Review Chapters 3 and 4  
MA 1161 - T. Olson

The review questions from test #2 are also relevant here . . . chapters 3 and 4 cover the same concepts, but with formulas for basic functions. For example, you still need to know the concepts in order to interpret the formulas or to use when the formulas don’t apply.

1. Given a formula for a function \( f(x) \), how do you find the equation for the line tangent to \( f \) at \( x = 3 \)?
2. For which kinds of functions do we have formulas for the derivative?
3. How can you tell the difference between a power function and an exponential function? What are the derivative formulas in each case?
4. What are the product and quotient rules? How do you know if you need to use them?
5. What is the chain rule and why do we need it?
6. What are the basic derivative rules (formulas)? How do these change if you replace \( x \) with a function of \( x \)?
7. How do you know when to use each of the rules (formulas) for differentiation? Compare: power rule vs. exponential functions, product rule vs. chain rule, derivative of a constant vs. derivative of a constant multiple.
8. Try to write each of the differentiation formulas in terms of the function \( g(t) \) instead of \( f(x) \).
9. How can you check a derivative formula using your calculator?
10. What are the steps you use to find the formula for the line tangent to a curve at a point?
11. If the derivative of \( f(x) \) is positive over an interval, what does that tell you about \( f \) itself?
12. Suppose you want to divide up the \( x \)-axis into regions where \( f' > 0 \) and where \( f' < 0 \). How do you decide where the divisions go? How do you decide the sign of \( f' \) on each of the regions?
13. If \( f''(x) \) is positive over an interval, what does that tell you about \( f \) itself?
14. Suppose you want to divide up the \( x \)-axis into regions where \( f'' > 0 \) and where \( f'' < 0 \). How do you decide where the divisions go? How do you decide the sign of \( f'' \) on each regions?
15. Give an example of the graph of a function \( f(x) \) for each of the following scenarios:
   \( f'(x) > 0 \) and \( f''(x) > 0 \)
   \( f'(x) > 0 \) and \( f''(x) < 0 \)
   \( f'(x) < 0 \) and \( f''(x) > 0 \)
   \( f'(x) < 0 \) and \( f''(x) < 0 \)

16. How does implicit differentiation work? Practice by differentiating \( x = e^y \) (your answer for \( dy/dx \) should be the formula for the derivative of \( y = \ln(x) \)).
17. What is a critical point?
18. What is a local maximum? A local minimum? A global (absolute) maximum? A global (absolute) minimum? How do you go about finding these using derivatives? How can you check you answer?
19. What is an inflection point? How is it related to the rate of change of slope?
20. Explain three ways to check whether a critical point is a local maximum/minimum or neither (using the first derivative, the second derivative, or the function itself).
21. Sketch the graph of a function which has a critical point that is NOT a maximum or a minimum.
22. Sketch the graph of a function which has \( f''(x_0) = 0 \), but which does NOT have an inflection point at \( x_0 \).
23. Suppose we have a point \( x^* \) at which the SLOPE of \( f \) is a maximum. What can we say about \( f''(x^*) \)?
24. When can you have a critical point at which the first derivative is NOT zero?
25. If you have a function of one variable, where do you look for the global maximum and minimum? Why?
26. What are the questions Tami asks you to answer when dealing with any optimization (max. or min.) problem?
27. What is your game plan for attacking an optimization word problem?
28. What is your game plan for attacking a related rates word problem?