Chem 110 **Fall 2006** **Exam III** **Whelan**

Question 1 (10 Points) Consider the following endothermic equilibrium reaction:

$COBr_2(g) \Leftrightarrow CO(g) + Br_2(g)$

The production of $CO(g)$ is favored by – ***Circle the correct answer***

1. **True** False **Increasing** the temperature.
2. **True** False **Decreasing** the pressure.
3. True **False** **Decreasing** the volume.
4. True **False** **Removing** $COBr_2$.
5. **True** False **Removing** Br_2.

Question 2 (4 Points)

1. Write a **net ionic equation** to show that hydrofluoric acid, **behaves** as an **acid** in **water**.
   $HF(aq) + H_2O(l) \Leftrightarrow H_3O^+ + F^-$
2. Write a **net ionic equation** to show that isoquinoline, **behaves** as a **base** in **water**.
   $C_9H_7N + H_2O(l) \Leftrightarrow C_9H_7NH^+ + OH^-$

Question 3 (4 Points) Assign each substance given on the **left** with a category given on the **right**.

HF	2	**1.** Strong Acid
LiOH	3	**2.** Weak Acid
$(C_2H_5)_2NH$	4	**3.** Strong Base
HNO_2	2	**4.** Weak Base

Question 4 (4 Points) Consider the amino acids listed below:

Lysine, $K_a = 1.0\times10^{-9}$ @ 25^0C
Tyrosine, $K_a = 1.6\times10^{-10}$ @ 25^0C
Histidine, $K_a = 7.9\times10^{-7}$ @ 25^0C
Cysteine, $K_a = 5.0\times10^{-9}$ @ 25^0C

1. The **strongest** of the four acids is: Histidine
2. The acid with the **largest pK_a** value is: Tyrsoine

Question 5 (8 Points) The **pH** of an aqueous solution was found to be **12.00**.

1. The pOH of this solution is: 2
2. The hydronium concentration is: 1×10^{-12}
3. The hydroxide concentration is: 1×10^{-2}
4. This solution is: basic
   (a buffer, acidic, neutral, basic)

Question 6
12 Points

1. In the following net ionic equation, identify each species as either a Bronsted-Lowry **acid** or a Bronsted-Lowry **base**.
$CH_3COO^- + HSO_3^- \Leftrightarrow CH_3COOH(aq) + SO_3^{2-}$

- Circle the appropriate answer

CH_3COO^-	B-L Acid	**B-L Base**
HSO_3^-	**B-L Acid**	B-L Base
CH_3COOH	**B-L Acid**	B-L Base
SO_3^{2-}	B-L Acid	**B-L Base**

2. The formula for the conjugate **acid** of CH_3COO^- is: **CH_3COOH**
3. The formula for the conjugate **base** of HSO_3^- is: **SO_3^{2-}**

Question 7
8 Points

Are the following aqueous solutions, **buffer solutions?**

- Circle the appropriate answer

1. 0.40M NH_4Cl and 0.30M NH_3	**Yes**	No
2. 0.30M HF and 0.10M NaF	**Yes**	No
3. 0.40M HI and 0.40M NaI	Yes	**No**

Which buffer would absorb the greatest quantity of H_3O^+? **1** 2 3

Question 8
4 Points

A buffer solution made from **HClO** and **KClO** has a **pH** of **7.15**. 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 9
4 Points

A buffer solution is **0.476** M in **CH_3COOH** and **0.379** M in **CH_3COONa**. If Ka for CH_3COOH is **1.8×10^{-5}**, what is the pH of this buffer solution?
[Show Work]

$$pH = pK_a + \log_{10}\frac{[A^-]}{[HA]}$$

$$pH = -\log_{10}(1.8\times10^{-5}) + \log_{10}\frac{0.379}{0.476}$$

$$pH = 4.74 + \log_{10}(0.796)$$

Ph = **4.65**

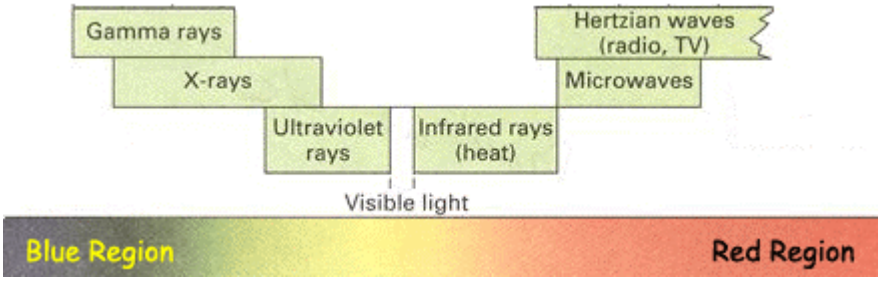
Question 10
8 Points

A small amount of **strong acid** 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 11
6 Points



a. Rank the following (1-3) forms of electromagnetic radiation in order of **increasing energy**: 1= Lowest Energy 3 = Highest Energy

Visible: **2** Radio wave: **1** Gamma ray: **3**

b. Rank the following (1-3) forms of electromagnetic radiation in order of **increasing wavelength**: 1= Shortest Wavelength 3 = Longest Wavelength

Infrared: **2** Radio wave: **3** Visible: **1**

Question 12
x Points

Write a **balanced nuclear equation** for the following:

1. The nuclide $^{222}_{86}$**Rn** undergoes **alpha** emission. $^{222}_{86}Rn \rightarrow {}^{4}_{2}He + {}^{218}_{84}Po$
2. The nuclide $^{18}_{7}$**N** undergoes **beta** decay. $^{18}_{7}N \rightarrow {}^{0}_{-1}e + {}^{18}_{8}O$
3. The nuclide $^{129}_{55}$**Cs** decays by **electron capture**. $^{129}_{55}Cs + {}^{0}_{-1}e \rightarrow {}^{129}_{54}Xe$
4. The nuclide $^{25}_{13}$**Al** undergoes **positron emission**. $^{25}_{13}Al \rightarrow {}^{0}_{+1}e + {}^{25}_{12}Mg$

Which of the above represents the decay of an isotope with too many neutrons. **2**

Question 13
3 Points

Iodine-131 **(half-life, 8.04 days)** is used as a treatment for thyroid cancer. How many milligrams of an **80.1** milligram sample of iodine-131 will remain after **40.2** days? **[Show Work]**

$$\frac{40.2}{8.04} = 5 \text{ Half-lives}$$

$$80.1 \quad \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 2.50$$

Miligrams of Iodine-131 remaining: 2.50

Question 14
4 Points

According to the following reaction, how many **moles** of **potassium hydroxide** are necessary to form 0.668 moles **potassium carbonate?**

carbon dioxide (g) + potassium hydroxide (aq) ➔ potassium carbonate (aq) + water (l)

[Show Work]

$$CO_2(g) + 2\ KOH(aq) \rightarrow K_2CO_3 + H_2O$$

$$0.668\ mol\ K_2CO_3 \quad \frac{2\ KOH}{1\ K_2CO_3} = 1.34\ mol\ KOH$$

Moles of potassium hydroxide: 1.34

Question 15
6 Points

An aqueous solution of **hydrobromic acid** is standardized by titration with a **0.0768** M solution of **barium hydroxide**. If **39.2** mL of base are required to neutralize **25.3** mL of the acid, what is the **molarity** of the **hydrobromic** acid solution?

$$2\ HBr(aq) + Ba(OH_2)(aq) = BaBr_2(aq) + 2\ H_2O(l)$$

$$0.0392 \times 0.0768 = \mathbf{0.00301\ mol\ Ba(OH)_2}$$

$$0.00301\ mol\ Ba(OH)_2 \quad \frac{2\ HBr}{1\ Ba(OH)_2} = \mathbf{0.00602\ mol\ HBr}$$

$$\frac{0.00602}{0.0253} = 0.238\ M$$

Molarity of hydrobromic acid: 0.238

Question 16
5 Points

According to the following reaction, how many **moles** of **ammonium nitrite** are needed to form **30.3** grams of **water?**

ammonium nitrite (aq) ➔ nitrogen (g) + water (l)

$$NH_4NO_2 \rightarrow N_2(g) + 2\ H_2O(l)$$

$$30.3g\ H_2O \quad \frac{1\ mol}{18.02g} = \mathbf{1.7\ mol\ H_2O}$$

$$1.7\ mol\ H_2O \quad \frac{1\ NH_4NO_2}{2\ H_2O} = 0.8\ mol\ NH_4NO_2$$

Moles of ammonium nitrite: 0.8

Exam III Score