \rightarrow x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\text{ m}$ $a = -2\sin t$ $t = \frac{2\pi}{3} a = -\sqrt{3} = -\frac{1.73}{4}\text{ ms}^{-2}$	<b>B1</b>  <b>B1ft</b>  <b>DB1ft</b>	awrt ft <i>their</i> $v$ (2 <sup>nd</sup> differential) ft using <i>their</i> <b>angle</b> $t$ in correct $a$ awrt
8	(i)	$\frac{dy}{dx} = \frac{(2+x^2) \times 2x - x^2 \times 2x}{(2+x^2)^2} = \frac{4x}{(2+x^2)^2}$ $k = 4$	<b>M1</b> <b>A1</b>  <b>A1</b>	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	<b>B1</b> <b>B1</b>	$\frac{1}{\text{their } k} \times$ original function

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9	$(a + 3\sqrt{5})^2 = a^2 + 3\sqrt{5}a + 3\sqrt{5}a + 45 \text{ oe}$ <p>Equate: <math>a^2 + a + 45 = 51</math> and <math>6a - b = 0</math></p> $(a + 3)(a - 2) = 0$ <p><math>a = -3, 2</math> <math>b = -18, 12</math></p>	<p><b>B1</b></p> <p><b>B1</b> <b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b> <b>A1</b></p>	<p>anywhere</p> <p>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</p>
10 (i)	$\sec x \csc x = \frac{1}{\cos x \sin x}$ $\cot x = \frac{\cos x}{\sin x}$ $\text{LHS} = \frac{1 - \cos^2 x}{\cos x \sin x} \text{ oe}$ $= \frac{\sin^2 x}{\cos x \sin x} = \tan x \quad \text{AG}$	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1ft</b></p> <p><b>B1</b></p>	<p>anywhere</p> <p>anywhere</p> <p>correct addition of <i>their</i> terms</p> <p>use of identity and cancel</p>
11 (ii)	$\text{Area of sector} = \frac{1}{2} \times x^2 \times 0.8 (= 0.4x^2 \text{ cm}^2)$ $SR = 5 \sin 0.8 (= 3.59) \text{ or}$ $OR = 5 \cos 0.8 (= 3.48)$ <p>Area of triangle =</p> $\frac{1}{2} \times 5 \cos 0.8 \times 5 \sin 0.8 = 6.247 \text{ cm}^2$ $0.08x^2 = 6.247$ $x = 8.837 \text{ cm} \quad \text{AG}$	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>M1</b> <b>A1</b></p> <p><b>A1</b></p>	<p>anywhere</p> <p><math>SR</math> may be seen in stated <math>\frac{1}{2}ab \sin C</math></p> <p>insert correct terms into correct area formulae</p> <p>two lengths from <math>SQ, PR, PQ</math> awrt</p> <p>third length awrt</p> <p>sum</p>
	<p>(iii)</p> $\text{Area } PQSR = 4 \times 6.247$ $= 25 \text{ cm}^2$	<p><b>M1</b></p> <p><b>A1</b></p>	<p>24.95 to 25</p>

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