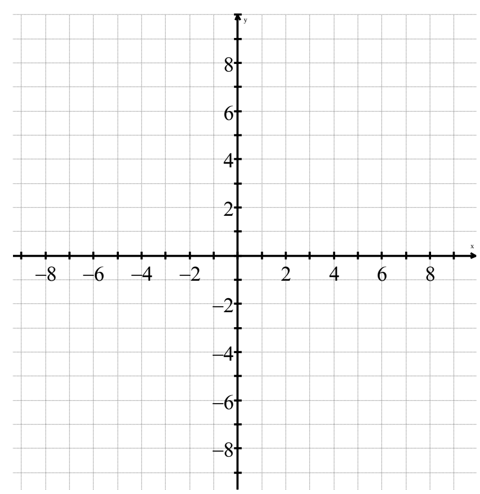
5.4 /5.5 Derivative of the Natural Exponential Function and exponential functions

Review: Definition: The inverse of the natural log function f(x)=ln x is the natural exponential function.

Solve for x: $6 = e^{2x}$

Graph of $y = e^x$



Domain:
Range:
End behavior:

Always increasing

Given $y = e^x$ **Find f'(x) using log differentiation.**

The general derivative of $y = e^u$ **is**

Ex. 1: Find the derivative of the following functions:

a. $y = e^{2x}$ b. $y = \frac{1}{e^{\frac{x}{4}}}$ c. $y = x^{1-e}$

Ex. 2 Harder

a) $f(x) = 3\cos x - e^x$

b) $g(x) = \frac{3}{\sqrt{x}} + \frac{4\pi}{e^2}e^x$

c) $y = \sec\left(xe^{\sin 2x}\right)$

d) $y = \ln|x + e^{x^2}|$

Ex. 3: Find the average rate of change over the interval from $[0,2]$ of the function $h(x) = x^2 + e^x$ and then find the instantaneous rate of change at each of the endpoints.

Ex. 4: At what points does this function have a horizontal tangent line? $y = \frac{e^x}{x}$

EX. 5: A particle moves along the *x*-axis such that its position can be modeled by the equation $x(t) = 3t^2 + 9t - e^t$, where t represents the time in seconds, $t \geq 0$ and x(t) is meters.

a) Find the velocity and acceleration function.

b) Find the initial position, velocity and acceleration of the particle.

c) What is the velocity of the particle when the acceleration is zero?

d) When is the particle moving to the right? Justify your answer.

Theorem – Derivatives for Bases Other than *e*

Let *a* be a positive real number ($a \neq 1$) and let *u* be a differentiable function of *x*.

$$\frac{d}{dx}\left[a^u\right] =$$

Ex. 6: Find the derivative of each of the following:

a) $y = 2^{3x}$

b) $\frac{d}{dx}\left[(1-2^{3x})^2\right] =$

c) $\frac{d}{dx}\left[x^4 4^x\right] =$

We don't use these much!!!