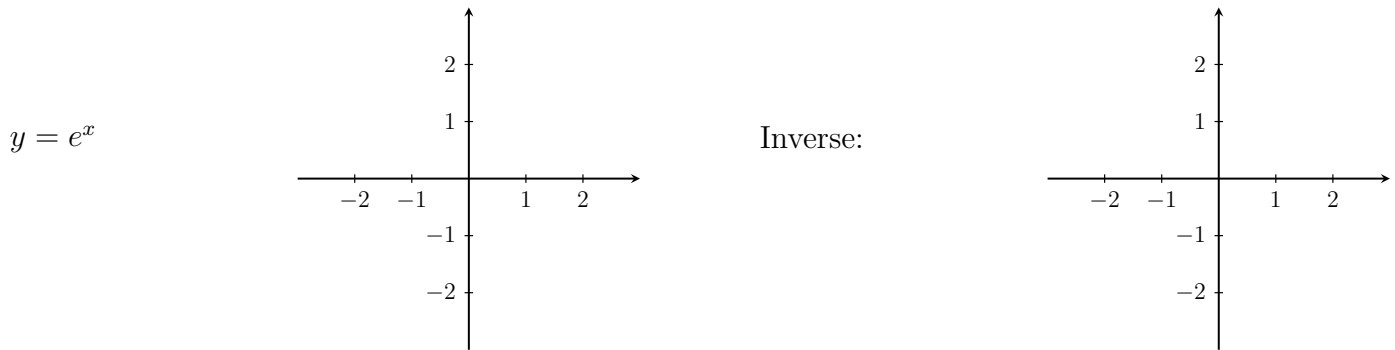


Objectives:

- Find derivatives of logarithmic functions.

Review of logarithmic functions:



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:

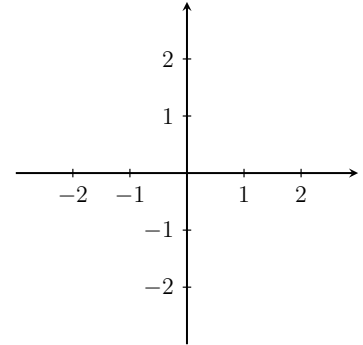
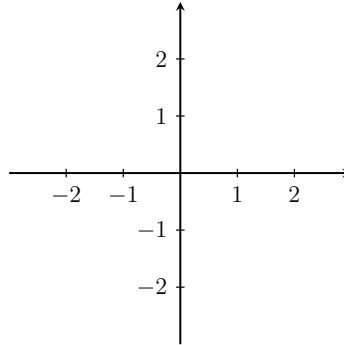
Solve $5e^{0.34t} = 6$ for t .

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

Derivatives of logarithmic functions:

$$1. \frac{d}{dx} (\ln x) =$$

$$2. \frac{d}{dx} (\log_a x) =$$



Proof: (of 1.)

Try the proof for 2 at home!

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

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

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

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

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

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

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

- Use it with functions that have products/quotients/powers, like $f(x) = \frac{x^4\sqrt{x^2+1}}{(3x+4)^2}$
- Use 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. $f(x) = \frac{x^4\sqrt{x^2+1}}{(3x+4)^2}$.

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