

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2014 series**

**0606 ADDITIONAL MATHEMATICS**

**0606/22**

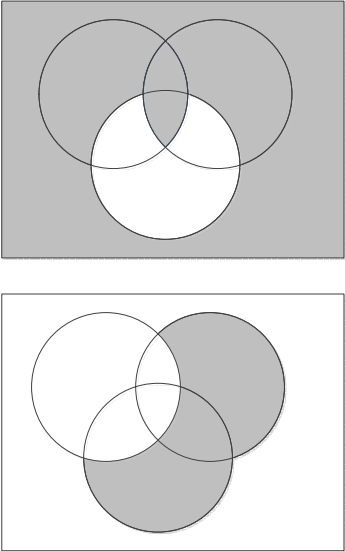
Paper 2, maximum raw mark 80

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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<p>1 (a)</p>  <p>(b)</p> <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></p> <p><math>x = 14</math></p>	<p>B1</p> <p>B1</p> <p>B1 M1 A1</p>	<p>Both written or on diagram  Add at least 3 terms each with <math>x</math> involved and equate to 98 so</p>
<p>2</p>	$9x^2 + 2x - 1 < (x+1)^2$ $8x^2 < 2 \text{ oe isw}$ $-\frac{1}{2} < x < \frac{1}{2}$	<p>M1</p> <p>A1</p> <p>A1</p> <p>Expand and collect terms</p>
<p>3</p>	$\log_2(x+3) = \log_2 y + 2 \rightarrow x+3 = 4y$ $\log_2(x+y) = 3 \rightarrow x+y = 8$ $x+3 = 4(8-x)$ $5x = 29 \rightarrow x = 5.8, \text{ oe}$ $y = 2.2 \text{ oe}$	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>Eliminate <math>y</math> or <math>x</math> from two linear three term equations</p>

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4	(i)	$f(37) = 3$ 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	
	(ii)	$y = \sqrt{x-1}-3 \rightarrow (y+3)^2 = x-1$ $(x+3)^2 + 1 = f^{-1}(x)$ oe isw	M1 A1	Rearrange and square in any order Interchange $x$ and $y$ and complete
	(iii)	$y = \frac{x-2}{2x-3}$ $2xy - 3y = x - 2 \rightarrow 2xy - x = 3y - 2$ $\frac{3x-2}{2x-1} = g^{-1}(x)$ oe	M1 A1	Multiply and collect like terms Interchange and complete Mark final answer
5	(i)	$B = 900$	B1	
	(ii)	$B = 500 + 400e^2 = 3455$ or 3456 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)	$10000 = 500 + 400e^{0.2t} \rightarrow e^{0.2t} = (23.75)$ $0.2t = \ln 23.75$ $t = 15.8$ (days)	M1 DM1 A1	$e^{0.2t} = k$ take logs: $0.2t = \ln k$ 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)	$t = \frac{2\pi}{3} \rightarrow x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\text{ m}$ $a = -2\sin t$ $t = \frac{2\pi}{3} a = -\sqrt{3} = -1.73$ or $-1.74\text{ ms}^{-2}$	<b>B1</b> <b>B1ft</b> <b>DB1ft</b>	awrt ft <i>their</i> $v$ (2 <sup>nd</sup> differential) ft using <i>their angle</i> $t$ 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)	$\operatorname{sexcosec}x = \frac{1}{\cos x \sin x}$ $\cot x = \frac{\cos x}{\sin x}$ <p>LHS = <math>\frac{1 - \cos^2 x}{\cos x \sin x}</math> oe</p> $= \frac{\sin^2 x}{\cos x \sin x} = \tan x \quad \text{AG}$	<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>
(ii)	$3 \cot x - \cot x = \tan x \rightarrow 2 \cot x = \tan x$ <p><math>\tan^2 x = 2</math> oe <math>x = 54.7, 125.3, 234.7, 305.3</math></p>	<p><b>M1</b></p> <p><b>A1</b> <b>A1</b> <b>A1</b></p>	<p>equate and collect like terms, allow sign errors</p> <p>2 values only 2 more values. awrt</p>
11 (i)	<p>Area of sector = <math>\frac{1}{2} \times x^2 \times 0.8 (= 0.4x^2 \text{ cm}^2)</math></p> <p><math>SR = 5 \sin 0.8 (= 3.59)</math> or <math>OR = 5 \cos 0.8 (= 3.48)</math></p> <p>Area of triangle = <math>\frac{1}{2} \times 5 \cos 0.8 \times 5 \sin 0.8 = 6.247 \text{ cm}^2</math> <math>0.08x^2 = 6.247</math> <math>x = 8.837 \text{ cm} \quad \text{AG}</math></p>	<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>
(ii)	<p><math>SQ = 8.84 - 5 (= 3.84 \text{ cm})</math> <math>PR = 8.84 - 5 \cos 0.8 (= 5.35 \text{ or } 5.36 \text{ cm})</math> <math>PQ = 8.84 \times 0.8 (= 7.07 \text{ cm})</math> Perimeter = 19.84 to 19.86 cm or rounded to 19.8 or 19.9</p>	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1</b></p>	<p>two lengths from <math>SQ, PR, PQ</math> awrt</p> <p>third length awrt sum</p>
(iii)	<p>Area <math>PQSR = 4 \times 6.247</math> <math>= 25 \text{ cm}^2</math></p>	<p><b>M1</b></p> <p><b>A1</b></p>	<p>24.95 to 25</p>

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<b>12 (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