

Exam 1

Ch. 13

IR—be able to evaluate which functional groups are in a molecule from the spectrum
Be able to predict the IR spectrum of a given molecule

Ch. 14

^1H and ^{13}C NMR—be able to systematically evaluate spectra for structure determination

Ch. 15

UV-visible spectroscopy—be able to identify chromophores and to explain how you can use UV to tell the difference in two compounds with varying degrees of conjugation
MS—be able to find the parent ion and the base ion, to determine if Cl or Br is present in the molecule, and to use simple fragmentation patterns for structure determination

Exam 2

Ch. 11

HCl and HBr addition to alkynes
and to conjugated dienes (know the mechanism)
Br₂ addition to alkynes
Kinetic vs. thermodynamic control of reactions
Carbene generation and addition to alkene
Epoxidation (know the mechanism)
Dihydroxylation
Ozonolysis with oxidative and reductive workup conditions
Click chemistry
Retrosynthetic analysis

Ch. 12

Naming aromatic compounds
Benzene, toluene, naphthalene, phenol, styrene, aniline, phenyl, benzyl,
ortho, meta, para
Naming aldehydes and ketones
Benzaldehyde, formaldehyde, acetaldehyde, acetone
Naming carboxylic acids
Formic acid, acetic acid, benzoic acid
Naming anhydrides
Acetic anhydride, benzoic anhydride
Naming esters, amides, and carboxylate salts
DMSO, TsOH
Table 12.3 priority order

Ch. 16

Aromaticity and antiaromaticity— $4n$ and $4n+2$
MOs for aromatics and antiaromatics

Ch. 17

EAS-chlorination, bromination, nitration, sulfonation, F-C alkylation, F-C acylation

Activating and deactivating groups, o,p and m directors

Know the mechanisms including resonance structures!

NAS-Sandmeyer reaction, addition/elimination reactions with highly ewg rings, benzyne

Additional reactions-Wolff-Kishner and KMnO_4 oxidation, nitro group reduction

Exam 3

Ch. 18

LiAlH_4 and NaBH_4 reduce aldehydes and ketones to alcohols

Hydrate formation with aldehydes (know the mechanism)

Grignard reagent and organolithium reagent generation

Organometallic reagent plus aldehyde/ketone gives alcohol (know the mechanism)

Plus CO_2 gives carboxylic acid (know the mechanism)

Wittig reaction

Imine formation (know the mechanism)

Enamine formation (know the mechanism)

Wolff-Kishner reduction of ketones to alkanes (know the mechanism)

Reductive amination (with NaCNBH_3)

Acetal formation (know the mechanism)

Enone with LAH gives ene/alcohol

Enone (aldehyde) with grignard/R-Li gives ene/alcohol

Cuprate with aldehyde or ketone gives 1,4-addition product

Retrosynthetic analysis

Ch. 19

Reactivity scale

Prep of acyl chlorides (carboxylic acid plus SOCl_2)

Prep of anhydrides (carboxylic acid plus acyl chloride)

Prep of esters

Alcohol plus acyl chloride or anhydride

Alcohol plus carboxylic acid, acid catalyzed (Fischer esterification) (know the mechanism)

$\text{S}_\text{N}2$, basic conditions

Transesterification

Prep of carboxylic acids

Acyl chloride/anhydride plus water

Ester hydrolysis, acid or base-catalyzed (know the mechanisms)

Amide hydrolysis, acid or base catalyzed (know the mechanisms)

Nitrile hydrolysis, rigorous conditions give CO_2H , milder acidic conditions give amide, basic conditions give carboxylate

Prep of amides (anhydride or acyl chloride plus amine)

LAH with

Carboxylic acid gives alcohol

Ester gives alcohol (know the mechanism)

Amide gives amine

Nitrile gives amine
DIBAL with
Ester gives aldehyde
Nitrile gives aldehyde
Grignard reagent with ester gives alcohol (w/2 identical groups) (know the mechanism)
Cuprate with acyl chloride gives ketone
Nitrile with Grignard gives ketone
Weinreb's amide with Grignard gives ketone

Ch. 20

Keto to enol tautomerism (acid and base catalyzed) (know the mechanism)
Ketone plus halogen gives alpha-halo ketone (via enol formation) (know the mechanism)
Ketone plus alkyl halide (know the mechanism)
Kinetic vs thermodynamic control in enolate formation
Active methylene compounds as nucleophiles
Decarboxylation of beta-carbonyl compounds
Dianion formation and reactions with dianions
Aldol condensations (with 2 of the same aldehydes, 2 different aldehydes, 1 aldehyde and 1 ketone) (know the mechanism)
Ester condensations (Claisen condensations with 2 of the same ester, 2 different esters, and intramolecular-Dieckman) (know the mechanism)
Enamine reactions
Michael additions

Ch. 21

Making radicals
Chain reaction mechanisms
Allylic and benzylic bromination
Radical bromination of alkenes (know the mechanism)
Dissolving metal reduction (Birch, enone reduction, triple bond reduction)

New after Exam 3

Ch. 22

MO theory, drawing MO diagrams
Electrocyclic reactions (disrotatory vs. conrotatory ring closures)
Cycloaddition reactions
Which are thermally and photochemically allowed?
Reactive vs unreactive dienes in Diels-Alder reactions
Reactive vs unreactive dienophiles in Diels-Alder reactions
Stereoselectivity in Diels-Alder reactions (endo vs. exo product formation, etc.)
Regioselectivity in Diels-Alder reactions
Sigmatropic rearrangements
Hydrogen migrations, alkyl group migrations, Cope and Claisen rearrangements
Which are allowed?
Which proceed with retention (and which with inversion) of configuration?

Ch. 23

Protecting groups for alcohols (acetals, ethers, silyl ethers, esters)

Protecting groups for aldehydes and ketones (acetals)

Protecting groups for carboxylic acids (esters)

Protecting groups for amines (amides, carbamates)

Retrosynthetic analysis