



Part II

Answer the following questions:

- 1- a) How can you classify surface active compounds, illustrate your answer by structures. (4Marks)
- b) Write the mechanism of the reaction of propylene oxide with fatty alcohol. (4Marks)
- c) How can you prepare anionic surfactants from each of the following compounds:
- i- Fatty acids. (2Marks)
- ii- Sorbitan. (2Marks)
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- 2- a) What is the difference between each of the following pairs (Explain your answer by structures):
- i- Soap and detergents. (2Marks)
- ii- Sulfonation and sulfation. (2Marks)
- b) From fatty acid and ethanol amine how can you prepare anionic surfactants. (2Marks)
- c) From fatty alcohol how can you prepare cationic surfactants. (2Marks)
- d) Write two different methods to prepare cationic surfactants. (4Marks)

Best wishes
Dr. Mohamed Abo-Riya

Model answer

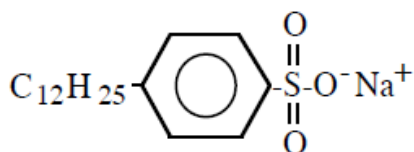
1 a) How can you classify surface active compounds, illustrate your answer by structures?

Answer

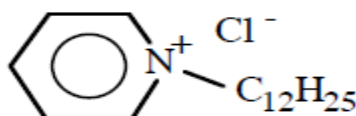
CLASSIFICATION OF SURFACTANTS:

The most accepted and scientifically sound classification of surfactants is based on their dissociation in water.

Anionic Surfactants are dissociated in water in an amphiphilic anion. Anionic surfactants contain anionic functional groups at their head, such as sulfate, sulfonate, phosphate, and carboxylates.



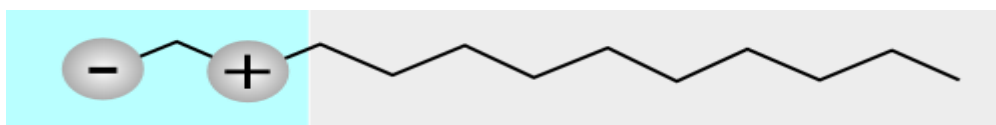
Cationic Surfactants are dissociated in water into an amphiphilic cation and an anion, most often of the halogen type. A very large proportion of this class corresponds to nitrogen compounds such as fatty amine salts and quaternary ammoniums, with one or several long chain of the alkyl type, often coming from natural fatty acids.



N-Dodecyl Pyridinium Chloride

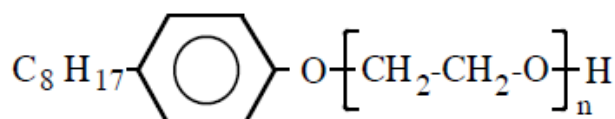
Zwitterionic surfactants

Zwitterionic (amphoteric) surfactants have both cationic and anionic centers attached to the same molecule. The cationic part is based on primary, secondary, or tertiary amines or quaternary ammonium cations. The anionic part can be more variable and include sulfonate



Nonionic surfactant:

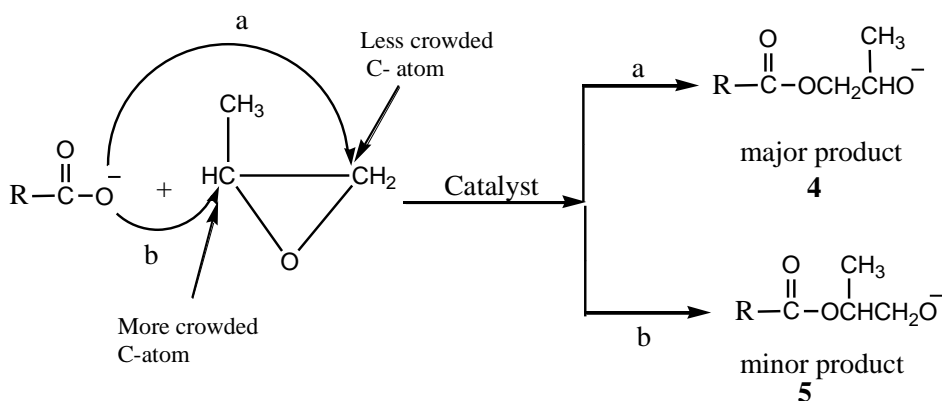
Many long chain alcohols exhibit some surfactant properties. Prominent among these are the fatty alcohols, cetyl alcohol, stearyl alcohol, and cetostearyl alcohol (consisting predominantly of cetyl and stearyl alcohols), and oleyl alcohol condensed with polyethylene glycol and polypropylene glycol.



Polyethoxylated Octyl Phenol

b) Write the mechanism of the reaction of propylene oxide with fatty alcohol.

Answer



c) How can you prepare anionic surfactants from each of the following compounds:

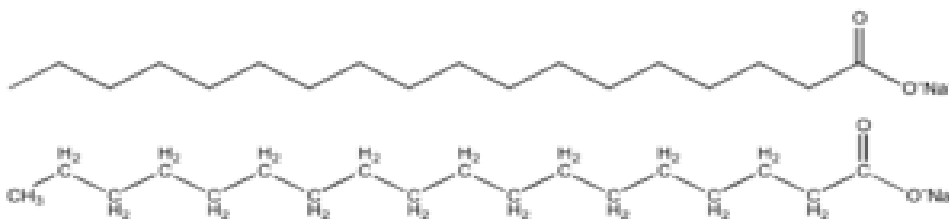
i- Fatty acids.

(2Marks)

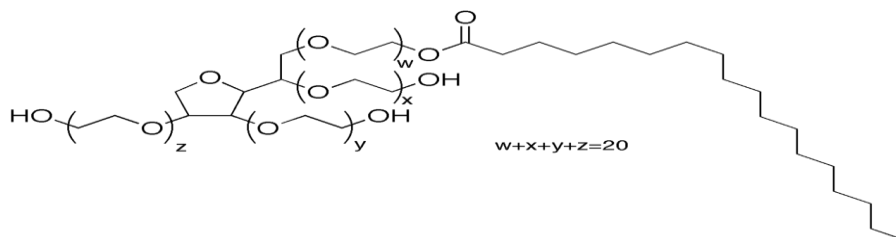
ii- Sorbitan.

Answer

i- From Fatty acids: By the reaction of fatty acids with alkali NaOH or KOH to produce the anionic salt of fatty acids.



ii- Sorbitan. By the reaction of fatty acids and sorbitan.



1- a) What is the difference between each of the following pairs (Explain your answer by structures):

i- Soap and detergents.

Answer

A soap is a cleaning agent that is composed of one or more salts of fatty acids only prepared by saponification of oils or fats. But soap reacts with lime to form an insoluble deposit (soap scum) in "hard water". A detergent is a chemical compound or mixture of compounds used as a cleaning agent can be anionic or cationic or

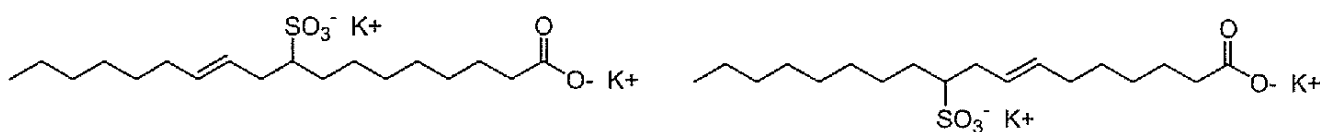
nonionic work in hard water. Detergents consist of a hydrophobic tail portion, usually a long-chain hydrocarbon, and a hydrophilic polar head group, which is often ionic or strongly polar groups.

ii- Sulfonation and sulfation.

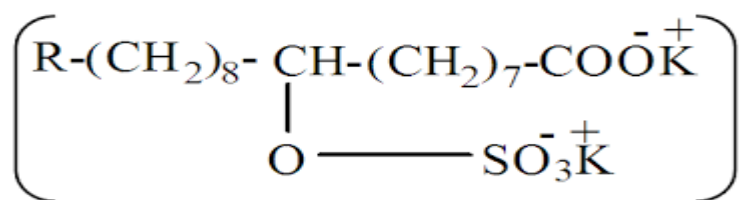
Answer

The Sulfonation and sulfation is the reaction with fatty compounds but the sulfonation the sulfur atom is attached directly with carbon atom and in sulfation the sulfur atom is attached directly with oxygen atom.

The simple aliphatic sulfonic acids and their salts are represented by the general formula $R-SO_3^- M^+$ where R is normal or branched-chain.



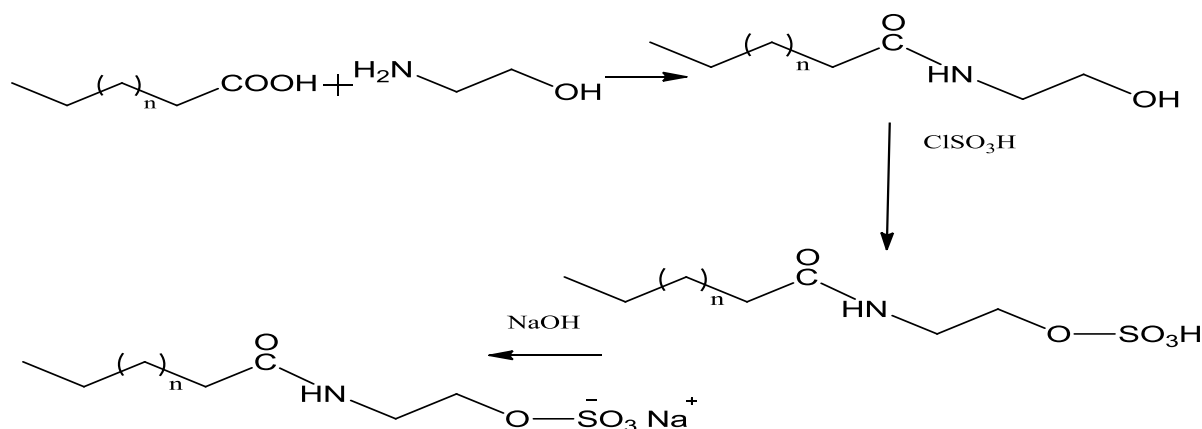
The sulfate esters are obtained by the treatment of a variety of hydroxylated or unsaturated natural fats and oils with sulfuric or chlorosulfonic acids.



b) From fatty acid and ethanol amine how can you prepare anionic surfactants.

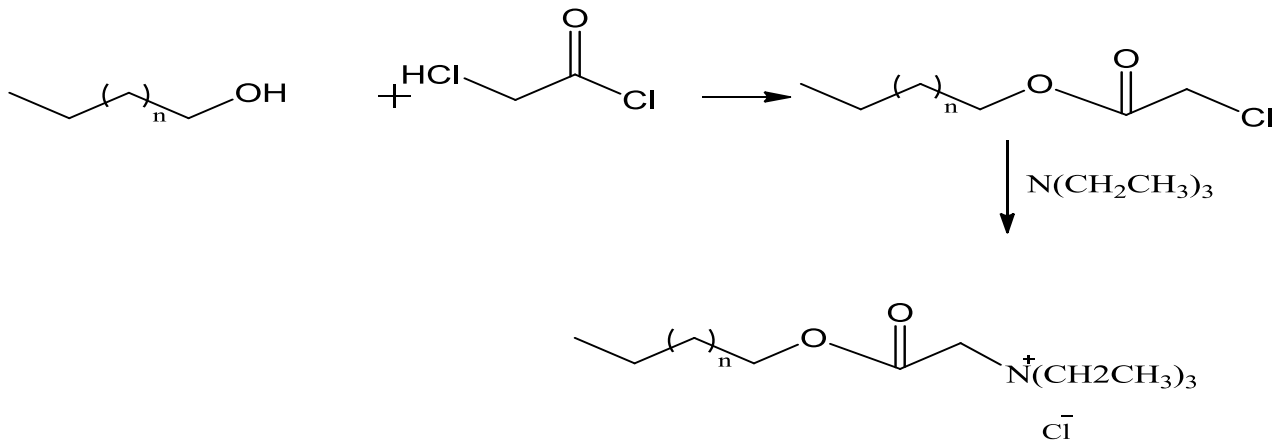
Answer

By reaction the fatty acid with ethanolamine and sulfated the product with chlorosulfonic acids or with sulfuric acid the neutralize with NaOH.



c) From fatty alcohol how can you prepare cationic surfactants.

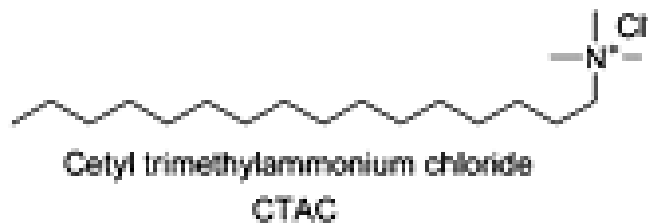
By reaction the fatty alcohol with chloroacetic acid followed by quaternization with triethylamine



d) Write two different methods to prepare cationic surfactants.

Answer

1- From fatty amines by reaction with alkylhalides to form quaternary salt:



From alcohol by reaction the fatty alcohol with chloroacetic acid followed by quaternization with trimethylamine.

2-

