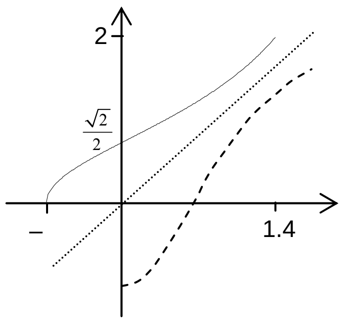
8(i) At P, $x\cos 3x = 0$ $\Rightarrow$ $\cos 3x = 0$ $\Rightarrow$ $3x = \pi/2, 3\pi/2$ $\Rightarrow$ $x = \pi/6, \pi/2$ So P is $(\pi/6, 0)$ and Q is $(\pi/2, 0)$	M1 M1 A1 A1 [4]	or verification $3x = \pi/2, (3\pi/2\ldots)$ dep both Ms condone degrees here
(ii) $\frac{dy}{dx} = -3x\sin 3x + \cos 3x$ At P, $\frac{dy}{dx} = -\frac{\pi}{2}\sin\frac{\pi}{2} + \cos\frac{\pi}{2} = -\frac{\pi}{2}$ At TPs $\frac{dy}{dx} = -3x\sin 3x + \cos 3x = 0$ $\Rightarrow$ $\cos 3x = 3x\sin 3x$ $\Rightarrow$ $1 = 3x\sin 3x / \cos 3x = 3x\tan 3x$ $\Rightarrow$ $x\tan 3x = 1/3$ *	M1 B1 A1 M1 A1cao M1 E1 [7]	Product rule $d/dx(\cos 3x) = -3\sin 3x$ cao (so for $dy/dx = -3x\sin 3x$ allow B1) mark final answer substituting their $-\pi/6$ (must be rads) $-\pi/2$ $dy/dx = 0$ and $\sin 3x / \cos 3x = \tan 3x$ used www
(iii) $A = \int_0^{\pi/6} x\cos 3x\,dx$ Parts with $u = x$, $dv/dx = \cos 3x$ $du/dx = 1$, $v = 1/3 \sin 3x$ $\Rightarrow$ $A = \left[\frac{1}{3}x\sin 3x\right]_0^{\frac{\pi}{6}} - \int_0^{\pi/6}\frac{1}{3}\sin 3x\,dx$ $= \left[\frac{1}{3}x\sin 3x + \frac{1}{9}\cos 3x\right]_0^{\frac{\pi}{6}}$ $= \frac{\pi}{18} - \frac{1}{9}$	B1 M1 A1 A1 M1dep A1 cao [6]	Correct integral and limits (soi) – ft their P, but must be in radians can be without limits dep previous A1. substituting correct limits, dep 1st M1: ft their P provided in radians o.e. but must be exact

9(i) $f'(x)=\frac{(x^2+1)4x-(2x^2-1)2x}{(x^2+1)^2}$ $=\frac{4x^3+4x-4x^3+2x}{(x^2+1)^2}=\frac{6x}{(x^2+1)^2}$ * When $x > 0$, $6x > 0$ and $(x^2 + 1)^2 > 0$ $\Rightarrow$ $f'(x) > 0$	M1 A1 E1 M1 E1 [5]	Quotient or product rule correct expression www attempt to show or solve $f'(x) > 0$ numerator > 0 and denominator > 0 or, if solving, $6x > 0 \Rightarrow x > 0$
(ii) $f(2) = \frac{8-1}{4+1}=1\frac{2}{5}$ Range is $-1 \le y \le 1\frac{2}{5}$	B1 B1 [2]	 must be $\le$, y or $f(x)$
(iii) $f'(x)$ max when $f''(x) = 0$ $\Rightarrow$ $6 - 18x^2 = 0$ $\Rightarrow$ $x^2 = 1/3$, $x = 1/\sqrt{3}$ $\Rightarrow$ $f'(x)=\frac{6/\sqrt{3}}{(1\frac{1}{3})^2}=\frac{6}{\sqrt{3}}.\frac{9}{16}=\frac{9\sqrt{3}}{8}=1.95$	M1 A1 M1 A1 [4]	 ($\pm$)$1/\sqrt{3}$ oe (0.577 or better) substituting $1/\sqrt{3}$ into $f'(x)$ $9\sqrt{3}/8$ o.e. or 1.95 or better (1.948557..)
(iv) Domain is $-1 < x < 1\frac{2}{5}$ Range is $0 \le y \le 2$  	B1 B1 M1 A1 cao [4]	ft their 1.4 but not $x \ge -1$ or $0 \le g(x) \le 2$ (not f) Reasonable reflection in $y = x$ from (–1, 0) to (1.4, 2), through (0, $\sqrt{2}/2$) allow omission of one of –1, 1.4, 2, $\sqrt{2}/2$
(v) $y=\frac{2x^2-1}{x^2+1}$ $x \leftrightarrow y$ $x=\frac{2y^2-1}{y^2+1}$ $\Rightarrow$ $xy^2 + x = 2y^2 - 1$ $\Rightarrow$ $x + 1 = 2y^2 - xy^2 = y^2(2 - x)$ $\Rightarrow$ $y^2=\frac{x+1}{2-x}$ $\Rightarrow$ $y=\sqrt{\frac{x+1}{2-x}}$ *	 M1 M1 M1 E1 [4]	(could start from g) Attempt to invert clearing fractions collecting terms in y^2 and factorising www