Chapter 2 Derivatives

2.3 Differentiation Formulas

Constant Function.

Derivative of a Constant Function

$$\frac{d}{dx}\left(c\right) = 0$$

Power Functions.

$$n=1. \hspace{1.5cm} n=2. \\$$

n = 3.

The Power Rule If n is a positive integer, then

$$\frac{d}{dx}\left(x^{n}\right) = nx^{n-1}$$

EXAMPLE 4 Find the points on the curve $y = x^4 - 6x^2 + 4$ where the tangent line is horizontal.

Multiplication by a constant.

$$\frac{d}{dx}[cf(x)] = c\frac{d}{dx}f(x)$$

Sum.

The Sum Rule If f and g are both differentiable, then

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

Difference.

The Difference Rule If f and g are both differentiable, then

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

Product.

The Product Rule If f and g are both differentiable, then

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

Caution!!!

$$\frac{d}{dx}(fg) \neq \frac{d}{dx}(f)\frac{d}{dx}(g).$$

Example.

Example. Find the derivative of the function $f(x) = (5x^2 - 2)(x^3 + 3x)$.

The Quotient Rule If f and g are differentiable, then

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

Caution !! Example.
$$\frac{d}{dx} \left(\frac{f}{g} \right) \neq \frac{\frac{d}{dx}(f)}{\frac{d}{dx}(g)}$$

EXAMPLE 8 Let $y = \frac{x^2 + x - 2}{x^3 + 6}$. Compute the derivative.

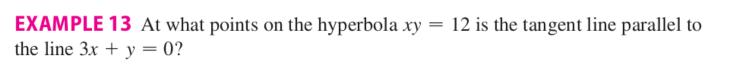
General Power rule.

The Power Rule (General Version) If n is any real number, then

$$\frac{d}{dx}\left(x^{n}\right) = nx^{n-1}$$

Case n = 0:

Example. Find the derivative of the function $\ f(x)=x^{2/3}$.



Summary of Differentiation Formulas.

Table of Differentiation Formulas

$$\frac{d}{dx}(c) = 0 \qquad \qquad \frac{d}{dx}(x^n) = nx^{n-1}$$

$$(cf)' = cf' \qquad \qquad (f+g)' = f'+g' \qquad \qquad (f-g)' = f'-g'$$

$$(fg)' = fg' + gf' \qquad \qquad \left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$$