Math 130 Day 16

Homework and Practice.

Today we will explore the exponential function $y = e^x$ and its derivative. This is the easiest of the derivative rules!

1. a) Review Section 3.3. Read about the exponential and higher-order derivatives on pages 147–150. Then read ahead in Section 3.4 about the product and quotient rules through page 156.

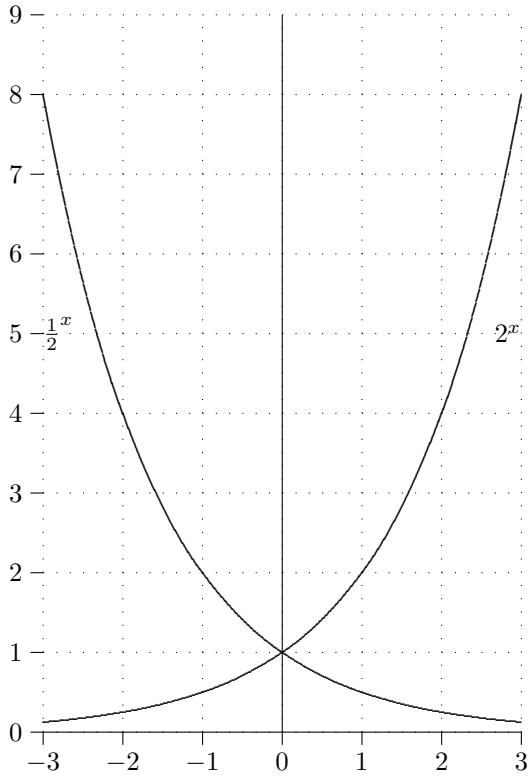
b) You should be able to do all of these: Page 151f #21–27 odd, 29 (simplify first), 31 (simplify first), 41, 43, 47 (good questions!), 51, 71, and 75.

Class Work: Derivatives of 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			$\frac{1}{8}$	

h	$\frac{(2^h - 1)}{h}$
.01	
.0001	
.000001	
$-.001$	
$-.000001$	



2. We will know the derivative of a^x once we determine $\lim_{h\to 0} \dfrac{a^h - 1}{h}$. Estimate this limit for various values of a using your calculator with $h = 0.000001$. In other words evaluate: $\dfrac{a^{0.000001} - 1}{0.000001}$.

a	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3	2.5
$\lim_{h\to 0} \dfrac{a^h - 1}{h}$						

3. Try to locate a value of a so that $\lim_{h\to 0} \dfrac{a^h - 1}{h} = 1$. Estimate this limit using $h = 0.000001$. From the table above, should you start with $a > 3$? Between 2 and 3? Less than 2?

Your a						
$\lim_{h\to 0} \dfrac{a^h - 1}{h}$						

Solution: (a) $f'(t) = 6t + 2$. (b) **velocity** at time $t = 1$: $f'(1) = 8$. (c) Tangent: $y = 2 + 8(x - 1) = 8x - 6$.

Office Hours (LN 301/301.5): M 3:30-4:30, Tu 11:00-1:00, W 12:15-1:15, F 1:30-2:30. Other times by appointment. **Math Intern:** Sun through Thurs: 3:00–6:00, 7:00–10:00pm. **Website:** Use the links at the course homepage on **Canvas** or go to my course Webpage: `http://math.hws.edu/~mitchell/Math130F16/index.html`.

WeBWorK

New set: WeBWorK Day16A due Thursday. Remember to finish WeBWorK Day 15.

One Minute Self Quiz. Answers on the other side.

1. a) Let $f(t) = 3t^2 + 2t - 3$ represent the **position** of an object at time t. Find $f'(t)$.

b) What is the object's **velocity** at time $t = 1$. Use your work in part (a).

c) What is the **equation of the tangent line** at $t = 1$.

Hand In.

You need to do lots of differentiation practice: To use the power rule formula, you need to use exponent notation properly. For example if $f(x) = \frac{3}{x^{1/2}} + \frac{1}{2x}$, this can be rewritten as $f(x) = 3x^{-1/2} + \frac{1}{2}x^{-1}$. Similarly, $2\sqrt[3]{x^5} = 2x^{5/3}$.

Use proper mathematical grammar. Remember when taking derivatives **DO NOT** write expressions such as

$$f(x) = 6x^2 + 2x \overset{\text{This is wrong}}{=} 12x + 2.$$

The original function is NOT the same as its derivative. What you mean is

$$f(x) = 6x^2 + 2x \text{ and so } f'(x) = 12x + 2 \text{ or else write } \frac{d}{dx}(6x^2 + 2x) = 12x + 2.$$

☞**The problems are on the next page.**

Math 130, Day 16. Hand In. Name: _____

1. Use proper notation. Use the basic derivative rules we have developed to find the derivatives of

a) $f(x) = 6x^8 + \dfrac{x^{-12}}{2} - 7$

b) $g(x) = 9x^{12/5} + 9x^{-12/5} + \pi$

c) $s(t) = 2t^{-3/5} - \dfrac{e^t}{4}$

d) $s(x) = \dfrac{5e^x}{2} - 3\sqrt[7]{x^4}$ (first rewrite in exponent form)

e) $q(x) = 6\sqrt{x} - 2e^x + 7$

.

f) $g(w) = \dfrac{1}{4\sqrt[3]{w^5}}$ (first rewrite in exponent form)

g) $f(t) = \frac{4}{t^8} - 3e^t + t$

h) Suppose in the previous part the function $f(t)$ represents the position of an object at time t. What is the instantaneous velocity at time $t = 1$?

2. Compute and compare the derivatives of

a) $r(x) = \dfrac{1}{5x^{11}}$

b) $s(x) = \dfrac{5}{x^{11}}$.

c) Were they the same? (They should not be!)

4. a) Close Reading: In Section 3.3, the authors state what they believe is a **remarkable fact** about the exponential function. What is it?

b) Close Reading: Read ahead in Section 3.4. The authors use a 'useful tactic' in the proof of the product rule. Explain what the tactic is.

5. a) Do page 151 #28. Read the instructions first!

b) Do page 151 #30.

c) Do page 151 #38.