Chapter 20 – Things to Know

- 1. What is oxidation? Reduction? An oxidizing agent? A reducing agent?
- 2. Know how to find oxidation numbers
- 3. Balancing redox equations (any method)
- 4. Be able to sketch and label a voltaic (galvanic) cell. Direction of electron flow, + and electrodes, anode, cathode, salt bridge, direction of ion flow, etc.
- 5. Standard cell notation: anode||cathode

6.
$$1 V = 1 J/C$$

- 7. What are standard conditions?
- 8. Determining E°_{cell}: if it's spontaneous, E°_{cell} must be positive overall. One substance must be oxidized, the other must be reduced. Find the half-reactions and their corresponding E°'s, and add them. (Make sure to reverse the anode reaction first.)
- 9. Comparing the strengths of oxidizing and reducing agents, given a table of reduction potentials: remember, the most positive (or least negative) potential is the easiest or most favorable. For oxidizing agents, look at reductions (oxidizing agents get reduced). For reducing agents, look at oxidations you have to reverse the reactions and their E° values.

10. $\Delta G^{\circ} = - nFE^{\circ}, \Delta G = - nFE$ (positive overall E means spontaneous)11.For nonstandard conditions:

$$E = E^\circ - \frac{0.0257 \text{ V}}{n} \ln Q$$

Understand and be able to explain how changes in concentrations of reactants or products will affect the voltage. (Explain both mathematically and in terms of chemical principles.)

Types of problems using this equation:

1) Given actual concentrations, calculate E_{cell} (must first get overall reaction, find E° , get setup of Q, determine n)

2) Given actual voltage and some concentrations, calculate the missing concentration (first get overall rxn, E°, n, Q setup)

3) Given K_{sp} and certain other concentrations, get actual voltage (use K_{sp} to calculate the missing concentration, then proceed as above.)

4) Given actual voltage and certain other concentrations, calculate K_{sp} (get rxn,

E°, n, Q. Calculate missing concentration. Then use K_{sp} expression to get K_{sp}).

- 12. Also: concentration cells know how to determine the voltage or one of the concentrations.
- 13. Relationship of E^o and K:

 $\mathrm{E^{\circ}_{cell}} = \frac{0.0257 \mathrm{~V}}{\mathrm{n}} \ln \mathrm{K}$

14. Batteries – what are they? How do they work? What are the electrodes in a car battery? Why is a car battery rechargeable? How is a fuel cell different from a battery? What is the main advantage of fuel cells?

- 15. How can corrosion be prevented? What is a sacrificial anode? Why doesn't Al corrode?
- Predict the half reactions that would occur at each electrode in aqueous 16. electrolysis. Remember water can also react. Choose the easiest oxidation and the easiest reduction, and remember that the predicted half reactions aren't always the ones that actually occur. (Why?) Rxns for water: $2 H_2O + 2 e^- \rightarrow H_2 + 2 OH^ E^{o} = -0.83 V$ $E^{o} = -1.23 V$ $2 H_2 O \rightarrow O_2 + 4 H^+ + 4 e^-$ Electrolysis stoichiometry – use conversion factors 17. 1) Given current, time, how much will react? (be used up or plate out) 2) Given amount reacted, current, how much time? 3) Given amount, time, how much current? Etc. For all of these, you need a half-reaction to determine n. Also use 1 A = 1 C/sec, 1 F = 96485 C/mole e $w_{max} = -nFE.$ 18. For a nonspontaneous reaction being driven by a power supply, $w = nFE_{applied}$. In this case, E is the voltage applied by the power supply, and w is the amount

Chapter 21 – Things to Know

- 1. What are some important differences between nuclear reactions and chemical reactions?
- 2. Symbols of nuclear particles and types of radiation: alpha, beta, gamma, positron, electron, neutron, proton

of energy needed in J/mole (for the reaction as written).

- 3. How to write and/or balance and/or complete a nuclear equation (mass number and atomic number must balance)
- 4. Writing equations for different types of decay (alpha emission, beta emission, positron emission, electron capture)
- 5. Band of stability general characteristics
- 6. Be able to predict the likely type of decay for a given radioactive nucleus.
- 7. How are elements artificially produced? What type of transmutations require a particle accelerator? Given the summary notation for a transmutation, be able to write the nuclear reaction. Neutrons are easily absorbed by nuclei, but protons are not. Why?
- 8. Half-life: definition and use, be able to sketch a graph of how the amount changes as time goes on, be able to reason out conceptually the amount left after a certain number of half lives or a certain amount of time.
- 9. First order rate equations:

$$\ln\left(\frac{N_t}{N_0}\right) = -kt \qquad \qquad \ln\left(\frac{A_t}{A_0}\right) = -kt \qquad \qquad t_{\frac{1}{2}} = \frac{0.693}{k}$$

10. Activity – rate of decay Rate = kN_t units of activity: dps, dpm, Ci

- 11. 1 Ci = 3.70×10^{10} dps (nuclei/sec) Be able to calculate the activity of any radioactive sample, and do variations using Rate = kN_t . Be able to calculate the amount of radioactive isotope present given the activity and half-life.
- 12. If you need the molar mass of an isotope in a problem involving activity, estimate it using the mass number of that isotope.
- 13. ¹⁴C dating: use the first order rate equation.
- A_0 of ¹⁴C = 15.2 dpm/g C, $t_{1/2}$ = 5715 years, t is how long ago it died.
- 14. Argon dating be able to do problems using this. Must interpret the given ratio correctly.
- 15. Detection: film badge, Geiger counter, scintillation counter (advantages and disadvantages of each)
- 16. $\Delta E = (\Delta m)c^2$ c = 3.00 x 10⁸ m/sec, Δm in kg or kg/mole, E in J
- 17. Given the masses of all particles involved in a reaction, calculate Δm and then ΔE_{rxn} .
- 18. Binding energy what is it? How do you calculate it? What is mass defect? Use binding energy per nucleon to compare stabilities of different nuclei (higher binding energy/nucleon, more stable). Be able to sketch the graph of binding energy per nucleon vs. number of nucleons and explain the reason for the shape of the graph.
- 19. Fission: typical reaction, sign of ΔE , magnitude, uses, problems What is "critical mass"? What is a chain reaction?
- 20. Fusion: typical reaction, sign of ΔE , magnitude, uses, problems
- 21. Why do both fission and fusion both give off energy?
- 22. Biological effects of radiation
- 23. "ionizing radiation" what is it? What does it do?
- 24. What is a "free radical"? What does it do?
- 25. Background radiation: what is it? sources?)
- 26. Types of shielding needed for different types of radiation
- 27. What kinds of things affect the amount of damage done by radiation?
- 28. What are some uses/applications of radioactivity?

Chapter 23 – Things to Know

- 1. Determining electron configurations of transition metal ions. They lose electrons from the outermost s orbital first. Example: Fe³⁺ [Ar]₃d⁵
- 2. Exceptions to normal filling order: Cr, Cu, etc. Why?
- 3. Definitions/terms: complex, complex ion, coordination compound, ligand,
- coordination number, bidentate, polydentate.
- 4. Symbols, formulas and charges of ligands
- 5. Experimentally determining formula of complexes *#* ions per formula unit, *#* "free" Cl⁻ ions, etc.
- 6. How to find the oxidation number of a metal in a complex
- 7. Geometries of complexes be able to sketch

- 8. Chelating agents why are complexes made with chelating agents stable? What are some uses of EDTA⁴⁻?
- 9. What is a metalloprotein?
- 10. Naming or writing formulas of coordination compounds or complex ions
- 11. Structural isomerism (linkage or coordination-sphere isomers) vs. stereoisomerism (geometric or optical isomers): give examples to illustrate the differences between these types of isomerism. Given a complex, what type of isomerism is possible?
- 12. Geometric isomerism (cis/trans, fac/mer) vs. optical isomerism (chiral)
- 13. Be able to draw cis/trans and fac/mer isomers and enantiomers
- 14. Color absorbed = complementary to the color observed. Use color wheel to determine colors (sketch it yourself)
 - Low E, long λ ROYGBIV High E, short λ
- 15. Shapes and orientations of d orbitals (and s, p orbitals)
- 16. Crystal Field theory what is it?
- 17. For each geometry (octahedral, tetrahedral, and square planar), know the splitting pattern of the d levels <u>and</u> which d orbital is which in the splitting pattern <u>and</u> why!
- 18. What is $\overline{\Delta}$?
- 19. High spin vs. low spin what's the difference? How can you tell whether a complex will be high or low spin? (If it's octahedral, you can tell by the strength of the ligand. If it's tetrahedral, it must be high spin. Square planar must be low spin.)
- 20. Have a general idea of the spectrochemical series which ligands tend to be strong, weak, medium.
- 21. Colors have to do with the magnitude of Δ .
- 22. Higher E of light absorbed \rightarrow greater splitting, stronger ligand
- 23. Paramagnetic, diamagnetic, determining *#* unpaired electrons
- 24. Why is Δ_0 always larger than Δ_t ?