## Exponential Growth and Decay

A general Exponential Growth/Decay function looks like:

$$A = A_0 e^{kt}$$

Examples:

- Strontium-90 has a half-life of 28 days and a sample has a mass of 50 mg initially. Find a formula for the mass remaining after t days.

  Find the mass remaining after 40 days.

  How long does it take the sample to decay to a mass of 2 mg?

- A bacteria culture grows with constant relative growth rate. The bacteria count was 400 after 2 hours and 25,600 after 6 hours. What is the relative growth rate and what was the initial size of the culture?

  Find an expression for the number of bacteria after $t$ hours.

  Find the number of cells after 4.5 hours.

  Find the rate of growth after 4.5 hours.

  When will the population reach 50,000?

## Inverse Trig Functions

Simplify the expression.

- $\cos(\arcsin \frac{1}{2})$
- $\cos(2\sin^{-1}(\frac{5}{13}))$
- $\tan(\sin^{-1} x)$
- $\sin(\tan^{-1} x)$

Find the derivatives of the following functions:

- $R(t) = \arcsin(\frac{1}{t})$
- $y = \arctan(\cos\theta)$

- $y = \cos^{-1}(\sin^{-1} t)$

Find the integrals of the following functions:

- $\int \frac{t^2}{\sqrt{1-t^6}}\,dt$
- $\int \frac{dx}{\sqrt{1-x^2}\sin^{-1} x}$
- $\int \frac{1+x}{1+x^2}\,dx$
- $\int \frac{e^{2x}}{\sqrt{1-e^{4x}}}\,dx$

## L'Hospital's Rule

### What is an indeterminate form?

If we "plug in" our limit value into the function we might get things that look like:
*(Keep in mind, we're not *actually plugging in anything*. For example, you can't "plug in" infinity. It's not a number!)*

- $\frac{0}{0}$
- $\frac{\pm\infty}{\pm\infty}$
- $0^0$
- $\infty^0$
- $1^\infty$
- $\infty - \infty$
- $\pm\infty \cdot 0$

Find the following limits:

- $\lim_{x\to 3} \frac{x-3}{x^2-9}$
- $\lim_{t\to 0} \frac{e^{2t}-1}{\sin t}$
- $\lim_{x\to \infty} \frac{\ln x}{\sqrt{x}}$
- $\lim_{\theta\to \pi} \frac{1+\cos\theta}{1-\cos\theta}$
- $\lim_{x\to 0^+} \frac{1}{x} - \frac{1}{e^x-1}$
- $\lim_{x\to 0^+} x^{\sqrt{x}}$

- $\lim_{x \to \infty} x^{e^{-x}}$
- $\lim_{x \to 0^+} (1 + \sin(3x))^{1/x}$
- $\lim_{x \to 0^+} (\tan x)^x$