**EDEXCEL CORE MATHEMATICS C4 PRACTICE PAPER A4 MARK SCHEME**

| Question Number | Scheme | Marks |
|---|---|---|
| **1.** (*a*) | $10x, +(2y+2x\frac{dy}{dx}), -6y\frac{dy}{dx}=0$ | M1, (B1), A1 |
| | At (1 , 2) $10+(4+2\frac{dy}{dx})-12\frac{dy}{dx}=0$ | M1 |
| | $\therefore \frac{dy}{dx}=\frac{14}{10}=1.4$ *or* $\frac{7}{5}$ *or* $1\frac{2}{5}$ | A1 (5) |
| (*b*) | The gradient of the normal is $-\frac{5}{7}$ | M1 |
| | Its equation is $y-2=-\frac{5}{7}(x-1)$ (allow tangent) | M1 |
| | $y=-\frac{5}{7}x+2\frac{5}{7}$ or $y=-\frac{5}{7}x+\frac{19}{7}$ | A1cao (3) |
| | | **(8 marks)** |
| **2.** | $[\text{f}(x)]^2 = x^2 + \frac{4}{x^4} + \frac{4}{x}$ | M1 |
| | $\int [\text{f}(x)]^2\,\text{d}x = \left[\frac{x^3}{3} - \frac{4}{3x^3} + 4\ln x\right]$ | M1 A1 B1 |
| | $\int_1^2 [\text{f}(x)]^2\,\text{d}x = \left(\frac{8}{3}-\frac{4}{24}+4\ln 2\right)-\left(\frac{1}{3}-\frac{4}{3}+4\ln 1\right)$ | M1 |
| | $\left(=\frac{7}{2}+4\ln 2\right)$ | |
| | $V=\pi\int_1^2 [\text{f}(x)]^2\,\text{d}x \Rightarrow V=\pi\left(\frac{7}{2}+\ln 16\right)$ or $a=\frac{7}{2}$, $b=16$ | M1 A1 A1 |
| | | **(8 marks)** |

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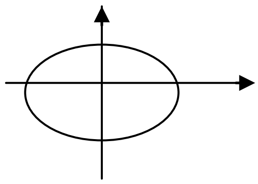
| **3.** (*a*) | $x$   $0$   $\frac{\pi}{6}$   $\frac{\pi}{3}$   $\frac{\pi}{2}$     1, 0 | B1 |
| | $y$   1   1.46   1.42   0     1.146, 1.42 | B1, B1 (3) |
| (*b*) | $I \approx \frac{1}{2}\left(\frac{\pi}{6}\right)\ldots$ | B1 |
| | $\approx \ldots(1+2(1.46+1.42)+0)$ | M1 A1 ft |
| | $\approx 1.8$ | A1 (4) |
| (*c*) | underestimates | B1 |
| | diagram or explanation | B1 (2) |
| | *NB. Exact answer is* $\frac{1}{2}\left(e^{\frac{\pi}{2}}-1\right) \approx 1.905\ldots$ | |
| | | **(9 marks)** |
| **4.** (*a*) | $5\cos t = 0 : t = \frac{\pi}{2},\ y = \ 2\ \ (0,\ \ 2)$ <br> $t = \frac{3\pi}{2}, y = -6 \quad (0, -6)$ | M1 A1 |
| | $4\sin t = 2 : t = \frac{\pi}{6},\ x = \frac{5\sqrt{3}}{2} \quad t = \frac{5\pi}{6},\ x = -\frac{5\sqrt{3}}{2} \quad (\pm\frac{5\sqrt{3}}{2}, 0)$ | M1 A1 (4) |
| (*b*) |  shape | B1 |
| | position | B1 (2) |
| | $\frac{dx}{dt} = -5\sin t,\quad \frac{dy}{dt} = 4\cos t,\quad \frac{dy}{dx} = \frac{-4\cos t}{5\sin t}$ | M1 A1 |
| (*c*) | $y = \frac{5\tan\frac{\pi}{6}}{4}(x - \frac{5\sqrt{3}}{2})$ , i.e. $8\sqrt{3}y = 10x - 25\sqrt{3}$ ★ | M1 A1 (4) |
| | | **(10 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **5.** (*a*) | $f^1(x)=0$ for maximum (or stationary point or turning point) | B1 |
| | $f^1(1.48) = e^{1.48} - 2\times1.48^2 = 0.0121\ldots$<br>$f^1(1.49) = \qquad = -0.0031\ldots$ | M1 |
| | change of sign $\therefore$ root / maximum in range | A1 (3) |
| (*b*) | $y = e^x - \frac{2}{3}x^3 \ (+c)$ | M1 A1 |
| | at $(0,\ 5)$ $\quad 5 = e^0 - 0 + c$ | M1 |
| | $\underline{c=4}$ $\quad \left(y = e^x - \frac{2}{3}x^3 + 4\right)$ $\qquad (c=4)$ | A1 (4) |
| (*c*) | Area $= \int_0^2 \left(e^x - \frac{2}{3}x^3 + 4\right)dx$ | M1 |
| | $= \left[e^x - \frac{2}{12}x^4 + 4x\right]_0^2$ | A1 |
| | $= \left(e^2 - \frac{16}{6} + 8\right) - \left(e^0 - 0 + 0\right)$ | M1 |
| | $= \underline{\underline{e^2 + 4\frac{1}{3} \quad or \quad e^2 + \frac{13}{3}}}$ | A1 cao (4) |
| | | **(11 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **6.** (*a*) | $na = -6,\qquad \frac{n(n-1)}{2}a^2 = 27$ | B1 B1 |
| | Attempts solution by eliminating variable | |
| | e.g. $\frac{n(n-1)36}{n^2} = 54$ or $-\frac{6}{a}(-\frac{6}{a}-1)a^2 = 54$ | M1 |
| | $n = -2,\qquad a = 3$ | A1 A1 (5) |
| (*b*) | $\frac{(-2)(-3)(-4)3^3}{6} = -108$ for M1 allow $a$ instead of $a^3$ | M1 A1 (2) |
| (*c*) | $\|x\| < \frac{1}{3}$ or $-\frac{1}{3} < x < \frac{1}{3}$ | B1 ft (1) |
| **7.** (*a*) | 1 × 4 – 2 × 1 – 2 × 1 = 0, i.e. $\begin{pmatrix}1\\-2\\2\end{pmatrix} . \begin{pmatrix}4\\1\\-1\end{pmatrix} = 0$, therefore perpendicular. | M1 A1 (2) |
| (*b*) | $3 + \lambda = 9 + 4\mu$ | M1 |
| | and *either* $4 - 2\lambda = 1 + \mu$ *or* $-5 + 2\lambda = -2 - \mu$ | A1 |
| | Eliminate to obtain $\mu = -1$ or $\lambda = 2$ | M1 A1 |
| | Point is (5, 0, –1) Vector is $\begin{pmatrix}5\\0\\-1\end{pmatrix}$ | B1 (5) |
| (*c*) | $\lambda = -3 \Rightarrow$ point lies on first line $l_1$ | M1 A1 |
| | show contradiction for $\mu \Rightarrow$ point not on $l_2$ | B1 (3) |
| (*d*) | $\sqrt{(5^2 + 10^2 + 10^2)} = 15 \Rightarrow 1.5$ km | M1 A1 (2) |
| | | **(12 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **8.** (*a*) | $\int \frac{\mathrm{d}x}{(1-2x)(1-4x)} = \int k \quad \mathrm{d}t$ | B1 |
| | $\int \frac{-1}{1-2x} + \frac{2}{1-4x}\,\mathrm{d}x = \int k \quad \mathrm{d}t$ | M1 A1 |
| | $\frac{1}{2}\ln(1-2x) - \frac{1}{2}\ln(1-4x) = kt\ (+\frac{1}{2}c)$ | M1 A1 A1 |
| | $\ln \frac{1-2x}{1-4x} = 2kt + c \quad (*)$ | A1 cso (7) |
| (*b*) | Use $x = 0$ when $t = 0 \Rightarrow c = 0$ | B1 |
| | $\therefore \frac{1-2x}{1-4x} = e^{2kt}$ | M1 |
| | $\therefore x(4e^{2kt} - 2) = e^{2kt} - 1, \quad \therefore x = \frac{e^{2kt} - 1}{4e^{2kt} - 2}$ | M1 A1 (4) |
| (*c*) | As $t \to \infty$, $x \to \frac{1}{4}$ | M1 A1 (2) |
| | | **(13 marks)** |