### Answers for Assignment I

**p. 43, # 13**

<table>
<thead>
<tr>
<th>Formula</th>
<th># atoms O</th>
<th># atoms Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ca$_3$(PO$_4$)$_2$</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Ca(OH)$_2$</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CaCr$_2$O$_7$</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Ca$_5$(PO$_4$)$_3$OH</td>
<td>13</td>
<td>5</td>
</tr>
</tbody>
</table>

Ratio of # atoms O to # atoms Ca is given by
(entry in second column) : (entry in third column)

**p. 43, # 19a**

\[
\frac{2.005 \text{ g Si per 1.000 g N in cpd 2}}{1.504 \text{ g Si per 1.000 g N in cpd 1}} = 1.333 = 4:3
\]

**p. 43, # 19b**

If cpd 1 is Si$_3$N$_4$, cpd 2 is Si$_4$N$_4$, which would be written as SiN.

(The “N$_4$” portion of the formula is the same in both compounds, corresponding to the “fixed mass of N” used to prepare the two compounds. If the “Si$_3$” portion combines with “N$_4$” in compound 1, then a “Si$_4$” portion is needed in cpd 2 (3 x 1.333 = 4).

Dalton had no way of knowing how many molecules were present in his samples (X molecules of Si$_4$N$_4$ contains the same numbers of silicon and nitrogen atoms as X molecules of SiN). His formulas were actually *empirical* formulas which show the ratio of atoms of different types but may not correspond to an the actual number of atoms in the molecule.

**p. 44, # 21**

\[
2 \text{ N}_2\text{O (g)} + 3 \text{ O}_2 \text{(g)} \rightarrow 4 \text{ NO}_2 \text{(g)}
\]

| Volumes | 2.0 L | 3.0 L | 4.0 L |

If the gas volumes are measured at the same temperature and pressure, then their ratio is the same as the coefficients in the balanced chemical equation. Thus, 2.0 L of dinitrogen monoxide will react with 3.0 L of oxygen gas to produce 4.0 of nitrogen dioxide.
Van Helmont’s conclusion was not valid. He didn’t realize that the plant was extracting carbon dioxide from the air, using it to make the hydrocarbon compounds it needed for growth and energy, and expelling oxygen and other waste products.

Van Helmont was trying to disprove the Law Of Conservation of Mass. He saw that the soil had not changed mass significantly and assumed that he had not added a mass of water that would account for the increase in the mass of the tree as it had grown. Again, his problem was that he did not consider the masses of the gases involved in the growth process.

The naturopath could be correct in stating that it is better to drink rose-hip tea than to take vitamin C pills. It might be that the curative powers come from some other component of the tea, rather than the vitamin C. It is also possible that the mixture of substances in the tea work together in some way that makes the curative agent more effective. In addition, the laboratory-synthesized vitamin C might have a somewhat different structure from the vitamin C that is found in nature.

If 8 g of oxygen contained the same number of atoms as 1 g of hydrogen, the formula of water would be HO because the mass ratio of oxygen to hydrogen in water is 8:1.

In hydrogen peroxide, 1.00 g of hydrogen reacts with 15.9 g of oxygen.

1.0 g Hydrogen x (94.07 g oxygen/5.93 g hydrogen) = 15.9:1.

Because 8g of oxygen contain X atoms O, 16 g of oxygen contain 2X atoms of O. According to the assumption of question 88a, 1 g of hydrogen contains X atoms H. Therefore, the formula of hydrogen peroxide would be HO₂.
\[ A = \frac{1}{2} bh = 0.5 \times (42.07 \text{ cm})(16.0 \text{ cm}) = 337 \text{ cm}^2 \]

The minimum area would be obtained when both base and height are at their lowest values.

\[ A_{\text{min}} = \frac{1}{2} bh = 0.5 \times (42.04 \text{ cm})(15.8 \text{ cm}) = 332 \text{ cm}^2 \]

The maximum area would be obtained when both base and height are at their highest values.

\[ A_{\text{max}} = \frac{1}{2} bh = 0.5 \times (42.10 \text{ cm})(16.2 \text{ cm}) = 341 \text{ cm}^2 \]

Therefore, the area should be reported as 337 cm$^2$ ± 5 cm$^2$.

The number of significant figures in the answer is three whether we follow the simple rule (the answer and the least precise measurement have the same number of significant figures) or calculate the uncertainty (the last significant digit is the one which has some uncertainty associated with it).