Chem 110 **Fall 2012** **Exam III** **Whelan**

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

Question 1 (6 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	**1.** Strong Acid
b.	C_9H_7N	4	**2.** Weak Acid
c.	CH_3COOH	2	**3.** Strong Base
d.	$Ba(OH)_2$	3	**4.** Weak Base

Question 3 (6 Points)

Circle the appropriate answers

	Acid	K_a
A	Acetic	1.8×10^{-5}
B	Histidine	7.9×10^{-7}
C	Carbonic	4.2×10^{-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**? 5.13×10^{-10}

Question 5 (9 Points)

The **hydroxide** concentration in an aqueous solution is **3.5×10^{-2}** M.

a. The **hydronium** ion concentration is: 2.86×10^{-13} M

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

c. The **pOH** is: 1.46

Question 6 (6 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
6 Points

A buffer solution that is **0.436M** in **HCN** and **0.436M** in **KCN** has a pH of **9.40**.

Addition of **which of the following** would **increase the capacity of the buffer** for added **OH^-**?

- ☐ KCN
- ☐ HCN
- ☐ both HCN and KCN
- ☐ pure water
- ☐ none of these choices

Question 8
5 Points

Which of the following aqueous solutions are buffer solutions ?

- ☐ 0.24 M HI + 0.18 M NaI
- ☐ 0.10 M CH_3COOH + 0.18 M CH_3COOK
- ☐ 0.27 M NH_4Br + 0.31 M NH_3
- ☐ 0.34 M NH_4NO_3 + 0.39 M $NaNO_3$
- ☐ 0.10 M HCl + 0.21 M NaF

Question 9
6 Points

A buffer solution is made that is **0.434M** in **HF** and **0.434M** in **KF**

1. If **Ka** for HF is **7.2×10^{-4}**, what is the pH of the buffer solution? 3.14

2. Write the net ionic equation for the reaction that occurs when **0.129** mol **HCl** is added to 1.00 L of the buffer solution.

H_3O^+ + F^- = $H_2O(l)$ + $HF(aq)$

Question 10
5 Points

A buffer solution is **0.414M** in **H_2CO_3** and **0.324M** in **$KHCO_3$**. If Ka for **H_2CO_3** is **4.2×10^{-7}**, what is the pH of this buffer solution?
Must show work

$$pH = pKa + \log_{10} \frac{[Base]}{[Acid]}$$

$$= -\log_{10}(4.2 \times 10^{-7}) + \log_{10}\left(\frac{0.324}{0.414}\right)$$

$$= 6.38 + \log_{10}(0.783)$$

$$= 6.27$$

pH = $\boxed{6.27}$

Question 11
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 following.

Choose from the following choices:

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

1. **pH** Increase slightly
2. **[OH^-]** Increase slightly
3. **[HCN]** Decrease
4. **[CN^-]** Increase

Question 12
6 Points

When the nuclide ^{218}**Po** decays to ^{214}**Pb**, what kind of decay does ^{218}**Po** undergo? $^{4}_{2}He$. The instability of ^{218}**Po** is probably due to the fact that it has too many Protons.

Question 13
6 Points

Write a balanced nuclear equation for the following:

- $^{59}_{26}$**Fe** undergoing beta decay: $^{59}_{26}Fe = ^{0}_{-1}e + ^{59}_{27}Co$
- $^{25}_{13}$**Al** undergoing positron emission: $^{25}_{13}Al = ^{0}_{+1}e + ^{25}_{12}Mg$
- $^{41}_{20}$**Ca** undergoing electron capture: $^{41}_{20}Ca + ^{0}_{-1}e = ^{41}_{19}K$

Question 14
6 Points

What **volume** of **hydrogen gas** is produced when **1.33** mol of **iron** reacts completely according to the following reaction at **25°C** and **1 atm**?

iron (s) + hydrochloric acid (aq) = iron(II) chloride (aq) + hydrogen (g)

For full credit you must show work and include a balanced chemical equation.

$$Fe(s) + 2HCl(aq) = FeCl_2(aq) + H_2(g)$$

$$1.33 \text{ mol Fe} \times \frac{1\ H_2}{1\ Fe} = 1.33 \text{ mol Fe}$$

$$PV = nRT$$

$$(1)V = 1.33 \times 0.08205 \times 298$$

$$V = 32.5L$$

$\boxed{32.5}$ L

Question 15 An aqueous solution of **hydrochloric acid** is standardized by titration with a **0.453** M
8 Points 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?

For full credit you must show work and include a balanced chemical equation.

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

29.4 15.6

0.453M

$\#\text{mol } Ba(OH)_2 = 0.453 \times 0.0294 = 1.33\times10^{-2} \text{ mol } Ba(OH)_2$

$\dfrac{1.33\times10^{-2} \text{ mol } Ba(OH)_2 \mid 2\, HCl}{\mid 1\, Ba(OH)_2} = 2.66\times10^{-2} \text{ mol } HCl$

$M = \dfrac{2.66\times10^{-2}}{0.0156} = 1.71$

1.71 **M**

Question 16 How many **grams** of **iron(II) bromide** are there in **43.5**mL of an aqueous solution that has
5 Points a concentration of **0.166**M ?

Must show work

$\#\text{mol } FeBr_2 = 0.166 \times 0.0435 = 7.22\times10^{-3}$

$FeBr_2 : 55.85 + 2(79.90) = 216.65 \text{ g}\cdot\text{mol}^{-1}$

$\dfrac{7.22\times10^{-3} \text{ mol } FeBr_2 \mid 216.65\text{ g}}{\mid 1 \text{ mol}} = 1.56\text{g}$

1.56 **grams**

Exam III Score