Name _____

**EXAMINATION ONE**

I _____ II _____ III _____ IV _____ V _____ Total _____

This exam consists of several questions. Please glance over the entire exam, and then attempt the questions in the order of your choice. ***You must <u>show your work</u> to receive any credit for a calculated answer.*** Draw a box around your final answer given to the correct number of ***<u>significant figures</u>*** as defined by out text (Harris 8e), and ***be sure to include the <u>correct units</u>***. An information packet was passed out before the exam. Good luck!

I. (35 points) The fuel used in most "gas" grills is LP gas, where "LP" stands for liquid propane. The formula of propane is C_3H_8, and the balance chemical equation for the combustion of propane is given below.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$
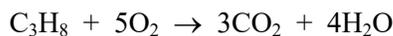
We want to know the "carbon footprint" of a standard LP gas tank.

A. First you need to model the shape of the tank. What shape are you going to use? Equations to calculate volume for various shapes are given in the info pack.

B. Now estimate the dimension(s) you need to calculate the volume and the absolute uncertainty (best guess) in the estimated dimension(s). Give the values in cm. (In case you are better at estimating in inches, remember that $1 \text{ in} \equiv 2.54 \text{ cm}$.)

C. Calculate the volume of the tank using the dimension(s) you provided in Part B.

D. Calculate the absolute uncertainty in for the volume you calculated in Part C using the uncertainties you provided in Part B.

Continuing from the previous page, we are estimating the "carbon footprint" of a standard LP gas tank based on the combustion of propane according to the chemical equation shown below.

$$C_3H_8 \ + \ 5O_2 \ \rightarrow \ 3CO_2 \ + \ 4H_2O$$
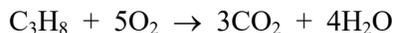
D. Write down your answer to Part C from the previous page. _____

E. Now use that volume to estimate the mass of propane in a full tank. The density of liquid propane at room temperature is 0.49 g/mL.*

F. So finally, what is the carbon footprint of a standard LP gas tank. In other words, how many grams of carbon dioxide would be produced if you burned a full tank of LP gas?

*Why so low? Rhetorical question, so you do not need to answer it, but 0.49 g/mL that is a surprisingly low density for a "liquid" hydrocarbon.

II. (25 points) A rural town decided to add fluoride to its drinking water to reduce tooth decay in the community. The decision was very controversial, however, as too much fluoride can stain or even etch teeth in a process termed dental fluorosis, and some folks even claimed that fluoridation of water was a communist plot. After a heated city council meeting, it was finally decided to maintain a fluoride concentration of 1.6 ppm (same value recommended in Q10 from HW 00), and that the concentration of fluoride would be monitored on a monthly basis.

One month the fluoride concentration averaged 1.9_6 ppm with a standard deviation of 0.1_8 ppm, based on six separate measurements of the concentration.

What is the 95% confidence interval for the concentration of fluoride that month?

Do the results differ from the mandated 1.6 ppm at the 95% confidence level? _____

You are the only chemist in this rural community. The fluoride was added to the water as NaF. How you would determine the amount of NaF you would add to the water supply to achieve a concentration of 1.6 ppm, corresponding to 1.6 g of fluoride in 1000 L of drinking water. What other information do you need? Describe the calculation or set it up, but you do not carry out the calculation.

III. (20 points) As part of a routine check of water quality, a sample of seawater from Pensacola Beach was collected at 9:00 am on March 25, 2010, and analyzed for total hydrocarbons, giving the following results:

number of measurements	5
mean concentration	$37._7$ ppb
standard deviation	$5._2$ ppb

A few months later a decision was made to repeat this analysis at 9:00 am on March 25, 2011. A sample of seawater was taken from the exact same spot and analyzed as before for total hydrocarbons:

number of measurements	9
mean concentration	$52._4$ ppb
standard deviation	$4._8$ ppb

A. Do the data indicate that the concentration of hydrocarbon has increased compared to last year at the 95% confidence level? Be sure to show your work. You may assume that the population standard deviations are the same for both sets of measurements.

B. *"You may assume that the population standard deviations are the same for both sets of measurements."*

Or can you? How would you have approached the above question if you were concerned that the above assumption might not be valid? Do not do the calculation or describe the procedure in any detail. Just identify the appropriate course of action.

C. Why is it important to repeat this measurement at the same time and on the same day?

D. Speculate on what event prompted the decision was made to repeat the analysis a year later.

IV. (20 points) The examination you are taking now is not the best way to measure what you know and what you have learned. Oral exams are better. Consider the totally made up data set below.

Student	written exam	oral exam	difference	$(d_i - \bar{d})^2$
1	83	80	3	0.64
2	96	80	16	190.44
3	65	70	−5	51.84
4	78	80	−2	17.64
5	89	90	−1	10.24
			$\bar{d} = 2.2$	$\Sigma = 270.8$

A. Based on this fake data set, do written exams and oral exams measure the same thing?

B. Show that you know how to complete the table by filling in the last two blanks below.

Student	written exam	oral exam	difference	$(d_i - \bar{d})^2$
6	72	50		

Note: you will need to calculate a new value for "d bar." Do not use the data for student #6 to answer Part A.