Chemistry

X

Resource material for Ziauddin board

Prepared by: Ms. Saima Pervaiz Ahmed under the supervision of Madam Naheed Muneer Siddiqui

Benchmarks

Students will display a sense of curiosity and wonder about the natural world and demonstrate an increasing awareness that this has led to new developments in science and technology. They will learn from books and other sources of information and reconstruct previously learned knowledge.

Students will describe and explain common properties, forms, and interactions between matter and energy; their transformations and applications in biological, chemical and physical systems.

Students will demonstrate an understanding of the impact of science and technology on society and use science and technology to identify problems and creatively address them in their personal, social and professional lives. They will explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; and how people have contributed to and influenced developments in science.

Content

Class X	
Chapter 1	**Carbon , Nitrogen, Oxygen and Sulphur (NEW)**
Chapter 2	**Acid , Bases and salts**
Chapter 3	**Organic Chemistry**
Chapter 4	**Hydrocarbons**
Chapter 5	**Halogens (NEW)**
Chapter 6	**Environmental chemistry I: Atmosphere**
Chapter 7	**Environmental chemistry II: Water**
Chapter 8	**Chemical industries**
Practicals =10	

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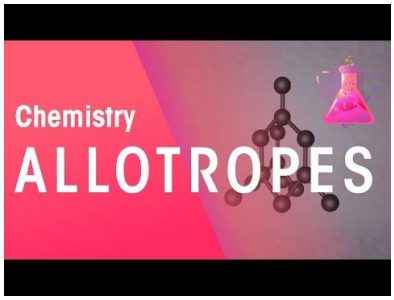
Chapter 1

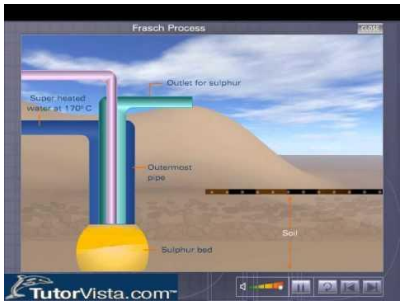
Carbon ,Nitrogen, Oxygen and Sulphur

Chapter	Understandings	Practical
Carbon, nitrogen, oxygen and sulphur • **Carbon and its allotropic forms** • **Diamond, Graphite and fluorescent Buckminster** • **Nitrogen and its properties** • **Oxygen and oxides** • **Sulphur and its allotropic forms**	Student will be able to • Identify allotropic forms of carbon • Differentiate between diamond and graphite • Demonstrate bucky balls. • Demonstrate nitrogen and its property • Define oxygen and oxides • Identify and demonstrate allotropic forms of sulphur	• To prepare oxygen gas in laboratory by hydrogen peroxide. • To prepare Carbon di oxide gas in laboratory by Calcium carbonate • **Formation of allotropic form of sulphur (monoclinic sulphur)**. (NEW)

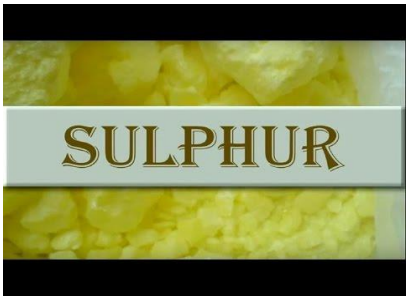
Videos



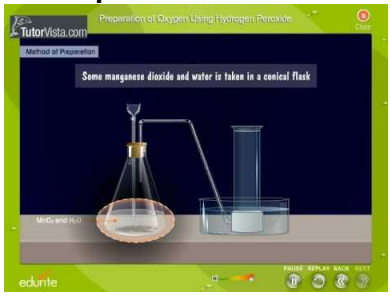
Allotropes of carbon



frasch process of sulphur extraction



Sulphur and its allotropic forms



To prepare oxygen gas in laboratory. (Practical)

formation of monoclinic sulphur. (Practical)

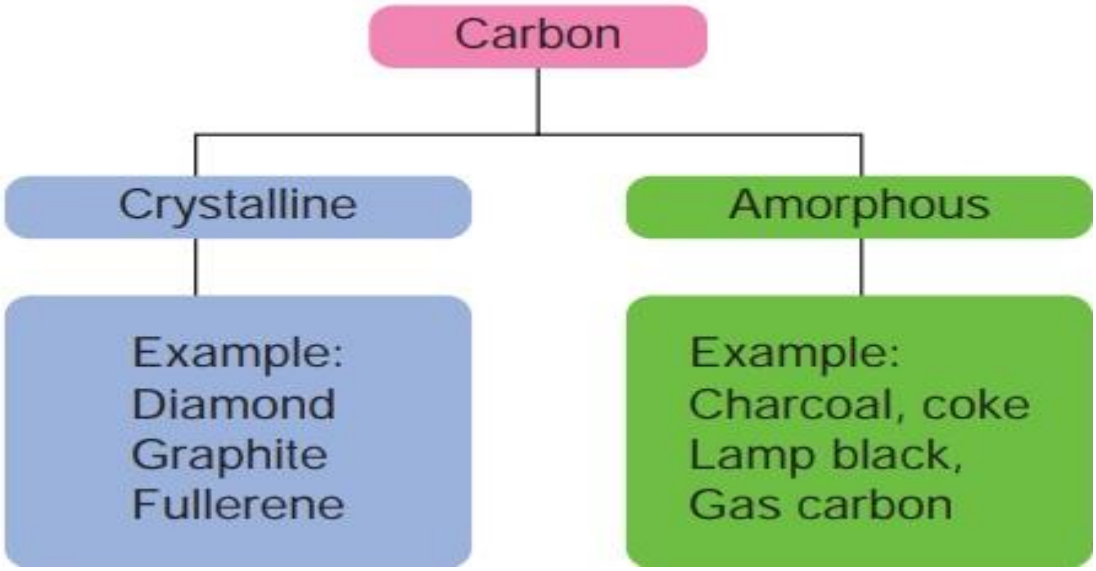
Chapter overview

What is the definition of allotropes?

The term allotrope refers to one or more physical forms of a chemical element that occurs in the same physical state. Allotropes may show differences in chemical and physical properties.

Allotropic forms of carbon

The phenomenon by which an element can exist in more than one physical state is called allotropy.
The allotropes forms of carbon can be categorized into two:
Amorphous Carbon Allotropes
Crystalline Carbon Allotropes



Diamond

Physical Properties of Diamond

- It is extremely hard
- It has a very high melting point
- It has a high relative density
- It is a bad conductor of electricity
- It is a good conductor of heat
- It is insoluble in all solvents

Uses and Applications:

Diamond is known to be the hardest substances on the Earth.
It is used in making of tools that are utilized for grinding, cutting, drilling, etc.
Diamond is used in the manufacture of filaments made of tungstens used for light bulbs.
It is used in the making of jewelry.
Diamonds are used by most of the surgeons in the removal of the cataract from the eyes as a high precision instrument.

Graphite

Physical Properties of Graphite

- It also has metallic luster which helps in the conduction of electricity.
- It is a very good conductor of both heat and electricity
- One of the most important properties of graphite is that it is used as a dry lubricant for machines at high temperature where we cannot use oil.
- It is malleable and ductile

Uses and Applications:

Graphite powder is utilized as a lubricant in the form of dispersion material or powder.
Graphite is widely used in lead pencils.

It is used in the manufacture of electrodes of carbon employed in the electrolytic cells, as it is an excellent conductor of electricity.
It is utilized in the making of graphite crucibles since it possesses high melting points.
It is widely used in the nuclear reactors and moderators.

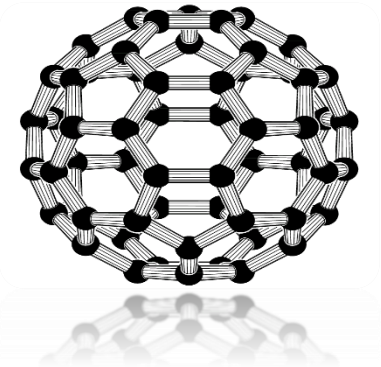
Other Carbon Allotropes

Buckminsterfullerene

Buckminsterfullerene (C60) is also one of the allotropes of carbon. The structure of fullerene is like in a cage shape due to which it looks like a football.

Fullerenes

They are spheroidal molecules having the composition, C2n, where n ≥ 30. These carbon allotropes can be prepared by evaporating graphite with a laser.



Unlike diamond, fullerenes dissolve in organic solvents.

The fullerene C60 is called 'Buckminster Fullerene'. The carbon atoms are sp2 hybridized.

Silicates

Fusing alkali oxides with SiO2 gives silicates. They contain discrete tetrahedral units. Silicon is sp3 hybridized. These allotropes of carbon are classified based on their structures.
Some common examples are water glass, silica gel.

Water glass

Water glass is the common name for an aqueous solution of either sodium silicate or potassium silicate. It's also called "liquid glass".
It gets its name because it's essentially glass (silicon dioxide) in water. As the water evaporates, the solution solidifies into a glassy solid.

Chemical Formula of Water Glass

The most common formula is $Na_2(SiO_2)_nO$

Water Glass Uses

- Water glass is used to make silica gel beads or packets, which are used to protect clothing and electronics from moisture.
- The chemical is used in passive fire protection, to make cements, to stabilize bore holes when drilling wells, in the manufacture of cardboard, as a flocculent in waste water treatment, for food preservation, for automotive repair, and in the processing of lumber and textiles.
- Placing freshly laid eggs in a water glass solution seals the pores of the eggs against bacteria and gases, so it can be used to preserve eggs when refrigeration isn't an option.

Silica gel

Silica gel, a highly porous, nan crystalline form of silica used to remove moisture from gases and liquids, to thicken liquids, to impart a dull surface to paints and synthetic films, and for other purposes.

Chemical Formula of Silica gel

SiO_2

Silica gel Uses

- Silica gel uses is also used to dry the air in industrial compressed air systems.
- The silica gel adsorbs moisture from the air, preventing damage at the point of use of the compressed air .

- You will find little silica gel packets in anything that would be affected by excess moisture or condensation.
- In electronics it prevents condensation, which might damage the electronics.

Nitrogen

- The seventh element of the periodic table between carbon and oxygen is Nitrogen.
- It's an important part of amino acids.
- Around eighty percent of the Earth's atmosphere comprises nitrogen gas.
- It has no colour, mostly diatomic nonmetal gas along with odourless and colourless in nature.
- Since it is a component of DNA and part of a genetic code, it is an essential element of life.
- It is found in nitrates and nitrites in soil and water.
- All these substances are part of the nitrogen cycle and interconnected.

Uses of Nitrogen

- It is used in the manufacture of ammonia, to produce nitric acid and subsequently used as a fertilizer.
- Nitric acid salts include important compounds like potassium nitrate, ammonium nitrate, and nitric acid. Nitrated organic compounds such as nitroglycerine are often explosives.
- Liquid nitrogen is utilized as a refrigerant for transporting foodstuff and freezing purposes.
- Preservation of bodies and reproductive cells and stable storage of biological samples also makes use of liquid nitrogen.

Oxygen

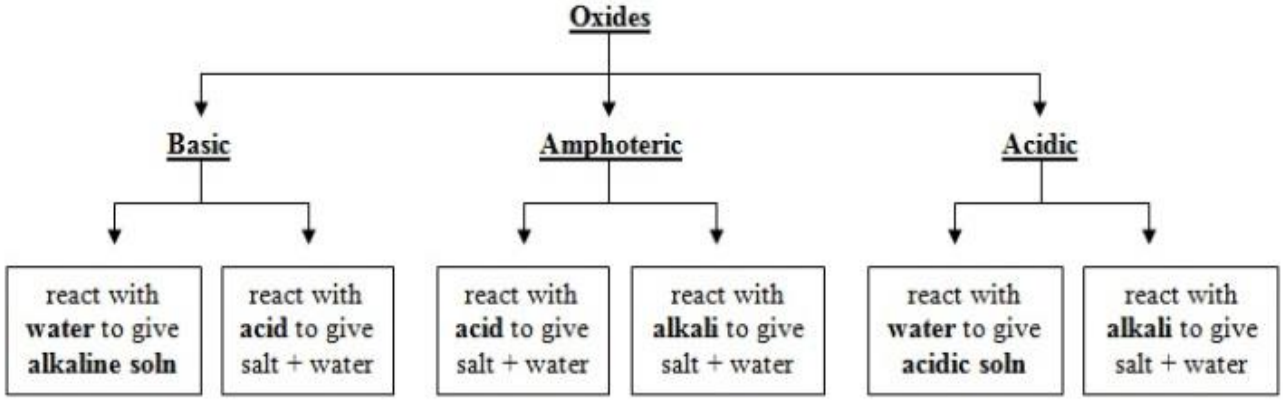
Dioxygen, O_2, is a colorless and odorless gas that occupies 21% of air.
The isotopes of oxygen are ^{16}O (99.762% abundance), ^{17}O (0.038%), and ^{18}O (0.200%).

What are Oxides?

The classification of oxides is done into neutral, amphoteric and basic or acidic based on their acid-base characteristics.

Classification of Oxides

Depending upon nature and the properties exhibited by compounds, they are classified into
Acidic oxides Basic oxides Amphoteric oxides Neutral oxides



Acidic oxide:

An acidic oxide is an oxide which when combined with water gives off an acid.
Non-metals react with oxygen to form acidic compounds of oxides which are held together by covalent bonds.
Examples: NO, CO_2
$SO_3 + H_2O \rightarrow H_2SO_4$
$B_2O_3 + H_2O \rightarrow 2H_3BO_3$

Basic oxide:

A basic oxide is an oxide which when combined with water gives off a base.
Metals react with oxygen to give basic compounds of oxygen. These compounds are usually ionic in nature. Examples:
$Na_2O + H_2O \rightarrow 2NaOH$

Amphoteric oxide:

When a substance reacts chemically, both as a base or acid it termed as an amphoteric solution.
These oxides when reacting with acid undergoes a neutralization reaction to form water and salt.
Example: aluminum oxide

Acidic characteristics: $AL_2O_3 + 6HCl \rightarrow 2Al_3+ + 6Cl– + 3H_2O$

Basic characteristics: $Al_2O_3 + 2OH– + 3H_2O \rightarrow 2[Al(OH)_4]–$

Neutral Oxides:

Neutral Oxide is one which neither has an acidic characteristic or a basic one
Example: NO, CO.

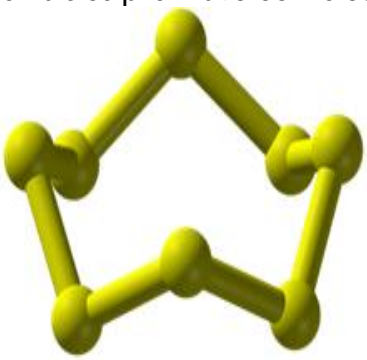
Sulphur And Its Allotropic Forms

Introduction to Sulphur And Its Allotropic Forms

In the periodic table Sulphur is found in group 16. 0.17 % of earth's crust consists of Sulphur.
It is a non-metal and is obtained as a byproduct after the production of natural gas.
Sulphur forms numerous allotropes, most important allotropes of Sulphur-
yellow rhombic sulphur (α-sulphur) and the monoclinic (β-Sulphur).

Rhombic sulphur (α-sulphur)

Rhombic sulphur is crystalline in nature and has octahedral shape.
On heating the solution of roll sulphur in CS2 we get rhombic sulphur.
It is yellow in colour with a melting point of 385.8K and specific gravity 2.06.
Rhombic sulphur cannot be dissolved in water but can be dissolved in benzene, ether, alcohol etc.
Rhombic Sulphur have S8 molecules.



Monoclinic Sulphur (β-Sulphur)

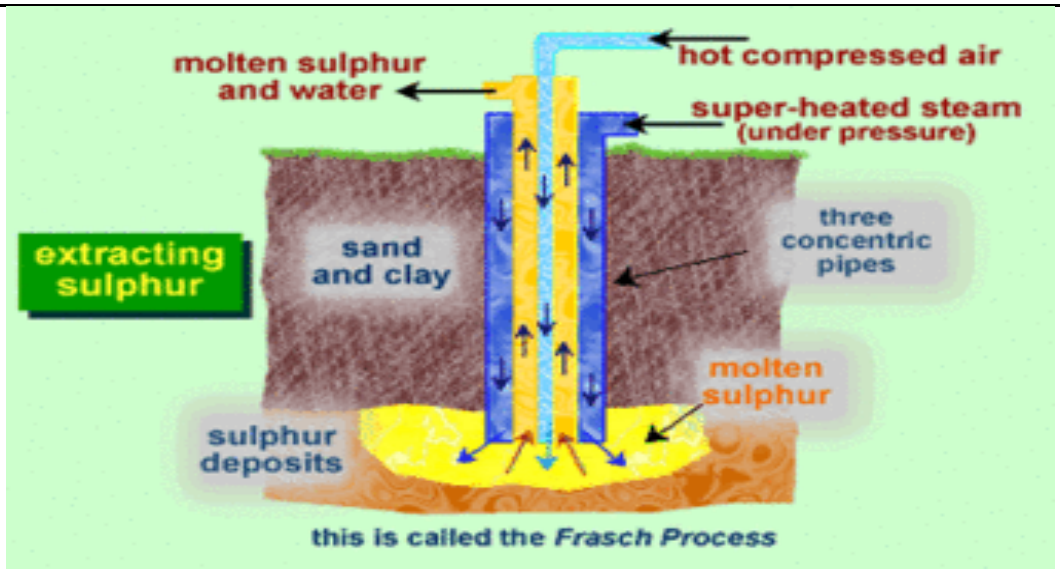
When we take a dish and melt rhombic Sulphur in that dish we obtain monoclinic sulphur after cooling it
In this process we make two holes in the crust and pour out the remaining liquid.
After this we get colourless needle-shaped crystals of β-sulphur when the crust is removed
monoclinic Sulphur have S8 molecules.

Uses of Sulphur

- Sulphur is used for the vulcanization of rubber.
- Many of its compounds are used as insecticides in crops.
- Many bleaching agents can be manufactured using sulphur.
- It is also used in the manufacturing of carbon disulphide which in turn is used in skin ointments and other such products.
- it also plays a vital role in our ecosystem by affecting the growth of plants.

Extraction of Sulphur by Frasch process:

Sulphur is melted underground (with the help of super-heated steam) and pumped upto the surface of the earth. Pumping is done by passing hot compressed air that produces foam of molten sulphur, which rises upwards and is collected in wooden tubs. Sulphur is then converted into solid blocks.



Reference pages

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https://sciencenotes.org/water-glass-water-glass-sodium-silicate-facts/
https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_(Saito)/04%3A_Chemistry_of_Nonmetallic_Elements/4.03%3A_Oxygen_and_oxides_(Part_1)
https://byjus.com/chemistry/classification-of-oxides/

Lesson plan

https://open.alberta.ca/dataset/8876d2c5-e6ad-4cea-ae02-f1dc00e63076/resource/dcacf727-dc37-463e-8665-30d293f7159c/download/6136596-2011-nanotechnology-lesson-plans-grade-9-carbon-nanocaper.pdf

Worksheet

Q1:
Carbon has many allotropes. Which of the following allotropes of carbon has a simple molecular structure?

A Buckminsterfullerene
B Diamond
C Graphene
D Graphite

Q2:
Which of the following is the best description of graphene?

A Spherical shells of carbon atoms arranged into pentagons and hexagons
B A one-atom-thick sheet of carbon atoms arranged into hexagons
C A one-atom-thick sheet of carbon atoms in a diamond-like arrangement
D Cubic lattices of carbon atoms in a diamond-like arrangement
E A one-atom-thick sheet of carbon atoms folded into a cylinder

Q3:
Which of the following features of fullerenes makes them suitable for use as industrial catalysts?

A High surface area
B Low density
C Dark color
D Low solubility

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E Flammability

Q4:

Which feature of graphite is responsible for its electrical conductivity?

A Strong covalent bonds

B A high sublimating temperature

C Weak interlayer interactions

D Delocalized electrons

Q5:

Which of the following structural features explains why diamond does not conduct electricity?

A In diamond, there is a large surface-area-to-volume ratio.

B In diamond, carbon atoms form layers that can slide over each other.

C In diamond, only the core electrons are free to move.

D In diamond, there are no ions or free electrons to carry the charge.

E In diamond, the electrons are trapped inside a hollow-shaped structure.

Q7:

Which of the following statements best describes an allotrope?

A An element that can exist either as a solid, a liquid, or a gas

B A large molecular structure consisting of two or more elements

C A mixture of a metal with another element

D An element that can exhibit different colors

E Two or more different molecular forms of the same element in the same physical state

Q8:

Which of the following is not an allotrope of carbon?

A Graphene

B Fullerene

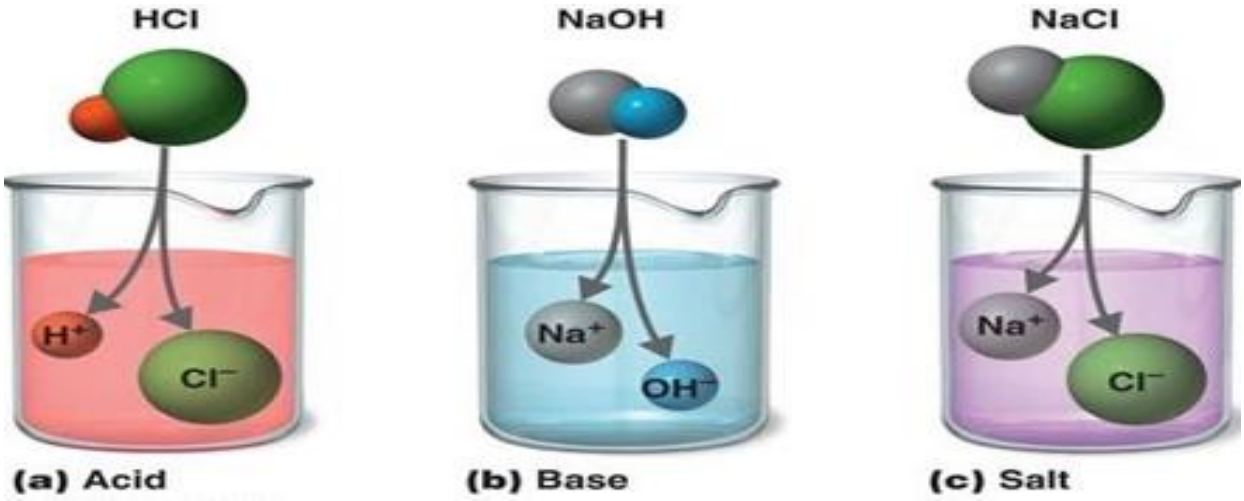
C Graphite

D Diamond

E Silica

Chapter 02

Acid, Bases and Salts



Chapter	Understandings	Skills	Practical
Acid, Bases and Salts • **Concepts of Acids and Bases** • **Arrhenius Concept of Acids and Bases** • **Bronsted Concept of Acids, and Bases** • **Lewis Concept of Acids and Bases** • **pH Scale** **Salts** • **Preparation** • **Types of** • **Uses of some Salts**	Students will be able to: • Define and give examples of Arrhenius acids and bases. (Understanding) • Use the Bronsted-Lowry theory to classify substances as acids or bases, or as proton donors or proton acceptors. (Applying) • Classify substances as Lewis acids or bases. (Analyzing) • Write the equation for the self-ionization of water. (Remembering) • Given the hydrogen ion or hydroxide ion concentration, classify a solution as neutral, acidic, or basic. (Applying) • Complete and balance a neutralization reaction. (Applying)	Students will be able to: • Use litmus paper, pH paper and other indicators for measuring pH of solutions. (Applying) • Perform acid base titrations and related calculations. (Analyzing)	• Sodium hydroxide is neutralized with hydrochloric acid to produce the soluble salt sodium chloride in solution. **Titration** • KMNO4 is standardized with Oxalic acid. **Redox Titration.** (NEW) • **To determine the pH level of saliva and any citrus fruit than compare them. Also write effects pH level of your saliva.**

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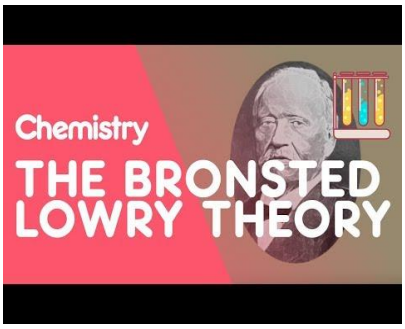
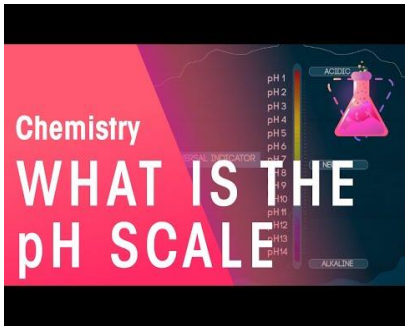
Videos

Acid, Base and salt



Bronsted Lowry Theory



pH scale

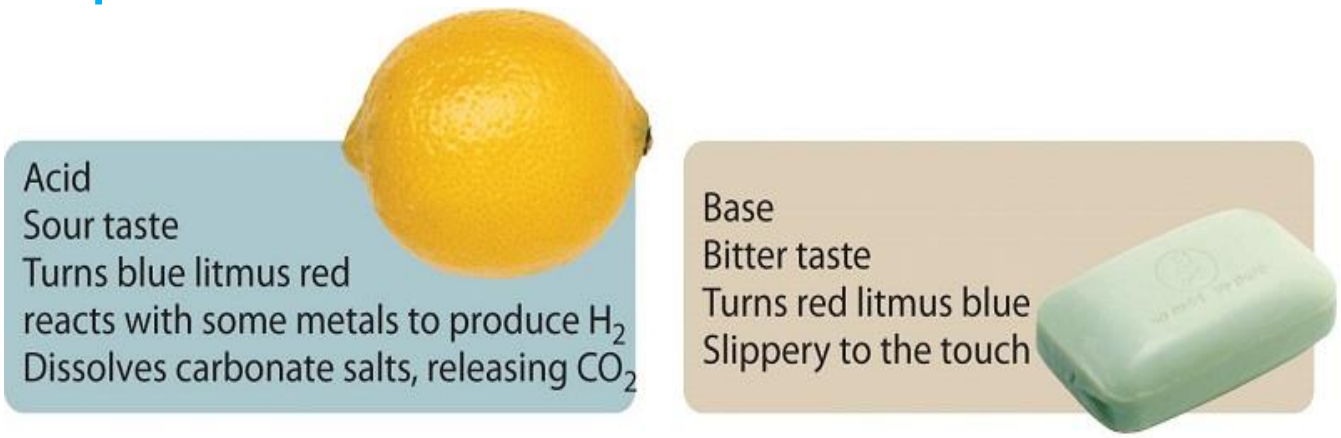
What are Salts?

Neutralization

Test pH level of saliva (Practical)

KMNO4 is standardized with Oxalic acid. Redox Titration Practical

Chapter Overview



Physical and chemical properties of Acids

- Acids have long been recognized as a distinctive class of compounds whose aqueous solutions exhibit the following properties:
- A characteristic sour taste.
- Changes the color of litmus from blue to red.
- Reacts with certain metals to produce gaseous H_2.
- Reacts with bases to form a salt and water.
- Acidic solutions have a pH less than 7, with lower pH values corresponding to increasing acidity. Acids can conduct electricity.

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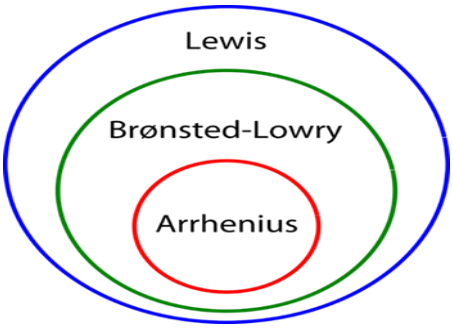
- Some Acids are highly corrosive in nature which means that they corrode or rust metals.
- Acids tend to evolve hydrogen gas whilst reacting with an active metal such as Zn, Mg, etc.
- Acids lose their acidity when mixed with a base.
- When equal amounts of acid and base are combined the process of neutralization occurs and salt and water is formed,
- Acids react with carbonates and hydrogen carbonates to form a salt, water, and carbon dioxide gas.
- Extremely active metals such as Potassium (K), Calcium (Ca), Sodium (Na), etc tend to explode when combined with acids.
- Weak Acids like Carbonic Acid doesn't act with any metal at all.
- Common examples of acids include acetic acid (in vinegar), sulfuric acid (used in car batteries), and tartaric acid (used in baking)

Physical and chemical properties of Base

- Bases change the colour of litmus from red to blue.
- They are bitter in taste.
- They can conduct electricity.
- Bases feel slippery or soapy.
- Bases lose their basicity when mixed with acids.
- Bases react with acids to form salt and water. This process is called Neutralisation Reaction(Read)..
- Bases like sodium hydroxide, potassium hydroxide, etc are used as electrolytes.
- Alkalis are bases that produce hydroxyl ions (OH-) when mixed with water.
- Strong alkalis are highly corrosive in nature whereas other alkalis are mildly corrosive.
- The pH value of bases ranges from 8-14.
- Alkalis and ammonium salts produce ammonia.
- Hydrogen gas is evolved when metals react with a base.
- Bases are classified on the basis of strength, concentration and acidity.
- The different kinds of acids are strong base acid, weak base acid, concentrated base, dilute base, monoacidic base, diacidic base and triacidic base.

Theories of Acid and Base

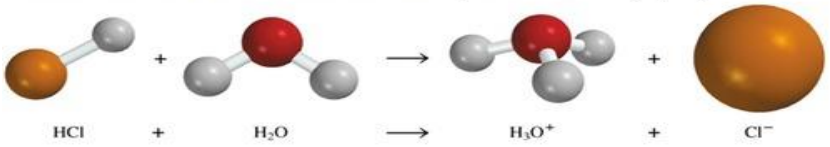


Our concepts of acids and bases have grown from the fundamental ideas of Arrhenius to Brønsted-Lowry to Lewis. Each step adds to our understanding of the world around us and makes the "big picture" even bigger.

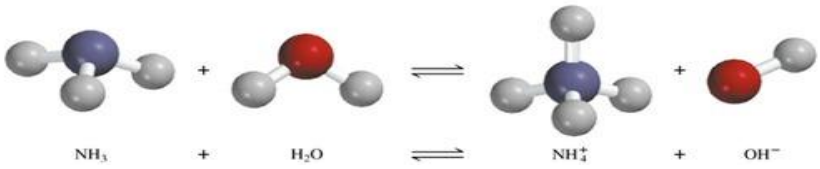
Arrhenius theory of Acid and Base

Arrhenius's work with Friedrich Wilhelm Ostwald in establishing the presence of ions in aqueous solution in 1884. This led to Arrhenius receiving the Nobel Prize in Chemistry in 1903.
As defined by Arrhenius:
An Arrhenius acid is a substance that dissociates in water to form hydrogen ions (H^+). In other words, an acid increases the concentration of H^+ ions in an aqueous solution. This protonation of water yields the hydronium ion (H_3O^+); in modern times, H^+ is used as a shorthand for H_3O^+ because it is now known that a bare proton (H^+) does not exist as a free species in aqueous solution.
An Arrhenius base is a substance that dissociates in water to form hydroxide (OH^-) ions. In other words, a base increases the concentration of OH^- ions in an aqueous solution.

Arrhenius acid is a substance that produces H^+ (H_3O^+) in water



Arrhenius base is a substance that produces OH^- in water



Limitations of the Arrhenius Definition

The Arrhenius definitions of acidity and alkalinity are restricted to aqueous solutions and refer to the concentration of the solvated ions. Thus, the Arrhenius definition can only describe acids and bases in an aqueous environment.

Bronsted-Lowry Theory of Acid and Base

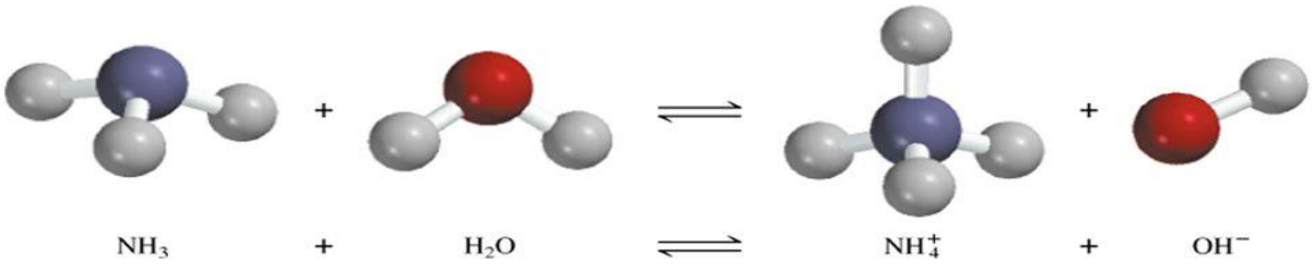
Johannes Nicolaus Brønsted and Thomas Martin Lowry, in 1923, both independently proposed an alternative definition of acids and bases. In this newer system,

Bronsted-Lowry acids were defined as any molecule or ion that is capable of donating a hydrogen cation (proton, H^+).

Bronsted-Lowry base is a species with the ability to gain, or accept, a hydrogen cation.

A Brønsted-Lowry acid is a proton donor

A Brønsted-Lowry base is a proton acceptor



base acid

Brønsted-Lowry acid/base reaction can be visualized in the form:

acid + base ⇌⇌ conjugate base + conjugate acid

Amphoteric: Having the characteristics of both an acid and a base; capable of both donating and accepting a proton (amphiprotic).

Conjugate acid: The species created when a base accepts a proton.

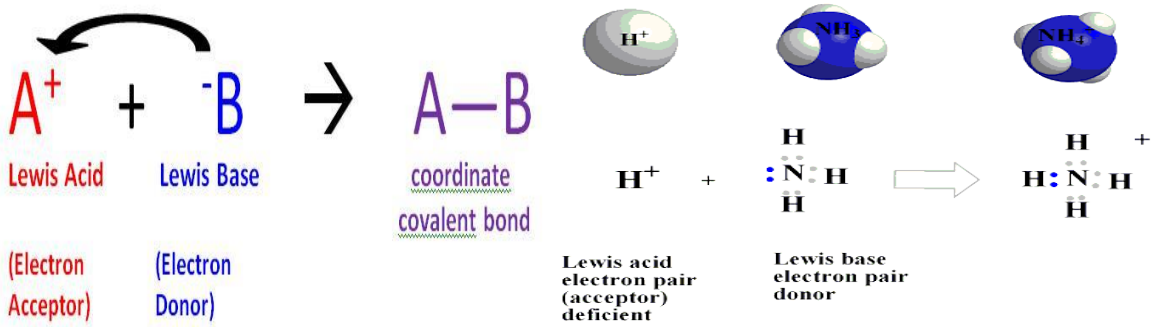
Conjugate base: The species that is left over after an acid donates a proton

Lewis Theory of Acids and Bases

Gilbert Lewis (1875–1946) proposed a third theory of acids and bases that is even more general than either the Arrhenius or Brønsted-Lowry theories.

A **Lewis acid** is a substance that accepts a pair of electrons to form a covalent bond.

A Lewis base is a substance that donates a pair of electrons to form a covalent bond. So, a Lewis acid-base reaction is represented by the transfer of a pair of electrons from a base to an acid



The lone pair on the nitrogen atom is transferred to the hydrogen ion, making the NH_3 a Lewis base while the H^+ is a Lewis acid.

Summary of Acid Base Theories

Type	Acid	Base
Arrhenius	H^+ ions in solution	OH^- ions in solution
Bronsted-Lowry	H^+ donor	H^+ acceptor
Lewis	electron-pair acceptor	electron-pair donor

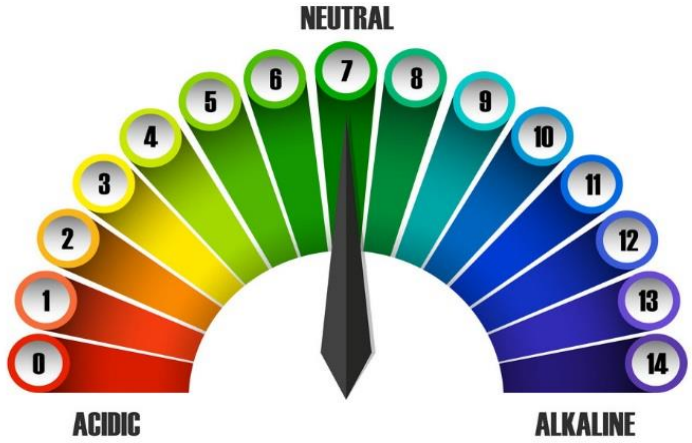
Neutralization Reaction

Neutralization is a type of chemical reaction in which a strong acid and strong base react with each other to form water and salt

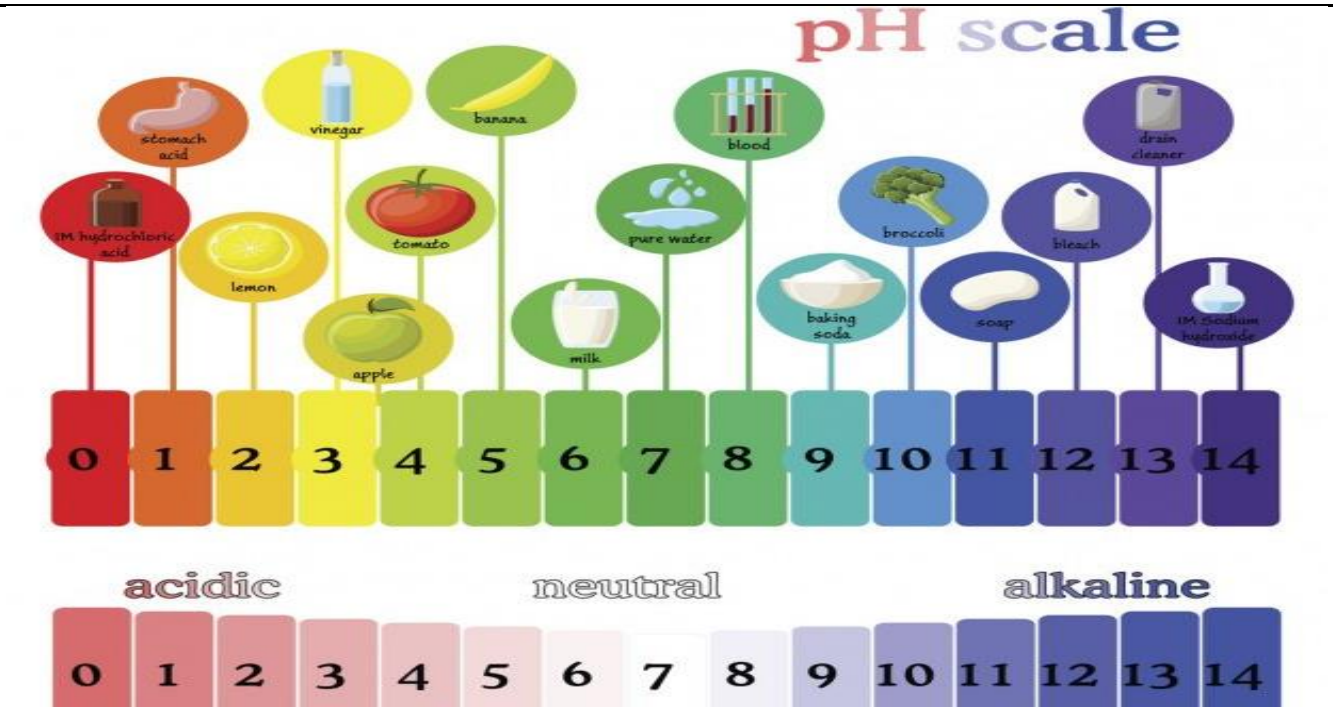
$$\underset{\text{Acid}}{HCl} + \underset{\text{Base}}{NaOH} \rightarrow \underset{\text{Salt}}{NaCl} + \underset{\text{Water}}{H_2O}$$

$$\underset{\text{Acid}}{HBr} + \underset{\text{Base}}{KOH} \rightarrow \underset{\text{Salt}}{KBr} + \underset{\text{Water}}{H_2O}$$

PH (power/potential of hydrogen)



PH, quantitative measure of the acidity or basicity of aqueous or other liquid solutions. A solution with a pH less than 7 is considered acidic; a solution with a pH greater than 7 is considered basic, or alkaline.
The measurement was originally used by the Danish biochemist S.P.L. Sørensen to represent the hydrogen ion concentration, expressed in equivalents per litre, of an aqueous solution: $pH = -\log[H^+]$



Calculation of pH from $[H_3O^+]$

What is the pH of stomach acid, a solution of HCl with a hydronium ion concentration of 1.2×10^{-3} *M*?

Solution

$pH = -\log[H_3O^+]$

$= -\log(1.2 \times 10^{-3})$

$= -(-2.92) = 2.92$

Calculation of Hydronium Ion Concentration from pH

Calculate the hydronium ion concentration of blood, the pH of which is 7.3 (slightly alkaline).

Solution

$pH = -\log[H_3O^+] = 7.3$

$\log[H_3O^+] = -7.3$

$[H_3O^+] = 10^{-7.3}$ or $[H_3O^+]$ = antilog of -7.3

$[H_3O^+] = 5 \times 10^{-8}$ *M*

(On a calculator take the antilog, or the "inverse" log, of -7.3, or calculate $10^{-7.3}$.

Check Your Learning

Calculate the hydronium ion concentration of a solution with a pH of -1.07.

Answer: 12 M

Worksheet of pH and pOH numerical with answers.

w335-ph-worksheet-3.pdf

What is Salt in Chemistry?

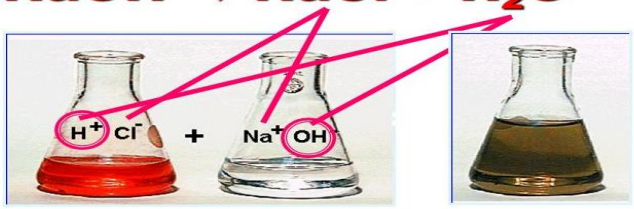
- Salt is an ionic compound that contains a cation (base) and an anion (acid).
- It is present in large quantities in seawater, where it is the ***main mineral constituent***.
- Salt is essential for animal life and saltiness is one of the basic human tastes.
- Salt is an ionic compound that has a cation other than H^+ and an anion other than OH^- and is obtained along with water in the neutralization reaction between acids and bases.
- ***Eg:-*** *NaCl, $CuCl_2$ etc.*
- **Acid + Base → Salt + water**

- Sodium chloride is one of the best-known salt. One salt is known to almost everyone because of its widespread use in every day.

The example of
Hydrochloric acid + Sodium hydroxide (base)

ACID + BASE → SALT + WATER

$HCl + NaOH \rightarrow NaCl + H_2O$

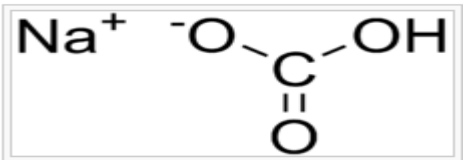


Salt water!

Types of Salt

1. Acidic Salt –

The salt formed by partial neutralization of a diprotic or a polyprotic acid is known as an acidic salt. These salts have ionizable H^+ ion along with another cation. Mostly the ionizable H^+ is a part of the anion. Some acid salts are used in baking.
For eg:- $NaHSO_4$, KH_2PO_4 etc.



$H_2SO_4 + NaOH \rightarrow NaHSO_4 + H_2O$

2. Basic or Alkali Salt –

The salt formed by the partial neutralization of a strong base by a weak acid is known as a basic salt. They hydrolyze to form a basic solution. It is because when hydrolysis of basic salt takes place, the conjugate base of the weak acid is formed in the solution.
For eg:- White lead ($2PbCO_3 \cdot Pb(OH)_2$).

3. Double salt –

The salts that contain more than one cation or anion are known as double salt. They are obtained by the combination of two different salts crystallized in the same ionic lattice.
For eg:- Potassium sodium tartrate ($KNaC_4H_4O_6.4H_2O$) also known as Rochelle salt.
4. Mixed Salts – The salt that consists of a fixed proportion of two salts, often sharing either a common cation or common anion is known as mixed salt.
For e.g. :- $CaOCl_2$

Properties of Salt

The compounds sodium chloride has very different properties from the elements sodium and chlorine. Saltwater contains ions and is a fairly good conductor of electricity.
This electrostatic force of attraction holds the ions together and a chemical bond is said to form between them.

Name of Salts	Uses
Sodium Chloride or Common Salt (NaCl)	• Used in cooking food as well as for cooking gas. • Used as a preservative in pickles and in curing meat and fish. • Used in the manufacture of soap. • Used to melt the ice in winter in cold countries. • Used for making chemical likes washing Soda, baking soda etc.
Sodium Hydroxide (NaOH)	• Used for making soap and detergent • Used for making artificial textile fibre (rayon) • Used in the manufacturing of paper • Used for purification of bauxite ore • Used in de-greasing metals, oil refining and making dyes and bleaches
Sodium Carbonate or Washing Soda ($Na_2CO_3.10H_2O$)	• Used as cleansing agent • Used for removing permanent hardness of water • Used in the manufacturing of glass, soap and paper
Baking Soda or Sodium Bi-carbonate ($NaHCO_3$)	• Used as neutralising agent (antacid) • Used for making baking powder • Used in fire extinguisher
Bleaching Powder or Calcium Hypochlorite	• Used as bleaching agent in cotton industry and paper industry for bleaching cotton and linen as well as wood pulp respectively • Used for disinfecting drinking water • Used for making chloroform ($CHCl_3$) • Used for making the wool unshrinkable
Plaster of Paris or Hemihydrate Calcium sulphate, $CaSO_4$ 1/2 H_2O	• Used in hospital for setting fractured bone • Used for making toys, decoration material cheap ornament, chalk etc • Used for fire-proofing material • Used for making surface smooth.

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https://slideplayer.com/slide/10888409/

lesson plan

https://slideplayer.com/slide/2986985/

worksheet

What do You Know About Acids and Bases?

Letter	Matching	
	1. Acid	A. To mix acids and bases to cancel each other out and make water and salt
	2. Base	B. A compound that adds H+ ions to water
	3. Neutral	C. Equal number of H+ and OH- ions; water is an example
	4. Neutralize	D. A compound that adds OH- ions to water.
	5. Acid Rain	E. When pollution causes rain to have a pH less than 5.6.
	6. pH	F. The measure of how acidic or basic a solution is
	7. Salt Water	G. A compound that adds a few OH- ions to water
	8. Strong Acid	H. The product of a neutralization reaction between an acid and a base
	9. Weak Base	I. A compound that adds a few H+ ions to water
	10. Weak Acid	J. A compound that adds a lot of H+ ions to water.

Is it an Acid or a Base?		
Circle the acids and underline the bases		
11. HCl	17. H_2CO_3	23. apple juice
12. $Mg(OH)_2$	18. NaOH	24. lemonade
13. H_3PO_4	19. $Al(OH)_3$	25. soap
14. KOH	20. HBr	26. laundry detergent
15. $Ca(OH)_2$	21. H_2SO_4	27. soft drinks
16. LiOH	22. H_2O	28. bathroom cleaner

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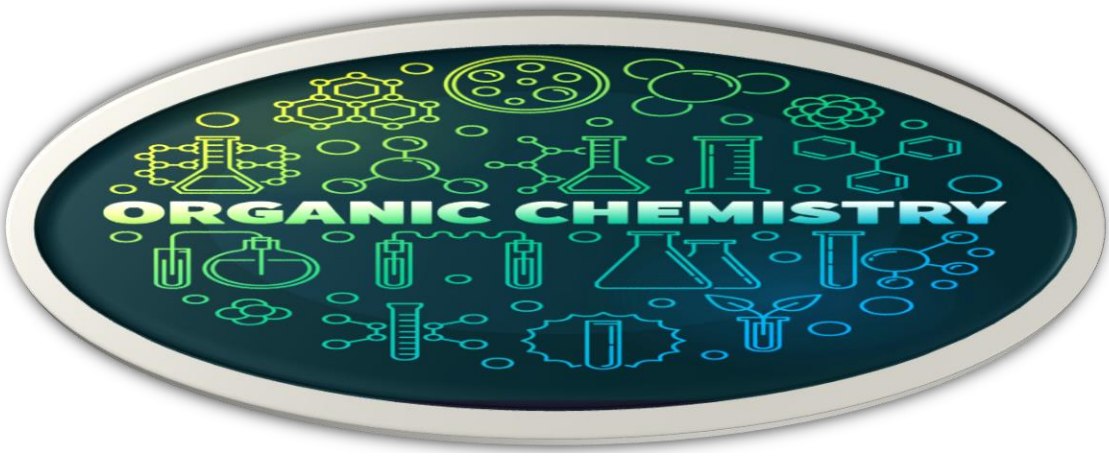
Chapter 03

Organic Chemistry



Chapter	Understandings	Skills
• Organic Compounds • Sources of Organic Compounds • Coal • Petroleum • Natural Gas • Plants • Synthesis in the Lab • Uses of Organic Compounds • Alkanes and Alkyl Radicals • Functional Groups • Functional Groups Containing Carbon, Hydrogen and Oxygen • Functional Groups Containing Carbon, Hydrogen and Nitrogen • Functional Groups Containing Carbon, Hydrogen and Halogens • Double and Triple Bond	Students will be able to: • Recognize structural, condensed, and molecular formulas of the straight chain hydrocarbons up to ten carbon atoms. (Understanding) • Identify some general characteristics of organic compounds. (Remembering) • List some sources of organic compound (Applying) • List the uses of organic compounds (remembering) • Recognize and identify a molecule's functional groups.(Understanding) • Name the alkanes up to decane. (Remembering) • Convert alkanes into alkyl radicals. (Applying) • Differentiate between alkanes and alkyl radicals. (Analyzing) • Define functional group. (Remembering) • Differentiate between different organic compounds on the basis of their functional groups. (Analyzing) • Classify organic compounds into straight chain, branched chain and cyclic compounds. (Understanding)	Students will be able to: Distinguish between saturated and unsaturated compounds using iodine, bromine and potassium permanganate solutions. (Applying)

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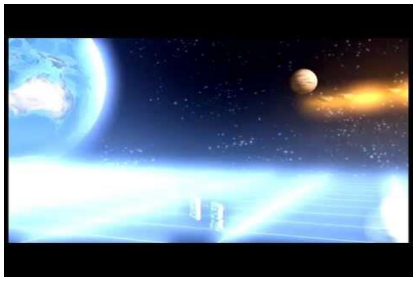
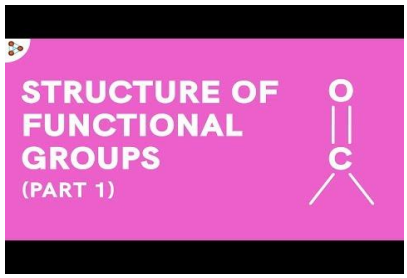
Videos



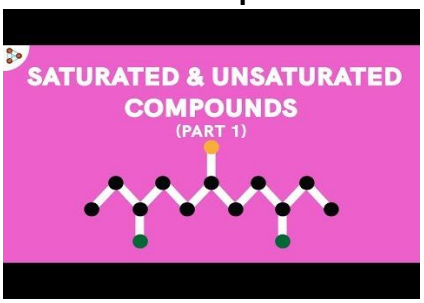
Coal Formation

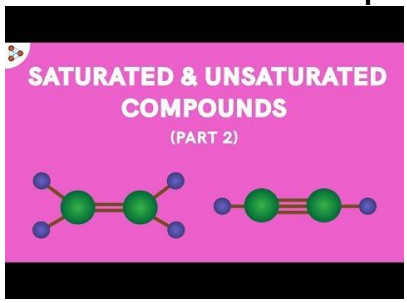
Fuctional Groups



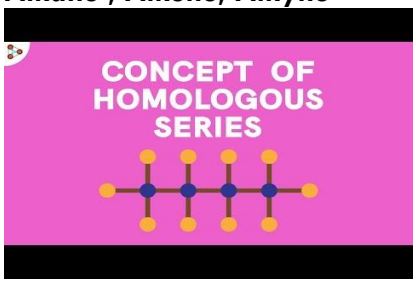
Structure Of Functional Groups

Alkane , Alkene, Alkyne





Saturated and unsaturated hydrocarbons



Homologous series

Chapter overview

What are Organic Compounds?

There are so many materials catering to our various needs on a daily basis. We drink water, eat food, breathe air, go to school etc. All these things are available to us, but are all free of cost and readily accessible without fear of being depleted one day?

The compounds in solid, liquid or gaseous state which contain carbon in its molecule are known as organic compounds. There are a large number of organic compounds and therefore a proper systematic classification was required.

SOURCES OF ORGANIC COMPOUNDS.

All organic compounds at one time came from plants or animals. many of our most importants substance are still derived from these sources directly or indirectly.

1) PLANTS AND ANIMALS

- Many organic compounds are obtained directly from plant and animals sources by suitable met few familiar EXAMPLE are carbohydrates (cellulose, sugar, and starches.)
- proteins (silk, wool, casein, and food proteins)
- fats and oils(cottonsed soybean oils lard, butter)
- alkaloids (quinine ,morphine, strychnine) hormones, vitamins, perfumes, flavors and resins.

2) NATURAL GAS AND PETROLEUM.

- Natural gas and petroleum are now the major sourcse of organic compounds.
- They are used as fuels and also, through synthetic organic reaction. Such as synthetic rubber, explosive, and plastic.

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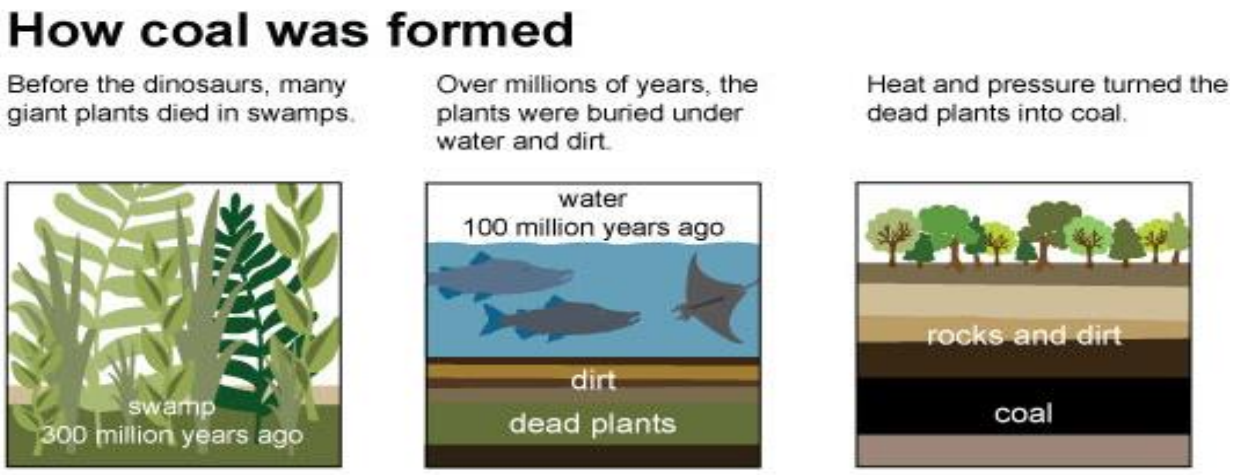
3) COAL

- Coal is another major sources of organic compounds.it yield coke and coal-tar on pyrolysis or destructive distillation.
- More than 200 organic compounds have been directly isolated from coal-tar.
- These coal-tar products from the starting materials for the manufacture of thousands of useful aromatic compounds, including pefumes, drugs, dyes, photographic developers, and other.

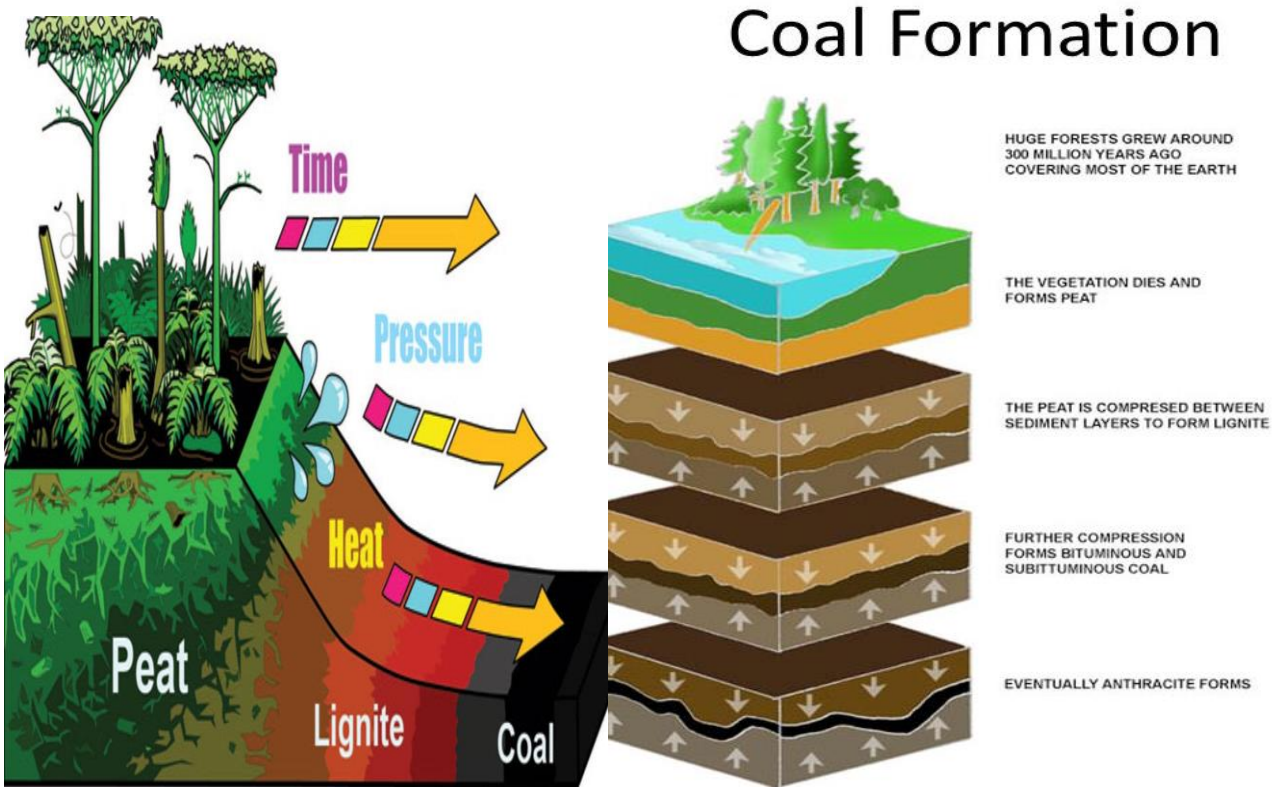


Over time, heat and pressure from geological processes transformed these materials into coal.
Since these are formed from essentially fossils, they are also known as fossil fuels.

Types Of Coal

Coal is a readily combustible rock containing more than 50% by weight of carbon.
Coal formed can be of three types depending on the amount of oxygen, carbon and hydrogen they contain, they are:

- Lignite
- Bituminous
- Anthracite



Petroleum

- Petroleum is a fossil fuel that naturally occurs in the liquid form created by the decomposition of organic matter beneath the surface of the earth millions of years ago.
- These fossil fuels are then refined into usable substances such as petrol, kerosene etc.
- It is formed by the combination of hydrocarbons and other substances, mainly sulphur.
- When first collected in its natural form, it is termed as crude oil.
- Refining petroleum thus obtained yields many useful products. Let's have a look at it.

Products of Petroleum

Few of the products obtained from petroleum are:

- Gasoline
- Diesel oil
- Kerosene
- Tar
- Heavy fuel oil
- Petroleum coke
- Lubricants
- Special Naphthas
- Paraffin wax
- Aviation Gasoline

Uses of Petroleum

Petroleum is one of the most important and widely used fuels in today's time. Some of its advantages are:

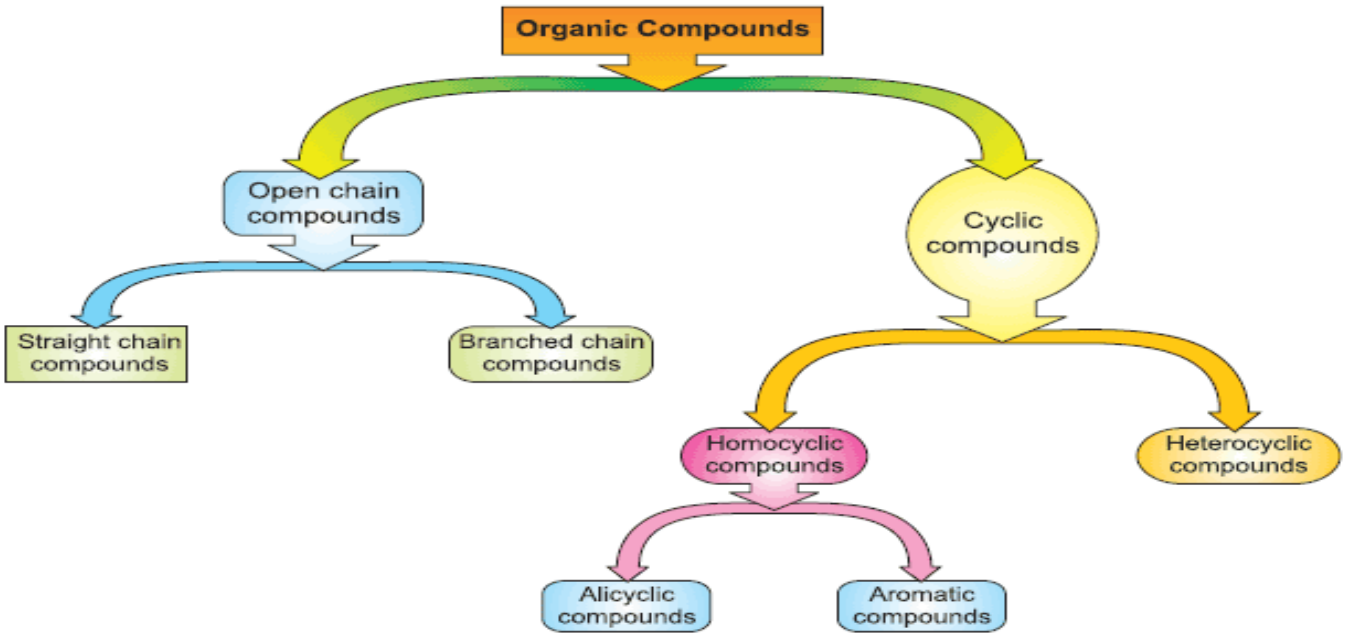
- These are transportation fuels, i.e, via air, water or land.
- Diesel is used to power turbines for the production of electricity in large scale industries.
- Oil is used to produce electricity at homes and shops.
- Oils help lubricate different types of high-end machines used in different industries, hospitals etc.
- Kerosene is used for domestic purposes at home.
- Used by chemical industries to produce plastic, dyes, paints, synthetic rubber, pesticides, perfumes etc.

Uses of Organic compound

- Organic molecules are used in a variety of industries in human society, including food, pharmaceuticals, fuels, and building, to name but a few.
- Organic compounds are essential because they contain carbon in all living organisms. They are the basic components that move the world in many of the cycles. For example, the carbon cycle.
- Compounds used as medicinal products are most usually organic compounds, sometimes divided into large groups of small organic molecules (e.g., atorvastatin, fluticasone, clopidogrel) and "biologics" (infliximab, erythropoietin, insulin glargine), the latter more widely used as protein medicinal products.

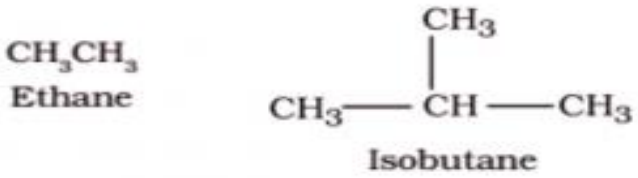
Classification of organic compound

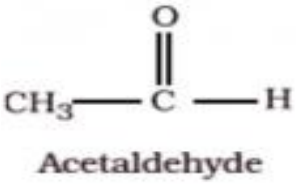
Organic compounds can be broadly classified as acyclic (open chain) or cyclic (closed chain). Moving on to their classification in detail:

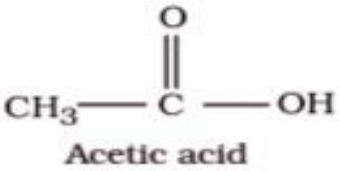


1. Acyclic or Open Chain Compounds:

These compounds are also known as aliphatic compounds, they have branched or straight chains. Following are the examples in this category.







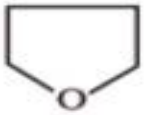
2. Alicyclic or Closed Chain or Ring Compounds:

These are cyclic compounds which contain carbon atoms connected to each other in a ring (homocyclic). When atoms other than carbon are also present then it is called as heterocyclic. Examples of this type are as follows:

Cyclopropane

Cyclohexane

Cyclohexene



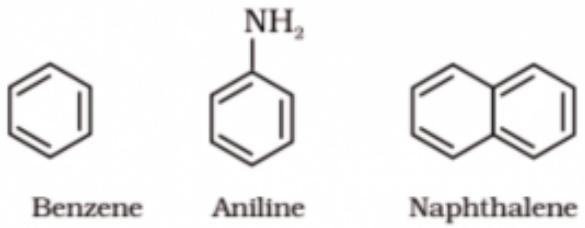
Tetrahydrofuran

Examples of Alicyclic or closed chain or ring compounds
They exhibit some properties similar to aliphatic compounds.

3. Aromatic Compounds

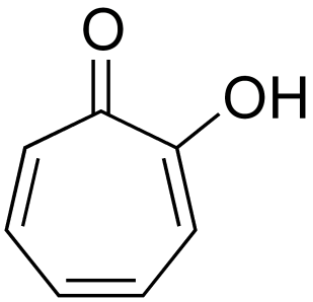
They are a special type of compounds which contain benzene and other ring related compounds. Similar to alicyclic, they can also have heteroatoms in the ring. Such compounds are called heterocyclic aromatic compounds. Some of the examples are as follows:

(a) Benzenoid aromatic compounds



Examples of Aromatic compounds

(b) Non-benzenoid aromatic compounds



Example of Non-benzenoid aromatic compound

4. Heterocyclic Aromatic Compounds

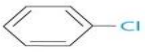
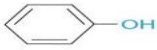
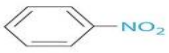
Examples of Heterocyclic aromatic compounds

Classification of Organic compounds on the basis of functional groups

Organic compounds can also be classified on the basis of functional groups into families or homologous series.

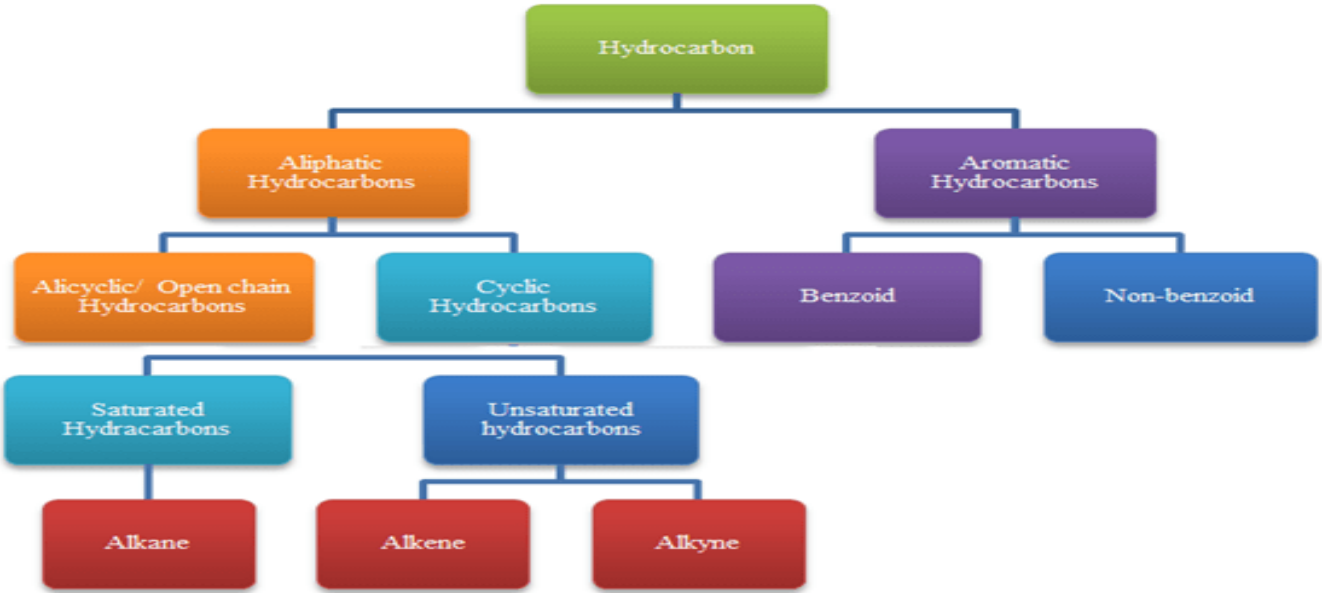
1. Functional group

The functional group can be defined as an atom or a group of atoms that are joined together in a specific manner which is responsible for the characteristic chemical properties of organic compounds. Examples, in this case, are the hydroxyl group -OH, aldehyde group -CHO and carboxylic acid group -COOH.

Class	General Formula	Example	Common Name (Systematic Name)	Common Suffix/Prefix (Systematic)
Hydrocarbons				
Alkanes	RH	CH_3CH_3	ethane	-ane
Alkenes	RR′C═CR″R‴	$H_2C{=}CH_2$	ethylene (ethene)	-ene
Alkynes	RC≡CR′	HC≡CH	acetylene (ethyne)	(-yne)
Arenes	ArH[a]		benzene	-ene
Halogen-Containing Compounds				
Alkyl halides	RX	CH_3CH_2Cl	ethyl chloride (chloroethane)	halide (halo-)
Aryl halides	ArX[a]		chlorobenzene	halo-
Oxygen-Containing Compounds				
Alcohols	ROH[a]	CH_3CH_2OH	ethyl alcohol (ethanol)	-ol
Phenols	ArOH[b]		phenol	-ol
Ethers	ROR′	$H_3CH_2COCH_2CH_3$	diethyl ether	ether
Aldehydes	RCHO	$CH_3\overset{O}{\overset{\|}{C}}H$	acetaldehyde (ethanal)	-aldehyde (-al)
Ketones	RR′C═O	$CH_3\overset{O}{\overset{\|}{C}}CH_3$	acetone (2-propanone)	-one
Carboxylic acids	RCO_2H	$CH_3\overset{O}{\overset{\|}{C}}OH$	acetic acid (ethanoic acid)	-ic acid (-oic acid)
Carboxylic Acid Derivatives				
Esters	RCO_2R'	$CH_3\overset{O}{\overset{\|}{C}}OCH_3$	methyl acetate (methyl ethanoate)	-ate (-oate)
Amides	RCONHR′	$CH_3\overset{O}{\overset{\|}{C}}NHCH_3$	*N*-methylacetamide	-amide
Nitrogen-Containing Compounds				
Amines	RNH_2, RNHR′, RNR′R″	$CH_3CH_2NH_2$	ethylamine	-amine
Nitriles	RC≡N	$H_3CC{\equiv}N$	acetonitrile	-nitrile
Nitro compounds	$ArNO_2$[a]		nitrobenzene	nitro-

2.Hydrocarbons:

Hydrocarbons are organic compounds that contain **only** carbon and hydrogen. The four general classes of hydrocarbons are: alkanes, alkenes, alkynes.



3. Homologous series

A group or a series of organic compounds in which each member contains the same characteristic functional group and differs from each other by a fixed unit form a homologous series and therefore its members are known as homologous. The members of the homologous series can be represented by a

general formula and the successive members differ from each other in the molecular formula by a CH_2 unit. There are a number of homologous series in organic chemistry such as alkanes, alkenes, alkynes, haloalkanes, alkanols, amines, etc

Homologous Series	General Formula	Functional Group	Example
Alkanes	C_nH_{2n+2}		Methane, CH_4 Ethane, C_2H_6 Propane, C_3H_8 Butane, C_4H_{10}
Alkenes	C_nH_{2n}	C=C	Ethene, C_2H_4 Propene, C_3H_6 Butene, C_4H_8
Alcohols	$C_nH_{(2n+1)}OH$	-OH	Methanol, CH_3OH Ethanol, C_2H_5OH Propanol, C_3H_7OH Butanol, C_4H_9OH
Carboxylic Acids	$C_nH_{(2n+1)}COOH$	-COOH	Methanoic Acid, HCOOH Ethanoic Acid, CH_3COOH Propanoic Acid, C_2H_5COOH Butanoic Acid, C_3H_7COOH

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Worksheet

Organic Chemistry Packet

Alkanes, Alkenes, Alkynes

1. List the prefixes for hydrocarbons

Number of Carbons	Prefix		Number of Carbons	Prefix

2. Give the general formula for each type of hydrocarbon:
   a. Alkane
   b. Alkene
   c. Alkyne
3. Give the formula for the following:
   a. An alkane with 5 carbons
   b. An alkene with 3 carbons
   c. An alkyne with 8 carbons
4. Draw the structural formula for each molecule with question 3:
   a.
   b.
   c.

Prepared by: Ms. Saima Pervaiz Ahmed under the supervision of Madam Naheed Muneer Siddiqui

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Lesson plan

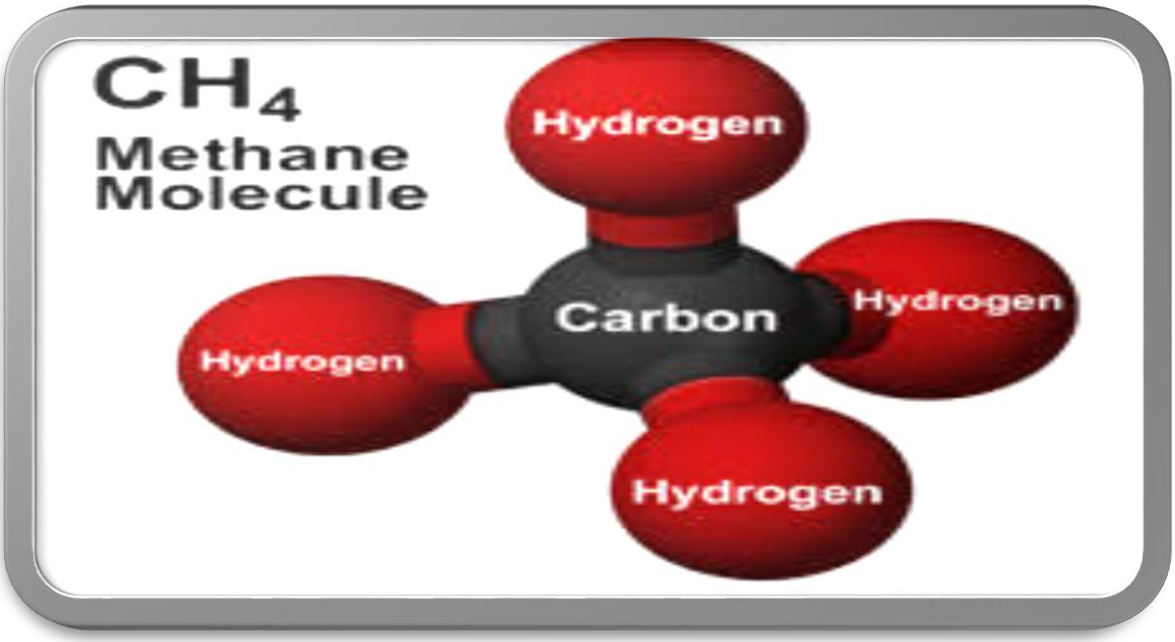
LESSON plan
organic chemistry.pd

LESSON PLAN

Course Name: CHEM 1014 – Introduction to Chemistry **Topic:** Introduction to Organic Chemistry	**Week: 6** **Date: Thurs. Feb. 13, 2014**
Introduction: This lesson, Introduction to organic chemistry, between Electronegativity and Chemical Reactions and Quantities which will be discussed in week 7.	
Outcomes for 2 hour lesson: • To define organic compounds • To differentiate between the various types of organic compounds • To draw the molecular formulas according to the expanded, condensed and line bond structures • To name organic compounds by using the IUPAC system • To identify between same compounds and	
Objectives: By the end of the lesson students will be able to: • Name organic compounds by using the IUPAC system	
Formative Assessments: • One slide with structures to be named by the students and their partners as a learning check. 5 min	
Summative Assessment/s: • Quiz week 7 a combination of multiple choice questions, true and false and short answer questions. (30 min. and worth 10%)	
Motivation: (5 min) • Video on "What does organic mean to you?" 2.17 min • http://www.youtube.com/watch?v=b2lSR64kbDEReflect on the video • Ask the students what they understood from the video (3min)	
Comprehension: 30 min • Lecturing with question/ answer strategy to engage students • Delivery method by powerpoint slides • Use of whiteboards to practice naming and drawing compounds	

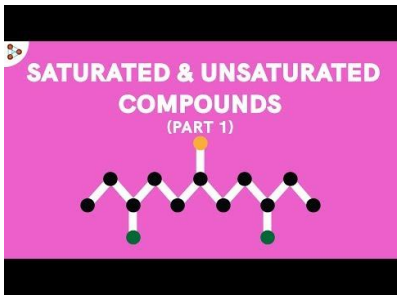
Chapter 04

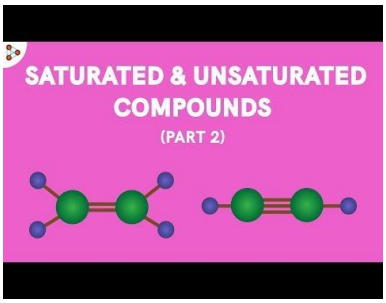
Hydrocarbons



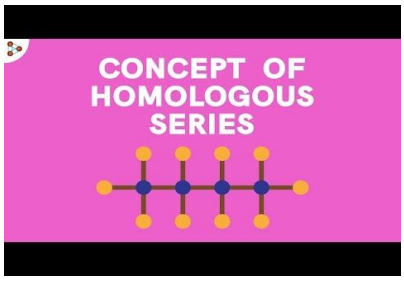
Chapter	Understandings	Skills
Hydrocarbons • Preparation • Hydrogenation of Alkenes and Alkynes • Important Reactions • Halogenation • Combustion • Preparation • Dehydration of Alcohols Dehydrohalogenation of Alkyl Halides • Important Reactions • Addition of Halogens • Addition of Hydrogen Halides Oxidation With KMnO4 • Alkynes Preparation Dehalogenation of Adjacent Dihalides • Dehalogenation of Tetrahalides Important Reactions • Addition of Halogens	Students will be able to: • Explain why a systematic method of naming chemical compounds is necessary. (Analyzing) • Characterize a hydrocarbon. (Understanding) • Write a chemical equation to show the preparation of alkanes from hydrogenation of alkenes and alkynes and reduction of alkyl halides.(Remembering) • Draw structural formulas of alkanes, alkenes and alkynes up to 5 carbon atoms. (Understanding). • Write a chemical equation to show the preparation of alkenes from dehydration of alcohols.(Remembering). • Write a chemical equation to show the preparation of alkynes from Dehalogenation. (Remembering) • Write chemical equations showing halogenation for alkanes, alkenes and alkynes. (Remembering)	Students will be able to: Determine the boiling point of alcohol. (Applying)

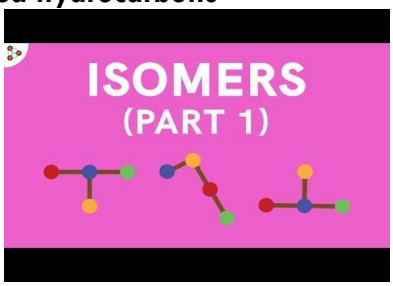
Videos

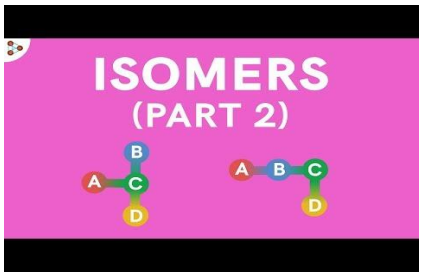




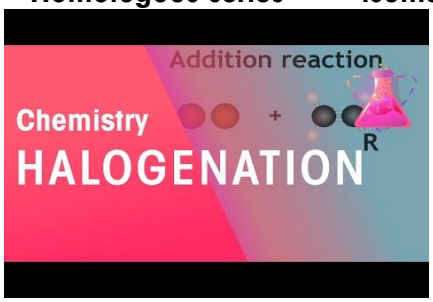
Saturated and unsaturated hydrocarbons

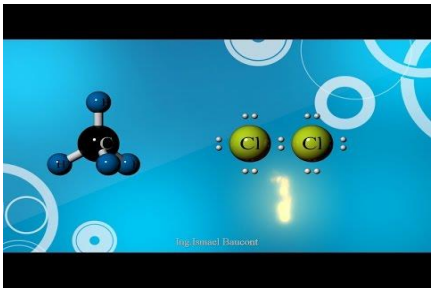






Homologous series **isomers formation in homologous series of alkane, alkene and alkyne**



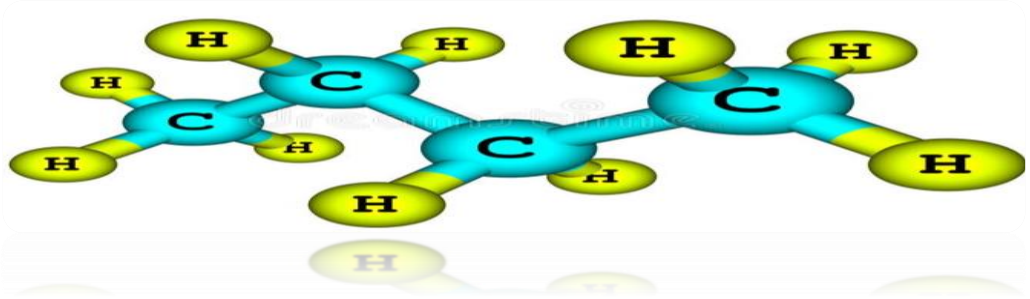


Halogenation **Halogenation in alkane(methane)**

Chapter overview

What are Hydrocarbons?

Hydrocarbons, as the name suggests, are organic compounds composed of elements carbon and hydrogen only. The study of hydrocarbons gives an insight into the chemical properties of other functional groups and their preparations.



Structure of Hydrocarbon

The molecular formula for these compounds is C_xH_y. The existence of hydrocarbons is seen in plants and trees. For example, Carotenes is an organic pigment which is found in green leaves and carrots. These hydrocarbons make up to 98% of natural crude rubber.

Classification and Types of Hydrocarbons

Older chemists classified hydrocarbons as either aliphatic or aromatic. The classification was done based on their source and properties. As such, it was found out that Aliphatic hydrocarbons were derived from chemical degradation of fats or oils whereas aromatic hydrocarbons contained substances that were a result of chemical degradation of certain plant extracts. However, today we classify hydrocarbons on the basis of structure and not merely on the origin.

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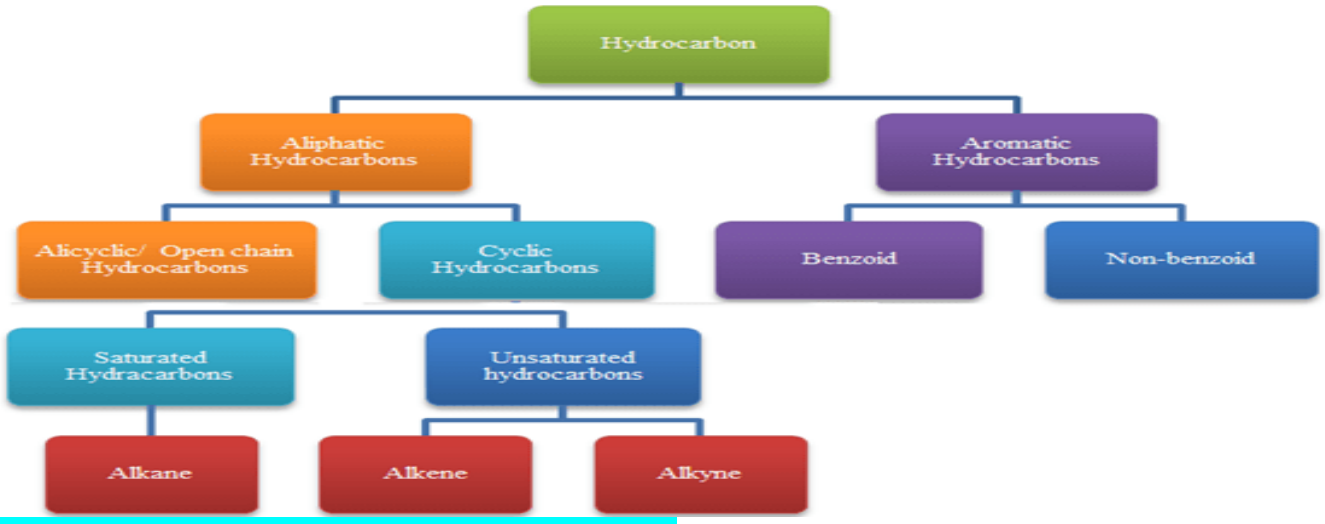


Classification of Hydrocarbons

Saturated Hydrocarbons: In these compounds, carbon-carbon atoms and carbon-hydrogen atoms are held together by single bonds.
These single bonded compounds are the simplest hydrocarbons.
These types of hydrocarbons don't have double or triple bonds. In terms of hybridization, they have Sp^3 hybridized carbon atom with no Sp^2 or Sp hybridized Carbon atoms.
They are together called as alkanes which have a general formula C_nH_{2n+2}. For example, $CH_4C_3H_6$.

Unsaturated Hydrocarbons: These compounds consist of a single, double or a triple bond between carbon-carbon atoms. The double-bonded compounds are called alkenes and the triple bonded compounds are called alkynes. The general formula for alkenes is C_nH_{2n} and for alkynes the general formula is C_nH_{2n-2}.

SATURATED HYDROCARBONS VERSUS UNSATURATED HYDROCARBONS

Saturated hydrocarbons	Unsaturated hydrocarbons
are hydrocarbons with only single covalent bonds	are hydrocarbons with multiple covalent bonds
Include alkanes	Include alkenes, alkynes, and aromatic hydrocarbons
Have a less amount of carbon and high amount of hydrogen	Have a high amount of carbon and less amount of hydrogen
Less reactive	More reactive
Burning in air result in a blue, non-sooty flam	Burning in air result in a yellow, sooty flame
Usually obtained from fossilized plant and animal materials	Usually obtained from plants

Alkanes	Alkenes	Alkynes
Alkanes are hydrocarbons in which all the linkages between the carbon atoms are single covalent bonds.	Alkenes are unsaturated aliphatic hydrocarbons which contain one double bond.	Alkynes are unsaturated aliphatic hydrocarbons which contain one triple bond.
Alkanes are saturated hydrocarbons with general formula C_nH_{2n+2}.	Alkenes are unsaturated hydrocarbons with general formula C_nH_{2n}.	Alkynes are unsaturated hydrocarbons with general formula C_nH_{2n-2}.
They are less reactive because of the non-availability of electrons in the single covalent bond.	Alkenes are most reactive than alkanes and alkynes because of the presence of a double bond.	Alkynes are more reactive than alkanes because of the presence of a triple bond.
They undergo substitution reaction.	They undergo addition reaction.	They undergo addition reaction.
Example: Ethane	Example: Ethene	Example: Ethyne

Cycloalkanes: These hydrocarbons possess one or multiple carbon rings. The hydrogen atom is attached to the carbon ring.

Aromatic Hydrocarbons: These are also called as arenes. Arenes are compounds which consist of at least one aromatic ring.

Aliphatic Hydrocarbons: They are straight chain structures having no rings in them.

Alicyclic Hydrocarbons: They are hydrocarbons having a ring structure in them. The carbons atoms can be Sp, Sp^2 or Sp^3 hybridized.

Properties of Hydrocarbons

Due to their different molecular structures, the empirical formula of hydrocarbons is also different from each other. For instance, alkanes, alkynes or alkenes, the amount of bonded hydrogen decreases in alkenes and alkynes.

Physical Properties of Alkane

- Alkanes with 10 C-atoms or less are generally gases at room temperatures more than 10 C-atoms, the molecules are gases or liquid.
- Alkanes generally having low boiling and melting points.
- Alkanes have weak Vanderwal's interaction.
- Alkanes are also *saturated hydrocarbons*.
- Alkanes are the simplest and least reactive hydrocarbon species containing only carbons and hydrogen.

$$C_nH_{2n+2}$$

General Molecular Formula for Alkanes: C_nH_{2n+2}

Molecular Formula	Name	Relative Molecular Formula	State at room temperature
CH_4	Methane	16	gas
C_2H_6	Ethane	30	gas
C_3H_8	Propane	44	gas
C_4H_{10}	Butane	58	gas
C_5H_{12}	Pentane	72	liquid
C_6H_{14}	Hexane	86	liquid
C_7H_{16}	Heptane	100	liquid
C_8H_{18}	Octane	114	liquid
C_9H_{20}	Nonane	128	liquid
$C_{10}H_{22}$	Decane	142	liquid

Chemical Properties of Alkanes

Alkanes are the least reactive type of organic compound. Alkanes are not absolutely unreactive. Two important reactions that they undergo are combustion, which is the reaction with oxygen and halogenation, which is the reaction with halogens.

1. Combustion

A combustion reaction is a chemical reaction between a substance and oxygen that proceeds with the evolution of heat and light. Alkanes readily undergo combustion reactions when ignited. When sufficient oxygen is present to support total combustion then carbon dioxide and water are the products.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy

$2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$ + energy

The exothermic nature of alkane combustion reactions explains the extensive use of alkanes as fuels. Natural gas, used in home heating is predominantly methane.

2. Halogenation

Halogenation of an alkane produces a hydrocarbon derivative in which one or more halogen atoms have been substituted for hydrogen atoms. An example of an alkane halogenation reaction is

CH_3-$CH_3 + Br_2 \rightarrow CH_3$-$CH_2$-Br + HBr

Alkane halogenation is an example of a substitution reaction a type of reaction that occurs often in organic chemistry.

A general equation for the substitution of a single halogen atom for one of the hydrogen atoms of an alkane is

R-H + $X_2 \rightarrow$ R-X + H-X

Preparation of Alkane

Preparation of Alkanes from unsaturated hydrocarbon: (methane preparation)

Alkane can be prepared from alkene and alkyne through the process of hydrogenation. In this process, dihydrogen gas is added to alkynes and alkenes in the present catalyst. This catalysts which are finely divided is like nickel, palladium or platinum to form alkanes..

$$CH-Cl + H_2 \xrightarrow{Zn,H^+} CH_4 + HCl$$

Preparation of Alkanes from carboxylic acid:

Preparation of alkanes from carboxylic acids:

Preparation of alkanes from carboxylic acids mainly happens via two means:

Alkanes can be prepared from carboxylic acid via the removal of carbon dioxide. This process is known as decarboxylation. It produces alkane with a carbon atom lesser than that present in the carboxylic acid.

$$CH_3COO\text{-}Na+ + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$$

Physical Properties of Alkenes

- Alkenes contain a carbon-carbon double bond which changes the physical properties of alkenes.
- Alkenes are unsaturated carbon compounds which have a general formula of CnH2n.
- These compounds are also known as olefins.
- Alkenes are a family of compounds containing hydrogen and carbon only (hydrocarbons) with a carbon-carbon double bond.
- Ethene and Propene are the first two hydrocarbons.

$$C_nH_{2n}$$

- Characterized by the presence of a C-C double bond (C=C)
- General Molecular Formula: C_nH_{2n}

Molecular Formula	Name	Relative Molecular Formula	State at room temperature
C_2H_4	Ethene	28	gas
C_3H_6	Propene	42	gas
C_4H_8	Butene	56	gas
C_5H_{10}	Pentene	70	liquid
C_6H_{12}	Hexene	84	liquid
C_7H_{14}	Heptene	98	liquid
C_8H_{16}	Octene	112	liquid
C_9H_{18}	Nonene	126	liquid
$C_{10}H_{20}$	Decene	140	liquid

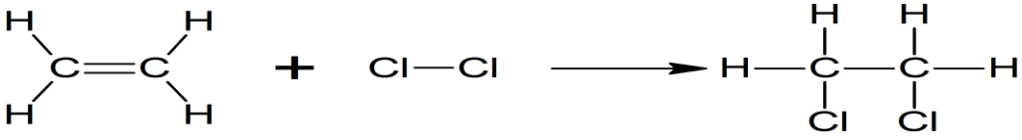
Chemical Properties of Alkenes

Alkenes are unsaturated compounds, which makes them highly reactive. Most of these chemical reactions occur at the Carbon-Carbon double bonds. This makes alkenes far more reactive than alkanes. Alkenes undergo three types of main reactions, which are as follows

1.Addition of Halogens. (halogenation)

Halogens will react with alkenes to form vicinal dihalides. From the halogens, iodine will not react with alkenes. But Bromine reacts with alkenes and will attach at the unsaturated site. In fact, the reaction is used to as proof of unsaturation.

$C_2H_4(g) + Cl_2(aq) \rightarrow C_2H_4Cl_2(aq)$



2.Addition of Water:

According to the Markovnikov rule, water will react with an alkene to form alcohols. This happens in the presence of sulphuric acid.

$CH_2=CH_2 + H_2O \rightarrow CH_3CH_2OH$

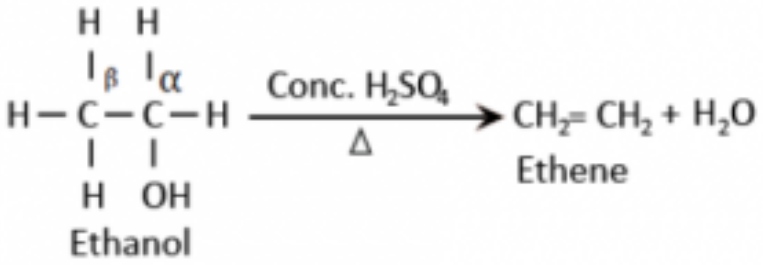
3.Oxidation Reactions

• Combustion Reaction: The combustion of alkenes is very exothermic, it will give out huge amounts of thermal energy. A practical example of this reaction is seen in welding of metals. It is known as oxy-ethylene welding

Preparation of Alkene

By dehydration of Ethyle Alcohol. (ethene preparation)

From alcohols: Alcohols reacts with concentrated sulphuric acid which results in the formation of alkenes due to the elimination of a water molecule. As water molecule is removed in this reaction, it is called as acidic dehydration of alcohol and the dehydrating agent is concentrated sulphuric acid.



Physical Properties of Alkynes

- Alkynes are unsaturated hydrocarbons which consist of at least one triple bond between carbon atoms.
- There are two types of alkynes: terminal and internal.
- Terminal alkynes are triple bonded compounds in which a carbon atom shares the triple bond with the carbon at the end of the chain.
- Internal alkynes are compounds in which the triple bond is between two carbon atoms, none of which are terminal.
- The general molecular formula of alkynes is

$$C_nH_{2n-2}$$

Carbon atoms in chain	Molecular formula	Name and simple formula
2	(C_2H_2) $CHCH$	Ethyne
3	(C_3H_4) CH_3CCH	Propyne
4	(C_4H_6) CH_3CH_2CCH	Butyne
5	(C_5H_8) $CH_3CH_2CH_2CCH$	Pentyne
6	(C_6H_{10}) $CH_3CH_2CH_2CH_2CCH$	Hexyne
7	(C_7H_{12}) $CH_3CH_2CH_2CH_2CH_2CCH$	Heptyne
8	(C_8H_{14}) $CH_3CH_2CH_2CH_2CH_2CH_2CCH$	Octyne

9	(C_9H_{16}) $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CCH$	Nonyne	
10	($C_{10}H_{18}$) $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CCH$	Decyne	

Chemical Properties of Alkynes

Addition Reactions

Under suitable conditions (temperature and pressure) alkynes will undergo hydration reactions quite easily. Alkynes will react with halogens, hydrogen and other such elements to give a saturated compound as a product.

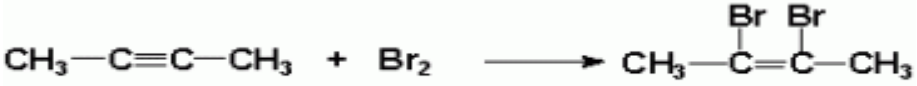
1] Addition of Dihydrogen

The reaction occurs in presence of a catalyst such as Nickel or Platinum or Palladium. Here the addition of hydrogen to the alkyne gives us an alkene.

$C_3H_4(g) + 2H_2(g) \longrightarrow C_3H_8(g)$

2] Addition of Halogens

When alkynes and halogens like Bromine react, halogen will add itself to the structure of the alkynes and result in halogen substituted alkenes. The resulting product will be tetrabromopropane.



Preparation of Alkyne

Preparation of acetylene from calcium carbide

For large scale production of an alkyne, calcium carbide (CaC_2) is made to react with water. It is prepared by heating quicklime in the presence of coke. Quicklime is obtained by introducing limestone to heat. The reactions for the preparation of acetylene from calcium carbide are as shown below:

$CaCO_3 \rightarrow CaO + CO_2$

$CaO + 3C \rightarrow CaC_2 + CO$

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

Uses of Hydrocarbons

Hydrocarbons are widely used as fuels. For example LPG (liquefied petroleum gas), CNG (Liquefied natural gas).

They are used in the manufacturing of polymers such as polyethene, polystyrene etc.

These organic compounds find their application in the manufacturing of drugs and dyes as a starting material.

They serve as lubricating oil and grease.

Halogenation

Halogenation is the replacement of one or more hydrogen atoms in an organic compound by a halogen (fluorine, chlorine, bromine or iodine)..

$CH_4 + Cl_2 + \text{energy} \rightarrow CH_3Cl + HCl$

Reference Pages:

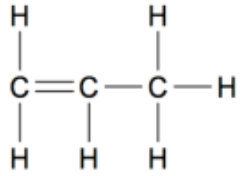
https://byjus.com/jee/hydrocarbons/

https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/27%3A_Reactions_of_Organic_Compounds/27.07%3A_Reactions_of_Alkanes
https://byjus.com/chemistry/physical-properties-of-alkanes-and-their-variations/
https://www.toppr.com/guides/chemistry/hydrocarbons/properties-of-alkenes/

Worksheet

Task - Use the molecular models to build each of the alkene molecules. Use them to help you fill in the missing information.

Molecular model Key: C - Carbon = black, 4 holes. H - Hydrogen = White, 1 hole.

Name of Alkene	Number of Carbon atoms	Formula of Hydrocarbon	Displayed Formula of Hydrocarbon	My Model
Ethene	2	C_2H_4		
Propene				
Butene		C_4H_8		

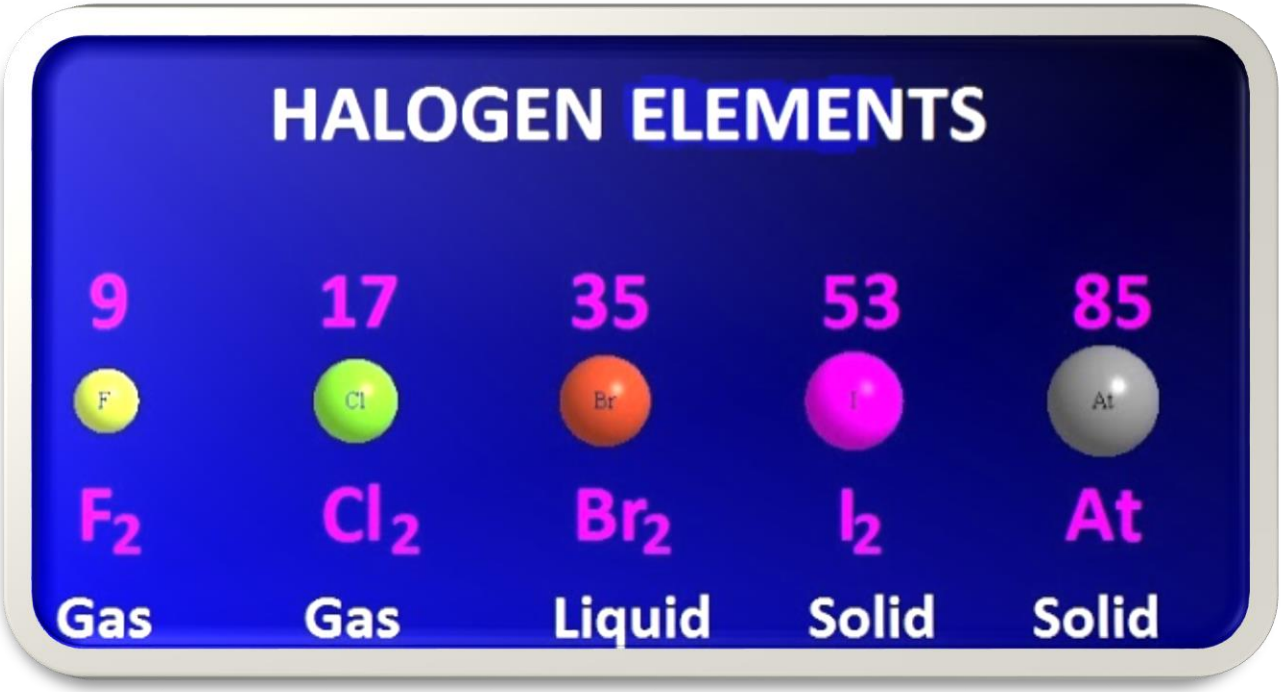
ALKANES

Complete the table.

Name	Molecular Formula	Number of carbons	Number of hydrogens	Structural formula
Methane	CH_4	1	4	
Ethane			6	
Propane	C_3H_8			
Butane		4		
Pentane				
Hexane				

Chapter 05

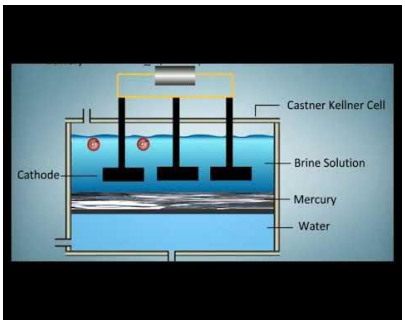
Halogens



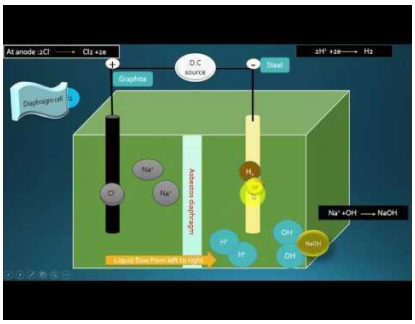
Chapter	Understandings	Practical
Halogens • Importance of halogens in daily life • Properties of chlorine • Preparation of chlorine by Castner kellner's cell • Preparation of chlorine by Nelson cell cell • Chlorine, Fluorine , Iodine and its uses	Student will be able to: • Identify the halogens. • Describe the physical properties of chlorine, bromine, iodine, fluorine and astatine. • Describe the chemical properties of chlorine. • Describe and understand about preparation of chlorine by Castner-kellner's cell and Nelson cell	Identify the ions in given salts. Chlorine, Bromine, Fluorine and iodine.

Videos

Halogen



Chlorine preparation by castner-kellner cell



and Nelson cell

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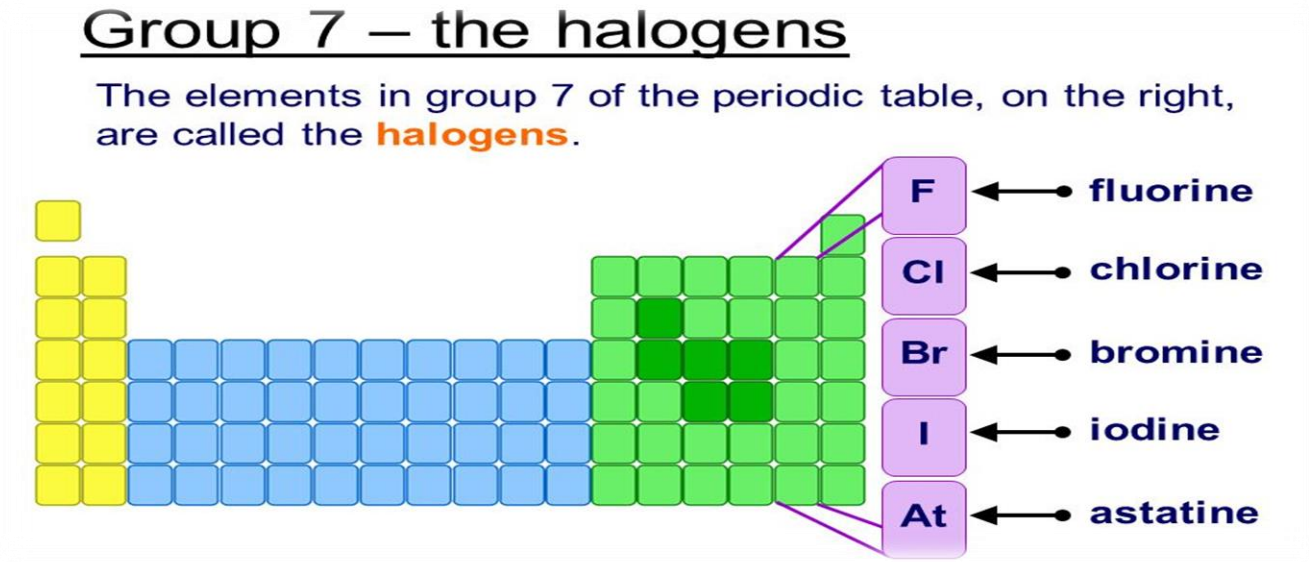
Chapter overview

Halogen Group Elements – importance

Halogen group or Group 17 of the periodic table consists of five elements which play a significant role in our daily lives as fluorine is used in toothpaste or chlorine is used as a disinfectant to clean the water. The five members of Group 17 are:



These elements are collectively known as halogens. The word halogen has been derived from a Greek descent in which 'halo' means salt and 'genes' mean born. Therefore, halogens in Greek mean salt producers. Astatine is placed in the halogen group since its behaviour is similar to that of iodine although it is a radioactive element.

Halogen properties

- They are highly reactive nonmetals.
- Atoms of belonging to the halogen group have 7 electrons in their outermost (valence) shell. These atoms need one more electron in order to have a stable octet.
- Halogens are highly electronegative, with high electron affinities.
- The melting and boiling points of the halogens increase as you increase atomic number (as you move down the periodic table).
- The elements change their state of matter at room temperature and pressure as you increase atomic number. Fluorine and chlorine are gases. Bromine is a liquid element. Iodine is a solid.

Fluorine:

- Fluorine is a chemical element which is represented with a symbol F and has an atomic number 9.
- It takes the first position in group 7 of the periodic table.
- It is abundantly found in the earth's crust.
- Fluorine is mainly found in cryolite (Na_3AlF_6), fluorspar(CaF_2) and fluorapatite ($3Ca_3(PO_4)_2.CaF_2$) deposits.
- For commercial purposes, fluorspar is the most common source fluorine.

Uses of fluorine and its compounds

- **Toothpaste** and mouthwash **contain** many ingredients to enhance the quality and health benefits.
- **Fluorine** is added in typical amounts of 1000 to 1500 ppm to prevent cavities by strengthening tooth enamel
- Compounds of fluorine, including **sodium fluoride,** are used in toothpaste and in drinking water to prevent dental cavities. Hydrofluoric acid can dissolve **glass** and is used to etch the **glass** in light bulbs and in other products.

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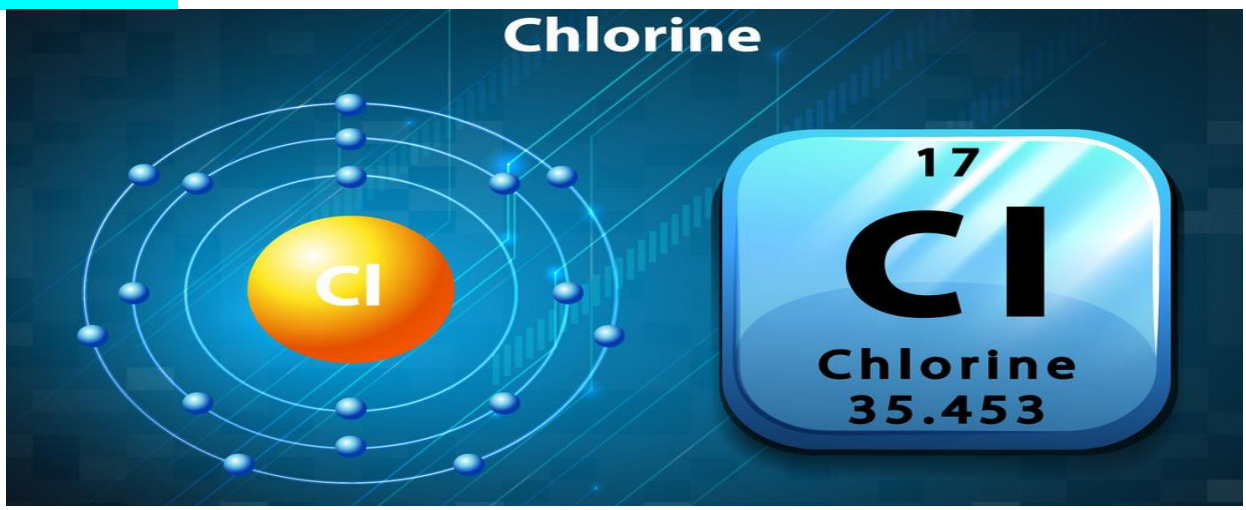
Chlorine:



- Chlorine is a chemical element which is represented with the symbol Cl and has an atomic number 17.
- It is abundantly found in the lithosphere.
- It is never found in the free state due to its strong chemical affinity except in rare cases.
- It is a minor constituent of products from volcanic eruptions.
- The most common minerals containing chlorides are rock salt (NaCl), sylvite (KCl) and carnallite ($MgCl_2.KCl.6H_2O$).

What is Chlorine gas?

Chlorine is a **green yellow gas with a very pungent odour** that is twice as dense as air.

Chemical Properties of Chlorine gas – Cl_2

- Chlorine reacts with organic compounds and ammonia to form chloro-organics or chloramines.
- Chloramines are part of the group of chlorine compounds that have disinfectant properties and show up as part of chlorine residue test.
- It acts as a reducing agent present in wastewater. These reactions are called chlorine demand. The reaction is as below.**$H_2O + Cl_2 \rightarrow HCl + HClO$**

Preparation of chlorine by castner-kellner's cell

Construction of Castner-Kellner's Cell

The Castner-Kellner's cell consist of a steel tank which contain Hg flows from right to left in the cell and is connected with the negative terminal of the battery therefore it acts as cathode. The cell is filled with saturated aqueous solution of NaCl, which also flows in the same direction as Hg. Some graphite rods are dipped into the solution of NaCl. These rods connected with positive terminal of the battery therefore act as anode.

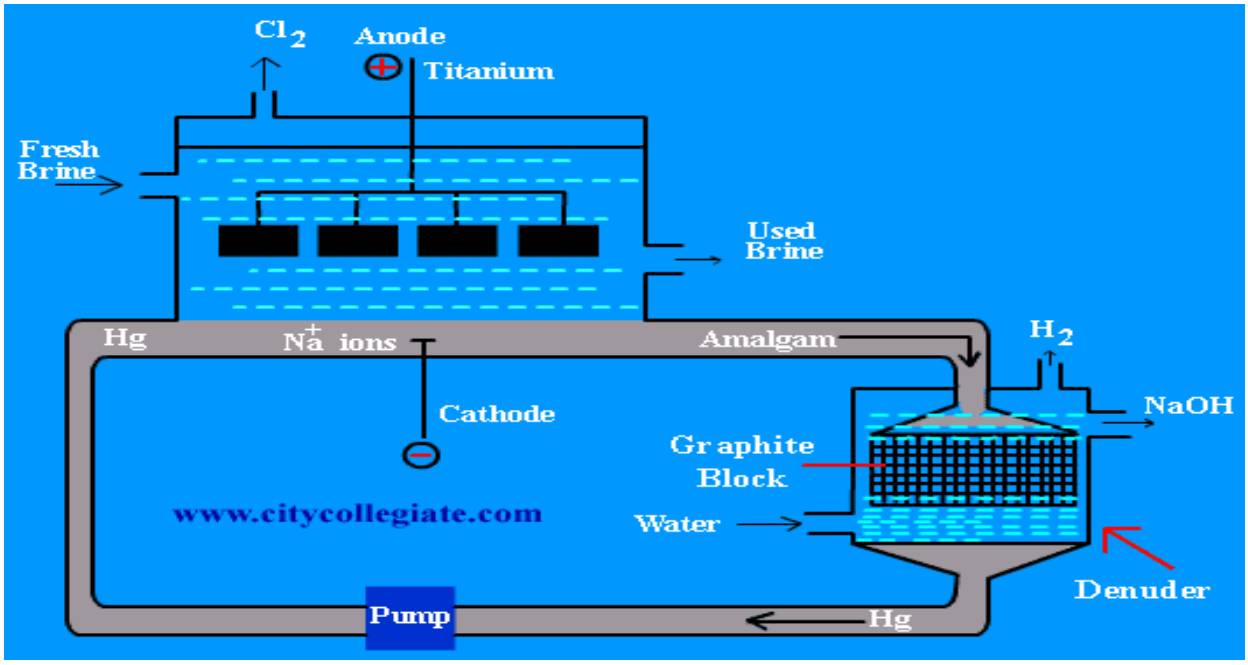
Working of Castner-Kellner's Cell

When the electric current is passed through the cell. The sodium ion and chloride ion migrate towards their respective electrodes. Chlorine ion moves towards anode, loses its electron and converts into chlorine gas. The free chlorine gas comes out of the tube at the top of the cell. The sodium ion migrates towards cathode gains electrons and converts into sodium metal. The sodium is dissolved in Hg to form sodium amalgum which comes out with the flow of Hg from the cell.

NaCl <—-> Na+ + Cl-

Na+ + e- —-> Na0 (At Cathode)

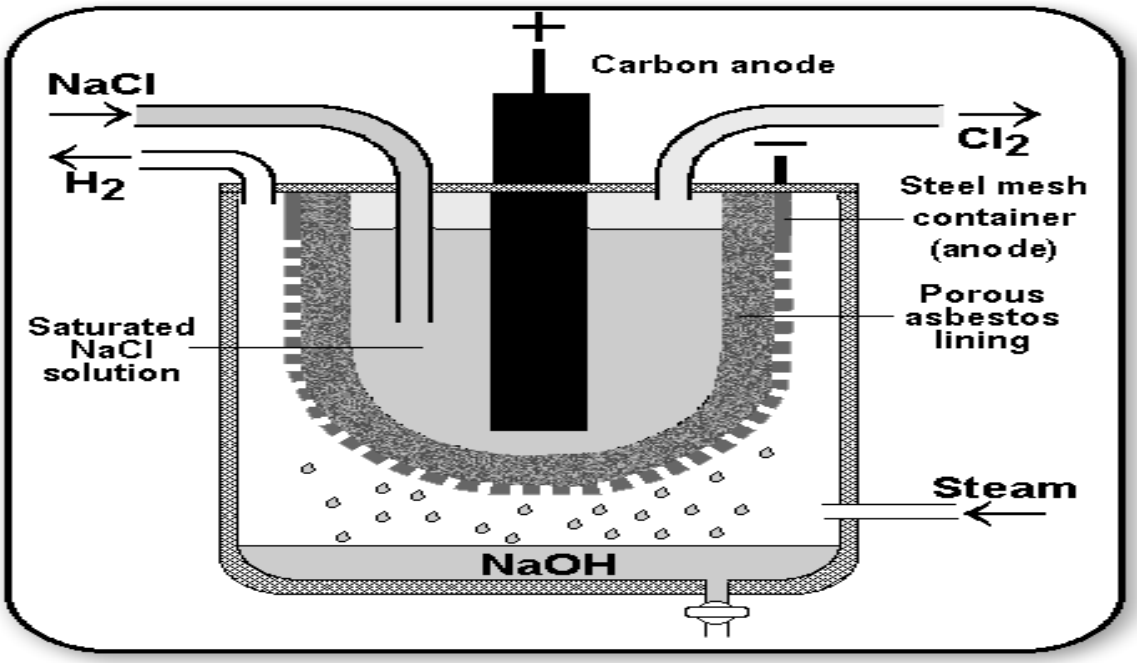
2Cl —-> Cl2↑ + 2e (At anode)



Preparation of chlorine by Nelson's cell

We can acquire the gas by the electrolysis of salt water in a Nelson cell. This is the least expensive technique and gives the purest form of the gas

Electrolysis involves the movement of ions to the electrode. Solid-state does not allow the movement of ions and unsuitable for electrolysis. When melted at high temperature, sodium chloride separates into sodium and chloride ions, so that, electrolysis can take place to form sodium atom and chlorine gas.



Uses of Chlorine gas – Cl_2

- Chlorine gas was used by the Germans as a chemical weapon against the allied troops during the First World War.
- The most common use of chlorine in wastewater treatment is for disinfection.
- Used in odor control and in the control of filamentous organisms in the activated sludge process.
- Despite of all these it is used for preventing the spread of waterborne disease and the most common means of disinfection in use.

Uses of Chlorine and its compounds

- Chlorine is commonly used as an antiseptic and is used to make drinking water safe and to treat swimming pools.
- Large amounts of chlorine are used in many industrial processes, such as in the production of paper products, plastics, dyes, textiles, medicines, antiseptics, insecticides, solvents and paints.
- sodium chloride (NaCl) commonly known as table salt, is used to season food and in some industrial processes.
- Hydrochloric acid, a strong and commercially important acid.
- Other chlorine compounds include: chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), potassium chloride (KCl), lithium chloride (LiCl), magnesium chloride ($MgCl_2$) and chlorine dioxide (ClO_2).

Bromine:

- Bromine is a chemical element which is represented with symbol Br and has an atomic number 35.
- It takes the twenty-fifth position in an order of abundance in nature.
- It is always found as a halide with other elements due to its high chemical reactivity.
- Bromine is majorly produced by the United States, Germany, and Israel.
- Ocean water is a primary natural source of this halogen.

Uses of bromine and its compounds

- Bromine is used in many areas such as agricultural chemicals, dyestuffs, insecticides, pharmaceuticals and chemical intermediates. Some uses are being phased out for environmental reasons, but new uses continue to be found.
- Bromine compounds can be used as flame retardants. They are added to furniture foam, plastic casings for electronics and textiles to make them less flammable. However, the use of bromine as a flame retardant has been phased out in the USA because of toxicity concerns.
- Organobromides are used in halon fire extinguishers that are used to fight fires in places like museums, aeroplanes and tanks.
- Silver bromide is a chemical used in film photography

Iodine:

- Iodine is a chemical element which is represented with the symbol I and has an atomic number 53.
- It is found in nature as iodides or iodates.
- Iodine is usually found in rocks, underground brines and soil.
- Seawater is also a source of iodine.

Uses of iodine and its compounds

- **Iodide** salts are used in pharmaceuticals and disinfectants, printing inks and dyes, catalysts, animal feed supplements and photographic chemicals.
- **Iodine** is also used to make polarizing filters for LCD displays.
- Iodine can also be used to treat thyroid cancer.
- Iodine is also used as a catalyst in the industrial production of acetic acid and some polymers.

Astatine:

- Astatine is a radioactive chemical element which is represented with the symbol At and has an atomic number 85.
- It occupies the last position of the halogen group. It derives its name from Greek which means unstable
- It is a very rarely found element and at any given time the concentration of this component is less than one gram in the earth's crust.

Reference pages

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https://byjus.com/chemistry/chlorine/
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Worksheets

The Halogens and The Noble Gases MCQs

1. Among the halogens the rare element is
A. Fluorine
B. Chlorine
C. Astatine
D. Iodine

2. The colour of chlorine gas is
A. Pale yellow
B. Greenish yellow
C. Reddish brown
D. Greyish black

3. The most powerful oxidizing agent among the halogens is
A. F2
B. Cl2
C. Br2
D. I2

4. Which of the following statements is incorrect about fluorine
A. Fluorine is restricted to -1 oxidation state
B. Fluorine follows octet rule and as well as extended octet rule
C. Fluorine has the lowest dissociation energy among the halogens
D. Both B and C

5. The halogen which reacts spontaneously with gold (Au) to form Au+3 is
A. F2
B. Cl2
C. Br2
D. I2

6. Which one of the following is the weakest acid in water
A. HF
B. HCl
C. HBr
D. HI

7. The halogen which reacts very slowly with halogen is
A. Fluorine
B. Chlorine
C. Bromine
D. Iodine

8. The halogen having highest electron affinity is
A. Fluorine
B. Chlorine
C. Bromine
D. Iodine

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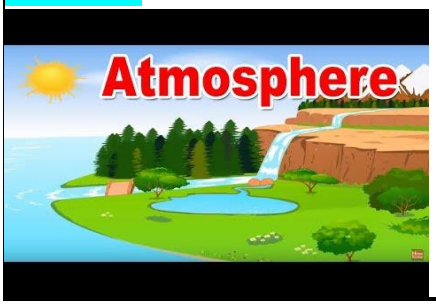
Chapter 06

Environmental chemistry I: The Atmosphere

Chapter	Understandings	Skills
Environmental chemistry: The Atmosphere • Composition of Atmosphere • Layers of Atmosphere • Troposphere • Stratosphere • Pollutants • Major Air Pollutants • Sources of Air Pollutants • Acid Rain and Its Effects • Ozone Depletion and Its Effects	Students will be able to: • Define atmosphere. (Remembering) • Explain composition of atmosphere. (Understanding) • Differentiate between stratosphere and troposphere. (Analyzing) • Summarize the components of stratosphere and troposphere. (Understanding) • Describe major air pollutants. (Understanding) • Describe sources and effects of air pollutants. (Understanding) • Explain ozone formation. (Understanding) • Describe acid rain and its effects (Understanding) • Describe ozone depletion and its effects. (Understanding)	Students will be able to: • Perform filtration experiments in the lab on different water samples having suspended impurities. (Analyzing)

Videos



Prepared by: Ms. Saima Pervaiz Ahmed under the supervision of Madam Naheed Muneer Siddiqui

Atmosphere

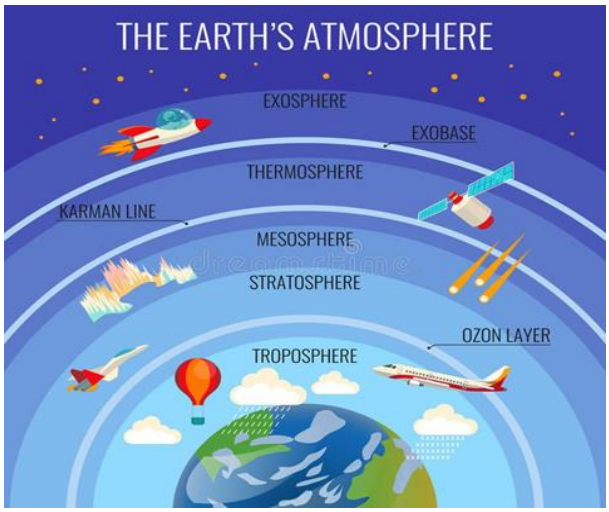
An atmosphere is a blanket of gases that surrounds Earth. It is held near the surface of the planet by Earth's gravitational attraction. Argon, oxygen and nitrogen from the three main constitutions of the atmosphere.

The atmosphere:

- **contains the air that we breathe**
- **helps retain the sun's heat and prevents it from escaping back into space**
- **protects life from harmful radiation from the sun**
- **plays a major role in Earth's water cycle**
- **helps keep the climate on Earth moderate**

There is no boundary between the atmosphere and the outer space. The atmosphere gets less dense and denser until it "blends" into outer space. The Earth's atmosphere is divided into five layers based on the temperature. In the next section let us discuss these different Earth's atmosphere layers.

Layers of Atmosphere



About 80% of the mass of earth's atmosphere is contained below 10 km altitude. The atmosphere of earth is mostly composed of many gases including nitrogen, oxygen, carbon dioxide. This helps protect living organisms from genetic damage by solar ultraviolet radiation, solar wind and cosmic rays.

Troposphere
Stratosphere
Mesosphere
Thermosphere
Ionosphere
Exosphere

Troposphere

It is the undermost layer of the earth's atmosphere. At the base of the troposphere, the air is warmer. Density and air pressure also decrease with altitude.

Stratosphere

It is the 2nd layer of the atmosphere. It occurs at an altitude of fifty kilometers.

Mesosphere

It lies beneath troposphere and above the stratosphere. Temperature decreases with the altitude.

Thermosphere

It extends to six hundred kilometers high. Aurora and satellites occur in this layer. It starts just above the mesosphere.

The ionosphere

It is an abundant layer composed of ionized atoms, molecules and electrons that expand from about forty-eight kilometers above the surface overlapping into the mesosphere and thermosphere.

The exosphere

It is the upper limit of the earth's atmosphere. It extends from the top of the thermosphere up to 10,000 km.

Air Pollution & Its Control

Air Pollution Definition

"Air Pollution is the release of pollutants such as gases, particles, biological molecules, etc. into the air that is harmful to human health and the environment."

What is Air Pollution?

Air pollution refers to any physical, chemical or biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affects the plants, animals, and humans drastically.

There is a certain percentage of gases present in the atmosphere. An increase or decrease in the composition of these gases is harmful to survival. This imbalance in the gaseous composition has resulted in an increase in earth's temperature which is known as global warming.

Types of Air Pollutants

There are two types of air pollutants:

Primary Pollutants

The pollutants that directly cause air pollution are known as primary pollutants. Sulphur-dioxide emitted from factories is a primary pollutant.

Secondary Pollutants

The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants. Smog, formed by the intermingling of smoke and fog, is a secondary pollutant.

Causes of Air Pollution

Following are the important causes of air pollution:

Burning of Fossil Fuels

The combustion of fossil fuels emits a large amount of Sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

Automobiles

The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.

Agricultural Activities

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilizers emit harmful chemicals in the atmosphere and contaminate it.

Factories and Industries

Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons, and chemicals. These are released into the air degrading its quality.

Mining Activities

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air but also deteriorate the health of the workers and people living in the nearby areas.

Domestic Sources

The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.

Effects of Air Pollution

The hazardous effects of air pollution on the environment include:

Diseases

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.

Global Warming

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global

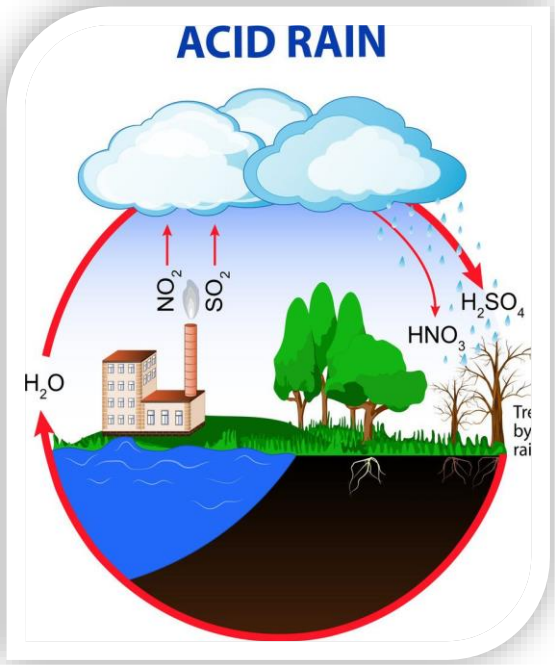
warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged under water.

Acid Rain

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic, and fall as acid rain which damages human, animal and plant life.

Harmful effects:

- Harmful for agriculture, trees and plants as it dissolves and washes away nutrients needed for their growth.
- Causes respiratory ailments in human beings and animals.
- Affects plant and animal life in aquatic ecosystem when acid rain falls and flows as ground water to reach rivers, lakes etc.
- Corrodes water pipes resulting in the leaching of heavy metals such as iron, lead and copper into the drinking water.
- Damages buildings and other structures made of stone or metal.



Ozone Layer Depletion

The release of chlorofluorocarbons, halons, and hydrochlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

Ozone-Depleting Substances	Sources
Chlorofluorocarbons (CFCs)	Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
Halons	Fire-extinguishers
Carbon tetrachloride	Fire extinguishers, solvents
Methyl chloroform	Adhesives, aerosols
Hydrofluorocarbons	Solvent cleaning, fire extinguishers, solvent cleaning

Causes of Ozone Layer Depletion

The ozone layer depletion is a major concern and is associated with a number of factors.

Chlorofluorocarbons

- Chlorofluorocarbons or the CFC are the main cause of ozone layer depletion. These are released by soaps, solvents, spray aerosols, refrigerators, air-conditioners, etc.
- The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

Unregulated Rocket Launches

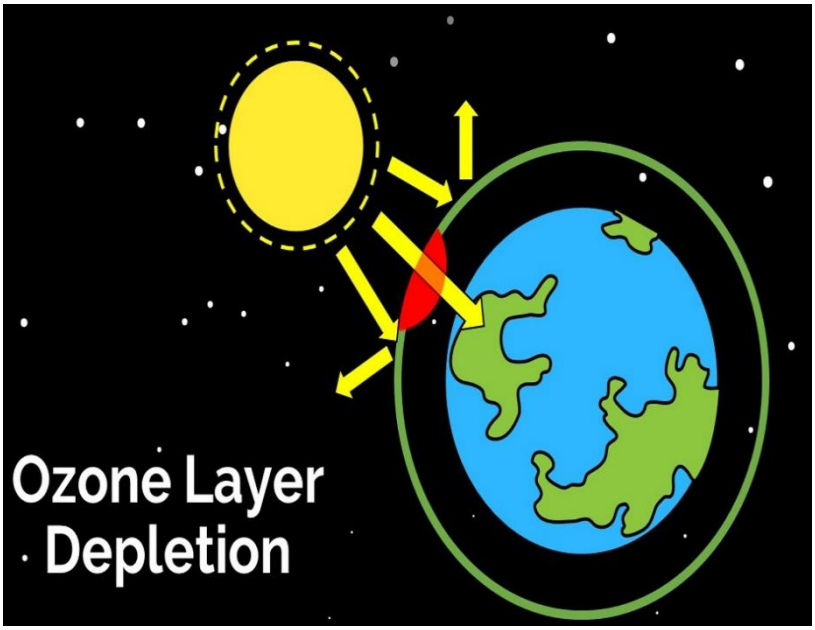
- Researchers say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.

Nitrogenous Compounds

- The nitrogenous compounds such as NO2, NO, N2O are highly responsible for the depletion of the ozone layer.

Natural Causes

- The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion.
- The volcanic eruptions are also responsible for the depletion of ozone layer.



Effects of Ozone Layer Depletion

The depletion of ozone layer has harmful effects on the environment.

Effects on Human Health

- The humans will be directly exposed to the harmful ultraviolet radiations of the sun due to the depletion of ozone layer. This might result in serious health issues among humans such as skin diseases, cancer, sunburns, cataract, quick ageing, and weekend immune system.

Effects on Animals

- Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.

Effects on the Environment

- Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.

Effects on Marine Life

- Planktons are greatly affected by the exposure to harmful ultraviolet rays.. If the planktons are destroyed the organisms present in the lower food chain are also affected.

Effect on Animals

The air pollutants suspend on the water bodies and affect the aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animals species.

Air Pollution Control

Following are the measures one should adopt to control air pollution:

- People should avoid using vehicles for shorter distances. Rather they should prefer public modes of transport to travel from one place to another. This not only prevents pollution but also conserves energy.
- Since industrial emissions are one of the major causes of air pollution, the pollutants can be controlled or treated at the source itself to reduce its effects.
- Fuel substitution is another way of controlling air pollution. In many parts petrol and diesel are being replaced by CNG – Compressed Natural Gas fuelled vehicles. These are mostly adopted by vehicles that aren't fully operating with ideal emission engines.
- A large number of fossil fuels are burnt to generate electricity. Therefore, do not forget to switch off the electrical appliances when not in use. Thus, you can save the environment at the individual level. Use of energy-efficient devices such CFLs also controls pollution to a greater level.
- Another way of controlling air pollution caused by industries is to modify and maintain existing pieces of equipment so that the emission of pollutants is minimized.

- ❖ Sometimes controlling pollutants at the source is not possible. In that case, we can have process control equipment to control the pollution.
- ❖ The last and the best way of reducing the ill effects of air pollution is tree plantation. Plants and trees reduce a large number of pollutants in the air. Ideally, planting trees in areas of high pollution levels will be extremely effective.

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https://byjus.com/chemistry/air-pollution/

https://byjus.com/biology/ozone-layer-depletion/

https://studylib.net/doc/7203017/name--core--_____-date--_____-stations-worksheet-%E2%80%93-poll...

Worksheet

Name: _____ Date: _____

Pollution in the Atmosphere

1: TYPES OF POLLUTANTS

1. The two types of air pollutants are primary pollutants, which enter the atmosphere _____, and
Secondary pollutants, which form from a _____.
2. Give one example of a natural primary pollutant: _____
Give one example of a man-made primary pollutant: _____.
3. What human activities add nitrogen oxides to the atmosphere, which contributes to acid rain)?
4. How does photochemical smog form?

2: OZONE DEPLETION

5. Why can't the children in Punta Arenas (Chile) go outside in the spring?
6. How can ozone be both "good" and "bad"? (Hint: Where is it good? Where is it bad?)
7. What breaks CFC's apart, which then breaks apart the ozone molecule (O3)? _____

3: THE OZONE HOLE

8. Ozone destruction creates the _____ where the layer is dangerously thin. As air _____over Antarctica in the _____, the ozone hole expands northward over southern continents, including Australia, _____, southern South America, and southern _____.
9. UV levels may rise as much as _____% beneath the ozone hole.
10. Why is there less ozone loss over the North Pole area?
11. List 1effects of ozone loss on human health and the environment:

4: REDUCING OZONE DEPLETION

12. What would havehappened if CFCs had not been phased out?
13. The Montreal Protocol controls the _____ and _____ of 96 chemicals that damage the _____. Hazardous substances are phased out first by _____ nations and one _____ later by developing nations.
14. Why will the ozone hole probably continue to grow for some time before it begins to shrink?

5: CAUSES OF AIR POLLUTION

15. Where do most air pollutants come from?
16. What percentage of air pollutants come from transportation: _____ %
17. _____are burned in most motor vehicles and power plants. These _____resources are the power for nearly all manufacturing and other industries.
18. Fossil fuels are _____ plants and animals that have been converted into _____ hydrocarbons.
19.The primary way biomass is burned is for _____ agriculture. The rainforest is slashed down and then the waste is _____ to clear the land for _____.
20. Burning forests increases _____ gases in the atmosphere by releasing CO2 _____ in the biomass and also by _____ the forest so that it cannot store CO2 in the _____.

21. ____% of the particulates that enter the air in the US is from industry and about _____% are from vehicles.
22. Methane, the most common volatile organic compound, forms when organic material _____ in an_____ environment.

6: EFFECTS OF AIR POLLUTION ON HUMAN HEALTH

26. Nitrogen and sulfur dioxides cause _____ disease and increased rates of _____, emphysema, and viral infections such as the flu.
27. High ozone levels are associated with increased _____ disease and _____.
28. When Atlanta, Georgia closed off their downtown area to private vehicles for the 1996 Olympics, ozone levels decreased by _____% and there were 48% fewer hospital visits for _____.
29. One study found that in the US, children develop asthma at more than _____ the rate of two decades ago and at ____ times the rate of children in _____.
30. The asthma rate worldwide is rising _____% to _____% every decade (10 years).

7: ACID RAIN

37. Acid rain is caused by sulfur and nitrogen oxides emanating from _____ and metal refineries. As they move, these pollutants combine with _____ to form sulfuric and nitric _____.
38. Acid rain water is more acidic than normal rain water. Natural rain has an acidity of 5.6; acid rain must have a pH of less than _____.
A small change in pH represents a _____ change in acidity.

8: EFFECTS OF ACID RAIN

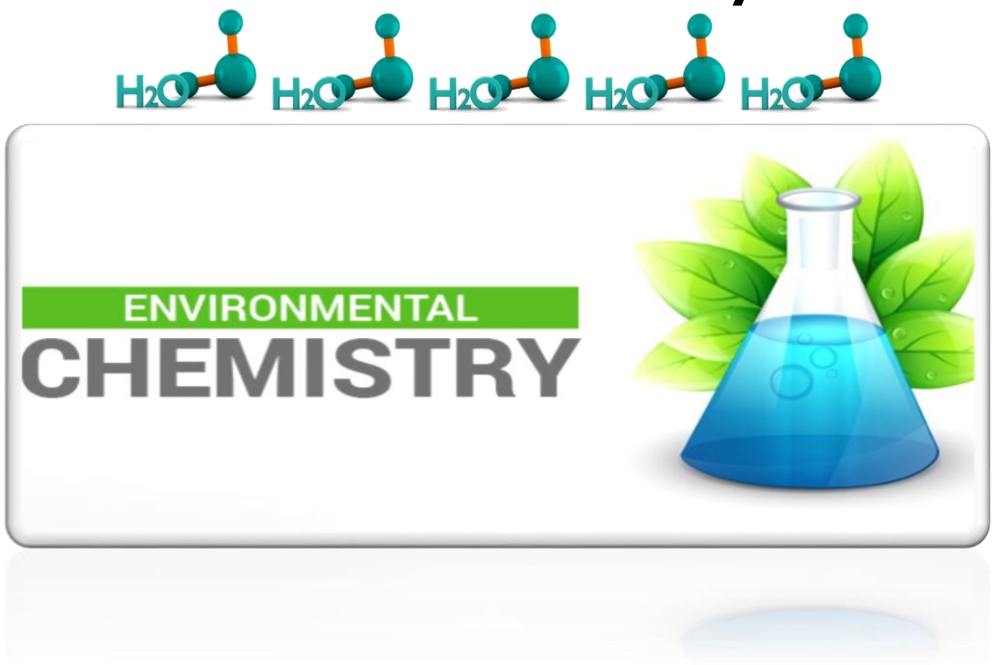
39. No fish can live is pH drops below _____. Organic material cannot _____, and mosses take over the lake.
40. Acid rain damages cultural monuments like _____ and _____.
41. Because pollutants can _____ so far, much of the acid that falls hurts states or nations other than the ones where the pollutants were released.

Lesson plan

https://betterlesson.com/lesson/637315/the-atmosphere
https://study.com/academy/lesson/layers-of-the-atmosphere-lesson-plan.html

Chapter 07

Environmental Chemistry: Water



Chapter	Understandings	Skills	Practical's
Environmental chemistry: water • Preparation Properties of Water • Water as Solvent. • Soft and Hard Water • Types of Hardness of Water. • Methods of Removing Hardness • Disadvantages of Water Hardness • Pollution • Industrial Wastes • Household Wastes • Agricultural Waste • Water Borne Diseases	Students will be able to: • Students will be able to: • Describe the occurrence of water and its importance in the environment including industry. (Analyzing) • Describe the composition and properties of water. (Understanding). • Differentiate among soft, temporary and permanent hard water. (Analyzing) • Describe methods for eliminating temporary and permanent hardness of water. (Applying) • Identify water pollutants. (Analyzing) • Describe industrial wastes and household wastes as water	Students will be able to: • Test water quality by checking its color, odor, hardness and conductivity. (Applying) • Determine boiling point of water. (Applying) • Perform distillation of impure water samples. (Applying)	• **Demonstrate the softening of water by removal of calcium ions from hard water.** **(NEW)**

	pollutants. (Understanding) • Describe the effects of these pollutants on life. (Understanding) • Describe the various types of water borne diseases. (Understanding)		

Videos

Properties of water

Soft and hard water.

Water pollution

Chapter overview

Properties of Water

Water is the most abundant compound on Earth's surface. In nature, water exists in the liquid, solid, and gaseous states.

- Water is a liquid at standard temperature and pressure (25 degrees Celsius and 1 atm, for liquids).
- Water is is tasteless and odorless.
- Water is transparent in the visible part of the electromagnetic spectrum.
- Water can act as either an acid or a base.
- Water is a universal solvent, dissolving many substances found in nature.

Selected physical properties of water
• molar mass
• melting point
• boiling point
• maximum density (at 3.98 °C)
• density (25 °C)
• vapour pressure (25 °C)
• heat of fusion (0 °C)
• heat of vaporization (100 °C)
• heat of formation (25 °C)
• entropy of vaporization (25 °C)
• viscosity
• surface tension (25 °C)

Chemical properties of water

Water reacts with a lot of substances to form different compounds. Some significant reactions are as follows:

Amphoteric nature:

Water can act as both acid and base, which means that it is amphoteric in nature.
Example:

Acidic Behavior: $H_2O(l)+NH_3(aq) \rightleftharpoons H_3O^+(aq)+NH_4^+(aq)$

Basic Behavior: $H_2O(l)+H_2S(aq) \rightleftharpoons H_3O^+(aq)+HS^-(aq)$

Redox reactions:

Electropositive elements reduce water to hydrogen molecule. Thus water is a great source of hydrogen. Let us see an example in this case:

$2H_2O(l)+2Na(s) \rightarrow 2NaOH(aq)+H_2(g)$

During the process of photosynthesis, water is oxidized to O_2. As water can be oxidized and reduced, it is very useful in redox reactions.

Hydrolysis reaction

Water has a very strong hydrating tendency due to its dielectric constant. It dissolves many ionic compounds. Some covalent and ionic compounds can be hydrolyzed in water.

Water's Solvent Properties

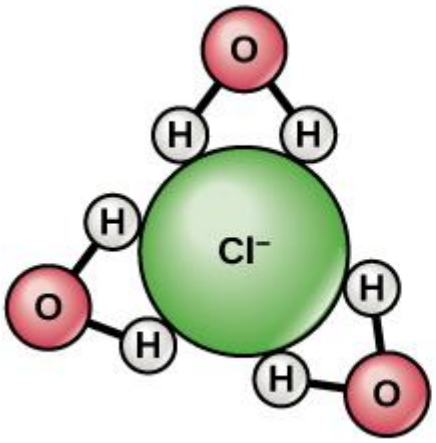
Water, which not only dissolves many compounds but also dissolves more substances than any other liquid, is considered the universal solvent.

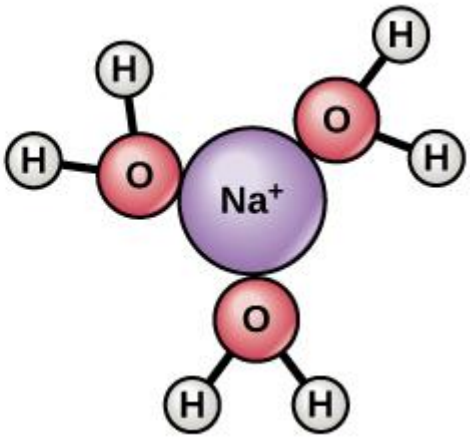
A polar molecule with partially-positive and negative charges, it readily dissolves ions and polar molecules.

Water is therefore referred to as a solvent: a substance capable of dissolving other polar molecules and ionic compounds.

The charges associated with these molecules form hydrogen bonds with water, surrounding the particle with water molecules.

Consider table salt (NaCl, or sodium chloride): when NaCl crystals are added to water, the molecules of NaCl dissociate into Na^+ and Cl^- ions, and spheres of hydration form around the ions.





Types of water

These two types are not differentiated based on their touch and feel or appearance. This difference is based on the mineral content of each.

Hard water:

The water with naturally present minerals like magnesium and calcium with detectable amount is called hard water. These minerals are beneficial for health. They add flavor to hard water.

Soft water:

It is treated water. It is left with only cations and that is sodium. It has a salty taste.

Difference between Hard water and Soft water	
HARD WATER	**SOFT WATER**
• It is rich in minerals	• Contains very few elements
• Soap is not so effective	• Soap is easily effective
• No foam and lather from soaps	• Bubbly lather from soaps
• Leaves spots on the washed dishes after they are dried	• Does not leave any spots on dishes after they are dried
• Contains minerals like magnesium and calcium	• Contains sodium ion
• Sometimes preferred drinking water	• Sometimes not preferred drinking water
• Example: Groundwater like deep wells	• Example : Rainwater
• Hair and skin become dry	• Hair and skin become soft

Types of Hardness of Water

The hardness of water can be classified into two types:

Temporary Hardness

Permanent Hardness

Temporary Hardness of Water:

The presence of magnesium and calcium carbonates in water makes it temporarily hard. In this case, the hardness in water can be removed by boiling the water.

When we boil water the soluble salts of $Mg(HCO_3)_2$ is converted to $Mg(OH)_2$ which is insoluble and hence gets precipitated and is removed. After filtration, the water we get is soft water.

Permanent Hardness of Water:

When the soluble salts of magnesium and calcium are present in the form of chlorides and sulfides in water, we call it permanent hardness because this hardness cannot be removed by boiling.

We can remove this hardness by treating the water with washing soda. Insoluble carbonates are formed when washing soda reacts with the sulfide and chloride salts of magnesium and calcium and thus hard water is converted to soft water.

Disadvantages of Hardness

Wastage of soap

Wastage of fuel

Formation of scales on metallic boilers.

Remove Hardness of Water (Temporary)

By Boiling:

Soluble bicarbonates are converted into insoluble carbonates which are removed by filtration.

Reactions: $Ca(HCO3)2 \rightarrow \Delta Calo3\downarrow + H2O + CO2$

$\Rightarrow Mg(HCO3)2 \rightarrow \Delta MgCO3\downarrow + H2O + CO2$

By Clarks Method:

Calcium hydroxide is Clark's reagent. It removes the hardness of water by converting bicarbonates into carbonate.

Reaction: $Ca(OH)2 + Ca(HCO3)2 \rightarrow 2CaCO3\downarrow + 2H2O$

How to Remove Permanent Hardness of Water?

Gan's Permutit Method:

In this method, sodium aluminum ortho silicate known as permutit or zeolite is used to remove the permanent hardness of water.

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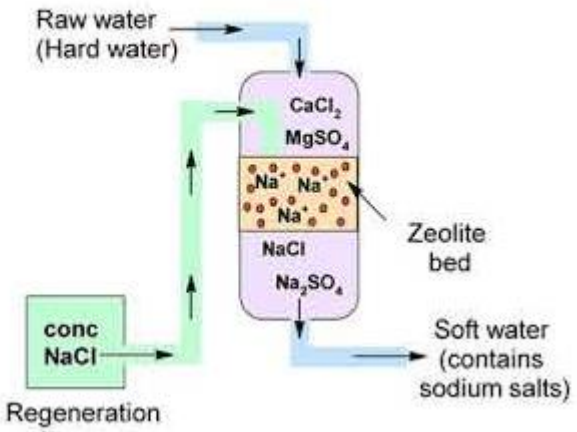
Reaction: $Na_2 Al_2 Si_2 O_8.KH_2O + Ca^{++} \rightarrow 2Na^+ + Ca\ Al_2 Si_2 O_8.xH_2O$

ZEOLITE PROCESS



Ion Exchange Resin Method:

In this method, the permanent hardness of water is removed by using resins. Ca^{++}/Mg^{++} ions are exchanged with Cl^-, SO_4^{-2} ions are exchanged with anion exchange resin (RNH_2OH). Demineralized water is formed in this process.

$\Rightarrow 2RCOOH + Ca^{++} \rightarrow (RCOO)2Ca + 2H^+$

$\Rightarrow RNH2OH + Cl^- \rightarrow RNH2Cl + OH^-$

$\Rightarrow H^+ + OH^- \rightarrow H2O$

By the addition of washing soda

$$CaSO_4 + Na_2CO_3 \longrightarrow \underset{\text{Insoluble}}{CaCO_3\downarrow} + Na_2SO_4$$

$$MgCl_2 + Na_2CO_3 \longrightarrow \underset{\text{Insoluble}}{MgCO_3\downarrow} + 2NaCl$$

Calcium ions present in hard water react with washing soda (sodium carbonate) and precipitate out as insoluble calcium carbonate. Similarly, magnesium ions react with washing soda to form insoluble magnesium carbonate.

Harmful Effects/ Disadvantages of Hard Water

- **Some of the most common signs of hard water include:**
- Linens and clothes look dull and feel rough.
- Ugly stains on white porcelain and scale buildup on faucets
- Low water pressure from showers due to clogged pipes.
- Chalky, white residue or spots appear on dishes.
- Strains appearing in the shower.

Pollution

Pollution is the process of making land, water, air or other parts of the environment dirty and not safe or suitable to use.

With the ever-increasing population and pollution, the demand for water has increased and the quantity of usable water has decreased.

Water pollution: The contamination of water bodies such as rivers, lakes, etc. due to several contaminants being discharged in them, directly or indirectly, is known as water pollution. Water pollution has severe and hazardous impacts on our environment. In this article, we will discuss the causes of water pollution.

Causes of Water Pollution

Contaminated water from household, industries, power plants, etc., results in the pollution of water. Usually, they are polluted to the extent that they cause problems for humans and animals.
Some of the major causes of water pollution are listed below.

Organic Wastes

Organic water pollutants include food waste, detergents, leaves, grass, etc. They originate from domestic sewage, discharge from food processing factories and farm wastes which reach the water sources through runoff and pollute them. It is a fact that the bacteria decompose the complex organic matter into the simple organic matter. They consume oxygen which is dissolved in water. They use up a lot of oxygen which results in the depletion of oxygen content in water.

Industrial Waste

These are the wastes created in factories and industries. Most industries dump their wastes in rivers and seas which cause a lot of pollution.
Example: plastic, glass, etc.

Commercial Waste

Commercial wastes are produced in schools, colleges, shops, and offices.
Example: plastic, paper, etc.

Domestic Waste

The different household wastes which are collected during household activities like cooking, cleaning, etc. are known as domestic wastes.
Example: leaves, vegetable peels, excreta, etc.

Agricultural Waste

Various wastes produced in the agricultural field are known as agricultural wastes.
Example: cattle waste, weed, husk, etc.

Pathogens (Water borne diseases)

Infectious diseases caused by pathogenic bacteria, viruses and protozoan parasites are among the most common and widespread health risk of drinking water.
People are introduced to these microorganisms through contaminated drinking water, water drops, aerosols and washing or bathing.
Some waterborne pathogenic microorganisms spread by water can cause severe, life-threatening diseases. Examples are typhoid fever, cholera diarrhea and Hepatitis A or E. People with low resistance, mainly elderly people and young children, are vulnerable to these diseases as well

What is Heavy Water?

Heavy water is a compound that is made up of oxygen and **deuterium**, a heavier isotope of hydrogen which is denoted by '^{2}H' or 'D'. **Heavy Water is also called deuterium oxide** and is denoted by the chemical formula D_2O.
It has a greater molar mass than regular water since the atomic mass of deuterium is greater than that of protium.
This causes heavy water (D_2O) to have slightly different chemical and physical properties when compared to H_2O.

Properties of Heavy Water

Heavy Water (Deuterium Oxide)	**D_2O**
Molecular Mass	20.02 grams/mole
Density	1.107 g/mL
Dipole moment	1.87 D
Melting Point	3.82°C
Boiling Point	101.4°C

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https://byjus.com/chemistry/waste/
https://www.lenntech.com/processes/disinfection/deseases/waterborne-diseases-contagion.htm#ixzz6PammtiSh

Lesson plan

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https://www.keslerscience.com/properties-of-water-lesson-plan-a-complete-science-lesson-using-the-5e-method-of-instruction/

Worksheet

1. https://www.keslerscience.com/properties-of-water-lesson-plan-a-complete-science-lesson-using-the-5e-method-of-instruction/
2. **MCQS**

1.Water which forms scum with soap is called
hard water
soft water
distilled water
non distilled water
2. Water that easily gives lather with soap is called
hard water
soft water
dirty water
clean water
3. Water that gives little lather is called
hard water
soft water
dirty water
clean water
4. The hardness which can be removed by boiling is called
permanent hardness
temporary hardness
stiffness
toughness
5. Water that does not form scum is called
hard water
soft water
dirty water
clean water

Chapter 08

Chemical industries

Chapter	Understandings	Practical
Chemical industries **Basic Metallurgical Operations with Reference to Copper** • Concentration • Extraction • Electro-Refining **Manufacture of Sodium Carbonate by Solvay's Process** • Raw Materials • Basic Reactions • Flow Sheet Diagram **Petroleum Industry** • Origin of Petroleum • Mining of Petroleum • Important Fractions of Petroleum **Soap its types and saponification**	Students will be able to: • Describe some metallurgical operations. (Applying). • Make a list of raw materials for Solvay process. (Applying). • Outline the basic reactions of Solvay process. (Analyzing). • Develop a flow sheet diagram of Solvay process. (Creating). • Define petroleum (Remembering) • Describe the formation of petroleum and natural gas. (Understanding) • Describe the composition of petroleum. (Remembering) • Describe briefly the fractional distillation of petroleum. (Applying)	• **Prepare ice in laboratory with vinegar and baking soda. (NEW)** • **Preparation of soap in laboratory.(Saponification) (NEW)**

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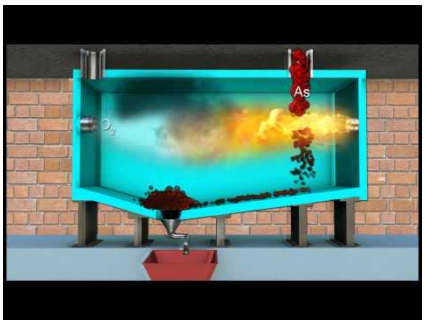
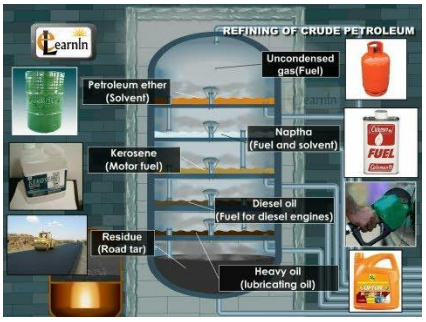
Videos

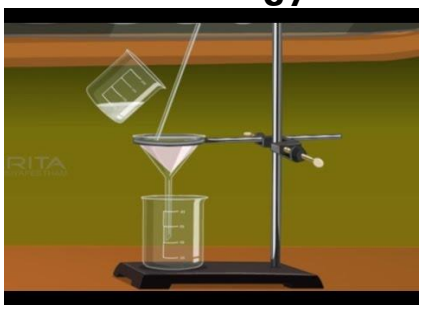
Metallurgy



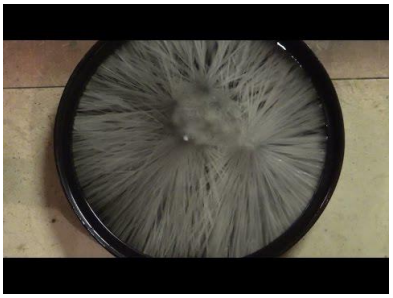
Extraction of copper



Refining of petroleum



Soap and saponification (practical)



ice preparation (practical)

Chapter overview

Metallurgy is defined as a process that is used for the extraction of metals in their pure form.

The compounds of metals mixed with soil, limestone, sand, and rocks are known as **Minerals.**

- Metals are commercially extracted from minerals at low cost and minimum effort. These minerals are known as **Ores.**
- A substance which is added to the charge in the furnace to remove the gangue (impurities) is known as **flux.**

Metallurgy deals with the process of purification of metals and the formation of alloys.

Steps involved in Extraction of metals from ore include mining or ore, concentration, roasting, refining and mixing.

- ❖ The surface of some metals, such as iron, is corroded when they are exposed to moist air for a long period of time. This phenomenon is known as **corrosion.**

Corrosion can be prevented by barrier protection, sacrificial protection and cathode protection.

Extraction of copper

Copper Mining:

The commonest ore used in the extraction of copper is **Chalcopyrite** ($CuFeS_2$) also known as Copper Pyrites and other such sulfides. The concentration of ore is required and it is done by the Froth Flotation method.

Concentration of Ore:

The ore is crushed into a fine powder and a suspension is created in water. To this are added, Collectors (pine oils, fatty acids etc) and Froth Stabilizers. The oil wets the metal and the water wets the gangue. Paddles and air constantly stir up the suspension to create the froth. This frothy metal is skimmed off the top and dried to recover the metal.

Copper Smelting:

Smelting is a metallurgy technique to extract base metals from their ores with the help of heat and a chemical reducing agent. Copper Smelting means that the concentrated ore is heated strongly with silicon dioxide (silica), calcium carbonate ($CaCO_3$) and air in a furnace. The major steps in the extraction of copper are

Copper in Chalcopyrite is reduced to copper sulfide.

Just like in Blast Furnaces, calcium carbonate is added as a flux to create the slag.

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Iron in Chalcopyrite is removed as Iron silicate slag.
Most of the sulfur in Chalcopyrite turns into Sulphur dioxide (SO_2).
The reaction of these processes can be written as:
$2CuFeS2+2SiO2+4O2 \rightarrow Cu2S+2FeSiO3+3SO2$
The copper extracted from this process is mixed with the slag and is called Matte Copper due to its texture and appearance. This mainly consists of Cu2S which is reduced to pure metal by blasting Matte Copper with air.
$Cu2S+O2 \rightarrow 2Cu+SO2$
The sulphur dioxide escapes the copper and this causes bubbles to appear and burst as SO2 leaves. This causes the final product to have a very blistery appearance and hence it is called Blister Copper; 98 – 99.5 % pure.

Manufacture of Sodium Carbonate by Solvay's Process

The Solvay process is used to make sodium carbonate. This lesson will help you understand the different reactions, conditions, products and the environmental issues that are involved in the manufacturing of sodium carbonate by the Solvay process.

What Is Sodium Carbonate?

Sarah's barbecue party is over and it's time to clean up! Sarah uses a product containing washing soda that effectively removes all the grease and oil that was on the barbecue grill and other utensils.
Washing soda (or soda ash or sodium carbonate), Na_2CO_3, is a key component to laundry soaps and many other household products. Sodium carbonate is also used in the paper and wool industries, but the major demand comes from the glass industry

The Solvay Process

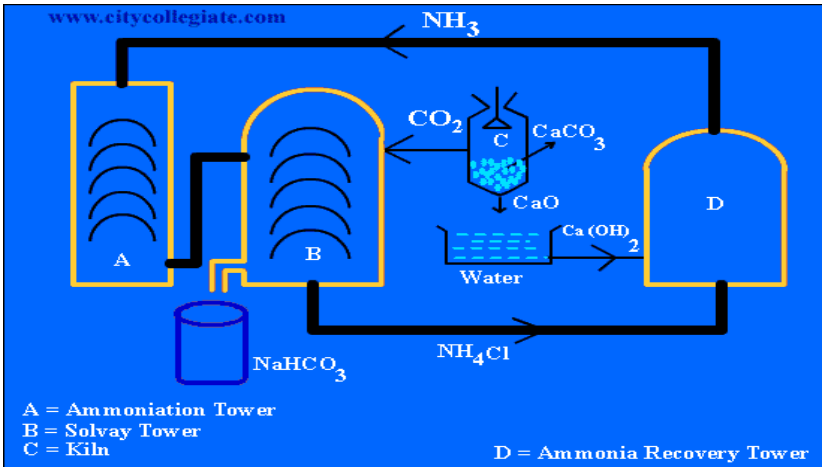
The Solvay process, also known as the ammonia-soda process, was developed in 1861 by the Belgian industrial chemist, Ernest Solvay.

- The materials used in the Solvay process are easily available and inexpensive.

They include:

- Brine, or sodium chloride solution. It provides sodium ions in the making of the sodium carbonate. Brine can be easily sourced from both inland and the ocean.
- Limestone, or calcium carbonate. It provides carbonate ions in the production of the sodium carbonate. Limestone is readily available from mining.
- Ammonia is made industrially by the Haber's process. Ammonia is expensive, but as you will see, it's recycled in the process.
- Principle of Solvay process lies in the low solubility of sodium bicarbonate at low temperature i.e. at 15°C.
- When CO2 is passed through an ammonical solution of NaCl called ammonical brine, only NaHCO3 precipitates.

$Na+(aq) + HCO3–(aq) \rightarrow NaHCO3$



Basic Reactions:

The process consists of the following steps:

(i) Preparation of ammoniacal brine:
First -of all ammonical brine is prepared by dissolving ammonia gas in sodium chloride solution (brine),

(ii) Carbonation of ammonical brine:
Ammonical brine is fed into carbonating tower and carbon dioxide is passed through it.

Following reactions take place in the carbonating tower.
$CO2(g) + NH3(g) + H2O \rightarrow NH4HCO3(1)$
$NH4HCO3(1) + NaCl\ (brine) \rightarrow NaHCO3(1) + NH4Cl(s)$
The temperature of the mixture is lowered to 15°C and precipitates of NaHCO3 are obtained.

(iii) Filtration of precipitates

The milky solution from the carbonating tower is filtered to get sodium bicarbonate. It is used as a baking soda.

(iv) Formation of sodium carbonate

Sodium carbonate is heated to get sodium carbonate.

$2NaHCO3(1) \longrightarrow Na2CO3(s) + CO2(g) + H2O(1)$

$CO2$ is again used in tower. It is about half of $CO2$ needed in the process.

(v) Preparation of carbon dioxide and slaked lime:

$CO2$ is prepared by heating limestone in a lime kiln. Then it is carried to carbonating tower

$CaO3(s) \dashrightarrow CO2(g) + CO2(g)$

Quick lime (CaO) formed in lime kiln is slaked with water. Then, it is pumped to the ammonia recovery tower.

$CaO(g) + H2O(1) \longrightarrow Ca(OH)2$ (Slaked lime)

(vi) Ammonia recovery tower

Ammonia is recovered in this tower from ammonium chloride solution produced in the carbonated tower and calcium hydroxide formed in lime kiln.

$2NH4Cl(s) + Ca(OH)\ 2(1) \longrightarrow 2NH3(g) + CaCl2(s) + 2H2O\ (1)$

Advantages of Solvay's process

(i). It is a cheap process as raw materials are available at very low prices.
(ii). Carbon dioxide and ammonia are recovered and reused.
(iii). Process is pollution free, because the only waste is calcium chloride solution.
(iv). Sodium carbonate of very high purity is obtained.
(v). Consumption of fuel is very less since no solution is to be evaporated.

What is Petroleum?

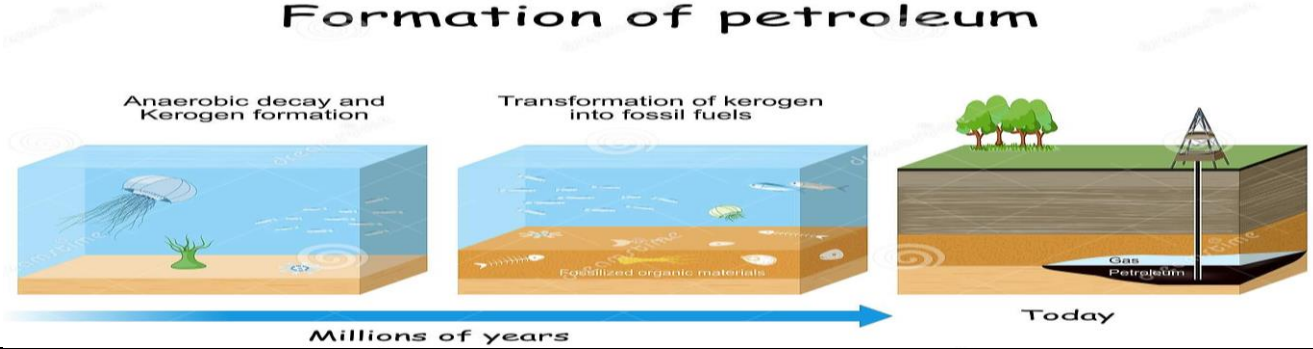
Petroleum is referred to as "Black Gold." This name itself is an indication of its importance to humans. Crude oil is considered to be the "mother of all commodities" as it is used to manufacture various products such as pharmaceuticals, plastics, gasoline, synthetic fabrics, etc. Petroleum or oil has also been the world's leading source of energy.

Petroleum Meaning

The word petroleum translates to "rock oil." It is derived from the Greek word "petra" and the Latin word "oleum". When it is drilled from the ground in the liquid form, it is called crude oil.

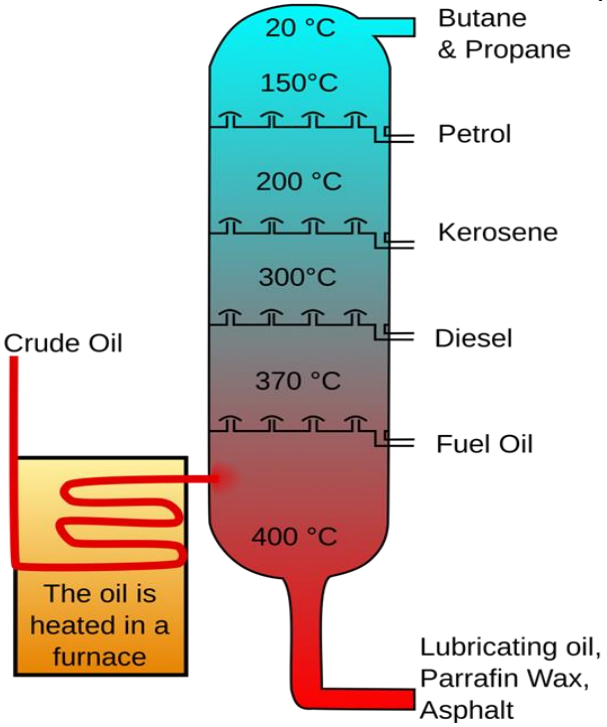
How is Petroleum Formed?

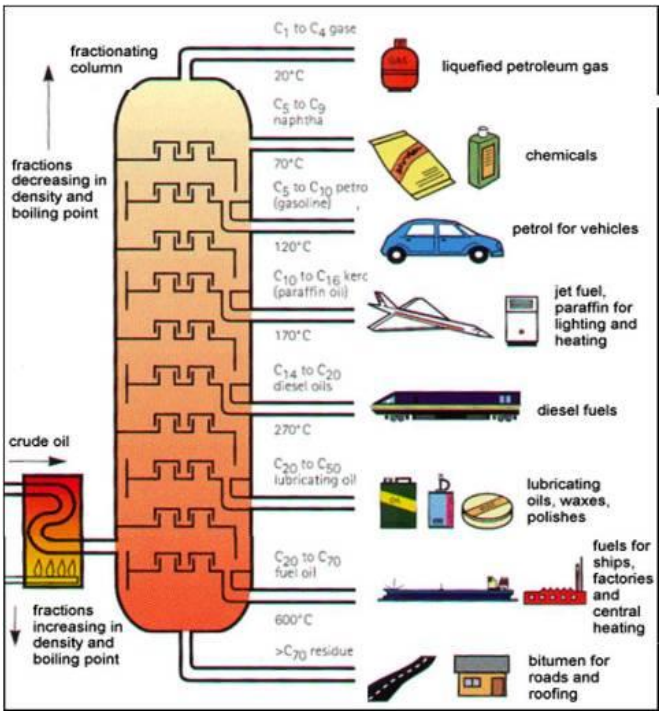
- Petroleum is formed from the remains of dead plants and animals.
- When plants and animals die, they sink and settle on the seabed.
- Millions of years ago, these dead wildlife and vegetation decomposed and got mixed with sand and silt.
- Certain bacteria helped in the decomposition of this organic matter and caused some chemical changes.
- Matter consisting of largely carbon and hydrogen was left behind. However, as there is not sufficient oxygen at the bottom of the sea, the matter could not decompose completely.
- The partially decomposed matter remained on the seabed and eventually was covered with multiple layers of sand and silt.
- This burying took millions of years, and finally, due to high temperature and pressure, the organic matter decomposed completely and formed oil.



Petroleum Refining

- Petroleum is a mixture of many substances such as gas, petrol, diesel, kerosene, lubricating oil, paraffin wax, etc.
- As these constituents serve different purposes, it is important to separate them, or in other words, refine the crude oil. This process of separation of various constituents of petroleum is called petroleum refining.
- This is done in oil refineries. It is a three-step process.





The first step is separation where the crude oil is separated into various components through distillation process. The heavier constituents remain settled at the bottom whereas lighter constituents rise up as vapor, or remain liquid.

The second step: these constituents, which are still quite heavy are converted into gas, gasoline, and diesel. Thus,

Third step is conversion.

These have certain impurities, so the last step is treating, where they are treated to obtain pure forms of various products.

Petroleum
Crude Oil Distillation

Uses of Petroleum

- Refined products obtained from crude oil have a number of uses.
- Liquefied Petroleum Gas or LPG is used in households as well as in the industry.
- Diesel and petrol are used as fuels for vehicles. Diesel is generally preferred for heavy motor vehicles.
- Petrol is also used as a solvent for dry cleaning, whereas diesel is also used to run electric generators.
- Kerosene is used as a fuel for stoves and jet planes.
- Lubricating oil reduces wear and tear and corrosion of machines.
- Paraffin wax is used to make candles, ointments, ink, crayons, etc.
- Bitumen or asphalt is mainly used to surface roads.

What are Soaps?

A soap is a water-soluble compound which is made via a process called saponification by the reaction between sodium hydroxide or potassium hydroxide with vegetable or animal oil (fats).

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Characteristics of Soap

Hardness – Harder soap which is a dense bar lasts longer.
Cleansing – The first reason the majority of people use soap is to get clean. A soap molecule consists of a chain of carbon atoms where one end of the chain attracts oil and the other attracts water. Soap should be balanced and not too much or too less of cleansing ingredient should be added.
Conditioner – Soap conditioners are referred to as emollients. Once you have washed your hands and what's left behind on your skin after you rinse, depends on the type of soap a person uses.
Lather – Most people like soap which produces lather. The balance of bubbles and cleansing, soothing cream makes lather so satisfying.
Fragrance – It is an essential factor. Aromas evoke a unique combination of personal memory and enrich our daily life. Fragrances revitalize us, calm us, and most importantly mask our body odors.

Soaps	Detergents
➢ They are sodium salts of long chain fatty acid.	➢ They are sodium and potassium salts of sulphonic acids of hydrocarbons.
➢ They cannot be used with hard water.	➢ Detergents work well with hard and soft water.
➢ They are fully biodegradable.	➢ They are non-biodegradable.
➢ They take time to dissolve in water.	➢ They dissolve faster in water.

What is Saponification?

Saponification is simply ***the process of making soaps***. Soaps are just potassium or sodium salts of long-chain fatty acids. During saponification, ester reacts with an inorganic base to produce alcohol and soap. Generally, it occurs when triglycerides are reacted with potassium or sodium hydroxide (lye) to produce glycerol and fatty acid salt, called 'soap'.

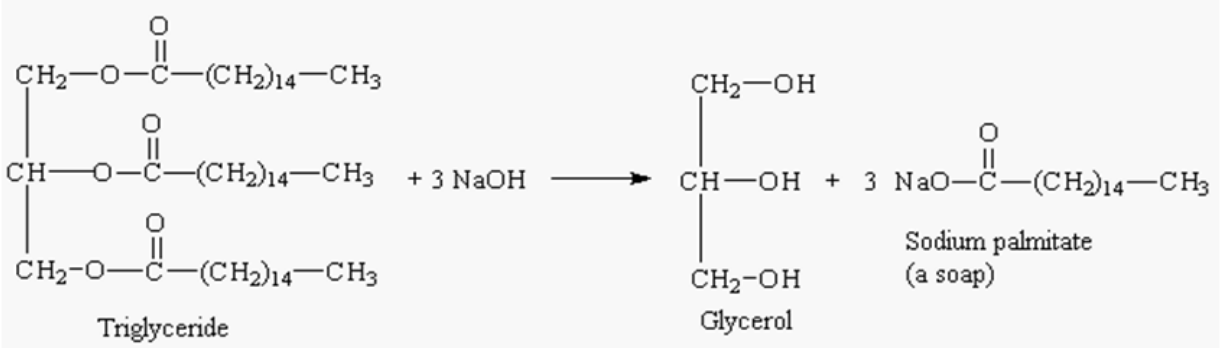
Saponification Reaction

Triglycerides are generally animal fats and vegetable oils. When they are reacted with sodium hydroxide, a hard form of soap is created. This is where potassium comes and creates a softer version of the soap.
The equation can be written as:

Ester + Base ————> Alcohol + Soap

Example of a Saponification Reaction:

In a saponification reaction, a base (for example sodium hydroxide) reacts with any fat to form glycerol and soap molecules. One of the saponification reaction taking triglyceride as an ester and sodium hydroxide as the base is as follows:



Types of Soaps

- **Toilet Soaps:** Toilet soaps use a higher quality of oils and fatty acids to give them better quality. Sometimes perfumes and colours are added for cosmetic purposes.
- **Medicated Soaps:** In these types of soaps we add antiseptics to the soap as an ingredient. The antiseptic is to help kill germs from the surface along with the dirt and dust.
- **Shaving Soaps:** These soaps must not dry to fast. So glycerol is added to it to keep it from drying. Also, we add a substance known as rosin to help the soap lather.
- **Soap Chips:** These are leftover pieces of soap that are left over in soap production. They can also be made by the scrapping of small pieces of soap from a thin sheet of soap
- **Laundry soaps** are formulated to eliminate grease, solid particles and organic compounds from clothes. They can be found in **liquid, powder** and **gel forms.**
- **Cleaning soaps (Kitchen soaps):** Cleaning soaps have different formulations to clean grease and soil. The difference between cleansers and cleaning soaps is that cleaning soaps **don't contain harsh abrasives.**

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Worksheet

MCQs

Which of the following is true about petroleum?

- (•) It can be refined into gasoline
- ( ) It can be separated by using distillation
- ( ) It can be refined into Vaseline
- ( ) All of these answers are correct

1. A substance that is made up of carbon atoms and hydrogen atoms is known as a(n):

- ( ) Hydrocarbon
- ( ) Sulfurcarbon
- ( ) Carbohydro
- (•) Fraction

2. Separating a substance based on different boiling points is known as:

- (•) Distillation
- ( ) Fractions
- ( ) Cracking
- ( ) Hydrocarbon

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Coal and Petroleum

Multiple Choice Questions

1. When coal burns in air _____ is formed.
   A. carbon dioxide B. sulphur dioxide
   C. carbon monoxide D. hydrogen gas

Ans. a. carbon dioxide is formed

2. Which one of the following is obtained from coal tar?
   A. petrol B. coke
   C. air D. naphthalene balls

Ans. D. Naphthalene balls

3. Which one of the following is NOT a fossil fuel?
   A. petrol B. coal
   C. Wood D. Diesel

Ans. C. wood

4. Which one of the following is NOT a non-renewable energy resource?
   A. coal B. petroleum
   C. solar energy D. electricity

Ans. C. solar energy

5. _____ is a natural resource.
   A. car B. bus
   C. water D. parks

Ans. C. water

6. Which one is least polluting Fuel?
   A. petrol B. diesel
   C. CNG D. kerosene

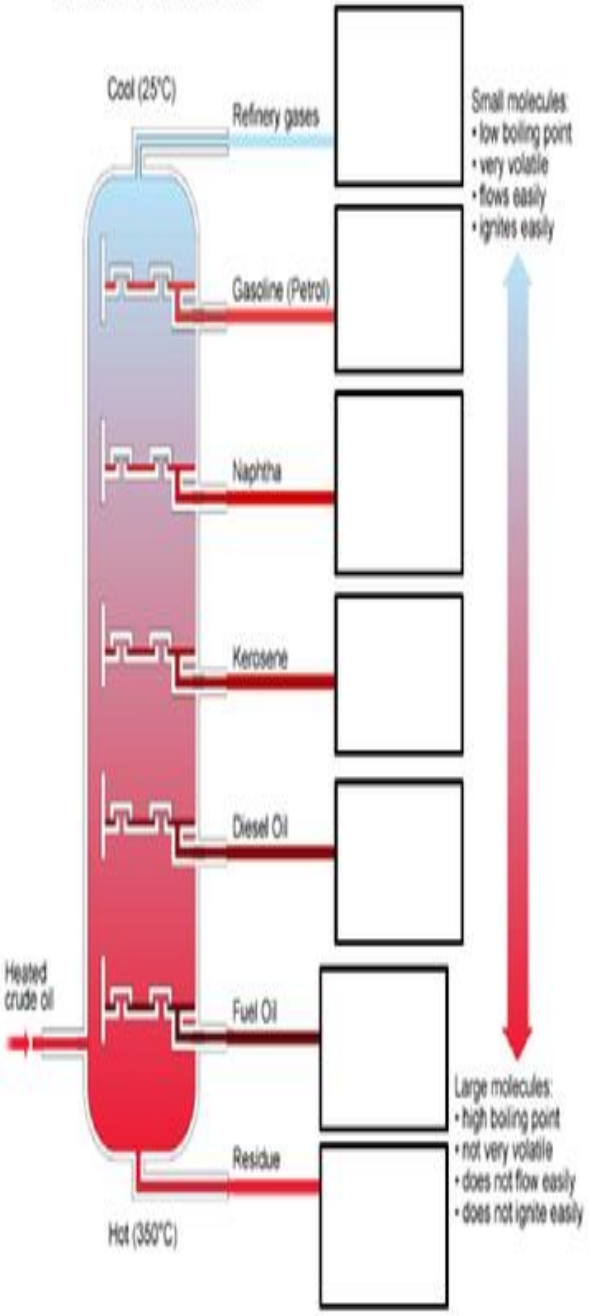
Ans. C. CNG

7. Coal tar contains about _____.
   A. 300 substance B. 400 substance
   C. 200 substance D. 100 substance

Ans. c. 200 substance

Fractional Distillation

Find a use for each fraction, and fill in the boxes with pictures or explanations.



What's New in it?

Although it is based on National curriculum and Sindh curriculum.

New Practical's	New topics
Formation of allotropic form of sulphur (monoclinic sulphur). (NEW)	**Chapter 1** **Carbon, Nitrogen, Oxygen and sulphur.** Its summarized combination of three chapters from Sindh text book. **Chapter 5** **Halogens.** Contain uses and importance of halogens and their compounds in daily life
KMNO4 is standardized with Oxalic acid. Redox Titration. (NEW)	
To determine the pH level of saliva and any citrus fruit than compare them. Also write effects pH level of your saliva. (NEW)	
Demonstrate the softening of water by removal of calcium ions from hard water. (NEW)	

Education opens up the mind, expands it and allows you to improve your life in so many ways.

If you want to inspire and make change in the lives of your students than I hope you'll find this material helpful.

Thankyou

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