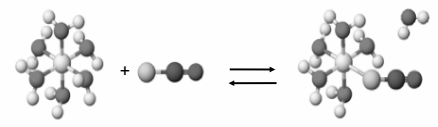
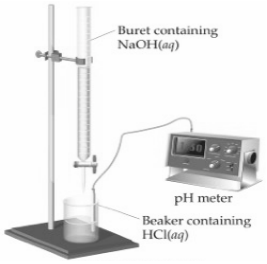
# Chemistry 223 Exam I Review
## *Chapters 13 and 14 ("Part I & II")*






**Chemistry 223**
**Professor Michael Russell**

*Last update: 6/14/23*

***MAR***

We place 0.010 mol of $N_2O_4$(g) in a 2.0 L flask at 200 °C. After reaching equilibrium, $[N_2O_4]$ = 0.0038 M. Calculate $K_c$ for the following reaction:

$N_2O_4$ (g) ⇌ 2 $NO_2$(g)

A. 1600
B. 1.5 x $10^{-3}$
C. 6.1 x $10^{-4}$
D. 8.8 x $10^{-6}$
E. -3.1 x $10^{-3}$

***MAR***

*Given the following two equilibria:*

**$NiCO_3$(s) ⇌ $Ni^{2+}$(aq) + $CO_3^{2-}$(aq)  $K_1$ = 6.6 x $10^{-9}$**

**$HCO_3^-$(aq) + $H_2O$(l) ⇌ $CO_3^{2-}$(aq) + $H_3O^+$(aq)  $K_2$ = 4.8 x $10^{-11}$**

*calculate the equilibrium constant for the following reaction:*

**$NiCO_3$(s) + $H_3O^+$(aq) ⇌ $Ni^{2+}$(aq) + $HCO_3^-$(aq) + $H_2O$(l)**

A. 7.3 x $10^{-3}$
B. 3.2 x $10^{-19}$
C. 140
D. 1.8 x $10^{-9}$
E. 1100

***MAR***

**$H_2$(g) + $I_2$(g) ⇌ 2 HI(g), $K_c$ = 54.3**

Initially, $[H_2]$ = 0.00623 M, $[I_2]$ = 0.00414 M, and [HI] = 0.0424 M. Find the equilibrium concentrations.

A. $[H_2]$ = 0.00201 M, $[I_2]$ = 0.00112 M, [HI] = 0.0643 M
B. $[H_2]$ = 0.00222 M, $[I_2]$ = 0.00168 M, [HI] = 0.0112 M
C. $[H_2]$ = 0.00917 M, $[I_2]$ = 0.00667 M, [HI] = 0.0212 M
D. $[H_2]$ = 0.00676 M, $[I_2]$ = 0.00467 M, [HI] = 0.0414 M
E. $[H_2]$ = 0.00623 M, $[I_2]$ = 0.00414 M, [HI] = 0.0424 M

***MAR***

$\Delta H^o$ = –18.8 kJ, $K_c$ = 10.5, for:

2 $CH_2Cl_2$(g) ⇌ $CH_4$(g) + $CCl_4$(g)

If the temperature on the equilibrium system is suddenly decreased, the value of $K_c$:

A. increases
B. decreases
C. remains the same

***MAR***

You add 0.535 g of NaOH (MM = 40.0 g $mol^{-1}$) to 100.0 mL of water at 25 °C. What is $[H_3O^+]$ in this solution?

A. 0.134 M
B. 7.48 x $10^{-14}$ M
C. 1.34 x $10^{13}$ M
D. 6.87 x $10^{-12}$ M

***MAR***

Considering only $H_2S$ ($K_a = 1 \times 10^{-7}$) and HCN ($K_a = 4 \times 10^{-10}$), predict in which direction the following equilibrium lies:

$$HCN(aq) + HS^-(aq) \rightleftharpoons CN^-(aq) + H_2S(aq)$$

A. equilibrium lies to the left
B. equilibrium lies to the right
C. equilibrium is perfectly balanced left and right
D. cannot be determined

*MAR*

What is $[H_3O^+]$ in a 0.10 M solution of HCN at 25 °C? ($K_a$ for HCN = $4.0 \times 10^{-10}$)

A. $1.6 \times 10^{-9}$ M
B. $6.3 \times 10^{-6}$ M
C. $2.0 \times 10^{-5}$ M
D. $4.0 \times 10^{-11}$ M
E. 0.10 M

*MAR*

In a 0.15 M solution of $Na_2CO_3$, what are $[H_3O^+]$, $[OH^-]$ and the pH? $K_b$ for $CO_3^{2-}$ is $2.1 \times 10^{-4}$.

| | $[H_3O^+]$ | $[OH^-]$ | pH |
|---|---|---|---|
| A. | $5.6 \times 10^{-3}$ | $1.8 \times 10^{-12}$ | 5.61 |
| B. | $1.8 \times 10^{-12}$ | $5.6 \times 10^{-3}$ | 11.75 |
| C. | $5.6 \times 10^{-3}$ | $1.8 \times 10^{-12}$ | 11.75 |
| D. | $1.8 \times 10^{-12}$ | $5.6 \times 10^{-3}$ | 5.61 |

*MAR*

Place the following acids in order of increasing acid strength.

(a) Anilinium ion, $pK_a = 4.60$
(b) Benzilic acid, $pK_a = 3.09$
(c) Chloroacetic acid, $pK_a = 2.98$
(d) Dibromophenol, $pK_a = 8.06$

A. a, b, c, d
B. d, c, b, a
C. c, b, a, d
D. d, a, b, c
E. a, c, d, c

*MAR*

Classify the following as ***Lewis*** acids or bases.

$BH_3$, $NH_3$, $Cl^{-1}$, $Al^{3+}$, $Cr^{3+}$

A. acid, base, base, acid, acid
B. base, base, base, acid, acid
C. base, acid, acid, base, base
D. acid, base, acid, base, base
E. Public Enemy is #1!

*MAR*

You have a solution of $NH_4Cl$. What effect will addition of $NH_3$ have on the pH of the solution?

A. increase pH
B. no effect
C. decrease pH
D. cannot tell from information given

*MAR*

You have a solution of $NH_4Cl$. What effect will addition of NaCl have on the pH of the solution?

A. increase pH
B. no effect
C. decrease pH
D. cannot tell from information given

*MAR*

Which choice would be an ideal buffer solution?

A. 0.20 M HCN and 0.10 M KCN
B. 0.20 M HCl and 0.10 M KOH
C. 0.20 M $CH_3CO_2H$ and 0.10 M $HCO_2H$
D. 0.10 HCl and 0.010 M KCl
E. 0.10 M $CH_3OH$ and 0.10 M NaOH

*MAR*

What is the pH of a buffer that is composed of 0.20 M $NH_4Cl$ and 0.20 M $NH_3$? ($K_a$ for $NH_4^+$ = $5.6 \times 10^{-10}$)

A. 4.85
B. 5.65
C. 7.00
D. 9.25
E. 10.05

*MAR*

What is the pH of a buffer that is composed of 0.20 M $NH_4Cl$ and 0.50 M $NH_3$? ($K_a$ for $NH_4^+$ = $5.6 \times 10^{-10}$)

A. 4.75
B. 5.65
C. 7.00
D. 9.25
E. 9.65

*MAR*

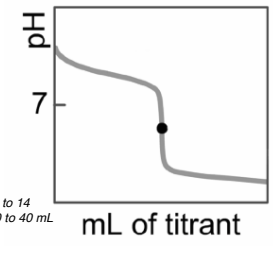
What volume of 0.10 M sodium acetate must be added to 100. mL of 0.10 M acetic acid ($K_a$ = $1.8 \times 10^{-5}$) to have a pH of 4.00?

A. 100. mL
B. 50. mL
C. 36 mL
D. 18 mL
E. 9.0 mL

*MAR*

What type of titration does the graph below represent?

A. strong acid + strong base
B. strong base + strong acid
C. weak acid + strong base
D. weak base + strong acid
E. weak base + weak acid




*pH scale: from 0 to 14*
*Volume scale: from 0 to 40 mL*

*MAR*

You mix 15.0 mL of 0.400 M HCl with 15.0 mL of 0.400 M $NH_3$. What is the pH of the resulting solution? ($K_b$ = 1.8 x $10^{-5}$)

A. 11.43
B. 9.26
C. 7.00
D. 5.54
E. 4.98

*MAR*

0.40 g of NaOH (MM = 40. g/mol) are mixed with 100 mL of 0.10 M acetic acid. What is the pH of the resulting solution? ($K_a$ = 1.8 x $10^{-5}$)

A. 1.00
B. 2.87
C. 7.00
D. 8.87
E. 13.00

*MAR*

What is the pH of the solution when 50. mL of 0.10 M HCl and 100. mL of 0.10 M NaCN are mixed? $K_a$(HCN) = 4.0 x $10^{-10}$

A. 8.65
B. 8.80
C. 5.20
D. 5.35
E. 9.40

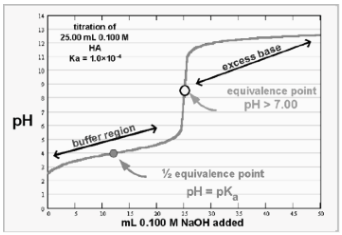
*MAR*

Add 40. mL of 0.50 M NaOH to 50.0 mL of 1.00 M $NH_4Cl$. What is the pH of the resulting solution? $K_b(NH_3)$ = 1.8 x $10^{-5}$

A. 4.56
B. 4.74
C. 7.00
D. 9.08
E. 10.70

*MAR*

**End of Review - *good luck with your studying!***




*Need more practice?*

- *Practice Problem Sets (online)*
- *Concept Guides (Companion and online)*
- *Chapter Guides (online)*
- *End of Chapter Problems in Textbook (every other question has answer at end)*

*Good luck with your studying!*

*MAR*