In the Lab Syllabus, I gave you a lot of details regarding the writing of your lab reports. I know you have probably been overwhelmed with information the first week or so of this course. I will refer you to this sample lab report for Lab #1, to the lab syllabus for a list of all of the items you need to include in your lab reports, and to the lab directions for Lab #1 listed on the Chemistry 103 Website. If, after reviewing the resources listed, you have any questions regarding the format and/or content of the lab reports, please contact me.

I did conversions listed below. But, there is usually more than one way to do get the same answer in mathematics. So, if you find other ways to get the same result, then that is fine. I just didn’t want this to confuse you. Also, as you read in Chapter 2, you should always let your calculator carry along all of the numbers or digits in a set of calculations, and then round once you have the answer. Remember, if you round at each step, then you can determine a result that is different than if you only rounded after you had performed all of the calculations.

A Final Note before Moving On: As you can see in this sample report, I attempted to give you enough information in the purpose and procedure sections listed so someone could probably take this experiment and report, and reproduce the results. If you write your report in such a way that you think a stranger to this course, with the necessary skills, could read you report and reproduce your results, then you have probably included enough information in your report. This is typically the most common error students make on their lab reports. That is, they leave off important details and pieces of information, which are crucial for an outside reader, me, to completely understand what you did, what you observed and experienced, how you did the experiment, how you explained your results and observations, etc. As I have said before, you can probably not give me too much information in your report. So, make sure you always include all of the steps you took, the observations you made, etc. when you are writing up your experiment and results.

The following is a sample lab report. It is in an acceptable format and can be used as a guide for what I am looking for in your lab report.

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**Sample Lab Write-up**

Instructor: Mark M. Nelson  
Student: Great Student  
4-Digit Code: 0007  
e-mail: greatstudent@ulv.edu  
Date: March 17, 2007

Chemistry 103 Laboratory, Spring 2007  
Laboratory #1

**Experiment #1:** English to Metric Unit Conversions

**Purpose:** In this experiment, I learned how to put into practice the conversion from one set of units to another, using the techniques discussed in all of the material for Chapter 2 and the conversion factors listed in the text. In particular, I was asked to gather 5 or 6 items and convert from the English units listed on the product label to the Metric units listed in parenthesis.

**Procedure:** I gathered 5 items from my home that had a label on each product which listed both the English and Metric units. I made sure I picked items with varying weights and sizes, so I would do
various conversions, rather than the same type of conversion 5 or 6 times in a row. I took the English unit value listed and used the appropriate conversion factors from the tables in the textbook and used the techniques I learned in the lecture notes for Chapter 2 and the corresponding material in the text to convert them to the Metric units listed on the product. The tables I used for obtaining the conversion factors were in Chapter 2, Table 2.7, and in the tables at the end of the book on the inside cover. However, I mostly used the tables that are located on the back cover of your textbook because there were more conversion factors and they had more significant digits than the ones listed in Table 2.7. I then compared the Metric units I calculated to the units listed on the product to see if there was agreement, after appropriate rounding of the results.

Materials Used: The products I chose were: A large bottle of Tide HE laundry detergent, a small can of Dole Sliced Pineapples, a relatively large bag of Yesterday’s News Cat Litter, a bottle of Propel Fitness Water, and a large bottle of generic White Vinegar. I also needed to use a calculator to perform the calculations listed below and the tables with the conversion factors that I listed in the Procedure Section above.

Calculations for Experiment and Observations:

1) The bottle of Tide HE laundry detergent said it contained 200 Fl. Oz., which was equal to 1.56 gallons, and equal to 5.91 liters. To perform these conversions, I need to know how to convert Fl. Oz. to gallons, and then gallons to liters. The conversion factors I found to accomplish this were from the table on the back cover of the text: 1 quart = 32 fl. oz., 1 gallon = 4 quarts, and 1 gallon = 3.7854 liters. I first converted the fluid ounces to quarts and then converted this to gallons. Once I had this done, then I could convert this to liters:

\[
\text{gallons} = \frac{200 \text{ fl oz.}}{32 \text{ fl oz.}} \times \frac{1 \text{ gal}}{4 \text{ qt}} = 1.5625 \text{ gal} = 1.56 \text{ gallons}
\]

As you can see, I rounded this down appropriately to get the same result as the product label, 1.56 gallons. Next, I need to convert the gallons to liters, using the full result from above:

\[
1.5625 \text{ gallons} \times \frac{3.7854 \text{ L}}{1 \text{ gal.}} = 5.914687 \text{ L} = 5.91 \text{ Liters}
\]

As you can see, I did not use the rounded value of gallons in the second conversion, I used the entire number stored in my calculator, and after appropriate rounding down I got the same result as was listed on the package. That is, 200 Fl. Oz. = 1.56 Gal. = 5.91 Liters

2) The can of Dole Pineapples said 15 ounces, which was equal to 425 grams. In order to do this conversion, I needed to know how to relate ounces (weight not fluid) and grams. To accomplish this, the conversion factors I found on the back cover of the text were: 1 lb = 16 oz. and 1 lb = 453.59 grams. I used both of these conversion factors to first convert from ounces to pounds and then pounds to grams. The calculation is:

\[
15 \text{ oz.} \times \frac{1 \text{ lb}}{16 \text{ oz.}} \times \frac{453.59 \text{ grams}}{1 \text{ lb}} = 425.240625 \text{ grams} = 425 \text{ grams}
\]
As you can see, I rounded this down appropriately to get the same result as the product label, 15 ounces = 425 grams.

3) The bag of cat litter said it contained 26.4 pounds, which was equal to 11.9 kg. In order to do this conversion, I needed to know how to relate pounds to kilograms. The conversion factors I found were on the back cover of the text: 1 lb = 0.45359 kg or 1 kg = 2.2046 lbs. I used the first conversion factor listed above in the calculation below, but I could have used either one appropriately and still obtained the exact same result.

\[
26.4 \text{ lb.} \times \frac{0.45359 \text{ kg}}{1 \text{ lb.}} = 11.9747 \text{ kg} = 12.0 \text{ kg}
\]

As you can see, I rounded this appropriately to get a result that was 0.1 kg higher than the value listed by the product's manufacturer. According to my calculations, I found that 26.4 pounds is equal to 12.0 kilograms (after rounding correctly). However, the product listed 26.4 pounds is equal to 11.9 kilograms.

4) The bottle of Propel Fitness Water said it contained 23.7 fluid ounces and was equal to 700 milliliters. In order to do this conversion, I needed to know how to relate fluid ounces and milliliters. To accomplish this, the conversion factors I found on the back cover of the text were: 1 qt = 32 fl. oz. = 0.94635 liters, and 1 liter = 1000 mL. I used these conversion factors to first convert from fluid ounces to quarts, then quarts to liters, and lastly, from liters to milliliters. The calculation is:

\[
23.7 \text{ fl. oz.} \times \frac{1 \text{ qt}}{32 \text{ fl. oz.}} \times \frac{0.94635 \text{ liters}}{1 \text{ qt}} \times \frac{1000 \text{ milliliters}}{1 \text{ liter}} = 700.89 \text{ mL} = 701 \text{ mL}
\]

As you can see, after I rounded this up appropriately I got a result that was 1 mL higher than listed on the product label for Propel Water, 23.7 fluid ounces = 701 mL.

5) My final product is the generic bottle of white vinegar. The bottle of vinegar states 1.32 gallons = 5.0 liters. In order to do this conversion, I need to relate gallons and liters. The conversion factor I found on the back cover of the text was: 1 gallon = 3.7854 liters. The calculation is:

\[
1.32 \text{ gal.} \times \frac{3.7854 \text{ Liters}}{1 \text{ gal.}} = 4.996728 \text{ Liters} = 5.0 \text{ Liters}
\]

As you can see, after I rounded this up appropriately I got the same result listed on the product label for, 1.32 gallons = 5.0 Liters.

Observations and Results: In two of the calculations, I ended up rounding appropriately to get the value listed on the product label, in two I rounded down, and see the following calculations to see that it sometimes depends upon what you do. In all cases, the rounding I did was very reasonable.
and I did not find any of the products where the English units and corresponding Metric units were
greatly different than the ones listed.

The following example shows you what happens if you use conversion factors with a smaller
number of significant digits. As you will see below, it really depends on how you do the
calculations, the source for your conversion factors, and when you round your results. Though, we
know we should always try to use conversion factors with the largest number of significant digits, to
let our calculator carry all of the numbers along during a calculation, and then round correctly (using
the rules from the text and lecture notes).

The following example shows what happens it you do the same type of conversion, but you may use
a slightly different method of calculating and/or obtain your conversion factors from another
source. In the Propel Fitness Water, 4) above, I determined from the conversion that 23.7 fluid
ounces = 701 mL, yet the product label said it was just 700 mL. One mL is not a big deal, but what
if we did the calculation a different way? Would we get the same result? How did the manufacturer
do the calculation? What conversion factors did they use? Does the Federal Government have a
standard set of conversion factors that must be used for product labeling purposes? Or, is the
choice of conversion factors and methods used for calculating the units left up to the individual
company?

Anyway, from the calculation for Propel above, I determined 23.7 fluid ounces is 701 mL. What
would happen if I used the data from Table 2.7 in the text to do the same conversion? From Table
2.7, I found 1 liter = 1.06 quarts and I still used 1 qt = 32 fl. oz., and 1 liter = 1000 mL. The
following is a result of using the 1 liter = 1.06 quarts:

\[
\text{23.7 fl. oz.} \times \frac{1 \text{ qt}}{32 \text{ fl. oz.}} \times \frac{1 \text{ liter}}{1.06 \text{ qt}} \times \frac{1000 \text{ milliliters}}{1 \text{ liter}} = 698.7028 \text{ mL} = 699 \text{ mL}
\]

As you can plainly see, I used the same source for my conversion factors, I just used a slightly
different approach, yet now after rounding appropriately, I get that 23.7 fluid ounces is equal to 699
mL and not equal to 700 mL or 701 mL. So, which one is it? Is it 699, 700, or 701? Well, I know
the way I calculated it in 4) above, I used conversion factors with a lot more significant digits than
the conversion factors listed in Table 2.7 of the text. So, I would probably say that the 23.7 fl. oz. =
701 mL is the best conversion given the tables in the text. But, as you can plainly see, your result
can vary depending on how many significant digits you have in the conversion factors and how
many you carry along in the calculation.

Explanation of Results and Observations: As I stated above, I do not know if the Federal
Government requires manufacturers to use a set method for performing these types of conversions.
If they did, then I would need to use that information to replicate the results listed on the product
labels. And, if they don't, then I would need to know what the manufacturer used for the
conversion factors. All in all, my calculations with appropriate were very close to what was listed on
the product label. I did not find anything which caused me to question the information provided to
me on the label. If I had found great differences, then I would have wanted to know more about
how the conversion was done for the product in question.
All in all, this was an interesting application of the conversions from one set of units to another set of units discussed in the materials provided for Chapter 2. I saw I could use the conversion factors listed in the textbook and verify the information being provided to me on the products I used in this experiment were correct. I enjoyed being able to put something I learned in a class to practice. That is, to be able to apply something I was studying to real world cases. It might be interesting to do a web search to see if the Federal Government requires product manufacturers to use a standard set of conversion factors and methods of conversion to provide the product label information to the consumer.

Experiment #2 Search the Web: In the directions for Lab #1, I was asked to search the Web for a chemistry related site and report on my findings.

Purpose: The purpose of this exercise was to make me aware of the chemistry related information available to everyone, to make me use a search engine, to make me use the proper queries to get the information I was looking for, and to determine if the information being provided was reliable and objective.

Procedure: I actually did two searches. In one search I used Google for my search engine and in the other search; I used Alta Vista as my search engine.

Search #1: In the first search I used Alta Vista as my search engine (www.altavista.com) and I was interested in finding if anyone had done something creative and fun with the Periodic Table of Elements. In particular, I was wondering if anyone had ever made a comic strip of any of the elements or something like this. In the search engine I used the following for my search: “periodic table”+comics By using the quotes around periodic table, I was telling the search engine to look for sites with this phrase and by using the plus sign with comics following it; I was telling it to also search for this word or item along with the exact phrase, periodic table. I was surprised by the number of results I obtained. There were 140,000 results, which is just amazing to me. I can’t believe how much info is available on such a specific item.

Anyway, the first link was a commercial site, which provides software for an animated periodic table for educators to use in a classroom setting. I tried some of the free features out and I was pretty impressed with the amount of work that went into creating this product. I believe this would be a wonderful tool for educators, all the way from grade school to college. They are a local company located in Carlsbad, CA. They seem to have some great educational software for the periodic table as well as other products. They were very reasonably priced; the Animated Periodic Table sells for $49.95 with free lifetime upgrades. I was quite impressed with what I saw in their demonstration product and I assume all of the information listed and given is correct and accurate, however I could not find out anything about the individuals who wrote the program or provided the information for the product. So, before I would ever purchase this product, I would make sure I contacted them, either on the phone or via e-mail, so I could verify their credentials and the validity of the product. It is a very worthwhile site and seems like it would be fun for kids to check out the demo product on-line at: http://www.animatedsoftware.com/apt.html

The second link that came up was a Periodic Table with Comic Book type characters for all of the elements. I could not believe the amount of work that went into this site. It is a very cool site and I would encourage anyone to take their kids there to check it out. The site is from uky.edu, meaning it is out of the University of Kentucky and it was created by two faculty members out of the
Department of Chemistry. I actually know one of the authors, James Holler, and this gives me an edge on the reliability of the information. But, even I did not know Dr. Holler, I would assume with a lot of confidence that the information provided on the site was valid and correct.

Coming from an edu site gives me more confidence in information than an org or com site. That is, an org site usually has a particular agenda and thus probably will provide information that advances their cause. I am not saying the information is invalid or incorrect, I am just saying the writings and conclusions may be biased in order to advance the cause of the organization. And, a com site is definitely there to make money. It may provide a service and have a valid product, but it is always a good idea to invest a little bit of time making sure you are going to get what you want by checking the credentials of the site and other information that would give you confidence in their product before you buy it.

Anyway, if you have kids or enjoy the old fashioned type comic books, I would really recommend taking some time and going to the Comic Book Periodic Table. It is a well done site and entertaining while also being very informative. My son is currently taking chemistry in high school and he really thought this site was cool or maybe he also used the word, tight, which I assume is a good thing. The address is: http://www.uky.edu/Projects/Chemcomics/

Search #2: In the second search, I used Google as my search engine (www.google.com). I wanted to look for information regarding hydrogen fuel cells and what is going on in California. In the Google search line, I entered: "hydrogen fuel cells"+california+government This told the search engine to look for the phrase in quotes, and the plus sign with California and government, I was trying to filter off as many of the commercial sites as possible. Or, it is possible to go to the advanced search settings and tell Google to provide government sites only. And, even when I did this, it came back with 13,100 hits. It is interesting to see how many sites appear with applications for hydrogen fuel cells and automobiles.

I am not going to go into a lot of detail here, but this is one of those things where you have politicians making decisions on allocation of resources without having the fundamental understanding about the science. That is, current technology of hydrogen fuel cells operates in a very limited temperature range. They will not work when they are too hot or too cold. So, how do you put these into automobiles and expect them to work in the extreme temperatures? Also, current fuel cells can’t handle the high demands that would be imposed on them in automobiles. Fuel cells operate better when they are providing a constant level of power and they degrade and wear out very fast if the power demands fluctuate all of the time. And, this is what we do in a car. We want to accelerate and then slow down, and then accelerate again, and so on. Thus, fuel cells would not last very long if they had to operate a car. However, they work great if they are providing power to a home or a large office building since the power demands do not fluctuate so much in these types of electric power applications.

The last thing I wanted to mention was something that happened recently. As voters we were asked to vote on a fuel cell bill for California. I am very glad that it did not pass because I believe this is an item, which needs to be funded at the Federal level and not at the State level. And, it is. I was so surprised that during this election no one ever talked about the Energy Policy Act of 2005. This came out of the House of Representatives and was signed into Federal Law in August of 2005 by President Bush. In a nutshell, this bill was allocating billions of dollars to the public and private sector for all sorts of advancements in hydrogen fuel cell technology. Now, realize it takes the Feds
time to setup up the infrastructure for such a vast program, but the funding is out there and I saw no reason for the State of California to fund the same type of research and duplicate infrastructure, etc. And, if you want to read more about this, there is a 550 page document describing the bill under H.R 6 from 2005.

There are a lot of sites out there, but if you are interested in learning a little bit more about this subject, then you could go to a Federal Government site: http://www.hydrogen.gov/

This site is very easy to navigate and gives you a nice snapshot of what I am talking about. I am very knowledgeable in the area of fuel cells and I was even in Washington D.C. in February of 2006 to talk to senators and congressmen about the funding opportunities for colleges and universities since we have a hydrogen fuel cell research program at the University of La Verne. This was quite an interesting trip and it opened my eyes to how little knowledge the law makers have with regards to this technology. And, they need to rely heavily on their advisors. Nonetheless, I applaud the Federal Government for realizing we need to do something about our current fuel consumption and power production, and the only way to accomplish this is by funding research, make the funding competitive, and include the private sector in the funding opportunities. By including the private sector, I believe the technologies will be advanced much faster since the private sector will not exist if they are not producing results. So, they are probably more agile than large organizations and are able to move faster due to the lack of internal bureaucracy.

Fuel cells have a great amount of potential in aiding in the power needs of the future. However, a lot of research still needs to be done to refine the technologies and applications.

A Final Note: I realize this sample lab report has a lot more information in it than you may be able to include. I took this opportunity to not only show you a sample, but also to talk about a couple of items that are relative to what is going on today. So, what am I expecting from you on your report? In this sample report, you should use all of the information given above for Experiment #1. That is, what I have above for the purpose, procedure, materials used, calculations and observations, a summary of the results and observations, and the explanations of results and observations, is very reasonable for me to expect you to produce something similar to this. Though, you may not go into as much detail as I did. And, for Experiment #2, I probably gave you a lot more information than you will on your actual report. So, please use this Sample Lab Report as a guide for producing your first lab report for me. Lastly, I have a sample lab report for the second lab you will be reporting on for this course. The reason for the second sample is due to the fact that the first experiment is a lot different from the remaining experiments. So, I wanted to make sure you had a sample for the report for Lab #2. You may use the sample for Lab #2 as a guide for helping and assisting you in writing your reports for Labs #2 to #10. And, if you ever have any questions, you can always ask me and I will do my best to assist you.