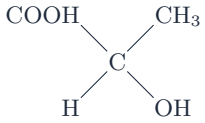
utfcode
utf8.sty 3.10 UTF-8 input encoding 13.06.2000
scanner for code UTF-8 installed.
3

I. STEREOCHEMISTRY & ISOMERISM

R/S Configuration (Cahn-Ingold-Prelog Rules)

1. Assign priorities by atomic number (Z) of directly attached atom.
2. In case of tie, compare atoms along chain at first point of difference.
3. Double/triple bonds are treated as multiple single bonds.
4. Position lowest priority group (4) away from viewer (dashed wedge).
5. $1 arrow 2 arrow 3$: Clockwise = **R**, Counter-Clockwise = **S**.



Fischer Projection

Enantiomers vs. Diastereomers

- **Enantiomers:** Non-superimposable mirror images. Opposite configuration at *all* stereocenters. Equal physical properties (except optical rotation $[\alpha]$).
- **Diastereomers:** Non-superimposable non-mirror images. Differ at one or more (but not all) stereocenters. Different physical properties.
- **Meso Compounds:** Contain stereocenters but possess an internal plane of symmetry (achiral, $[\alpha] = 0^\circ$).

$$\text{Total Stereoisomers} \leq 2^n \quad (n = \text{chiral centers})$$

II. NUCLEOPHILIC SUBSTITUTION

SN1 vs. SN2 Mechanism Comparison

Property	SN1	SN2
Kinetics	Rate $= k[RX]$	Rate $= k[RX][Nu]$
Steps	2 Steps (Carbocation)	1 Step (Concerted)
Substrate	$3^\circ > 2^o \gg 1^\circ$	$1^\circ > 2^o \gg 3^\circ$
Nucleophile	Weak (e.g., H_2O, ROH)	Strong (e.g., OH^-, CN^-)
Solvent	Polar Protic	Polar Aprotic
Stereochem	Racemization	Inversion (Walden)
Rearrange?	Yes (Carbocation shift)	No

E1 vs. E2 Elimination

- **Zaitsev Rule:** Highly substituted, more stable alkene dominates.
- **Hofmann Rule:** Less substituted alkene formed with bulky base (e.g., t-BuOK).
- **E2 Requirement:** Anti-periplanar geometry of H and Leaving Group.

$$\text{R}\text{—}\text{CH}_2\text{—}\text{CH}_2\text{—}\text{X} \xrightarrow[\text{-HX}]{\textbf{Base}} \text{R}\text{—}\text{CH}{=}\text{CH}_2$$

III. CARBOCATION INTERMEDIATES

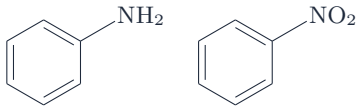
Stability Order

Benzylic ≈ Allylic > 3° > 2° > 1° > Methyl > Vinylic

Common Shifts

Directing Effects on Benzene Ring

Directing Group	Substituents
Ortho/Para Activators	$-OH, -NH_2, -OR, -R$ (Strong/Mod)
Ortho/Para Deactivators	$-F, -Cl, -Br, -I$ (Halogens)
Meta Deactivators	$-NO_2, -CN, -COOH, -CHO, -CF_3$



Ortho/Para Directing Meta Directing

VI. CARBONYL CHEMISTRY

Nucleophilic Acyl Addition vs Substitution

- **Aldehydes/Ketones:** Addition *arrow* Tetrahedral Intermediate *arrow* Alcohol.
- **Carboxylic Acid Derivatives:** Substitution *arrow* Tetrahedral Intermediate *arrow* Re-form Carbonyl + Leaving Group.

Reactivity: Acyl Chloride > Anhydride > Ester ≈ Carboxylic Acid > Amide

Key Named Reactions

1. Grignard Reaction

2. Aldol Condensation Enolate addition to carbonyl followed by dehydration to yield α, β-unsaturated carbonyl.

3. Wittig Reaction Converts Aldehyde/Ketone to Alkene via Phosphorus Ylide.

$$\mathrm{R_2C{=}O + Ph_3P{=}CR'_2 \longrightarrow R_2C{=}CR'_2 + Ph_3P{=}O}$$

VII. OXIDATION & REDUCTION MATRIX

Starting Material	Reagent	Product
1° Alcohol	PCC / CH_2Cl_2	Aldehyde
1° Alcohol	H_2CrO_4 (Jones)	Carboxylic Acid
2° Alcohol	PCC or H_2CrO_4	Ketone
Alkene	OsO_4/NMO	Syn-1,2-diol
Aldehyde / Ketone	$NaBH_4/EtOH$	1°/2° Alcohol
Ester / Acid	$LiAlH_4/Et_2O$	1° Alcohol
Nitro ($-NO_2$)	Fe/HCl or H_2, Pt	Amine ($-NH_2$)

height

VIII. SPECTROSCOPY CHEAT SHEET

^1H-NMR Chemical Shifts (ppm)

- **0.9 - 1.5:** Alkyl (CH_3, CH_2)
- **2.0 - 2.5:** Proton α to Carbonyl ($CH - C = O$)
- **3.3 - 4.5:** Proton attached to O or N ($CH - O$)
- **4.5 - 6.5:** Vinylic Protons ($C = C - H$)
- **6.5 - 8.5:** Aromatic Protons ($Ar - H$)
- **9.0 - 10.0:** Aldehyde Proton ($-CHO$)
- **10.5 - 12.0:** Carboxylic Acid Proton ($-COOH$)

IR Spectroscopy Key Absorptions (cm^{-1})

Functional Group	Wavenumber (cm^{-1})	Peak Shape
Alcohol ($O - H$)	3200 – 3600	Broad, Strong
Amine ($N - H$)	3300 – 3500	Medium, Sharp
Alkynyl ($C \equiv C - H$)	$\sim$ 3300	Sharp, Strong
Carbonyl ($C = O$)	1680 – 1750	Strong, Sharp
Alkene ($C = C$)	1620 – 1680	Medium
Nitro ($-NO_2$)	1350 & 1550	Strong (Two peaks)

height