Esters: They are pleasant fruity smelling compounds. They are formed by reaction of carboxylic acids and alcohols. They are used in making ice creams, cold drinks, perfumes and in flavouring agents.

Acidic hydrolysis of Esters : Esters, on hydrolysis in presence of H^+ give carboxylic acid and alcohol.

$$\underset{\text{Ethylethanoate}}{CH_3COOC_2H_5} + \underset{\text{Water}}{H_2O} \xrightarrow{H^+} \underset{\text{Ethanoicacid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH}$$

Saponification: It is a process in which an ester reacts with sodium hydroxide to form sodium salt of acid and alcohol is formed.

$$\underset{\text{Ethylethanoate}}{CH_3COOC_2H_5} + \underset{\text{Sodium hydroxide}}{NaOH} \text{ ?? } \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Ethanol}}{C_2H_5OH}$$

Saponification is also used for preparation of soap.

Soaps and Synthetic Detergents :

Soaps : Soaps are sodium or potassium salts of higher fatty acids. Fatty acids are carboxylic acids containing 12 or more carbon atoms, e.g.,

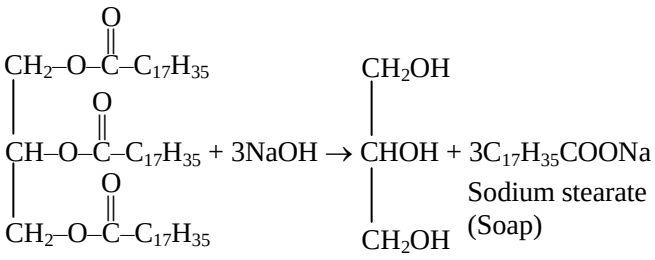
The common fatty acids and their formula are given below :

Table : Some Examples of fatty acids

Formula	**Name of fatty acid**	**Formula**	***Name of Fatty acid***
$C_{15}H_{31}COOH$	Palmitic acid	$C_{17}H_{35}COOH$	*Stearic acid*
$C_{17}H_{33}COOH$	Oleic acid	$C_{11}H_{23}COOH$	*Lauric acid*
$C_{17}H_{31}COOH$	*Linoleic acid*	$C_{13}H_{27}COOH$	*Myristic acid*

Glycerides : They are esters of glycerol, an alcohol containing three hydroxyl group and fatty acids. Glycerides are present in fats or oils of animal and vegetable origin

Saponification : The process in which oil or fat (glyceride) is hydrolysed with sodium hydroxide to get soap and glycerol is called saponification.



Other examples of soaps are Sodium palmitate ($C_{15}H_{31}COONa$), Sodium oleate ($C_{17}H_{33}COONa$)

Sodium linoleate ($C_{17}H_{31}COONa$) etc.

Advantages of Soap :

(i) Soap is cheaper and readily available.

(ii) It works well for cleaning of clothes with soft water (water which does not contain Ca^{2+} and Mg^{2+})

(iii) Soaps are 100% biodegradable, i.e., decomposed by micro-organisms present in sewage, therefore, they do not create water pollution.

Disadvantages of Soap :

(i) It does not work well with hard water containing Ca^{2+} or Mg^{2+}. It reacts with Ca^{2+} and Mg^{2+} to form white precipitate which is called scum and soap goes waste. The reaction which takes place is a follows.

$$\underset{\text{(Present in Hard water)}}{Ca^{2+}} + \underset{\text{Sodium stearate (Soap)}}{2C_{17}H_{35}COONa} \rightarrow \underset{\text{Calcium stearate}}{(C_{17}H_{35}COO)_2Ca} + 2Na^+$$

$$\underset{\text{(Present in Hard water)}}{Mg^{2+}} + 2C_{17}H_{35}COONa \rightarrow \underset{\text{Magnesium stearate}}{(C_{17}H_{35}COO)_2Mg}$$

Thus, soap solution forms less lather with hard water.

(ii) Soap is not suitable for washing woolen garments because it is basic in nature and woolen garments have acidic dyes.

(iii) Soap are less effective in saline water and acidic water.

Detergents : Detergents are sodium or potassium salts of sulphonic acids of hydrocarbons of alkene type. They have $–SO_3H$ group, i.e., sulphonic acid group.

Examples :

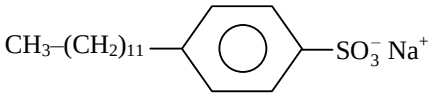
(i) Sodium lauryl sulphate

$CH_3(CH_2)_{10}CH_2O\,SO_3^-\,Na^+$

(ii) Sodium dodecylbenzenesulphonate

$C_{12}H_{25}–C_6H_4–SO_3^-\,Na^+$

OR



Advantages of Detergents over soaps :

(i) Detergents work well even with hard water but soaps do not.

(ii) Detergents may be used in saline or acidic water

(iii) Detergents are more easily soluble in water than soaps.

(iv) Detergents can be used for washing woolen garments whereas soaps cannot be used.

(v) Detergents having linear hydrocarbon chain are biodegradable.

Disadvantages of Detergents over Soaps :

(i) Synthetic detergents having branched hydrocarbon chain are not fully biodegradable, i.e., they are not decomposed by micro-organisms in sewage and create water pollution.

(ii) They are more expensive than soaps. Let us take up differences between soaps and detergents.

Table : Difference between soaps and detergents

Soaps	Detergents
1. They are sodium or potassium salts of fatty acids	1. They are sodium or potassium salts of sulphonic acids.
2. They have –COONa group	2. They have– SO_3Na group
3. They do not work well with hard water, acidic water and saline water	3. They work well with hard water, acidic water and saline water.
4. They are fully biodegradable	4. Some detergents having branched hydrocarbon chain are non-biodegradable
5. They do not work well with woolen garments.	5. They work well with woolen garments
6.It may cause irritation to skin	6. They do not cause irritation to skin
7.They take time to dissolve in water	7. They dissolve faster in water

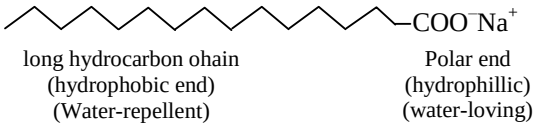
8. Example : Sodium stearate, Sodium palmitate	8. Examples : Sodium lauryl sulphate, sodium dodecylbenzenesulphonate.

Cleansing Actions of Soaps and Detergents : Soaps and detergents consist of a large hydrocarbon taill with a negatively charged head as shown in figures. The hydrocarbon tail is hydrophobic (water-hating or water repelling) and negatively charged head is hydrophilic (water-loving).

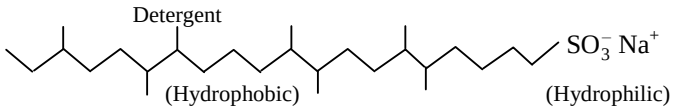
In aqueous solution, water molecules being polar in nature, surround the ions and not the hydrocarbon part of the molecule

When a soap or detergent is dissolved in water, the molecules associate together as clusters called

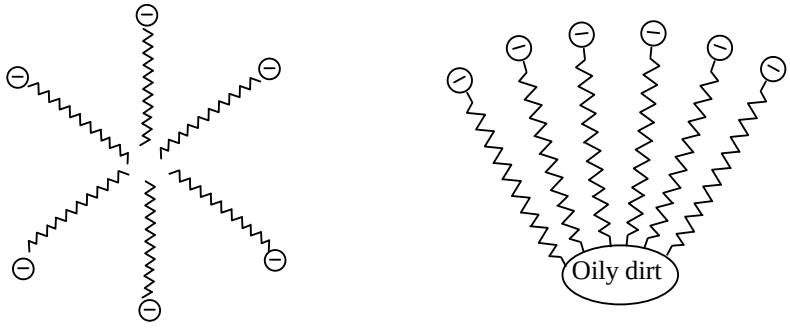
micelles as shown in figure (C)



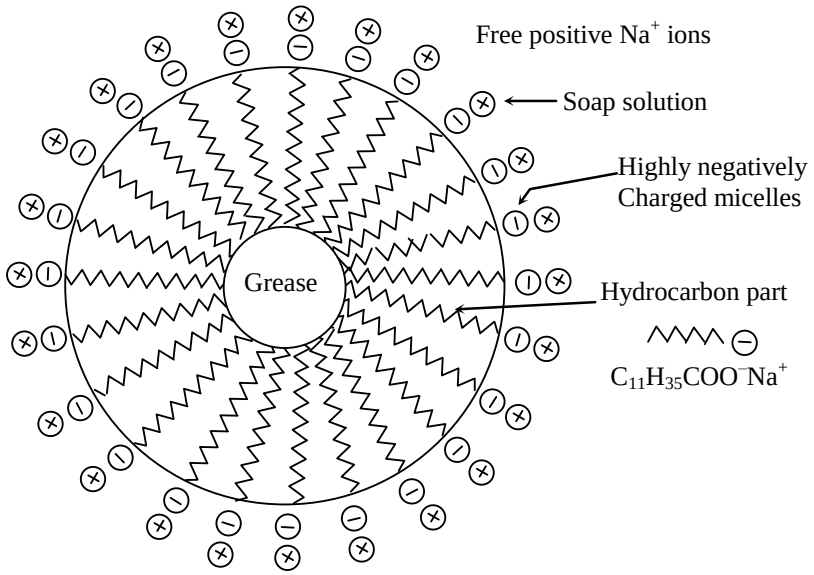
(a) Hydrophilic (water-loving) and hydrophobic (water-repellent) ends of a soap molecule



(b) Hydrophilic and hydrophobic ends of a detergent



(c) Micelle Formed by detergent molecules in water
The hydrocarbon tails stick the oily dirt



Cleansing action of soap. Soap micelle entraps the oily dirt particle

The tails stick inwards and the heads outwards.

In cleansing, the hydrocarbon tail attaches itself to oily dirt. When water is agitated (Shaken vigorously),the oily dirt tends to lift off from the dirty surface and dissociate into fragments.

This gives opportunity to other tails to stick to oil. The solution now contains small globules of oil surround by detergent molecules.

The negatively charged heads present in water prevent the small globules from coming together and form aggregates. Thus, the oily dirt is removed.

In the past, detergents caused pollution in rivers and waterbodies. The long carbon chain present in detergents used earlier, contained lot of branching. These branched chain detergent molecules were degraded very slowly by the micro-organims present in sewage discharge septic tanks and water bodies. Thus, the detergents persisted in water for long time and made water unfit for aquatic life. Nowadays, the detergents are made up of molecules in which branching is kept at minimum. These are degraded more easily than branched chain detergents.