

**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

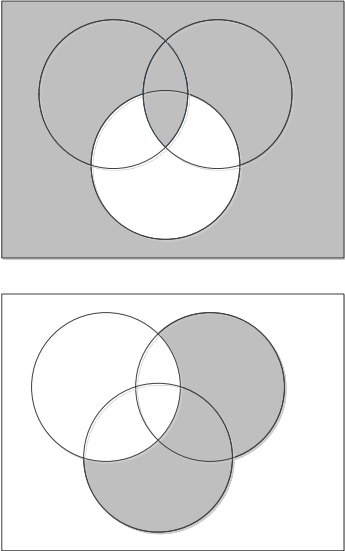
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1	(a)		B1	
	(b)	<p>No. in <math>H</math> only = <math>50 - x</math>; No in <math>F</math> only = <math>60 - x</math>  Sum: <math>50 - x + 60 - x + x + 30 - 2x = 98</math></p> $x = 14$	B1 M1 A1	Both written or on diagram Add at least 3 terms each with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

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4	(i)	$f(37) = 3$ 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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<p><b>6 (i)</b></p> <p><math>(x+2)^2 + x^2 = 10</math>  <math>x^2 + 2x - 3 = 0 \rightarrow (x+3)(x-1) = 0</math>            Points (1, 3), (-3, -1) isw</p> <p>or elimination of <math>x</math> leads to <math>y^2 - 2y - 3 = 0</math>,            then as above</p> <p><b>(ii)</b></p> <p><math>m^2x^2 + 10mx + 25 + x^2 = 10</math>  <math>(m^2 + 1)x^2 + 10mx + 15 = 0</math>  <math>b^2 - 4ac = (0)^2 \rightarrow 100m^2 - 60(m^2 + 1) = 0</math>  <math>m = \pm\sqrt{\frac{3}{2}}</math> oe isw</p> <p>Alternative solution:  <math>\frac{dy}{dx} = \frac{-x}{\sqrt{10-x^2}}</math> or <math>\frac{dy}{dx} = -\frac{x}{y}</math>            Result:  <math>y^2 = x^2 + 5y</math> after inserted in <math>y = mx + 5</math>            Attempt to solve with <math>x^2 + y^2 = 10</math>  <math>y = 2, x = \pm\sqrt{6}</math>  <math>m = \pm\frac{3}{\sqrt{6}}</math> oe</p>	<p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>A1</b></p> <p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>A1</b></p> <p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>A1</b></p>	<p>3 term quadratic with attempt to solve both <math>x</math> or a pair both <math>y</math> or second pair</p> <p>attempt to use discriminant on three term quadratic. Allow unsimplified cao <math>\pm</math> is required</p> <p>allow unsimplified</p> <p>Eliminate <math>x</math> or <math>y</math> both</p>
<p><b>7 (i)</b></p> <p><math>v = 2\cos t + 1</math></p> <p><b>(ii)</b></p> <p><math>2\cos t + 1 = 0</math></p> <p><math>t = \frac{2\pi}{3}</math> or 2.09</p> <p><b>(iii)</b></p> <p><math>t = \frac{2\pi}{3} \rightarrow x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\text{ m}</math></p> <p><math>a = -2\sin t</math></p> <p><math>t = \frac{2\pi}{3} a = -\sqrt{3} = -\frac{1.73}{4}\text{ ms}^{-2}</math></p>	<p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>B1</b></p> <p><b>B1ft</b></p> <p><b>DB1ft</b></p>	<p>mark final answer</p> <p>equate their <math>v</math> to zero (must be a differential) and attempt to solve to find an <b>angle</b> awrt</p> <p>awrt</p> <p>ft <i>their</i> <math>v</math> (2<sup>nd</sup> differential)</p> <p>ft using <i>their angle</i> <math>t</math> in correct <math>a</math> awrt</p>
<p><b>8 (i)</b></p> <p><math>\frac{dy}{dx} = \frac{(2+x^2) \times 2x - x^2 \times 2x}{(2+x^2)^2} = \frac{4x}{(2+x^2)^2}</math></p> <p><math>k = 4</math></p> <p><b>(ii)</b></p> <p><math>\int \frac{x}{(2+x^2)^2} dx = \frac{1}{4} \times \frac{x^2}{2+x^2} + (c)</math> isw</p>	<p><b>M1</b></p> <p><b>A1</b></p> <p><b>A1</b></p> <p><b>B1</b></p> <p><b>B1</b></p>	<p>apply quotient or product rule unsimplified</p> <p><math>k=4</math> does not need to be specifically identified</p> <p><math>\frac{1}{\text{their } k} \times</math> original function</p>

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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> <b>B1</b> <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