1. Use the product rule to differentiate the function.

a. $f(x) = (x^2 + \sin x)(3x - 15)$

b. $f(x) = \sqrt{x}\tan x$

2. Use the quotient rule to differentiate the function.

a. $f(x) = \frac{\cos x}{x^2}$

b. $f(x) = \frac{2(\cos x - 1)}{3\sin x}$

3. Find $f'(3)$ given that $g(3) = 2,\ g'(3) = -1,\ h(3) = 5,$ and $h'(3) = -2$

a. $f(x) = 2g(x)h(x)$

b. $f(x) = 2g(x) + h(x)$

c. $f(x) = 7 + \frac{g(x)}{h(x)}$

4. Find the second derivative of the function.

a. $f(x) = \frac{\tan x - 2}{3}$

b. $f(x) = \csc^2 \pi x$

1. Use the product rule to differentiate the function.

a. $f(x) = (x^2 + \sin x)(3x - 15)$

b. $f(x) = \sqrt{x}\tan x$

a. $f'(x) = (x^2+\sin x)'(3x-15) + (x^2+\sin x)(3x-15)'$

$= (2x+\cos x)(3x-15) + (x^2+\sin x)(3)$

b. $f'(x) = (x^{1/2})'\tan x + \sqrt{x}\cdot(\tan x)'$

$= \frac{1}{2}x^{-1/2}\tan x + \sqrt{x}\cdot\sec^2 x$

2. Use the quotient rule to differentiate the function.

a. $f(x) = \frac{\cos x}{x^2}$

b. $f(x) = \frac{2(\cos x - 1)}{3\sin x}$

a. $f'(x) = \frac{x^2(-\sin x) - (\cos x)(2x)}{(x^2)^2}$

b. $f'(x) = \frac{(3\sin x)(-2\sin x) - 2(\cos x - 1)(3\cos x)}{(3\sin x)^2}$

3. Find $f'(3)$ given that $g(3) = 2,\ g'(3) = -1,\ h(3) = 5,$ and $h'(3) = -2$

a. $f(x) = 2g(x)h(x)$

b. $f(x) = 2g(x) + h(x)$

c. $f(x) = 7 + \frac{g(x)}{h(x)}$

a. $f'(x) = 2g'(x)h(x) + 2g(x)h'(x)$

$f'(3) = 2(-1)(5) + 2(2)(-2)$

$= -10 - 8 = \boxed{-18}$

b. $f'(x) = 2g'(x) + h'(x)$

$f'(3) = 2(-1) + (-2) = \boxed{-4}$

c. $f'(x) = \frac{h(x)g'(x) - g(x)h'(x)}{[h(x)]^2}$

$f'(3) = \frac{5(-1) - 2(-2)}{5^2} = \frac{-5+4}{25} = \boxed{\frac{-1}{25}}$

4. Find the second derivative of the function.

a. $f(x) = \frac{\tan x - 2}{3}$ $= \frac{1}{3}\tan x - \frac{2}{3}$

b. $f(x) = \csc^2 \pi x$ $= [\csc(\pi x)]^2$

a. $f'(x) = \frac{1}{3}\sec^2 x = \frac{1}{3}[\sec x]^2$

$f''(x) = \boxed{\frac{2}{3}\sec x \cdot \sec x \tan x}$

b. $f'(x) = 2\csc(\pi x) \cdot [-\csc \pi x \cot \pi x] \cdot \pi$

$= -2\pi \csc^2(\pi x)\cot(\pi x)$

$f''(x) = -2\pi(\csc^2 \pi x)'\cot \pi x + (-2\pi)\csc^2 \pi x (\cot \pi x)'$

$= -2\pi(-2\pi \csc^2 \pi x \cot \pi x)\cot \pi x - 2\pi \csc^2 \pi x(-\csc^2 \pi x)\cdot \pi$

$= \boxed{4\pi^2 \csc^2 \pi x \cot^2 \pi x + 2\pi^2 \csc^4 \pi x}$