Chem 110 **Fall 2013** **Exam III** **Whelan**

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

Question 1 (6 Points)

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

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

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

$NaOH(aq)$ = (= or ⇔) $Na^+ + OH^-$

Question 2 (8 Points)

a. HNO_3	1	**1.** Strong Acid
b. $HCOOH$	2	**2.** Weak Acid
c. C_5H_5N	4	**3.** Strong Base
d. NH_4^+	2	**4.** Weak Base

Question 3 (4 Points)

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

a) What is the **hydronium ion** concentration in this solution? 1×10^{-12} M

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

Question 4 (6 Points)

An aqueous solution has a **pOH** of **6**

a) What is the **pH** of this solution? 8

b) What is the **hydronium ion** concentration in this solution? 1×10^{-8} M

c) What is the **hydroxide ion** concentration in this solution? 1×10^{-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 **pH = 11** 1

b) Solution with a **hydroxide ion** concentration = **1×10^{-11} M** 3

c) Solution with a **hydronium ion** concentration = **1×10^{-9} M** 2

Question 6 (6 Points)

The **hydronium** concentration in an aqueous solution is **3.51×10^{-2} M.**

a. The **hydroxide** ion concentration is: 2.82×10^{-13} M

b. The **pH** of this solution is: 1.45

c. The **pOH** is: 12.55

Question 7 (6 Points)

a) For following net ionic equation:

$HClO(aq) + H_2O(l) \Leftrightarrow ClO^- + H_3O^+$

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

H_2O	B-L Acid	(B-L Base)
ClO^-	B-L Acid	(B-L Base)

b) The formula for the conjugate Base of **H_3O^+** is: H_2O

c) The formula for the conjugate Acid of **ClO^-** is: $HClO$

Question 8 (4 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 **H_3O^+**?

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

Question 9 (4 Points)

Which of the following aqueous solutions are buffer solutions ?

- (☑) 0.14M HF + 0.17M KF
- ☐ 0.34M $Ba(ClO_4)_2$ + 0.25M BaI_2
- ☐ 0.19M $Ca(OH)_2$ + 0.21M $CaCl_2$
- (☑) 0.34M NH_4NO_3 + 0.34M NH_3
- ☐ 0.25M HCl + 0.17M KCl

Question 10 (6 Points)

A buffer solution is made that is **0.472M** in **H_2CO_3** and **0.472M** in **$NaHCO_3$**.

a) **Ka** for **H_2CO_3** is **4.2×10^{-7}**, what is the pH of the buffer solution? 6.4

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

$H_2CO_3(aq) + OH^- = H_2O(l) + HCO_3^-$

Question 11 (6 Points)

A buffer solution is **0.440M** in **HCN** and **0.324M** in **NaCN**. If **Ka** for **HCN** is **4.0×10^{-10}**, what is the pH of this buffer solution?

Must show work

$$pH = -\log_{10}(4.0\times10^{-10}) + \log_{10}\frac{[CN^-]}{[HCN]}$$

$$= 9.397 + \log_{10}\left(\frac{0.324}{0.440}\right)$$

$$= 9.397 + \log_{10}(0.736)$$

$$= 9.397 - 0.133$$

pH = **9.26**

Question 12 (6 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 following.

Choose from the following choices:

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

a) **pOH** — Increase slightly

b) **[HCN]** — Increase

Question 13 (6 Points)

The isotope $^{60}_{27}$**Co** is but one of many isotopes whose **Neutron/Proton ratio** is **too large**.

a) The **only** form of **radioactive decay** available to $^{60}_{27}Co$ is: Beta emission

b) The **balanced nuclear equation** for this decay: $^{60}_{27}Co$ = $^{0}_{-1}e$ + $^{60}_{28}Ni$

Question 14 (6 Points)

Write a balanced nuclear equation for the following:

a) $^{214}_{82}$**Pb** undergoing beta decay: $^{214}_{82}Pb$ = $^{0}_{-1}e$ + $^{214}_{83}Bi$

b) $^{28}_{15}$**P** undergoing positron emission: $^{28}_{15}P$ = $^{0}_{+1}e$ + $^{28}_{14}Si$

c) $^{41}_{20}$**Ca** undergoing electron capture: $^{41}_{20}Ca + ^{0}_{-1}e$ = $^{41}_{19}K$

Question 15 (6 Points)

How many **moles** of **water** will be formed upon the complete reaction of **27.3 grams** of **sulfuric acid** with excess **zinc(II) hydroxide**?

sulfuric acid (aq) + zinc(II) hydroxide (s) = zinc(II) sulfate (aq) + water (l)

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

$H_2SO_4(aq) + Zn(OH)_2(aq) = ZnSO_4(aq) + 2H_2O(l)$

27.3g

H_2SO_4: $2(1.01) + 32.07 + 4(16.00) = 98.09\ g.mol^{-1}$

$$27.3\,g\ H_2SO_4 \left| \frac{1\ mol}{98.09\,g} \right. = 0.278\ mol\ H_2SO_4$$

$$0.278\ mol\ H_2SO_4 \left| \frac{2\ H_2O}{1\ H_2SO_4} \right. = 0.557\ mol\ H_2O$$

0.577 mol

Question 16
8 Points

An aqueous solution of **barium hydroxide** is standardized by titration with a **0.140 M** solution of **hydrochloric acid**.

If **26.8 mL** of **base** are required to neutralize **19.4 mL** of the acid, what is the **molarity** of the **barium hydroxide** solution?

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

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

$Ba(OH)_2$: 26.8 mL

HCl: 19.4 mL, 0.140 M

$$\#\text{ mol } HCl = 0.140\,(0.0194) = 2.72\times10^{-3}\text{ mol } HCl$$

$$2.72\times10^{-3}\text{ mol } HCl \left| \frac{1\ Ba(OH)_2}{2\ HCl} \right. = 1.36\times10^{-3}\text{ mol } Ba(OH)_2$$

$$M = \frac{1.36\times10^{-3}}{0.0268} = 0.0507$$

0.0507 M

Question 17
6 Points

What volume of a **0.142 M** solution of **aluminum bromide** contains the same number of moles of **aluminum bromide** as there are in **43.2 mL** of a **0.124 M** solution of **aluminum bromide**?

Must show work

$$\#\text{ mol } AlBr_3 = 0.124\,(0.0432) = 5.36\times10^{-3}$$

$$\#\text{ mol } AlBr_3 = M \times V(L)$$

$$5.36\times10^{-3} = 0.142 \times V(L)$$

$$V(L) = \frac{5.36\times10^{-3}}{0.142} = 0.0377$$

0.0377 L

Exam III Score