CHEM 024b 2008
Tutorial Quiz #1 – Group A
Friday, January 25th 2008

YOUR NAME: JONES **TA'S NAME:** _____

(1) Chalcopyrite is a mineral that contains 34.62 % copper (Cu), 30.43 % iron (Fe), and 34.95 % sulfur (S) by mass. What is the chemical formula for chalcopyrite? [6 marks]

Imagine you have 100 g chalcopyrite

$\Rightarrow$ $34.62\ g\ Cu \equiv \frac{34.62\ g}{63.55\ g\ mol^{-1}} = 0.545\ mol$

$30.43\ g\ Fe \equiv \frac{30.43\ g}{55.85\ g\ mol^{-1}} = 0.545\ mol$

$34.95\ g\ S \equiv \frac{34.95\ g}{32.07\ g\ mol^{-1}} = 1.09\ mol$

$\Rightarrow$ chalcopyrite has the formula: $CuFeS_2$.

(2) [5 marks] In an experiment, 1.00 g of CO_2 gas was isolated from the combustion of glucose ($C_6H_{12}O_6$) in excess oxygen (O_2). What mass of glucose was burned if the experimental yield was 90 %. The combustion reaction is:

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$$

100% yield would be $\frac{100}{90} \times 1.00\ g = 1.11\ g\ CO_2$

$\equiv \frac{1.11\ g}{(12.01 + 2 \times 16.00)\ g\ mol^{-1}} = 0.025\ mol\ CO_2$

mol. ratio CO_2 : glucose

6 : 1

$\therefore$ # moles glucose burned $= \frac{1}{6} \times 0.025\ mol$

$= 4.21 \times 10^{-3}\ mol$

$mw(glucose) = 6 \times 12.01 + 12 \times 1.008 + 6 \times 16.00\ g\ mol^{-1}$

$= 180.16\ g\ mol^{-1}$

$\Rightarrow$ mass of glucose burned $= 180.16\ g\ mol^{-1} \times 4.21 \times 10^{-3}\ mol$

$= \underline{0.76\ g}$

(3) Write balanced equations for the following reactions [2 marks each]:

(a) The "rocket reaction" between N_2H_4 and N_2O_4.

$$2\ N_2H_4(l) + N_2O_4(l) \longrightarrow 3\ N_2(g) + 4\ H_2O(g)$$

(b) The precipitation of silver chloride (AgCl) from mixing of aqeous silver nitrate ($AgNO_3$) and iron(III) chloride solutions.

$$FeCl_3(aq) + 3\ AgNO_3(aq) \longrightarrow 3\ AgCl(s) + Fe(NO_3)_3(aq)$$

(4) Silver (Ag) has two naturally occurring isotopes. The first, ^{107}Ag, has a mass of 106.9 amu and an abundance of 51.8 %. Calculate the mass of the other isotope of silver. [5 marks]

$$\frac{51.8}{100} \times 106.9 + \frac{100-51.8}{100} \times x = 107.9 \text{ amu}$$

(from the periodic table)

$$55.37 + 0.482x = 107.9$$

$$\Rightarrow x = \frac{107.9 - 55.37}{0.482}$$

$$= 108.97 \text{ amu.}$$

(5) (a) In the following reaction, identify two acid and base pairs [2 marks]:

Acid Base Base Acid

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

(b) Say whether the following statements are true or false [1 mark each]:

(i) CH_3COOH is a stronger acid than H_3O^+. False

(ii) The equilibrium lies completely on the right hand side. False

(6) For each of the following elements

Bismuth (Bi)
Selenium (Se)
Barium (Ba)

State [1 mark each]:

(a) The name of the group into which the element falls
(b) The nearest noble gas element
(c) The charge borne by ions of the element

Answers:

Bi (a) Main group
(b) Radon (Rn)
(c) Bi^{3-}

Se (a) Main group
(b) Krypton (Kr)
(c) Se^{2-}

Ba (a) Alkaline earth metal
(b) Xenon (Xe)
(c) Ba^{2+}

(7) How many hydrogen atoms are there in 2 mol of cyclobutane (C_4H_8) [1 mark]?

$2 \times 8 \times 6.02 \times 10^{23} = 9.63 \times 10^{24}$ H-atoms

(8) Give the formulae of the following compounds [1 mark each]:

(a) dinitrogen tetraoxide

N_2O_4

(b) sodium hypochlorite

NaOCl

(c) magnesium nitrite

$Mg(NO_2)_2$

(9) Give the names of the following compounds [1 mark each]:

(a) P_4O_6

tetraphosphorus hexaoxide

(b) $NaSO_3$

sodium sulfite

(c) $FeCl_2$

iron(II) chloride (or, ferrous chloride).