UNIT ONE

ELEMENTS AND THE PERIODIC TABLE

Mention the four blocks of the periodic table.

- Metals
- Metalloids
- Non-metals and transition metals.

Which are the general trends in the periodic table?

- Atomic radii
  - Increase as you go down the group
  - Does not change from left to right.
  - Increase in atomic radii increases the shielding effect of the effective nuclear charge.
  - Shielding effect is also called screening effect.
  - This refers to the reduced attraction by nucleus for the outermost electrons.
  - It is caused by electrons within the inner energy level.
- Ionisation energy
  - Is the energy that is required in order to remove the outermost electron from an atom.
  - Is a measure of how difficult it is to remove an electron from at atom in gaseous state.
  - The higher the ionization energy the more difficult it is to remove an electron from the atom.
    - ✓ Lithium has a radius of 0.15um and ionization energy of 520.
    - ✓ Sodium has a radius of 0.19 um and ionization energy of 496
    - ✓ Potassium has a radius of 0.23 and ionization energy of 479
  - Increase in atomic radius reduces ionization energy.
- Electron affinity

- Is ability of an atom to attract electrons.
- Electron affinity decreases down the group and increase across the period i.e. left to right.
- Increase in atomic radius increases the distance for effective nuclear charge.
- As you go from left to right across the period, the effective nuclear charge is increased hence increase electron affinity.

- Electronegativity
  - Is a tendency of an atom to attract electrons from another atom more than what the atom can attract.
  - This makes one atom positively charged while the other is negatively charged.
  - Electronegativity results in formation of polar molecules.

The periodic table

$^{1}_{1}H$							$^{4}_{2}He$
$^{7}_{3}Li$	$^{9}_{4}Be$	$^{11}_{5}B$	$^{12}_{6}C$	$^{14}_{7}N$	$^{16}_{8}O$	$^{19}_{9}F$	$^{20}_{10}Ne$
$^{23}_{11}Na$	$^{24}_{12}Mg$	$^{27}_{13}Al$	$^{28}_{14}Si$	$^{31}_{15}P$	$^{32}_{16}S$	$^{36}_{17}Cl$	$^{40}_{18}Ar$
$^{39}_{19}K$	$^{40}_{20}Ca$						

Discuss the trends in the physical and chemical properties of the various families of elements.

- Group I elements
  - Also called alkali metals.
  - Are in the most reactive group of metals.
  - Found in the extreme left hand side of the periodic table.

- ✓ Lithium (Li)
- ✓ Sodium (Na)
- ✓ Potassium (K)

➢ Have the following physical properties down the group.

- ✓ Melting and boiling points decrease down the group.
- ✓ Atoms become bigger due to increase in number of energy levels.
- ✓ Density increase due to increase in mass.
- ✓ Ionization energy decreases due to increase in atomic size which weakens force of attraction between the possible nucleus and outer most energy level electrons.
- ✓ Electron affinity reduces as the atom becomes bigger.
- ✓ Electronegativity decreases due to increase in atomic size.

➢ Have the following chemical properties.

- ✓ React with air or oxygen.
- ✓ React with water.
- ✓ React with chlorine

➢ Uses of alkali metals include

- ✓ Lithium
  - ❖ Used in production of lubricating grease
  - ❖ Used in deoxidizing copper and copper alloys.
  - ❖ Lithium -6 is a main source for the production of tritanium.
  - ❖ Used in batteries which contain more energy compared to other metals. (batteries used in cell phones and computers)

- ✓ Sodium
  - ❖ Used in preparation of tetraethyl lead which is used as

antiknock reagent in petrol. (Tetraethyl lead is being phased out to reduce lead pollution problem).

- ❖ Used in extraction of titanium metal from titanium chloride.
- ❖ Sodium vapour is used in lamps for street lighting.
- ❖ Sodium chloride (NaCl) is used to add taste to food.
- ❖ Sodium carbonate is used in manufacturing of glass, detergents and for softening hard water.
- ❖ Sodium hydroxide and sodium chloride are used in manufacture of soap and detergents.

✓ Potassium

- ❖ Potassium chloride is used in making fertilizers (Is essential for plant growth).
- ❖ Potassium chromate is used in tanning leather, in manufacture of inks, gun powder and dyes.
- ❖ Potassium nitrate is used as food preservative.

- Group II elements
  - ➢ Also called alkaline – earth metals.
  - ➢ Found at the left hand side of the periodic table just after Group I elements.
  - ➢ Examples include
    - ✓ Beryllium (Be)
    - ✓ Magnesium (Mg)
    - ✓ Calcium (Ca)
  - ➢ Have the following physical properties down the group
    - ✓ Melting and boiling points decrease down the group.
    - ✓ Atoms become bigger due to increase in number of energy levels.
    - ✓ Density increase due to increase in mass.
    - ✓ Ionization energy decreases due to increase in atomic size

which weakens force of attraction between the possible nucleus and outer most energy level electrons.

- ✓ Electron affinity reduces as the atom becomes bigger.
- ✓ Electronegativity decreases due to increase in atomic size.

- Have the following chemical properties
  - ✓ React with air or oxygen.
  - ✓ React with water.
  - ✓ React with chlorine
- Alkaline-earth metals have the following uses
  - ✓ Beryllium
    - ❖ Used in transmission of X-rays.
    - ❖ Alloy of beryllium and copper is hard, strong with high resistance to wear hence used to make computer parts.
    - ❖ Alloy of beryllium are used as structural materials for high performance aircrafts, missiles, space crafts and satellites.
    - ❖ Beryllium oxide is used in nuclear industry.
  - ✓ Magnesium
    - ❖ Used in making alloys used for manufacturing aircraft, parts of car engine casing and for missile construction.
    - ❖ Used as a reducing agent in the production of uranium and other metals from salts.
    - ❖ Used in pharmaceutical industry to manufacture medicine such as
      - o Milk of magnesium (Magnesium hydroxide)
      - o Magnesium chloride.
      - o Epsom salt (magnesium sulphate.
    - ❖ Magnesium oxide is used in brick-liners in furnaces.
    - ❖ Used in computer for radio-frequency shielding.

- ✓ Calcium
  - ❖ Used as reducing agent in the preparation of metals such as
    - o Thorium
    - o Uranium
    - o zirconium
  - ❖ Calcium form calcium carbonate which is a component of cement.
  - ❖ Calcium carbonate is used in antacid tablets.

- Group VII elements
  - ➢ Also called halogens.
  - ➢ The name was derive from two Greek names
    - ✓ 'hal' meaning salt.
    - ✓ 'gen' meaning produce.
    - ✓ Found at the right hand side before noble gases.
  - ➢ Have the following physical properties
    - ✓ Bright and darken down the group
    - ✓ Are gas, liquid through solids at room temperature
    - ✓ Are all diatomic.
    - ✓ Have low melting and boiling points.
    - ✓ Do not conduct electricity and heat.
    - ✓ Atomic radii increase down the group.
    - ✓ Ionic size increase down the group.
  - ➢ Have the following chemical properties
    - ✓ Are highly reactive.
    - ✓ React with metals to form metal halides.
    - ✓ React with other non-metals.

- Have the following uses
  - ✓ Fluorine
    - ❖ Used in manufacture of plastics.
    - ❖ Hydrofluoric acid is used in air conditioning and refrigerators.
    - ❖ Small amount in water prevents tooth decay (for making tooth paste)
  - ✓ Chlorine
    - ❖ Used in water treatment.
    - ❖ For production of
      - o paper products
      - o dye stuffs
      - o textile
      - o petroleum
      - o medicine
  - ✓ Bromine
    - ❖ Used in making petrol engine anti-knock compounds.
    - ❖ Used in the manufacture of
      - o Fumigants
      - o Flame proof agents
      - o Water purification compounds
      - o Dyes
      - o Medicine
      - o pesticides
  - ✓ iodine
    - ❖ used in medicine such as
      - o disinfectant for external wounds is made from a solution of potassium iodide and iodine in alcohol.

- ❖ silver iodide is used in photography.
- ❖ Is added to stable salt to prevent goitre
- ❖ Used in testing for starch in biological science
    - o Turns reacted starch blue black in colour.

- Group VIII elements
    - ➢ Also called noble gases.
    - ➢ Were initially called inert gases before the discovery of krypton and xenon.
    - ➢ Found in the right of the periodic table.
    - ➢ All shells are filled up.
    - ➢ They are non-reactive.
    - ➢ Are monoatomic
    - ➢ Are bright coloured gases
    - ➢ Have the following physical properties
        - ✓ Do not conduct heat and electricity.
    - ➢ Have the following uses
        - ✓ Helium
            - ❖ Used in filling meteorological balloons
            - ❖ Used as a cooling medium for nuclear reaction.
            - ❖ A mixture of 80% helium and 20% oxygen is used as an artificial atmosphere for divers and others working under pressure.
            - ❖ Used as a protective gas for semiconductor material.
            - ❖ Used in pressuring rocket fuels to liquid.
        - ✓ Neon
            - ❖ Used in making neon advertising coloured signs.
            - ❖ Used to make high-voltage indicators.
            - ❖ Neon and helium are used in making gas lasers.

- ❖ Liquid neon is an economical refrigerant.

✓ Argon

- ❖ Used in electrical light bulbs and fluorescent tubes.
- ❖ Used as an inert gas shield for arc welding and cutting.

UNIT TWO

CHEMICAL BONDING

What is bonding?

- Is the union of two or more particles to form a new one or large particle than original.
- It is done because there is a force of attraction between those particles.

What a chemical bond?

- Is an attraction between two particles.
- Particles could be atoms or ions.

Mention the three types of bond.

- Ionic bond (electrovalent bond)
- Covalent bond
- Metallic bond

What is ionic bonding?

- Is the bonding that occurs between metals and non-metals.
- Metals lose electron(s) and become positively charged.
- Non-metals gain electron(s) and become negatively charged.

What is covalent bonding?

- Is the bonding between non-metals.
- All atoms share electrons.
- There is sharing of the electrons in the bonded atoms.
    - Hydrogen bonding
        - ✓ Where hydrogen is bonded to another atom.

What is metallic bonding?

- Is the bonding among metal particles.
- Metals have free electrons to move.
- The movement of electron cleats a positive charge from where it is coming from and negative charge it is going.
- These opposite charges form a force of attraction between particles.
- Hence, articles attract and bond.

UNIT THREE

ACIDS AND BASES

What are acids?

- Are proton donors.
- Are also define as substances with sour taste.
- These can found in
    - Citrus fruits such as oranges, lemons, malambe
        - ✓ Citric acid
    - Grapes, health salt, baking powder, bwemba
        - ✓ Tartaric acid
    - Sour milk
        - ✓ Lactic acid
    - Vinegar
        - ✓ Ethanoic acid
    - In ants such as bee and nettle stings
        - ✓ Methanoic acid
    - Coke, lemonade, other fizzy drinks
        - ✓ Carbonic acid
    - Cheese
        - ✓ Butanoic acid
    - Tea
        - ✓ Tannic acid
    - Found as dilute acid in stomach
        - ✓ Hydrochloric acid
    - Car batteries, fertilizers, detergent

        - ✓ Sulphuric acid
    - Fertilizers and explosives
        - ✓ Nitric acid.

What are the uses of acid in everyday life?

- Organic acids
    - Vinegar
        - ✓ has 6% acetic acid.
        - ✓ Used in food preparation and preservation.
    - Citric acid
        - ✓ Used in preparation of effervescent salts
        - ✓ Used for food preservation
    - Tannic acid
        - ✓ For manufacturing of ink
        - ✓ In processing of leather
    - Acetylsalicylic acid
        - ✓ Also known as aspirin
        - ✓ Used to relief pain, fever
        - ✓ Reduces inflammation
    - Ascorbic acid
        - ✓ Also known as vitamin C
        - ✓ Used as an antioxidant.
    - Carbonic acid
        - ✓ Used to make carbonic drinks like soda
- Mineral acids
    - Sulphuric acid
        - ✓ Used in manufacture of fertilizers

        - ❖ Ammonia sulphate
    - ✓ Used in car batteries.
- ➢ Bothe nitric and sulphuric acids
    - ✓ For manufacture of
        - ❖ Dyes
        - ❖ Paints
        - ❖ Drugs
        - ❖ Explosives
- ➢ Hydrochloric acid
    - ✓ Used in cleaning steel (pickling.
- ➢ Phosphoric acid
    - ✓ Used to make
        - ❖ Detergents
        - ❖ Fertilizers
        - ❖ Soft drinks.

Mention some properties of acids.

- Has sour taste.
- Turn red litmus paper blue.
- Contains hydrogen which may be displaced by some metals
- Liberates carbon dioxide from carbonate and hydrogen carbonates.
- Reacts with a base to give a salt and water only.

What are bases?

- Are proton accepter.
- Also defined as substances with bitter taste.

Mention examples of common bases.

- Sodium hydroxide

- Calcium hydroxide
- Magnesium hydroxide
- Ammonium hydroxide
- Potassium hydroxide

What are the common uses of bases in everyday life?

- Sodium hydroxide.
    - Manufacturing of soap.
    - Used in petroleum refining.
    - Manufacturing of medicine, paper and pulp.
    - Making rayon in the textile industry.
- Calcium hydroxide (also called slaked lime).
    - Manufacturing of bleaching powder.
    - Neutralise acid in water supply.
    - Mixed with sand and water to make mortar which is used in the construction of buildings'
    - Neutralise acidic soils in order to improve soil fertility.
    - Used as an antidote for food poisoning.
    - Used preparation of fungicides.
- Ammonium hydroxide.
    - To remove ink spots from clothes.
    - To remove grease from window-panes.
    - For water purification.
- Potassium hydroxide.
    - Used in manufacturing of alkaline batteries.
- Magnesium hydroxide.
    - Used in laxative (i.e. stimulation of bowel movement).
    - Used as antacid in treatment of heart burn.

What are the properties of bases?

- Is a substance with bitter taste.
- Turns blue litmus paper red.
- React with acids to produce salt and water.

What are acid/base indicators?

- Are all substances that can be used to show that the substance you have is an acid or base.
- Indicators turn acid colour or base colour when added to it.
- There are local or commercial indicators.
- Local indicators.
    - Can be prepared from local materials such as plant extract.

How can you prepare local indicator?

- Materials can include
    - Test tubes
    - Leaves e.g. acacia and tomatoes
    - Pestle and mortar
    - Ethanol
    - Hibiscus flower
    - Water
- Procedure
    - Crush some hibiscus flowers in a mortar using a pestle.
    - Add little amount of ethanol.
    - Grind the petals until you get enough extract of the flower used.
    - Filter the liquid into a clean beaker.
    - Add a few drops of indicator to the liquid to be tested
    - Record the colour change

Give examples of commercial indicators.

- Litmus paper.
    - Blue litmus paper turns red on presence of bases.
    - Red litmus paper turns blue on presence of acids.
- Methyl-orange.
    - Turns yellow on presence of bases.
    - Turns pink on presence of acids.
- Phenolphthalein.
    - Turns bases orange.
    - No effect on acids.
- Screened methyl orange.
    - Turns orange in presence of bases.
    - Turns purple in presence of acids.

What are universal indicators?

- These are mixtures of dyes which gives a range of colours depending on strength of acid and base.
- Acids have colours ranges of
    - Red strongest acid
    - Orange medium acid
    - Yellow weak acid
- Base have colours ranges of
    - Violet strongest base.
    - Blue weak base
- Green colour is not acid is not base. (is neutral).

What is the pH scale?

- It is a scale of numbers that shows strength of an acid or a base.
- Numbers range from 1through 14.

- 1 is the strongest acid.
- 14 is the strongest base.
- 7 is neutral.

Define neutralisation.

- It is the act of making acid or base loose its acidity or basicity.
- It done by reacting base and acid.
- The product is water and salt.

What is the application of neutralisation in everyday life?

- Aluminium hydroxide, hydrogen carbonate, magnesium hydroxide is used to neutralise excess hydrochloric acid in the stomach.
- Calcium oxide (quick lime) or calcium hydroxide (slaked lime) is used to neutralise excess acids in acidic soils.
- Tooth paste for mouth cleaning has a base which neutralises the acid which causes teeth decay.

UNIT FOUR

HYDROCARBONS

What is organic chemistry?

- Is the study of carbon, oxides and carbonates.
- The ability of carbon to be bonded to other elements such as hydrogen and oxygen is called catenation..
- The products formed are organic compounds.
- Organic compounds have homologous series.
    - These are compounds with similar properties and behave in certain similar ways.
    - They have certain general formula.
    - Compounds differ from one another with a constant atom or group of atoms.
    - Can be prepared using similar method.
    - Show gradual change in physical properties.
    - Have similar chemical properties.
- Examples of homologous series of organic chemistry include
    - Alkanes
    - Alkenes
    - Alkanols
    - Alkanoic acids
    - alkynes

What are hydrocarbons?

- Are all organic compounds which contain carbon and hydrogen only.
- Examples of hydrocarbons include
    - Alkanes

- Alkenes

ALKANES

- **Examples;** petroleum, gas fuels.

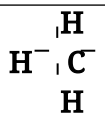
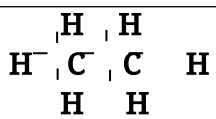
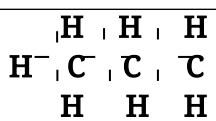
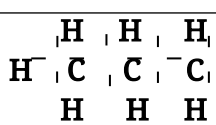
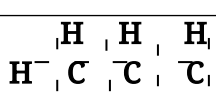
FUNCTIONAL GROUP:

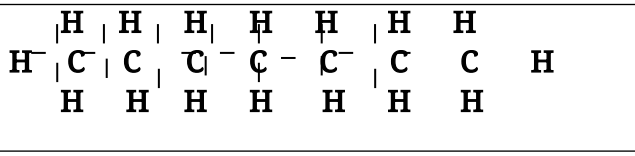
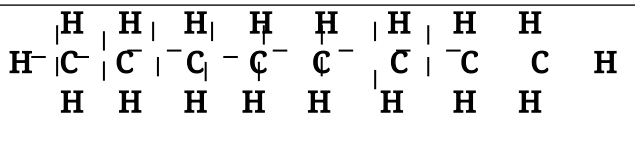
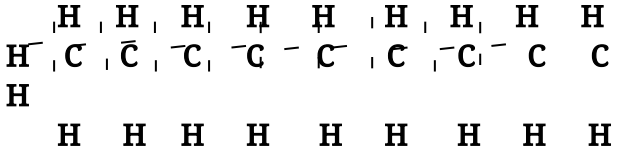
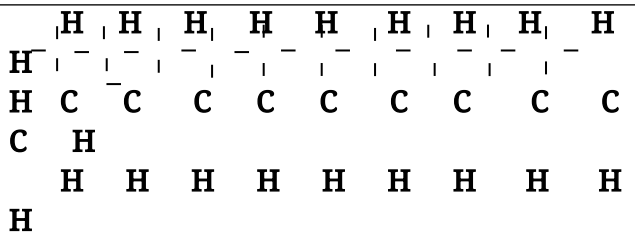
- Has no functional group.

GENERAL FORMULA:

- C_nH_{2+2n} (where n is number of carbons in the element)

COMMON NOMENCLATURE

Number Of carbons	Formula	Prefix	Surfix	Name	Structure
1	CH_4	Meth-	-ane	Methane	
2	C_2H_6	Eth-	-ane	Ethane	
3	C_3H_8	Prop-	-ane	Propane	
4	C_4H_{10}	But-	-ane	Butane	
5	C_5H_{12}	Pent-	-ane	Pentane	
6	C_6H_{14}	Hex-	-ane	Hexane	

7	C_7H_{16}	Hept-	-ane	Heptane	
8	C_8H_{18}	Oct-	-ane	Octane	
9	C_9H_{20}	Non-	-ane	Nonane	
10	$C_{10}H_{22}$	Dec-	-ane	Decane	

TEST FOR ALKANES

- **Solubility test**
  - To 15 drops of water in a test tube, add at least 6 drops of the test liquid i.e. alkane.
- **Result:**
  - Two layers are seen.
- **Deduction:**
  - Insoluble in water.

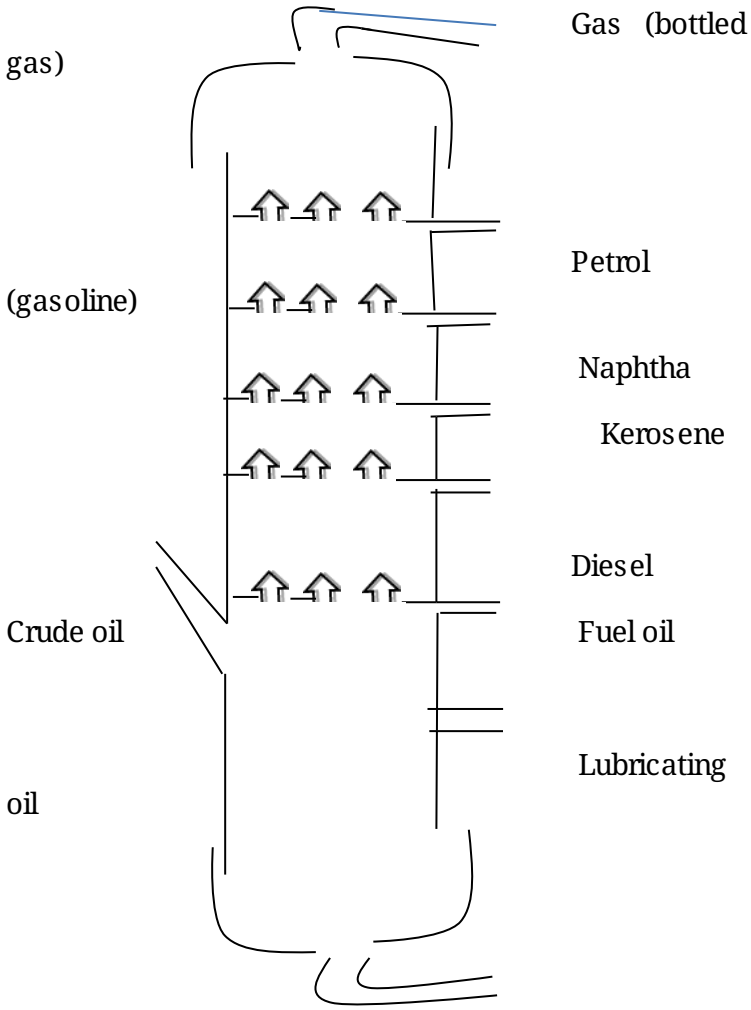
- **Conclusion:**
  - Can be a hydrocarbon.
- **Bromine test:**
  - To 15 drops of bromine solution add 2 drops of the test liquid i.e. alkane.
- **Results:**

- No colour change observed.

- **Deduction:**
  - Only single bond.
- **Conclusion**
  - Alkane.

SOURCES OF ALKANES

- Fractional distillation of crude oil.



PHYSICAL PROPERTIES OF ALKANES

- Melting and boiling points increase down the group.
- Are gases, liquids through solids at room temperature.
- Are insoluble in water.
- Are soluble in organic solvents.
- Do not conduct electricity.
- Viscosity increases down the group.

CHEMICAL PROPERTIES OF ALKANES

- Are less reactive.
- Burn in air or oxygen.
- Under goes substitution reaction.

USES OF ALKANES

- Methane is used as a source for cooking and fuel in vehicles.
- Propane and butane are used in school laboratories and industries for heating purposes.
- Butane mixed with small proportions of propane are compressed in gas cylinders used in household lighting, water heating and cooking.
- Petrol is used in automobile.
- Alkanes with higher numbers of carbons are used as solvent in the manufacture industrial chemicals.
- Solid alkanes have others uses such as
    - Bitumen

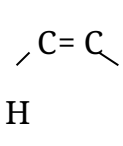
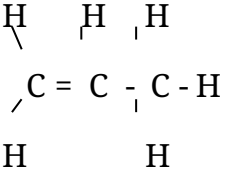
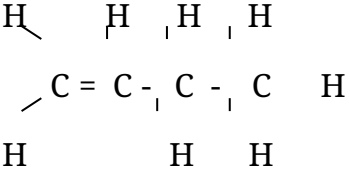
- Vaseline Petroleum jelly.

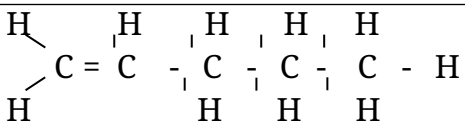
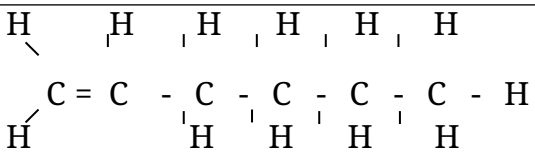
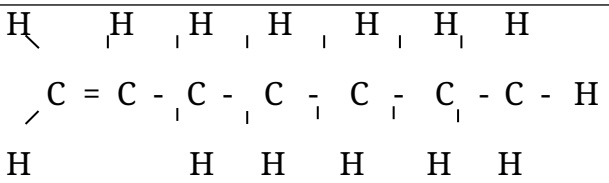
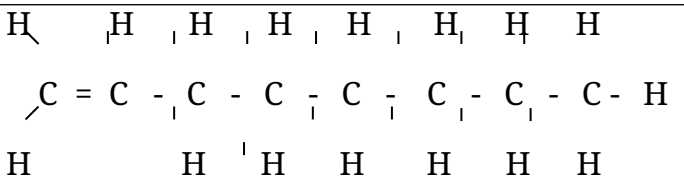
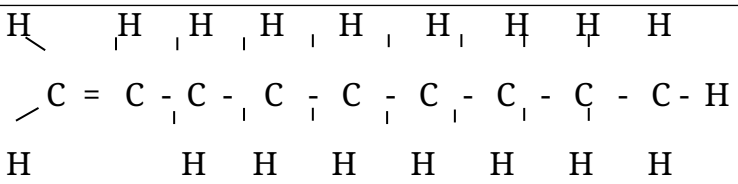
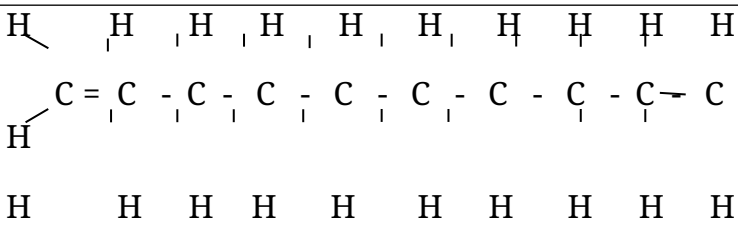
- Candle burns to give light. (candle wax is hydrocarbon).

ALKENES

- **Examples:**
  - Plastics
- **Functional group:**
  - C = C i.e carbon to carbon double bond.
- **General formula**
  - C_nH_{2n}

COMMON NOMENCLATURE

Number of carbon	Formula	Prifix	Surfix	Name	Structure
2	C_2H_4	Eth-	-ene	Ethene	
3	C_3H_6	Pro-	-ene	Propene	
4	C_4H_8	But-	-ene	Butene	

5	C_5H_{10}	Pent-	-ene	Pentene	
6	C_6H_{12}	Hex-	-ene	Hexene	
7	C_7H_{14}	Hept-	-ene	Heptene	
8	C_8H_{16}	Oct-	-ene	Octene	
9	C_9H_{18}	Non-	-ene	Nonene	
10	$C_{10}H_{20}$	Dec-	-ene	Decene	

TEST FOR ALKENES

- **Solubility test:**
  - To 15 drops of water in the test tube add at least 6 drops of test liquid. i.e alkene.
- **Result:**
  - Two layers are seen.
- **Deduction:**
  - Insoluble in water.

- **Conclusion:**
  - Can be a hydrocarbon.

- **Bromine test:**
  - To 15 drops of bromine solution add 2 drops of the test liquid.
- **Results:**
  - Becomes clear or colourless.
- **Deduction:**
  - Has double bond that has made it possible for the reaction.
- **Conclusion:**
  - Alkene.

SOURCES OF ALKENES

- Dehydration of alcohol
  - Dehydration is the process of removing water from a compound.
  - When water has been removed from alcohol, the result is alkene

$$C_4H_9OH \xrightarrow[\text{heat}]{\text{concentrated acid}} C_4H_8 +$$

  - The final product is alkene called butane.
- Cracking of hydrocarbons.
  - This involves the breaking of long chain alkane molecule into a shorter one and an alkene molecule..
  - This is done under a high temperature.

$$C_6H_{14} \xrightarrow{\text{700 degrees Celsius}} C_4H_{10} + C_2H_4$$

PHYSICAL PROPERTIES OF ALKENES

- Boiling and melting points increases down the group.

- Density increases down the group.
- Are solid or liquid at room temperature.
- Are insoluble in water.
- Are soluble in organic solvents.

CHEMICAL PROPERTIES

- Can burn in air or oxygen.
- Under go addition reactions
    - ➢ Addition of hydrogen
        - ✓ also called hydrogenation.
        - ✓ Ethane reacts with hydrogen in the presence of catalyst to form ethane.
    - ➢ Hydration
        - ✓ When ethane is reacted with concentrated sulphuric acid it forms a compound called ethylhydrogesulphate.
        - ✓ When added to water and warmed, an alcohol is formed called ethanol.
    - ➢ Addition of halogens to ethane.
        - ✓ Also called halogenation
        - ✓ This produces halogenal-alkane.
            - ❖ Bromo-alkane
            - ❖ Chloro-alkane
            - ❖ Iodo-alkane
        - ✓ Halogen breaks the double bond of alkene.

USES OF ALKENES

- Ethane and propene are used in the manufacture of plastics.
- Ethane is used in artificial ripening of fruits

UNIT FIVE

AIR

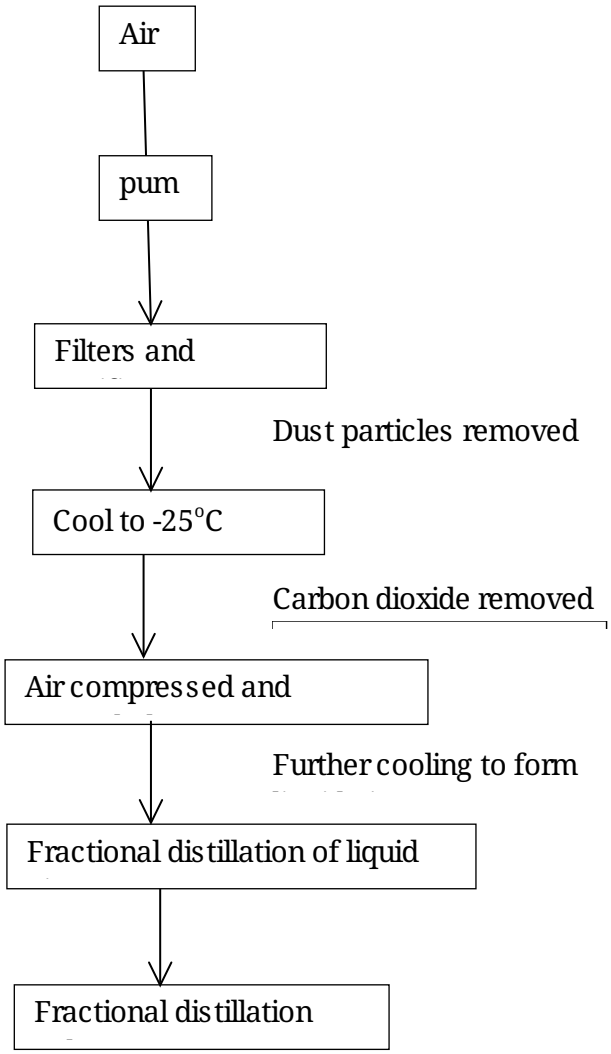
What is air?

- Is the mixture of gases.
- Air contains the following
    - 78% nitrogen.
    - 21% oxygen.
    - 0.03% carbon dioxide.

- About 1 noble gas
- Variable smoke/dust particles
- Variable polluting gases

How can you separate components of air?

- By using fractional distillation of liquid air.



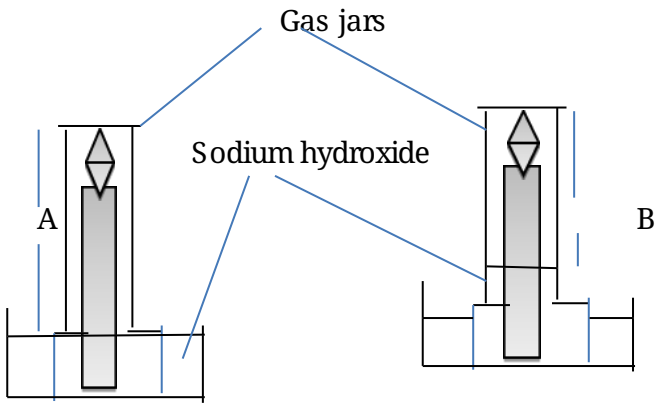
Nitrogen at -196°C, Argon at -186°C, Oxygen at -

What are the uses of gases found in the air?

- Nitrogen
  - Dilute the oxygen in the air
    - ✓ Weakens the process of burning and rusting in air.
  - Leguminous plants have bacteria which converts air nitrogen into useful compound rich in nitrogen.
- Oxygen
  - Is active fraction of air.
  - Necessary for breathing.
  - Used for burning.
  - Used in rusting and decay.
  - Without oxygen, there would be no life.
- Carbon dioxide
  - Air contains only 0.03%.
  - Exhaled air is about 3%
  - Some comes from burning wood, coal, petrol, oil and other compounds.
  - Used in plants for photosynthesis.
- Noble gases
  - Examples include argon, neon, helium, krypton and xenon.
  - Do not react with any other substance
  - Argon is used in electric bulbs.
  - Helium is used in weather balloons.
  - Neon is used in coloured advertisement signs.

QUANTITATIVE DETERMINATION OF THE FRACTION OF OXYGEN IN AIR

- Aim
  - To determine the percentage of air used when a candle burns.
- Apparatus
  - Trough
  - Beehive shelf
  - Candle
  - Gas jar
  - 30cm ruler
  - Sodium hydroxide solution
- Procedure
  - Invert an empty gas jar over the candle before lighting it.
  - Measure the length of A in cm as shown in the figure below.
  - Remove the gas jar.
  - Light the candle and immediately cover it with the empty gas jar.
  - When the candle flame goes off, measure height B in cm



  - When the candle is lit, it burns for some time then goes off.
  - The water level rises inside the gas jar and goes down in the trough.
  - Amount of air in the gas jar was A.
  - Amount of air used during burning is A-B i.e. the rise in the level of

water.

- Percentage of air $= \frac{\text{(height A -height B) x 100}}{\text{height A}} = C\%$

- Oxygen can also be prepared in the laboratory by reacting manganese oxide and hydrogen peroxide.
  - Hydrogen peroxide breaks into water and oxygen.
  - Manganese dioxide is used as a catalysts.
- Oxygen can also react with metals to produce rust under the presence of water
- Oxygen can also cause burning of metals and other substances.

PHYSICAL AND CHEMICAL PROPERTIES OF OXYGEN

- Physical properties include
  - Is colourless gas
  - Has no smell
  - Is slightly soluble in water
  - Is slightly denser than air
  - Is neutral to litmus paper.
- Chemical properties include
  - Is very reactive.
  - Supports burning.

USES OF OXYGEN

- In welding and cutting of metals.
- Used as aid to breathing where the natural supply is insufficient.
- Used to remove impurities in the process of making steel.
- Liquid oxygen is used to burn fuel in some space rockets.
- A mixture of charcoal, petrol and liquid oxygen is used as an explosive.

ATMOSPHERIC POLLUTANTS AND NTHEIR SOURCES

- Atmospheric pollution is the introduction of substance to the environment which have harmful effects on the ability of the environment to support life.
- Can also be define as making environment dirty.
- Atmospheric pollution can be
    - Poisonous gases
    - Solid particles

POISONOUS GASES AND THEIR EFFECTS ON HEALTH AND ENVIRONMENT

- Sulphur dioxide (SO_2)
    - From most fuels.
    - Are toxic and cause respiratory diseases.
    - Also form acidic rain.
- Nitrogen dioxide (NO_2)
    - When nitrogen in the air combines with oxygen.
    - Toxic gas.
    - Promotes respiratory diseases.
    - Also forms acid rain
- Carbon dioxide (CO_2)
    - Prevents warm air from escaping into the atmosphere.
    - Causes greenhouse effects.
    - Greenhouse effects leads to global warming.
    - Causes the melting of polar ice caps which can rise the level of the oceans.
    - Hence lead to flooding.
- Carbon monoxide (CO)
    - From the burning fuels.
    - Poisonous gas.
    - Can combine with haemoglobin in the red blood cells to form stable

compound called carboxyhaemoglobin.

- Causes suffocation and death
- Has no order or colour which makes it difficult to be recognised

- Un burnt hydrocarbons
  - Can be carcinogenic.
- Chlorine
  - From decayed insecticides and perfume sprays.
  - Destroys ozone gas.
- Ozone (O_3)
  - Generally light blue gas.
  - Causes headaches among people.

SOLID PARTICLES

- Large particles dumped by people in the environment.
- These may in water or on land.
- Examples include
  - Cement
  - Flour
  - Sugar
  - Plastic bags
  - Mining
  - Quarry

SOURCES OF POLLUTANTS

- Smoke from industries.
- Smoke from vehicles
- Charcoal burning
- Floods

EFFECT MADE TO REDUCE ATMOSPHERIC POLLUTION

- Improvement of combustion of fuels.
- Introduction of better processing of fuels to make them free from sulphur.
- Introducing more better filter systems in industries.
- Introducing of smokeless solid fuels or fuels like hydrogen.

UNIT SIX

SOIL

What is soil?

- Is a top material on the earth's crust that supports living.
- Soil is composed of

- Inorganic matter.
- Organic matter.
- Water.
- Air.

- Inorganic matter
  - 50% of the soil.
  - Include rock particles from weathering, and minerals.
  - These form soil particles such as
    - ✓ Sand
    - ✓ Silt
    - ✓ Clay
  - Also form mineral elements such as
    - ✓ Iron
    - ✓ Aluminium
    - ✓ Copper
    - ✓ Silicates
- Organic matter
  - 5% of the soil.
  - From
    - ✓ animal wastes and human
    - ✓ decayed parts of plants and animals.
  - Also called humus.
- Water (moisture)
  - 25% of the soil.
  - Is a solvent for minerals.
  - Too much water causes water logged soil.

- Air
    - 25% of the soil.
    - Found in soil pores.
    - Also called atmosphere or soil air.

CHEMICAL COMPOSITION OF SOIL.

- Cations exchangeable capacity
    - Is amount of exchangeable ions in 100g of soil.
    - These include
        - ✓ Calcium
        - ✓ Potassium
        - ✓ Sodium
    - Fertile soil have very high amount of exchangeable capacity (CEC).
    - Soil with very high exchangeable sodium is toxic to most crops.
- Soil salinity
    - Amount of salts in the soil per unit mass is called salinity.
    - Saline soils have excess salts especially sodium chloride which can be toxic.
- Soil pH
    - Most important chemical property of the soil.
    - Determines the soil fertility in terms of mineral nutrients.
    - Can be acidity or alkalinity.
    - The degree of acidity is determined by the concentration of the hydrogen in the soil.
    - Strong acidic is 1 while weak acidic is 6.
    - Strong alkaline is 14 and weak alkaline is 8
    - 7 is not acidic nor alkaline . is neutral.

SOIL POLLUTION

- Can be polluted by
    - Oxides of sulphur
        - ✓ Cause acidic rains.
        - ✓ Also cause leaching of mineral nutrients leading to decrease in fertility of the soil.
- Aerosols
    - Are used to control pests and diseases in plants and animals.
    - Usually contain heavy metals such as
        - ✓ Copper
        - ✓ Mercury
    - These are absorbed by plants.
    - These plants are toxic when eaten by animals.
    - Can cause death.
    - They can also kill soil microorganism.
- Petroleum products
    - oil spills kill soil microorganisms.
- Agro-chemicals
    - Include chemicals such as
        - ✓ Fertilizers
        - ✓ Insecticides
        - ✓ Pesticides
        - ✓ Fungicides
- Solid wastes
    - From households and industries.
    - Some are biodegradable while other are non-biodegradable..
    - Can cause injuries.
    - Examples include

- ✓ Glass bottles
- ✓ Scrap metals.

PREVENTION OF SOIL POLLUTION

- Recycle all solid wastes
- Burn biodegradables wastes which can be burnt.
- Use organic farming to discourage excess use of chemical fertilizers.
- Encourage using biological control of pests and diseases.
- Pipeline transport of petrol and petroleum products to minimise the risk of spilling.