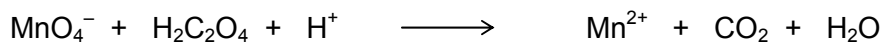


ASSORTED STOICHIOMETRY PRACTICE PROBLEMS PART I

(1) A 1.2156-gram sample of a mixture of CaCO_3 and Na_2SO_4 was analyzed by dissolving the sample and completely precipitating the Ca^{2+} as CaC_2O_4 . The CaC_2O_4 was dissolved in sulfuric acid and the resulting $\text{H}_2\text{C}_2\text{O}_4$ was titrated with a standard KMnO_4 solution.

- a. Write the balanced equation for the titration reaction, shown unbalanced below:



Also, indicate which substance is the oxidizing agent and which substance is the reducing agent.

- b. The titration of the $\text{H}_2\text{C}_2\text{O}_4$ obtained required 35.62 milliliters of 0.1092 M MnO_4^- solution. Calculate the number of moles of $\text{H}_2\text{C}_2\text{O}_4$ that reacted with the MnO_4^- .
- c. Calculate the number of moles of CaCO_3 in the original sample.
- d. Calculate the percentage by weight of CaCO_3 in the original sample.

- (2) Water is added to 4.267 grams of UF_6 . The only products are 3.730 grams of a solid containing only uranium, oxygen, and fluorine and 0.970 gram of a gas. The gas is 95.0 percent fluorine, and the remainder is hydrogen.
- From these data, determine the empirical formula of the gas.
 - What fraction of the fluorine of the original compound is in the solid and what fraction in the gas after the reaction?
 - What is the formula of the solid product?
 - Write a balanced equation for the reaction between UF_6 and H_2O . Assume that the empirical formula of the gas is the true formula.

- (3) Three volatile compounds X, Y, and Z each contain element Q. The percent by weight of element Q in each compound was determined. Some of the data obtained are given below.

Compound	Percent by Weight of Element Q	Molecular Weight
X	64.8%	?
Y	73.0%	104.
Z	59.3%	64.0

- a. The vapor density of compound X at 27 °C and 750. mm Hg was determined to be 3.53 grams per liter. Calculate the molecular weight of compound X.
- b. Determine the mass of element Q contained in 1.00 mole of each of the three compounds.
- c. Calculate the most probable value of the atomic weight of element Q.
- d. Compound Z contains carbon, hydrogen, and element Q. When 1.00 gram of compound Z is oxidized and all of the carbon and hydrogen are converted to oxides, 1.37 grams of CO₂ and 0.281 gram of water are produced. Determine the most probable molecular formula of compound Z.
- (4) A mixture of H₂ (g), O₂ (g), and 2 milliliters of H₂O (l) is present in 0.500-liter rigid container at 25 °C. The number of moles of H₂ and the number of moles of O₂ are equal. The total pressure is 1,146 millimeters of mercury. (The equilibrium vapor pressure of pure water is 24 millimeters mercury). The mixture is sparked, and H₂ and O₂ react until one reactant is completely consumed.

- a. Identify the reactant remaining and calculate the number of moles of the reactant remaining.
- b. Calculate the total pressure in the container at the conclusion of the reaction if the final temperature is 90°C . (The equilibrium vapor pressure of water at 90°C is 526 millimeters mercury).
- c. Calculate the number of moles of water present as vapor in the container at 90°C .
- (5) Propane, C_3H_8 , is a hydrocarbon that is commonly used as fuel for cooking.
- a. Write a balanced equation for the complete combustion of propane gas, which yields $\text{CO}_2(g)$ and $\text{H}_2\text{O}(l)$.
- b. Calculate the volume of air at 30°C and 1.00 atmosphere that is needed to burn completely 10.0 grams of propane. Assume that air is 21.0 percent O_2 by volume.
- c. The heat of combustion of propane is $-2,220.1$ kJ/mol. Calculate the heat of formation, ΔH_f° , of propane given that ΔH_f° of $\text{H}_2\text{O}(l) = -285.3$ kJ/mol and ΔH_f° of $\text{CO}_2(g) = -393.5$ kJ/mol.
- d. Assuming that all of the heat evolved in burning 30.0 grams of propane is transferred to 8.00 kilograms of water (specific heat = 4.18 J/g \cdot K), calculate the increase in temperature of the water.

KEY: ASSORTED STOICHIOMETRY PRACTICE PROBLEMS I

- (1) a. $5 \text{H}_2\text{C}_2\text{O}_4 + 2 \text{MnO}_4^- + 6 \text{H}^+ \longrightarrow 10 \text{CO}_2 + 2 \text{Mn}^{2+} + 8 \text{H}_2\text{O}$
b. $9.724 \times 10^{-3} \text{ mol}$
c. $9.724 \times 10^{-3} \text{ mol}$
d. 80.07 %
- (2) a. HF
b. 33 % of the original fluorine is in the solid
67 % of the original fluorine is in the gas
c. UO_2F_2
d. $\text{UF}_6 + 2 \text{H}_2\text{O} \longrightarrow \text{UO}_2\text{F}_2 + 4 \text{HF}$
- (3) a. 88.1 g/mol
b. one mole of X contains 57.1 grams of Q
one mole of Y contains 75.9 grams of Q
one mole of Z contains 38.0 grams of Q
c. 19 g/mol
d. $\text{C}_2\text{H}_2\text{Q}_2$
- (4) a. O_2 is in excess, $7.54 \times 10^{-3} \text{ mol O}_2$ remains
b. 868 mm Hg
c. $1.16 \times 10^{-2} \text{ mol H}_2\text{O}$