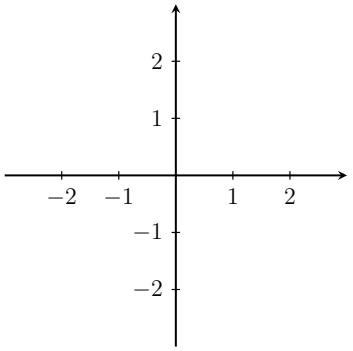
Objectives:

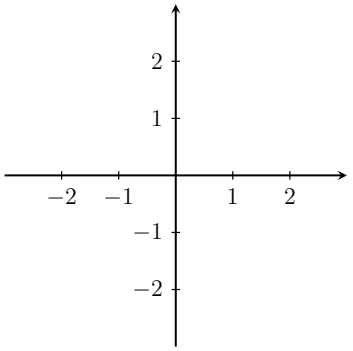
- Find derivatives of logarithmic functions.

Review of logarithmic functions:

$y = e^x$



Inverse:



Important facts:

$y = e^x$ means and $y = a^x$ means

$\log_2 8 =$	is equivalent to	
$\log_{10} 100 =$	is equivalent to	
$\log_{10} 0.001 =$	is equivalent to	
$\ln \sqrt{e} =$	is equivalent to	
$y = \log_a x$	is equivalent to	
	is equivalent to	$y = e^x$

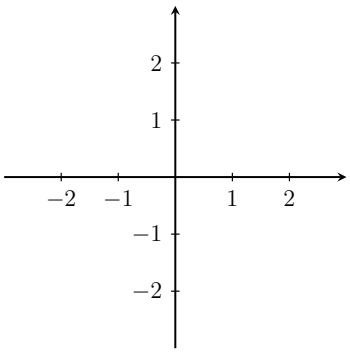
Solving Equations:

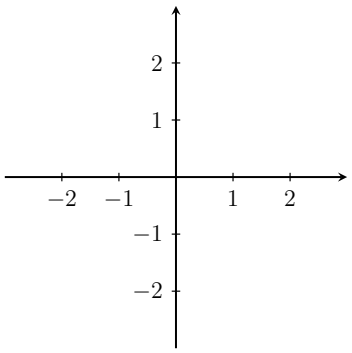
Solve $5e^{0.34t} = 6$ for t.

Solve $\log_2(x) + \log_2(x-1) = 1$.
(Hint: use laws of logs)

Derivatives of logarithmic functions:

1. $\dfrac{d}{dx}(\ln x) =$
2. $\dfrac{d}{dx}(\log_a x) =$





Proof: (of 1.)

Try the proof for 2 at home!

Examples: Find the derivatives of the following functions using our new formulas.

1. $f(x) = x\ln(x)$

2. $f(x) = \ln\big(\arctan(x)\big)$

3. $f(x) = \sqrt{\log_2(x)} =$

4. $f(x) = \arcsin\left(e^{\tan(x^2)}\right)$

5. $f(x) = \ln\left(\dfrac{x^2\sqrt{x-1}}{(x+3)^4}\right)$

Logarithmic Differentiation: Why would we take logarithms to take derivatives?

- Use it with functions that have products/quotients/powers, like $f(x) = \dfrac{x^4\sqrt{x^2+1}}{(3x+4)^2}$
- Use if if there is a variable in the base and the exponent, like $f(x) = x^{\sin x}$, since neither the power rule nor the exponential rule apply.

Examples Find $f'(x)$ for the following functions.

1. $f(x) = \dfrac{x^4\sqrt{x^2+1}}{(3x+4)^2}$.

   Step 1: Use y for $f(x)$

   Step 2: Take ln of both sides

   Step 3: Use laws of logs to simplify

   Step 4: Differentiate implicitly

   Step 5: Solve for y'

2. $f(x) = x^{\sin x}$