Math 16B: Short Calculus II  
Winter 2018, Section 3  
Homework Sheet 2  
Due: Monday, January 22, 2018

Submit your solutions to the following problems in lecture on the due date above. Present your work in a clean and organized fashion, either on a printed copy of this document (preferred) or a separate sheet of paper. As stated in the syllabus, late submissions will not be accepted.

1. Find the derivatives of the following functions.

   (a) \[ f(x) = \frac{\ln(x)}{e^x} \]

\[ f'(x) = \frac{\frac{1}{x} e^x - \ln(x) e^x}{(e^x)^2} \]

(b) \[ f(x) = \ln(x^2(x + 1)^3) \]

\[ f'(x) = \frac{1}{x^2(x + 1)^3} \cdot \frac{d}{dx} \left[ x^2(x + 1)^3 \right] \]

\[ = \frac{1}{x^2(x + 1)^3} \left( 2x(x + 1)^3 + 2x^2(3(x + 1)^2) \right) \]

2. Using properties of logarithms, write the following using only a single logarithm.

\[ 3(\ln(x + 2) - 4\ln(2x^3) + \ln(x^2 + 1)) \]

\[ = 3 \left( \ln(x + 2) - \ln(2x^3)^4 + \ln(x^2 + 1) \right) \]

\[ = 3 \left( -\ln(\frac{1}{2x^3}) + \ln(x^2 + 1) \right) \]

\[ = 3 \left( \ln\left( \frac{2x^3}{x^2 + 1} \right) \right) \]

3. Find the half-life of a radioactive substance for which 99% remains after 1 year.

\[ R(t) = Ce^{-kt} \]

\[ C = \text{initial count} \]

\[ R(1) = 0.99C \]

\[ 0.99C = Ce^{-k(1)} \]

\[ 0.99 = e^{-k} \]

\[ \ln(0.99) = -k \]

\[ |C| = -\ln(0.99) \]

\[ \frac{1}{2} C = Ce^{\ln(0.99)} \]

\[ 0.5 = e^{\ln(0.99)} \]

\[ t = \frac{\ln(C)}{\ln(0.99)} \text{ yrs} \]