ii

Let

$$v(x) = \int_1^x sin^3 t\ dt$$

and

$$q(x) = \int_3^x \frac{1}{1 + sin^6 t + t^2}\ dt$$

So, $F(x) = v(q(x))$, so $\frac{dF}{dx} = \frac{dv}{dq}\frac{dq}{dx}$, so

$$\begin{aligned}\frac{dF}{dx} &= \frac{1}{1 + sin^6(x) + v^2} sin^3(x)\\ &= \frac{sin^3(x)}{1 + sin^6(\int_1^x sin^3 t\ dt) + (\int_1^x sin^3 t\ dt)^2}\end{aligned}$$

iv

$$\begin{aligned}F(x) &= \int_b^x \frac{1}{1 + t^2 + sin^2 t} \quad dt\\ &= -\int_b^x \frac{1}{1 + t^2 + sin^2 t} \quad dt\\ F'(x) &= \frac{-1}{1 + x^2 + sin^2 x}\end{aligned}$$

vi

$$\begin{aligned}u(x) &= \int_0^x sin(\int_0^y sin^3 t \quad dy) \quad dt\\ F(x) &= sin(u(x))\\ F' &= cos(u(x))u'\\ &= cos(\int_0^x sin(\int_0^y sin^3 dt)dy) sin(\int_0^x sin^3 t dt)\end{aligned}$$

viii

$$\begin{aligned}F(F^{-1}(x)) &= x\\ \int_0^{F^{-1}(x)} \frac{1}{\sqrt{1 - t^2}} dt\\ \frac{d}{dx} F(F^{-1}(x)) &= 1\\ F'(F^{-1}(x)) F^{-1\prime}(x) &= 1\\ \frac{1}{\sqrt{1 - (F^{-1}(x))^2)}} F^{-1\prime}(x) &= 1\\ F^{-1\prime}(x) &= \sqrt{1 - (F^{-1}(x))^2)}\end{aligned}$$