

Math 130 Day 20

Come see me if you need help. **The Math Intern** is available for help Sunday through Thursday: 7–10 pm and Monday through Thursday noon to 5 pm in Lansing 309. Most Assignments and Labs are available at <http://math.hws.edu/~mitchell/Math130F03/index.html>

Homework

Today we discuss exponential functions and their derivatives. We will derive the formula $D_x(e^x) = e^x$. Amazing... we have found a function that is its own derivative! An easy formula to remember.

1. Quick Quiz on Monday on all Derivative Rules.

- Review your notes on exponential functions and reread Chapter 2.2, page 129 and Chapter P.6 pages 47–48. Then read about logarithms in Chapter P.6 and look at the corresponding material on derivatives in Chapter 2.4 pages 152–155. Skim ahead in Chapter 4.5.
- Exponential derivatives: Page 143ff #15, 41, 51, 53, 67, 71, 89.
- Chain rule practice (with exponentials): Page 156ff #7, 49, 65, 67, 69, 103, 105.

2. Find the derivatives of the following functions. (Simplified answers below.)

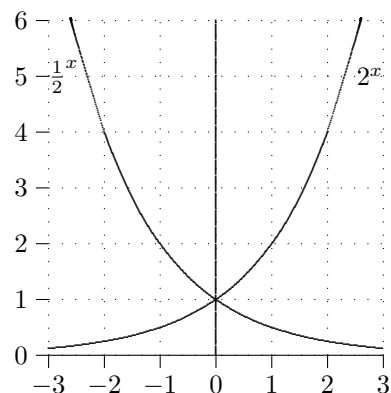
- | | | | | |
|-----------------------|------------------------|------------------------------|------------------|-------------------------|
| a) $e^x \sin x$ | b) $e^x + x^e + x + e$ | c) $\frac{e^x - 1}{e^x + 1}$ | d) $6x^4 e^x$ | e) $\frac{\tan x}{e^x}$ |
| f) $\frac{e^{2x}}{x}$ | g) e^{8x^2+1} | h) $e^{\sec x}$ | i) $(e^x + 1)^4$ | j) $2e^{-x}$ |

3. Study Tip: Once a week review the previous lab. Select parts of 5 or 6 problems and pretend it's a test. Take 60 minutes and see how you do. Check your answers using the answer sheet.

Class Work On Exponentials

1. Fill in the tables below for the values of $y = a^x$. Then draw the graphs. What is the relationship between corresponding pairs of graphs?

x	2^x	3^x	1^x	$\frac{1}{2}^x$	$\frac{1}{3}^x$
-3	$\frac{1}{8}$			8	
-2	$\frac{1}{4}$			4	
-1	$\frac{1}{2}$			2	
0	1			1	
1	2			$\frac{1}{2}$	
2	4			$\frac{1}{4}$	
3	8			$\frac{1}{8}$	



2. We will know the derivative of a^x once we determine $\lim_{\Delta x \rightarrow 0} \frac{a^{\Delta x} - 1}{\Delta x}$. Estimate this limit for various values of a using your calculator with $\Delta x = 0.00001$.

a	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3
$\lim_{\Delta x \rightarrow 0} \frac{a^{\Delta x} - 1}{\Delta x}$					

- | | | | | |
|-------------------------------|-------------------------|--------------------------------|----------------------|------------------------------------|
| a) $e^x(\sin x + \cos x)$ | b) $e^x + ex^{e-1} + 1$ | c) $\frac{2e^x}{(e^x + 1)^2}$ | d) $6x^3(x+4)e^x$ | e) $\frac{\sec^2 x - \tan x}{e^x}$ |
| f) $\frac{e^{2x}(2x-1)}{x^2}$ | g) $16xe^{8x^2+1}$ | h) $(\sec x \tan x)e^{\sec x}$ | i) $4e^x(e^x + 1)^3$ | j) $-2e^{-x}$ |

Homework to Hand In

You may wish to **review** Lab 6 before doing these.

1. Practice using the basic derivative laws. Find the derivatives of each of these functions.

a) $6x^{-4/3} \sec x$ b) $\frac{2e^x}{\cos x}$ c) $\left(15 + \frac{\sin x}{4}\right)^{1/2}$ d) $\tan(2x^3)$

2. A particle moves along a straight line so that its position is $s(t) = t \sin t + \cos t$, where t is measured in seconds and s in meters.

- Determine the velocity of the particle.
- Determine the acceleration of the particle. (The is just the rate of change in the velocity. Use a derivative.)
- Determine the **jerk** of the particle. (The jerk is the rate of change in acceleration.)
- During the time interval $[0, 2\pi]$, when is the particle at rest? Which function is relevant: Position, velocity, acceleration, or jerk?

3. a) Let $f(x) = x^2 e^x$ on the interval. Find the points where f has horizontal tangents. These are called **stationary** or **critical** points of f . Hint: Simplify the derivative.

- b) What is the equation of the tangent line at $x = 1$? (Remember e is just a number like π .)

4. I want to make sure that you remember how to use the limit definition of the derivative. Let $f(x) = \sin 3x$. Use the **limit definition** of the derivative to find $f'(0)$, the derivative at the point $x = 0$. You will need to use the methods for calculating trig limits that we developed Monday.

Math 130 Quick Quiz Day 20. Name:

1. Use the rules we have developed to quickly determine the derivatives of each of these functions.

a) $f(x) = 2 \sec x$

b) $f(x) = \frac{1}{2\sqrt[5]{x^3}}$

c) $f(x) = \frac{\cos x}{3}$

d) $f(x) = 7 + x^4 \tan x$

e) $f(x) = \frac{1 - \cos x}{1 + \sin x}$. Simplify your answer.

f) $f(x) = (x^2 - x + 1)^3$

2. Carefully evaluate $\lim_{x \rightarrow 0} \frac{\sin 8x}{4x}$. Show work.