CHEM 344 Final Quiz Study Guide Spring 2014

Purification techniques

Acid-Base Extraction

identification and re actions of acids and bases (organic and inorganic);

formation and solubilities of conjugate acids and bases;

use of a pKa table (table will be provided);

Solvent-solvent Extraction

relative solubilities and densities of solvents used in lab (don't need specific 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;

what makes a good recrystalization solvent (think about solubility *vs*. temperature);

melting ranges (broad *vs*. sharp as indicator of purity);

mixed melting point determination (how we do it/what it tells us).

Spectroscopic techniques

NMR

determination of structure by NMR spectroscopy (quiz/problem set questions);

coupling constants in alkyl/aromatic/alkene systems;

^{1}H- and ^{13}C-NMR chemical shift trends and ranges (chem. shift table will be provided);

procedure for preparation of a ^{1}H-NMR sample (p.113 in lab manual);

use of integration values to calculate ratios of compounds in a mixture;

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;

isotope patterns;

WebMO

use of WebMO data (energies, atomic charges, molecular orbitals, geometries, hybridization) to explain simple structural and reactivity trends;

relationship between # p-atomic orbitals and # π-molecular orbitals;

features of a potential energy surface (transition states, intermediates, activation energy).

absolute and relative energies of molecules.

"Other"

general lab safety

correct disposal of solvents, chemical waste, and other materials;

calculation of mass, volume, molar amounts of reagents, %yield;

common abbreviations for organic groups (Me, Et, Ph, etc.).

Lab reactions and concepts

Oxidation of 4-*t*Bu-cyclohexanol (oxidations were covered in CHEM 343)

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;

identification and use of a phase-transfer catalyst;

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 of a reaction;

Zaitzev's rule

Reduction of a carbonyl group/Acetal formation

(also covered in CHEM 345)

reactivity of carbonyl functional groups;

reactivity of metal hydride reducing agents toward carbonyl groups.

R/S nomenclature;

diastereomers *vs*. enantiomers;

identification of *meso* compounds;

identification of acetals;

Nitrogen Functional Groups (also covered in CHEM 345)

reactivity of 1^{o}, 2^{o}, 3^{o} amines toward carbonyls;

effect of impurities on melting range of a solid.

EAS reactions (Nitration and Friedel-Crafts acylation)

(also covered in CHEM 345)

identification of activating/deactivating groups on an aryl ring;

effect of above on ^{1}H-NMR chemical shifts of aryl rings;

generation of electrophiles used in lab experiments;

use of EAS reactions in synthesis;

work-up/purification of reaction mixtures.

Wittig Olefination (also covered in CHEM 345)

generation and reactivity of ylides;

typical products and byproduct(s) of Wittig reaction;

use of Wittig reaction in synthesis;

identification of *trans* vs*. cis* alkenes in ^{1}H-NMR spectrum.

Grignard (also covered in CHEM 345)

bond polarity/reactivty relationship in organometallic compounds;

generation of Grignard and organolithium reagents;

typical reaction conditions/appropriate solvents for Grignard/organolithiums;

use of Grignard and organolithium reagents in organic synthesis;

work-up/purification of reaction mixtures;

Pd-catalyzed coupling reactions

definition of a catalyst; what a catalyst does/does not do.

reaction profiles of catalyzed and uncatalyzed reactions;

general role of ligands in catalytic reactions;

role of the added base in the Suzuki-Miyaura reaction;

synthesis of arylboronic acids;

typical reaction conditions/starting materials/products for reactions;

drawing a catalytic cycle for a general Pd-catalyzed coupling reaction;

identification of key steps of the catalytic cycle in a general Pd-catalyzed coupling;

use of Pd-catalyzed coupling reactions in organic synthesis;

molecular and electronic structure of biaryl compounds.

There will be no "predict the product" or other specific questions about the Heck reaction

Cu/TEMPO/bpy catalyzed aerobic oxidation of alcohols

identification of 1^{o}, 2^{o}, 3^{o} alcohols and corresponding oxidation products;

identification of catalyst components;

role of each catalyst component in the reaction;

use of Cu/TEMPO catalyzed aerobic oxidation reaction in synthesis.

The style of question in the final quiz will be similar in standard and style to the questions found in the practice problem sets (NMR/GC-MS/IR/organometallics), the spectroscopy quiz and problem set, the midterm quiz, TA quizzes, and the lab manual post-lab questions.