

## Chemistry 30: Final Exam Review Suggestions

Please note that you are responsible for all material that has been discussed or assigned within this course. The final exam will consist of, but is not limited to, the material and topics listed below. Use the topics below as a place to start (or check on) your studying!

### Unit: Chemical Bonding

Definitions: ionic/polar covalent/non-polar covalent bonds

1. Complete the following table for an atom and an ion.

Symbol	Atomic Mass	Protons	Neutrons	Electrons	Full Electron Configuration	Valence Electrons
Cl						
O <sup>-2</sup>						

2. Distinguish between Bohr's concept of electron orbits and the quantum mechanical model of electron orbitals.

3. Draw Lewis structures for: a. Na<sub>2</sub>O

b. C<sub>2</sub>H<sub>2</sub>

c. CO<sub>3</sub><sup>-2</sup>

4. Match the 3-D VESPR structures below with the following descriptions. Answers may be used more than once.

i. linear

ii. trigonal planar

iii. trigonal pyramidal

iv. tetrahedral

v. Trigonal bipyramidal

vi. bent

- \_\_\_ a. four pairs of bonding electrons
- \_\_\_ b. three pairs of bonding electrons, one lone pair of electrons
- \_\_\_ c. two pairs of bonding electrons, two lone pairs of electrons
- \_\_\_ d. describes the structure of PCl<sub>5</sub>
- \_\_\_ e. describes the structure of BF<sub>3</sub>
- \_\_\_ f. two pairs of bonding electrons
- \_\_\_ g. describes the structure of NF<sub>3</sub>

5. Draw Lewis and VSEPR structures for carbon dioxide and sulfur dioxide. Use these to help explain why carbon dioxide does not have a dipole moment but sulfur dioxide does.

6. a. Differentiate between the types of intermolecular forces (i.e., London dispersion, dipole-dipole, hydrogen bonding).

b. Name the intermolecular force that has the greatest impact on: CH<sub>3</sub>OH, C<sub>3</sub>H<sub>8</sub>, and HCl.

### Unit: Organic Chemistry

Definitions: saturated/unsaturated hydrocarbons; structural isomers/stereoisomers; monomer/polymer

7. Distinguish between each of the following (and be able to name examples of each!):

a. alkanes, alkenes, and alkynes

b. alcohols, ethers and thiols

c. aldehydes and ketones

d. carboxyl acids and esters

8. Draw and name three structural isomers of hexane.
9. Draw and name the *cis* and *trans* isomers of 3-hexene.

#### Unit: Equilibrium

10. What is the equilibrium expression for:  $2\text{KClO}_3(\text{s}) \rightleftharpoons 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$ ?
11. Calculate  $K_{\text{eq}}$  for the following reaction at equilibrium at 25°C:  $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + 2\text{O}_2(\text{g})$   
given the equilibrium concentration of nitrogen is 1.5 mol/L, oxygen is 3.0 mol/L, and nitrogen dioxide is 4.5 mol/L.
12. Understand Le Chatelier's principle and be able to describe the effects of changes in concentration, volume/pressure, temperature and presence of a catalyst.
13. Consider the decomposition of hydrogen iodide gas into its elements. If 1.6 mol of HI was placed in a 1.0 L container and allowed to reach equilibrium, what would the equilibrium concentrations be for all participants if  $K_{\text{eq}} = 36$ ? (Write the BALANCED reaction and then use ICE. Know WHEN to use ICE charts.)

#### Unit: Solutions

Definitions: unsaturated/saturated/supersaturated solutions

14. Write the  $K_{\text{sp}}$  expression and solve for the concentration of ions in 1.5 M  $(\text{NH}_4)_2\text{SO}_4$ .
15. A solution of  $\text{Ag}_2\text{S}$  at equilibrium was found to contain  $1.6 \times 10^{-16}$  M sulfur ions and  $2.5 \times 10^{-16}$  M silver ions. Find the  $K_{\text{sp}}$  of  $\text{Ag}_2\text{S}$ .
16. Calculate the  $K_{\text{sp}}$  for  $\text{AlCl}_3$  if 100.0 g is required to saturate 150 mL of a solution.
17. Be able to use a solubility curve and a Table of Solubility.

#### Unit: Acid-Base Equilibria

Definitions: acid/base; amphiprotic/polyprotic; equivalence point / end point

18. Be able to identify the acid/base and its conjugate base/acid in reactions. For example:



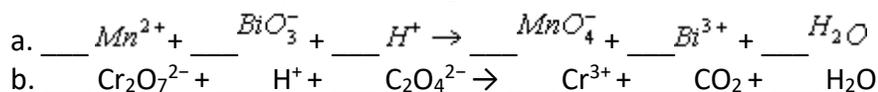
19. For each of the following, make sure to start with the dissociation equation and then determine if you have a weak or strong acid or base as this will impact how you do the calculations. Remember you have  $K_{\text{a}}/K_{\text{b}}$  provided on your formula sheet.
- Calculate the pH of a solution that consists of 5.0 g of HCl in 250 mL of solution.
  - What is the pH of an aqueous solution containing 0.00200 M barium hydroxide,  $\text{Ba}(\text{OH})_2$ ?
  - Find the pH of a phosphoric acid solution, given 0.15 moles were required to make 875 mL of solution.
  - Find the pH of a 0.010 M solution of ammonia.

20. A given solution is yellow in methyl red, yellow in phenol red, and yellow in alizarin yellow. What is the solution's approximate pH?
21. It takes 25.0 mL of 0.0500 M  $\text{HCl}_{(\text{aq})}$  to neutralize 355 mL of  $\text{NaOH}_{(\text{aq})}$ . What is the concentration of  $\text{NaOH}_{(\text{aq})}$ ?
22. Be familiar with titration curves for any combination of strong/weak acids and bases. Be able to choose an appropriate indicator.

### Unit: Redox Reactions

Definitions: oxidation/reduction, oxidizing agent/reducing agent, anode/cathode

23. Be able to balance equations using oxidation numbers and half-reactions. For example:



24. Understand the electrochemical cell and its notation. For example: Two half-cells are connected under standard conditions to make an electrochemical cell using lithium and iron II.
- write the equation for each half-reaction that will occur
  - write the net overall balanced redox equation
  - find the net voltage
  - diagram the cell
  - write the line notation for the cell

### Exam Format

- 50 Multiple Choice Questions (1 mark each)
- 5 pairs of definitions (2 marks each)
- 6 short answer questions (5 marks each, 1 from each of the first 5 units; 1 question worth 10 marks from Redox)

### Answers to Select Questions:

4. a. iv      b. iii      c. vi      d. v      e. ii      f. I      g. iii
- 6b.  $\text{CH}_3\text{OH}$  = H bonding;  $\text{C}_3\text{H}_8$  = London dispersion;  $\text{HCl}$  = dipole-dipole
11.  $K_{\text{eq}} = 0.67$
13.  $[\text{H}_2] = [\text{I}_2] = 0.74 \text{ M}$        $[\text{HI}] = 0.12 \text{ M}$
14.  $\text{NH}_4^+ = 3.0 \text{ M}$        $\text{SO}_4^- = 1.5 \text{ M}$
15.  $K_{\text{sp}} = 1.0 \times 10^{-47}$
16.  $K_{\text{sp}} = 1.7 \times 10^4$
19. a. pH = 0.26      b. pH = 11.6      c. pH = 1.46      d. pH = 10.6
20. pH = 6.0-6.6
21. 0.00352 M
23. a. 2, 5, 14, 2, 5, 7      b. 1, 14, 3, 2, 6, 7
24. b.  $2 \text{Li}_{(\text{s})} + \text{Fe}^{2+}_{(\text{aq})} \rightarrow 2 \text{Li}^{+}_{(\text{aq})} + \text{Fe}_{(\text{s})}$       c. +2.56 V