Question Number	Scheme	Marks
2	Assume that C_1 and C_2 do intersect so that $x^4+10x^2+8=2x^2-7$ (and has real solutions).	B1
	$x^4+8x^2+15=0\Rightarrow\left(x^2+5\right)\left(x^2+3\right)=0\Rightarrow x^2=...$ or $x^4+8x^2+15=0\Rightarrow x^2=\dfrac{-8\pm\sqrt{8^2-4\times15}}{2}$ or $x^4+8x^2+15=0\Rightarrow\left(x^2+4\right)^2-1=0\Rightarrow x^2=...$	M1
	$x^2=-5,-3$	A1
	e.g. The two values of $x^2 < 0$ (so $x^4+8x^2+15=0$ has no real roots) which is not possible so C_1 and C_2 do not intersect	A1
		(4)
		Total 4

Note that B0M1A1A1 is possible

B1: Sets up the contradiction by
- making a statement assuming that the two curves intersect e.g. let/assume/suppose C_1 and C_2 / the curves intersect/meet/cross
- equating the curves i.e. $x^4+10x^2+8=2x^2-7$ o.e. (the equation must be correct)

Condone no reference to the equation having real solutions.

M1: Attempts to solve a three-term quadratic equation in x^2 by any valid (**non-calculator**) method. Usual rules apply. **If the roots are just stated then M0A0A0 follows.**

A1: $x^2=-5,-3$. Allow e.g. $m^2=-5,-3$
Do not condone e.g. $y=-5,-3$ without reverting back to $x^2=...$ or making valid deductions about e.g. x^2 being negative

A1: **This mark can only be scored provided the previous M1A1 has been scored.**
Acceptable conclusion which
- refers to x^2 being negative which is not possible or the equation has no real roots or $x^2=-3,-5$ but $x^2\ldots0$
- refers to C_1 and C_2 not intersecting
- Correct use of inequalities throughout e.g. $x^2\ldots0$ (not just $x^2\geqslant0$)

Alternative considering the sign of each term / the expression

B1: As above in main scheme notes

M1: Either one of:

- considers the sign of one side of an equation or inequality which includes either an x^2 or x^4 term. e.g. $x^4+8x^2\ldots0$ e.g. $x^4+8x^2+15>0$ Allow to compare with 0 e.g. $x^2+3\neq0$
- considers the sign of x^2 or x^4 e.g. $x^2\ldots0$
- considers separately at least one part of the product of two terms. e.g. $x^2(x^2+8)\geqslant0$ or $(x^2+8)>0$
- considers the range of values using their completed square form e.g. $\left(x^2+4\right)^2\ldots16$ or $x^2+4\ldots4$

Do not be concerned by > or …

A1: Correct three-term quadratic in x^2 and correct deductions that e.g. $x^4\ldots0$ and $x^2\ldots0$ depending on their expression (condone > 0)

This mark cannot be scored if the expression they use to make their deductions is incorrect.

e.g. $x^2(x^2+8)$ is positive (or zero) since x^2 and $\left(x^2+8\right)$ are **both** greater than (or equal to) zero is A1

e.g. $x^4+8x^2\ldots0$ since x^2 and x^4 are both $\ldots0$ is A1

e.g. $x^2+4\ldots4$ since $x^2\ldots0$ is A1

e.g. $x^4+8x^2\ldots0$ is A0

A1: **This mark can only be scored provided the previous M1A1 has been scored.**

Acceptable conclusion which refers to

- the equation $x^4+8x^2+15=0$ gives no solutions o.e. e.g. x^4+8x^2+15 cannot equal zero, e.g. x^4+8x^2 cannot equal -15 e.g. x^2+4 cannot equal -1
- C_1 and C_2 not intersecting
- Correct use of inequalities throughout e.g. $x^2\ldots0$ (not just $x^2\geqslant0$).

  Do not accept e.g. $-3,, 0$

Question Number	Scheme	Marks
3(a)	$x = 3\sin^3\theta \Rightarrow \frac{\mathrm{d}x}{\mathrm{d}\theta} = 9\sin^2\theta\cos\theta$ o.e.	B1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{-2\sin 2\theta}{9\sin^2\theta\cos\theta}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{-4\sin\theta\cos\theta}{9\sin^2\theta\cos\theta} = -\frac{4}{9}\mathrm{cosec}\,\theta$	A1
		(3)
(b)	$\theta = \frac{\pi}{6} \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = "-\frac{8}{9}",\ x = 3\left(\frac{1}{2}\right)^3 = ...,\ y = 1+\frac{1}{2} = ...$	M1
	$y - \frac{3}{2} = -\frac{8}{9}\left(x - \frac{3}{8}\right)$	dM1
	$16x + 18y - 33 = 0$	A1
		(3)
(c)	e.g. $x = 3\sin^3\theta \Rightarrow \sin\theta = \sqrt[3]{\frac{x}{3}} \Rightarrow\ y = 1+\cos 2\theta = 1+1-2\sin^2\theta = 2-2\left(\frac{x}{3}\right)^{\frac{2}{3}}$	M1
	$y = 2-2\left(\frac{x}{3}\right)^{\frac{2}{3}} \Rightarrow 2\left(\frac{x}{3}\right)^{\frac{2}{3}} = 2-y \Rightarrow 8x^2 = 9(2-y)^3$*	A1*
	$q = 3$	B1
		(3)
Alt(c)	e.g. $8x^2 = 72\sin^6\theta,\quad 9(2-y)^3 = 9(2-\cos 2\theta - 1)^3 = 9\left(1-\left(1-2\sin^2\theta\right)\right)^3$	M1
	$72\sin^6\theta = 9\times 8\sin^6\theta \Rightarrow 8x^2 = 9(2-y)^3$*	A1*
	$q = 3$	B1
		Total 9

(a)

B1: Correct expression for $\frac{\mathrm{d}x}{\mathrm{d}\theta}$ which may be part of their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$. Condone poor labelling/notation provided the intention is clear. Must be in terms of θ

May use identities before differentiating using the product rule e.g. $\sin\theta\left(\frac{1-\cos 2\theta}{2}\right)$

M1: Correct method for $\frac{\mathrm{d}y}{\mathrm{d}x}$. They must be attempting $\frac{\mathrm{d}y}{\mathrm{d}\theta}\times\frac{\mathrm{d}\theta}{\mathrm{d}x}$ o.e. condoning copying slips and condoning poor differentiation, labelling /notation provided the intention is clear.

A1: Achieves $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{4}{9}\mathrm{cosec}\,\theta$ with no errors but condone invisible brackets and poor notation being recovered. Allow equivalent fractions to $-\frac{4}{9}$. Note $\frac{\mathrm{d}y}{\mathrm{d}x} =$ may be seen in an earlier line of their solution which is acceptable.