Things you should know for Final Exam

(When studying, it is better for you to look up these concepts (alone or with a team) rather than asking a T.A. or instructor to "remind [me] what that is again.")

1. Bonding and Shapes of Molecules

- a. Identification of Ionic bonds and (polar & non-polar) Covalent bonds
- b. Calculation of formal charge
- c. Lewis Structure
- d. Electron configuration
- e. Hybridization (sp^x ; where you determine x based on item f below; also, know how more *p*-character in a hybridized bond affects orbital size/length)
- f. Know how to predict the geometry of orbitals used by an atom in a molecule based on the following:
 - Electron group (E.G.) geometry
 - Molecular geometry (M.G.)

2. Acid-Base reactions

- a. Know how to identify Acids, Bases, Conjugate Acid (C.A.), and Conjugate Base (C.B.)
- b. Determine the position of equilibrium when comparing the C.A. or C.B. in an acid/base reaction
- c. Rules of identifying Strong Acids via:
 - pK_a and K_a values
 - Structure of the compound (stability of conjugate base). How (do differences in Atom electronegativity, Resonance, Induction, and Orbital Size i.e., hybridization) affect the stability of the negative charge on a conjugate base
- d. Know how to identify Lewis Acid (L.A.) and Lewis Base (L.B.)

3. Alkanes and Cycloalkanes

- a. Alkane & Cycloalkane Nomenclature
 - IUPAC Rules
 - Important substituent common names
 - R/S rules

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- b. Identify a 1°, 2°, 3°, and 4° carbon and know which ones contain a similarly designated H. This knowledge helps with our limited coverage of radical chemistry.
- c. Newman Projection
 - Know how to draw Newman projection
 - Know how to convert Newman projection into a bond-line structure
- d. Know to determine isomeric relationships (D.I.C.E.N. Diastereoisomers, Identical, Constitutional Isomers, Enantiomers, or Not related)
- e. Cyclohexane Chair conformation
 - Know how to convert flat cyclohexane structure to its chair conformation

- Know ring flipping and how it affects the orientation of attached bonds/substituents
- Stability of cyclohexane chair conformation (be able to take 1,3-diaxial interaction energies (given data) and determine which chair conformation is more stable)

4. Stereoisomerism and Chirality

- a. How to determine chiral carbons
- b. R/S configuration rules
- c. How to determine more D.I.C.E.N work + Meso. Know the definition of chiral vs. Achiral
- d. Determine R/S on Fischer projection and correctly draw a Fischer Projection. Make sure you use the workspace on the exam to determine configurations without marking work on an answer already given; this practice confuses the graders.

5. Alkene Nomenclature

- a. IUPAC Rules
- b. Important substituent common names
- c. E/Z and cis/trans rules
- d. R/S rules

6. Alkene Classification and Stability

- a. How to determine different types of alkenes (mono, di, tri, tetra)
- b. Alkenes stability rules
- 7. Alkene (Reactions + <u>Mechanisms</u>). Since helper sheets are accessible, the testing material must represent more than copying and pasting for problems.
 - a. Halogenation reaction (Addition of X₂)
 - b. Halo-hydrogenation reaction (Addition of H-X)
 - c. Halohydrin
 - d. Hydration (Addition of H-OH)
 - H₂SO₄ /H₂O
 - Oxymercuration
 - Hydroboration
 - e. Addition of (H-OR): Make sure that you get the R group drawn correctly
 - f. Hydrogenation (Reduction reaction)
 - g. Dihydroxylation (Addition of two hydroxy groups (O.H.))
 - h. Epoxidation
 - i. Oxidation Cleavage
 - Ozonolysis

8. Alkyne Nomenclature

- a. IUPAC rules
- b. Important substituent common names
- c. R/S rules

9. Alkyne Classification

a. How to determine Internal and Terminal alkyne

10. Alkyne (Preparation and *Mechanisms*)

a. Two consecutive E2 reactions with dihaloalkanes (using ¬NH₂ equivalent to NaNH₂)

11. Alkyne (Reactions + Mechanisms)

- a. Halogenation (Addition of X₂)
- b. Halo-hydrogenation (Addition of H-X)
- c. Reduction reactions
 - H_2/Pd or Pt
 - H₂/ Lindlar's Catalyst
 - Li or Na / NH_3
- d. Hydration (Addition of H-OH)
- e. Enol-carbonyl Tautomerization
- f. Oxymercuration reaction
- g. Disiamylborane ((Sia)₂BH) reaction
- h. S_N2 reactions (to convert a Terminal alkyne (or acetylene H-C≡C-H) into an Internal alkyne) via an acetylide anion (⁻:C≡C-H) the structure of the reactant with the leaving group can be inferred from the structural intermediates

12. Alkyl Halides Nomenclature

- a. IUPAC rules (drop the "ine" suffix of the halogen atom and at "o". For example, fluor*ine* becomes fluor<u>o</u>.
- b. Important substituents, namely the common names
- c. R/S rules

13. Alkyl Halides Classification

a. Know how to determine each alkyl halide as 1° , 2° , and 3° .

14. Alkyl Halides (Preparation + <u>Mechanisms</u>)

- a. Free radical reaction using: X₂/uv light (X: F, Cl, Br, I)
- Free radical reaction using: NBS/uv light succinimide portion of NBS should NOT be considered a product of this reaction, nor should any part of succinimide appear in a final product.
 - Know how to determine allylic protons understand how to draw the resonance structure of an allylic radical AND determine if the resonance structure is unique from the original radical drawn. Know that the B of "NBS" is the operative reminder of what is found in the final product.
 - Note: NBS reaction needs *at least one* (there could be more) allylic proton

15. Know how to determine Polar Protic and Polar Aprotic Solvents

16. Alkyl Halides (Substitution Reaction + Mechanisms)

- a. $S_N 2$ mechanism
- b. S_N1 mechanism
 - Know carbocation stability rules (benzylic > allylic > $3^\circ > 2^\circ > 1^\circ$). Why are benzylic and allylic C⁺ more stable?

17. Alkyl Halides (Elimination Reaction + Mechanisms)

- a. E2 mechanism
 - Know how to determine (α and β) (carbon and hydrogen)
 - Know the stereochemistry (Leaving group MUST be *anti* to and *planar* () with the β hydrogen). ONE step reaction, in part, limits the stereoisomerism of E2 reactions with some halo cycloalkanes and some acyclic compounds with limited β-hydrogens.
- b. E1 mechanism
 - Know carbocation stability rules and alkene stability and remember that a *p*-orbital has a top and bottom lobe that electrons from an acid H can add to and form a pi-bond. Ask: How does this affect your assessment of the stereoisomers made for an E1 rxn?



18. I.R. Spectroscopy

a. Identify absorbance and the functional groups they represent, for example: (*sp*³ C-H stretch(es, ing): Note, writing 'Alkane' is NOT correct, but a 'saturated C-H stretch' or 'alkane C-H stretch' IS okay.

 $(sp^2 = C-H \text{ stretch}(es, ing) \text{ Note, writing 'Alkene' is NOT correct, but a 'C=C-H stretch' stretch' or 'alkene C-H stretch' IS okay.$

(sp C≡C-H stretch(es, ing) Note, writing 'Alkyne' is NOT correct, but a 'C≡C-H stretch' or 'alkyne C-H stretch' IS okay.

(C=O stretch(es, ing),

(O-H stretch(es, ing))

(N-H stretch(es, ing)

Be able to apply deductions from the information given.

Please Do Not forget to write "STRETCH" after each functional group identification to distinguish it from a 'bend' or 'wag' energy.