Chapter 2

Derivatives

2.3 Differentiation Formulas

Derivative of a Constant Function $\frac{d}{dx}(c) = 0$

Power Functions.

n = 1.

n = 2.

The Power Rule If *n* is a positive integer, then

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

Derivatives rules: Constant multiple, Sum and Difference

EXAMPLE. Find the derivative of $y = x^4 - 6x^2 + 4$.

Multiplication by a constant.

The Constant Multiple Rule If c is a constant and f is a differentiable function, then

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

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.

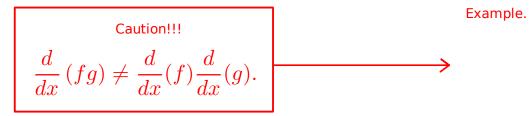
The Difference Rule If f and g are both differentiable, then

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

Product.

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

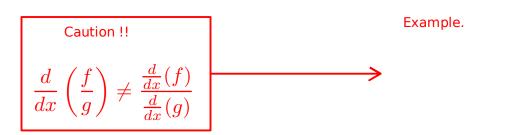
$$\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}[g(x)] + g(x)\frac{d}{dx}[f(x)]$$



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

Quotient.

The Quotient Rule If f and g are differentiable, then $\frac{d}{dx} \left[\frac{f(x)}{g(x)} \right] = \frac{g(x) \frac{d}{dx} [f(x)] - f(x) \frac{d}{dx} [g(x)]}{[g(x)]^2}$



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

Case
$$n = 0$$
:

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

EXAMPLE 13 At what points on the hyperbola xy = 12 is the tangent line parallel to the line 3x + y = 0?

Summary of Differentiation Formulas.

Table of Differentiation Formulas

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

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

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