**CHE1031 Quiz 4A: Stoichiometry of chemical reactions - KEY**

*A periodic table, table of conversion factors and precipitation chart are provided. You will have a ‘magic moment’ to refer to handwritten notes. Please show all work for full & partial credit.*

**4.1: Writing and balancing chemical equations**

**1.** Balance the following equations:

(a) Fe(*s*) + H2O(*l*) ⟶ Fe3O4(*s*) + H2(*g*)

(b) Ca3(PO4)2(*aq*) + H3(PO4)(*aq*) ⟶ Ca(H2PO4)2(*aq*)

(a) **3**Fe(*s*) + **4**H2O(*l*) ⟶ Fe3O4(*s*) + **4**H2(*g*)

(b) Ca3(PO4)2(*aq*) + **4**H3(PO4)(*aq*) ⟶ **3**Ca(H2PO4)2(*aq*)

**2.** Write a balanced equation describing each of the following chemical reactions.

(a) Solid aluminum metal reacts with solid diatomic iodine to form solid Al2I6.

(b) When solid sodium chloride is added to aqueous sulfuric acid, hydrogen chloride gas and aqueous sodium sulfate are produced.

(a) 2Al(s) + 3I2(s) 🡪 Al2I6(s)

(b) 2NaCl(s) + H2(SO4)(aq) 🡪 2HCl(g) + Na2(SO4)(aq)

**4.2: Classifying chemical reactions**

**3.** Identify the combination of reactants that produces a precipitate and write: (1) a balanced chemical equation; (2) a complete ionic equation; and (3) a net ionic equation.

(a) Na(C2H3O2) + HCl no ppt

(b) K(OH) + Cu(NO3)2 Cu(OH)2

(c) Fe(SO4) + K(NO3) no ppt

(b) 2K(OH) + Cu(NO3)2 🡪 2K(NO3) + Cu(OH)2

~~2K~~~~+1~~ + 2(OH)-1 + Cu+2 + ~~2(NO3)~~~~-1~~ 🡪 ~~2K~~~~+1~~ ~~+ 2(NO3)~~~~-1~~ + Cu(OH)2

2(OH)-1 + Cu+2 🡪 Cu(OH)2

**4.** A solution of Sr(OH)2 is added to a solution of H(NO3).

(a) Write a complete balanced equation

(b) Write a complete ionic equation.

(c) Write a net ionic equation.

(a) Sr(OH)2 + 2H(NO3) 🡪 Sr(NO3)2 + 2H2O

(b) ~~Sr~~~~+2~~ + 2(OH)-1 + 2H+1 + ~~2(NO3)~~~~-1~~ 🡪 ~~Sr~~~~+2~~ ~~+ 2(NO3)~~~~-1~~ + 2H2O

(c) 2(OH)-1 + 2H+1 🡪 2H2O

**5.** These reactants participate in an oxidation-reduction reaction: Ba(s) + HBr(aq).

(a) Write a balanced chemical equation.

(b) Assign oxidation numbers.

(c ) Identify the elements that are oxidized and those that are reduced.

(a) Ba + 2HBr 🡪 BaBr2 + H2  
(b) 0 +1/-1 +2/-1 o

(c) Ba is oxidized & H is reduced

**6.** Balance this redox reaction using to the half-reaction method.

CN−1(*aq*) + ClO2(*aq*) ⟶ CNO−1(*aq*) + Cl−1(*aq*) (in acidic aqueous solution)

(CN−1(*aq*) + **H2O**⟶ CNO−1(*aq*)(in acid) + **2H+1 + 2e-**)x5

(ClO2(*aq*) + **4H+1 + 5e-** ⟶ Cl−1(*aq*) (in acid) + **2H2O**)x2

**4.3: Reaction stoichiometry**

**7.** Write the balanced equation, then determine the number of moles and the mass of Mg required to react with 5.00 g of HCl and produce MgCl2 and H2.

Mg + 2HCl 🡪 MgCl2 + H2

? 5.00 g

5.00 g 1 mol 1 mol Mg = 0.0685 mol Mg 24.31 g = 1.67 g Mg

36.46 g 2 mol HCl 1 mol

**4.4: Reaction yields**

**8.** In a combustion reaction**,** 30.0 g of propane, C3H8, is combined with 75.0 g of oxygen.

(a) Determine the limiting reactant.

(b) Determine the theoretical yield.

(c ) Calculate the percent yield if the actual yield is 50.0 g of CO2.

BCE; for each reactant g🡪 mol 🡪 mol of either product; lower yield is limiting

C3H8 + 5O2 🡪 3CO2 + 4H2O

30.0 g 75.0g

30.0 g 1 mol C3H8 3 mol CO2 = 2.04 mol CO2

44.11 g 1 mol C3H8

75.0 g 1 mol O2 3 mol CO2 = 1.41 mol CO2 So O2 is limiting.

31.98 g 5 mol O2

1.41 mol CO2 43.99 g = 62.0 g theoretical yield % yield = (50.0/62.0)(100) = 80.6%

1 mol CO2

**4.5: Quantitative chemical analysis**

**9.** Titration of a 20.0-mL sample of acid rain required 1.7 mL of 0.0811 M Na(OH) to reach the end point. If we assume that the acidity of the rain is due to the presence of sulfuric acid, what was the concentration of sulfuric acid in this sample of rain?  
2Na(OH) + H2(SO4) 🡪 2H2O + Na2(SO4)

1.7 mL 20.00 mL

0.0811 M X M

0.0017 L 0.0811 mol Na(OH) 1 mol H2(SO4) = 3.4 E-3 M

1 L 2 mol Na(OH) 0.02000 L

**10.** Potatoes can be peeled commercially by soaking them in a 3-M to 6-M solution of sodium hydroxide, then removing the loosened skins by spraying them with water. Does a sodium hydroxide solution have a suitable concentration if titration of 12.00 mL of the solution requires 30.6 mL of 1.65 M HCI to reach the end point?

Na(OH) + HCl 🡪 H2O + NaCl

12.00 mL 30.5 mL

X M 1.65 M

0.0305 L 1.65 mol HCl 1 mol Na(OH) = 4.19 M Na(OH) … yes

1 L 1 mol HCl 0.01200 L