Directed Study in Mathematics Name ______________________

1.6 Differentials Date ______________ Pd ______

<u>Required reading:</u>

- Larson 9e: pages 235-239
- Dawkins: Calculus I, section 4-12: Differentials
  http://tutorial.math.lamar.edu/Classes/CalcI/Differentials.aspx
  - Notes: Read all. (Last modified: 05/30/2018)
  - Practice Problems: Review all. (Last modified: 02/20/2018)

<u>Required homework:</u>

- Larson 9e: pages 240-241, problems 28, 30, 34, 42, 43
- Dawkins: Assignment problems 7, 11, 13 (Last modified: 02/20/2018)

<u>Additional comments regarding this topic:</u>

Since we are dealing with numbers that include small decimals, we sometimes need to use a calculator to perform numerical computations. We are still expected to perform all derivatives by hand—the calculator should only be used for evaluating, not for determining derivative values at a point.

When computing differentials where the result contains a sum or difference, do not forget a set of parentheses around the expression. That is because the dx applies to the entire sum/difference, not just the last term in the sum/difference. For example, given $y = xe^x$, we would state that $dy = (xe^x + e^x)\,dx$, and <u>not</u> $xe^x + e^x\,dx$.

Note that we required similar grouping symbols when writing integrals—we would write $\int (xe^x + e^x)\,dx$, and <u>not</u> $\int xe^x + e^x\,dx$. The fact that the integral has a starting $\int$ and an ending dx gives us some leeway in forgetting our parentheses, but that is sloppy communication.

<u>Additional comments regarding the Larson reading:</u>

Example 1 is nothing new—we used tangent lines to approximate function values in AP Calculus BC. In fact, we even took this idea further in our study of series—tangent line approximations are simply first-degree Taylor polynomials, whereas higher-degree Taylor polynomials gave us better approximations.

In our study of differentials, note that we have our point of tangency $(c, f(c))$ and a nearby point $(c + \Delta x, f(c + \Delta x))$, as shown in Figure 3.66. Δx is the <u>actual</u> change in x, and $\Delta y = f(c + \Delta x) - f(c)$ is the <u>actual</u> change in y. But $\Delta y \approx f'(c)\,\Delta x$ is an <u>approximation</u> change in y. This is because we are using the tangent line, and not the function f itself, to determine $f'(c)\,\Delta x$.

For problems such as Example 7, be careful with the choice of x and dx. We want our choice of x to be close to the approximation value (i.e., we want dx to be small in magnitude). We could easily perform a calculation with $x = 9$ and $dx = 7.5$, but that would not be as accurate.