Edexcel GCE
Core Mathematics C4
Silver Level S4
(Mark Scheme)

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Question Number	Scheme	Marks
Q1	(a) $(1-8x)^{\frac{1}{2}} = 1 + (\frac{1}{2})(-8x) + \frac{(\frac{1}{2})(-\frac{1}{2})}{2}(-8x)^2 + \frac{(\frac{1}{2})(-\frac{1}{2})(-\frac{3}{2})}{3!}(-8x)^3 + \ldots$	M1 A1
	$= 1 - 4x - 8x^2; -32x^3 - \ldots$	A1; A1 (4)
	(b) $\sqrt{(1-8x)} = \sqrt{\left(1 - \frac{8}{100}\right)}$	M1
	$= \sqrt{\frac{92}{100}} = \sqrt{\frac{23}{25}} = \frac{\sqrt{23}}{5}$ *	A1 (2)
	cso	
	(c) $1 - 4x - 8x^2 - 32x^3 = 1 - 4(0.01) - 8(0.01)^2 - 32(0.01)^3$	
	$= 1 - 0.04 - 0.0008 - 0.000\,032 = 0.959\,168$	M1
	$\sqrt{23} = 5 \times 0.959\,168$	M1
	$= 4.795\,84$	A1 (3)
	cao	
		[9]

2.	$\mathrm{f}(x) = (\ \ldots + \ldots)^{-\frac{1}{2}}$		M1
	$= 9^{-\frac{1}{2}}(\ \ldots + \ldots)^{\cdots}$	3^{-1}, $\frac{1}{3}$ or $\frac{1}{9^{\frac{1}{2}}}$	B1
	$(1+kx^2)^n = 1 + nkx^2 + \ldots$	n not a natural number, $k \neq 1$	M1
	$(1+kx^2)^{-\frac{1}{2}} = \ldots + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2}(kx^2)^2$	ft their $k \neq 1$	A1 ft
	$\left(1 + \frac{4}{9}x^2\right)^{-\frac{1}{2}} = 1 - \frac{2}{9}x^2 + \frac{2}{27}x^4$		A1
	$\mathrm{f}(x) = \frac{1}{3} - \frac{2}{27}x^2 + \frac{2}{81}x^4$		A1 **(6)**
			[6]

3. (a) $\frac{dV}{dh} = \frac{1}{2}\pi h - \pi h^2$	or equivalent	M1 A1
At $h = 0.1$, $\frac{dV}{dh} = \frac{1}{2}\pi(0.1) - \pi(0.1)^2 = 0.04\pi$	$\frac{\pi}{25}$	M1 A1 **(4)**
(b) $\frac{dh}{dt} = \frac{dV}{dt} \div \frac{dV}{dh} = \frac{\pi}{800} \times \frac{1}{\frac{1}{2}\pi h - \pi h^2}$	or $\frac{\pi}{800} \div$ their (a)	M1
At $h = 0.1$, $\frac{dh}{dt} = \frac{\pi}{800} \times \frac{25}{\pi} = \frac{1}{32}$	awrt 0.031	A1 **(2)**
		[6]

4.	Volume $= \pi \int_0^2 \left(\sqrt{\left(\frac{2x}{3x^2+4}\right)}\right)^2 \, dx$	Use of $V = \pi \int y^2 \, dx$.	B1
	$= (\pi)\left[\frac{1}{3}\ln(3x^2+4)\right]_0^2$	$\pm k\ln(3x^2+4)$	M1
		$\frac{1}{3}\ln(3x^2+4)$	A1
	$= (\pi)\left[\left(\frac{1}{3}\ln 16\right) - \left(\frac{1}{3}\ln 4\right)\right]$	Substitutes limits of 2 and 0 and subtracts the correct way round.	dM1
	So Volume $= \frac{1}{3}\pi \ln 4$	$\frac{1}{3}\pi\ln 4$ or $\frac{2}{3}\pi\ln 2$	A1 oe isw
			[5] **(5 marks)**

Question Number	Scheme		Marks
5.	***Working parametrically:***		
	$x = 1 - \frac{1}{2}t, \quad y = 2^t - 1$ or $y = e^{t\ln 2} - 1$		
(a)	$\{x = 0 \Rightarrow\}\ 0 = 1 - \frac{1}{2}t \Rightarrow t = 2$	Applies $x = 0$ to obtain a value for t.	M1
	When $t = 2$, $y = 2^2 - 1 = 3$	Correct value for y.	A1 **[2]**
(b)	$\{y = 0 \Rightarrow\}\ 0 = 2^t - 1 \Rightarrow t = 0$	Applies $y = 0$ to obtain a value for t. (Must be seen in part (b)).	M1
	When $t = 0$, $x = 1 - \frac{1}{2}(0) = 1$	$x = 1$	A1 **[2]**
(c)	$\frac{dx}{dt} = -\frac{1}{2}$ and either $\frac{dy}{dt} = 2^t \ln 2$ or $\frac{dy}{dt} = e^{t\ln 2}\ln 2$		B1
	$\frac{dy}{dx} = \frac{2^t \ln 2}{-\frac{1}{2}}$	Attempts their $\frac{dy}{dt}$ divided by their $\frac{dx}{dt}$.	M1
	At A, $t = "2"$, so $m(\mathbf{T}) = -8\ln 2 \Rightarrow m(\mathbf{N}) = \frac{1}{8\ln 2}$	Applies $t = "2"$ and $m(\mathbf{N}) = \frac{-1}{m(\mathbf{T})}$	M1
	$y - 3 = \frac{1}{8\ln 2}(x - 0)$ or $y = 3 + \frac{1}{8\ln 2}x$ or equivalent.		M1 A1 oe cso **[5]**
(d)	$\text{Area}(R) = \int (2^t - 1).\left(-\frac{1}{2}\right)dt$	Complete substitution for both y and dx	M1
	$x = -1 \to t = 4$ and $x = 1 \to t = 0$		B1
	$= \left\{-\frac{1}{2}\right\}\left(\frac{2^t}{\ln 2} - t\right)$	Either $2^t \to \frac{2^t}{\ln 2}$ or $(2^t - 1) \to \frac{(2^t)}{\pm\alpha(\ln 2)} - t$ or $(2^t - 1) \to \pm\alpha(\ln 2)(2^t) - t$	M1*
		$(2^t - 1) \to \frac{2^t}{\ln 2} - t$	A1
	$\left\{-\frac{1}{2}\left[\frac{2^t}{\ln 2} - t\right]_4^0\right\} = -\frac{1}{2}\left(\left(\frac{1}{\ln 2}\right) - \left(\frac{16}{\ln 2} - 4\right)\right)$	**Depends on the previous method mark.** Substitutes their changed limits in t and subtracts either way round.	dM1*
	$= \frac{15}{2\ln 2} - 2$	$\frac{15}{2\ln 2} - 2$ or equivalent.	A1 **[6]** **15**

Question Number	Scheme		Marks
6. (a)	$x = \tan^2 t\,,\qquad y = \sin t$		
	$\frac{dx}{dt} = 2(\tan t)\sec^2 t\,,\ \frac{dy}{dt} = \cos t$	Correct $\frac{dx}{dt}$ and $\frac{dy}{dt}$	B1
	$\therefore \frac{dy}{dx} = \frac{\cos t}{2\tan t \sec^2 t} \quad \left(= \frac{\cos^4 t}{2\sin t}\right)$	$\frac{\pm\cos t}{\text{their } \frac{dx}{dt}}$	M1
		$\frac{+\cos t}{\text{their } \frac{dx}{dt}}$	A1 $\sqrt{}$
			[3]
(b)	When $t = \frac{\pi}{4}$, $x = 1$, $y = \frac{1}{\sqrt{2}}$ (need values)	The point $\underline{\left(1, \frac{1}{\sqrt{2}}\right)}$ or $\underline{(1, \text{awrt } 0.71)}$ **These coordinates can be implied.** ($y = \sin\left(\frac{\pi}{4}\right)$ is not sufficient for B1)	B1, B1
	When $t = \frac{\pi}{4}$, m(**T**) $= \frac{dy}{dx} = \frac{\cos\frac{\pi}{4}}{2\tan\frac{\pi}{4}\sec^2\frac{\pi}{4}}$		
	$= \underline{\frac{\frac{1}{\sqrt{2}}}{2.(1)\left(\frac{1}{\frac{1}{\sqrt{2}}}\right)^2}} = \underline{\frac{\frac{1}{\sqrt{2}}}{2.(1)\left(\frac{1}{\frac{1}{2}}\right)}} = \underline{\frac{\frac{1}{\sqrt{2}}}{2.(1)(2)}} = \underline{\frac{1}{4\sqrt{2}}} = \underline{\frac{\sqrt{2}}{8}}$	any of the five underlined expressions or awrt 0.18	B1 aef
	T: $y - \frac{1}{\sqrt{2}} = \frac{1}{4\sqrt{2}}(x - 1)$	Finding an equation of a tangent with ***their point*** and ***their tangent gradient*** or finds *c* by using $y = \underline{(\text{their gradient})}x + \text{"}\underline{c}\text{"}$.	M1 $\sqrt{}$ aef
	T: $\underline{y = \frac{1}{4\sqrt{2}}x + \frac{3}{4\sqrt{2}}}$ or $\underline{y = \frac{\sqrt{2}}{8}x + \frac{3\sqrt{2}}{8}}$	Correct simplified EXACT equation of <u>tangent</u>	<u>A1</u> aef **cso**
	or $\frac{1}{\sqrt{2}} = \frac{1}{4\sqrt{2}}(1) + c \Rightarrow c = \frac{1}{\sqrt{2}} - \frac{1}{4\sqrt{2}} = \frac{3}{4\sqrt{2}}$		
	Hence **T:** $\underline{y = \frac{1}{4\sqrt{2}}x + \frac{3}{4\sqrt{2}}}$ or $\underline{y = \frac{\sqrt{2}}{8}x + \frac{3\sqrt{2}}{8}}$		
			[5]

Question Number	Scheme	Marks
7.	$x^2 + 4xy + y^2 + 27 = 0$	
(a)	$\left\{\frac{\cancel{dy}}{\cancel{dx}} = \right\}$ $\underline{2x} + \underline{\underline{\left(4y + 4x\frac{dy}{dx}\right)}} + \underline{2y\frac{dy}{dx}} = \underline{0}$	M1 A1 B1
	$2x + 4y + (4x + 2y)\frac{dy}{dx} = 0$	dM1
	$\frac{dy}{dx} = \frac{-2x - 4y}{4x + 2y}$ $\left\{= \frac{-x - 2y}{2x + y}\right\}$	A1 **cso oe**
		(5)
(b)	$4x + 2y = 0$	M1
	$y = -2x$ | $x = -\frac{1}{2}y$	A1
	$x^2 + 4x(-2x) + (-2x)^2 + 27 = 0$ | $\left(-\frac{1}{2}y\right)^2 + 4\left(-\frac{1}{2}y\right)y + y^2 + 27 = 0$	M1*
	$-3x^2 + 27 = 0$ | $-\frac{3}{4}y^2 + 27 = 0$	
	$x^2 = 9$ | $y^2 = 36$	dM1*
	$x = -3$ | $y = 6$	A1
	When $x = -3$, $y = -2(-3)$ | When $y = 6$, $x = -\frac{1}{2}(6)$	ddM1*
	$y = 6$ | $x = -3$	A1 **cso**
		(7) **[12]**

8.	(a)	$\int \sin^2\theta \, d\theta = \frac{1}{2}\int (1-\cos 2\theta)\, d\theta = \frac{1}{2}\theta - \frac{1}{4}\sin 2\theta \quad (+C)$	M1 A1 (2)
		$x = \tan\theta \Rightarrow \frac{dx}{d\theta} = \sec^2\theta$	
	(b)	$\pi\int y^2 \, dx = \pi\int y^2 \frac{dx}{d\theta}\, d\theta = \pi\int (2\sin 2\theta)^2 \sec^2\theta \, d\theta$	M1 A1
		$= \pi\int \frac{(2\times 2\sin\theta\cos\theta)^2}{\cos^2\theta}\, d\theta$	M1
		$= 16\pi\int \sin^2\theta \, d\theta$ $\quad k = 16\pi$	A1
		$x = 0 \Rightarrow \tan\theta = 0 \Rightarrow \theta = 0, \quad x = \frac{1}{\sqrt{3}} \Rightarrow \tan\theta = \frac{1}{\sqrt{3}} \Rightarrow \theta = \frac{\pi}{6}$	B1 (5)
	(c)	$\left(V = 16\pi\int_0^{\frac{\pi}{6}} \sin^2\theta \, d\theta\right)$	
		$V = 16\pi\left[\frac{1}{2}\theta - \frac{\sin 2\theta}{4}\right]_0^{\frac{\pi}{6}}$	M1
		$= 16\pi\left[\left(\frac{\pi}{12} - \frac{1}{4}\sin\frac{\pi}{3}\right) - (0-0)\right]$ $\quad$ Use of correct limits	M1
		$= 16\pi\left(\frac{\pi}{12} - \frac{\sqrt{3}}{8}\right) = \frac{4}{3}\pi^2 - 2\pi\sqrt{3}$ $\quad p = \frac{4}{3},\ q = -2$	A1 (3)
			(10 marks)

Statistics for C4 Practice Paper Silver Level S4

Qu	Max score	Modal score	Mean %	Mean score for students achieving grade:							
				ALL	A*	A	B	C	D	E	U
1	9		78	7.03		7.96	7.01	6.33	5.78	5.20	3.68
2	6		69	4.14	5.54	4.55	4.15	3.73	3.23	2.59	1.66
3	6		66	3.94	5.78	5.11	4.12	2.93	1.90	1.17	0.58
4	5		61	3.07	4.76	3.76	2.72	1.93	1.15	0.73	0.22
5	15	11	60	8.98	13.00	10.01	8.50	7.11	5.89	4.77	2.86
6	12		57	6.87		9.42	6.87	5.16	3.56	2.15	0.98
7	12	8	54	6.51	10.57	7.99	6.48	5.2	4.08	2.93	1.47
8	10		39	3.93		6.21	3.36	1.99	1.06	0.54	0.19
	75		**59**	**44.47**		**55.01**	**43.21**	**34.38**	**26.65**	**20.08**	**11.64**