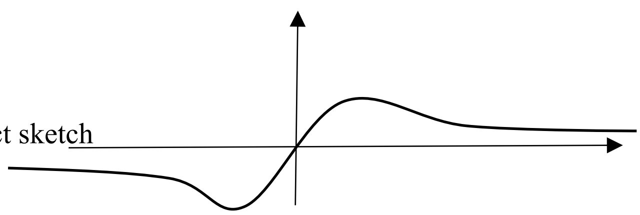
Question number	Scheme	Marks
7 (a)	$\dfrac{dy}{dx}=\dfrac{(x^2+4)-x(2x)}{\left(x^2+4\right)^2}$	M1
	$=\dfrac{4-x^2}{\left(x^2+4\right)^2}$	A1
	$\dfrac{dy}{dx}=0\Rightarrow 4-x^2=0$	M1
	So $\left(2,\dfrac{1}{4}\right)$ and $\left(-2,-\dfrac{1}{4}\right)$	A1 A1 (5)
(b)	$\dfrac{d^2y}{dx^2}=\dfrac{-2x(x^2+4)^2-4x(4-x^2)(x^2+4)}{(x^2+4)^4}$	M1
	$\dfrac{d^2y}{dx^2}=\dfrac{-2x^3-8x-16x+4x^3}{(x^2+4)^3}$	M1
	$\dfrac{d^2y}{dx^2}=\dfrac{2x^3-24x}{(x^2+4)^3}$	M1
	$\dfrac{d^2y}{dx^2}=\dfrac{2x(x^2-12)}{(x^2+4)^3}$ *	A1 cso (4)
(c)	When $x=2$ $\left[\dfrac{d^2y}{dx^2}=-\dfrac{1}{16}\right]$ When $x=-2$ $\left[\dfrac{d^2y}{dx^2}=\dfrac{1}{16}\right]$	
	$\dfrac{d^2y}{dx^2}<0$ so maximum $\dfrac{d^2y}{dx^2}>0$ so minimum	M1 A1ft (2)
		Total 11 marks

Part	Mark	Notes
(a)	**M1**	For an attempt at Quotient rule. The definition of an attempt is that there must be a minimal attempt to differentiate both terms and the denominator must be $\left(x^2+4\right)^2$. Allow the terms in the numerator to be the wrong way around, but the terms must be subtracted. [See General Guidance for an attempt at differentiation]. $\dfrac{dy}{dx}=\dfrac{(x^2+4)-x(2x)}{\left(x^2+4\right)^2}$
	A1	For the correct $\dfrac{dy}{dx}$ simplified or unsimplified. Award the mark for a correct $\dfrac{dy}{dx}$ seen even if there are later errors in simplification.
	M1	For setting their $\dfrac{dy}{dx}=0$ which must be a quadratic equation solving to find x: $4-x^2=0\Rightarrow x=\pm 2$

	A1	For the correct coordinates of either $\left(2, \frac{1}{4}\right)$ or $\left(-2, -\frac{1}{4}\right)$
	A1	For both correct coordinates $\left(2, \frac{1}{4}\right)$ and $\left(-2, -\frac{1}{4}\right)$
(b)	**M1**	For an attempt at Quotient rule on their $\frac{dy}{dx} = \frac{(x^2+4)-x(2x)}{\left(x^2+4\right)^2}$ which must be as a minimum: $\frac{ax^2+bx+c}{\left(x^2+4\right)^2}$ where *a*, *b* and *c* are constants and $a, c \neq 0$ The definition of an attempt is that there must be a minimal attempt to differentiate the numerator and denominator and the correct formula applied. $\left(x^2+4\right)^2$ must differentiate to $ax(x^2+4)$, the denominator must be $\left(x^2+4\right)^4$ Allow the terms in the numerator to be the wrong way around, but the terms must be subtracted. Apply General Guidance for an attempt at differentiation on ax^2+bx+c. $\frac{d^2y}{dx^2} = \frac{-2x(x^2+4)^2 - 4x(4-x^2)(x^2+4)}{(x^2+4)^4}$
	M1	For cancelling through by (x^2+4) $\frac{d^2y}{dx^2} = \frac{-2x(x^2+4) - 4x(4-x^2)}{(x^2+4)^3}$
	M1	For simplifying the numerator to achieve as a minimum $\frac{d^2y}{dx^2} = \frac{ax^3+bx}{(x^2+4)^3}$ where *a* and *b* are constants
	A1 cso	For obtaining the answer as given with no errors. $\frac{d^2y}{dx^2} = \frac{2x(x^2-12)}{(x^2+4)^3}$ *
(c)	**M1**	Substitutes either their 2 or their – 2 into their $\frac{d^2y}{dx^2}$ Note: When $x = 2$ $\left[\frac{d^2y}{dx^2} = -\frac{1}{16}\right]$ and when $x = -2$ $\left[\frac{d^2y}{dx^2} = \frac{1}{16}\right]$
	A1ft	For the conclusion $\frac{d^2y}{dx^2} < 0$ so maximum $\frac{d^2y}{dx^2} > 0$ so minimum
	ALT – tests gradient or sight of a sketch	
	M1	Tests gradient on either side of one the turning points (their 2 or their – 2) using their $\frac{dy}{dx}$ or a correct sketch 
	A1ft	For the correct conclusion