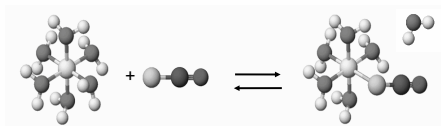


Chemistry 223 Exam I Review

Chapters 12, 13 and 14

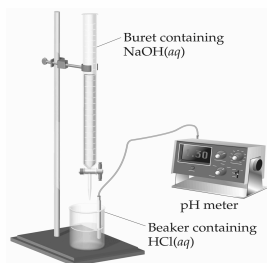


Chemistry 223

Professor Michael Russell

MAR

Last update:
7/6/26



Midterm I

Chapters 12, 13, 14

- Bring: calculator, pencil, "Acid Base Titrations" lab, Exam Prep Worksheet I, "Titration Weak Acids" printed lab
- 12 multiple choice questions, 4 short answer questions, ~90 minutes in length
- Returned following lab period with "summary sheet" **Good luck with your studying!**

Let's start the review!

MAR



L1: Mon, 4/26 1:10 PM, AC 2501
L2: Wed, 4/28 1:10 PM, AC 2501

Check with instructor to ensure correct dates and times!



Calculate the standard entropy change for the following reaction:



* $S^\circ[\text{CCl}_4(\text{l})] = 214.39 \text{ J/K} \cdot \text{mol}$

* $S^\circ[\text{CO}_2(\text{g})] = 213.74 \text{ J/K} \cdot \text{mol}$

* $S^\circ[\text{O}_2(\text{g})] = 205.07 \text{ J/K} \cdot \text{mol}$

* $S^\circ[\text{Cl}_2(\text{g})] = 223.08 \text{ J/K} \cdot \text{mol}$

- A. -17.36 J/K
B. +17.36 J/K
C. +240.44 J/K
D. -25.78 J/K
E. 42

MAR

Calculate $\Delta G_{\text{rxn}}^\circ$ for the following reaction:



* $\Delta G_f^\circ[\text{CO}_2(\text{g})] = -394.4 \text{ kJ/mol}$

* $\Delta G_f^\circ[\text{CH}_4(\text{g})] = -50.8 \text{ kJ/mol}$

* $\Delta G_f^\circ[\text{H}_2\text{O}(\text{g})] = -228.6 \text{ kJ/mol}$

- A. 572.2 kJ/mol·rxn
B. -673.7 kJ/mol·rxn
C. -572.2 kJ/mol·rxn
D. -436.4 kJ/mol·rxn
E. -800.8 kJ/mol·rxn

MAR

Given the following information, calculate ΔG° for the reaction below at 25 °C:



$\Delta H^\circ = -601.24 \text{ kJ/mol} \cdot \text{rxn}$

$\Delta S^\circ = -108.36 \text{ J/K} \cdot \text{rxn}$

- A. 664.5 kJ/mol·rxn
B. -568.9 kJ/mol·rxn
C. 31700 kJ/mol·rxn
D. -528.3 kJ/mol·rxn
E. 42

MAR

A reaction has a ΔH° which is **positive** and a ΔS° which is **positive**. What can be said about the reaction spontaneity at different temperatures?

- A. product favored at all temperatures
B. product favored only at high temperature
C. product favored only at low temperature
D. not product favored at any temperature

MAR

Calculate ΔG° at 25 °C for: $2 \text{H}_2\text{O}_2(\text{l}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$

	$\Delta H^\circ(\text{kJ/mol})$	$S^\circ(\text{J/K} \cdot \text{mol})$
$\text{H}_2\text{O}_2(\text{l})$	-187.8	109.6
$\text{H}_2\text{O}(\text{l})$	-285.8	69.9
$\text{O}_2(\text{g})$	-----	205.1

- A. -157.9 kJ/mol•rxn
- B. -192.3 kJ/mol•rxn
- C. -37700 kJ/mol•rxn
- D. -233.5 kJ/mol•rxn
- E. 42

MAR

A reaction has $\Delta H = -96.0 \text{ kJ/mol}$ and $\Delta S = -12.6 \text{ J/K} \cdot \text{mol}$. If the temperature is increased slowly, at what temperature will this reaction become nonspontaneous?

- A. It will never be spontaneous
- B. 7162 °C
- C. 762 K
- D. 7620 K
- E. It will always be spontaneous

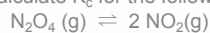
MAR

Barium sulfite is poorly soluble in water with a K_{sp} value of 8.0×10^{-7} . What is ΔG° at 25 °C?

- A. 15.1 kJ/mol•rxn
- B. 34.8 kJ/mol•rxn
- C. -34.8 kJ/mol•rxn
- D. 343 kJ/mol•rxn
- E. 42

MAR

We place 0.010 mol of $\text{N}_2\text{O}_4(\text{g})$ in a 2.0 L flask at 200 °C. After reaching equilibrium, $[\text{N}_2\text{O}_4] = 0.0038 \text{ M}$. Calculate K_c for the following reaction:



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

MAR

Given the following two equilibria:



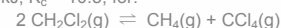
calculate the equilibrium constant for the following reaction:



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

MAR

$\Delta H^\circ = -18.8 \text{ kJ}$, $K_c = 10.5$, for:



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

- A. increases
- B. decreases
- C. remains the same

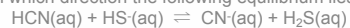
MAR

You add 0.535 g of NaOH (MM = 40.0 g mol⁻¹) to 100.0 mL of water at 25 °C. What is [H₃O⁺] in this solution?

- A. 0.134 M
- B. 7.48 x 10⁻¹⁴ M
- C. 1.34 x 10¹³ M
- D. 6.87 x 10⁻¹² M

MAR

Considering only H₂S (K_a = 1 x 10⁻⁷) and HCN (K_a = 4 x 10⁻¹⁰), predict in which direction the following equilibrium lies:



- 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 [H₃O⁺] in a 0.10 M solution of HCN at 25 °C? (K_a for HCN = 4.0 x 10⁻¹⁰)

- A. 1.6 x 10⁻⁹ M
- B. 6.3 x 10⁻⁶ M
- C. 2.0 x 10⁻⁵ M
- D. 4.0 x 10⁻¹¹ M
- E. 0.10 M

MAR

In a 0.15 M solution of Na₂CO₃, what are [H₃O⁺], [OH⁻] and the pH? K_b for CO₃²⁻ is 2.1 x 10⁻⁴.

	[H ₃ O ⁺]	[OH ⁻]	pH
A.	5.6 x 10 ⁻³	1.8 x 10 ⁻¹²	5.61
B.	1.8 x 10 ⁻¹²	5.6 x 10 ⁻³	11.75
C.	5.6 x 10 ⁻³	1.8 x 10 ⁻¹²	11.75
D.	1.8 x 10 ⁻¹²	5.6 x 10 ⁻³	5.61

MAR

Place the following acids in order of increasing acid strength.

- (a) Anilinium ion, pK_a = 4.60
- (b) Benzoic 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

You have a solution of NH₄Cl. What effect will addition of NH₃ 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 $\text{CH}_3\text{CO}_2\text{H}$ and 0.10 M HCO_2H
- D. 0.10 M 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 $\text{NH}_4^+ = 5.6 \times 10^{-10}$)

- 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 $\text{NH}_4^+ = 5.6 \times 10^{-10}$)

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

MAR

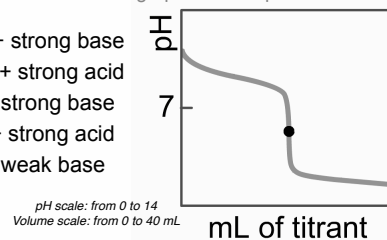
What volume of 0.10 M sodium acetate must be added to 100. mL of 0.10 M acetic acid ($K_a = 1.8 \times 10^{-5}$) to have a pH of 4.00?

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

MAR

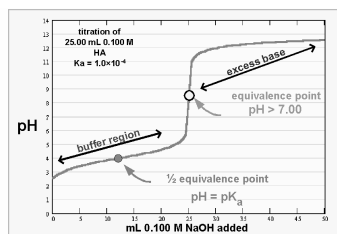
What type of titration does the graph below represent?

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



MAR

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



Need more practice?

- Practice Problem Sets (Companion and 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

