Math 130 Day 21

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`.

Practice

1. Read/Re-read **Chapter 3.9** on Derivatives of Logs and Exponentials. Review the **online notes**. We will finish this next time and also review Implicit Differentiation. (So review Chapter 3.8)

2. Page 211 #3, 9, 11, 15 (simplify first with a log rule), 17, 19(a classic).

a) Page 211 #23, 25, 27

3. Find the derivatives of these three exponentials (answers below)

a) $x^3 5^x$ **b)** $4^{6\cos x}$ **c)** $9^{e^{2x}\tan x}$

d) Find the tangent line to the curve in (a) at the point $(2, 1)$ Answers: Use $D_x(b^u) = b^u \frac{du}{dx}$.

a) $D_x(x^3 5^x) = 3x^2 5^x + x^3 5^x \ln 5 = x^2 5^x (3 + x\ln 5)$ **b)** $D_x(4^{6\cos x}) = -4^{6\cos x} 6 \sin x \ln 4$

c) $D_x(9^{e^{2x}\tan x}) = 9^{e^{2x}\tan x}(2e^{2x}\tan x + e^{2x}\sec^2 x)$

Hand In Next Time

Do WeBWorK Set Day 21. Due Thursday night. Remember Set Day 20 (Chain Rule Review) due Wednesday.

1. Determine the tangent line to $y^3 + \ln(y^2) = x^3 + x + 1$ at $(-1, 1)$.

$$\frac{d}{dx}\left(y^3 + \ln(y^2)\right) = \frac{d}{dx}(x^3 + x + 1)$$

$$3y^2\frac{dy}{dx} + \frac{2y}{y^2}\frac{dy}{dx} = 3x^2 + 1$$

$$\left(3y^2 + \frac{2}{y}\right)\frac{dy}{dx} = 3x^2 + 1$$

$$\boxed{\frac{dy}{dx} = \frac{3x^2+1}{3y^2 + \frac{2}{y}}}$$

Note: $(-1, 1)$ is not on the curve (my error)

if it were

at $(-1, 1)$:

$$m = \left.\frac{dy}{dx}\right|_{(-1,1)} = \frac{3(-1)^2 + 1}{3(1)^2 + \frac{2}{1}} = \frac{4}{5}$$

Eqn of tangent: $\boxed{y - 1 = \frac{4}{5}(x+1)}$ or $y = \frac{4}{5}x + \frac{9}{5}$

2. Compute and compare the derivatives of

a) $\frac{d}{dx}\left[\ln(x^6)\right] = \frac{6x^5}{x^6} = \boxed{\frac{6}{x}}$

or $\frac{d}{dx}(\ln(x^6)) = D_x(6\ln x) = \frac{6}{x}$

b) $\frac{d}{dx}\left[(\ln x)^6\right] = 6(\ln x)^5 \cdot \frac{1}{x} = \frac{6(\ln x)^5}{x}$

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3. Determine and simplify the derivative of $f(t) = \frac{3+\ln t}{e^{4t}}$.

$$f'(t) = \frac{\left(\frac{1}{t}\right)\cancel{e^{4t}} - (3+\ln t)4\cancel{e^{4t}}}{(e^{4t})^{\cancel{2}}} = \boxed{\frac{\frac{1}{t} - 12 - 4\ln t}{e^{4t}}}$$

4. Find and simplify the derivative of $g(t) = 8 - 7\ln(\cos t)$ (where $t \in (-\pi/2, \pi/2)$ so that g is defined).

$$g'(t) = \frac{-7(-\sin t)}{\cos t} = \boxed{7\tan t}$$

5. Find the derivative of $g(x) = \ln(x^2+9)^{1/2}$. Hint: Simplify using a log law before differentiating.

$$g(x) = \frac{1}{2}\ln(x^2+9)$$

$$g'(x) = \frac{1}{2} \cdot \frac{2x}{x^2+9} = \boxed{\frac{x}{x^2+9}}$$

6. If $p(x) = 7x^5 \ln(6x)$, then $p'(x) =$ $35x^4 \ln(6x) + 7x^{\cancel{5}\,4} \cdot \frac{\cancel{6}}{\cancel{6x}} = 35x^4\ln(6x) + 7x^4$

$$= 7x^4\left[5\ln(6x) + 1\right]$$

7. Find the derivative of $g(x) = \ln\left(\frac{2x^3+1}{x^2+3x+1}\right)$. Hint: Simplify using a log law before differentiating.

$$g(x) = \ln(2x^3+1) - \ln(x^2+3x+1)$$

$$g'(x) = \frac{6x^2}{2x^3+1} - \frac{2x+3}{x^2+3x+1}$$

8. Complete the definition: The function g is the **inverse** of the function f if

1) $f(g(x)) = x$ for all x in the domain of g

2) $g(f(x)) = x$ for all x in the domain of f