AP Chemistry

Winter Break Extra Credit 2018/2019

1) A 1.405 g sample of an alkane yields 4.305 g CO_2 and 2.056 g H_2O on combustion. A 0.403 g sample of the gaseous hydrocarbon occupies a volume of 145 ml at 99.8 ^oC and 749 Torr. Draw structural formulas and give the names for all of the possible isomers of this hydrocarbon.

2) The composition of a particular natural gas, expressed on a mole fraction basis, is CH_4, 0.830; C_2H_6, 0.112; C_3H_8, 0.058. A 2.15 L sample of this natural gas, measured at 24.5 ^oC and 744 mm Hg, is burned in an excess of oxygen. How much heat is evolved in the combustion? (Hint: What are the heats of combustion of the individual gases?)

3) A 10.25 g sample of a metal alloy is heated to 99.10°C, and is then dropped into 20.0 g of water in a calorimeter. The water temperature rises from 18.51°C to 22.03°C. Calculate the specific heat of the alloy.

4) A 65.0 ml sample of 0.600 M hydroiodic acid at 18.46°C is mixed with 84.0 ml of 1.00 M potassium hydroxide at 18.46°C in a coffee cup calorimeter, and the temperature rises to 21.96°C. Calculate ΔH for the reaction.

5) Methanol can reduce chlorate ion to chlorine dioxide in an acidic solution. The methanol is oxidized to carbon dioxide. What volume of methanol (d=0.791 g/ml), in liters, is needed to produce 125 kg chlorine dioxide gas?

6) In order to standardize an oxalic acid solution, its exact concentration is determined by an acid-base titration. Then, the oxalic acid solution is used to determine the concentration of a potassium permanganate solution by a redox titration. The titration of 25.00 ml samples of the oxalic acid solution requires 32.15 ml of 0.1050 M sodium hydroxide and 28.12 ml of the potassium permanganate solution. What is the molarity of the potassium permanganate solution. (Hint: Oxalic acid is oxidized to carbon dioxide.)

7) Two cylinders of gas are used in welding. One cylinder is 1.2 m high and 18 cm in diameter, containing oxygen gas at 2550 psi and 19°C. The other is 0.76 m high and 28 cm in diameter, containing acetylene gas (ethyne) at 320 psi and 19°C. ($V = \pi r^2 h$) a) Assuming complete combustion, which tank will empty first? b) What volume will the excess gas occupy?

8) You drop a 15.0 g ice cube(initially at 0 Celsius) in a perfect calorimeter holding 100.0 mL of water (initially at 30.0 Celsius). What is the final temperature? Feel free to look up relevant data.

9) At 25°C and 380 mm Hg, the density of sulfur dioxide is 1.31 g/L. The rate of effusion of sulfur dioxide through an orifice is 4.48 ml/s. What is the density of a sample of gas that effuses though an identical orifice at the rate of 6.78 ml/s under the same conditions? What is the molar mass of the gas?

10. The following 'cycle of copper" experiment is performed in some general chemistry laboratories. The series of reactions starts with metallic copper and ends with metallic copper. The steps are as follows:

a) A piece of copper wire of known mass is allowed to react with concentrated nitric acid.

b) The copper (II) nitrate is treated with a sodium hydroxide solution to produce a precipitate.

c) On heating, the precipitate produces copper (II) oxide.

d) The copper (II) oxide is reacted with concentrated sulfuric acid.

e) Copper (II) sulfate is treated with an excess of zinc metal to form metallic copper.

f) The remaining zinc is removed by treatment with hydrochloric acid, and metallic copper is filtered, dried, and weighed.

Write a balanced equation for each step and classify the reactions. Assuming that 65.6 g of copper was used, calculate the theoretical yield of the copper containing substances at each step.

(Most of these questions were written by my dear friend/colleague Linda Dillard)