TEST TWO SKILLS/OBJECTIVES / OUTCOMES / COMPETENCIES

- The following list specifies **major** skills/competencies that you may be asked to demonstrate on tests.
- The list should not be viewed as exhaustive; anything that is addressed in the notes and is not designated either in the notes or in the lectures as "not test responsible" should be considered to be fair game for test assessment.

Ch		**TEST TWO Nuclear Magnetic Resonance Spectroscopy and Infrared**	**Self-Assessment** (Some but not all Graded)	**Graded Assessment**
13	Nuclear Magnetic Resonance Spectroscopy	1. Given a structure, determine which protons or which carbons are equivalent and which are nonequivalent 2. Given a structure, predict the approximate chemicals shifts for the hydrogens or the carbons 3. Use integrals to determine the relative numbers of different types of protons. 4. Use proton spin-spin splitting patterns, combined with integration and chemicals shifts, to determine the structure of alkyl and other groups and to track as far as possible from one end of a molecule. 5. Given a chemical structure, predict the approximate integration, chemical shift, and splitting for each hydrogen signal set. 6. Given a chemical structure, predict the approximate chemical shift for the carbons, and perhaps the splitting that would occur were a carbon NMR to be acquired. 7. Use integration, splitting, and chemical shifts to recognize and identify common groups, for example hydroxyl; methyl, ethyl, isopropyl, propyl; methoxy, ethoxy, isopropoxy, propoxy; methyl carbonyl, ethyl carbonyl, isopropyl carbonyl, propyl carbonyl; monosubstituted benzene, and disubstituted benzene. Given a chemical formula and an H-NMR, use the integration, chemical shifts, and splitting to solve for the structure of the chemical. 8. Distinguish overlapping signals from "clean" signal sets in an H-NMR. 9. Demonstrate and apply common terminology, such as "upfield" and "downfield"; "shielding" versus "deshielding"; and "methylene" and "methine" as well as methyl. 10. Demonstrate an understanding of the additive impact of functional groups on systems that have multiple functional groups. 11. Given a formula and a C-NMR, solve for a plausible structure of the chemical. 12. Given a formula, use whatever combination of H-NMR, C-NMR, and infrared data that is provided to solve for the structure of the chemical.	1. In-lecture in-notes problems 2. Practice sets online 3. Practice Tests 4. Sapling homework problems 5. Book practice problems	Sapling homework Test 2 Final Exam
12	Infrared Spectroscopy	13. Given an IR spectrum or summary, identify characteristic peaks, particularly for OH and carbonyl groups 14. Distinguish whether a carbonyl is present, including whether it is saturated or unsaturated. 15. Distinguish whether an alcohol hydroxyl group is present.. 16. Given formulas with one or two oxygens present, identify which functional groups are present (such as ester; alcohol; carboxylic acid; hydroxyl ketone; ether; and saturated versus unsaturated carbonyl). 17. Match characteristic peaks with actual molecules. 18. Use IR in combination with H-NMR to solve for the structures of chemicals.	1. In-lecture in-notes problems 2. Practice sets online 3. Practice Tests 4. Sapling homework problems 5. Book practice problems	Sapling homework Test 2 Final Exam