Week 9-Lab 1: Worksheet 11: Sections 3.9 and start of 3.10

Logarithmic Differentiation

(I) Take the natural logarithm of both sides of an equation $y = f(x)$ and use the Laws of Logarithms to simplify the expression.

(II) Differentiate the expression implicitly with respect to x.

(III) Solve for dy/dx, replacing y with $f(x)$.

Solving Related Rates Problems

(1) If applicable, draw one or more figures representing the situation found in the problem.

(2) Identify the quantities in the problem. Clearly identify which are constants and which are variables.

(3) Determine which rates of change are known and which rates need to be calculated.

(4) Find an equation which **relates** the quantities whose rates you know to quantities whose rates you need to calculate.

- Often, this equation is geometric.

(5) Differentiate the equations implicitly and then substitute known quantities. Solve explicitly for the rates that need to be calculated.

Names: _____

Work in groups to do this portion of the worksheet. Make sure to take parts in solving the problems. Your participation score is a combination of being prepared, willing to explore the problem, working in groups and contributing toward the solution.

1. **Background Story:** We use combine logarithmic differentiation and other rules.

   (a) Calculate the derivative of $z = x^{7x+2}$.

   (b) **Use Part (a)** to calculate the derivative of $y = 3e^{x^{7x+2}} + 8$. [1]

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[1] *(Precalculus review:* $e^{x^{7x+2}} = e^{(x^{7x+2})}$, $\ln|uv| = \ln|u| + \ln|v|$, $\ln(u^v) = v\ln(u)$, $\ln(e) = 1$ & $\ln(1) = 0$.)

2. Use **logarithmic differentiation** to calculate the derivative of

$$f(x) = (x^2 + 1)(2x + 3)(7x + 5)(10x + 14)^3.$$

Video: https://youtu.be/7xgmasS3n4s

3. **Background Story:** In solving related rate problems, first step is to understand what are the variables and what are the constants. Then remembering that derivative of each term with those variable will have rate of change of those variable as derivative of inside function.

   Questions: The volume of a square based prism is given in terms of the side of the base, b, and the height, h, as $V = b^2h$. The base and height are changing over time. At a particular instant, $b = 7$, $\dfrac{db}{dt} = 4$, $h = 6$, and $\dfrac{dh}{dt} = -5$.

   (A) What are the variable in this question?

   (B) Find an equation relating the rates.

   (C) **What is $\dfrac{dV}{dt}$ at that instant?**

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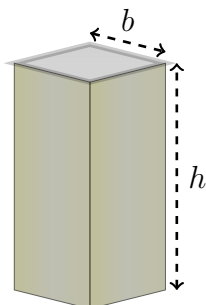
GroupWork Rubrics:

Preparedness: ——/0.5, Contribution: ——/0.5, Correct Answers: ——/0.5

Individual Portion of the Worksheet

Name: _____

Upload this section individually on canvas or turn it in to your instructor on the 2nd lab day of the week. You can ask questions in class and work in groups but you turn in the individual work. Start before the class so you can ask questions during the class. If you didn't complete the work in class, make sure to work on it outside the class and complete it. Show all your work; your score depends on the work you have shown.

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4. *(3.5 points)* Let $f(x) = \left(6x + 1 \right)^{\frac{1}{\sin(x)}}$. Calculate $f'(x)$.

Video: https://youtu.be/ZDbUy5rcprQ