AP Chemistry – Chapter 3 Worksheet Answers (Kotz)

1.

Fe_3S_4 could be a homogeneous mixture composed of one unit of FeS, iron(II) sulfide and one unit of Fe_2S_3, iron(III) sulfide. This would lead to the formula Fe_3S_4. In fact, the solid is something like this, a lattice of S^{2-} anions, in which there are both Fe^{2+} and Fe^{3+} cations.

2.

(a) potassium nitrate (b) sodium carbonate (c) calcium oxide
(d) hydrochloric acid (e) magnesium sulfate (f) magnesium hydroxide

3.

FW = 18(12.01) + 27(1.008) + 1(14.01) + 3(16.00) = 305.4 amu

$$\% \text{ C} = \frac{18(12.01)\text{ amu}}{305.4\text{ amu}} \times 100 = 70.8\%$$

4.

(a) $$\frac{5.342 \times 10^{-21}\text{ g}}{1\text{ molecule penicillin G}} \times \frac{6.0221 \times 10^{23}\text{ molecules}}{1\text{ mol}} = 3217\text{ g/mol penicillin G}$$

(b) 1.00 g hemoglobin (hem) contains 3.40×10^{-3} g Fe.

$$\frac{1.00\text{ g hem}}{3.40 \times 10^{-3}\text{ g Fe}} \times \frac{55.85\text{ g Fe}}{1\text{ mol Fe}} \times \frac{4\text{ mol Fe}}{1\text{ mol hem}} = 6.57 \times 10^{4}\text{ g/mol hemoglobin}$$

5.

The mass percentage is determined by the relative number of atoms of the element times the atomic weight, divided by the total formula mass. Thus, the mass percent of bromine in $KBrO_x$ is given by $0.5292 = \frac{79.91}{39.10 + 79.91 + x(16.00)}$. Solving for x, we obtain x = 2.00. Thus, the formula is $KBrO_2$.

6.

Strategy: Because different sample sizes were used to analyze the different elements, calculate mass % of each element in the sample.

i. Calculate mass % C from g CO_2.

ii. Calculate mass % Cl from AgCl.

iii. Get mass % H by subtraction.

iv. Calculate mole ratios and the empirical formulas.

i. $$3.52\text{ g } CO_2 \times \frac{1\text{ mol } CO_2}{44.01\text{ g } CO_2} \times \frac{1\text{ mol C}}{1\text{ mol } CO_2} \times \frac{12.01\text{ g C}}{1\text{ mol C}} = 0.9606 = 0.961\text{ g C}$$

$$\frac{0.9606\text{ g C}}{1.50\text{ g sample}} \times 100 = 64.04 = 64.0\%\text{ C}$$

ii. $$1.27\text{ g AgCl} \times \frac{1\text{ mol AgCl}}{143.3\text{ g AgCl}} \times \frac{1\text{ mol Cl}}{1\text{ mol AgCl}} \times \frac{35.45\text{ g Cl}}{1\text{ mol Cl}} = 0.3142 = 0.314\text{ g Cl}$$

$$\frac{0.3142\text{ g Cl}}{1.00\text{ g sample}} \times 100 = 31.42 = 31.4\%\text{ Cl}$$

iii. $\%\text{ H} = 100.0 - (64.04\%\text{ C} + 31.42\%\text{ Cl}) = 4.54 = 4.5\%\text{ H}$

iv. Assume 100 g sample.

$$64.04\text{ g C} \times \frac{1\text{ mol C}}{12.01\text{ g C}} = 5.33\text{ mol C};\ \ 5.33 / 0.886 = 6.02$$

$$31.42\text{ g Cl} \times \frac{1\text{ mol Cl}}{35.45\text{ g Cl}} = 0.886\text{ mol Cl};\ \ 0.886 / 0.886 = 1.00$$

$$4.54\text{ g H} \times \frac{1\text{ mol H}}{1.008\text{ g H}} = 4.50\text{ mol H};\ \ 4.50 / 0.886 = 5.08$$

The empirical formula is probably C_6H_5Cl.

The subscript for H, 5.08, is relatively far from 5.00, but C_6H_5Cl makes chemical sense. More significant figures in the mass data are required for a more accurate mole ratio.

7.

$? \text{ g X} = 1.84 \times 30.97 = 56.98\text{ g}$

$? \text{ g X} = 3.06 \times 30.77 = 94.77\text{ g}$

$$\frac{3.06}{1.84} = 1.66 \times 3 = 5$$

3.06 and 1.84 are in a 5 : 3 ratio, so are PX_3 and PX_5

$$\frac{56.98\text{ g}}{3} = 18.99 \qquad \frac{94.77\text{ g}}{5} = 18.95$$

The element is F; the compounds are PF_3 and PF_5.

8.

$$? \text{ g BaCl}_2\text{•2 H}_2\text{O} = (1.6992 \text{ g} - 1.4804 \text{ g}) \times \frac{\text{mol H}_2\text{O}}{18.016 \text{ g}} \times \frac{\text{mol BaCl}_2\text{•2 H}_2\text{O}}{2 \text{ mol H}_2\text{O}} \times \frac{244.26}{\text{mol BaCl}_2\text{•2 H}_2\text{O}} = 1.483 \text{ g BaCl}_2\text{•2 H}_2\text{O}$$

$$? \text{ \% BaCl}_2\text{•2 H}_2\text{O} = \frac{1.483 \text{ g BaCl}_2\text{•2 H}_2\text{O}}{1.6992 \text{ g}} \times 100 \text{ \%} = 87.28 \text{ \% BaCl}_2\text{•2 H}_2\text{O}$$

12.72 % NaCl

9.

(a) phosphorus trifluoride
(b) diodine pentoxide
(c) tetraphophorus decasulfide
(d) silicon tetrachloride
(e) PCl_5 (f) SF_4 (g) N_2O_5 (h) P_4O_6

10.

$$? \text{ tablets} = 550 \text{ mg Fe}^{2+} \times \frac{151.9 \text{ g FeSO}_4}{55.85 \text{ g Fe}} \times \frac{\text{tablet}}{325 \text{ mg FeSO}_4} = 4.6 \text{ tablets}$$

5 tablets would be lethal.