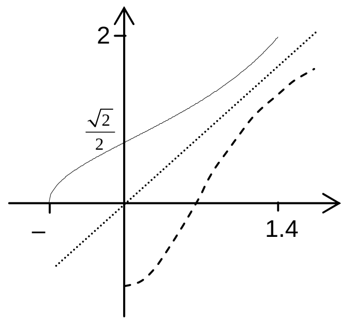
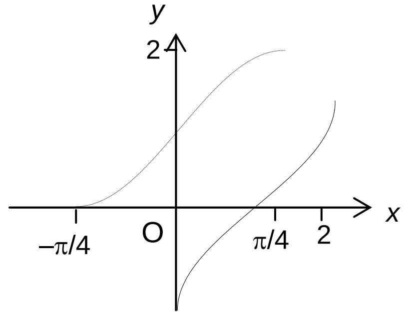
1(i) $f'(x) = \frac{(x^2+1)4x-(2x^2-1)2x}{(x^2+1)^2}$ $= \frac{4x^3+4x-4x^3+2x}{(x^2+1)^2} = \frac{6x}{(x^2+1)^2}$ * When $x > 0$, $6x > 0$ and $(x^2 + 1)^2 > 0$ $\Rightarrow$ $f'(x) > 0$	M1 A1 E1 M1 E1 [5]	Quotient or product rule correct expression www attempt to show or solve $f'(x) > 0$ numerator > 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

2'(i) $\frac{2}{3}x^{-1/3}+\frac{2}{3}y^{-1/3}\frac{dy}{dx}=0$ $\Rightarrow \frac{dy}{dx}=-\frac{\frac{2}{3}x^{-1/3}}{\frac{2}{3}y^{-1/3}}$ $=-\frac{y^{1/3}}{x^{1/3}}=-\left(\frac{y}{x}\right)^{\frac{1}{3}}$ *	M1 A1 M1 E1 [4]	Implicit differentiation (must show = 0) solving for dy/dx www. Must show, or explain, one more step.
(ii) $\frac{dy}{dt}=\frac{dy}{dx}.\frac{dx}{dt}$ $=-\left(\frac{8}{1}\right)^{\frac{1}{3}}.6$ $=-12$	M1 A1 A1cao [3]	any correct form of chain rule

3 (i) Stretch in x-direction s.f. translation in y-direction 1 unit up	M1 A1 M1 A1 [4]	(in either order) – allow 'contraction' dep 'stretch' allow 'move', 'shift', etc – direction can be inferred from $\begin{pmatrix}0\\1\end{pmatrix}$ or $\begin{pmatrix}0\\1\end{pmatrix}$ dep 'translation'. $\begin{pmatrix}0\\1\end{pmatrix}$ alone is M1 A0
(ii) $A=\int_{-\pi/4}^{\pi/4}(1+\sin 2x)dx$ $=\left[x-\frac{1}{2}\cos 2x\right]_{-\pi/4}^{\pi/4}$ $= \pi/4 - ½ \cos \pi/2 + \pi/4 + ½ \cos (-\pi/2)$ $= \pi/2$	M1 B1 M1 A1 [4]	correct integral and limits. Condone dx missing; limits may be implied from subsequent working. substituting their limits (if zero lower limit used, must show evidence of substitution) or 1.57 or better – cao (www)
(iii) $y = 1 + \sin 2x$ $\Rightarrow$ dy/dx = 2cos 2x When x = 0, dy/dx = 2 So gradient at (0, 1) on f(x) is 2 $\Rightarrow$ gradient at (1, 0) on $f^{-1}(x) = ½$	M1 A1 A1ft B1ft [4]	differentiating – allow 1 error (but not x + 2cos 2x) If 1, then must show evidence of using reciprocal, e.g. 1/1
(iv) Domain is $0 \le x \le 2$.  	B1 M1 A1 [3]	Allow 0 to 2, but not $0 < x < 2$ or y instead of x clear attempt to reflect in $y = x$ correct domain indicated (0 to 2), and reasonable shape
(v) $y = 1 + \sin 2x$ $x \leftrightarrow y$ $x = 1 + \sin 2y$ $\Rightarrow$ $\sin 2y = x - 1$ $\Rightarrow$ $2y = \arcsin(x - 1)$ $\Rightarrow$ $y = ½ \arcsin(x - 1)$	M1 A1 [2]	or $\sin 2x = y - 1$ cao