Problem Set for Chapter 2
AP Chemistry

2.3. The elements nitrogen and oxygen can form a variety of different compounds. Two such compounds, NO and N₂O₄, were decomposed into their constituent elements. One produced 0.8756 g N for every gram of O; the other produced 0.4378 g N for every gram of O. Show that these results are consistent with the law of multiple proportions.

2.6. Both FeO and Fe₂O₃ contain only iron and oxygen. The mass ratio of oxygen to iron for each compound is given in the following table:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Mass O : mass Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>FeO</td>
<td>0.2865</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.4297</td>
</tr>
</tbody>
</table>

Show that these data are consistent with the law of multiple proportions.

2.22. For each of the following species, determine the number of protons and the number of neutrons in the nucleus: ³²He, ⁴²He, ²⁴¹₂Mg, ²⁵¹₂Mg, ⁴⁸²₂Ti, ⁷⁹³⁵Br, ¹⁹⁵⁷⁸Pt.

2.28. The following radioactive isotopes are used in medicine for imaging organs, studying blood circulation, treating cancer, and so on. Give the number of neutrons present in each isotope: ¹⁹⁸Au, ⁴⁷Ca, ⁶⁰Co, ¹⁸F, ¹²⁵I, ¹³¹I, ⁴²K, ⁴¹⁹K, ²⁴Na, ³²P, ⁸⁵Sr, ⁹⁹Tc.

2.32. Give two examples of each of the following: (a) alkali metals, (b) alkaline earth metals, (c) halogens, (d) noble gases, (e) chalcogens, (f) transition metals.

2.40. What is an atomic mass unit? Why is it necessary to introduce such a unit?

2.41. What is the mass (in amu) of a carbon-12 atom? Why is the atomic mass of carbon listed as 12.01 amu in the table on the inside front cover of this book?

2.44. The atomic masses of (75.53 percent) and (24.47 percent) are 34.968 and 36.956 amu, respectively. Calculate the average atomic mass of chlorine. The percentages in parentheses denote the relative abundances.

2.48. What is the mass in grams of 13.2 amu?

2.49. How many atomic mass units are there in 8.4 g?

2.51. What are allotropes? Give an example. How are allotropes different from isotopes?
2.55. Give an example of a case in which two molecules have different molecular formulas but the same empirical formula.

2.62. Give two examples of each of the following: (a) a diatomic molecule containing atoms of the same element, (b) a diatomic molecule containing atoms of different elements, (c) a polyatomic molecule containing atoms of the same element, (d) a polyatomic molecule containing atoms of different elements.

2.64. Write the empirical formulas of the following compounds: (a) Al₂Br₆, (b) Na₃S₂O₄, (c) N₃O₅, (d) K₂Cr₂O₇, (e) H₂C₂O₄.

2.67. Name the following binary molecular compounds: (a) NCl₃, (b) IF₇, (c) P₄O₁₀, (d) S₂Cl₂.

2.68. Write chemical formulas for the following molecular compounds: (a) phosphorus tribromide, (b) dinitrogen tetrafluoride, (c) xenon tetroxide, (d) selenium trioxide.

2.76. Give the number of protons and electrons in each of the following common ions: K⁺, Mg²⁺, Fe³⁺, Br⁻, Mn²⁺, C⁴⁺, Cu²⁺.

2.78. Write the formulas for the following ionic compounds: (a) copper bromide (containing the Cu⁺ ion), (b) manganese oxide (containing the Mn²⁺ ion), (c) mercury iodide (containing the ion), (d) magnesium phosphate (containing the ion).

2.80. Which of the following compounds are likely to be ionic? Which are likely to be molecular? CH₄, NaBr, BaF₂, CCl₄, ICl, CsCl, NF₃.

2.82. Name the following compounds: (a) KClO₃, (b) Ag₂CO₃, (c) HNO₃, (d) KMnO₄, (e) CsClO₃, (f) KNH₄SO₄, (g) FeO, (h) Fe₂O₃, (i) TiCl₄, (j) NaH, (k) Li₃N, (l) Na₂O, (m) Na₂O₂.

2.84. Write the formulas for the following compounds: (a) copper(I) cyanide, (b) strontium chlorite, (c) perbromic acid, (d) hydroiodic acid, (e) disodium ammonium phosphate, (f) potassium dihydrogen phosphate, (g) iodine heptafluoride, (h) tetraphosphorus decasulfide, (i) mercury(II) oxide, (j) mercury(I) iodide, (k) selenium hexafluoride.
2.93. What is wrong with or ambiguous about the phrase “four molecules of NaCl?”

2.96. What is wrong with the name (given in parentheses or brackets) for each of the following compounds: (a) BaCl₂ (barium dichloride), (b) Fe₂O₃ [iron(II) oxide], (c) CsNO₂ (cesium nitrate), (d) Mg(HCO₃)₂ [magnesium(II) bicarbonate]?

2.114. Predict the formula and name of a binary compound formed from the following elements: (a) Na and H, (b) B and O, (c) Na and S, (d) Al and F, (e) F and O, (f) Sr and Cl.

2.118. Some compounds are better known by their common names than by their systematic chemical names. Give the chemical formulas, and the systematic names of the following substances: (a) dry ice, (b) salt, (c) laughing gas, (d) marble (chalk, limestone), (e) baking soda, (f) ammonia, (g) water, (h) milk of magnesia, (i) epsom salt.