Chem 110 **Fall 2007** **Exam III – Key** **Whelan**

Question 1
8 Points

a. Write a **net ionic equation** to show that **perchloric** acid, behaves as an acid in water.

$HClO_4(aq) + H_2O(l)$ = $H_3O^+ + ClO_4^-$

(= or ⇔)

b. Write a **net ionic equation** to show how **ammonia** behaves as a base in water.

$NH_3(aq) + H_2O(l)$ ⇔ $NH_4^+ + OH^-$

(= or ⇔)

Question 2
8 Points

a. HNO_2 2
b. C_9H_7N 4
c. CH_3COOH 2
d. $Ba(OH)_2$ 3

1. Strong Acid
2. Weak Acid
3. Strong Base
4. Weak Base

Question 3
6 Points

Circle the appropriate answers

	Acid	K_a
A	Acetic	$1.8x10^{-5}$
B	Histidine	$7.9x10^{-7}$
C	Carbonic	$4.2x10^{-7}$

a. The acid with the **smallest $[H_3O^+]$** in a **0.10** M aqueous solution is: **A** **B** ***C***

b. The acid with the **smallest pKa**: ***A*** **B** ***C***

c. The acid with the **smallest pOH** in a 0.10 M aqueous solution is: **A** **B** ***C***

Question 4
4 Points

A student determines that the value of **pKa** for HCN = **9.29** .

What is the value of **Ka**? $5.13x10^{-10}$

Question 5
9 Points

The **hydroxide** concentration in an aqueous solution is $3.5x10^{-2}$ M.

a. The **hydronium** ion concentration is: $2.88x10^{-13}$ M

b. The **pH** of this solution is: 12.54

c. The **pOH** is: 1.46

Question 6
10 Points

1. For following net ionic equation:

$CN^-(aq) + HSO_3^-(aq)$ ⇔ $HCN(aq) + SO_3^{2-}(aq)$

– Circle the appropriate answer – B-L = Bronsted Lowry

SO_3^{2-}	B-L Acid	**B-L Base**
HSO_3^-	**B-L Acid**	B-L Base

2. The formula for the conjugate **acid** of CN^- is: **HCN**
3. The formula for the conjugate **base** of HSO_3^- is: SO_3^{2-}

Question 7
4 Points

A buffer solution made from **HClO** and **KClO** has a **pH** of **7.65**. If **pKa** for HClO is **7.46**, this implies that: ***- Circle the appropriate answer***

1. $[ClO^-]/[HClO] = 1$
2. **$[ClO^-]/[HClO] > 1$**
3. $[ClO^-]/[HClO] < 1$

Question 8
4 Points

A buffer solution made from **HF** and **NaF** has a pH of **2.87**. If pKa for HF is 3.**14**, what is the $[F^-]/[HF]$ in the buffer?

$$pH = pK_a + \log_{10}\frac{[F^-]}{[HF]}$$

$$2.87 = 3.14 + \log_{10}\frac{[F^-]}{[HF]}$$

$$\log_{10}\frac{[F^-]}{[HF]} = -0.27$$

$[F^-]/[HF]$ 0.54

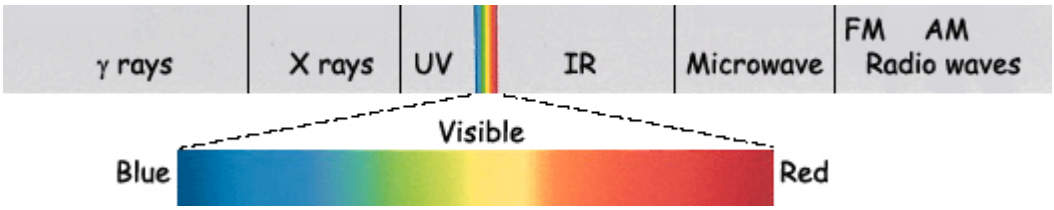
Question 9
8 Points

A small amount of **strong base** is added to a **buffer** made from **HCN** and **NaCN**. What changes if any will occur to the solution.

- Circle the appropriate answer

1.	**pH**	**Increase**	Decrease	Remain the same
2.	**$[OH^-]$**	**Increase**	Decrease	Remain the same
3.	**[HCN]**	Increase	**Decrease**	Remain the same
4.	**$[CN^-]$**	**Increase**	Decrease	Remain the same

Question 10
9 Points



a. Which has the **greater frequency**, **FM** or **AM** Radio Waves? **FM**

b. Which has the **longer wavelength**, **Red** or **Blue**? **Red**

c. The **region** with the **shortest wavelengths**? **γ rays**

Question 11
6 Points

a. When the nuclide **^{218}Po** decays to **^{214}Pb**, what kind of decay does **^{218}Po** undergo? **^4_2He (Alpha)**. The instability of **^{218}Po** is probably due to the fact that it has too many **protons**.

b. What type of radioactive decay would account for the transformation of **^{51}Cr** to **^{51}V**? **^0_1e (Positron)**

Question 12
3 Points

^{131}I **(half-life, 8.04 days)** is used as a treatment for thyroid cancer. How many milligrams of a **32** milligram sample of ^{131}I will remain after **32.16** days?

$$\frac{32.16}{8.04} = 4$$

$$32 \times \tfrac{1}{2} \times \tfrac{1}{2} \times \tfrac{1}{2} \times \tfrac{1}{2} = 2$$

2 **Milligrams ^{131}I**

Question 13
6 Points

According to the following reaction, how many **grams** of **oxygen gas** are required for the complete reaction of **21.3** grams of **carbon monoxide**?

carbon monoxide (g) + oxygen (g) = carbon dioxide (g)

$$2CO + O_2 = 2CO_2$$

$$\frac{21.3\ g\ CO}{} \left| \frac{1\ mol}{28.01g} \right. = \mathbf{0.76}\ mol\ CO$$

$$\frac{0.76\ mol\ CO}{} \left| \frac{1\ O_2}{2\ CO} \right. = \mathbf{0.38}\ mol\ O_2$$

$$\frac{0.38\ mol\ O_2}{} \left| \frac{\mathbf{32g}}{1\ mol} \right. = 12.2g$$

12.2 **Grams of oxygen gas**

Question 14
7 Points

An aqueous solution of **hydrochloric acid** is standardized by titration with a **0.453** M solution of **barium hydroxide**.
If **29.4** mL of base are required to neutralize **15.6** mL of the acid, what is the **molarity** of the **hydrochloric acid** solution?

$$2HCl + Ba(OH)_2 = BaCl_2 + 2\ H_2O$$

$$0.453 \times 0.0294 = \mathbf{1.33x10^{-2}}\ mol\ Ba(OH)_2$$

$$\frac{1.33x10^{-2}\ mol\ Ba(OH)_2}{} \left| \frac{2\ HCl}{Ba(OH)_2} \right. = \mathbf{2.66x10^{-2}}$$

$$\frac{2.66x10^{-2}\ mol\ HCl}{0.0156L} = \mathbf{1.71\ M}$$

1.71 **M**

Question 15
8 Points

How many **grams** of solid **calcium hydroxide** are needed to exactly neutralize **18.3** mL of a **0.690 M perchloric acid** solution?
Assume that the volume remains constant.

$$Ca(OH)_2 + 2HClO_4 = Ca(ClO_4)_2 + 2H_2O$$

$$0.690 \times 0.0183 = \mathbf{0.0126}\ mol\ HClO_4$$

$$\frac{0.0126\ mol\ HClO_4}{} \left| \frac{Ca(OH)_2}{2\ HClO_4} \right. = \mathbf{6.31x10^{-3}}\ mol$$

$$\frac{6.31x10^{-3}\ mol\ Ca(OH)_2}{} \left| \frac{\mathbf{74.1g}}{1\ mol} \right. = 0.468\ g$$

0.468 **g**

Exam III Score