

2018 Checklist for Exam 4 (not necessarily complete)

Chapter 18. Electrochemistry

Section 18.1. Balancing oxidation-reduction reactions. (or as per my lecture notes)

- I know how to balance redox reactions in acidic solution.
- I know how to balance redox reactions in basic solution.

Sections 18.2 and 3. Galvanic cells.

- I know how to sketch a galvanic cell.
- I can label the cathode cell, the anode cell, and the direction of electron flow.
- I can write the cathode half-reaction, the anode half-reaction and I can combine them (overall reaction.)
- I can read and write cell notation for galvanic cells.

Section 18.4. E and ΔG and E° and ΔG° .

- I know when and how to use these equations, provided on the exam:

$$\Delta G = -nFE$$

$$\Delta G^\circ = -nFE^\circ$$

Section 18.5 and 6. Using a Table of Standard Reduction Potentials.

- I can use a Table of Standard Reduction Potentials in order to calculate E° for any pair of half-reactions. In addition, I can write them as a spontaneous overall reaction.
- I know that I do not multiply E° values even though I may have to multiply half-reactions in order to balance a pair of half-reactions.
- I can use a Table of Standard Reduction Potentials in order to determine qualitatively if one reagent will react spontaneously with another, as long as both of them are in the table.
- I know that the least common multiple is always the number of electrons transferred, n . I know this is an important number when using the Nernst and other equations.

Section 18.7 and 8. Nernst equation.

- Given the Nernst equation on the exam, I can calculate E for any reaction as long as I know the concentrations of the aqueous species present. I can write Q_c expressions and I know that I must remember to include coefficients as exponents when writing Q_c .
- I know when the reaction contains H^+ or OH^- , I could be asked to express my answer as a pH. Also, given a pH, I could convert to $[H^+]$ or $[OH^-]$ and solve the problem.

Section 18.9. At equilibrium.

- I know that $E = \Delta G = 0$ at equilibrium. This lets me convert the Nernst equation into $E^\circ = (0.0592/n)\log K$. As was the case with the Nernst equation, I can write K_c expressions and I know that I must remember to include coefficients as exponents when doing so. Moreover, I can solve for K given E° , and visa versa.

Section 18.12 and 14. Electrolytic cells.

- I can write half-cell reactions for the two processes occurring in any electrolytic cell.
- I can convert current, time and charge (given two, I can calculate the 3rd), using the equations, given:
 $Charge(coul) = Current(amps) \times time(s)$ $F = 96500 C/mol = 1 \text{ faraday} = 1 \text{ mol } e^- = 96500 \text{ coul}$
- Knowing the charge, I can convert charge to moles of electrons, n_{e^-} , and then n_{e^-} into moles of an element, n_E . I will be careful to remember that for many elements, more than one equivalent of electrons are required to reduce the cation to the neutral metal.

Chapter 19. Nuclear Chemistry

- I can write the isotope designation using the format: ${}_{\text{atomic number}}^{\text{mass number}}E$. I can use this notation in order to determine the number of protons and neutrons for any isotope.
- I know what an α -particle is and how to balance a nuclear equation using one. Ditto for β -particles, positrons. I can also balance reactions involving EC.
- I know about the “Sea of Stability” and can predict what sort of transformation may take place for unstable isotopes that have too many or too few neutrons. I know what radioactivity means in terms of unstable nuclei. I know that stable nuclei are not radioactive and do not spontaneously convert into something else.

Sections 19.4 and 19.9. Kinetics of nuclear decay

- I understand how to use the time-concentration and half-life equations for the first order kinetics that all nuclear decay processes follow. These equations will be given on the exam.

$$\text{rate} = kN \quad \ln\left(\frac{N_o}{N_t}\right) = kt \quad t_{1/2} = \frac{0.693}{k} \quad k = \frac{0.693}{t_{1/2}}$$

Sections 19.5 – 19.7 Nuclear transformations.

- I understand how to use balance reactions involving fission and fusion nuclear transformations and how to calculate ΔE for these reactions.
- I can work problems dealing with nuclear transmutations.

Chapter 11 (Solids and Liquids)

The first seven items (in blue) are a review of intermolecular forces which are important to understanding phase changes.

- I can use Lewis dots and the ABE formula in order to predict if a molecule is polar — has a molecular dipole moment — or not.
- I can label the δ^+ and δ^- end of a molecule.
- Knowing that a molecule is polar is enough to conclude that molecules are held together by dipole-dipole intermolecular forces.
- “Hydrogen bonding” occurs when hydrogen is covalently bonded to N, O, or F. The hydrogen bond is the intermolecular force between such a bond and another N, O, or F on a neighboring molecule. For example, the H-bond is represented by the dashed line:
$$\text{H—F} \cdots \text{H—F}$$
- London dispersion forces (LDF) are another important type of intermolecular force. LDF are somewhat proportional to MM and so molecules with large MM have large LDF and these can be considerable. Thus, every substance has LDF forces.
- I know that intermolecular forces explain why and when solids melt and liquids boil, for example. In order to boil a liquid, enough energy has to be added to overcome all of the intermolecular forces.
- I can predict the sign for ΔH for phase changes. If one has to add energy, the process is endothermic, $\Delta H > 0$. If heat is given off, the process is exothermic, $\Delta H < 0$.
- I can use ΔH values in order to calculate q , the heat transferred and I know that q is an extensive property. I can use the units to do these q calculations. For example, given ΔH_{vap} which has units of kJ/mol, I can calculate q by multiplying ΔH_{vap} by the number of moles. Or, given the specific heat (units J/g deg), I multiply by mass and ΔT , and so on.
- I can answer questions about vapor pressure diagrams and can use the Clausius-Clapyron equation (provided), to plug in four variables to calculate a value for the fifth. I know to use units, so that ΔH_{vap} will be in the same units as R , in terms of J or kJ.

- ❑ I can identify simple unit cells (cubic, body-centered, and face-centered.) I know how these relate to metals and I know the four important positions: corners, center, edge-centers and face-centers.
- ❑ I know how many net atoms are wholly contained within each of the cubic unit cells.
- ❑ I know where atom contact takes place for each of the cubic unit cells and can show how the radius, r , relates to the edge length, e .
- ❑ I know how to use the density of a solid and its unit cell dimensions to calculate the atomic radius and visa versa.
- ❑ I know that for ionic compounds, the big ions, usually the anions, often arrange themselves in the same patterns as metals do (simple, body-centered and face-centered unit cells) with the smaller ions going in some of the other positions such as edge-centers, and so on.
- ❑ I know that the formula of an ionic salt is represented by the relative number of ions within each unit cell because a bulk material is simply just a large number of unit cells.
- ❑ I can classify solids as ionic, molecular, covalent network, or metallic, and I can give the major forces of attraction of each.
- ❑ I can answer questions about bonding in metals and network covalents.
- ❑ I can answer questions about phase diagrams, condensable and permanent gases, triple points, critical temperature, etc.