**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.

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

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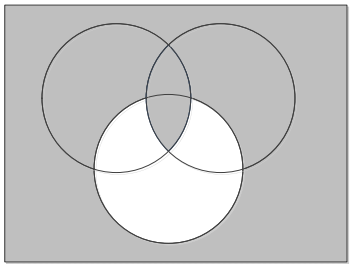
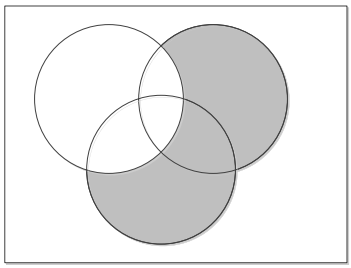
|---|---|---|---|
| **1** **(a)** |  | **B1** | |
| |  | **B1** | |
| **(b)** | No.in $H$ only $= 50 - x$ ; No in $F$ only $= 60 - x$<br>Sum: $50 - x + 60 - x + x + 30 - 2x = 98$<br>$x = 14$ | **B1**<br>**M1**<br>**A1** | Both written or on diagram<br>Add at least 3 terms each with $x$ involved and equate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

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| **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<br>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** | |
| | | $t=10 \quad \rightarrow \quad \dfrac{\mathrm{d}B}{\mathrm{d}t}=80\mathrm{e}^2=591\,(/\mathrm{day})$ | **B1** | awrt |
| | **(iv)** | $10\,000=500+400\mathrm{e}^{0.2t} \quad \rightarrow \quad \mathrm{e}^{0.2t}=(23.75)$ | **M1** | $\mathrm{e}^{0.2t}=k$ |
| | | $0.2t=\ln 23.75$ | **DM1** | take logs: $0.2t=\ln k$ |
| | | $t=15.8\,(\mathrm{days})$ | **A1** | awrt |

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| **6** | **(i)** | $(x+2)^2 + x^2 = 10$ | **B1** | |
| | | $x^2 + 2x - 3 = 0 \rightarrow (x+3)(x-1) = 0$ | **M1** | 3 term quadratic with attempt to solve |
| | | Points (1, 3), (–3, –1) isw | **A1** | both $x$ or a pair |
| | | | **A1** | both $y$ or second pair |
| | | or elimination of $x$ leads to $y^2 - 2y - 3 = 0$, then as above | | |
| | **(ii)** | $m^2x^2 + 10mx + 25 + x^2 = 10$ | **B1** | |
| | | $(m^2+1)x^2 + 10mx + 15 = 0$ | | |
| | | $b^2 - 4ac = (0) \rightarrow 100m^2 - 60(m^2+1) = 0$ | **M1** | attempt to use discriminant on three term quadratic. Allow unsimplified |
| | | | **A1** | |
| | | $m = \pm\sqrt{\frac{3}{2}}$ oe isw | **A1** | cao ± is required |
| | | Alternative solution: | | |
| | | $\frac{dy}{dx} = \frac{-x}{\sqrt{10-x^2}}$ or $\frac{dy}{dx} = -\frac{x}{y}$ | **B1** | allow unsimplified |
| | | Result: | | |
| | | $y^2 = x^2 + 5y$ after inserted in $y = mx + 5$ | | |
| | | Attempt to solve with $x^2 + y^2 = 10$ | **M1** | Eliminate $x$ or $y$ |
| | | $y = 2, x = \pm\sqrt{6}$ | **A1** | both |
| | | $m = \pm\frac{3}{\sqrt{6}}$ oe | **A1** | |
| **7** | **(i)** | $v = 2\cos t + 1$ | **B1** | mark final answer |
| | **(ii)** | $2\cos t + 1 = 0$ | **M1** | equate their $v$ to zero (must be a differential) and attempt to solve to find an **angle** |
| | | $t = \frac{2\pi}{3}$ or 2.09 | **A1** | awrt |
| | **(iii)** | $t = \frac{2\pi}{3} \rightarrow x = 2\sin\left(\frac{2\pi}{3}\right) + \frac{2\pi}{3} = 3.83\,\text{m}$ | **B1** | awrt |
| | | $a = -2\sin t$ | **B1ft** | ft *their* $v$ (2nd differential) |
| | | $t = \frac{2\pi}{3}\, a = -\sqrt{3} = -\frac{1.73}{4}\,\text{ms}^{-2}$ | **DB1ft** | ft using *their* **angle** $t$ in correct $a$ awrt |
| **8** | **(i)** | $\frac{dy}{dx} = \frac{(2+x^2)\times 2x - x^2 \times 2x}{(2+x^2)^2} = \frac{4x}{(2+x^2)^2}$ | **M1** | apply quotient or product rule |
| | | | **A1** | unsimplified |
| | | $k = 4$ | **A1** | $k$=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** | $\frac{1}{\textit{their } k} \times$ original function |
| | | | **B1** | |

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

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