Chem 110 **Fall 2018** **Exam III** **Whelan**

SID | | | | | | | | | Last Key First Answer

Question 1 (7 Points)

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

$HCN(aq) + H_2O(l)$ ⇔ $H_3O^+ + CN^-$

(= or ⇔)

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

$Ba(OH)_2(aq)$ = $Ba^{2+} + 2\,OH^-$

(= or ⇔)

Question 2 (8 Points)

Assign each species on the **left** to a **category** on the **right**.

a) HF 2

b) $Ba(OH)_2$ 3

c) $(CH_3)_2NH$ 4

d) HNO_3 1

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

Question 3 (6 Points)

An aqueous solution has a **hydroxide ion** concentration of **1.0 X 10^{-2}** M.

a) What is the **hydronium ion** concentration in this solution? 1.0×10^{-12} M

b) Is this solution **acidic**, **basic** or **neutral**? Basic

Question 4 (6 Points)

An aqueous solution has a **pH** of **8.30**

a) What is the **pOH** of this solution? 5.70

b) What is the **hydronium ion** concentration in this solution? 5.01×10^{-9} M

c) What is the **hydroxide ion** concentration in this solution? 2.00×10^{-6} M

Question 5 (6 Points)

Arrange the following solutions in order of **increasing acidity**:
1 = **least acidic** ; 3 = **most acidic**

a) Solution with a **pOH** = **8** 2

b) Solution with a **hydroxide ion** concentration = **1×10^{-10}** M 3

c) Solution with a **hydronium ion** concentration = **1×10^{-13}** M 1

Question 6 (3 Points)

Hydrocyanic acid (HCN) has a Ka = **4.0×10^{-10}** @ 25°C. Which of the following **amino acids** has an **acid strength closest** to that of **HCN**?

- ☐ Arginine pKa = 12.0
- ● Lysine pKa = 9.0
- ☐ Cysteine pKa = 8.3
- ☐ Histidine pKa = 6.1

Question 7 (9 Points)

In the following net ionic equation:

$$CH_3NH_2(aq) + H_2O(l) \rightleftharpoons CH_3NH_3^+ + OH^-$$

a) CH_3NH_2 is a Bronsted-Lowry **Base**

b) H_2O is a Bronsted-Lowry **Acid**

c) The formula of the **product** that acts as a **proton acceptor**: **OH^-**

Question 8 (6 Points)

a) The formula for the **conjugate acid** of **HSO_3^-** is: **H_2SO_3**

b) The formula for the **conjugate base** of **HSO_3^-** is: **SO_3^{2-}**

Question 9 (6 Points)

Which of the following aqueous solutions are **buffer solutions**?

- ☐ 0.21M HI + 0.17M KI
- ☐ 0.13M NaOH + 0.24M NaCl
- ● 0.16M CH_3COOH + 0.21M CH_3COOK
- ● 0.31M HClO + 0.28M KClO
- ☐ 0.26M NH_4NO_3 + 0.37M KNO_3

Question 10 (8 Points)

A buffer solution is made that is **0.432M** in **H_2S** and **0.432M** in **NaHS**

(2 Points) a) If Ka for H_2S is 1.0×10^{-7}, what is the **pH of the buffer solution**? **7**

(4 Points) b) Write the **net ionic equation** for the reaction that occurs when 0.088mol **HBr** is **added** to 1.00 L of the buffer solution.

H_3O^+ + **HS^-** = **$H_2O(l)$** + **$H_2S(aq)$**

(2 Points) c) The **Buffer capacity** for removal of added **OH^-** is: **0.432** M

Question 11 (5 Points)

A buffer solution is **0.398M** in **HCN** and **0.324M** in **NaCN**. If **Ka** for **HCN** is 4.0×10^{-10}, what is the **pH of this buffer** solution?

For full credit you must show work

$$pH = pKa + \log_{10} \frac{[CN^-]}{[HCN]}$$

$$= -\log_{10}(4.0 \times 10^{-10}) + \log_{10} \frac{0.324}{0.398}$$

$$= 9.40 + \log_{10} 0.814$$

$$= 9.40 - 0.09$$

$$= 9.31$$

pH = **9.31**

Question 12 — 6 Points

The pKa value for HNO_2 is **3.35**.

a) (3 Points) Would a buffer prepared from **HNO_2** and **KNO_2** with a **pH of 3.00** be considered to be an effective buffer? (Yes or No) YES

b) (3 Points) A buffer in which the mole ratio of **KNO_2** to **HNO_2** is **0.46**.

Would this buffer solution have a greater capacity for added acid (**H_3O^+**) or added base (**OH^-**)? OH^-

Question 13 — 6 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 following.

Choose from the following choices:

Increase significantly	**Increase**	**Increase slightly**
Decrease significantly	**Decrease**	**Decrease slightly**

a) **pOH** Decrease slightly

b) **[HCN]** Decrease

Question 14 — 6 Points

Balance the following **nuclear reactions**.

a) $^{241}_{94}Pu + {}^{16}_{8}O = {}^{252}_{102}No + 5\ {}^{1}_{0}n$

b) $^{55}_{26}Fe = {}^{0}_{1}e + {}^{55}_{25}Mn$

Question 15 — 6 Points

You need to make an aqueous solution of **0.145M iron(III) sulfate** for an experiment in lab, using a **500mL** volumetric flask. How many **grams** of **iron(III) sulfate** should you add?

For full credit you must show work.

$Fe_2(SO_4)_3$: $2(55.85) + 3(32.07 + 64.00) = 399.91\ g.mol^{-1}$

$\#\ mol\ Fe_2(SO_4)_3 = 0.145 \times 0.5 = 0.0725$

$$0.0725\ mol\ Fe_2(SO_4)_3 \left| \frac{399.91\ g}{1\ mol} \right. = 29.0\ g$$

29.0 g

Question 16 6 Points	An aqueous solution of **barium hydroxide** is standardized by titration with a **0.199M** solution of **hydrochloric acid**. If **21.0mL** of base are required to neutralize **18.9mL** of the acid, what is the **molarity** of the **barium hydroxide** solution? *For full credit you must show work and give a balanced chemical equation.*

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

21.0 ml — 18.9 ml

M = ? — 0.199 M

$$\#\ mol\ HCl = 0.199 \times 0.0189 = 3.76 \times 10^{-3}$$

$$3.76 \times 10^{-3}\ mol\ HCl \left| \frac{1\ Ba(OH)_2}{2\ HCl} \right. = 1.88 \times 10^{-3}$$

$$M = \frac{\#\ mol\ Ba(OH)_2}{V(L)} = \frac{1.88 \times 10^{-3}}{0.021} = 0.0896$$

0.0896 M

Do Not Write Below This

Exam III Score:-