1. For each function below, write it as a nontrivial composition of functions in the form $f(g(x))$.

   (a) $H(x) = \sqrt[3]{4-2x}$ $= (4-2x)^{1/3}$

   outside $f(x) = \sqrt[3]{x} = x^{1/3}$
   inside $g(x) = 4-2x$

   $$H'(x) = \underbrace{\tfrac{1}{3}(4-2x)^{-2/3}}_{f'(g(x))}\underbrace{(-2)}_{g'(x)}$$

   (b) $H(x) = \tan(2 - x^4)$

   outside $f(x) = \tan x$
   inside $g(x) = 2 - x^4$

   $$H'(x) = \underbrace{\left[\sec^2(2-x^4)\right]}_{f'(g(x))} \cdot \underbrace{(-4x^3)}_{g'(x)}$$

   (c) $H(x) = e^{2-2x^3}$

   outside $f(x) = e^x$
   inside $g(x) = 2-2x^3$

   $$H(x) = \underbrace{\left(e^{2-2x^3}\right)}_{f'(g(x))}\cdot\underbrace{(-6x^2)}_{g'(x)}$$

   (d) $H(x) = \frac{4}{x+\sin(x)}$ $= 4(x+\sin x)^{-1}$

   outside $f(x) = \frac{4}{x} = 4x^{-1}$
   inside $g(x) = x + \sin x$

   $$H'(x) = 4\cdot\underbrace{(-1)(x+\sin x)^{-2}}_{f'(g(x))}\underbrace{(1+\cos x)}_{g'(x)}$$

2. Complete the Chain Rule (using both types of notation)

   - If $F(x) = f(g(x))$,

     then $F'(x) = f'(g(x)) \cdot g'(x)$

   - If $y = f(u)$ and $u = g(x)$,

     then $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$

3. Return to problem 1 above and find the derivatives.

4. For each problem below, find the derivative.

(a) $z(t) = (2x^3 - 5x)^7$

$z'(t) = 7(2x^3-5x)^6(6x^2-5)$

(b) $x(\theta) = \cos^3(\theta)$ $= (\cos\theta)^3$

$x'(\theta) = 3(\cos\theta)^2(-\sin\theta) = -3\sin\theta(\cos\theta)^2$

(c) $y = x^2 - 3\sin(x^3)$

$y' = 2x - 3\cdot\cos(x^3)(3x^2) = 2x - 9x^2\cos(x^3)$

(d) $y = 10e^{\sqrt{x}}$ $= 10\,e^{(x^{1/2})}$

$\frac{dy}{dx} = 10\cdot e^{x^{1/2}}\cdot\left(\frac{1}{2}x^{-1/2}\right) = \frac{5e^{\sqrt{x}}}{\sqrt{x}}$

(e) $f(x) = \frac{\sqrt{2}}{\sqrt{x^2-4}}$ $= \sqrt{2}(x^2-4)^{-1/2}$

$f'(x) = \sqrt{2}\left(-\frac{1}{2}\right)(x^2-4)^{-3/2}(2x) = \frac{-\sqrt{2}\,x}{(x^2-4)^{3/2}}$

(f) $g(x) = \frac{\sec(x^2+2)}{12}$ $= \frac{1}{12}\sec(x^2+2)$

$g'(x) = \frac{1}{12}\left(\sec(x^2+2)\tan(x^2+2)\right)(2x) = \frac{x}{6}\sec(x^2+2)\tan(x^2+2)$

(g) $k(s) = \frac{A^2}{B+Cs}$ $= A^2(B+Cs)^{-1}$

$k'(s) = A^2(-1)(B+Cs)^{-2}(C) = \frac{-A^2C}{(B+Cs)^2}$