CHEM 344 Midterm Exam Study Guide

Purification techniques

Acid-Base Extraction
identification and reactions of acids and bases (organic and inorganic);
formation and solubilities of conjugate acids and bases;
relative solubilities and densities of solvents used in lab (don’t need exact numbers);
washing, neutralization, and drying steps – how are they done, why are they needed?
difference between extraction and washing.

Distillation
identification and correct/safe set-up of distillation apparatus;
difference between distillation and refluxing (what does each one accomplish?)

Recrystalization
why/how we do it;
how it works;
what makes a good recrystalization solvent (think about solubility vs. temperature)
melting ranges (broad vs. sharp as indicator of purity);
mixed melting point determination

Spectroscopic techniques

NMR
determination of structure by NMR spectroscopy (quiz/problem set questions);
use of coupling constants in alkyl/aromatic/alkene systems;
NMR chemical shift trends and ranges (chem. shift table will be provided);
use of integration values to calculate relative ratios of compounds in a mixture;
common impurities in a ¹H-NMR spectrum (Appendix K in lab manual)

IR
Use of IR spectroscopy for functional group identification (table will be provided).

GC-MS
use of GC-MS to assess purity of a reaction mixture or product;
types of species that are/are not detected by EI-MS;
correct drawing of molecular ions and fragments;
common isotope patterns.
**Oxidation of 4-tert-butyl-cyclohexanol**
identification of common oxidizing agents;
oxidation products of organic compounds;
generation of oxidizing agent used in lab experiment;
use of TLC to monitor the progress of a reaction;
calculation of $R_f$ values on a TLC plate;
relative polarities of common solvents and functional groups in TLC (website handout);
use of starch-KI paper to determine presence of oxidant;
types of drying agent and their appropriate use

**Nucleophilic substitution reactions (also covered in CHEM 343)**
identification of $S_N1$ and $S_N2$ reactions & appropriate substrates and conditions for each;
mechanisms of $S_N1$ and $S_N2$ reactions.

**Elimination reactions (also covered in CHEM 343)**
identification of E1 and E2 reactions & appropriate substrates and conditions for each;
mechanisms of E1 and E2 reactions;
thermodynamic vs. kinetic control;
Zaitzev's rule.

**WebMO**
use of WebMO data (energies, atomic charges, molecular orbitals, hybridization) to explain simple structural and reactivity trends;
relationship between # p-atomic orbitals and # $\pi$-molecular orbitals;
features of a potential energy surface (transition states, intermediates, activation energy).
absolute and relative energies of molecules.

**Other**
lab safety, appropriate disposal of waste;
calculation of mass, volume, molar amounts of reagents;
calculation of % yield of product.