Math 16A Discussion Problem Set
Week 7 Question Bank

October 13th

Group 1

A company that manufactures bicycles has determined that a new employee can assemble $M(t)$ bicycles per day after t days of on-the-job training, where

$$M(t) = \frac{100t^2}{3t^2 + 10}.$$

1. Find the rate of change function for the number of bicycles assembled with respect to time.
2. Find and interpret $M'(2)$ and $M'(5)$.
3. does there exist a day where the rate of change of bicycles assembed over time is zero?

Group 2

Find $f[g(x)]$, $g[f(x)]$, $\frac{d}{dx}(f(g(x))$, and $\frac{d}{dx}(g(f(x)))$.

1. $f(x) = \frac{x}{8} + 7$; $g(x) = 6x - 1$
2. $f(x) = \frac{8}{x}$; $g(x) = \sqrt{3 - x}$

Group 3

Zenzizenzizenzic is an obsolete word with the distinction of containing the most z's of any word found in the *Oxford English Dictionary*. It was used in mathematics, before powers were written as superscript numbers, to represent the square of the square of the square of a number. In symbols, zenzizenzizenzic is written as $((x^2)^2)^2$.

1. Use the chain rule twice to find the derivative.
2. Use the properties of exponents to first simplify the expression, and then find the derivative.

Group 4

The Richter scale provides a measure of the magnitude of an earthquake. In fact, the largest Richter number M ever recorded for an earthquake was 8.9 from the 1933 earthquake in Japan. The following formula shows a relationship between the amount of energy released and the Richter number.

$$M = \frac{2}{3} \log \frac{E}{0.007}$$

where E is measured in kilowatt-hours.

1. For the 1933 earthquake in Japan, what value of E gives a Richter number $M = 8.9$?
2. If the average household uses 247 kWh per month, how many months would the energy released by an earthquake of this magnitude power 10 million households?
3. Find the rate of change of the Richter number M with respect to energy when $E = 70,000$ kWh.
4. What happens to dM/dE as E increases?

Group 5

In 1958, L. Lucy developed a method for predicting the world record for any given year that a human could run a distance of 1 mile. His formula is given as follows:

$$t(n) = 218 + 31(0.933)^n,$$

where $t(n)$ is the world record (in seconds) for the mile run in year $1950 + n$. Thus, $n = 5$ corresponds to the year 1955.

1. Find the estimate for the world record in the year 2020.
2. Calculate the instantaneous rate of change for the world record at the end of year 2020 and interpret.
3. Find $\lim_{n\to+\infty} t(n)$ and interpret.

Extra Problems

1. If $g(3) = 4$, $g'(3) = 5$, $f(3) = 9$, $f'(3) = 8$, find $h'(3)$ when $h(x) = f(x)g(x)$.

2. Find derivatives of the functions defined as follows.

   (a) $f(z) = (2z + e^{-z^2})^2$

   (b) $y = -10^{3x^2-4}$

3. Find the derivative of the functions defined as follows.

   (a) $y = x \ln |2 - x^2|$

   (b) $z = 10^y \log y$