Chem 110 **Fall 2010** **Exam III** **Whelan**

SID ☐☐☐☐☐☐☐☐ Last Key First Answer

Question 1
8 Points

Consider the following system at equilibrium at 298 K:

$$N_2(g) + O_2(g) + 43.2\ \text{kcal} \Leftrightarrow 2\ NO(g)$$

The **production** of NO(g) is **favored by**:

Indicate **True** or **False** for each of the following:

- ☐ **Increasing** the temperature. True
- ☐ **Adding** NO. False
- ☐ **Increasing** the volume. False
- ☐ **Removing** O_2. False

Question 2
8 Points

Consider the following system at equilibrium at 346 K:

$$CO(g) + Br_2(g) \Leftrightarrow COBr_2(g) + 18.2\ \text{kcal}$$

The **production** of $COBr_2(g)$ is **favored by**:

Indicate **True** or **False** for each of the following:

- ☐ **Decreasing** the temperature. True
- ☐ **Adding** Br_2. True
- ☐ **Decreasing** the pressure. False
- ☐ **Removing** $COBr_2$. True

Question 3
4 Points

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

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

Question 4
8 Points

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

a. $C_2H_5NH_2$ 4

b. HF 2

c. NH_3 4

d. $Ba(OH)_2$ 3

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

Question 5
6 Points

The **hydroxide** concentration in an aqueous solution is **4.47×10^{-4}** M @ 25°C

a. The **hydronium** ion concentration is: 2.24×10^{-11} M

b. The **pH** of this solution is: 10.65

c. The **pOH** is: 3.35

Question 6
6 Points

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

1. $[H_3O^+] = 1\times10^{-6}M$ 2
2. pOH = 3 1
3. $[OH^-] = 1\times10^{-9}M$ 3

Question 7
8 Points

In the following **net ionic equation**, identify **each reactant** as either a **Bronsted-Lowry acid** or a **Bronsted-Lowry base**:

$$CH_3CO_2H(aq) + H_2O(l) \Leftrightarrow CH_3CO_2^- + H_3O^+$$

Bronsted-Lowry acid: BLA **Bronsted-Lowry base: BLB**

1. CH_3CO_2H BLA
2. H_2O BLB
3. $CH_3CO_2^-$ BLB
4. H_3O^+ BLA

Question 8
6 Points

Give the formula for:

1. The **conjugate acid** of $H_2PO_4^-$ H_3PO_4
2. The **conjugate base** of $H_2PO_4^-$ HPO_4^{2-}

Question 9
4 Points

Which of the following aqueous solutions are buffer solutions?

☐ 0.19 M KOH + 0.25 M KCl

☐ 0.34 M NH4Br + 0.38 M NH_3

☐ 0.34 M $Ba(ClO_4)_2$ + 0.23 M $Ba(NO_3)_2$

☐ 0.17M CH_3COOH+0.17M CH_3COOK

☐ 0.22 M HI + 0.19 M NaI

Question 10
4 Points

A buffer solution that is 0.354 M in HNO_2 and 0.354 M in $NaNO_2$ has a **pH of 3.35**.

Addition of **which of the following** would **increase the capacity** of the buffer for added H_3O^+?

☐ $NaNO_2$

☐ pure water

☐ HNO_2

☐ both HNO_2 and $NaNO_2$

☐ None of the these

Question 11
5 Points

A buffer solution is **0.422 M** in **HCN** and **0.273 M** in **KCN**. If **Ka** for HCN is **4.0×10^{-10}**, what is the pH of this buffer solution?

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

$$pH = -\log_{10}(4.0 \times 10^{-10}) - \log_{10} \frac{0.273}{0.422}$$

pH = 9.21

Question 12
8 Points

A small amount of **strong base** is added to a **buffer** made from **HNO_2** and **$NaNO_2$**. What changes if any will occur to the solution?

- Circle the appropriate answer

a. **pH**	[✓ Increase]	Decrease	Unchanged
b. **$[NO_2^-]$**	[✓ Increase]	Decrease	Unchanged
c. **$[HNO_2]$**	Increase	[✓ Decrease]	Unchanged
d. **$[OH^-]$**	[✓ Increase]	Decrease	Unchanged

Question 13 How many grams of copper(II) chloride are there in **48.9 mL** of an aqueous solution that has a concentration of **0.196 M** ?

6 Points

Must show work

$CuCl_2$: 63.55 + 2(33.45) = **134.45 g.mol^{-1}**

#mol $CuCl_2$ = 0.196 x 0.0489 = **9.58x10^{-3} mol $CuCl_2$**

$$\begin{array}{l|l} 9.58\text{x}10^{-3}\text{ mol } CuCl_2 & 134.45\text{ g} \\ \hline & 1\text{ mol} \end{array} = \mathbf{1.29\ g}$$

1.29 g

Question 14 You wish to make a **0.233** M **nitric acid** solution from a stock solution of **6.00** M **nitric acid**. How much concentrated acid must you add to obtain a total volume of **75.0** mL of the dilute solution ?

6 Points

Must show work

#mol HNO_3 = 0.233 x 0.075 = **1.75x10^{-2} mol HNO_3**

$$M = \frac{\#\text{ mol } HNO_3}{V(l)}$$

$$6.00 = \frac{1.75\text{x}10^{-2}\text{ mol } HNO_3}{V(l)}$$

V = **0.00291 L**

2.91 mL

Question 15 According to the following reaction, how many moles of **bromine trifluoride** are necessary to form **0.162** moles **fluorine gas**? **bromine trifluoride** (*g*) = **bromine** (*g*) + **fluorine** (*g*)

5 Points

Must show work and include a balanced chemical equation.

$2\ BrF_3(g) = Br_2 + 3\ F_2(g)$

$$\begin{array}{l|l} \mathbf{0.162\text{ mol } F_2} & 2\ BrF_3 \\ \hline & 3\ F_2 \end{array} = \mathbf{0.108\text{ mol } BrF_3}$$

0.108 mol

Question 16
8 Points

An aqueous solution of **barium hydroxide** is standardized by titration with a **0.264** M solution of **nitric acid**.

If **23.6** mL of base are required to neutralize **23.3** mL of the acid, what is the molarity of the **barium hydroxide** solution?

Must show work and include a balanced chemical equation.

$Ba(OH)_2$	+	$2\ HNO_3$ =	$Ba(NO_3)_2$	+ 2	H_2O
23.6 mL		23.3 mL 0.264M			

$$\#\ \text{mol}\ HNO_3 = 0.264 \times 0.0233 = \mathbf{6.15x10^{-3}\ mol\ HNO_3}$$

$$\frac{6.15\text{x}10^{-3}\ \text{mol}\ HNO_3}{} \left| \frac{1\ Ba(OH)_2}{2\ HNO_3} \right. = \mathbf{3.07 \times 10^{-3}\ mol\ Ba(OH)_2}$$

$$M = \frac{\mathbf{3.07 \times 10^{-3}\ mol\ Ba(OH)_2}}{0.0236} = \mathbf{0.130}$$

0.130 M

Exam III Score