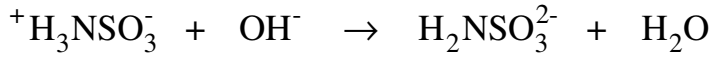
CHEM 241 - EXAM 3 REVIEW GUIDE
Chapters 10 and 11

Chapter 10 (and part of Ch. 1) Introduction to Titrations and Acid-Base Titration
NOTE: Review your problem set and lecture notes; pay attention to sample and assigned problems

1. Distinguish between the terms *end point* and *equivalence point* of a titration.

2. Explain the following:
- Problem 10-4. Sketch the general appearance of the curve for the titration of a weak acid with a strong base. Explain (in words) what chemistry governs the pH in each of the four distinct regions of the curve.
- Problem 10-12. Sketch the general appearance of the curve for the titration of a weak base with a strong acid. Explain (in words) what chemistry governs the pH in each of the four distinct regions of the curve.
- Problem 10-13. Why is the equivalence-point pH necessarily below 7 when a weak base is titrated with strong acid?
- Problem 10-19, Harris. Sketch the general appearance of the curve for the titration of a weak diprotic acid with NaOH. Explain (in words) what chemistry governs the pH in each distinct region of the curve.
- Problem 10-42. Cresol red has two transition ranges listed in Table 10-3. What color would you expect it to be at the following pH values? (a) 0; (b) 1; (c) 6; (d) 9
- Problem 10-43. Would the indicator bromocresol green, with a transition range of pH 3.8–5.4, ever be useful in the titration of a weak acid with a strong base?

3. Problem 1-45, Harris: Sulfamic acid is a primary standard that can be used to standardize NaOH.

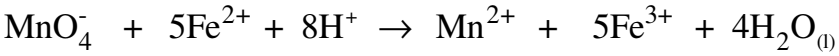


$^{+}H_3NSO_3^{-} + OH^{-} \rightarrow H_2NSO_3^{2-} + H_2O$

Sulfamic acid
(MM 97.094)

What is the molarity of a sodium hydroxide solution if 34.26 mL react with 0.3337 g of sulfamic acid?

4. (Adapted from Brown, Lemay and Bursten, 10th ed.) A sample of iron ore is dissolved in acid, and the iron is converted to Fe2+. The sample is them titrated with 47.20 mL of 0.02240 M KMnO4 solution. The oxidation-reduction reaction that occurs during titration is as follows:



$MnO_4^{-} + 5Fe^{2+} + 8H^{+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O_{(l)}$

[NOTE: All the other species are in aqueous form.]
(a) How many grams of Fe were in the sample?

(b) If the sample had a mass of 0.8890 g, what is the percentage of iron in the sample?

5. Problem 10-8, Harris. What is the pH at the equivalence point when 0.100 M hydroxy-acetic acid is titrated with 0.0500 M KOH?

OMIT. 6. Problem10-9, Harris. Find the equilibrium constant for the reaction of MES (Table 8-2) with NaOH.

7. Problem 10-10, Harris. When 22.63 mL of aqueous NaOH were added to 1.214 g of cyclohexyl-aminoethanesulfonic acid (MM 207.29, structure in Table 8-2) dissolved in 41.37 mL of water, the pH was 9.24. Calculate the molarity of the NaOH.

8. Calculate the pH of 25.00 mL solution of 0.125 M acetic acid ($K_a = 1.75 \times 10^{-5}$) after the addition of each of the following volumes of 0.100 M KOH: 10.00 mL, V_{ep}, and 35.00 mL.

9. Problem 10-19, Harris. Sketch the general appearance of the curve for the titration of a weak diprotic acid with NaOH. Explain (in words) what chemistry governs the pH in each distinct region of the curve.

Chapter 11: EDTA TITRATIONS

1. *Be able to explain each of the following terminologies*: Back titration, blocking (of indicator), chelate, chelate effect, complexometric titration, direct titration, formation constant, metal ion indicator, multidentate ligand

2. Problem 11-25. Calcium ion was titrated with EDTA at pH 11 using calmagite as indicator (Table 11-3). Which is the principal species of Calmagite at pH 11 ? What color was observed before the equivalence point? After the equivalence point?

3. Problem solving (see lecture notes on water hardness (as $CaCO_3$) determination).

4. Problem 11-31. How many milliliters of 0.0500 M EDTA are required to react with 50.0 mL of 0.0100 M Ca^{2+}? With 50.0 mL of 0.0100 M Al^{3+}?

Challenge question: 5. Problem 11-32. A 50.0-mL sample containing Ni^{2+} was treated with 25.0 mL of 0.0500 M EDTA to complex all the Ni^{2+} and leave excess EDTA in solution. The excess EDTA was then back-titrated, requiring 5.00 mL of 0.0500 M Zn^{2+}. What was the concentration of Ni^{2+} in the original solution?