PROBLEM SET #8 **NAME:**_____

Math 196L (Spring 2018)

Instructions: Read each problem. Write a sentence or two about the approach you might take to solve each problem. Draw a picture to illustrate the scenario. Write a formula that might be needed to help set up or solve the problem. **DO NOT SOLVE THE PROBLEMS**.

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1. The concentration of alcohol in a person's blood is measurable. Suppose that the risk R (given as a percent) of having an accident while driving a car can be modeled by the equation $R = 3e^{kx}$ where x is the variable concentration of alcohol in the blood and k is a constant. Suppose that a concentration of alcohol in the blood of 0.06 results in a 10% risk ($R = 10$) of an accident. *You may round k to 4 decimal places. Approx. concentration of alcohol in the blood to 3 decimal places*.

   A) Risk if no alcohol in the blood stream?
   B) If the law asserts that anyone with a risk of having an accident of 15% or more should not have driving privileges, at what concentration of alcohol in the blood should a driver be arrested and charged with DUI? (*Must solve using algebra skills.*)

2. Wild life managers have noticed that the populations of lemmings fluctuate periodically with a period of 4 years. If the peak population of 11,000 was seen in January of 1975, and the minimum population is 3,000, what would the population be in January of 2012 if we assume that the population varies sinusoidally? What would it be if we assume that the population varies following a "sawtooth" pattern, i.e. it is linearly increasing half of the time, and linearly decreasing the other half of the time? Do you prefer one model over the other? What do your models predict for population half way through 2012?

3. The fox population in a certain region has a relative growth rate of 6% per year. It is estimated that the population in 2000 was 15,000. (A) What is the doubling time for the fox population? (B) What is the annual percentage rate ? (*Write as a percent using 2 decimal places*)

4. Astronomers have noticed that the number of visible sunspots varies from a minimum of about 10 to a maximum of about 110 per year. Further, this variation is sinusoidal, repeating over an 11 year period. If the last maximum occurred in 2003, write a cosine function which models this phenomenon in terms of the time which represents the year.
   A) Find a formula for when t is the number of years since 2003.
   B) Find a formula for when t is the number of years since 2000.
   C) What is the visible sunspots in 2012?
   D) Find a formula in terms of the sine function.

5. If $\theta = \frac{\pi}{4}$, calculate the exact value of each expression, without the calculator.

(A) $\sin(\theta)$

(B) $\sin\left(\frac{2\theta}{3}\right)$

(C) $\frac{\sin(\theta)}{2}$

(D) $\sin(2\theta)$

(E) $2\sin(\theta)$

(F) $\sin^2(\theta)$

(G) $[\sin(\theta)]^{-1}$

6. The rate of intake during a respiratory cycle (liters/sec) for a person at rest is proportional to a sine wave with period six seconds. Suppose at 1.5 seconds the rate is 0.85 liters/sec. Graph and find an equation that describes the rate of intake as a function of time. On which interval(s) is the person inhaling and exhaling?