

CHEMICALS FOR CONSUMERS

DETAILED NOTES AND SAMPLE QUESTIONS

S4 TERM TWO TOPIC 2

NEW LOWER SECONDARY CURRICULUM (CHEMISTRY)

Introduction

The products we use in our daily life at home, school and in any place human beings visit or stay are made up of chemicals.

Examples of most commonly used products used in daily life.

- Soapy and soap less detergents (soaps and detergents)
- Food additives
- Medicines
- Paints and many others

Soaps and detergents

Soap is a potassium or sodium salts of a carboxylic acid attached to a long aliphatic chain.

Alternatively;

Soapy detergents are cleansing agents made by the reaction between fats or oils from animals or plants and sodium or potassium hydroxide. Soaps are sodium or potassium salts of fatty acids, formed by the reaction fats and oils with an alkali.

Physical properties of soap.

- Soap is normally cream but takes up the colour of the palm oil. Mere palm oil produces creamy soap while palm kernel oil produces white solid soap.
- Soap takes up the odour of the kind of perfume used.
- Soap has a smooth texture.
- Easily soluble while washing.

Chemical properties of soap

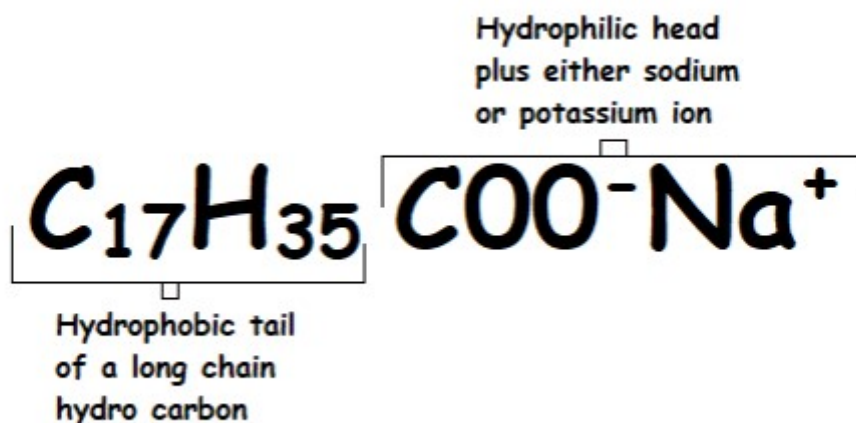
- Soap has a pH within the range of 9-10. Soap is majorly alkaline.
 - Soap forms lather readily with soft water.

Chemical name of soap

- Sodium stearate ($C_{17}H_{35}COONa$) or potassium stearate ($C_{17}H_{35}COOK$). Normally, **C₁₇H₃₅** (alkyl group) is represented by **R**. i.e. $R-COONa$ or $R-COOK$

Chemical formula of soap

The exact chemical formula is $C_{17}H_{35}COO^-$ plus either sodium or potassium ion



The history of making soap

Earlier on, soap making was carried out by reacting fats and oils from animals and plants with ashes as a source of alkaline solution.

The mixture could be boiled to obtain the soap solution that could be molded into a shape according to one's desire.

Sample questions

1. What were the first materials used for making soap?
Animal fat and ashes
2. What challenges in production of soap were faced during early times?
Soap was heavily taxed
3. What improvements have been made in the production of soap?
 - *Improved alkaline substances like caustic soda*
 - *Fats are now clean and free from animal body fat*
 - *Soap can now be made without boiling the mixture of fats/oils and caustic soda, but instead, just stirring and pouring in the mold.*

Chemical nature of soap.

Soaps are water-soluble sodium or potassium salts of fatty acids.

The nature of soap depends on the chemicals used, the method and the intended use of the soap.

Chemicals used to make soap

- Sodium hydroxide solution
- Fat/oil (long chain triglyceride)

Structure of a soap molecule.

A soap molecule is made up of two parts, a long hydrocarbon part and a short ionic part containing the -COO-Na^+ group.

The long hydrocarbon chain is hydrophobic in nature but it is soluble in grease and oil.

The ionic portion of the soap molecule is hydrophilic.

Importance of fats and oils in soap-making

- They help in the hardening of soap.
- Production of lather.
- Responsible for moistening.
- Enhancing the cleaning action of soap.

Cleaning action of soap

During washing, the soap molecules dissolve in water.

The soap molecules orient themselves in dirt/grease and water, the hydrophobic tails dissolve in oil/grease/dirt while the hydrophilic heads face in water.

Agitation begins to separate the grease from the object being cleaned.

Continuous agitation takes place until all the dirt leaves the surface of the object.

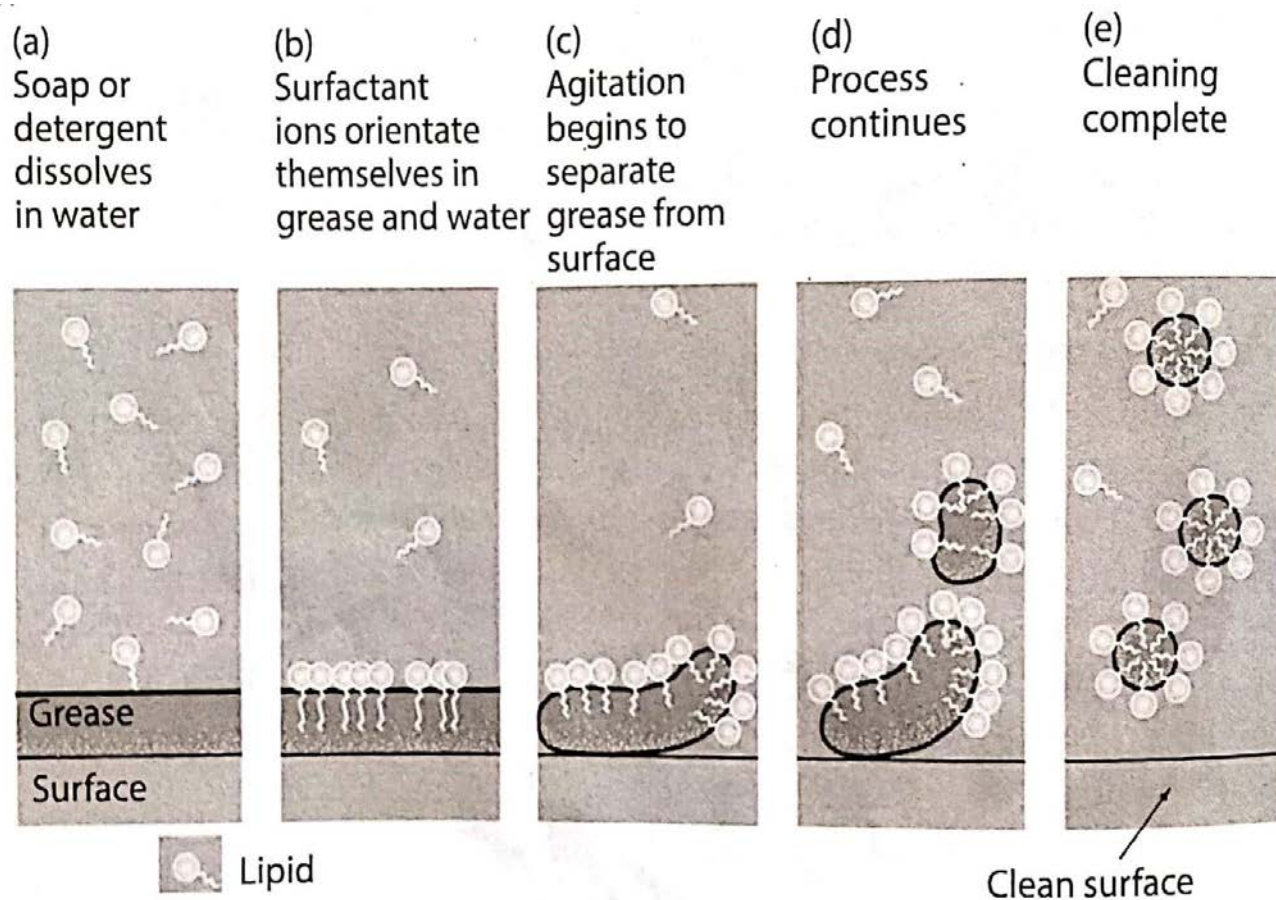
The cleaning will be completed when the broken dirt particles move in water after rinsing.

Diagrammatic/flow chart cleansing/cleaning action of soap

Key words;

- Surfactant, is a substance that when added to a liquid reduces its surface tension thereby increasing its spreading and wetting.
- Agitation means disturbing or removing something by force.

The processes **(a)** to **(e)** are the cleaning actions of soap and also detergents.



How a piece of cloth appears on rinsing

- The cloth appears clean and free from the previous dirt stains.

Effect of soap on the dirty piece of cloth

- The soap dissolves the dirt off the cloth into the water, leaving the cloth clean.

Detergents.

A detergent is the potassium or sodium salt of a long alkyl chain ending with a sulphonate group.

A detergent is a water-soluble cleansing agent which combines with impurities and dirt to make them more soluble.

Detergents differ from soap in not forming a scum with salts in hard water. Detergents are also in powder form.

Chemical name and formula of detergents.

Detergents are chemically known as *sodium alkyl sulphonate (or sodium dodecyl sulphate)/sodium alkyl benzene sulphonate/sodium dodecylbenzene sulphonate*.

The chemical formula is **C₁₂H₂₅NaO₃S**. The alkyl (C₁₂H₂₅) can be represented by capital R, hence **RNaO₃S**.

Examples of detergents.

- Nomi
- Omo
- Sunlight
- Liquid soap
- Sanitizers
- Jik
- Bleaches

Chemical composition of detergents.

- Alkyl sulphonic acid
- Sodium hydroxide
- Perfume and water

Additives (and their uses) present in detergents.

Additives	Uses
Fluorescent whitening agents	Convert stain to colourless substances
Fragrances (these are pleasant sweet smells)	Add fragrances to fabrics and detergents
Bleach (a chemical used to make materials whiter or lighter) e.g., sodium hypochlorite or sometimes hydrogen peroxide.	Make fabrics appear whiter
Enzymes	Breakdown fat and protein molecules in food stains.
Fabric softening agents (e.g., calcium hydroxide, sodium carbonate/soda ash)	To soften hard water To make the solid detergent dry and enable the liquid detergent to be poured out easily.
Drying agents	Change and improve on the final color of the detergent.
Colorants	Used to add colour to foods

Cleaning action of detergents.

The cleaning/cleansing action of detergents is exactly the same as for soap since they both have the hydrophilic and hydrophobic parts.

Preparation of detergents.

- Alkenes (any, especially from petroleum) are mixed with sulphuric acid to form alkane sulphonic acid.
- Sodium hydroxide is added to the sulphonic acid to neutralize it and form the detergent.
- Additives are then added to the formed detergent to enhance on the cleaning efficiency, add fragrance and control foaming.

Alternatively;

You can make your own powder detergent at home or in any place you stay using the following materials, get them from sunrise hotel opposite mukwano mall - Namayiba park Kampala.

Materials

- Soda ash 1
- STPP kg
- SLS 60g
- Caustic soda 300g (pound it to powder form)
- Fragrances. 40g

Procedures

- Place caustic soda in a container/bucket, add STPP and mix until a uniform mixture is formed,
- Add SLS to the mixture and continue mixing until a uniform mixture is formed.
- Add caustic soda and continue mixing to form your detergent.
- Fragrances are added to the formed detergent and kept for 24 hours. Then get your product and either use or sell.

Advantages of detergents over soaps.

- Detergents cannot form scum with hard water while soaps form scum with hard water.
- Detergents can work even in acidic medium while soaps cannot.
- Detergents are stronger cleansing agents than soaps.
- Detergents have a higher solubility than soaps.

Similarities between soaps and detergents.

- Their structures consist of a hydrophobic tail and a hydrophilic head.
- Soaps detergents are both surfactants as their structures allow them to reduce tension between oil and water.
- They both clean effectively in soft water.
- They both act as emulsifying agents.

Differences between soaps and detergents.

Soap	Detergent
Biodegradable	Non-biodegradable
Does not cause pollution	Causes pollution
Not effective in hard water	Effective in hard water
Not effective in acidic water	Effective in acidic water
Form scum in hard water	Does not form scum in hard water.
Made from natural resources (animal fats or vegetable oils)	Made from synthetic resources (petroleum fractions)
Form precipitate in acidic water	Do not form precipitate in acidic water

Food additives

A food additive is any substance added to food to maintain or improve its safety, freshness, taste, texture and appearance.

Types of food additives.

Food additives are classified according to their source or their functions.

Types according to source;

- Natural food additives
- Synthetic food additives

Types according to function;

Type of additive	Its example (chemicals present)	Use of the additive
Preservatives	Sodium benzoate, Ethylene oxide	Increase the shelf life of food by preventing the growth of micro-organisms like yeast or bacteria in food.

Antioxidants	Naturally available ascorbic acid, Butylated Hydroxy Anisole (BHA), Sulphur dioxide, Butylated Hydroxy Toulene (BHT)	Added to food products to prevent rancidity.
Sequestrants	Iron or copper	Act as metal scavengers and prevent oxidation, there by thereby improving the quality and stability of food.
Surface active agents	Lecithin found in egg Yolk. Mono diglycerides.	Are necessary to stabilize an emulsion, whether its oil in water or gas in liquid type.
Stabilizers and thickening agents	Pectin. Amylose Gelatin.	Increase viscosity by combining with water to form gels, hence are used for thickening.
Bleaching and maturing agents	Benzoyl peroxide, Hydrogen peroxide.	Used to bleach yellow colour. Used to alter properties of Maida (all-purpose flour especially for making breads) into aata (more pure form of maida) due to reaction with benzoyl peroxide.
Food colour	Turmeric, Annatto, Caramel, Saffron, Carotene, Cochineal, Certified coal tar dye.	Added to improve on the visual looks.
Dietary sweeteners	Aspartame	Improve on aroma and taste.
Flavouring agents	Ethyl butyrate for pineapple flavour, Amyl acetate for banana flavour, Methyl anthranilate for grape flavour. Benz aldehyde for cherry flavour. Etc.	Improve on the food odor, Improve on the food quality.
Anti-caking agents	Calcium phosphate, Magnesium carbonate.	Used to keep the product from clumping together.

Banned food additives.

Some food additives can trigger allergic reactions and other mid health problems. However, some food additives pose serious health risks and have been banned for consumption.

Examples of banned food additives and the reason

Food additive	
Bisphenol A	Reasons for banning Changes the timing of puberty,
Phthalates	Decreases fertility and increases body fat. Affects male genital development and increases childhood
Nitrates/nitrites	obesity. Cause tumours (a swelling of a part of the body without inflammation, caused by abnormal growth of tissue) in the
Synthetic/artificial food colours.	digestion and nervous system. They have effects on child behaviour and attention.

Medicines

Medicines are classified into two;

Type 1

➤ Traditional medicine

These are medicines derived from plants or animals.

They are usually not processed.

They cause a lot of side effects

Types of traditional medicine

Traditional medicine	Source	Function
Garlic extract	Garlic leaves	Controlling the level of cholesterol and blood pressure.
Guava leaf and flower extract.	Guava plant	Treats malaria, ulcers, coughs, diarrhoea
Aloe vera extract	Aloe vera plant	Treatment of malaria
Lemon juice	Lemon plant	Treats hypertension, obesity, bronchitis and fever.
Pawpaw leaf and root extract.	Pawpaw	A natural contraceptive, improves liver and kidney function.
Bitter leaf Bombo(Momordica foetida)	Some plants	Used for fever and malaria treatment
Sodom apple	Sodom plant	Treatment of; leprosy, toothaches, wounds and scabies.
Cactus juice (take it before or after an exercise	Cactus plant	It promotes immune system, soothes joint inflammation, reduces pain and prevents inflammation
Avocado leaves	Avocado plant	Treats a variety of diseases, including cancer, diabetes and more.

Type 2

➤ **Modern or Conventional medicine**

These are medicines made by scientists in laboratories and are based on substances found in nature.

The active ingredients in the substances are identified, extracted and purified.

The medicine is then tested repeatedly in many different ways before it is marketed. This allows scientists to make sure that the medicine is safe and to identify its side effects.

Modern medicines may come in many forms such as liquids, powders, capsules and tablets, capsules and tablets.

Types of modern medicine

Modern medicine	Examples	Function
Analgesics	Aspirin	Analgesic (against minor pains and aches) Prevent heart attacks, Works on fever.
	Paracetamol	Painkiller used to treat aches and pain.
	Codeine	Relieve mild to moderate.
Antibiotics	Penicillin	Cure diseases that are caused by bacteria infection such as gonorrhea, syphilis, anthrax, pneumonia, meningitis.
	Streptomycin	Antibiotic remedy for dry cough, tuberculosis.
	Cofita tablets	Used for treatment of flue and cough.
Psychotherapeutic	Stimulants	Therapeutically drugs to increase alertness.
	Antidepressants	Affects moods and emotions helping you to feel better.
	Antipsychotics	Regulate the function of the brain that controls thinking, mood and perception
Antidepressants	Hormones	They evoke responses from specific organs or tissues.
	Insulin	Regulates the level of sugar in the blood
	Steroids	Responsible for; Sexual differentiation, Growth, Development, Reproduction.
	Anabolic steroids	They promote cell growth and division.

Side effects of modern medicines and how to reduce their effects

Side effect	How to manage the effect
constipation	Drink plenty of fluids.
Daytime drowsiness	Ask your doctor if you can take your medicine at bedtime. It goes away when the body adjusts to the medicine.
Diarrhea	Eat fibre foods, Avoid spicy and high-fat foods until you feel better.
Dizziness	Get up slowly from sitting or lying down.
Dry mouth	Take frequent sips of water throughout the day.
Headaches	Ask your doctor which medicine you can take for a headache. Headache normally goes away as the body adjusts to the medicine.
Loss of appetite	Include your favorite foods at each meal, Try to eat more often, Take a walk before you eat, this may make you hungrier.
Sleep problems	Don't exercise in the late afternoon or evening, Keep your bedroom quiet, dark and cool, Change the time of day you take your medicine to the morning, Avoid caffeine, nicotine and alcohol.

Contribution of the chemical industry to people's lives.

The chemical industry has contributed to people's lives through the following sectors

Sector	Chemical product	Importance to people's lives
Transportation	Fuel	Source of fuel which provides energy for moving.
Decoration	Dyes	Chemical dyes have pigments of different colors for coloring objects.
Hygiene	Sanitizers, and other detergents like methylated spirit, etc	Sanitizers improve on people's health by killing disease causing organism on the body.

Food	Food additives	Additives in making food stuffs to improve appearance, taste and quality.
Water treatment	Chlorine	Provides safe water for domestic use when added to water, for example small amounts of chlorine
Agriculture	Fertilization	Manufacture of fertilizers and pesticides which improve crop yield.

Traits of a good science researcher.

- Analytical mind
- Ability to stay calm
- Intelligence
- Curiosity
- Quick thinking
- Being systematic (getting involved personally)

Qualities of scientists carrying out research.

Good and successful science researchers should have the following characteristics

- **Patience**
Enables researchers not to diminish their persistence and passion
- **Meticulousness**
Enables researchers to do things very carefully and pay great attention to detail.
- **Perseverance**
Enables researchers to keep doing work and studying regularly and to never give up even under difficult situations
- **Innovativeness**
Enables researchers to come up with new ideas to get the work done

END