Chem 180 *Coastline College*
Summer 2015 *Dupon*

Practice Exam 2

For review on July 9, 2015

PART A (MULTIPLE CHOICE) Circle the correct response to each question:

1. When 4.50 g of Fe_2O_3 is reduced with excess H_2 in a furnace, 2.60 g of iron metal is recovered. What is the percent yield (the molar mass of Fe_2O_3 is 159.7 g/mole)

$Fe_2O_{3(s)} + 3\,H_{2(g)} \text{----------} > 2\,Fe_{(s)} + 3\,H_2O_{(g)}$

(A) 82.6%
(B) 58.0%
(C) 40.5%
(D) 31.5%

2. The limiting reagent in a particular reaction can be recognized because it is the reagent that

(A) has the smallest coefficient in the balanced equation
(B) has the smallest mass in the reaction mixture
(C) is present in the smallest molar quantity
(D) would be used up first

3. In which of the following does nitrogen have an oxidation state of +4?

(A) HNO_3
(B) NO_2
(C) N_2O
(D) NH_4Cl

4. What volume of 12M HCl is required to prepare exactly 500 mL of 0.60 M HCl?

(A) 10 mL
(B) 14 mL
(C) 25 mL
(D) 40 mL

5. What volume of $H_2O(g)$ measured at STP is produced by the combustion of 3.85 g of natural gas (CH_4) according to the following equation?

CH4 + 2 O2 ----------> CO2 + 2 H2O

(A) 5.38 L
(B) 10.8 L
(C) 2.69 L
(D) 11.7 L

6. What is the molar mass of an ideal gas if a 0.622 g sample of this gas occupies a volume of 300. mL at 35°C and 789 mm Hg?

(A) 44.8 g/mole
(B) 48.9 g/mole
(C) 50.5 g/mole
(D) 54.5 g/mole

7. A vessel with a volume of 41.8 L contains 2.80 g of nitrogen gas, 0.403 g of hydrogen gas, and 79.9 g of argon gas. At 25°C, what is the pressure in the vessel?

(A) 48.6 atm
(B) 0.113 atm
(C) 1.52 atm
(D) 1.35 atm

8. How much heat is required to raise the temperature of a 4.48-g sample of iron (specific heat = 0.450 J/g°C) from 25.0°C to 79.8°C?

(A) 1.98 J
(B) 246 J
(C) 546 J
(D) 110 J

9. Given the heats of the following reactions:

		$\Delta H°$ kJ
I.	$P_4(s) + 6Cl_2(g) \text{----> } 4PCl_3(g)$	–1225.6
II.	$P_4(s) + 5O_2(g) \text{----> } P_4O_{10}(s)$	–2967.3
III.	$PCl_3(g) + Cl_2(g) \text{----> } PCl_5(g)$	–84.2
IV.	$PCl_3(g) + \frac{1}{2} O_2(g) \text{----> } Cl_3PO(g)$	–285.7

Calculate the value of $\Delta H°$ for the reaction below:

$$P_4O_{10}(s) + 6PCl_5(g) \text{---------> } 10Cl_3PO(g)$$

(A) –110.5 kJ
(B) –610.1 kJ
(C) –2682.2 kJ
(D) –7555.0 kJ

10. The heat of combustion of acetylene, $C_2H_2(g)$, at 25°C is –1299 kJ/mol. At this temperature, ΔH_f° values for $CO_2(g)$ and $H_2O(l)$ are –393 and –286 kJ/mol, respectively. Calculate ΔH_f° for acetylene.

(A) 2376 kJ/mol
(B) 625 kJ/mol
(C) 227 kJ/mol
(D) –625 kJ/mol

PART B (SHORT ANSWERS) Please show all of your calculations <u>in the places provided</u>.

1. **(a)** (*5 pts*) 15 mL of a 0.07M solution of $Pb(NO_3)_2$ is mixed with 9 mL of a 0.15 M solution of Na_2SO_4. What is the mass of $PbSO_4$ that would be expected to precipitate?

$Pb(NO_3)_{2(aq)} + Na_2SO_{4(aq)} \text{ ----------> } PbSO_{4(s)} + 2\ Na^+_{(aq)} + 2\ NO_3^-{}_{(aq)}$

(b) (*5 pts*) Aspirin (acetylsalicylic acid $C_9H_8O_4$) is prepared by heating salicylic acid $C_7H_6O_3$ with acetic anhydride $C_4H_6O_3$. The other product is acetic acid (vinegar, $C_2H_4O_2$).

$$C_7H_6O_3 + C_4H_6O_3 \text{ ----------> } C_9H_8O_4 + C_2H_4O_2$$

When 2.00 g of salicylic acid is heated with 4.0 g of acetic anhydride, 1.98 g of aspirin is recovered. What is the yield of aspirin?

2. (a) (*6 pts*) Write complete net ionic equations for the following combinations of solutions and the identity of the solid precipitate formed:

(i) solutions of $CuCl_2$ and Na_2S

(ii) solutions of NH_4Cl and $LiSO_4$

(iii) solutions of KOH and $Fe(NO_3)_2$

(b) (*4 pts*) Sulfamic acid, HSO_3NH_2 (molar mass = 97.1 g/mol), is a strong monoprotic acid that can be used to standardize a strong base:

$$HSO_3NH_2 + KOH \text{ ----------> } H_2O + K^+ + SO_3NH_2^-$$

A 0.177-g sample of HSO_3NH_2 required 19.4 mL of an aqueous solution of KOH

What is the molarity of the KOH solution?

(c) (*4 pts*) In the following equation: $C_3H_5(NO_3)_3$ --------> $N_2 + CO_2 + H_2O + O_2$ identify what is oxidized and what is reduced.

3. (a) (*5 pts*) A 3.50 g sample of acetylene is burned in excess oxygen:

$$2\ C_2H_{2(g)} + 5\ O_{2(g)} \text{ ----------> } 4\ CO_{2(g)} + 2\ H_2O_{(l)}$$

At STP, what volume of CO_2 gas is produced if all of the acetylene is used up?

(b) (*5 pts*) The gas inside of a sealed diving bell contains a mixture of oxygen and helium gases. If it holds 0.200 atm of O_2 and a total pressure of 3.00 atm, calculate the mass of helium in 10.0 L of the gas mixture at 20°C.

4. (a) (*5 pts*) If it takes 4.67 times longer for an unknown gas to effuse from a container than does hydrogen (H_2) gas under the same conditions, what is the molecular mass of the gas?

(b) (*5 pts***)** A 28.0 g piece of aluminum metal (C_{Al} = 0.897 $\frac{J}{g°C}$) is dropped into 100.0 g of water initially at 20° C. If the final temperature of the metal and the water is 24.0°C, what was the initial temperature of the aluminum?

5. a. (*5 pts*) You take 243.8 g of a solid at 30.0°C and let it melt in 425 g of water. The water temperature decreases from 85.1°C to 30.0°C. Calculate the heat of fusion of this solid.

(b)**(***5 pts***)** Consider the following data:

	$\Delta H°$ (kJ)
$Ca(s) + 2C(\text{graphite}) \text{ ----> } CaC_2(s)$	–62.8
$Ca(s) + \frac{1}{2} O_2(g) \text{ ----> } CaO(s)$	–635.5
$CaO(s) + H_2O(l) \text{ ----> } Ca(OH)_2(aq)$	–653.1
$C_2H_2(g) + \frac{5}{2} O_2(g) \text{ ----> } 2CO_2(g) + H_2O(l)$	–1300
$C(\text{graphite}) + O_2(g) \text{ ----> } CO_2(g)$	–393.51

Use Hess' law to find the change in enthalpy at 25°C for the following equation:

$$CaC_2(s) + 2H_2O(l) \text{ ----------> } Ca(OH)_2(aq) + C_2H_2(g)$$

Equations

Boyle's Law: $P_1V_1 = p_2V_2$ Charles' Law: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Gay-Lussac's Law: $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ Combined gas Law: $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$

Ideal Gas Law: $pV = nRT$ $R = 0.082 \frac{\text{L atm}}{\text{mole K}} = 63.26 \frac{\text{L torr}}{\text{mole K}}$

Dalton's Law of Partial Pressures: $p_T = \sum(p_1 + p_2 + p_3 + \ldots.)$

$q = m\ C\ \Delta T$ $M_1V_1 = M_2V_2$