For example: How many feet are in 60 inches?

1. **Identify the unknown.**
   (What are you looking for?)
   
   \[ \text{ft?} = \]

2. **Identify the given quantity.**
   (What kind of number are you given to start with?)
   
   \[ \text{ft?} = 60 \text{ in} \]

3. **Find the appropriate equality or equalities to solve the problem.**
   (What equation relates the two kinds of units? In some cases, there may not be just one equation that relates the two kinds of units and you may have to repeat the process.)
   
   \[ 1 \text{ ft} = 12 \text{ in} \]

4. **Make a fraction (conversion factor) that will cancel the first kind of unit and bring you closer to the desired kind of unit when you multiply.**

   \[
   \frac{1 \text{ ft}}{12 \text{ in}} \quad \text{or} \quad \frac{12 \text{ in}}{1 \text{ ft}}
   \]

   Remember that each equality can generate two conversion factors or fractions.

   \[ \text{ft?} = 60 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \]

5. **Multiply to solve the problem.**

   \[ \text{ft?} = 60 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 5 \text{ ft} \]

Note: You may have to repeat these steps if you did not find one equality that contained both kinds of units.
SELECTED EQUALITIES TO USE IN CONVERSION FACTORS

UNITS OF LENGTH: meter (m)

1 kilometer = 1000 meters
1 meter = 10 decimeters
1 meter = 100 centimeters
1 meter = 1000 millimeters
1 centimeter = 10 millimeters
2.54 centimeter = 1 inch (exact)

UNITS OF MASS: gram (g)

1 kilogram = 1000 grams
1 gram = 1000 milligrams
1 kilogram = 2.20 pounds (not exact)
1 pound = 454 grams (not exact)

UNITS OF TEMPERATURE: degrees Celsius (°C)

\[ T_F \] = \( (1.8) \, T_C + 32 \) \hspace{1cm} \text{(}T_F \text{ in °F, } T_C \text{ in °C)}
\[ T_K \] = \( T_C + 273 \) \hspace{1cm} \text{(}T_K \text{ in Kelvin, } T_C \text{ in °C)}

UNITS OF VOLUME: liter (l)

1 kiloliter = 1000 liters
1 liter = 1000 milliliters
1 liter = 1.06 quarts (not exact)
1 quart = 946 milliliters (not exact)

PREFIXES

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Number</th>
<th>Power of 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>mega-</td>
<td>M</td>
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<td>1 x 10^6</td>
</tr>
<tr>
<td>kilo-</td>
<td>k</td>
<td>1,000</td>
<td>1 x 10^3</td>
</tr>
<tr>
<td>hecto-</td>
<td>h</td>
<td>100</td>
<td>1 x 10^2</td>
</tr>
<tr>
<td>deca-</td>
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<tr>
<td>deci-</td>
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<tr>
<td>centi-</td>
<td>c</td>
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<td>1 x 10^-3</td>
</tr>
<tr>
<td>micro-</td>
<td>µ</td>
<td>0.000001</td>
<td>1 x 10^-6</td>
</tr>
</tbody>
</table>

OTHER RELATIONSHIPS:

length and volume
1 cm^3 = 1 mL for any substance

volume and mass
1 mL = 1 g for H_2O at 3.9 °C
APPENDIX B: LAB LAYOUTS WITH LOCATIONS OF SAFETY EQUIPMENT
APPENDIX C: PROPER WASTE DISPOSAL

Several types of waste will be generated throughout the course of chemistry 22 and are separated in clearly labeled containers. When the contents of any waste container reaches the full mark (located on the outside of each container) notify your instructor or lab technician who will immediately prepare another container for your use. Do not fill any waste container past the full mark. Overfilling containers will create a hazard for yourself, your classmates, your instructor and the lab technician. For any broken thermometers please notify your instructor and the lab technician so that your thermometer can be replaced.

Liquid Waste:
- Acid Base waste: Please put all acidic and basic waste in this container
- Heavy metals waste: Please put all waste that contains a heavy metal in this container. (examples: Iron, Copper, Silver, Nickel, Chromium, Cobalt, Manganese)
- Halogenated Organic Solvent waste: Put all organic waste that contains halogen (examples: Chlorine, Bromine, and Iodine)
- Non-halogenated Organic Solvent waste: Put all waste that contains hexane without a halogen into this container
- MnO₂ and H₂O₂ waste: Put all waste that contains Manganese Oxide and Hydrogen Peroxide in this container
- KI and I₂: Put all inorganic waste that contains Potassium Iodide or Iodine in this container

Solids:
- Zinc chips, Marble chips: Put all zinc and Marble chips in this container. Drain liquid into Heavy Metals waste container before adding the chips to their appropriate containers.
- Magnesium/sulfur/copper: All magnesium and copper in various states (shots, powder, ribbon) are to be disposed of in this container including copper with sulfur residue.
- Inorganic waste: See specific information in your lab procedures.
- Broken Thermometers: All broken thermometers are to be disposed of in a specific container
- Capillary tubes: All capillary tubes are to be disposed of in a specific container

Glass Waste:
- Notify your instructor if glass is broken in the classroom. There are dust pans and brooms in the laboratory coat closet and in each scale room. Use caution when sweeping and disposing of glass so that others are not at risk of injury. The glass disposal box is located in a corner of each classroom and can be located in Appendix B. NOTE: If glass is contaminated with chemicals, there is a special container in the waste hood for these kinds of glass waste.

Chemical Labels
- Each container that contains a hazardous chemical must be labeled by the manufacturer or distributor before it is sent to downstream users. Each label will contain the identity of the hazardous chemical(s) by common or chemical name. Appropriate hazard warnings. The name and address of the manufacturer, distributor, or the responsible party. You will see three types of labels in the classroom, 1) The right to know label, 2) Manufacture labels and 3) Chemistry stockroom labels
1) The right to know label: A standardized color coded label that will identify specific hazard, the strength of the hazard, Chemical name, molecular formula and CAS. These labels can be printed and hand written.
   Blue: Health
   Red: Flammability
   Yellow:
   White: reactivity

2) Manufacturers labels:
   These labels are not standardized and vary a great deal. The important information printed on these containers is the chemical name/common name/molecular formula, concentration (liquids/aq), a few potential hazards, and the manufacturers name. Often these labels will also have a chemistry stockroom label or right to know label added.

3) Chemistry stockroom label:
   These labels are generated by Laboratory technicians and are hand written. These labels will contain chemical name or molecular formula, concentration (liquids/aq),
APPENDIX D: USEFUL MATH RELATIONSHIPS

Absolute Error and Percent Error

Accuracy refers to the closeness of an experimental value to its “true” value. Quantitatively, accuracy is represented by absolute error and percent error.

Absolute error is the difference between the experimental value and the true value:

\[
\text{Absolute error} = |\text{experimental value} - \text{true value}| \tag{1}
\]

The percent error is the absolute error relative to the true value:

\[
\% \text{ error} = \frac{\text{absolute error}}{\text{"true" value}} \times 100 \tag{2}
\]

Deviation and Average Deviation

Precision refers to the closeness of a set of data to each other. Precision can be quantified by calculating the individual deviation of a result and the average deviation of a set of results:

\[
\text{Deviation} = |\text{individual result} - \text{average value}| \tag{3}
\]

\[
\text{Average deviation} = \frac{\sum |\text{individual result} - \text{average value}|}{\text{Number of measurements}} \tag{4}
\]

Percentage Error

If you have to compare two or more values to one another without knowing what is the “true” value, you can use the percentage error. A percentage difference between two (or more) numbers may be obtained by taking the difference between the high and low values, dividing that number by the average value, and then multiplying by 100%:

\[
\% \text{ difference} = \frac{\text{high value} - \text{low value}}{\text{average value}} \times 100\% \tag{5}
\]
APPENDIX E: RULES FOR COUNTING SIGNIFICANT FIGURES

1. **Nonzero integers**: any digit from 1 through 9 always counts as a significant figure.
   
   Example: 1234.56789 has 9 significant figures.

2. **Zeros**: there are three kinds of zeros:
   a. Leading zeros (zeros to the left of nonzero digits) never count as significant figures.
      
      Example: 0.0025 has 2 significant figures.
   b. Captive zeros (zeros between nonzero digits) always count as significant figures
      
      Example: 1.008 has 4 significant figures.
   c. Trailing zeros – zeros to the right of nonzero digits only count if the number contains a decimal point.
      
      Example: 100 has 1 significant figure.
      
      Example: 1.00 x 10² has 3 significant figures.
      
      Example: 100. has 3 significant figures.

3. **Exact numbers** have an infinite number of significant figures. There are two kinds of exact numbers:
   a. Counted numbers
      
      Example: 10 experiments, 3 apples or 8 molecules have an infinite number of significant figures.
   b. Defined numbers
      
      Example: 1 kilogram = 1,000 grams have infinite numbers of significant figures.

Hint: Sometimes writing numbers in proper scientific notation will make counting significant figures less ambiguous.

Additional Resources

Bishop “An Introduction to Chemistry, Atoms First”, Chapter 2, Unit Conversions
http://en.wikipedia.org/wiki/Significant_figures
APPENDIX F: RULES FOR Rounding Off

1. After calculating a number using multiplication or division, you must round off the answer to the correct number of significant figures.

   a. Determine whether each value is exact, and ignore exact values in counting significant figures.

      Remember: exact numbers are of two types:
      counted numbers (e.g., 12 objects = 1 dozen exactly) or
      defined numbers (e.g., 1000 mL = 1 L exactly). Look in Appendix E for help.

   b. Determine the number of significant figures for each value that is measured.

   c. Round off the answer (considering rule 3 below) to the same number of significant figures as the measured value with the fewest number of significant figures.

      Example: \(1.83 \text{ cm} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} = 0.72047244 \text{ in.} = 0.720 \text{ in.}\)

2. After calculating a number using addition or subtraction, you must round off the answer to the correct number of decimal places.

   a. Determine whether each value is exact, and ignore exact values.

   b. Determine the number of decimal places for each value that is not exact.

   c. Round off the answer (considering rule 3 below) to the same number of decimal places as the measured value with the fewest number of significant figures. Remember that this rule is different than the rule for multiplication and division.

      Example: \(43.6 \text{ g} + 132.31 \text{ g} = 175.9 \text{ g}\)

3. The following two rules always apply when you are rounding off:

   a. When the first digit of those to be dropped is less than 5, leave the preceding digit unchanged.

      Example: the number 56.748 rounded off to the nearest 0.1 becomes 56.7.

   b. If the first digit of those to be dropped is 5 or greater than 5, raise the preceding digit by 1.

      Example: the number 2.146 rounded off to the nearest 0.01 becomes 2.15.

Additional Resources

Bishop “An Introduction to Chemistry, Atoms First”, Chapter 2, Unit Conversions
http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch1/sigfigs.html
http://en.wikipedia.org/wiki/Significant_figures
### APPENDIX G: FORMULAS AND CHARGES FOR SELECTED IONS

<table>
<thead>
<tr>
<th>POSITIVE IONS (CATIONS)</th>
<th>NEGATIVE IONS (ANIONS)</th>
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</thead>
<tbody>
<tr>
<td><strong>1+</strong></td>
<td></td>
</tr>
<tr>
<td>Ammonium</td>
<td>NH(_4^+)</td>
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<tr>
<td>Copper (I)</td>
<td>Cu(^+)</td>
</tr>
<tr>
<td>Cuprous</td>
<td>H(^+)</td>
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<tr>
<td>Hydrogen</td>
<td>Li(^+)</td>
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<td>Lithium</td>
<td>K(^+)</td>
</tr>
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<td>Potassium</td>
<td>Ag(^+)</td>
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<tr>
<td>Silver</td>
<td>Na(^+)</td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
</tr>
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<td><strong>2+</strong></td>
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</tr>
<tr>
<td>Barium</td>
<td>Ba(^{2+})</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd(^{2+})</td>
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<tr>
<td>Calcium</td>
<td>Ca(^{2+})</td>
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<tr>
<td>Chromium(II)</td>
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<tr>
<td>Iron (II)</td>
<td>Fe(^{2+})</td>
</tr>
<tr>
<td>Lead (II)</td>
<td>Pb(^{2+})</td>
</tr>
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<td>Mg(^{2+})</td>
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<td>Mercury(II)</td>
<td>Hg(^{2+})</td>
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<td>Tin (II)</td>
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<td>Zinc</td>
<td>Zn(^{2+})</td>
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<td><strong>3+</strong></td>
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<td>Aluminum</td>
<td>Al(^{3+})</td>
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<tr>
<td>Antimony (III)</td>
<td>Sb(^{3+})</td>
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<td>Chromium (III)</td>
<td>Cr(^{3+})</td>
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<tr>
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<td>Fe(^{3+})</td>
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<td>Titanium (III)</td>
<td>Ti(^{3+})</td>
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<td><strong>4+</strong></td>
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<td>Manganese (IV)</td>
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<td><strong>5+</strong></td>
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<td>Antimony (V)</td>
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<tr>
<td>Arsenic (V)</td>
<td>As(^{5+})</td>
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</tbody>
</table>

| **1-**                  |                        |
| Acetate                 | C\(_2\)H\(_2\)O\(_2^−\) |
| Bromate                 | BrO\(_3^−\)            |
| Bromide                 | Br\(^−\)               |
| Chlorate                | ClO\(_3^−\)            |
| Chloride                | Cl\(^−\)               |
| Chlorite                | ClO\(_2^−\)            |
| Cyanide                 | CN\(^−\)               |
| Cyanate                 |                          |
| Diiodide                |                          |
| Dihydrogen phosphate    |                          |
| Hydrate                 |                          |
| Hydroxide               |                          |
| Hypobromite             |                          |
| Hypochlorite            |                          |
| Iodate                  |                          |
| Iodide                  |                          |
| Nitrate                 |                          |
| Nitrite                 |                          |
| Peroxide                |                          |
| Perchlorate             |                          |
| Perchlorate             |                          |
| Permanganate            |                          |
| Thiocyanate             |                          |

| **2-**                  |                        |
| Carbonate               | CO\(_2^−\)             |
| Chromate                | CrO\(_4^{2−}\)         |
| Dichromate              | Cr\(_2\)O\(_7^2−\)    |
| Monohydrogen phosphate  | HPO\(_4^{2−}\)         |
| Oxalate                 |                          |
| Oxide                   |                          |
| Peroxide                |                          |
| Silicate                |                          |
| Sulfate                 |                          |
| Sulfide                 |                          |
| Sulfite                 |                          |

| **3-**                  |                        |
| Arsenate                | AsO\(_4^{3−}\)         |
| Borate                  | BO\(_3^{3−}\)          |
| Nitride                 | N\(_3^{−}\)            |
| Phosphate               | PO\(_4^{3−}\)          |
| Phosphide               | P\(_3^{−}\)            |
| Phosphite               | PO\(_3^{−}\)           |
# APPENDIX H: SOLUBILITIES OF SELECTED SALTS

<table>
<thead>
<tr>
<th>Anions</th>
<th>C$_2$H$_3$O$_2^-$</th>
<th>AsO$_4^{2-}$</th>
<th>Br$^-$</th>
<th>CO$_3^{2-}$</th>
<th>Cl$^-$</th>
<th>CrO$_4^{2-}$</th>
<th>OH$^-$</th>
<th>I$^-$</th>
<th>NO$_3^-$</th>
<th>C$_2$O$_4^{2-}$</th>
<th>O$_2^-$</th>
<th>PO$_4^{3-}$</th>
<th>SO$_4^{2-}$</th>
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<th>SO$_3^{2-}$</th>
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<tr>
<td>Ba$^{2+}$</td>
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<td>aq</td>
<td>I</td>
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<td>sl. aq</td>
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<td>aq</td>
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<td>aq</td>
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<td>aq</td>
</tr>
<tr>
<td>Ag$^+$</td>
<td>sl. aq</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>-</td>
<td>I</td>
<td>aq</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Na$^+$</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
</tr>
<tr>
<td>Sr$^{2+}$</td>
<td>aq</td>
<td>-</td>
<td>aq</td>
<td>I</td>
<td>aq</td>
<td>I</td>
<td>aq</td>
<td>aq</td>
<td>aq</td>
<td>-</td>
<td>-</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>-</td>
</tr>
<tr>
<td>Zn$^{2+}$</td>
<td>aq</td>
<td>I</td>
<td>aq</td>
<td>I</td>
<td>aq</td>
<td>I</td>
<td>I</td>
<td>aq</td>
<td>aq</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>aq</td>
<td>I</td>
<td>I</td>
</tr>
</tbody>
</table>

Key:  
- $aq$ = Soluble in water  
- sl. $aq$ = Slightly soluble in water  
- $I$ = Insoluble in water (less than 1 g/100 g H$_2$O)  
- $d$ = Decomposes in water

It is useful to remember:  
- salts with Group I or ammonium cations are always soluble no matter what the anions are  
- salts with nitrate anions are always soluble no matter what the cations are (except for Bi$^{3+}$)

**Additional Resources**

http://en.wikipedia.org/wiki/Solubility_chart  
http://www.csudh.edu/oliver/chemdata/solrules.htm
APPENDIX I: COMMON PIECES OF EQUIPMENT USED IN STUDENT CHEMISTRY LABORATORIES
APPENDIX J: EXAMPLE EXPERIMENTAL SET-UPS
Figure 1: Experimental set up to separate a mixture using vacuum filtration
Figure 2: Experimental set up for comparing chemical and physical changes using a stainless steel temperature probe.
Figure 3: Experimental set up for calculating an empirical formula.
Figure 4: Experimental set up for experiment 8: production and investigation of four gases
Figure 7: Experimental set up for observing boiling point. Note: the temperature probe does not touch the glass container while the experiment is in progress. It also must not touch the liquid. This set-up can be varied by using other containers to hold the liquid being tested.
APPENDIX K: SAMPLE LOCKER CHECK-OUT AND CHECK-IN PROCEDURES

Locker Check OUT: beginning of the semester

1) Laboratory Technicians are:
   a. __________________________
   b. __________________________

2) Go through all materials that are in the locker assigned to you, following along with the Lab technician
   a. Check for cracks and nicks in all glassware and have any unusable equipment replaced if necessary
   b. Hold glassware up to the light to see if there are smudges or chemicals on/in glassware

3) Chemistry locker rules
   a. $25 fee will be charged for failure to clean locker at the end of the semester or once you have dropped the class. This fee is sent to the cashier who will place a hold on your record preventing you from ordering transcripts and registering for classes until the fee is paid.
   b. Do not put shared class materials in any student locker because other classes use these materials
   c. Fill soap bottles by the sinks using the soap dispenser at the back of the classroom under the window.

4) Waste
   a. All waste has to be placed in the appropriate container as outlined in Appendix C

Locker Check In: End of semester

1) Remove all materials from the locker assigned to you as the beginning of the semester
2) Replace paper towels on bottom of the drawer and wipe the drawer out
3) Using the protocol for washing glassware outlined in Appendix L, wash all glassware and dirty equipment
4) To check if glassware is clean, hold each piece up to the light – it should sparkle
5) A $25.00 fee is charged to students who do not check out their lockers
## APPENDIX L: SAMPLE LABORATORY EQUIPMENT LIST

### Locker Equipment - Chemistry 22

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Qt</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beakers, griffin low form</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAP: 50ml</td>
<td>1</td>
<td>$3.59</td>
</tr>
<tr>
<td>CAP: 150ml</td>
<td>1</td>
<td>$3.94</td>
</tr>
<tr>
<td>CAP: 250 ml</td>
<td>1</td>
<td>$4.19</td>
</tr>
<tr>
<td>Glass rod</td>
<td>1</td>
<td>$0.00</td>
</tr>
<tr>
<td>Water bottle, polyethylene</td>
<td>1</td>
<td>$3.72</td>
</tr>
<tr>
<td>Test tube brush (small)</td>
<td>1</td>
<td>$2.49</td>
</tr>
<tr>
<td>Test tube brush (large)</td>
<td>1</td>
<td>$2.49</td>
</tr>
<tr>
<td>Small test tube holder</td>
<td>1</td>
<td>$22.26</td>
</tr>
<tr>
<td>Crucible cover, “F”</td>
<td>1</td>
<td>$8.11</td>
</tr>
<tr>
<td>Crucible, porcelain, “o”</td>
<td>1</td>
<td>$3.97</td>
</tr>
<tr>
<td>Crucible tong</td>
<td>1</td>
<td>$9.39</td>
</tr>
<tr>
<td>Graduated cylinder 10ml</td>
<td>1</td>
<td>$12.56</td>
</tr>
<tr>
<td>Dropper bulbs, disposable</td>
<td>2</td>
<td>$0.00</td>
</tr>
<tr>
<td>Plastic weigh boats</td>
<td>2</td>
<td>$2.00</td>
</tr>
<tr>
<td>Watch glass 75mm</td>
<td>1</td>
<td>$2.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Qt</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flask, Erlenmeyer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAP: 50ml</td>
<td>1</td>
<td>$5.44</td>
</tr>
<tr>
<td>CAP: 125ml</td>
<td>1</td>
<td>$4.75</td>
</tr>
<tr>
<td>CAP: 250 ml (with stoppers)</td>
<td>2</td>
<td>$4.40</td>
</tr>
<tr>
<td>Litmus paper, blue &amp; red</td>
<td>2</td>
<td>$0.00</td>
</tr>
<tr>
<td>Padlock, combination type</td>
<td>1</td>
<td>$14.35</td>
</tr>
<tr>
<td>Iron wire triangle</td>
<td>1</td>
<td>$9.16</td>
</tr>
<tr>
<td><strong>Test tube, with lip</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIZE: 13 x 100 mm</td>
<td>8</td>
<td>$0.06</td>
</tr>
<tr>
<td>SIZE: 18 x 150 mm</td>
<td>2</td>
<td>$0.14</td>
</tr>
<tr>
<td>Wire gauze, ceramic center</td>
<td>1</td>
<td>$1.07</td>
</tr>
<tr>
<td>Spatula, stainless steel</td>
<td>1</td>
<td>$8.51</td>
</tr>
<tr>
<td>Plastic ruler</td>
<td>1</td>
<td>$0.45</td>
</tr>
<tr>
<td>Test tube rack</td>
<td>1</td>
<td>$27.00</td>
</tr>
<tr>
<td>Speedy watch glass</td>
<td>1</td>
<td>$5.00</td>
</tr>
</tbody>
</table>
APPENDIX M: ADDITIONAL RESOURCES

Experiment 1
Bishop “An Introduction to Chemistry, Atoms First”, Chapter 2, Unit Conversions
http://preparatorychemistry.com/Bishop_Tutorials.htm
http://physics.nist.gov/cuu/Units/units.html
http://www.dartmouth.edu/~chemlab/techniques/top_balance.html
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/labdrwr/labequip.htm
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/measurea/volume/gradcyl/gradcyl.htm

Experiment 2
Bishop “An Introduction to Chemistry, Atoms First”, Chapter 5, Chemical Compounds
http://preparatorychemistry.com/Bishop_Tutorials.htm
http://en.wikipedia.org/wiki/Molecular_geome

Experiment 3
http://en.wikipedia.org/wiki/Bunsen_burner
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/bunsbur/bunsbur2.htm

Experiment 4
CRC “Handbook of Chemistry and Physics”
http://www.dartmouth.edu/~chemlab/techniques/vfiltration.html
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/filter/filter.htm
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/mixing/mix/mixb.htm

Experiment 5
http://chemistry.about.com/library/weekly/aa091001a.htm
http://en.wikipedia.org/wiki/Qualitative_inorganic_analysis
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/mixing/mix/mixb.htm

Experiment 6
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/measurea/calorimt/calorimt.htm
http://www.vernier.com/

Experiment 7
Bishop “An Introduction to Chemistry, Atoms First”, Chapter 5, Chemical Compounds
http://legacyweb.chemistry.ohio-state.edu/betha/nealChemBal/

Experiment 8
http://legacyweb.chemistry.ohio-state.edu/betha/nealChemBal/
Experiment 9

Experiment 10
http://preparatorychemistry.com/Bishop_Tutorials.htm
http://legacyweb.chemistry.ohio-state.edu/betha/nealChemBal/
http://www.dartmouth.edu/~chemlab/techniques/vfiltration.html
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/filter/filter.htm
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/mixing/mix/mixb.htm

Experiment 11
http://dl.clackamas.edu/ch105-04/equation.htm

Experiment 12
http://www.dartmouth.edu/~chemlab/techniques/titration.html
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/measurea/concentr/titratre/titraon.htm
http://www.uwplatt.edu/chemep/chem/chemscape/labdocs/catofp/mixpour/volflask/volflask.htm

Experiment 13
CRC “Handbook of Chemistry and Physics”
http://www.vernier.com/