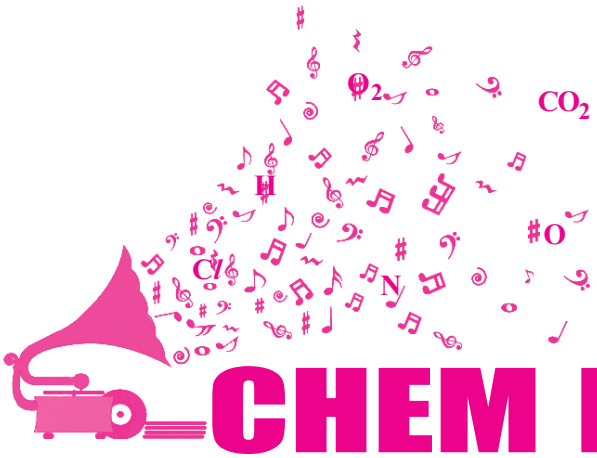


CHEM BEATS

- CHEM Beats are **confidence builders.**
- CHEM Beats are **confusion killers.**
- CHEM Beats makes you **love Chemistry**
- CHEM Beats Motivate you towards Basic concepts of each chapter.
- Every Day Life Conceptual Examples are cited here & there.
- Certain Concepts are correlated with some 'fun expressions'.
- Organic stories and story lines for organic terms and concepts.

ప్రియమైన లెక్చరర్స్ & స్టూడెంట్స్!

Organic Chemistry నిజంగా కష్టమా?

Organic Chemistry ను బోధించడం మరియు నేర్చుకోవడం అత్యంత క్లిష్టమైన విషయాలలో ఒకటిగా భావిస్తారు. విద్యార్థులు కనిపించని particles ను ఊహించాలి, abstract electron movements ను అర్థం చేసుకోవాలి, అలాగే అనేక mechanisms మరియు concepts ను ఒకేసారి గుర్తుంచుకోవాలి. సాంప్రదాయ teaching methods లో ఈ concepts ను విడివిడిగా definitions మరియు reactions రూపంలో జరుగుతుంటాయి. దీంతో learning యాంత్రికంగా అనిపించి, గుర్తుంచుకోవడం కష్టమవుతుంది. ఈ సమస్యను పరిష్కరించడానికి ఒక innovative approach ఇక్కడ ఉంది.

Story-Based Narrative Approach:

ఈ story-based narrative approach, Organic Chemistry లోని abstract concepts ను characters, events, మరియు relationships తో కూడిన జీవవంతమైన ప్రపంచంగా మార్చుతుంది.

ఈ method లో molecules వ్యక్తులుగా మారతాయి, reactions సంఘటనలుగా మారతాయి, electrons ప్రయాణికుల వలే ప్రవర్తిస్తాయి, mechanisms నాటకీయ ఘటనలు అవుతాయి.

Carbocations, free radicals, resonance, SN^1 మరియు SN^2 వంటి concepts కేవలం memorize చేయాల్సిన definitions గా కాకుండా, స్పష్టమైన behaviors మరియు motivations కలిగించే memorable characters గా మారతాయి.

BENEFITS FOR STUDENTS:

Organic Chemistry పై భయాన్ని తగ్గిస్తుంది: ఈ కథా విధానంలో క్లిష్టమైన topics సులభంగా మరియు ఆసక్తికరంగా మారతాయి.ఇది conceptual understanding ను మెరుగుపరుస్తుంది. Rote learning కి బదులుగా, reactions ఎందుకు జరుగుతాయో విద్యార్థులు stories లోని logical events తో అనుసంధానం చేసి అర్థం చేసుకుంటారు.

Memory Retention ను మెరుగుపరుస్తుంది: విడివిడిగా ఉన్న facts కంటే stories మానవ మేధస్సును సహజంగా ఎక్కువగా ఆకర్షిస్తాయి. Reaction వెనుక ఉన్న story గుర్తుండటం వల్ల విద్యార్థులు mechanisms ను సులభంగా recall చేయగలుగుతారు.

Visualization Skills ను పెంచుతుంది:

Mechanisms మరియు electron movements ను ఊహించడం మరియు అర్థం చేసుకోవడం సులభమవుతుంది.

Fast & better Revision : ఈ method ద్వారా students concepts ను వేగంగా revise చేయడమే కాకుండా, exams సమయంలో బాగా గుర్తుకు తెచ్చుకోగలరు.

BENEFITS FOR LECTURERS:

Classroom Engagement ను పెంచుతుంది: Creative, story-based narrative approach ద్వారా concepts బోధించినప్పుడు students చురుకుగా పాల్గొంటారు మరియు పాఠాలను శ్రద్ధగా వింటారు .

Hard Topics ను సులభతరం చేస్తుంది: Relatable analogies మరియు storytelling techniques ఉపయోగించి complex mechanisms ను సులభంగా Lecturers వివరించగలుగుతారు.

Active Learning ను ప్రోత్సహిస్తుంది: Reactions ను కేవలం memorized equations గా కాకుండా meaningful processes గా చర్చించడం Students ప్రారంభిస్తారు.

Conclusion: ఈ storytelling approach అనేది imagination మరియు science మధ్య ఉన్న అంతరాన్ని తగ్గిస్తుంది. Scientific accuracy ను తగ్గించకుండా chemistry ను మరింత మానవీయంగా చూపిస్తుంది. దీంతో Organic Chemistry కేవలం చదివే subject గానే కాకుండా, అనుభూతి చెందుతూ గుర్తుంచుకునే ప్రపంచంగా మారుతుంది.

Dear Faculty and Students!

Is Organic Chemistry really tough?

Organic Chemistry is often considered one of the most challenging subjects to teach and learn. Students are expected to visualize invisible particles, understand abstract electron movements, and remember numerous mechanisms and concepts simultaneously. Traditional teaching methods usually present these ideas through isolated definitions and reactions, which can make learning feel mechanical and difficult to retain. Here is an innovative approach to solve this issue.

The Story-Based Narrative Approach:

The story-based narrative approach to Organic Chemistry transforms abstract concepts into a living world of characters, events, and relationships. In this method, molecules become personalities, reactions become events, electrons behave like travelers, and mechanisms unfold like dramatic stories. Concepts such as carbocations, free radicals, resonance, SN^1 and SN^2 are no longer mere definitions to memorize; they become memorable characters with clear behaviors and motivations.

BENEFITS FOR STUDENTS:

Reduces Fear of Organic Chemistry: Complex topics become approachable and enjoyable. It enhances conceptual understanding. Instead of rote learning, students understand why reactions occur by relating them to logical events within the story.

Improves Memory Retention: Stories naturally engage the human brain better than isolated facts. Students can recall mechanisms more easily because they remember the "story" behind the reaction.

Boosts Visualization Skills: Mechanisms and electron movements become easier to imagine and understand.

Makes Revision Faster and More Effective: This method helps students revise quickly and remember concepts better during exams.

BENEFITS FOR LECTURERS:

Creates Better Classroom Engagement: Students listen more attentively and participate more actively when concepts are presented through a creative, story-based narrative approach.

Simplifies Difficult Topics: Lecturers can explain complex mechanisms using relatable analogies and storytelling techniques.

Encourages Active Learning: Students begin discussing reactions as meaningful processes rather than memorized equations.

Conclusion: Ultimately, this storytelling approach bridges the gap between imagination and science. It humanizes chemistry without compromising scientific accuracy, making Organic Chemistry not just a subject to study, but a world to experience and remember.

1) SOLUTIONS

Our Daily LIFE

CHEM BEATS!

- 3 Types of Solutions Offered to **GOD** in Prayer Hall:
- అగరుబత్తి, సాంబ్రాణి – ధూప నైవేద్యం – **Gaseous Solution!**
- తులసి తీర్థం, పంచామృతం – ద్రవ రూప నైవేద్యం – **Liquid Solution!!**
- పులిహోర, చక్రపొంగలి ప్రసాదం – ఘన రూప నైవేద్యం – **Solid Solution!!!**
- **MOLARITY:** 1 లీటరు నీళ్ళలో ఎంత బెల్లం కలుపుతారో అదే ఆ పానకం యొక్క **Molarity!**
- **MOLALITY:** 1 కేజీ తైలంలో ఎంత సుగంధ కర్పూరం కలుపుతారో అదే ఆ సుగంధద్రవ్యపు **Molality!!**
- **MOLE FRACTION:** 'బూంది మిక్చర్' లో కలిపిన జీడిపప్పులకు మిగిలిన పప్పులకు గల నిష్పత్తే జీడిపప్పు యొక్క **Mole Fraction!!!**

Molarity కి **best Example:** 'సాంబారులో వేసే ఉప్పు'. ఉప్పు ఎక్కువైనా బాగోదు, తక్కువైనా బాగోదు!

- టీ, కాఫీలలో షుగర్/ టీ, కాఫీ పొడి ఎక్కువైనా, తక్కువైనా అది మనకు రుచించదు కదా!
- **Tea, Coffee** లకు సరైన **Taste** అనేది షుగర్/ పౌడర్‌లను సరైన మోతాదులో కలిపే Concentration ద్వారానే వస్తుంది!

☺**Solution Chapter** ని బాగా వంట పట్టించుకున్నవారు పాకశాస్త్ర ప్రావీణ్యులౌతారు!☺

- For Non-diabetic; Range of Glucose Concentration in Blood : 3.9 m Mol/L(70mg/dL) to 5.6m Mol/L(100mg/dL).

2) ELECTRO CHEMISTRY

Our Daily LIFE

CHEM BEATS!

We used to 'Charge our Mobile Phone' for its regular usage.
While Charging our Phone, Electrical Energy is converted into Chemical Energy!
While using a Phone, Chemical Energy stored in the battery is converted into Electrical Energy!!

- చేతికున్న Watch లో Battery!
- నిత్యం వాడే సెల్‌ఫోన్‌లో Battery!
- ఫోటోలు తీసే డిజిటల్ కెమెరాలో Battery!
- చేతిలోని T.V. Remote Control లో Battery!
- నడిపే Bike లో బ్యాటరీ, తిరిగే Car లో Battery!

- Battery వాడకమే Electro Chemistry- యొక్క Basic Application!
- Ofcourse మన Body Cells లోని Cell Membranes లో నిరంతరం

Na^+, Cl^-, H^+ ions ల మధ్య Electro Chemical Reactions జరుగుతుంటాయి !!

- రంగు రంగుల కలర్‌ఫుల్ **Bike Paints, Car Paints** లలో Electrolysis!
- **Pure Gold** ను మరిపించే అందమైన **Rold Gold** ఆభరణాల తయారీలో Electrolysis!!
- Chemical Industry లో Chlorine, NaOH తయారీ, Bauxite నుండి Aluminium తయారీ,

Copper Purification Process.... వీటన్నింటిలోనూ Electrolysis Process జరుగుతుంది!!!

3) CHEMICAL KINETICS

Our Daily LIFE

CHEM BEATS!

• ప్రస్తుత స్పీడ్ యుగంలో పనులన్నీ 'స్పీడ్‌స్పీడ్'గా జరిగిపోవాలని నిత్యం అనేకమంది 'ఆత్రం' పడుతుంటారు.

• మన సెల్‌ఫోన్ బ్యాటరీ **Fast** గా ఛార్జింగ్ అవ్వాలి !

• మనం తిన్న **Food** ఫాస్ట్‌గా **Digestion** కావాలి!

• వచ్చిన జబ్బుల నుండి 'త్వరగా' కోలుకోవాలి!

• బట్టలకు పట్టిన మురికి 'వెంటనే' తొలిగిపోవాలి!

• జుట్టుకి వేసిన **Hair dye** 'ఎక్కువ రోజులు' ఉండాలి!

• ఫ్రిడ్జ్ లో ఉంచిన ఆహారం 'ఎక్కువ కాలం' చెడిపోకుండా ఉండాలి!

• **Obesity** ఉన్న వారు డైటింగ్, ఎక్సర్‌సైజ్ ప్రారంభించిన వెంటనే వేగంగా బరువు తగ్గాలి!

ఇలా రోజువారీ జరిగే నిత్యకృత్యాలలో కొన్ని **Speed** గా జరగాలి మరికొన్ని **Slow** గా జరగాలి!

ఇటువంటి విషయాలను **Micro Level** లో వివరించి, విశ్లేషించే రసాయనశాస్త్ర విభాగమే **CHEMICAL KINETICS!**

4) d&f BLOCK ELEMENTS

Our Daily LIFE

CHEM BEATS!

• **d-Block:** It's the **SOLID MALE** Metal Block

• It's the **Most Colourful CCC Block:** Catalysts, Coloured, Complexes!

• It's the Medal Block: Gold Medal Metal Au(79); Silver Medal Metal Ag(47); Bronze Medal Alloy Cu(29)

ఈ మూడు కూడా **d-Block** లోని **11th Group** లో ఒకదానికింద ఉండటం ఎంత అద్భుతమో!

• It's the 'Most Premium Block' : Costliest Metals Platinum, Gold, Silver ఇవన్నీ ఇందులోనే....

• It's the 'Heavy Weight Metal Block' : పెద్దపెద్ద Bridges, Trains, Skyscrapers లలో వాడే Steel Alloy.....

• **f-Block- FOOT** Block

ఇందులోని Special Elements:

Most **Useful Nuclear Fuel** Element **Uranium (92)** ,

World Famous and Favourite Scientist **Einstein** పేరుగల **Einstenium Es (99)**,

Most Popular, Amazing Number 100 **Fermium(Fm)**

సమస్త భూమండలాన్ని నాశనం చేయగలిగేంత **Powerful Atom Bomb** లో వాడే

Plutonium, Uranium లు అన్నీ **f-Block** లో ఉన్నాయి.

ORGANIC STORIES-1

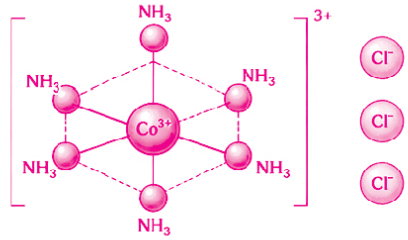
5) COORDINATION COMPOUNDS

The story of the Kingdom of Metal Ion Co (III) and His Inner Court - by Werner

In a lilliput microscopic kingdom, there lived a powerful ruler known as **King Metal Ion (Cobalt)**. He was not an ordinaryKing—he had a special ability to attract and hold loyal companions called **ligands**. These neutral travelers like ammonia or ligands could be warriors like chloride ions . However, the kingdom had a strict system, established long ago by the wise scholar **Werner**, who discovered the rules governing the King's court.

The Two Circles of Loyalty:

According to Werner's laws, King Metal Ion (Co) used to maintain **two types of attachments**:



Octahedral geometry (coordination number = 6)

1. **Primary Valency (Outer Court):**
   These are like the King's outer allies (associates).
   They are attached to the King outside loosely.
   They are ready to depart easily if needed.
   They determine the **ionizable part** of the compound.
2. **Secondary Valency (Inner Court):**
   These are the King's most trusted companions. They form the **inner circle**, directly bonded to the King. This group was fixed in number and it determines the **coordination number** of the central metal ion (the King Co)
   Ex: In the court of King Cobalt $[Co(NH_3)_6]Cl_3$, the six ammonia molecules stay close in the inner court, while three chloride ions remain outside (ready to leave when needed).
3. **Shapes of the Royal Court:**
   The inner court wasn't random—it followed strict geometric patterns:
   When the King has **6 ligands**, they are arranged themselves in an **octahedral shape**, like guards surrounding the King in all directions. With **4 ligands**, they could form a **tetrahedral** or **square planar** structure.This arrangement gives each kingdom its **unique structure and identity**.
4. **Mysterious Colours of the Kingdom:**
   One of the most fascinating properties of these kingdoms is their **vivid colours** like
   deep blue (Cu^{2+}), Purple (Ti^{2+}) , Violet(V^{2+})
   The King maker Werner explains that these colors arise due to the interaction between the King and his inner court—when light strikes the compound, certain wavelengths are absorbed, and the remaining light reflects the compound its color.
5. **Isomerism: Twin Kingdoms:**
   Sometimes, two Kingdoms have the same composition but look different. These are called **isomers**.
   In **geometrical isomerism**, ligands are arranged differently around the King (like cis and trans)
   In **optical isomerism**, two structures were mirror images, like left and right hands.
   Though similar in formula, their properties differed—just like twins with different personalities.
6. **Stability of the Kingdom:** The strength of the inner court determines how stable the kingdom was. Stronger bonds mean the ligands stay more loyal, while weaker ones allow easy exchange. This stability explains why some coordination compounds are highly reactive, while others remain unchanged for long periods.

☛ **Just a five minute study of this Illustrative Image Map leads you from confusion to clarity.**

The Kingdom of King Cobalt

A Story of Coordination Compounds

- Explained by Werner's Theory

In a tiny Kingdomof atoms and ions, there lived a powerful ruler named **King Cobalt (III)**

He was surrounded by loyal companions called **ligands.**

Some stayed very close to him, while others remained in the outer court.

1. Two Circles of Loyalty (Werner's Theory)

Secondary Valency (Inner Court)

The King's most trusted companions stay close and are directly bonded to him. Their number is fixed and is called the **coordination number.**

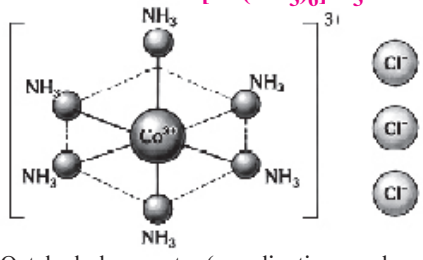
Primary Valency (Inner Court)

The outer allies are loosely held and readily leave. They balance the charge and are ionizable

$[Co(NH_3)_6]Cl_3$

- **6 NH_3** molecules are in the inner court (secondary valency)
- **3Cl^-** ions are in the outer court (primary valency)

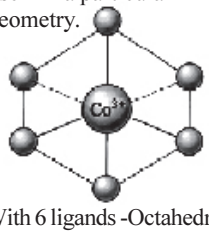
Structure of $[Co(NH_3)_6]Cl_3$



Octahedral geometry (coordiantion number=6)

2. Shapes of the Royal Court

The inner court arranges itself in a particular geometry.



With 6 ligands -Octahedral (Like 6 guards surrounding the King in all directions)

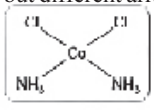
3. Mysterious Colors of the Kingdom

When light enters the Kingdom, some colors are absorbed due to interaction between the king and his inner court. The rest of the colors are reflected, and the compound appears colored.

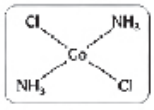
$[Co(NH_3)_6]Cl_3$ appears in **Violet** colour.

4. Isomerism – Twin Kingdoms

Sometimes, two kingdoms have the same opposition but different arrangements



cis-$[Co(NH_3)_4Cl_2]^+$



trans-$[Co(NH_3)_4Cl_2]^+$

Same formula, different arrangement, different properties.

5. Stability of the Kingdom

The strength of the bonds between the King and his inner court decides the Stability of the Kingdom.

Strong inner bonds → Stable Kingdom
Weak bonds → easy to react (exchange of ligands)

Thus, King Cobalt and his court teach us that the structure and properties of coordiantion compounds follow perfect rules.

Werner's Legacy

Werner's theory brought order to this microscopic kingdom by explaining:

• Primary and Secondary Valency • Coordiantion Number
• Geomertical arrangement of ligands.

Because of his work, coordination chemisty became a well organized and predictable world

- the **Kindgom of King Cobalt.**

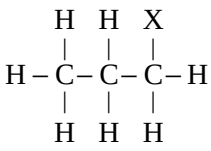
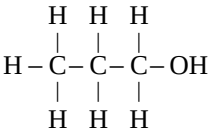
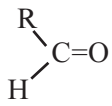
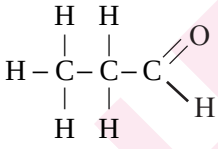
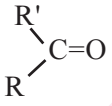
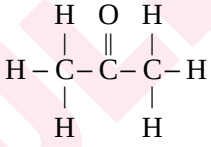
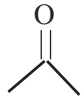
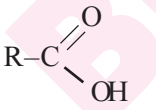
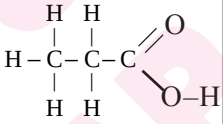
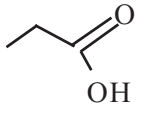
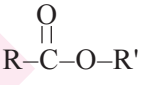
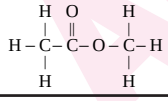
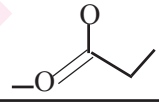
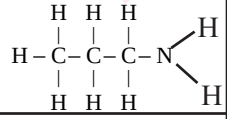
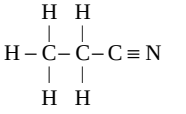
Co³⁺ = King Cobalt (III)
NH₃ = Loyal ligand (inner court)
Cl⁻ = Outerally (ionizable)
— = Strong bond (inner)
---- = Coordinate bond

Conclusion:

Thus, the story of King Metal Ion (Co) and his court beautifully explains the **structure and properties of coordination compounds**. Through Werner's vision, what once seemed mysterious became a well-organized kingdom governed by clear rules.

ORGANIC CHEMISTRY - FUNDAMENTALS

I) ILLUSTRATIVE TABLE OF FUNCTIONAL GROUPS

Functional Group	General Formula	Structural Formula	Displayed Formula	Skeletal Formula	Example
Alkylhalides (Haloalkanes)	$C_nH_{2n+1}–X$ $C_3H_7–X$	R–X			Propylhalide Halopropane $C_3H_7–X$
Alcohols (Alkanols)	$C_nH_{2n+1}–OH$ C_3H_7OH	R–OH			Propylalcohol Propan-1-ol $CH_3CH_2CH_2OH$
Aldehydes (Alkanals)	$C_nH_{2n+1}–CHO$ C_2H_5CHO				Propanaldehyde Propanal CH_3CH_2CHO
Ketones (Alkanones)	$C_nH_{2n}O$ C_3H_6O				Acetone propanone CH_3COCH_3
Carboxylic acids (Alkanoic acids)	$C_nH_{2n+1}COOH$ C_2H_5COOH				Propanoic acid CH_3CH_2COOH
Esters (Alkanoates)	$C_nH_{2n}O_2$ $C_3H_6O_2$				Methylacetate Methylethanoate
Amines (Alkanamine)	$C_nH_{2n+1}NH_2$ $C_3H_7NH_2$	$R–NH_2$			Propylamine Propanamine $CH_3CH_2CH_2NH_2$
Cyanides (Nitriles)	$C_nH_{2n+1}CN$ C_2H_5CN	R–C≡N			Propanitrile Ethylcyanide CH_3CH_2CN

The Four Core Functional Groups

1. **Hydrocarbon groups(C&H only):** a) Alkanes(–C–C–), b)Alkenes (–C=C–),c)Alkynes (–C≡C–)
2. **Halogen groups:** a) Halo alkanes(R-X) b) Halo arenes (Ar-X)
3. **Oxygen Functional Groups:** a) Alcohols (R-OH) & Phenols (Aromatic), Ethers (R-O-R')
   b) Aldehydes (R-CHO); Ketones (R–(C=O)–R') c) Carboxylic acids (R–COOH)
4. **Nitrogen Functional Groups:** a) Amines ($R-NH_2$) b) Cyanides (R-CN)
   c) Isocyanides (R-N≡C) d) Nitrogroup ($R-NO_2$)

II) 12 IMP. TERMS WITH ORGANIC STORY LINES

1. **Substrate:** The **substrate** is the organic molecule on which a reaction takes place.
It usually contains a functional group or reactive site.
It is the molecule that is attacked by a reagent (like a nucleophile or electrophile).
Ex: In the reaction CH_3 Br + OH^- → CH_3OH + Br^-, the **substrate** is CH_3Br.

ORGANIC STORY LINES

SUBSTRATE – The Target Person/ The main character

One day, a wealthy nobleman named **Sir Substrate** walked through the market carrying valuable treasures called functional groups.
Everyone in the city wants to join with him. All reactions (attacks) happens on him.
Memory Tip: Substrate = Subject of attack

2. **Intermediate:** A **reaction intermediate** is a short-lived, unstable species that exists between reactants and products. It forms during a chemical reaction.
Ex: Carbocations, carboanions, free radicals.
Stability of Intermediates:
Carbocations: 3° > 2° > 1° > CH_3^+; **Carbanions:** CH_3^- > 1° > 2° > 3°;
Free Radicals: 3° > 2° > 1°> CH_3^-
Memory Tips: i) Intermediate = In the middle, temporary. ii)Stability decides reaction pathway

ORGANIC STORY LINES

INTERMEDIATE – The Temporary Guest/ The temporary traveller

During reactions, some special guests appear only for a short time and then disappears.
They are like travelers who stay at an inn during a long journey.
They were neither reactants nor final products.
- Not all Kings survive.
- Strong Kings (3° carbocations) survive easily
- Weak ones vanish quickly

Memory Tip: Stability = Survivality.

3. **Bond Cleavage:** It is the breaking of a covalent bond, which can occur in two ways
i) Homolytic cleavage: Equal splitting → forms free radicals
ii) Heterolytic cleavage: Unequal splitting→forms ions (carbocation & carbanion)

ORGANIC STORY LINES

BOND CLEAVAGE – The Breaking Scene/ The Great Separation

In Chemistry City, one stormy night, a bond begins to break between two atoms by sharing of electrons. The bond breaks in two possible ways:
Equal breakup (Homolytic): Two atoms share equally. Each atom takes one electron.
Like two brothers dividing inheritance equally.A–B→ $A^\bullet$ + $B^\bullet$. This creates Free Radicals.
Unequal breakup (Heterolytic): One atom selfishly takes both electrons.The other atom becomes electron-deficient. A–B→ A^+ + B^- This creates carbocation, carbanion.
Memory Tip: Homo = Equal sharing →radicals; Hetero = Unequal → two types of ions

4. **Carbocation:** A **carbocation** is a positively charged carbon species in which the carbon atom has only six electrons in its valence shell (electron-deficient). **Ex:** CH_3^+

ORGANIC STORY LINES

CARBOCATION – The Electron-Deficient King/ The Electron-Hungry King

After heterolytic cleavage, King Carbon sometimes loses electrons.

He becomes positively charged **(Ex:** CH_3^+ .) He has only 6 electrons; an empty orbital; great hunger for electrons, So he constantly searches for electron-rich friends.

Stability of Carbocation: The King becomes more stable when surrounded by supportive alkyl groups.

Order: $3^o > 2^o > 1^o > CH_3^+$

The neighboring alkyl groups donates electron density through Inductive Effect and Hyperconjugation.

Memory Tip: Carbocation = Positive & Poor (needs electrons)

5. **Carbanion:** A **carbanion** is a negatively charged carbon species where the carbon atom has an extra pair of electrons (electron-rich). **Ex:** CH_3^-

ORGANIC STORY LINES

CARBANION – The Electron-Rich Rebel

Sometimes Carbon grabs extra electrons. Then he carries a negative charge with a lonepair.

Carbanion has excess electrons; So, he is rich but unstable. He donates electrons easily.

At the same time, He hates electron donating neighbours.

So stability order gets reversed: **Order:** $CH_3^- > 1^o > 2^o > 3^o$

Memory Tip: Carbanion = Negative & Rich (has extra electrons)

6. **Free Radical:** A **free radical** is a neutral species containing an unpaired electron, making it highly reactive. **Ex:** $CH_3^\bullet$

ORGANIC STORY LINES

FREE RADICAL – The Half-Electron Fighter/ The Lone Warrior

From homolytic cleavage, mysterious warriors emerged called Free Radicals.

They carried one unpaired electron: $Cl^\bullet$

These radicals are highly reactive; aggressive; short-lived

Like warriors they desperately search for a partner electron.

Memory Tip: Radical = Single (unpaired) electron

7. **Addition Reactions:** Addition reactions occur when atoms or groups are added to a molecule, typically across a **double or triple bond**, forming a saturated compound.

Ex: $CH_2 = CH_2 + H_2 \rightarrow CH_3 - CH_3$

ORGANIC STORY LINES

ADDITION REACTION – The Joining Party/ The Opening Gate

The Open Gate:

This is like opening a gate and allowing guests inside.

One day a double bond appeared in the chemistry city wall.

The wall had: one sigma bond, one weak pi bond

The weak pi bond easily broke and open.New atoms entered and attached.

Two atoms added across the double bond. Unsaturated compounds became saturated.

Memory Tip: Addition = Add more, break a bond; Double bond breaks - more atoms attach.

8. **Elimination Reactions:** Elimination reactions involve the removal of two atoms or groups from a molecule, usually forming a **double or triple bond**.

Ex: $CH_3 - CH_2 - Br \rightarrow CH_2 = CH_2 + HBr$; Loss of HBr creates a double bond.

ORGANIC STORY LINES

ELIMINATION REACTION – The Escape and the Birth of Double bond

Sometimes **Bases** force neighboring molecules/ atoms to leave. A small molecule escapes.

Hydrogen departs and halogens depart.A **double bond emerges**.

Thus alkenes were born through **Dehydrohalogenation**

Memory Tip: Addition and elimination are opposites.

Addition breaks bonds while elimination makes bonds (double)

9. **Substitution Reactions:** **Substitution reactions** involve the replacement of one atom or group in a molecule by another atom or group.

Ex: $CH_3Cl + OH^- \rightarrow CH_3OH + Cl^-$

ORGANIC STORY LINES

SUBSTITUTION REACTION – The Replacement Ceremony

In Organo City, sometimes one group simply replaces (substitutes) another.

One group kicks out another and takes its place.No change in structure type, just replacement.

Memory Tip: Substitution = Someone leaves, someone takes seat

10. Nucleophies & Electrophiles:

Nucleophile: A **nucleophile** is a chemical species that donates a pair of electrons to form a covalent bond (electron-rich). **Ex:** OH^-, CN^-, NH_3, H_2O

Electrophile: An **electrophile** is a chemical species that accepts a pair of electrons to form a covalent bond (electron-deficient). **Ex:** H^+, NO_2^+, $AlCl_3$, $FeCl_3$

ORGANIC STORY LINES

NUCLEOPHILES Vs ELECTROPHILES(Attack of Warriors):

Nucleophile (Nu^-): Electron-rich Donor attacks (OH^-, NH_3)

Electrophile (E^+): Electron-poor Acceptor accepts (H^+, NO_2^+)

Memory Tip: Rich attacks poor.

11. Nucleophilic Substitution Reactions (SN^1 & SN^2):

SN^1 (Unimolecular): Two-steps, carbocation forms, favoured by 3° substrates. [3°>2°>1°]

SN^2 (Bimolecular): One-step, backside attack, favoured by 1° substrates [1°>2°>3°]

Memory Tip: SN^1, SN^2 are seen mostly in Haloalkanes & Haloarenes

ORGANIC STORY LINES

SN^1 — The Two-Step Royal Drama

• SN^1 Gate (Front gate - Wide- Two entry checks) → slow, wide for fat Kings (3°)

Step 1: The leaving group (LG) leaves **slowly** from the substrate.

Step 2: A nucleophile attacks **fastly** on the carbocation and replaces LG.

This is like, King leaving the throne first, then a new minister occupying it.

SN^2 — The One-Step Assassin Attack

SN^2 Gate (Back gate - narrow - only one entry check) → fast, narrow for thin king. (1°)

Here nucleophile attacks instantly from the backside while leaving group departs simultaneously.

SN^2 is like an assassin pushing one guard out while entering at the same moment.

Memory Tip: SN^1 for fat King (3°); SN^2 for thin King (1°)

12. Electronic Effects (Inductive Effect , Resonance,Hyperconjugation):

Everything in organic chemistry depends on **how electrons move.**

Memory Tip: Electronic effects govern stability, acidity, reactivity.

12.1 Inductive Effect: The **inductive effect** is the permanent displacement of sigma (σ) electrons along a carbon chain due to differences in electronegativity of atoms or groups.

ORGANIC STORY LINES

INDUCTIVE EFFECT – The Pull & Push game/ The Magic of Pulling/ Pushing

In Organo School, some student atoms of a section I are greedy for electrons. Others are generous. In that class, some students are holding hands in a line (σ-bonds).

At one end, a very greedy student (high electronegativity) starts pulling electrons.

The pull spreads along the chain line, but gets weaker with distance.

During this pulling action the places of some student atoms changes permanently.

Pulling students → –I effect (electron-withdrawing)

Pushing students → +I effect (electron-donating)

Memory Tip: Inductive = Influence through chain. Vanishes after 3 carbon atoms.

12.2 Resonance: Resonance is the delocalization of electrons within a molecule.

Here the actual structure is a hybrid of two or more contributing structures (resonance forms).

ORGANIC STORY LINES

RESONANCE – The Place Changing game/ The Magic of Delocalisation

In Organo School, the student electrons enter the library. The library master is Mr. **Resonance.**

He observed that a group of electron students do not always sit in a particular place.

They spread over multiple places.

This type of spreading and sharing of electron density is named Resonance.

Here atoms (sitting tables) never move—only electrons shift.

Memory Tip: Resonance = Many structures, one real molecule

12.3 Hyperconjugation: Hyperconjugation is the delocalization of σ-electrons (usually C–H or C–C) into an adjacent empty or partially filled p-orbital, which stabilizes the molecule.

It is simply a **no bond resonance.**

ORGANIC STORY LINES

HYPERCONJUGATION – The Silent Supporters/ The Whispering Stabilizers

Near carbocation Palace there lived alkyl groups.

They secretly donate electron density through adjacent sigma bonds.

They don't fully move, but share electron density slightly. This makes the situation more stable.

This invisible stabilization is called **Hyperconjugation.**

Scientists called it: "no-bond resonance."

More alkyl groups → more hyperconjugation→ greater carbocation stability.

That is why tertiary carbocations are strongest.

Memory Tip: Hyperconjugation = Hidden help from nearby C–H bonds

ORGANIC STORIES-2

The SN^1 Story

Substitution Nucleophilic Unimolecular Mechanism

The two step attack:

Imagine a crowded party where **a King carbon atom (C)** is standing at the centre , surrounded by his close associates. One of those associates is a leaving group (LG), who has been feeling a bit unstable.

As the party begins, the bond between carbon and LG starts to weaken.

LG gets ready to leave & leaves slowly.This is the **slow step** and **rate-determining step.**

What happens now?

The central carbon (C) worried a little. It becomes a **carbocatio**n, positively charged .

It is like the host of the party suddenly losing an important guest and feeling incomplete.

The Carbocation's Struggle:

Being electron-deficient, the carbocation now looks around desperately for a companion.

It looks for someone to share electrons with it.

Meanwhile, in the crowd, a nucleophile (Nu^-) notices this positively charged carbon and thinks, *"Hey, I can help stabilize you!"*

The Rescue Operation: The nucleophile approaches (attacks very fast) and bonds with the carbocation.This is the **fast step.** Now the King carbon is happy again, with a new friend replacing the old leaving group.

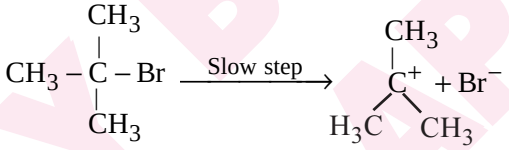
Extra Twist: Rearrangement (Sometimes!)

Sometimes, before the nucleophile arrives, the carbocation may rearrange itself (like shifting position to become more stable - secondary to tertiary, etc.).

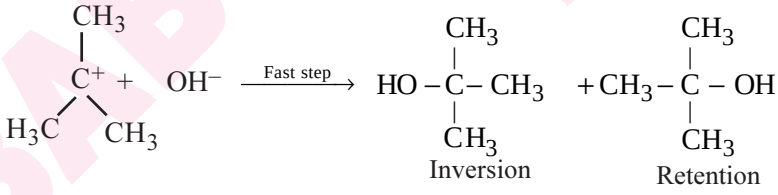
It's like moving to a more comfortable spot at the party before accepting a new guest.

SN^1 Mechanism

Step 1: Formation of Carbocation from alkyl bromide molecule. (Slow step)



Step 2: Attack of the Nucleophile on the Carbocation.(Fast step)



Summary Points of the Story

1. Organic King Carbon arranges a Party. **2.** Leaving group (LG) leaves

3. Carbocation forms (unstable intermediate - slow setp) **4.** Nucleophile attacks (fast step)

5. Inversion or Retention of configuration takes place.

6. Rate of reaction depends only on the concentration of substrate (unimolecular).

7. $3^o > 2^o > 1^o > CH_3X$

8. SN^1 occurs in tertiary carbons (most stable carbocation)

9. Changes of rearrangements are there.

ORGANIC STORIES-3

The SN^2 Story

Substitution Nucleophilic Bimolecular Mechanism

The One-Step Attack:

Imagine that the King carbon atom standing in a small open field, holding hands with a leaving group (LG-X(Br)). Suddenly, from the *backside*, a strong and determined nucleophile (Nu^- – OH^-) observes the situation and says: "I'can't wait, I'm coming in Now!"

The Direct Attack:

Unlike SN^1, there is no waiting here. The nucleophile doesn't wait until LG leaves.

Instead, it reaches (attacks) the carbon from the backside (opposite side) while LG is still attached.

What happens now?

The bond between carbon and nucleophile starts forming

The bond between carbon and LG starts breaking

It's like a simultaneous **push-and-pull action.**

The Transition Moment:

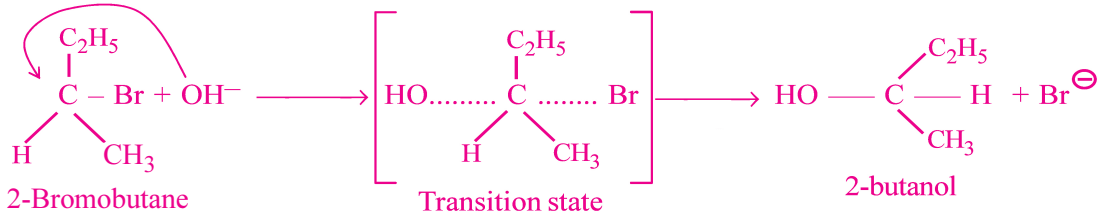
For a brief instant, the carbon is in a strange situation: Partially bonded to both Nu^- and LG

It's in a highly unstable state called the **transition state.**

Think of it like a **tug-of-war** where both sides are pulling at the same time.

The Inversion Twist: LG finally leaves, the nucleophile occupies (substitues) its place, but with a twist!. The structure **flips like an umbrella** turning inside out . This is called **Walden inversion.**

SN^2 Mechanism



Summary Points of the Story

1. Organic King Carbon stands in a small open field. **2.** Leaving group is always in a dilemma.

3. Nucleophile (Nu^-, OH^-) observes the situation and attacks from backside.

4. Bond formation & bond breaking happen simultaneously.

5. No intermediate carbocation is formed. **6.** Leaving group quits.

7. Transition state is formed for a moment (no intermediate).

8. Inversion of configuration occurs due to backside attack.

9. Rate of reaction depends on the concentration of both substrate and nucleophile (Bimolecular)

10. $CH_3X > 1^o > 2^o > 3^o$

11. SN^2 occurs with primary carbons (less steric hindrance)

III)FOUR CORE CHAPTERS AT A GLANCE

1) Haloalkanes 2) Alcohols 3) Aldehydes 4) Amines

I) BASICS OF FOUR CORE FUNCTIONAL GROUPS

Naming	Haloalkanes	Alcohols	Aldehydes	Amines
Common Name (Example)	Alkyl Halide C_2H_5Cl (Ethyl chloride)	Hydroxy(OH) C_2H_5OH (Ethyl alcohol)	Carboxyl(CHO) HCHO (Formaldehyde)	Alkylamine CH_3-NH_2 (Methylamine)
IUPAC Name (Example)	Haloalkane (Chloroethane)	Alkanol (Ethanol)	Alkanal (Methanal)	Alkamine (Methanamine)
Representation	R-X	R-OH	R-CHO/HCHO	R-NH_2
Sub-classification	Haloarenes	Phenols Ethers	Ketones Carboxylicacids	Alkylamines

II) PROPERTIES COMPARISON TABLE

Property	Haloalkanes	Alcohols	Aldehydes	Amines
Polarity	C–X polar	OH– highly polar	C=O strong polar	Polar (due to lone pair)
Stability	R–F > Cl > Br >I	3° > 2° > 1° (carbocation)	Ketone > Aldehyde	Depends on medium
Acidity	Very weak	1° > 2° > 3°	Weak (–H)	Basic (not acidic)

III) CORE REACTIONS OF FOUR GROUPS

Haloalkanes	Alcohols	Aldehydes	Amines
• Substitution SN^1/SN^2 • Elimination E_1/E_2	• Oxidation • Dehydration • Esterification	• Nucleophilic addition • Oxidation • Reduction	• Alkylation • Acylation • Diazotization

IV) USES

	Haloalkanes	Alcohols	Aldehydes	Amines
Main uses	Solvent Refrigerant	Sanitizer Cosmetics	Preservative Flavor	Dyes Medicines
Examples	Chloroform ($CHCl_3$) Freon	Ethanol Glycerol	Formaldehyde Vanillin	Aniline

"Halogen pulls, OH bonds, Carbonyl attracts, Nitrogen donates"

6) HALOALKANES & HALOARENES (H&H)

CHEM BEATS!

ORGANIC STORIES-4

THE KINGDOM OF HALOALKANES & HALO ARENES

The Land of Leaving Groups (LG)

1. Welcome to Haloalkane Soldiers:

In Chemistry City, halogens (Cl, Br, I) enter and attach to people.

If they attach to a simple chain (alkane)→ Haloalkane

If they attach to a benzene ring (royal circle) → Haloarene

Trick: Alkane = open chain, Arene = aromatic ring

2. Nature of the Bond (Polar C–X Bond):

Halogens(X) are greedy (electronegative) and they pull electrons.

Carbon becomes slightly positive (δ^+)

Halogen becomes negative (δ^-)

Order of Polarity: R–F >R–Cl >R–Br >R–I

Trick: Halogen pulls → Carbon becomes target

3. Leaving Group – The Exit Specialist:

Halogens are good at leaving the molecule.

$I^- > Br^- > Cl^- > F^-$ (best to worst)

Order of B.P: R–I >R–Br >R–Cl >R–F

Trick: Big halogen = better leaver

4. Main Attack – Nucleophilic Substitution(SN^1, SN^2):

A nucleophile (electron-rich attacker) enters the city and attacks the substrate.

Two styles:

SN^1 – Two Step Attack:

Step 1: First halogen leaves → carbocation forms.

Step 2: Then nucleophile attacks.

Trick: SN^1 = 1 slow step (carbocation).

SN^2 – Direct Attack:

Step 1: One-step attack from backside.

Fast in primary compounds.

Trick: SN^2 = 2 together (one step)

5. Competing Fight – Elimination (E_1 & E_2):

Instead of substitution, atoms may leave and form a double bond.

$E_1 \rightarrow$ via carbocation.

$E_2 \rightarrow$ one-step elimination.

Trick: Elimination = Exit $\rightarrow$ Double bond.

6. Special Case – Haloarenes (The Royal Rings):

In the Benzene Palace :

Halogen is strongly attached.

Due to resonance, bond becomes stronger. So substitution is very difficult.

Trick: Haloarene = Resistant due to resonance.

7. Activating & Deactivating Effects:

Halogens have dual behavior:

–I effect $\rightarrow$ withdraw electrons.

+R effect $\rightarrow$ donate via resonance.

Direct substitution to ortho & para positions.

Trick: Halogen: withdraws but still directs.

8. Important Reactions (City Events):

Wurtz Reaction: Two haloalkanes join$\rightarrow$ bigger alkane .

Hydrolysis: Haloalkane + water $\rightarrow$ alcohol.

Grignard Reagent: Haloalkane + Mg$\rightarrow$ Ether very reactive com

9. Daily life uses:

- **Chloroform ($CHCl_3$):** Earlier used as anesthetic; now mainly solvent in labs.
- **Freons (CFCs)**: Used in refrigerators &AC's(now restricted due to ozone depletion).
- **DDT (Dichloro-diphenyl-trichloroethane):** Powerful insecticide (now banned/restricted).
- **Teflon (PTFE)**: Non-stick coating in cookware.

10. ULTRA-FAST REVISION TIPS:

Haloalkane$\rightarrow$ Halogen + chain

Haloarene$\rightarrow$ Halogen + benzene

C–X bond$\rightarrow$Polar

Order of B.P of LG :

- I > Br > Cl > F
- $SN^2 \rightarrow$ One step
- Haloarene $\rightarrow$Less reactive
- $SN^1 \rightarrow$Carbocation
- $E_1/E_2 \rightarrow$Elimination
- Direction $\rightarrow$ Ortho/Para

FINAL MASTER STORY

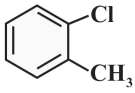
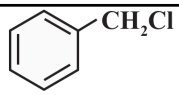
In Chemistry City, Halogens attach to chains (haloalkanes) or rings (haloarenes).

They pull electrons making carbon positive, then act as leaving groups (LG).

Nucleophiles attack via SN^1 or SN^2, or elimination forms double bonds.

In benzene palace, resonance makes halogens hard to replace but still directs reactions.

Common and IUPAC Names of Some Halides

Structure	Common Name	IUPAC Name
$CH_3CH_2CH(Cl)CH_3$	sec-Butyl chloride	2-Chlorobutane
$(CH_3)_3CCH_2Br$	neo-Pentyl bromide	1-Bromo-2,2-dimethylpropane
$(CH_3)_3CBr$	tert-Butyl bromide	2-Bromo-2-methylpropane
$CH_2 = CHCl$	Vinyl chloride	Chloroethene
$CH_2 = CHCH_2Br$	Allyl bromide	3-Bromopropene
	o-Chlorotoluene	1-Chloro-2-methylbenzene(or) 2-Chlorotoluene
	Benzyl chloride	Chlorophenylmethane
CH_2Cl_2	Methylene chloride	Dichloromethane
$CHCl_3$	Chloroform	Trichloromethane
$CHBr_3$	Bromoform	Tribromomethane
CCl_4	Carbon tetrachloride	Tetrachloromethane
$CH_3CH_2CH_2F$	n-Propyl fluoride	1-Fluoropropane

Nucleophilic Substitution of Alkyl Halides (R–X)

Reagent	Nucleophile (Nu^-)	Substitution product (R-Nu)	Class of main product
NaOH/KOH	OH^-	ROH	Alcohol
H_2O	H_2O	ROH	Alcohol
NaOR′	$R'O^-$	ROR′	Ether
NaI	I^-	R—I	Alkyl iodide
NH_3	NH_3	RNH_2	Primary amine
R′ NH_2	R′ NH_2	RNHR′	Sec. amine
R′ R″ NH	R′ R″ NH	RNR′R″	Tert. amine
KCN	$\bar{C} \equiv N:$	RCN	Nitrile (cyanide)
AgCN	Ag–CN:	RNC(isocyanide)	Isonitrile
KNO_2	O=N—O	R—O—N=O	Alkyl nitrite
$AgNO_2$	Ag—Ö—N=O	$R—NO_2$	Nitroalkane
R′ COOAg	R′ COO^-	R′COOR	Ester
$LiAlH_4$	H^-	RH	Hydrocarbon
R′– M^+	R'^-	RR′	Alkane

7) ALCOHOLS, PHENOLS & ETHERS (APE)

CHEM BEATS!

ORGANIC STORIES-5

THE KINGDOM OF OH GROUP

The Realm of Oxygen Spirits

1. The Arrival of –OH (The Hydroxy Guest):

A special guest –OH group enters the chemistry city.

On a chain → Alcohols (The friendly Citizens).

On a benzene ring → Phenols (The wise Scholars).

Between two carbons→ Ethers (R–O–R') (The Bridges).

Trick: OH decides identity: Chain = Alcohol, Ring = Phenol, Bridge = Ether

2. Nature of OH Bond – The Polar Power:

Oxygen is greedy.

Pulls electrons→ makes bond polar.

Forms hydrogen bonding.

Trick: Oxygen pulls→ strong bonding & high boiling point.

3. Hydrogen Bonding – The Sticky Network:

Alcohol people hold hands strongly.

Leads to: High boiling point.

Good solubility in water.

Trick: More H-bond = more stickiness.

4. Acidity Battle – Who Gives H^+ Easily:

A competition happens:

Phenol wins → more acidic.

Alcohol loses → less acidic.

Reason: Phenol's negative charge is stabilized by resonance.

Trick: Phenol = Powerful acid (due to resonance).

5. Reactions of Alcohols – The Busy Worker:

Alcohol is very active:

Substitution →forms haloalkane.

Dehydration→ forms alkene.

Oxidation → forms aldehyde/ketone/acid.

Trick: Alcohol = Substitute, Eliminate, Oxidize.

6. Phenol Reactions – The Activated Ring

In benzene palace:

–OH activates the ring strongly

Reactions happen easily at: Ortho, Para

Trick: Phenol = Super active director (o, p)

7. Ethers – The Silent Bridge:

Ethers are calm and quiet

Mostly non-reactive

Act like a bridge between two carbons.

But strong acids (HI, HBr) can break them.

Trick: Ether = Easy (less reactive)

8. Special Events in the City:

Williamson Ether Synthesis → Makes ethers

Lucas Test → Distinguishes alcohol types

Kolbe Reaction (Phenol) → Forms acids

9. Daily life uses:

- **Ethanol (C_2H_5OH):** Hand sanitizers, beverages, disinfectant.
- **Methanol (CH_3OH) :** Fuel, antifreeze, industrial solvent.
- **Glycerol (Glycerin):** Cosmetics, soaps, medicines.

10. ULTRA-FAST REVISION TIPS :

Alcohol →R–OH

Phenol → Ar–OH

Ether→R–O–R

H-bond →High boiling point

Phenol > Alcohol (acidity)

Alcohol → Oxidation, dehydration, substitution

Phenol → Ortho/para directing

Ether → Least reactive

FINAL MASTER STORY

In Chemistry City, the –OH group creates alcohols on chains, phenols on rings, and ethers as bridges.Oxygen pulls electrons forming strong hydrogen bonds.

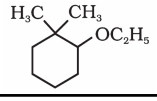
Phenol becomes more acidic due to resonance.

Alcohols react actively (substitution, elimination, oxidation), phenols activate the ring for substitution, while ethers stay calm unless broken by strong acids."

Common and IUPAC Names of Some Alcohols

Compound	Common name	IUPAC name
$CH_3–OH$	Methyl alcohol	Methanol
$CH_3–CH_2–CH_2–OH$	n-Propyl alcohol	Propan-1-ol
$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_3$	Isopropyl alcohol	Propan-2-ol
$CH_3–CH_2–CH_2–CH_2–OH$	n-Butyl alcohol	Butan-1-ol
$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_2-CH_3$	sec-Butyl alcohol	Butan-2-ol
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-OH$	Isobutyl alcohol	2-Methylpropan-1-ol
$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\vert}{C}}}}-OH$	tert-Butyl alcohol	2-Methylpropan-2-ol
$HO–H_2C–CH_2–OH$	Ethylene glycol	Ethane-1,2-diol
$\underset{\displaystyle OH}{\underset{\vert}{CH_2}}-\underset{\displaystyle OH}{\underset{\vert}{CH}}-\underset{\displaystyle OH}{\underset{\vert}{CH_2}}$	Glycerol	Propane -1, 2, 3-triol

Common and IUPAC Names of Some Ethers

Compound	Common name	IUPAC name
CH_3OCH_3	Dimethyl ether	Methoxymethane
$C_2H_5OC_2H_5$	Diethyl ether	Ethoxyethane
$CH_3OCH_2CH_2CH_3$	Methyl n-propyl ether	1-Methoxypropane
$C_6H_5OCH_3$	Methyl phenyl ether (Anisole)	Methoxybenzene (Anisole)
$C_6H_5OCH_2CH_3$	Ethyl phenyl ether (Phenetole)	Ethoxybenzene
$C_6H_5O(CH_2)_6–CH_3$	Heptyl phenyl ether	1-Phenoxyheptane
$CH_3O-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$	Methyl isopropyl ether	2-Methoxypropane
$C_6H_5-O-CH_2-CH_2-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$	Phenyl isopentyl ether	3- Methylbutoxybenzene
$CH_3–O–CH_2–CH_2–OCH_3$	—	1,2-Dimethoxyethane
	—	2-Ethoxy- -1,1-dimethylcyclohexane

8) ALDEHYDES, KETONES & CARBOXYLIC ACIDS

CHEM BEATS!

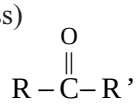
ORGANIC STORIES-6

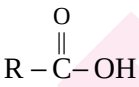
THE EMPIRE OF CARBONYL POWER

1. The Arrival of C=O (The Carbonyl Boss):

A powerful boss enters the city: C=O (carbonyl group).

At end of chain (–CHO) →Aldehyde (The reactive Princess)

In middle (–C=O–) → Ketone (The Stable Generals) 

With –COOH group → Carboxylic Acid (The Acid Queens) 

Trick: End = Aldehyde, Middle = Ketone, with COOH = Acid

2. Nature of Carbonyl – The Polar Center:

Oxygen pulls electrons strongly

Carbon becomes δ+ (positive).

Oxygen becomes δ– (negative). So, carbon is attacked by nucleophiles.

Trick: Carbonyl carbon = attack center.

3. Main Reaction – Nucleophilic Addition:

Nucleophiles attack the carbonyl carbon.

Double bond breaks → new atoms add.

Trick: Carbonyl = Addition hotspot.

4. Aldehyde vs Ketone – The Race

Two competitors:

Aldehyde (faster): Less crowd→ more reactive.

Ketone (slower): More crowd→ less reactive.

Trick: Aldehyde = open & fast, Ketone = crowded & slow.

5. Oxidation & Reduction – The Transformation Game

Reactions change identity:

1° Alcohol (on oxidation) → Aldehyde on oxidation →Carboxylic Acid

$$1^{o}\text{ Alcohol} \underset{R}{\overset{[O]}{\rightleftharpoons}} \text{Aldehydes} \underset{R}{\overset{[O]}{\rightleftharpoons}} \text{Carboxylic acid}$$

2° Alcohol (on oxidation) → Ketones (on oxidation) →Carboxylic Acid

$$2^{o}\text{ Alcohol} \underset{R}{\overset{[O]}{\rightleftharpoons}} \text{Ketones} \underset{R}{\overset{[O]}{\rightleftharpoons}} \text{Carboxylic acid} + CO_2$$

Trick: Aldehyde goes forward (oxidation), Ketone resists

6. Carboxylic Acid – The Strong Queen:

The queen of acidity

Easily gives H^+ (acidic)

Stabilized by resonance (carboxylate ion)

Forms strong dimers (H-bonding)

Trick: COOH = acidic & stable

7. Important Reactions of Acids:

Carboxylic acids perform:

Esterification (The Royal Marriage - Alcohols & Carboxylic acids) → forms esters

Decarboxylation → removes CO_2

Salt formation → soaps

Trick: Acid = Ester, CO_2, loss, Salt maker

8. Famous Tests (City Detectives):

Tollens' Test → Silver mirror (aldehydes)

Fehling's Test → Red ppt (aldehydes)

Ketones usually don't respond

9. Daily Life Uses:

- **Formaldehyde (HCHO / Formalin):** Preserving biological specimens
- **Vanillin:** Artificial vanilla flavor
- **Benzaldehyde:** Almond fragrance (perfumes & flavoring)

10. ULTRA-FAST REVISION:

Aldehyde→R–CHO

Ketone→ R–CO–R

Acid →R–COOH

C=O → Polar

Reaction → Nucleophilic addition

Reactivity → Aldehyde > Ketone

Oxidation → Aldehyde→ Acid

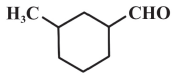
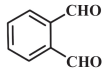
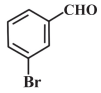
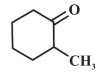
Acid → Strong, H-bonded

Esterification → Key reaction

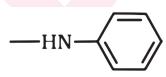
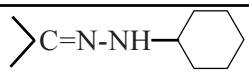
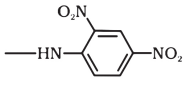
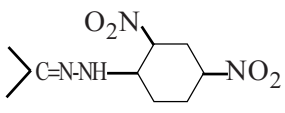
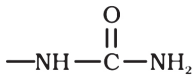
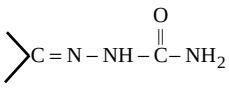
FINAL MASTER STORY

"In Chemistry City, the carbonyl group creates aldehydes at the end, ketones in the middle, and acids with COOH.The carbonyl carbon becomes positive and attracts nucleophiles for addition reactions.Aldehydes react faster than ketones.Aldehydes oxidize to acids, while acids act as strong, stable proton donors forming esters and salts."

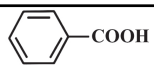
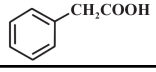
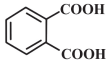
Common and IUPAC Names of Aldehydes and Ketones

Structure	Common name	IUPAC name
ALDEHYDES		
HCHO	Formaldehyde	Methanal
CH_3CHO	Acetaldehyde	Ethanal
$(CH_3)_2CHCHO$	Isobutyraldehyde	2-Methylpropanal
	γ-Methylcyclohexanecarbaldehyde	3-Methylcyclohexanecarbaldehyde
$CH_3CH(OCH_3)CHO$	α-Methoxypropionaldehyde	2-Methoxypropanal
$CH_3CH_2CH_2CH_2CHO$	Valeraldehyde	Pentanal
$CH_2=CHCHO$	Acrolein	Prop-2-enal
	Phthaldehyde	Benzene-1,2-dicarbaldehyde
	m-Bromobenzaldehyde	3-Bromobenzenecarbaldehyde or 3-Bromobenzaldehyde
KETONES		
$CH_3COCH_2CH_2CH_3$	Methyl n-propyl ketone	Pentan-2-one
$(CH_3)_2CHCOCH(CH_3)_2$	Diisopropyl ketone	2,4-Dimethylpentan-3-one
	α-Methylcyclohexanone	2-Methylcyclohexanone
$(CH_3)_2C=CHCOCH_3$	Mesityl oxide	4-Methylpent-3-en-2-one

N-Substituted Derivatives of Aldehydes and Ketones (>C=N-Z)

Z	Reagent name	Carbonyl derivative	Product name
-H	Ammonia	>C=NH	Imine
-R	Amine	>C=NR	Substituted imine (Schiff 's base)
—OH	Hydroxylamine	>C=N-OH	Oxime
$—NH_2$	Hydrazine	$>C=N-NH_2$	Hydrazone
	Phenylhydrazine		Phenylhydrazone
	2,4-Dinitrophenyl-hydrazine		2,4 Dinitrophenyl-hydrazone
	Semicarbazide		Semicarbazone

Carboxylic acids along with common and IUPAC names

Structure	Common name	IUPAC names
HCOOH	Formic acid	Methanoic acid
CH_3COOH	Acetic acid	Ethanoic acid
CH_3CH_2COOH	Propionic acid	Propanoic acid
$CH_3CH_2CH_2COOH$	Butyric acid	Butanoic acid
$CH_3(CH_2)_3COOH$	Valeric acid	Pentanoic acid
$(CH_3)_2CHCOOH$	Isobutyric acid	2-Methylpropanoic acid
HOOC-COOH	Oxalic acid	Ethanedioic acid
HOOC $-CH_2-$COOH	Malonic acid	Propanedioic acid
HOOC $-(CH_2)_2-$COOH	Succinic acid	Butanedioic acid
HOOC $-(CH_2)_3-$COOH	Glutaric acid	Pentanedioic acid
HOOC $-(CH_2)_4-$COOH	Adipic acid	Hexanedioic acid
HOOC-CH_2-CH(COOH)-CH_2-COOH	Tricarballylic acid or carballylic acid	Propane-1, 2, 3-tricarboxylic acid
	Benzoic acid	Benzenecarboxylic acid (Benzoic acid)
	Phenylacetic acid	2-Phenylethanoic acid
	Phthalic acid	Benzene-1, 2-dicarboxylic acid

Order of acidic strength:

$CF_3COOH > CCl_3COOH > CHCl_2COOH > NO_2CH_2COOH > NC\text{-}CH_2COOH > FCH_2COOH > ClCH_2COOH > BrCH_2COOH > HCOOH > ClCH_2CH_2COOH > C_6H_5COOH > C_6H_5CH_2COOH > CH_3COOH > CH_3CH_2COOH$

9) AMINES

CHEM BEATS!

ORGANIC STORIES-7

THE KINGDOM OF AMINES

The World of Nitrogen Minds

1. Entry of Nitrogen (The NH_2 Guest):

A new guest enters Chemistry City: Nitrogen ($-NH_2$)

Attached to one carbon (1R) → Primary amine (1°)

Two carbons (2R)→Secondary (2°)

Three carbons (3R) →Tertiary (3°)

On chain → Alkyl amine

On benzene → Aryl amine (aniline)

Trick: Count carbons (R's) = type of amine

2. Nature of Amines (The Lone Pair Scholars) :

Nitrogen has a lone pair of electrons .

Makes amines basic (they accept H^+).

They behave like nucleophiles.

Trick: Amine = Base (lone pair ready)

3. Basicity Battle (The power of electron donation) – Who is Stronger?

Competition happens:

In aqueous solution: $2° > 1° > 3° > NH_3$ (In the presence of CH_3 group)

Gas phase: $3° > 2° > 1° > NH_3$

Aromatic amines (aniline) are less basic.

Because lone pair is involved in resonance.

Trick: More availability of lone pair = more basic.

4. Effect of Resonance (Aryl Amines):

In benzene palace:

Nitrogen shares its lone pair with the ring.

So it becomes less available.

Trick: Resonance hides lone pair→ less basic.

5. Reactions of Amines – The Active Player:

Amines do many reactions:

Alkylation → H is replaced by alkyl group.

Acylation → form amides

Carbylamine reaction→ foul smell (test for 1° amine)

Trick: Amine = Adds groups easily.

6. Special Tests (City Detectives):

Hinsberg Test → distinguishes 1°, 2°, 3° amines.

Carbylamine Test → only 1° amines give smell.

Diazotization (aryl amines)→ forms diazonium salt.

Diazonium Magic (Aryl Amines Special Power).

7. Aryl amines have special powers:

Form **diazonium salts** (The frozen warriors).

Can convert into Dyes, Halides,Phenols.

Trick: Diazonium = Transformation master.

8. Daily life uses:

- Aniline ($C_6H_5NH_2$)-Used in dyes, rubber, pharmaceuticals.
- Amines (general) -Used in medicines, drugs, agrochemicals.
- Azo dyes (colour festival) derived from amines- Used for textile coloring.

9. ULTRA-FAST REVISION:

Amine →–NH_2, Types → 1°, 2°, 3°

Nature→ Basic (lone pair)

Basicity → 2° > 1° > 3°

Aniline → Less basic (resonance)

Reactions → Alkylation, Acylation

Tests → Hinsberg, Carbylamine

Diazonium →Very important

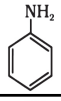
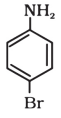
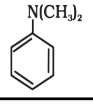
FINAL MASTER STORY

"In Chemistry City, nitrogen enters as amines (1°, 2°, 3°).Its lone pair makes it basic and reactive. Alkyl groups increase basicity, but resonance in aromatic amines reduces it. Amines undergo alkylation and acylation, while aryl amines form powerful diazonium salts for multiple transformations."

ONE-LINE MASTER MEMORY

"Amines are basic nitrogen compounds whose lone pair controls reactivity, decreases with resonance, and enables powerful transformations via diazonium salts."

Common & IUPAC Names of Alkylamines and Arylamines

Amine	Common name	IUPAC name
$CH_3-CH_2-NH_2$	Ethylamine	Ethanamine
$CH_3-CH_2-CH_2-NH_2$	n-Propylamine	Propan-1-amine
$CH_3-\underset{\displaystyle NH_2}{\underset{\vert}{CH}}-CH_3$	Isopropylamine	Propan-2-amine
$CH_3-\underset{\displaystyle H}{\underset{\vert}{N}}-CH_2-CH_3$	Ethylmethylamine	N-Methylethanamine
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{N}}-CH_3$	Trimethylamine	N,N-Dimethylmethanamine
$C_2H_5-\underset{\displaystyle C_2H_5}{\underset{\vert}{N}}-\overset{1}{CH_2}-\overset{2}{CH_2}-\overset{3}{CH_2}-\overset{4}{CH_3}$	N,N-Diethylbutylamine	N,N-Diethylbutan-1-amine
$NH_2-\overset{1}{CH_2}-\overset{2}{CH}=\overset{3}{CH_2}$	Allylamine	Prop-2-en-1-amine
$NH_2-(CH_2)_6-NH_2$	Hexamethylenediamine	Hexane-1,6-diamine
	Aniline	Aniline or Benzenamine
	o-Toluidine	2-Methylaniline
	p-Bromoaniline	4-Bromobenzenamine or 4-Bromoaniline
	N,N-Dimethylaniline	N,N-Dimethylbenzenamine

The Final Verdict of The Four Kindgoms

As centuries passed, scholars realized the four kingdoms were deeply connected.
Haloalkanes created **alcohols and amines.**
Alcohols transformed into **aldehydes and acids.**
Acids reacted with **alcohols to form esters.**
Amines and **acids** formed **amides.**
Carbonyl compounds welcomed **nucleophilic attacks.**
Resonance, inductance, and hyperconjugation controlled stability everywhere.
Thus, organic chemistry was not a collection of separate chapters;
It was one grand interconnected civilization — a world where **atoms** behaved like rulers, warriors, scholars, rebels, and travelers, all **governed** by the **movement of electrons.**

ORGANIC STORIES-8

10. BIOMOLECULES

THE TALE OF BIOMOLECULES -The Kingdom of LIFE

Deep inside every living cell, there existed a grand kingdom called **Life.**
This kingdom was ruled not by kings or warriors—but by six powerful families in the country called **Biomolecules**, each with a unique role that kept the kingdom alive & strong.

Family 1: The Sugar Soldiers (Carbohydrates)

- The first inhabitants were the Carbohydrates—the **energy providers.**
- The smallest units were monosaccharides (like glucose)
- They join to form disaccharides and polysaccharides
- These sugars were like **food packets** for the kingdom.
- **Starch** → stored energy;**Glycogen** →quick energy reserve**; Cellulose** → strong walls

Thumb Rule: Carbohydrates = Energy + Structure

Family 2: The Builders (Proteins)

- Next came the Proteins, the **builders** and **workers** of the kingdom.
- Made of amino acids; joined by peptide bonds; folded into complex shapes
- They built everything Muscles, Enzymes, Transport systems

Thumb Rule: Proteins = Structure + Function

Family 3: The Magical Catalysts - The accelerators of our body bikes (Enzymes) .

- Among proteins, a special group emerged-the Enzymes.
- They were enthusiastic youth who speed up reactions without being consumed.
- They follow **lock-and-unlock key;** Sensitive to temperature & pH
- Without them… the kingdom would **'slow** to a **stop'.**

Thumb Rule: Enzymes = Accelerators of life

Family 4: The Tiny Guardians (Vitamins)

- Small but powerful, the Vitamins act as protectors.;Need in tiny amounts; Help enzymes function well.
- **Two groups:**Water-soluble (B, C); Fat-soluble (A, D, E, K)
- If vitamins miss → diseases kiss.

Thumb Rule: Vitamins = Helpers (to enzymes) + Protectors (from diseases)

Family 5: The Royal Library (Nucleic Acids)

- At the center of the kingdom stood a grand library named **DNA & RNA**
- **DNA** stores all genetic information (Hereditary) ; **RNA** helps execute them.
- **Made of nucleotides:** Sugar + Base + Phosphate

Thumb Rule: DNA = Information & RNA = Action

Family 6: The Messengers (Hormones)

- Finally came the Hormones—the kingdom's messengers.
- **They travel through blood delivering signals:**
- Insulin → controls sugar; Adrenaline →emergency response

Thumb Rule: Hormones = Communication messengers.

Family characteristics of Biomolecules

- Carbohydrates **give energy**; Proteins **build & work** ; Enzymes **speed up reactions**
  Vitamins **protect**; DNA **stores information**; Hormones **communicate**

ULTIMATE LIFE LINE

Energy→ Build→ Speed→Protect →Store→ Signal = LIFE