1.a) Evaluate $\lim_{x\to\infty}\left(\frac{2}{\pi}\arctan 3x\right)^x$: $[1^\infty]$

Let $y=\left(\frac{2}{\pi}\arctan 3x\right)^x$. Then $\ln y = x\ln\left(\frac{2}{\pi}\arcta\right.$

$$\lim_{x\to\infty}\ln y=\lim_{x\to\infty}\frac{\ln\left(\frac{2}{\pi}\arctan 3x\right)}{\frac{1}{x}} : \left[\frac{0}{0}\right]$$

$$=\lim_{x\to\infty}\frac{\frac{1}{\cancel{\frac{2}{\pi}}\arctan 3x}\left(\cancel{\frac{2}{\pi}}\frac{3}{1+9x^2}\right)}{-\frac{1}{x^2}}$$

$$=\underbrace{\lim_{x\to\infty}\frac{1}{\arctan 3x}}_{\frac{\pi}{2}}\cdot\underbrace{\lim_{x\to\infty}\frac{-3x^2}{1+9x^2}}_{-\frac{1}{3}}$$

$$=-\frac{\pi}{6}$$

$$\lim_{x\to\infty}\left(\frac{2}{\pi}\arctan 3x\right)^x=e^{-\frac{\pi}{6}}.$$

b) Let $f(x)=\int_{\pi}^{x}(\cos(t^3))^2\,dt$ for all x, and let $f(\pi^{\frac{1}{3}})=c$. Find $\left(f^{-1}\right)'(c)$.

$$(f^{-1})'(c)=\frac{1}{f'(f^{-1}(c))}=\frac{1}{f'(\pi^{1/3})}$$

where $f'(x)=(\cos(x^3))^2$ and $f'(\pi^{1/3})=(\cos\pi)^2=1$

$$(f^{-1})'(c)=1.$$