CHEMISTRY 51 REVIEW TOPICS

FROM CHEM 5/6 (or 3/6 or 10)

• It's important that you do NOT feel that you are complete novices, starting your study of Organic Chemistry as a completely new and uncharted field. You have already studied most of the principles that you will need in order to understand, rather than just memorize, the very large amount of information that constitutes the body of knowledge called Organic Chemistry.

• However, it is important that you bring this prerequisite material back to the forefront of your memory, and keep it there!

• I understand that you have already encountered the following terms, concepts and topics from your prerequisite General Chemistry courses. We will use them repeatedly and build upon them. Some of these topics are reviewed in your new text, and in some early lectures, but you should go back to your General Chemistry notes and text to review them as well. They are prerequisites for this course and an understanding of these principles will be assumed in class.

Periodic table and periodic trends (Chem 6)

• The Periodic Table shows the component parts from which all known materials, including organic compounds, are made. KNOW IT. It is a calculator for determining numbers of valence electrons for atoms and ions. Knowledge of how atomic properties vary in a relative sense (Periodicity) is your guide to the chemistry of the elements and their compounds.

• electronic configurations of atoms and ions, Aufbau Principle, Hund's Rule

• ground states and excited states

• symbols and names of the elements

• ionization potential and electron affinity

• electronegativity and how it varies across the Periodic Table

Thermodynamics (Chem 5)

• Conventions for + and - signs

• enthalpy (H); enthalpy-driven reaction

• entropy (S); entropy-driven reaction
• free energy (G) and its relation to H and S
• equilibrium constant (K) and its relation to $\Delta G^\circ$
• strong and weak acids, pH and pKₐ

Kinetics (Chem 6)

• rate laws for 1ˢᵗ and 2ⁿᵈ order reactions — mechanistic implications
• activation energy; Arrhenius equation, rate determining step
• chain reactions — initiation, propagation, termination
• catalysis, effect of catalyst on equilibrium constants and rate constants
• reaction coordinate; free energy reaction profile

Atomic orbitals: s, p, (d) (Chem 6)

• angular portion (shape) & radical portion (size and penetration)
  which directions in 3D space to these atomic orbitals point?
• core and valence orbitals
• change of phase of wavefunction in different orbital lobes — nodes
• relative energies in H-like atoms and in multielectron atoms and ions

Valence Bonding Theory (Chem 5/6)

• Covalent and Ionic Bonds — ionic character — Hydrogen Bonding
• bond polarities & dipoles from electronegativity differences
• octet rule, and exceptions to it
• VSEPR Theory — molecular shapes and overall molecular dipoles
• hybridization — hybrid orbitals (sp, sp², sp³)
spatial distribution of hybrid orbitals and relative spatial location of leftover unhybridized atomic orbitals

Relative ENERGIES of hybrid and atomic orbitals

• σ-bonds and π-bonds — nodal characteristics

• Lewis Base (e-pair donor) and Acid (e-pair acceptor)

• bond lengths and bond strengths

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Intermolecular Forces (Chem 6)

• polar and non-polar molecules and their physical properties — HYDROGEN BONDING

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Resonance forms (Chem 5/6) — EXCEPTIONALLY IMPORTANT!!!

• evaluation of their relative importance using electronegativity ideas

• electron pair pushing to go from one resonance form to another

• bond orders and atom hybridization in resonance hybrids

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Molecular Orbital Theory (Chem 6)

• bonding, nonbonding, antibonding molecular orbitals — positions of nodes

• calculation of bond order

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Bonding and structure in ethane (C₂H₆), ethene (C₂H₄), ethyne (C₂H₂), and benzene (C₆H₆) (Chem 6)

• single, double, and triple bonds in terms of σ and π components

• relative rotation barriers about single and double bonds

• conformational isomers (eclipsed, staggered)

• geometric isomerism in olefins (cis/trans or Z/E isomers)

• consequences of π-bonding on shapes of ethene (C₂H₄) and allene (C₃H₄)