Math 130 Day 22

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. Practice Problems for Test 2 are now online. Answers posted by Monday ~~Wednesday~~ morning.

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

3. **a)** Page 199 #3, 9, 11, 15 (simplify first with a log rule), 17, 19(a classic).
b) Assuming we get this far: Page 199 #17 and 19.

4. More implicit differentiation problems. The answers are below. For each relation, find $\frac{dy}{dx}$.

a) $3y + \ln y = x^2 - x$ **b)** $\ln(x+y) = 2x$
c) Find the tangent line to the curve in (a) at the point $(2, 1)$

Answers

a) $\frac{dy}{dx} = \frac{2x-1}{3+\frac{1}{y}} = \frac{2xy-y}{3y+1}$ **b)** $\frac{dy}{dx} = 2x + 2y - 1$ **c)** $y = \frac{2}{7}x + \frac{3}{7}$

Hand In at Lab: Name: ____________________

1. Determine $\frac{dy}{dx}$ if $\sin(x^2y^2) = 2x - 1$.

$$\frac{d}{dx}\left(\sin(x^2y^2)\right) = \frac{d}{dx}(2x-1)$$

$$\cos(x^2y^2)\left[2xy^2 + 2x^2y\frac{dy}{dx}\right] = 2$$

$$2xy^2\cos(x^2y^2) + 2x^2y\cos(x^2y^2)\frac{dy}{dx} = 2$$

$$2x^2y\cos(x^2y^2)\frac{dy}{dx} = 2 - 2xy^2\cos(x^2y^2)$$

$$\frac{dy}{dx} = \frac{2 - 2xy^2\cos(x^2y^2)}{2x^2y\cos(x^2y^2)} = \frac{1 - xy^2\cos(x^2y}{x^2y\cos(x^2y^2)}$$

2. Determine the derivative of $f(x) = \ln|x^2 \sin x|$. Hint: Simplify using a log law before differentiating.

$$f(x) = \ln|x^2| + \ln|\sin x|$$

$$f'(x) = \frac{1}{x^2}\cdot 2x + \frac{1}{\sin x}\cdot\cos x$$

$$= \frac{2}{x} + \frac{\cos x}{\sin x} = \frac{2}{x} + \cot x$$

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3. Find the derivative of $g(x) = \ln\sqrt{x^4 + 9x^2 + 6}$. Hint: Simplify using a log law before differentiating.

$$g(x) = \ln(x^4+9x^2+6)^{1/2} = \frac{1}{2}\ln(\underbrace{x^4+9x^2+6}_{u})$$

So $g'(x) = \frac{1}{2} \cdot \frac{1}{u} \cdot \frac{du}{dx}$

$$= \frac{1}{2} \cdot \frac{1}{x^4+9x^2+6} \cdot (4x^3+18x) = \frac{2x^3+9x}{x^4+9x^2+6}$$

4. Find the derivative of $g(x) = 6x^5 \cdot 5^x$.

$$g'(x) = 30x^4 \cdot 5^x + 6x^5 \cdot 5^x \ln 5$$

$$= 6x^4 \cdot 5^x\,(5 + x\ln 5)$$

5. Find the derivative of $g(x) = 2^{\overbrace{\sin(3x^2)}^{u}}$. $= 2^u$

$$g'(x) = 2^u \ln 2 \frac{du}{dx} = 2^{\sin(3x^2)} \cdot \ln 2 \cdot \cos(3x^2) \cdot 6x$$

6. Use logarithmic differentiation to determine the derivative of $y = (x^2+1)^{4x^3}$.

$$\ln y = \ln(x^2+1)^{4x^3} = 4x^3\ln(x^2+1)$$

$$\frac{d}{dx}(\ln y) = \frac{d}{dx}\left(4x^3\ln(x^2+1)\right)$$

$$\frac{1}{y}\frac{dy}{dx} = 12x^2\ln(x^2+1) + 4x^3 \cdot \frac{1}{x^2+1} \cdot 2x$$

$$\frac{1}{y}\frac{dy}{dx} = 4x^2\left(3\ln(x^2+1) + \frac{2x^2}{x^2+1}\right)$$

$$\frac{dy}{dx} = y \cdot 4x^2\left(3\ln(x^2+1) + \frac{2x^2}{x^2+1}\right)$$

$$= (x^2+1)^{4x^3} \cdot 4x^2\left(3\ln(x^2+1) + \frac{2x^2}{x^2+1}\right)$$