Calculus Section 2.2 Basic Differentiation Rules

-Find the derivative of a function using the constant rule
-Find the derivative of a function using the power rule
-Find the derivative of the sine and cosine functions.

Homework: Page 114 #'s 3-22, 31, 40, 57, 61, 63

You do not have to use the limit definition of the derivative to find the derivative of a function because there is a shortcut.

Derivative Constant Rule and Power Rule
The derivative of a **constant number** is zero. This is because the graph of a constant is a horizontal line. Therefore, the slope of a constant must be zero.

The derivative of a function with **x raised to a power** $f(x) = x^n$ is $f'(x) = nx^{n-1}$

Examples)

1) $f(x) = x^5$

$f'(x) = 5x^4$

2) $f(x) = \frac{1}{x^2}$

$f(x) = x^{-2}$

$f'(x) = -2x^{-3}$

$f'(x) = \frac{-2}{x^3}$

3) $f(x) = \sqrt[3]{x^2}$

$f(x) = x^{2/3}$

$f'(x) = \frac{2}{3}x^{-1/3}$

$f'(x) = \frac{2}{3x^{1/3}}$

The Constant Multiple Rule
If *f* is a differentiable function and *c* is a real number, then *cf* is also differentiable:

$$f(x) = [cf(x)] \text{ then } f'(x) = [cf'(x)]$$

Examples)

1) $f(x) = 3x^2$

$f'(x) = 6x$

2) $f(x) = \frac{2}{x}$

$f(x) = 2x^{-1}$

$f'(x) = -2x^{-2}$

$f'(x) = \frac{-2}{x^2}$

3) $f(x) = 3\sqrt[5]{x^3}$

$f(x) = 3x^{3/5}$

$f'(x) = \frac{9}{5}x^{-2/5}$

$f'(x) = \frac{9}{5x^{2/5}}$

Sum and Difference Rule
If both *f* and *g* are differentiable, then the sum or difference of *f* and *g* is differentiable as well.

$$f(x) = [f(x) \pm g(x)] \text{ then } f'(x) = [f'(x) \pm g'(x)]$$

Examples)

1) $f(x) = x^3 + x^2 - 2$

$f'(x) = 3x^2 + 2x$

2) $f(x) = 3x^5 - 2x^3 + \frac{1}{x}$

$f'(x) = 15x^4 - 6x^2 - \frac{1}{x^2}$

Derivative of Sine and Cosine Functions

$\frac{d}{dx}[\sin x] = \cos x$ $\qquad$ $\frac{d}{dx}[\cos x] = -\sin x$

Examples)

1) $f(x) = 2\sin x$

$f'(x) = 2\cos x$

2) $f(x) = \frac{1}{2}\sin x$

$f'(x) = \frac{1}{2}\cos x$

3) $f(x) = x + \cos x$

$f'(x) = 1 - \sin x$

Horizontal Tangent Line

Horizontal tangent lines have many applications in calculus. You can find where a function has a horizontal tangent line by taking the derivative of the function and setting it equal to zero.

For what values of x do the following functions have a horizontal tangent line?

1) f(x) = 3x² – 2x + 1

$f'(x) = 6x - 2$

$0 = 6x - 2$

$6x = 2$

$x = 1/3$

2) f(x) = -cos(x)

$f'(x) = \sin x$

$0 = \sin x$

$x = 0, \pi, 2\pi, \ldots$