# Exponential Derivatives

**Goal**:

- Understands that $\frac{d}{dx}e^x = e^x$
- Can use implicit differentiation to show $\frac{d}{dx}\ln x = \frac{1}{x}$

**Terminology**:

- None

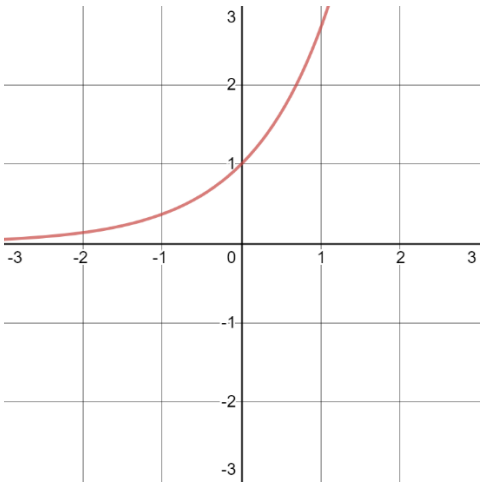
**Reminder**:

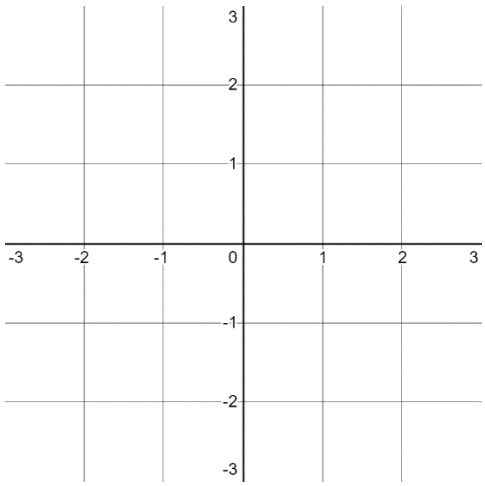
- Quiz on Implicit and Logarithmic Differentiation next Wednesday
- Test on Tuesday November 12th

**Review**: Show

$$\frac{d}{dx}\arctan u = \frac{1}{1+u^2}\cdot\frac{du}{dx}$$

Given the graph of $f$, draw the graph $f'$.



There is a very speacial number $e = 2.71828\ldots$ that is involved here. Our goal is to show that

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

And one way this is done is to use the definition of the derivative and the definition that

$$e = \lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$$

(watch the video on the website)

But I want to build this function organically and give a preview of **Taylor Series** to those who are going to write the BC exam.

**Example**: Find $\frac{df}{dx}$ given that $f(u) = e^{u^2} \cdot \arccos u$

**Example**: And of course we want to find the derivative of the exponential inverse, logarithm. So, what is the derivative of

$$y = \ln x$$

**Example**: Find $\frac{df}{dx}$ given that $f(u) = \ln(\operatorname{arcsec} u)$

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| **Practice Problems**: 3.8: # 1-10 and 21-30 (at least every other), 41, 42<br>  # 50, 52 |
| **Look Ahead**: How can logarithms help differentiate $y = \frac{1}{x(x+1)(x+2)}$ |

# In Class Evidence

Find $dy/dx$ for the following.

5. $y = e^{\frac{2x}{3}}$

8. $y = x^2e^x - xe^x$

29. $y = \ln(\ln x)$

30. $y = x \ln x - x$

42. Find an equation for a line that is tangent to the graph of $y = xe^x$ and goes through the origin.

52. Prove that the curve $y = -\frac{1}{2}x^2 + k$ is perpendicular to $y = \ln x + c$ at their points of intersection. (see textbook for illustration)