Second Exam Survival Skills

KNOW HOW TO ...

Basic skills (comprehensive):

- draw Lewis structures with formal charges, including resonance structures
- determine oxidation numbers and oxidation levels
- evaluate the relative importance of resonance structures
- evaluate charge distribution in molecules based on electronegativity and bond dipoles
- draw molecules in Newman and perspective representations
- name alkanes and alkenes (IUPAC) with up to 10 carbons in the main chain
- recognize and count isomers, including constitutional isomers and stereoisomers
- determine degrees of unsaturation based on molecular formula or structure
- recognize basic functional groups (alkene, alkyne, -OH, -NH₂, C=O (carbonyl group of aldehydes and ketones), -COOH (carboxylic acids), halides (X = F, Cl, Br, I).
- understand pKa’s and Brønsted treatment of acids and bases
- apply Lewis acids/electrophiles, and Lewis bases/nucleophiles concepts
- visualize 3D structures of molecules and intermediates, recognize their hybridization schemes, and hybridization changes during reactions
- identify the HOMO–LUMO interactions critical for a reaction

Stereochemistry:

- identify stereogenic centers
- assign absolute stereochemistry labels (E/Z, R/S) in all kinds of molecular representations
- define following terms: chiral, enantiomers, diastereomers, meso, racemic, optical activity
- recognize chiral and achiral molecules, including molecules with chiral shapes
- understand the consequence of facile bond rotations and lone-pair inversions on chirality
- recognize and distinguish enantiomers and diastereomers, meso compounds
- classify collections of molecules as optically active or inactive
- count the number of stereoisomers possible
- understand generalized chemical and physical properties of enantiomers and diastereomers in chiral and achiral environment
- understand stereochemical consequences of reaction mechanisms

Reaction Mechanism:

- use thermodynamic functions and thermodynamic cycles (ΔHᵣ, ΔH₀, ΔHᵣ, BDEs, ΔH_rxn), to estimate relative stabilities of reactants, products, and intermediates
- analyze reaction energy profiles (exo-, endo-, intermediates, activation energies, transition states, rate-limiting steps, Hammond postulate)
- write reaction mechanisms (mechanistic arrows, electrophiles and nucleophiles, polar and radical (chain), homo-, and hetero, HOMO-LUMO interactions)
- understand radical chain substitution reactions (initiation, propagation, termination steps, BDEs in thermodynamic evaluations of reactive sites and likely propagation steps, products’ stereochemistry)
- understand relative reactivity, regiochemical (Markovnikov) and stereochemical consequences of the mechanism in electrophilic addition reactions to π bonds
- understand stereochemical consequences of back-side substitution reactions
- evaluate stabilization effects for carbocations (hybridization, inductive effects, hyperconjugation, resonance)
- analyze structure, relative stability and rearrangements of carbocations