

Fields of Advanced Difficulty

Theoretical

1. Pericyclic reactions (Cycloaddition and electrocyclization reactions).
2. Nucleophilic substitution reactions at sp^2 carbon centers.
3. *Spectroscopy*: Basic ^1H and ^{13}C NMR spectroscopy (chemical shifts, signal multiplicity, intensity and coupling constants); simple IR spectroscopy.
4. *Kinetics*: Rate constant models and kinetic isotope effect.
5. *Basic quantum chemistry*: Electronic energy levels, transitions applied to conjugated systems, vibrational and rotational motions of molecules (formulas provided), and simple theories of conjugated systems.
6. *Inorganic chemistry*: Coordination chemistry (crystal structure, crystal field theory, and isomerism) and molecular orbital energy diagrams of homo/heteronuclear diatomic molecules.

Notes:

i) The following topics WILL NOT appear in the exam set:

- Metal-catalyzed cross-coupling reactions and olefin metathesis reactions.
- Use of Microsoft Excel or any related computer software.
- Use of derivatives and integrals.
- Although a few examples in the preparatory problems are related to biomolecules, students are not expected to cover any biochemistry or carbohydrate chemistry as advanced topics.
- Inorganic reaction mechanisms.
- Molecular orbital diagrams of polyatomic molecules.

ii) Unless important, the reaction conditions such as solvent and temperature have not been shown on the arrows in the reaction schemes.

Practical

1. Use of a spectrophotometer (mono/double-wavelength measurements).
2. Basic techniques in organic synthesis: recrystallization, thin layer chromatography (TLC), filtration, and drying of precipitates following the described procedures.
3. Distillation and extraction.

Notes:

During the practical exam, students WILL NOT be expected to:

- ⇒ Determine meltingpoints.
- ⇒ Use a rotaryevaporator.
- ⇒ Handle and work up moisture-sensitive compounds (using syringes and balloons).
- ⇒ Perform column chromatography.
- ⇒ Produce the hydrogel system by polymerization through the experiments.

