Differentiate between the Good, the Bad and the Ugly

Homework 2: Due Wednesday, September 7

In this homework we cover the differentiation rules \(Dx^n\), \(D\)trig fcns (You may make a heuristic guess of \(D\)sin and \(D\)cos from the graphs and compute the rest), \(D(f \cdot g)\), \(D(f/g)\) and \(D(f \circ g)\). You need to memorize all of these formulae, so put them on a special page and start now. It is helpful to write power functions in the form \(x^{\frac{p}{q}}\) not \(\sqrt[\frac{q}{p}]{x}\). The first form is best for calc, the second form is best for algebra. This is covered in sections 3.1, 3.2, 3.4 and 3.5. The derivative is incredibaly important, so there are many different notations that are used to represent derivatives. You should be able to recognize any of these notations: \(Dy\), \(Df(x)\), \(f'(x)\), \(\dot{y}\), \(\dot{z}\), \(f_x\), \(\frac{dy}{dx}\), \(\frac{d}{dx}f(x)\) there are probably some that I’m missing here.

sec 3.1 page 191: 4, 8, 10, 22, 26, 55, 56
sec 3.2 page 197: 7, 14, 17, 20, 32, 38
sec 3.4 page 216: 5, 9, 10, 14, 18, 19
sec 3.5 page 224: 2, 4, 19, 25, 33, 34, 37, 40

As an aside, let me describe some of the things that appear in some calc classes that we missed. Limits with compound fractions such as \(\lim_{x \to 0} \frac{1}{x^2} - 1\) (multiply the top and bottom of the big fraction by 3x to get rid of the compound fractons.) Limits with radicals such as \(\lim_{x \to 2} \frac{2 - \sqrt{2 + x}}{6 - 3x}\) (multiply the top and bottom of the fraction by the conjugate \(2 + \sqrt{2 + x}\).) Limits requiring cancelation with trig functions such as \(\lim_{x \to 0} \frac{\sin(4x)^2}{\tan(3x) \sin(3x)}\) (use the approximations \(\sin x \approx x\) when \(x \to 0\) and \(\cos x \approx 1 - \frac{1}{2}x^2\) when \(x \to 0\). In fact in calc II you will see that sin and cos are defined by \(\sin x = x - \frac{1}{6}x^3 + \frac{1}{120}x^5 \mp \ldots\) and \(\cos x = 1 - \frac{1}{2}x^2 + \frac{1}{24}x^4 \mp \ldots\).

Homework 3: Due Friday, September 16 (Including the More problems)

In this homework we continue with differentiation formulae. We cover \(De^x\), \(D\ln\), \(D\) arctan, and \(D\)hyperbolic trig (which you should memorize). We also cover the techniques of implicit differentiation and logarithmic differentiaiton. You need to practice until you can differentiate ANYTHING. The first test will contain a large section on differentiating with no partial credit. After enough drill this will become easy for you, so if you are having problems with 3-rule differentiation problems, keep practicing until you get it then move on to 5 and 6-rule differentiation problems.
More problems: Compute the derivatives of the following:

1. (2-rule) \( y = \left( \frac{13x^2 \sqrt[3]{3x}}{2 \sqrt[4]{x}} + \frac{5\sqrt{x}}{2x^2} \right) \csc x \)

2. (2-rule) \( y = \arcsin(4x) \)

3. (2-rule) \( y = x^5 \tan x \)

4. (5-rule) \( y = \cos(x^3 \sin x) \)

5. (7-rule) \( y = \ln(\cosh(3x) 5^x) \sin(e^x) \)

6. (8-rule) \( y = \frac{2 + \sqrt{e^{5x} + \sec x}}{\arctan 5x + 5 \coth x} \)

7. (10-rule)

\[
y = \frac{e^{4x}}{\left( \frac{1 + \sinh 5x}{\ln x} \right)^{\left( \frac{\ln x}{2 + \coth 2x} \right)}}
\]

8. (9-rule) \( y = \arcsin x \cdot \arcsinh x \cdot \arccos x \cdot \arctan x \cdot \arctanh x \)

9. (13-rule) \( y = \ln(\cos(x^2 \sinh(\sqrt[3]{\tanh(67x)}))) \)

Compute the following

11. \( \frac{de}{ds} \) given \( e = \pi \sqrt{7} s^4 \tanh(s^3 - 3s\sqrt{7}) \)

12. \( H_p \) given \( H = 5p \sin(p^2) + 4qp \)

13. \( \dot{z} \) given \( e^{5z} + 3z^3 - t \sin(2t^4) = 7 \)

14. \( f'(x) \) given \( f(x) = \left( \frac{\pi}{\sqrt{e}} + 45e^3 \right) \cot(143) \)