Edexcel GCE
Core Mathematics C4
Silver Level S1
(Mark Scheme)

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Question Number	Scheme	Marks
1.	$\mathrm{f}(x)=\dfrac{1}{\sqrt{(4+x)}}=(4+x)^{-\frac{1}{2}}$	M1
	$=(4)^{-\frac{1}{2}}(1+\ \dots\ )^{\dots}$ $\qquad \dfrac{1}{2}(1+\ \dots\ )^{\dots}$ or $\dfrac{1}{2\sqrt{(1+\dots)}}$	B1
	$=\ \dots\ \left(1+\left(-\frac{1}{2}\right)\left(\dfrac{x}{4}\right)+\dfrac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2}\left(\dfrac{x}{4}\right)^2+\dfrac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}\left(\dfrac{x}{4}\right)^3+\ \dots\right)$	M1 A1ft
	ft their $\left(\dfrac{x}{4}\right)$	
	$=\dfrac{1}{2}-\dfrac{1}{16}x,+\dfrac{3}{256}x^2-\dfrac{5}{2048}x^3+\ \dots$	A1, A1 (6)
		(6 marks)

Question Number	Scheme		Marks
	** represents a constant (which must be consistent for first accuracy mark)		
2. (a)	$(8-3x)^{\frac{1}{3}} = \underline{(8)^{\frac{1}{3}}}\left(1-\frac{3x}{8}\right)^{\frac{1}{3}} = \underline{2}\left(1-\frac{3x}{8}\right)^{\frac{1}{3}}$	Takes 8 outside the bracket to give any of $\underline{(8)^{\frac{1}{3}}}$ or $\underline{2}$.	B1
		Expands $(1+{**}x)^{\frac{1}{3}}$ to give a simplified or an un-simplified $1+(\frac{1}{3})({**}x)$;	M1;
	$= 2\left\{\underline{1+(\tfrac{1}{3})({**}x);+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}({**}x)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}({**}x)^3+\ldots}\right\}$ **with** ${**} \neq 1$	A correct simplified or an un-simplified $\{\underline{\ldots\ldots\ldots}\}$ expansion with candidate's followed through $({**}x)$	A1 $\sqrt{}$
	$= 2\left\{\underline{1+(\tfrac{1}{3})(-\tfrac{3x}{8})+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(-\tfrac{3x}{8})^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(-\tfrac{3x}{8})^3+\ldots}\right\}$		
	$= 2\left\{1-\tfrac{1}{8}x;-\tfrac{1}{64}x^2-\tfrac{5}{1536}x^3-\ldots\right\}$	Either $2\{1-\frac{1}{8}x \ldots\ldots\}$ or	
	$= 2-\frac{1}{4}x;-\frac{1}{32}x^2-\frac{5}{768}x^3-\ldots$	anything that cancels to $2-\frac{1}{4}x$; Simplified $-\frac{1}{32}x^2-\frac{5}{768}x^3$	A1; A1
			[5]
(b)	$(7.7)^{\frac{1}{3}} \approx 2-\frac{1}{4}(0.1)-\frac{1}{32}(0.1)^2-\frac{5}{768}(0.1)^3-\ldots$	***Attempt to substitute*** $x=0.1$ into a candidate's binomial expansion.	M1
	$= 2-0.025-0.0003125-0.0000065104166\ldots$		
	$= 1.97468099\ldots$	awrt 1.9746810	A1
			[2]
			7 marks

Question Number	Scheme	Marks
3. (a)	$\mathrm{f}(x) = \; ... \; (... \; - ... \, x)^{-\frac{1}{2}}$	M1
	$= 6\times 9^{-\frac{1}{2}}\,(\;...\;)$ $\qquad \dfrac{6}{9^{\frac{1}{2}}}, \; \dfrac{6}{3}$, 2 or equivalent	B1
	$= \; ... \left(1+\left(-\tfrac{1}{2}\right)(kx);+\dfrac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2}(kx)^2+\dfrac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}(kx)^3+\;...\right)$	M1; A1ft
	$= 2\left(1+\dfrac{2}{9}x+\;...\right)$ $\qquad$ or $2+\dfrac{4}{9}x$	A1
	$= 2+\dfrac{4}{9}x+\dfrac{4}{27}x^2+\dfrac{40}{729}x^3+\;...$	A1 **(6)**
(b)	$\mathrm{g}(x) = 2-\dfrac{4}{9}x+\dfrac{4}{27}x^2-\dfrac{40}{729}x^3+\;...$	B1ft **(1)**
(c)	$\mathrm{h}(x) = 2+\dfrac{4}{9}(2x)+\dfrac{4}{27}(2x)^2+\dfrac{40}{729}(2x)^3+\;...$	M1 A1 **(2)**
	$\left(= 2+\dfrac{8}{9}x+\dfrac{16}{27}x^2+\dfrac{320}{729}x^3+\;...\right)$	**[9]**

Qn	Scheme		Mark
4. (a)	$\left\{\sqrt[3]{(8-9x)}\ \right\} = (8-9x)^{\frac{1}{3}}$	Power of $\frac{1}{3}$	M1
	$= \underline{(8)^{\frac{1}{3}}}\left(1-\frac{9x}{8}\right)^{\frac{1}{3}} = \underline{2}\left(1-\frac{9x}{8}\right)^{\frac{1}{3}}$	$\underline{(8)^{\frac{1}{3}}}$ or $\underline{2}$	$\underline{\text{B1}}$
	$=\{2\}\left[\ 1+\left(\frac{1}{3}\right)(kx)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(kx)^3+...\ \right]$		M1 A1
	$=\{2\}\left[\ \underline{1+\left(\frac{1}{3}\right)\left(\frac{-9x}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}\left(\frac{-9x}{8}\right)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}\left(\frac{-9x}{8}\right)^3+...}\ \right]$		
	$= 2\left[\ 1-\frac{3}{8}x;-\frac{9}{64}x^2-\frac{45}{512}x^3+\ ...\ \right]$		
	$= 2-\frac{3}{4}x;-\frac{9}{32}x^2-\frac{45}{256}x^3+...$		A1; A1
			(6)
(b)	$\left\{\sqrt[3]{7100} = 10\sqrt[3]{71} = 10\sqrt[3]{(8-9x)},\right\}$ so $x = 0.1$	Writes down or uses $x = 0.1$	B1
	When $x = 0.1$, $\sqrt[3]{(8-9x)} \approx\ 2-\frac{3}{4}(0.1)-\frac{9}{32}(0.1)^2-\frac{45}{256}(0.1)^3+...$		M1
	$= 2-0.075-0.0028125-0.00017578125$ $= 1.922011719$		
	So, $\sqrt[3]{7100} = 19.220117919... = \underline{19.2201}$ (4 dp)	19.2201 **cso**	A1 **cao**
			(3) **[9]**

Question Number	Scheme	Marks
5. (a)	Differentiating implicitly to obtain $\pm ay^2\frac{dy}{dx}$ and/or $\pm bx^2\frac{dy}{dx}$	M1
	$48y^2\frac{dy}{dx} + \ ... \ -54 \ ...$	A1
	$9x^2y \to 9x^2\frac{dy}{dx} + 18xy$ or equivalent	B1
	$\left(48y^2+9x^2\right)\frac{dy}{dx} + 18xy - 54 = 0$	M1
	$\frac{dy}{dx} = \frac{54-18xy}{48y^2+9x^2} \quad \left(= \frac{18-6xy}{16y^2+3x^2}\right)$	A1 **(5)**
(b)	$18 - 6xy = 0$	M1
	Using $x = \frac{3}{y}$ or $y = \frac{3}{x}$	
	$16y^3 + 9\left(\frac{3}{y}\right)^2 y - 54\left(\frac{3}{y}\right) = 0$ or $16\left(\frac{3}{x}\right)^3 + 9x^2\left(\frac{3}{x}\right) - 54x = 0$	M1
	Leading to	
	$16y^4 + 81 - 162 = 0$ or $16 + x^4 - 2x^4 = 0$	M1
	$y^4 = \frac{81}{16}$ or $x^4 = 16$	
	$y = \frac{3}{2}, -\frac{3}{2}$ or $x = 2, -2$	A1 A1
	Substituting either of their values into $xy = 3$ to obtain a value of the other variable.	M1
	$\left(2, \frac{3}{2}\right), \left(-2, -\frac{3}{2}\right)$ both	A1 **(7)**
		[12]

Question Number	Scheme	Marks
6.	$\dfrac{d\theta}{dt} = \lambda(120-\theta), \quad \theta \leqslant 100$	
(a)	$\displaystyle\int \frac{1}{120-\theta}\,d\theta = \int \lambda\,dt$ or $\displaystyle\int \frac{1}{\lambda(120-\theta)}\,d\theta = \int dt$	B1
	$-\ln(120-\theta); = \lambda t + c$ or $-\dfrac{1}{\lambda}\ln(120-\theta); = t + c$	M1 A1; M1 A1
	$\{t=0,\ \theta=20 \Rightarrow\}\ -\ln(120-20) = \lambda(0)+c$	M1
	$c = -\ln 100 \Rightarrow -\ln(120-\theta) = \lambda t - \ln 100$	
	then either... $-\lambda t = \ln(120-\theta) - \ln 100$ $-\lambda t = \ln\left(\dfrac{120-\theta}{100}\right)$ $e^{-\lambda t} = \dfrac{120-\theta}{100}$ $100e^{-\lambda t} = 120-\theta$	
	or... $\lambda t = \ln 100 - \ln(120-\theta)$ $\lambda t = \ln\left(\dfrac{100}{120-\theta}\right)$ $e^{\lambda t} = \dfrac{100}{120-\theta}$ $(120-\theta)e^{\lambda t} = 100$ $\Rightarrow 120-\theta = 100e^{-\lambda t}$	dddM1
	leading to $\theta = 120 - 100e^{-\lambda t}$	A1 *
		(8)
(b)	$\{\lambda = 0.01,\ \theta = 100 \Rightarrow\}\quad 100 = 120 - 100e^{-0.01t}$	M1
	$\Rightarrow 100e^{-0.01t} = 120-100 \Rightarrow -0.01t = \ln\left(\dfrac{120-100}{100}\right)$ $t = \dfrac{1}{-0.01}\ln\left(\dfrac{120-100}{100}\right)$ Uses correct order of operations by moving from $100 = 120 - 100e^{-0.01t}$ to give $t = \ldots$ and $t = A\ln B$, where $B > 0$	dM1
	$\left\{t = \dfrac{1}{-0.01}\ln\left(\dfrac{1}{5}\right) = 100\ln 5\right\}$	
	$t = 160.94379\ldots = 161$ (s) (nearest second) awrt 161	A1
		(3) **[11]**

Question Number	Scheme		Marks
7 (a)	At A, $x=-1+8=7$ & $y=(-1)^2=1 \Rightarrow A(7,1)$	$A(7,1)$	B1 (1)
(b)	$x=t^3-8t$, $y=t^2$,		
	$\frac{dx}{dt}=3t^2-8$, $\frac{dy}{dt}=2t$		
	$\therefore \frac{dy}{dx}=\frac{2t}{3t^2-8}$	Their $\frac{dy}{dt}$ divided by their $\frac{dx}{dt}$ Correct $\frac{dy}{dx}$	M1 A1
	At A, $m(\mathbf{T})=\underline{\frac{2(-1)}{3(-1)^2-8}}=\underline{\frac{-2}{3-8}}=\underline{\frac{-2}{-5}}=\underline{\frac{2}{5}}$	Substitutes for t to give any of the four underlined oe:	A1
	$\mathbf{T}$: $y-(\text{their } 1)=m_T(x-(\text{their } 7))$ or $1=\frac{2}{5}(7)+c \Rightarrow c=1-\frac{14}{5}=-\frac{9}{5}$ Hence $\mathbf{T}$: $y=\frac{2}{5}x-\frac{9}{5}$	Finding an equation of a tangent with their point and their tangent gradient or finds c and uses $y=(\text{their gradient})x+"c"$.	dM1
	gives $\mathbf{T}$: $\underline{2x-5y-9=0}$ **AG**	$\underline{2x-5y-9=0}$	A1 **cso** (5)
(c)	$2(t^3-8t)-5t^2-9=0$	Substitution of both $x=t^3-8t$ and $y=t^2$ into $\mathbf{T}$	M1
	$2t^3-5t^2-16t-9=0$		
	$(t+1)\{(2t^2-7t-9)=0\}$ $(t+1)\{(t+1)(2t-9)=0\}$	A realisation that $(t+1)$ is a factor.	dM1
	$\{t=-1 \text{ (at } A)\}$ $t=\frac{9}{2}$ at B	$t=\frac{9}{2}$	A1
	$x=\left(\frac{9}{2}\right)^2-8\left(\frac{9}{2}\right)=\frac{729}{8}-36=\frac{441}{8}$ = 55.125 or awrt 55.1 $y=\left(\frac{9}{2}\right)^2=\frac{81}{4}=20.25$ or awrt 20.3 Hence $B\left(\frac{441}{8},\frac{81}{4}\right)$	Candidate uses their value of t to find either the x or y coordinate One of either x or y correct. Both x and y correct. awrt	ddM1 A1 A1 (6)
			[12]

Question Number	Scheme		Marks
8.	$l:\ \mathbf{r} = \begin{pmatrix}13\\8\\1\end{pmatrix} + \lambda\begin{pmatrix}2\\2\\-1\end{pmatrix},\quad A(3,-2,6),\quad \overrightarrow{OP} = \begin{pmatrix}-p\\0\\2p\end{pmatrix}$		
(a)	$\{\overrightarrow{PA}\} = \begin{pmatrix}3\\-2\\6\end{pmatrix} - \begin{pmatrix}-p\\0\\2p\end{pmatrix}$ | $\{\overrightarrow{AP}\} = \begin{pmatrix}-p\\0\\2p\end{pmatrix} - \begin{pmatrix}3\\-2\\6\end{pmatrix}$	Finds the difference between $\overrightarrow{OA}$ and $\overrightarrow{OP}$. Ignore labelling.	M1
	$= \begin{pmatrix}3+p\\-2\\6-2p\end{pmatrix}$ | $= \begin{pmatrix}-3-p\\2\\2p-6\end{pmatrix}$	Correct difference.	A1
	$\begin{pmatrix}3+p\\-2\\6-2p\end{pmatrix} \bullet \begin{pmatrix}2\\2\\-1\end{pmatrix} = 6 + 2p - 4 - 6 + 2p = 0$		M1
	$p = 1$		A1 **cso**
			(4)
(b)	$\lvert AP\rvert = \sqrt{4^2 + (-2)^2 + 4^2}$ or $\lvert AP\rvert = \sqrt{(-4)^2 + 2^2 + (-4)^2}$		M1
	So, PA or $AP = \sqrt{36}$ or 6 **cao**		A1 **cao**
	It follows that, $AB = \text{"6"}\ \{= PA\}$ or $PB = \text{"}6\sqrt{2}\text{"}\ \{= \sqrt{2}\,PA\}$		B1 ft
	{Note that $AB = \text{"6"} = 2$(the modulus of the direction vector of l)}		
	$\overrightarrow{OB} = \begin{pmatrix}3\\-2\\6\end{pmatrix} \pm 2\begin{pmatrix}2\\2\\-1\end{pmatrix}$ or		
	$\overrightarrow{OB} = \begin{pmatrix}13\\8\\1\end{pmatrix} - 3\begin{pmatrix}2\\2\\-1\end{pmatrix}$ and	Uses a correct method in order to find both possible sets of coordinates of B.	M1
	$\overrightarrow{OB} = \begin{pmatrix}13\\8\\1\end{pmatrix} - 7\begin{pmatrix}2\\2\\-1\end{pmatrix}$		
	$= \begin{pmatrix}7\\2\\4\end{pmatrix}$ and $\begin{pmatrix}-1\\-6\\8\end{pmatrix}$	Both coordinates are correct.	A1 **cao**
			(5) **[9]**

Statistics for C4 Practice Paper Silver Level S1

Qu	Max score	Modal score	Mean %	Mean score for students achieving grade: ALL	A*	A	B	C	D	E	U
1	6		83	4.96		5.59	5.19	4.77	4.16	3.41	2.12
2	7		73	5.12		6.21	5.13	4.28	3.51	2.96	1.65
3	9		74	6.65	8.56	7.64	6.85	6.06	5.05	3.92	2.32
4	9		66	5.97	7.61	6.28	5.73	4.45	4.18	3.11	1.32
5	12		63	7.60	11.50	9.41	7.62	5.96	4.53	3.16	1.69
6	11	11	64	7.04	10.81	9.8	7.67	5.12	3.26	1.97	0.88
7	12		60	7.25		8.99	6.53	5.57	4.20	3.05	1.29
8	9	0	41	3.71	7.65	5.45	3.63	1.93	0.97	0.53	0.21
	75		**64**	**48.30**		**59.37**	**48.35**	**38.14**	**29.86**	**22.11**	**11.48**