

Chem 201 Final Exam Guide

About 50% of the final will cover material taken up since the last midterm. However, the exam is cumulative and any material covered since the beginning of the quarter may appear in the test. To help focus your review, some items are mentioned below. As you know, this is not an inclusive list of all materials you are expected to understand. Most questions will be calculational but a few may be essay, illustrative or descriptive. A very good start in terms of finding actual problems for the new material is to look at the homework assignments. Below is a list of materials to review in addition to the material already covered in past midterms. Be sure you are very well versed on the chapters involving acids and bases.

- 1) Electrochemistry: galvanic cells, cell diagrams, Nernst equation, E° , E_{cell} . Know how to determine the contributions of Ohmic potential & over potential. Determine $\Delta G, \Delta G^\circ$, K_{eq} for redox reactions/ E-Chem cells. What does ΔG mean in terms of work? Do sample problems. How much Cu would have to react for a Cu/Zn galvanic cell to light a 60 watt bulb for 1 hour? (i.e. 60 volt-amperes, assume constant power over time).
- 2) Redox titrations & Potentiometric measurements: Balance equations, determine the V_e and N . (N =normality). Predict the E_{cell} potential during a redox titration, at various V , given the reference electrode (like SHE, SCE, etc).
- 3) Electrolytic cells: electrodeposition, coulometry (read on this), polarography (describe).
- 4) Chromatography, and Extraction/partition calculations. Try homework problems. Be able to calculate theoretical plates, resolution. Know about ion exchange columns. Given the column specifications & the actual chromatogram. Be able to determine parameters such as: K , k' , R , a , V_r , HETP, N Describe the properties of HPLC vs. GC, HPLC vs LC. (for instance in what way(s) is HPLC superior/). From memory write the van Deemter Equation and explain each term and each coefficient.
- 5) Know gravimetric analysis. Determine molar solubility, use K_{sp} . Precipitation titrations: Fajan's, Mohr's, Volhard's, Kjeldahl's.
- 6) Spectrophotometry: know the various parameters used in UV-vis absorption calculations, Beer's Law, atomic absorption instrumentation & process.
- 7) Know acid-base: calculate pH (know both approximate and "exact" calculations and when to use them). pK_a , K_a , buffers, H-H equation, K_{eq} for weak acid/weak base neutralization. Acid-Base titrations: get pH at various V_{titrant} . Mono and di-protic acids.
- 8) Complexometric titrations: get pM^{n+} @ various V_{EDTA} . Know K_f , K_f' , K' .
- 9) We could include material related to the lab experiments including the Gran plot.
- 10) Don't forget the basics! sig. figs., standard dev, kinds of concentration units, and so on.

Try the following: No answer key will be supplied.

1) Consider the galvanic cell (aqueous, at pH = 0.0) : $\text{Pt}|\text{MnO}_4^-(1.0\text{M})/\text{Mn}^{2+}(0.1\text{M})||\text{SO}_4^{2-}(1.0\text{M})/\text{SO}_3^{2-}(1.0\text{M})$

The cell has an internal resistance of 0.50 Ω . ($E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$; $E^\circ_{\text{SO}_4^{2-}/\text{SO}_3^{2-}} = -0.94\text{V}$),

a) Calculate E°_{cell} and E_{cell} when no current is flowing:

b) What is the maximum work that can be obtained from this galvanic cell?

c) If we convert the above to an electrolytic cell (use overpotential = 0.5V and overpotential = 0.3 V) what initial external voltage must be applied at a current of 250 mA? (ignore junction potential)

2) Determine the potential reading in a potentiometric titration of 50.0 mL of 0.10 M Fe^{2+} with 0.20 M $\text{Pr}(\text{NO}_3)_4$ using an S.C.E electrode (note: $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.771\text{V}$, and $E^\circ_{\text{Pr}^{4+}/\text{Pr}^{3+}} = 3.20 \text{ V}$). Use the following values of $V_{\text{Pr}^{4+}} = .1, 12.5, 25, 30, \text{ and } 50 \text{ mLs}$.

- 3) A chromatogram (C vs t) for a 10.0-cm column is given in a figure :
- Estimate from band A what the plate height equivalent and the number of plates is for the column.
 - How selective is the column in separating bands A and B? (Calculate relevant factor)
 - Estimate length, L, of column needed such that the 2 bands (i.e. A and B) can be separated with $R=1.50$
 - Determine the partition coefficient of B if the stationary phase volume is .78 mL and the mobile phase volume is 9.22 mL and the retention volume is 55.0 mL.
- 4) a) Discuss the van Deemter equation and what each of the terms is due to.
 b) Gas chromatography: Compare open tubular GC columns versus packed GC columns in terms of column efficiency as measured by their plate height.
 c) Liquid chromatography: Compare liquid chromatography(LC) and HPLC. What are the advantages of HPLC over LC? Illustrate with a "van Deemter" graph and explain the technological difference between the two. [10 pts]
- 5) 20.0 mL of a $MgSO_4$ analyte solution requires 25.0 mL of a 0.015M EDTA titrant buffered at pH 10.0. Given: $\log K_f = 8.79$ for $Mg-EDTA$, $\alpha_{Y^{4-}} = 0.36$ @ pH10.0.
- Determine the conditional formation constant and the original $[Mg^{2+}]$.
 - Calculate pMg^{2+} at $V_{EDTA} = 20.0$ mL, & 50mLs,
- 6) Suppose 35.0 mL of 0.45 M $FeSO_4$ was titrated with 0.90 M $Ce(SO_4)_2$. Determine the potential (versus sat'd calomel electrode) at each volume of $Ce(SO_4)_2$ added: a) $V_{Ce^{4+}} = 8.75$ mLs b) $V_{Ce^{4+}} = V_e$
- 7) Be able to do problems similar to the example on page 551 (effect of pH on extraction). and all the homework problems for example the ones in the electrochemistry chapters.

Don't memorize solutions. Be prepared to think about the concepts learned. Expect the test questions to test how well you understand the concepts! Don't get hooked on the "wording". Be flexible and ground yourself on the core material so you can deal with questions asked from different angles.