

B.Sc Semester – IV MJC – 6(T) Organic Chemistry
Unit – I Alcohols, Phenols , Esters and Epoxides
GLYCEROL : PREPARATION, PROPERTIES AND USES

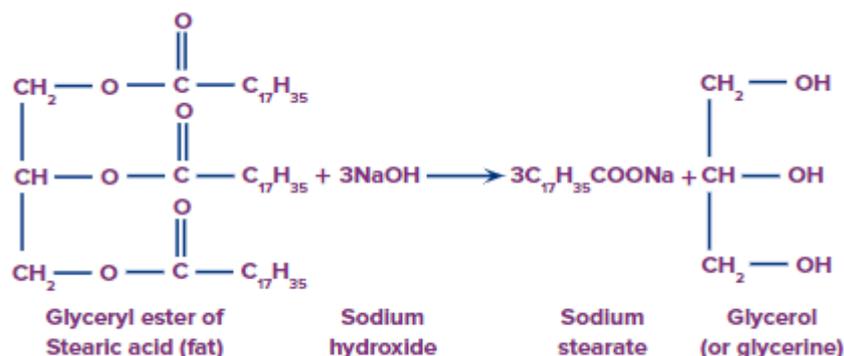
Methods of Preparation of Glycerol

1. Hydrolysis of Oils and Fats (Saponification)

This is the most common industrial method, where natural fats or oils (triglycerides) are hydrolyzed to produce soap and glycerol.

- **Reaction:** Oil/Fat + Water/NaOH → Soap + Glycerol
- **Process:** The process occurs in the presence of an alkali (NaOH). Glycerol is separated from the "spent lye" (liquor) by fractional distillation under reduced pressure.

Saponification is the procedure used to create soaps. Triglycerides are commonly used to prepare soaps, which are long carbon chains of fatty acids formed when they are combined with sodium or potassium hydroxides. The process of turning oils and fats into soaps by the action of aqueous alkalis is known as saponification. Alcohol and fatty acid salts are produced using alkalis like KOH and $NaOH$. The following generic equation represents the saponification reaction:



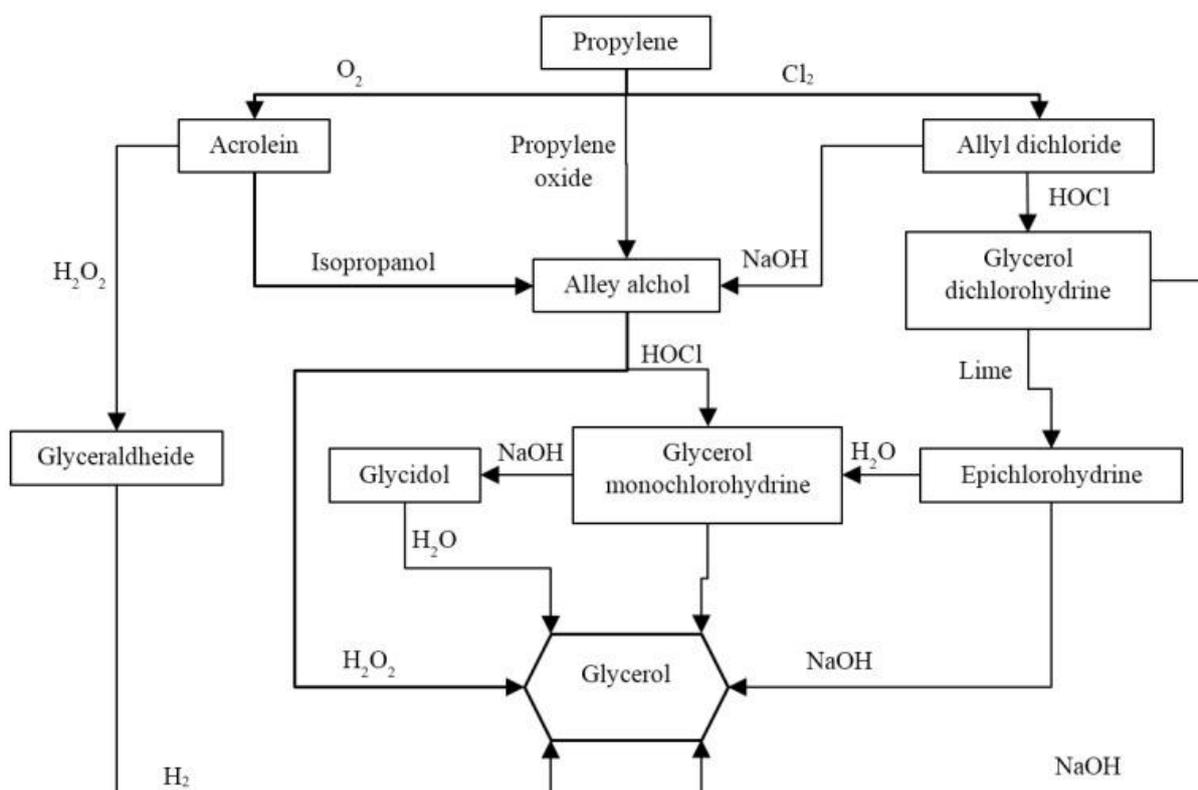
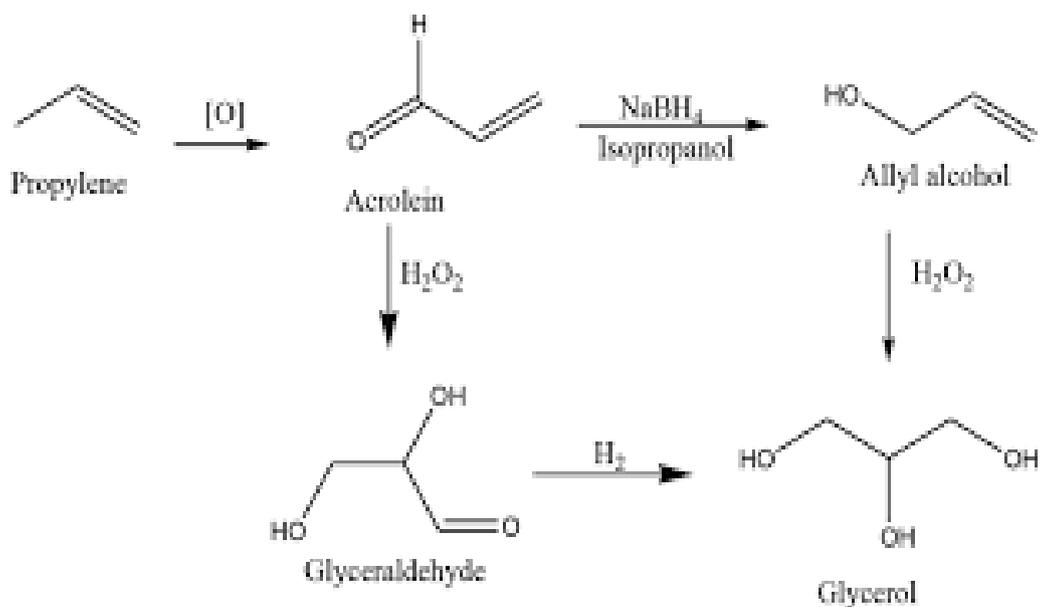
Saponification is a hydrolysis process, according to the aforementioned reaction. In the process of saponification, a hydroxide breaks the ester link between fatty acids and the triglyceride glycerol, resulting in the creation of free fatty acids and glycerol.

Triglycerides in fat and oil are transformed into soap and glycerol when they interact with aqueous $NaOH$ or KOH . This process is known as esters' alkaline hydrolysis. The Saponification Process is the name given to this reaction since it results in the production of soap.

2. From Propylene (Synthetic Method)

This is a modern synthetic route starting from propylene, a petroleum derivative.

- **Step 1 (Allyl Chloride Formation):** Propylene is treated with chlorine at high temperatures (about 500°C) to produce allyl chloride.
- **Step 2 (Hydrolysis):** Allyl chloride is hydrolyzed with sodium hypochlorite to yield glycerol.

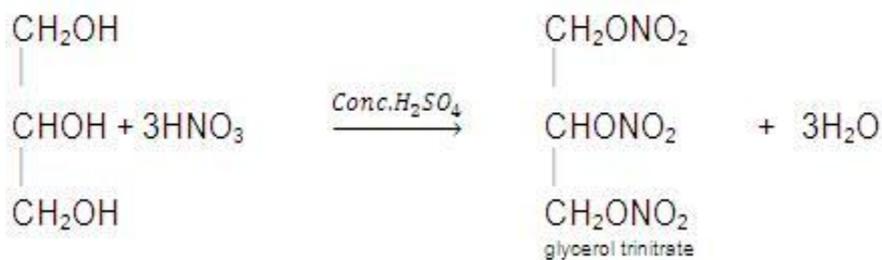


Physical Properties

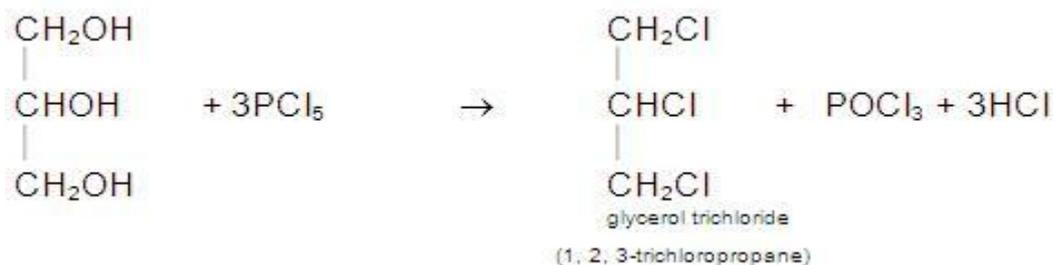
- **Formula:** $\text{C}_3 \text{H}_8 \text{O}_3$
- **Structure:** Trihydric alcohol (Propane-1,2,3-triol)
- **Nature:** Colorless, sweet-tasting, non-toxic, and viscous liquid
- **Solubility:** Highly soluble in water due to hydroxyl ($-\text{OH}$) groups

Chemical Reactions (BSc 2nd Year)

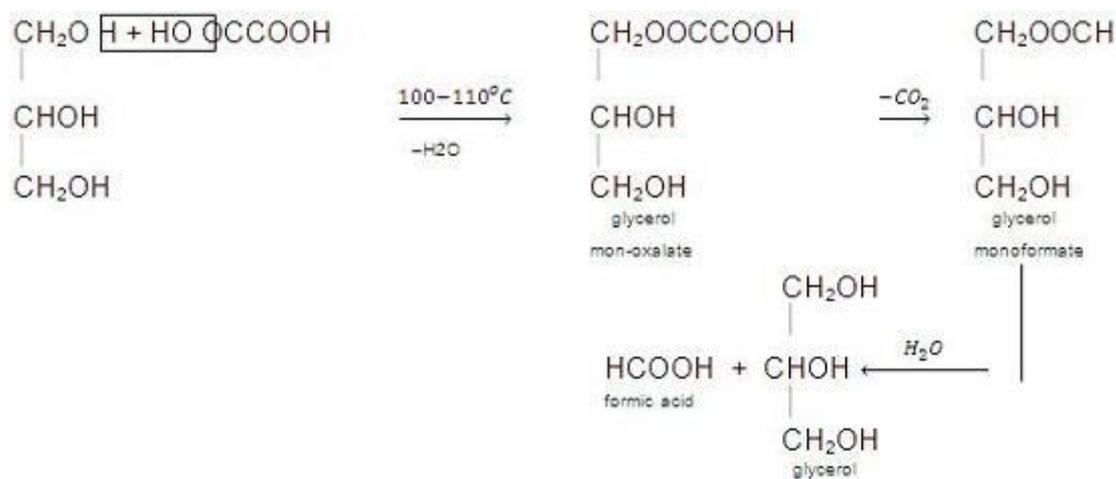
- **Reaction with HNO_3 :** Forms glycerol trinitrate (nitroglycerin), a known explosive.



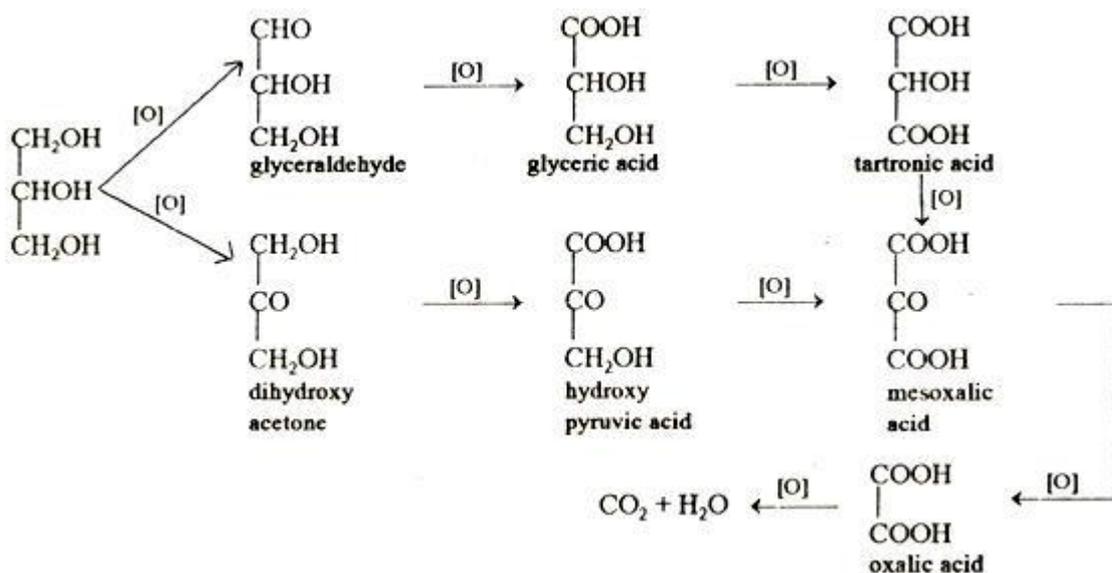
- **Reaction with PCl_5** : Replaces $-\text{OH}$ groups with Chlorine to form glycerol trichloride.



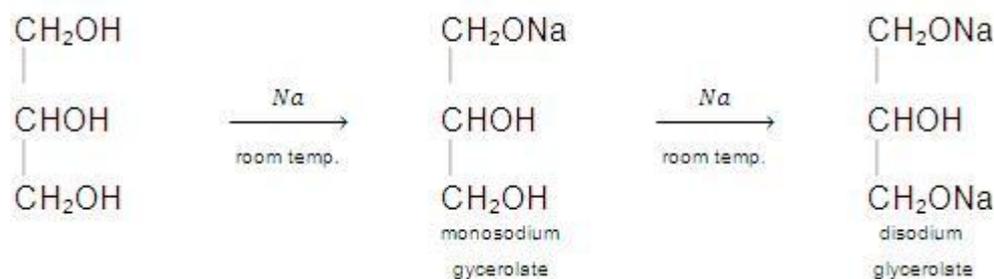
- **Reaction with Oxalic Acid**: Forms different products depending on temperature (e.g., glycerol mono-oxalate or monoformin).



- **Oxidation**: Forms glyceraldehyde and dihydroxyacetone, or glyceric acid depending on the oxidizing agent (e.g., Fenton's reagent, Dilute).



- Glycerol reacts with sodium metal to produce sodium glycerolate and hydrogen gas, typically acting as a substitution reaction on the hydroxyl groups. Specifically, sodium reacts with the $-OH$ groups in glycerol, often forming disodium glycerolate.



Uses of Glycerol

- **Personal Care and Cosmetics**: Acts as a humectant in soaps, lotions, creams, shampoos, and toothpaste to retain moisture and improve skin hydration.
- **Food and Beverage Industry**: Used as a sweetener, solvent, and filler (e.g., in low-fat cookies). It improves the texture of icing, fondant, and slushies, and adds thickness to liqueurs.
- **Pharmaceuticals and Medicine**:
 - **Laxative**: Used in suppositories to relieve constipation by drawing water into the bowel.
 - **Medication Ingredient**: Used in cough syrups to soothe the throat.
 - **Medical Treatment**: Reduces intracranial (brain) and intraocular (eye) pressure.
- **Industrial Applications**:
 - **Antifreeze**: Utilized in hydraulic jacks and automobile antifreeze.
 - **Production**: Used to create nitroglycerin (dynamite), glycerol esters, and resins.
 - **Lubricant**: Acts as a lubricant for machinery.