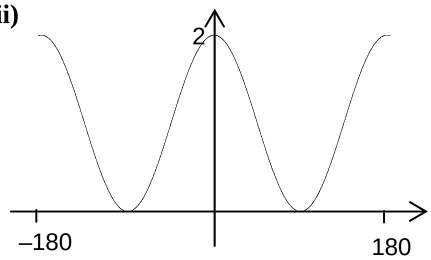
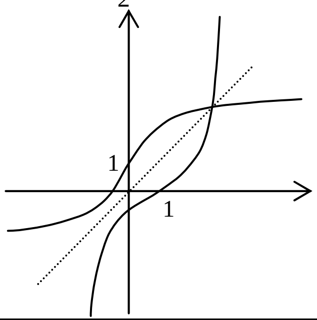
1	**(i)**		arcsin $x = \pi/6 \Rightarrow x = \sin \pi/6$ $= \frac{1}{2}$	M1 A1 **[2]**	allow unsupported answers	
	(ii)		$\sin \pi/4 = \cos \pi/4 = 1/\sqrt{2}$ $\Rightarrow \quad \arcsin(1/\sqrt{2}) = \arccos(1/\sqrt{2})$ $\Rightarrow \quad x = 1/\sqrt{2}$	B2 **[2]**	o.e. e.g. $\sqrt{2}/2$, must be exact; SCB1 0.707…	

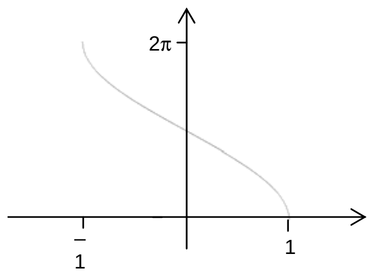
2 (i) $a = 0$, $b = 3$, $c = 2$	B(2,1,0)	or $a = 0$, $b = -3$, $c = -2$
(ii) $a = 1$, $b = -1$, $c = 1$ *or* $a = 1$, $b = 1$, $c = -1$	B(2,1,0) [4]	

3 Let arcsin $x = \theta$ $\Rightarrow$ $x = \sin\theta$ $\theta = \arccos y \Rightarrow y = \cos\theta$ $\sin^2\theta + \cos^2\theta = 1$ $\Rightarrow$ $x^2 + y^2 = 1$	M1 M1 E1 [3]	

4(i) period 180°	B1 [1]	condone $0 \le x \le 180°$ or π
(ii) one-way stretch in x-direction scale factor ½ translation in y-direction through $\begin{pmatrix}0\\1\end{pmatrix}$	M1 A1 M1 A1 [4]	[either way round…] condone 'squeeze', 'contract' for M1 stretch used and s.f ½ condone 'move', 'shift', etc for M1 'translation' used, +1 unit $\begin{pmatrix}0\\1\end{pmatrix}$ only is M1 A0
(iii) 	M1 B1 A1 [3]	correct shape, touching x-axis at -90°, 90° correct domain (0, 2) marked or indicated (i.e. amplitude is 2)

5 (i) bounds $-\pi + 1, \pi + 1$ $\Rightarrow$ $-\pi + 1 < f(x) < \pi + 1$	B1B1 B1cao [3]	or … $< y <$ … or $(-\pi + 1, \pi + 1)$	not … $< x <$ …, not 'between …'
(ii) $y = 2\arctan x + 1$ $x \leftrightarrow y$ $x = 2\arctan y + 1$	M1	attempt to invert formula	one step is enough, i.e. $y - 1 = 2\arctan x$ or $x - 1 = 2\arctan y$
$\Rightarrow \frac{x-1}{2} = \arctan y$	A1	or $\frac{y-1}{2} = \arctan x$	need not have interchanged x and y at this stage
$\Rightarrow y = \tan(\frac{x-1}{2}) \Rightarrow f^{-1}(x) = \tan(\frac{x-1}{2})$	A1		allow $y =$ …
	B1 B1 [5]	reasonable reflection in $y = x$ (1, 0) intercept indicated.	curves must cross on $y = x$ line if present (or close enough to imply intention) curves shouldn't touch or cross in the third quadrant

6(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

7 	M1 B1 A1 [3]	Can use degrees or radians reasonable shape (condone extra range) passes through (–1, 2π), (0, π) and (1, 0) good sketches – look for curve reasonably vertical at (–1, 2π) and (1, 0), negative gradient at (0, π). Domain and range must be clearly marked and correct.

8 (i) $-\pi/2 < \arctan x < \pi/2$ $\Rightarrow$ $-\pi/4 < \mathrm{f}(x) < \pi/4$ $\Rightarrow$ range is $-\pi/4$ to $\pi/4$	M1 A1cao [2]	$\pi/4$ or $-\pi/4$ or 45 seen not $\leq$
(ii) $y = ½ \arctan x$ $\quad x \leftrightarrow y$ $x = ½ \arctan y$ $\Rightarrow$ $2x = \arctan y$ $\Rightarrow$ $\tan 2x = y$ $\Rightarrow$ $y = \tan 2x$	M1 A1cao	tan(arctan y or x) = y or x
either $\dfrac{dy}{dx} = 2\sec^2 2x$	M1 A1cao	derivative of tan is $\sec^2$ used
or $y = \dfrac{\sin 2x}{\cos 2x} \Rightarrow \dfrac{dy}{dx} = \dfrac{2\cos^2 2x + 2\sin^2 2x}{\cos^2 2x}$ $= \dfrac{2}{\cos^2 2x}$	M1 A1cao	quotient rule (need not be simplified but mark final answer)
When $x = 0$, $dy/dx = 2$	B1 [5]	www
(iii) So gradient of $y = ½ \arctan x$ is ½ .	B1ft [1]	ft their '2', but not 1 or 0 or ∞

9 $x = ½$ $\cos \theta = ½$ $\Rightarrow$ $\theta = \pi/3$	B1 M1 A1 [3]	M1A0 for 1.04… or 60°