# CHEM 1110
# Midterm Exam 4 Study Guide (Ch. 8-10) + Ch. 11

This study guide is meant to provide only the barest direction as you study. Try to find practice problems from the textbook (both in the chapter text and in the end-of-chapter questions) rather than just relying on this guide. Note that most tables and equations will not be provided here, or on the exam. You can find them in your textbook now, but should memorize them in preparation for the exam.

## Chapter 8 – Gases, Liquids, and Solids

- $\Delta H$, $\Delta S$, and $\Delta G$ for all phase changes
- Intermolecular forces
  - London Dispersion Forces
  - Dipole-dipole Forces
  - Hydrogen Bonds
- Question: Is methanol ($CH_3OH$) capable of hydrogen bonding?
- Answer: Yes, it has both a H-bond donor and acceptor, so it can hydrogen bond
- Know the assumptions that make up the kinetic molecular theory of gases
- Pressure an the many different units for expressing it
- Gas laws: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
- Question: A balloon has $V = 3.21\ L$ at $P = 0.82\ atm$ and $T = 298\ K$. What temperature would give the balloon a volume of $V = 2.95\ L$ at $P = 0.67\ atm$?
- Answer: $T = 224\ K$
- Ideal Gas Law: $PV = nRT$
- Dalton's law of partial pressures
- Vapor pressures, boiling points, and Henry's law
- Viscosity and surface tension
- Different types of crystalline solids and amorphous solids
- Heats for phase changes: $q = m\Delta H$
- Question: How much heat is absorbed when $12.3\ g$ of dry ice sublimate in your home-made root beer? ($\Delta H_{sub} = 571\frac{J}{g}$)
- Answer: $7.02\ kJ$

## Chapter 9 – Solutions

- Solutions vs colloids
- Factors leading to solubility
- Recognize hydrates and using their molar mass properly
- Saturation and super-saturation
- Temperature dependence of solubility
- Henry's law and pressure dependence of solubility
- Different units of concentration
  - mass/mass percent
  - volume/volume percent
  - Molarity
  - Molality
- Question: $2.6\ g$ of NaCl are dissolved in $63.4\ g$ of water. What is the concentration in mass/mass percent, and in molality?
- Answer: $3.9\%$ and $0.70\ molal$ in NaCl, but $1.4\ molal$ overall since NaCl dissociates into two different parts
- Dilution
- Question: How many $ml$ of a $12.3\ M$ stock solution should you use to make $200.0\ ml$ of a $0.500\ M$ solution?
- Answer: $8.13\ ml$
- Strong vs weak electrolytes
- Equivalents and gram-equivalents
- Question: How many equivalents of positive charge are in $15.0\ g$ of $Ca(NO_3)_2$?
- Answer: $0.183\ eq$
- Question: How much is a gram-equivalent for the $Ca^{2+}$ ion?
- Answer: $20.0\ grams$
- Boiling point elevation and freezing point depression: $\Delta T = \kappa C_{molal}$
- Question: You place $3.5\ g$ of $MgCl_2$ in a pot with $62\ g$ of water. What are the new boiling point and freezing point for the water? (for water, $\kappa_b = 0.512\frac{^\circ C}{m}$ and $\kappa_f = -1.86\frac{^\circ C}{m}$)

- Answer: $T_b = 100.91°C$ and $T_f = -3.3°C$
- Osmotic pressure: $\pi = \dfrac{nRT}{V}$

## Chapter 10 – Acids and Bases

- Brønsted-Lowry Definition of Acids and Bases
- Acid/Base reactions with water
- Identify acid, base, conjugate acid, and conjugate base in acid/base reactions
- Weak vs. strong acids and bases (know the strong acids)
- Acid/base strength, and relationship between strength of conjugate pairs
- Acid dissociation constant $\left( K_a = \dfrac{[\mathrm{H_3O^+}][\mathrm{A^-}]}{[\mathrm{HA}]} \right)$
- Using $K_w$ to find $[\mathrm{H_3O^+}]$ or $[\mathrm{OH^-}]$
- Finding $pH$, $pOH$, and $pK_a$
- Use of color indicators
- Purpose and composition of a buffer solution
- Finding pH for a buffer solution (Henderson-Hasselbalch equation)
- Finding concentrations by titration
- Predicting acid/base properties of ionic compounds

**Note that chapter 11 material is *not* covered in midterm exam 4, but is provided here to help you study for the comprehensive final exam**

## Chapter 11 – Nuclear Chemistry

- Differences between $\alpha$, $\beta$, and $\gamma$ radiation
- Balancing nuclear equations
  - $\alpha$ emission
  - $\beta$ emission
  - Positron emission
  - Electron capture
  - Fission
  - Fusion
- Half-life and finding a sample's remaining fraction