Product And Quotient Rules

Product Rule: The product of 2 differentiable functions, f and g, is also differentiable.

$$\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$$

-Note: This rule can be applied to more than 2 functions:

$$\frac{d}{dx}[f(x)g(x)h(x)] = f'(x)g(x)h(x) + f(x)g'(x)h(x) + f(x)g(x)h(x)$$

Quotient Rule: The quotient f/g, of 2 differentiable functions, is also differentiable at all values for which $g(x) \neq 0$.

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}$$

Trig Derivatives Cont.

$$\frac{d}{dx}[\tan x] = \sec^2 x \qquad \frac{d}{dx}[\cot x] = -\csc^2 x$$

$$\frac{d}{dx}[\sec x] = \sec x \tan x \qquad \frac{d}{dx}[\csc x] = -\csc x \cot x$$

Examples: Differentiate –

1. $f(x) = (3x - 5)(x^4 + 8x - 1)$

2. $f(x) = \frac{2x-1}{x+5}$

3. $y = 6x^2 + 3\sec x$

4. $f(x) = 5x\csc x$

5. $y = \frac{3x^4 - 1}{x^2}$

6. $f(x) = \frac{1}{x} + \frac{1}{\sqrt[4]{x^3}}$

Higher – Order Derivatives

$s(t)$	*Position Function*
$v(t) = s'(t)$	*Velocity Function*
$a(t) = v'(t) = s''(t)$	*Acceleration Function (second derivative of position function)*

Example: An astronaut standing on the moon throws a rock into the air. The height of the rock is $s = -\frac{27}{10}t^2 + 27t + 6$ where s is measured in feet and t is measured in seconds. Find the time when the rock is at its highest point by finding the time when the velocity is 0. What is the height at this time? First, find expressions for the acceleration and velocity of the rock.