FUN LIM	AP CALCULUS	
1	Topic: 2.7	Derivatives of cos*x*, sin*x*, e^x, and ln*x*

Learning Objective FUN-3.A: Calculate derivatives of familiar functions.

Short Cuts to use from Notes 2.5 & 2.6

Reciprocal Rule

$$\frac{d}{dx}\left[\frac{1}{g(x)}\right] = -\frac{\frac{d}{dx}[g(x)]}{[g(x)]^2}$$

Example 1 c) $y = \frac{1}{x^3}$

Example 2 b) $g(x) = \frac{3}{x^2}$

Square Root Rule

$$\frac{d}{dx}\left[\sqrt{x}\right] = \frac{1}{2\sqrt{x}}$$

Example 5 b) $f(x) = 2\sqrt{x}$

Differentiating Sine and Cosine Functions

Derivatives of Sine and Cosine Functions

$$\frac{d}{dx}[\sin x] = \cos x \quad \text{AND} \quad \frac{d}{dx}[\cos x] = -\sin x$$

Proof of the derivative of $\sin x$.

Example 1: Find the derivative of each of the following.

a. $y = 2\sin x$

b. $y = \frac{\sin x}{2}$

c. $y = x + \cos x$

Differentiating e^x

Derivative of the Natural Exponential Function

$$\frac{d}{dx}[e^x] = e^x$$

Example 2: Find the derivative of each of the following.

a. $y = 5e^x$

b. $y = e^x - 4x$

c. $y = 7e^x + \cos x$

Differentiating $\ln(x)$

Derivative of the Natural Logarithmic Function

$$\frac{d}{dx}[\ln x] = \frac{1}{x}$$

Example 3: Find the derivative of the following function.

$y = 3\ln x - 2e^x - \frac{1}{2}\sin x$

Differentiating $\log_b(x)$

Derivative of the Logarithmic Function with base b

$$\frac{d}{dx}[\log_b x] = \frac{1}{x(\ln b)}$$

While we hate to reduce calculus and the concept of taking a derivative to rote memorization, there is an easy way to conceptualize this derivative formula.

Recall the change of base formula from College Algebra: $\log_b x = \frac{\ln x}{\ln b}$. Find $\frac{d}{dx}\left[\frac{\ln x}{\ln b}\right]$.

Log Rules you must know:

$\ln a + \ln b = \ln(ab)$

$\ln a - \ln b = \ln\left(\frac{a}{b}\right)$

$x \ln a = \ln a^x$

$\ln_b a = \frac{\ln a}{\ln b}$