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**FIRST TERM E-LEARNING NOTE**

**SUBJECT: CHEMSTRY**  **CLASS: SSS3**

**SCHEME OF WORK**

**Week TOPICS**

1. Revision, Saturated Hydrocarbon Alkanes e.g Methane CH4 – preparation, properties and uses, isomerism, IUPAC, Nomenclature.
2. Unsaturated hydrocarbon – Alkenes e.g ethane (C2H2) – Nomenclature, preparation, properties and uses.
3. Unsaturated Hydrocarbons, Alkynes e.gethyne (C2H2)-Nomenclature, preparation, properties and uses.
   1. Aromatic hydrocarbon, Benzene-structure, properties and uses,             derivatives of Benzene e.g methyl benzene.Alkanols – sources, general molecular formula, nomenclature, classification, types, preparation, properties and uses. Test for alkanols.
4. Alkanoicacids - sources, nomenclature, structure, preparation, properties and uses. Alkanoates, general molecular formular, nomenclature, preparation, properties and Uses.
5. Fat and Oil as higher Esters, sources, properties and Uses. Detergents and Soaps

- Structure, their mode and action.

1. Natural and synthetic polymers, polymerization(additional and condensation), plastics – Thermoplastic and Thermosetting polymers, Resins.
2. Carbohydrates - sources, general molecular formular, classification, properties and uses.

Test for carbohydrates.

Proteins – sources, structure, properties and uses, tests for proteins.

1. Amines and Amides , general molecular structure, preparation, properties and Uses.
2. Revision.
3. Examination.

Reference Book

New School Chemistry for Senior Secondary Schools by Osei Yaw Ababio.

Practical Chemistry for Senior Secondary Schools by Godwin Ojokuku

Outline Chemistry for Schools & Colleges by Ojiodu C. C.

Chemistry Pass Questions for S.S.C.E and UTME.

**WEEK ONE**

**Topic: Saturated Hydrocarbons**

Content: Alkanes e.g methane (CH4)

- preparation – properties - Uses

- Isomerism

- IUPAC Nomenclature

**Saturated Hydrocarbons**

Saturated hydrocarbons are hydrocarbons consisting of carbon chains with single bond between them in which carbon joins with another carbon by single covalent bond e.g Alkanes ( like ethane C2H6, propane C3H8 )

H H HHH

H - C C – H H – C - C - C - H

H HHHH

Alkanese.g Methane (CH4)

The alkanes are aliphatic hydrocarbons. They form homologous series of saturated hydrocarbons with general molecular formular of CnH2n+2

**EVALUATION**

1. What is saturated hydrocarbons?

2. Name one example of alkanes.

**Preparation of Methane (CH4).**

Methane is prepared in the laboratory by heating ethanoate salt with corresponding alkalis e.g Sodium ethanoate and soda-lime.

**Physical Properties**

1. Methane is a colourless and odourless gas

2. It is slightly soluble in water.

3. It is less dense than air

4. It has no action on litmus paper

**Chemical Properties.**

1. Combustion:- Methane burns in air or oxygen to produce steam, carbon(iv) oxide and a lot of heat CH4 + 2O2 2H2O + CO2.

The general equation of alkanes for combustion is represented as

CxHy(g) + ( x + y/4)O2 y/ 2H2O(g) + xCO2 (g).

2. Substitutional reaction:- With chlorine gas and bromme gas usually in the presence of ultra’-violet light ( as catalyst).

**Uses**

1. Methane is used as fuel

2. It is used for making hydrogen gas

3. It is used in making carbon black

4. Used in making carbon (iv) sulphide

5. It is used in making hydrocyanic acid

6 The derivatives of methane e.gtrichloro-methane can be used as anesthetic in surgical operation. Tetrachloromethane is an organic solvent.

**Evaluation**

1. State four (4) uses of methane

2. Identify two (2) chemical properties of methane.

**Isomerism.**

This is the existence of two or more organic compounds, (isomers) with the same molecular formula but different structures.

- Isomers are compounds having the same molecular formula but different structural formula.

- As the number of carbon atoms in a molecule increases, the number of isomers also increases, for example, pentane has the following three isomers.

H H HHH H H H H

H C C C C C H H C C C C H

H H H H H H HH

Pentame-CH3(CH2)3CH3 H C H

H

2 – methyl butane

H

H - C - H

H H

H C CC H

H H 2,2- dimethyl propane.

H -C - H

H

**TYPES OF ISOMERISM**

1. Structural Isomerism

2. Stereo Isomerism.

The structural isomerism occurs in organic compound with the same molecular formula but different structural arrangement of the carbon atom.

**Types of Structural Isomerism**

**1. Chain isomerism :-**This is the kind of isomerism which occurs due to the differences in the way by which the carbon atoms are arranged in the chain.

e.g H H H H H H H

H- C - C - C - C - H H- C - C - C - H

H H H H HH

H – C – H

Butane

H

2- methyl propane

ii. Functional isomerism:- This is the kind of isomerism which due to the difference in     functional group.

e.g H H H H

H- C - C – OH H C – O- C- H

H HHH

Ethanol Methoxyl methane.

iii. Positional isomerism:- This is the kind of isomerism which occurs as a result of the        difference in the way the functional group is positioned.

Example:

H H H H

H C CCC H H – C – C = C – C – H

H HHHHHHH

But-1-ene But-2- ene

**2.Stereo Isomerism**

Types of stereo isomerism

I. Geometric Isomerism :- This is the existence of compound with the same molecular formula but different spatial structural formula.

e.g CH3CH3

C = C CH3 H

C = C

H H Cis but-2-ene H CH3 Trans-but-2-ene

II.  Optical Isomerism:- They have different configuration and they rotate plane polarized        light e.g. H H

CH3 – C – COOH HOOC – C – CH3

OH OH

**IUPAC NOMENCLATURE**

In IUPAC nomenclature, every name of organic compound consists of a ROOT, SUFFIX and PREFIX names.

**ROOT NAME**:

Name of the parent alphatic hydrocarbon with the longest carbon chain in a molecule .

**SUFFIX NAME**

Name of the principal functional group substituents on the longest carbon chain in a molecule.

**PREFIX NAME**.

Name of the other substituents on the longest carbon chain which are not functional group e.g 1- chloroethan – 1- ol.

1- chloro = Prefix

ethane = root

-1- ol Suffix

**RULES FOR IUPAC NOMENCLATURE**.

1.  Select the longest continuous carbon chain as parent hydrocarbon.

2. Number the longest carbon chain. Starting from the end that gives lowest possible number to the suffix and then the prefix.

3. Indicate the other substitents by prefixes, preceded by number to show their position on the carbon chain.

4. If the same alky or other substituents group occur more than once as side chain show how many are present by using prefix di,tri, tetra, etc. and indicate by various number the position of each group on the longest carbon chain.

5. If there are several different alkyl groups attached to the present chain, name them in order of increasing size or in alphabetical order.

H H H

C - C - C – H

H H 2 methyl propane

H -C - H

H

H HHHH

H C CCCC H 2- methyl pentane

H HHH

H C H

H

H HHH CH3C2H5 HH

H – C - C - C- C - C - C - C - C - H

H HHH C3H7 H HH

3,3,-diethyl – 4- methyl 1-5 propyl octane.

6. If there are halogens together with alkyl groups attached to the parent chain, name the halogen first in alphabetical order and the alkyl group as explained earlier.

H Cl

1- bromo-2- chloro propan-2-ol.

H C - C- OH

Br CH3

**Evaluation**

Name the following compounds.

1a.        H HH

H – C - C - C - H

H HH

b. CH3CHClCH2OH

2. List the rules for IUPAC Nomenclature.

**READING ASSIGNMENT**

New School Chemistry by O.Y. AbabioPg

**WEEKEND ASSIGNMENT**

1. The structure of 1,2,3-trichloro-2-methyl butane is

a) CH3 H      H    H b)               Cl  Cl Cl H

H- C - C - C - C – H H- C - C - C - C – H

ClCl H HClClCl H

c) ClClCl H d) H HHH

H - C- C- C - C - H H - C - C – C- C – H

H H – C- H HH HHH

H – C- H

H H

2. Which of these compounds exhibits resonance ?

(a) Ethanol (b) Ethane (c) Benzene (d) Ethyne.

3. The solubility of alkane in organic solvent is due to presence of its

(a) polar molecule (b) non-polar molecule (c) Low melting points (d) low freezing           points.

4. Which of these is alkane member?

(a) Ethene (b) Pecane (c )Propyne (d) Butanol

5. The root in the organic compound below is:

H HH

H- C - C - C - H

H H OH.

(a) Propane (b) Propan-1-ol (c ) Propanol (d) hydrogen

**THEORY**

1. Write briefly on the following:

a. Cracking

b. Isomerism

c. Homologous Series

d. Stereo Isomerism

e. Optical Isomerism.

2. Name the following compound

1. CH2(OH)CH(OH)CH2OH
2. C2H4CL2

**WEEK TWO**

**Topic: Unsaturated Hydrocarbons – Alkenes**

**CONTENT**

* Nomenclature
* Preparation
* Properties
* Uses.

**UNSATURATED HYDROCARBONS**

These are hydrocarbons in which carbon atoms join with each other by multiple bonds. The multiple bond can be double bonds e.g Alkene or triple bonds e.g Alkyne.

1. Ethene2 .Ethyne

H – C = C – H H – C = C – H

H H.

Alkenes e.gEthene

Nomenclature

The process of naming in alkene is obtained by substitute “ane” in alkane with ‘ene’ e.g Ethane changes to Ethene, propane to prepene

PREPARATION (Lab. Preparation)

1.  Ethene is prepared by heating ethanol with excess concentrated tetraososulphate VI      acid at 170o C. The acid acts as a dehydrating agent by removing water from the ethanol .  Thus the process is called dehydration.

The reaction occurs in two stages

C2H5OH(aq) + H2SO4 (aq) C2H5HSO4 + H2O

C2H5HSO4 C2H4+ H2SO4.

The overall reaction is represented by the equation .

C2H5OH H2SO4 C2H4+ H2SO4

-H2O

2. Ethene can be prepared through cracking of Alkane e.g C3H8 C2H4 + CH4.

3. By dehydration

e.g H H Cl H H

H - C - C – H C = C + HCL

H Cl H H

**Physical Properties**

1. Ethene is a colourless gas with faint sweetish odour .

2. It is sparingly soluble in water

3. It is slightly less dense than air

4. It has no action on litmus paper

**Evaluation**

1. Write four (4) physical properties of Ethene

2. How would you prepare a jar of ethane gas in the laboratory?

**CHEMCIAL PROPERTIES**

1. **Combustion**

Ethene undergoes combustion/oxidation in air or in the presence of oxygen and produce carbon(iv)oxide and steam .

C2H4  + 3O2 2CO2 + 2H2O.

2. **Additional reaction**

a. With hydrogen known as hydrogenation

H H H        H

H- C= C – H + H2 H - C - C – H

Ethene H H Ethane

b. With halogen know as halogenation

H H HH

H - C = C- H + Cl2 H C - C - H

Ethene ClCl 1,2- dichloroethane

c. With Halides known as hydrogenation

e.g H- C = C – H + HBr H H

H HH C C – H

ethene H Br 1-Bromoethane.

d. With acidified /Alkaline KMnO4 known as hydroxylation. It decolourses acidified KMnO4, but turns alkaline KMnO4 to green and result to ethane -1,2- diol.

OH     OH

H – C = C – H + KMnO4 H - C - C - H

H H      HH

Ethane-1,2-diol (glycol)

e. With Hydrogen peroxide in the presence of osmium trioxde to form ethan -1,2- diol.

OH OH

H - C = C + H + H2O2 H – C - C - H

H HHH

Ethane -1,2- diol.

f. With conc. H2SO4 known as hydration to produce fuming liquid of ethyl hydrogen sulphate.C2H4  + H2SO4  C2H5HSO4

          When ethyl hydrogen sulphate is hydrolyzed, tetraoxosulphate (vi) acid and ethanol            are produced.C2H5SO4 C2H5OH + H2SO4

g. Ethene gas decolourizes bromine water to produce bromoethanol.

H H

H – C = C – H + HBrO H – C – C - H

H H (radiation brown) Br OH

Bromoethanol.

Similarly:

H H

H-C = C – H + HClO H – C – C – H

(Brown)

Cl OH

Chloroethanol

h. Polymerization of ethane to produce polythene.

H HHHHH

C = CC - C - C - C

H HHHHH

                                                                polyethene

i. With ozone known as ozomolysis to from etheneozomides.

e.g H H O

C = C + O3 H2C CH2

Ozone

H H O

EtheneEtheneozonide

j. Ethene can also undergo additional reaction with oxygen in the presence of silver catalyst at about250oC to form epoxy ethane.

H H HH

H – C = C - H + ½ O2 H – C - C - H

O

**USES**

* Used in the manufacture of plastics.
* Used in making synthetic rubber.
* Used to hasten the ripening of fruits.
* Used in the production of other organic compounds e.g halo-alkane,ethane, ethanol.

**Evaluation**

1. Describe the reaction of ethane with the following:

* 1. Bromine water
  2. Chlorine water
  3. Acidified KMnO4

2. State four (4) uses of Ethene.

**READING ASSIGNMENT**

New School Chemistry by O.Y. AbabioPg 459-492

**WEEKEND ASSIGNMENT**

1. The name of the organic compound with the structure below:

CH3 H

C = C

H CH3

1. Cis- but-2-ene
2. Trans –cis-but-2-ene
3. Trans-1-2- but-2-ene
4. 1,2- dimethyl ethane.

2. In the reaction given below:

C2H5OH Conc H2SO4  C2 H4Conc H2SO4is acting as

-H2O

A. oxidizing agent B reducing agent C. Dehydrating agent D. Drying agent.

3. One of the following is not a chemical property of ethane.

(a ) Polymerization (b) Substitutional (c ) Hydration (d) Addition.

4. Function of the empty bottle during the preparation of ethane gas is

(a) to remove oxygen (b) to remove CO2 ( c) to prevent sucking back of the gas         (d) None of the above.

5. Additional reaction of hydrogen and ethene is known as

(a) polymerization (b) additional (c) combustion (d) hydrogenation

**Theory**

1. Describe two (2) methods of obtaining ethene industrially.

2a. Write and name the geometric isomers of compound with the molecular formular C5H10

b. With chemical equation only, show how ethane reacts with the following:

- ozone

- oxygen

- alkaline KMnO4

- Conc. H2SO4

**WEEK THREE**

**Topic: ALKYNES** e.gEthyne

Alkynes are the homologous series of unsaturated hydrocarbon with a general molecular formua CnH2n-2.

Alkynes show a high degree of unsaturation than alkenes, hence,t hey are chemically more reactive than the corresponding alkenes or alkanes.

Examples are :

H

H – C = C – H HC - C = C- H

[

Ethyne. H prop-1-yne

**ETHYNE**

Ethyne is the first member of the alkyne series. It has a molecular formula, C2H2, and a structural formular of HC = CH.

**Laboratory Preparation**

Ethyne is usually prepared in the laboratory by the action of cold water on calcium carbide. The reaction is carried out on a heap of sand to prevent the flask from cracking as a result of the large quantity of heat evolved.

**Evaluation**

1. Write and name all possible structure of hexyne

2. How can you prepare a few jars of ethyne in the laboratory?

Nomenclature: The naming of alkyne are obtained by substituting “ane” in alkaens with ‘ene’.

**Physical Properties**

1. Ethyne is a colourless gas with a characteristic sweet smell when pure.

2. It is only sparingly soluble in water

3. It is slightly less dense than air.

4. It is unstable and may explode on compression to liquid.

**Chemical Properties**

1. Combustion :- it undergoes combustion reaction in air to form water and carbon(iv) oxide

2C2H2 + 5O22H2O + 4CO2.

NB: In limited air, it burns with very smoky and luminous flame because of its high carbon content. But in plenty of air and appropriate proportion, it burns with non-luminous very hot flame of about 3000oC.

2.  Additional Reaction :-Ethyne undergoes addition reaction to produce unsaturated      product with double bonds and then a saturated compound with single bond.

a. With hydrogen in the presence of nickel as catalyst.

H HHH

H- C = C – H + H2  H – C = C – H + H2 H – C - C - H

ethene H H Ethane

b. Halogenation: e.g Cl2, Br2, I2

ClClClCl

H- C = C – H + Cl2  H – C = C – H + Cl2 H – C – C - H

1,2- dichloroetheneClCl1,1,2,2tetrachloroethane

Br BrBrBr

C = C – H + Br2  H – C = C – H + Br2 H–C – C - H

1,2 - dibromoethane Br Br                                                                              1,1,2,2 -tetrabromoethane.

c. Addition of Halides**;**

Hydrogen halide reacts with ethyne to produce halo-alkene and further halogenation     produce halo-alkane.

    E.g: ClCl

H – C = C – H +HCl H – C = C – H + HCl H – C – C - H

H Cl H H.

Chloroethene 1,2- dichloro ethane.

d.Addition reaction with water through dilute tetraoxosulphate (vi) acid in the presence of     CuSO4  as catalyst to form ethanol.

           H OH H H

H-C=C-H + H2O H- C = C – H H- C – C – H

H OH Ethanol

                                          Ethenol

e. Addition reaction with alkaline KMnO4 added to ethyne, it first turns to green from      purple and then to colourless.

O O

H – C = C – H + 4[O] HO – C = C- OH

KMnO4 Ethane dioc acid.

3. Polymerization

In the presence of complex organic –nickel as catalyst to produce benzene.

3 C2H2 C6H6

3 (H – C = C – H ) C6H6

4. Substitutional Reaction

a. Withammomiacal solution of copper (1) chloride to form reddish brown copper (I)               dicarbide

C2H2 + 2CuCl Cu2C2 + 2HCl

H – C = C – H + 2CuCl Cu – C = C- Cu + 2HCl

b. With ammomiacal silver trioxonitrate (v) to form white silver dicarbide

C2H2 + 2AgNO3Ag2C2 + 2HNO3.

H- C = C – H + 2AgNO3 Ag – C = C – Ag + 2HNO3.

N.B: Alkynes can be distinguished from alkene by reacting with ammomiacal metals of           copper(I) chloride and silver trioxonitrate (vi).

**USES**

1. It is used to produce oxyacetylene flame for cutting and welding of metals
2. Used in the manufacture of PVC plastics
3. It is used in miner’s lamp
4. Used in making synthetic fibre
5. It is also used in making artificial rubber

**Test for Unsaturation**

Unsaturated compound decolorizes bromine water.

**Evaluation**

1. Give a chemical test to distinguish between alkyne and alkene.
2. Describe a test for unsaturated compounds

**READING ASSIGNMENT**

New School Chemistry by Y. O Osei yawAbabio Page

**WEEKEND ASSIGNMENT**

1. The concentration of hydrogen ion in a neutral solution is

(a) 10-6 moldm-3( b) 10-7moldm-3 (c) 5 x 10-7 moldm-3 (d) 1 x 10-8mol dm-3

2. Hydrogen can be prepared in a large scale using the

(a) Harber’s process (b) Down’s process (c ) Bosh Process (d) Contact Process.

3. Which of the following hydrocarbons is alkyne?

(a ) C2H4 (b) C2H6 (c) C2H2 (d) C3H8

4. The final product of complete reaction between ethyne and hydrogen gas is

(a) ethane (b)methyl ethane ( c) ethane ( d) hydroethyne

5. Ethynepolymerises in the presence of organomickelcomplext as catalyst to form

(a) polythene (b) benzene ( c) polythene (d) methyl benzene.

**Theory**

1. a. Calculate the H+ of a solution whose PH is 5.

b. State three (3) uses of ethyne

2. a. With the aid of labeled diagram, describe the laboratory preparation of ethyne.

b. Give a chemical test to distinguish between ethane and ethyne.

**WEEK FOUR**

**TOPIC: AROMATIC HYDROCARBONS**

**CONTENT**

Benzene, structure, properties and Uses

Derivative of Benzene

Aromatic Hydrocarbons

These are hydrocarbons that have the same structure as benzene.

Benzene: Benzene is a typical aromatic compound with molecular formula of C6H6. It has the structure of:

**Preparation:-**

1. From coal tar: The destructive distillation of coal produced coal tar which contain      benzene

2. From petreoleum; The dehydrogenated of alkane using valladim (v) oxide (v2O5) as     catalyst at 500oC and 20 atmos give benzene

C6H14  V2O2C6H6 + 4H2

The process is known as catalysticreforming .

3. From polymerization of ethyne

3 ( H – C = C – H ) C6H6

**Evaluation**

1. Describe three (3) ways of preparing benzene.
2. Draw the structure of benzene.

**Physical properties**

1. It has a pleasant odour.

2. It has boiling point of 80oC.

3. Benzene can dissolve in water.

4. It burns with sooty flame.

**Chemical Properties**

Benzene can undergo both additional reaction and substitutional reaction.

1. Additional Reaction.

i. Hydrogenaton: Benzene reduces to cyclo-hexane if hydrogen gas is passed through       finely divided mickel at 150oC.

ii. Halogenation: In the presence of ultra-violet light, benzene reacts with halogen to       produce cyclic compound.

C6H6 + 3 Cl2 UV

Light

2. **Substitution Reaction**.

NB. Benzene undergoes substitution reaction due to the presence of its single bonds.

i. Halogenation e.g Cl2, Br2, I2

+ Br2

Benzene Bromobenzene

ii. Nitration: This occurs in the mixture of HNO3 and H2SO4 together with benzene

HNO3  Nitrobenzene.

iii. Sulphonation:- Benzene reacts with conc, H2SO4 to form benzene sulphonic acid.

iv. Alkylation:- It involves reactions of benzene with halo-alkanes in the presence of AlCl3.

Uses.

1. It is used as a solvent to dissolve organic.

2. It is used as fuel in petrol.

3. It is used in the manufacture of aromatic compound e.g. benzoic acid.

**Evaluation**

1. State two (2) uses of benzene

2. Identify two (2) chemical properties of benzene with examples.

**Derivatives of Benzene**

Methyl benzene Ethyl benzene

(toluene)

1,2- dimethyl benzene 1,4- dimethyl benzene

Phenol Nitrobenzene Chlorobenzene

Napthalene

(C10H8)

**Evaluation**

1. Give another name to the following compounds

(a ) Phenol (b) Toluene

2. State four (4) derivatives of benzene.

**READING ASSIGNMENT**

New School Chemistry By .O.Y. Ababio, pg 492-494.

**WEEKEND ASSIGNMENT**

1. Which of the following is the structure of benzene

2. Benzene can be prepared from the following except

(a) Coal tar (b) petroleum ( c) Alkanol (d) Ethyne

3. Benzene can undergo additional reaction due to presence of

(a) double bonds (b) single bonds ( c) hydrogen ( d) carbon.

4. Benzene undergoes the following reaction except.

(a) substitution (b) addiction ( c) Hydrogenation ( d) polymerization

5. The technique used in separating a mixture of common salt and water is

(a) evaporation (b) sublimation (c) decantation (d) chromatography.

**Theory**

1. a. State two (2) uses of Benzene

b. identify two (2) physical properties of benzene.

2. a. How would you prepare benzene?

b. State two (2) chemical properties of benzene.

**WEEK FIVE**

**TOPIC: ALKANOLS**

**CONTENT**

-Source

-General molecular formula

-Nomenclature

- Classification

-Types, Preparation, Properties and Uses.

**Test for Alkanols**

**SOURCES OF ALKANOLS**

**-** From destructive distillation wood.

- From starchy food and sugar

**General molecular formular**

Alkanol is a homologous series with general molecular formular of Cn H2n+1OH or ROH.

Or (CnH2n+2O).

**Nomenclature:**

The names of alkanols are obtained by substituting “e” in alkanes with “Ol” in alkanol e.g. methanol

(CH3OH), ethanol (CH3CH2OH).

**Classification**

The alkanols are classified based on the number of alkyl groups directly linked to the carbon atom

holding the hydroxyl group.

1. **Primary alkanols** (10): It has only one alkyl group attached to the carbon atom that carries the

   hydroxyl group e.g. H

R - C OH

H

OR

H H H

H C C OH or H C OH

H H H

Ethanol Methanol

**II. Secondary alkanols** (20):- They have 2 alkyl groups directly linked with the carbon atom holding the hydroxyl group e.g.

H H H H

H C C C H or R C R1

H OH H OH

Propan - 2-ol

**III. Tertiary alkanols** (30 ): the alkanols here have 3 alkyl groups attached to the carbon atom holding the hydroxyl group

CH3 R1

CH3 C CH3 or R C OH

OH R11

2 – methylpropan -2 –ol

The R1, R11 are alkyl groups which may be the same or not.

N.B: Examine the structure of the alkanol, identify the carbon atom bonded to the –OH, count the number of alkyl groups that are directly attached to the carbon atom. Then you can say whether it is 10, 20 or 30.

**EVALUATION**

1. Name the functional group in the alkanol.

2. Give an example each by writing the structure and names of the classes of alkanols.

**Types of alkanol**

The type of alkanols is determined by the number of the hydroxyl group –OH, present in the molecule.

1. **MONOHYDRIC ALKANOLS**: This type has only one –OH, present in its molecule

e.g. C2H5OH, C3H7OH e.t.c.

2. **DIHYDRIC ALKANOLS**: This type has two of –OH group per molecule e.g.

H H

H C OH H C OH

H C OH H C H

H H C OH

H

Ethan -1, 2- diol Propan 1, 3-diol

1. **POLYHYDRIC ALKANOLS**: This type has three or more. OH groups per molecule e.g. glycerol.

H            H

H C OH H C OH

H C OH H C OH

H C OH H C OH

H H C OH

H C OH

H C OH

H

**PREPARATION** e.g. ethanol

1. Laboratory preparation

- Hydrolyzing ethyl esters with hot alkali

- Reducing ethanol with nascent hydrogen

2. Commercial preparation

- From ethene

Ethene is obtained by the cracking of petroleum. It is then absorbed in 95% H2SO4 at 800C and

30 atoms to form C2H5HSO4

C2H4  + H2SO4 C2H3HSO4

The C2H3HSO4 is bedded in water to produce ethanol; C2H3HSO4 + H2O C2H3OH + H2SO4.

The ethanol is distilled off leaving the acid behind which can be used again.

-Preparation by fermentation ethanol is prepared industrially from raw materials containing

starch or sugar by the process of fermentation.

-The fermentation is an enzymatic process which involves the decomposition of large organic

molecules to simple molecule by micro-organism.

-The common micro-organism used is YEAST

**EVALUATION**

1. Name three (3) types of alkanol and give one example each.

2. State two methods by which ethanol can be prepared industrially.

**PRODUCTION OF ETHANOL FROM STARCHY MATERIALS**

(e.g. rice, potatoes, maize etc)

The following steps are involved;

* Crush and pressure cook the starchy materials.
* Extract the starch granules by mixing with water.
* Allow the starch granules to settle and decant
* Treat the starch granules with malt (a partially germinated barley which contains the enzyme, DIASTASE) at 500C for I hour.
* The starch is then converted to MALTOSE. 2(C6H10O5)n + nH2O nC12H22O11

Then add yeast at room temperature for some time (at least one day). Yeast contains two enzymes,

namely MALTASE and ZYMASE. Maltase converts maltose to two glucose units, while zymase converts the glucose to ethanol and carbon (iv) oxide.

C12H22O11 + H2O maltase 2C6H12O6

C6 H12 O6 Zymase 2C2H3OH + CO2

Ethanol

**EVALUATION**

1. Describe fully, the production of ethanol from a named starchy material/food.

2. What type of chemical reaction is involved in fermentation of sugar?

**PHYSICAL PROPERTIES**

1. Ethanol is a colourless volatile liquid.

2. It is soluble in water.

3. It has boiling point of 780C.

4. It has no action on litmus paper.

**CHEMICAL PROPERTIES**

1. Combustion: the lower members of alkanols burn with clean flames in plenty air

2CH3OH + 3O2 2CO2 4 +H2O

2. Oxidation

The products of oxidation depend on the structure of the alkanol.

- Primary alkanols are oxidized to alkanol first and then to alkanoic acid in the presence of oxidizing agent e.g KNnO4

CH3CH2OH O CH3CHO O CH3COOH

- Secondary alkanols oxidize to ketone e.g.

R R

R C OH [O] R C = O + H2O

H

CH3 CH3

CH3 C OH [O ] CH3 C = O + H2O

H

Propon-2-ol propanone

- Tertiary alkanols are not oxidized because there is no carbon-hydrogen bond to be broken for the oxidation to take place.

N.B: Note the colour change of oxidizing agent if acidified.

- Purple KMnO4 changes to colourless.

- Orange K2Cr2O7 turns green.

3. **Esterification**

This is the reversible reaction between alkanol and alkanoic and to produce ester. The reaction is catalysed by conc H2SO4 e.g. CH3CH2OH + CH2COOCH2CH3 + H2O

4. **Dehydration**

Alkanols are dehydrated to alkenes in the presence of conc H2SO4

e.g. CH3CH2OH + conc H2SO4 CH3CH2HSO4 + H2O

CH3CH2HSO4170 C C2H4 + H2SO4

5. **Reaction with sodium and potassium**

sodium and potassium react vigorously with alkanols to liberate hydrogen gas and form corresponding organic salt of sodium and potassium.

E.g.2C2H3OH + Na 2C2H3ONa + H2

N.B: If sodium ethoxide reacts with water, it hydrolyses to ethanol and alkaline solution of NaOH.

6. **Reactions with the chlorides of phophorus**: Ethanol reacts vigorously with PCl5 in the cold

to produce time of HCl and chloroethanevapour C2H5OH + PCl5 C2H3Cl + POCl3  + HCl

-PCl3 gives a similar reaction, but less vigorous C2H5OH + PCL3 3C2H5Cl + H3PO3.

**USES OF ETHANOL**

1. It is used as organic solvent

2. It is the main constituent of methylated spirit used to clean wounds and to dissolve paint.

3. It is used as petrol addictive for use as fuel in vehicles.

4. Used to manufacture other chemicals such as ethanol and ethanoic acid.

5. It is used as ingredient in making alcoholic drinks e.g. beers, wines and spirits.

6. It is used as anti-freeze in automobile radiator because of its low freezing point (-1170C).

**TEST FOR ALKANOLS**

- It librates hydrogen gas on reacting with sodium methal.

- It changes to alkanoic acid (primary alkanol) on exposure to air or reacting with oxidizing agent.

**EVALUATION**

1. State five (5) chemical properties of ethanol.

2a. Identify two (2) physical properties of ethanol

b. State two (2) uses of alkannol.

**READING ASSIGNMENT**

- New School Chemistry By O.Y. Osei Yaw Ababio pages 496-501

**WEEKEND ASSIGNMENT**

1. The functional groups of the alkanol is

A. CnH2n + 1 OH B. carboxylic group C. hydroxyl group D. CnH2n+ 2

2. Primary alkanols are oxidized to carbonylic acid, secondary alkanols are oxidized to alkanones while tertiary alkanols are A. oxidized to alkanols B. oxidized to alkanones C. not oxidized D. oxidized to alkene

3. The soluble of alkanols in water is due to

A. the covalent nature B. hydrogen bonding C. their low melting point

D. their low melting point

4. When acidified KMnO4 is used as oxidizing agent for alkanol, the colour change observed is

A. yellow to red B. purple to colourless C. orange to green D. white to black

5. Which of the following enzymes converts glucose to ethanol?

A. maltose B. zymase C. diastase D. amylase

**THEORY**

1(a) Write the structural formula of two named secondary alkanols.

(b) Explain the structural difference between primary and tertiary alkanols.

2(a) What is fermentation?

(b) Describe the preparation of ethanol from table sugar.

**WEEK SIX**

**TOPIC: ALKANOIC ACIDS**

**CONTENT**

Sources

Nomenclature

Structure

Preparation

Properties and Uses

**ALKANOATES**

General molecular formula, nomenclature, preparation, properties and uses.

**SOURCES**:

The alkanoic acid or carboxylic acids are also called fatty acids because some of them are found in natural fats and oils. They contain the functional group called carboxy group.

**NOMENCLATURE:**

The IUPAC name of each homologue is obtained by changing the “-e” endind of the corresponding alkane to “-oic” acid e.g. mathanoic, ethanoic etc.

**STRUCTURE**:

Alkanoic acid has a general molecular fomular of CnH2n + 1COOH where n > 0. or RCOOH. Thus it has the following structure.

O

RC

OH

E.g.Ethanoic acid CH3COOH

H

O

H C C

H OH

PREPARATION e.g.Ethanoic acid

Ethanoic acid can be prepared by the complete oxidation of ethanol by acidified sodium heptaoxo dichromate (VI) solution. The oxidation reaction is a two stages of reaction

I. Ethanol oxidized to ethanol; CH3CH2OH O3 CH3CHO

II. Ethanol oxidized to ethanoic acid; CH3CHO O3 CH3COOH

Or

CH3CH2OH + [O] CH3CHO + [O] CH3COOH

**PHYSICAL PROPERTIES**

1. It is colourless liquid with a sharp and pungent smell.

2. It has sour taste.

3. It is soluble in water.

4. It freezes into ice-like at temperature below 170C therefore called gluciaethanoic acid (anhydrous ethanoic acid).

5. It has boiling point of 1180C

6. It turns blue litmus papers to red.

**CHEMICAL PROPERTIES**

1. It libratescarbon(IV) oxide from either trioxocarbonate (IV) or hydrogen trioxocarbonate (IV) salts. 2CH3COOH + Na2CO3 2CH3CONa + H2O + CO2.

2. It librates hydrogen gas when it reacts with highly electropositive metals e.g.

Mg &Ca; 2CH3COOH + Ca (CH3COO)2Ca + H2.

3. As an acid, it neutralizes boxes or alkalis to form salts known as ethanoate and water only

CH3COOH + NaOH CH3COONa + H2O.

4. It reacts with alkanols to form ester e.g. CH3COOH + CH3CH2OH CH3COOCH2CH3 + H2O

5. Reduction:

It can be reduced to ethanol in the presence of lithiumtetrahydridoaluminate III as

reducing agent (LiAlH4)

CH3COOH + 4H CH3CH2OH + H2O

6. It reacts with chlorme successively to form chloroethanoic acid e.g.

CH3COOH + Cl2 CH2ClCOOH + HCl

CH2ClCOOH + Cl2 CHCl2 COOH +HCl

CHCl2 COOH + Cl2 CCl3COOH + HCl

**EVALUATION**

1. (a) State four (4) chemical properties of ethanoic acid.

(b) Give two (2) physical properties of ethanoic acid.

2. How would you prepare ethanoic acid in the laboratory.

**CLASSIFICATION OF ALKANOIC ACID**

Alkanoic acids are classified based on the number of carbonxylic groups present per molecules.

1. Monocarboxylic Acids: these have one carboxylic group per molecule e.g.

methanoic acid (HCOOH)

O

H C

OH

Ethanoic acid CH3 COOH

H

O

H C C

H OH

2. Dicarboxylic Acids: these have two carboxyl groups per molecules e.g. ethan -1, 2-dioe acid

(oxalic acid)

COOH O O

or C     C

COOH HO OH

3. Tricarboxylic acids: these have 3 carboxylic acid per molecule e.g. 2-hydroxy propan 1,2, 3-

tricaboxylic acid.

                                H

H C COOH

HO C COOH

H C COOH

H

N.B: Two important aromatic caborxylicacid are

(1) Benzoic acid

(2) 2-hydroxy benzoic acid

**USES OF ETHANOIC ACID**

1. It is used in making compounds like cellulose ethanoate, dyes etc.

2. It is used as organic solvent.

3. It is used in the food industries for preserving and flavoring food.

4. Used for coagulating rubber latex.

**EVALUATION**

1. Give three (3) classes of alkanoic acid.

2. State four (4) uses of ethanoic acid.

**READING ASSIGNMENT**

New School Chemistry by O.Y. pages.504-506

**ALKANOATES**

General molecular formula.

The alkanoates are called esters. They have general molecular formula of RCOOR’.

It has structural formula of

O

R C

OR

e.gethylethanoate CH3COOCH2CH3

**NOMENCLATURE**

Naming of alkanoates are obtained by substituting “e” ending in alkane with “oates” in

alkanoates.

Preparation e.g. ethyl ethanoate .

Ethyl ethanoate is prepared by the esterification between ethanol and glaciusethanoic acid at 1500C in the presence of concentrated tetraoxosulphate (VI) acid

C2H5OH + CH3COOH CH3COOC2H5 + H2O

**PHYSICAL PROPERTIES**

1. Ethyl ethanoate is a colourles volatile liquid with a pleasant smell.

2. It is slightly soluble in water.

3..It has boiling point of 750C.

**CHEMICAL PROPERTIES**

1.  **Hydrolysis**.

Ethyl ethanoate can be hydrolysed by water to produce ethanoic acid and ethanol.

CH3COOC2H5 + H2O CH3COOH + C2H5OH.

**N.B**:If an alkali is used instead of water, it will produce the salt of the acid e.g.

CH3COOC2H5 + NaOH CH3COONa + C2H5OH

2. **REACTION WITH AMMONIA**

Ethyl ethanoate reacts with ammonia to produce ethanol and thenamide

CH3COOC2H3 + NH3 C2H5OH + CH3COOH2

3.**REDUCTION**

Ethyl ethanoate can be reduced by hydrogen from lithium tetrahydridoalluminute (III) as reducing agent CH3COOC2H5 + 4[H] 2C2H5OH

**USES OF ALKANOATES/ESTE**RS

- They are used as food flavours.

- Used in perfumes and cosmetics

- Used as solvent for cellulose nitrate .

- Used for quick-drying substances like paints, nail varnishes etc.

**EVALUATION**

1.Write the general structure of the ester.

2.Write a balanced equation for the reaction between propanol and butanoic acid.

(a) Name the products formed.

(b) What type of reaction is involved.

**READING ASSIGNMENT**

New School Chemistry by Osei Yaw Ababio page.504-509

**WEEKEND ASSIGNMENT**

1. The name of (CH3)2 CHCOOH is

A. Propane acid B. 2-methylhutanoic acid C. Dimethyl butanoic acid

D. Propanoic acid

2. Citric acid appears in unripe orange while enthanwie acid appears in

A. Unripe pawpaw B. Carrot C. Vineger D. Rice

3. Esters are employed in the following except.

A. Making perfumes B. Making cement C. Nail varnishes D. Making yeast

4. An alkanoic acid reacts reversibly with an alkanol to produce.

A. a salt B. an ester C. a sugar D. an alkene

5. Ethan-1, 2-dioe acid is

A. a mineral acid B. dicarboxylic acid C. citric acid D. a soap

**THEORY**

1a. Give the formula of ethanoic acid and indicate its functional group.

1. Ethanoic acid reacts with both sodium hydroxide and ethanol, suing equations to comparethe reactions and classify the products.

2a. Ethylethanoate reacts with both water and alkali; using equation to compare the reaction.

b. What happens when ethanoic acid is heated strongly with soda-line.

**WEEK SEVEN**

**TOPIC**: **Fats and Oils As Higher Esters.**

**CONTENT**

Sources, properties and uses detergents and soaps

Structure, their mode and action.

Fats and oils belong to a general group of compounds known as lipids.

**SOURCES:**

Fats are solids that usually come from animals e.g. Tallow (mutton fat). Oils are liquids that come from plants e.g. vegetable oil, coconut oil etc. Both fat and oil are esters of the trihydricalkanol(propane -1, 2, 3- triol).

**PHYSICAL PROPERTIES**:

1. Fats have higher melting points due to the presence of higher proportion of esters of saturated fatty acid.

2. Oils have lower melting points because of the presence of esters of unsaturated fatty acid.

**CHEMICAL PROPERTIES**:

1. Hydrogenation of oils.

This is carried out in the presence of nickel as catalyst at 1800C to yield margarine.

2. Saponification:

Hydrolysis of fats and oils with canotic alkali yields propane -1, 2, 3- triol and fatty acid        of sodium or potassium.

**USES OF FATS AND OILS**

1. Fats are consumed as food.

2. Oils are used to make margarine.

3. Tallow (a fat) is used for making soaps.

4. Ground nut oil and cotton seed oil are used for cooking.

5. Coconut oil and palm oil are used for making soap and for cooking.

**EVALUATION**

1. Identify two (2) uses of fats and oils.

2. Write two (2) chemical properties and two (2) physical properties of fats and oils.

**DETERGENTS:**

Detergents are any substance which have ability to clean an object e.g. soaps, soap powders, washing liquids and water.

**TYPES OF DETERGENT**

1.SOAPY DETERGENTS: This is soap of sodium salt of fatty acid.

**PREPARATION**

Animal fat or vegetable bits are steam-heated with sodium or potassium hydroxide in a large container. A concentrated Nuel solution is added to decrease the soluble of the soap – so that it comes out as hard

cake on cooling known as salting out

**STRUCTURE:-**

CH3(CH2)16 COOCH2

CH3(CH)2)16 COOCH + 3NaOH

(Sodium Hydroxide)

CH3(CH2)16 COOCH

Propane 1,2,3-triyltrioctadecanoate

**NATURE OF SOAP**

Each molecule of soap has long hydrocarbon chain (alkyl) which is attached to ionic head of either COO- Na+ or COO-K+. The alkyl tail hydrophobic) dissolves oil or organic solvent while the ionic soluble in water (hydrophilic).

**ACTION OF SOAP (CLEANSING ACTION)**

When soap solution is applied to a grease-coated piece of fabric, the soap molecule moves to thegrease spot. The hydrophobic tails dissolve in grease while the hydrophilic dissolves in the water.

The grease spot is lifted up and more soap particles dissolve the grease.

2.  **SOAPLESS DETERGENTS**

Soapless detergents are the more favouredall purpose cleansing agents nowadays. They are available as liquids or solids. The example of soapless detergent is alkyl benzenesulphates (ABS). These are sodium salt of an     acid e.g. sulphonic acid.

**STRUCTURE**:

The molecule of detergent has hydrophobic tail and hydrophilic head.

The hydrophobic tail is a long chain hydrocarbon or benzene ring with long alkyl group.

The hydrophilic unlike soap can be positively or negative change or neutral. The high solubility of soapless detergent in water is due to the presence of –SO3- Na+ in the molecules.

The soapless detergents are called synthetic detergents. The raw materials are petrochemicals from refining crude oil.

Hydrophilic

R - SO3- Na+

hydrophobic

tail

 R is a long hydrophobic chain.

**ACTION OF SOAPLESS DETERGENT**

* They do not form scum or react with hydrogen ions.

**EVALUATION**

1. Draw the structure of soapless detergent.

2. State one advantage of soapless detergent over soapy detergent.

**READING ASSIGNMENT**

New School Chemistry by Osei Yaw Ababio pages.509-514

**WEEKEND ASSIGNMENT**

1. The structure of soap according to suponification process is

A. CH3(CH2)16COONa B. CH3CH2COOCa C. CH3CH2CH2COONa

D. C2H5COONa

2 . The example of soapless detergent is

A. alkyl B. ethylethanoate C. alkanol D. alkylbenzenesulphonates

3. Hydrophobic tail of soap dissolves in grease while hydrophilic dissolves in

A. benzene B. water C. propanol D. kerosene

4. Fats and oils belong to a general group of compounds known as ………..

A. glycerol B. soap C. margarine D. lipids

5. Hydrolysis of fat and oil to yield alkanol and soap is called …………

A. esterification B. hydrogenation C. hydrolysis D. saponification

**THEORY**

1. Explain the structure of soapless detergent and its mode of action.

2. Explain the following;

     (a) saponification (b) hydrogenation

**WEEK EIGHT**

**TOPIC**: **NATURAL AND SYNTHETIC POLYMERS.**

Polymerisation (addition and condensation) plastics.

Thermosplastic and thermosetting polymers, resins.

Polymer is the final product, macromolecule of high molecular mars. It consists of a repeating units and its general molecular formula may be represented as [repeating units]n where n is a very large whole number.

N.B:- All polymers are macromolecules, but not all macromolecule but it is not polymeric.

**NATURAL POLYMERS:**

These are organic compounds which can be found in living thing e.g. carbohydrates like starch and cellulose and all proteins fats and oils are not large enough to be grouped as giant molecule or polymer.

**SYNTHETIC POLYMERS**

These are called plastics e.g. nylon polythene etc.

**EVALUATION**

1. State a difference between natural polymers and synthetic polymer with example each.

2. What is another name for synthetic polymer?

**POLYMERIZATION**

This is the process whereby two or more monomers link/join together to form a compound of

high molecular mass.

**TYPES OF POLYMERIZATION**

1. **Addition polymerization:-** these occur when two or more of the same monomers join together    to form the polymer without elimination of any small molecules.

**CHARACTERISTICS OF MONOMER**

- It must be simple.

- Unsaturated

- There should be double bonds between the carbon atom.

e.g.n[CH2CH2 ] ……..CH2CH2[CH2CH2]nCH2CH2……

2.  **CONDENSATION POLYMERIZATION**:- This is process whereby two or more smaller

    molecule (monomers) join together to form a giant molecule (polymer) with elimination of     trace/small molecule such as waters ammonia, hydrogen chloride.

**TYPES OF CONDENSATION POLYMERIZATION**

I. **COPOLYMER** :- This is formed from two condensing monomers of different types.

II. **HOMOPOLYMER** :- It is formed from monomers of the same type.

**CONDITIONS NECESSARY FOR POLYMERIZATION**

- High temperature

- High pressure

- Presence of catalyst (initiator) e.g. oxygen, hydrogen peroxide.

**EVALUATION**

1. State two conditions necessary for polymerization of ethane to from polythene.
2. Mention one difference between additional polymerization and condensation polymensation.

**PLASTICS**

Plastics are synthetic which can be heated or pressured to form any shape.

**THERMOPLASTIC**

Thermoplastics are type of synthetic materials which can be heated and remoulded to any shape e.g. nylon, polythene, polypropene, Perspex etc.

**THERMOSETS**

Thermosets, on the other hands cannot be softened or melted by heat and remoulded once they are formed e.g. uera-methanal, bakelite.

**Thermoplastics and thermosets**

|  |  |
| --- | --- |
| **Thermoplastics** | **Thermosets** |
| Polythene | Bakelite |
| Polypropene | Urea-methanal |
| Polystyrene |  |
| Nylon |  |
| Terylene |  |
| Perspex |  |

**RESINS**

This is obtained from the rubber tree. The fluid obtained from the tree can be heated and changed to elastic solid known as rubber. The rubber consists of 2-methyl but-1, 3- diene monomers known as isoprene.

CH3

nCH2 = C CH = CH2

2 – methylbuta -1, 3-diene.

**VULCANIZATION:**

This is the process of heating natural rubber with sulphur to give rubber a greater tensile, strength, durability and elasticity over a wide range of temperature.

**SYNTHETIC RUBBER:**

Examples of synthetic rubbers are poly 2-chlorobuta -1,3diene, styrenebutadiene rubber (SBR), poly bute -1, 3- diene and poly 2-methyl propene.

**EVALUATION**

1. What is resin?
2. State two (2) differences between thermoplastic and thermoset.

**READING ASSIGNMENT**

New School Chemistry by O.Y. Ababio pages 523-531

**WEEKEND ASSIGNMENT**

1. The following are examples of small molecules based during polymerization process.

     A. acid B. HCl C.H2O D. NH3

2. Polymerisation of ethane produces ……………

A. Perspex B. isoprene C. polythene D. ammonia

3. Bakelite is a good example of …………..

    A. natural rubber B. thermoset C. thermoplastic D. additional polymerization

4. Starch and cellulose are good examples of …………

    A. polythene B. natural polymer C. synthetic polymer D. food

5.  Joining together of smaller molecules to form a giant molecule is called ………..

     process. A. hydrogenation B. saponification C. esterification D. polymerization

**THEORY**

1 (a) What are the conditions necessary for polymerization.

(b) List two types of polymerization.

2 (a) Write an equation for the preparation of polythene from ethane.

(b) What are the monomer present in the following:

- polythene

- polyvinyl/chloride

- polytetrafluoro ethane

- polypropene

**WEEK NINE**

**CARBOHYDRATES**:

Carbohydrates are naturally occurring organic compounds containing carbon, hydrogen and oxygenwith oxygen in the ratio 1:2 as in water. The general molelcular formula of carbohydrates is Cx(H2O)y or CxH2yOy. Carbohydrates are generally polydroxyl aldehydes, ketones or any compound that on hydrolysis yields any of the polyhydroxides. They are synthesized in green plants by photosynthesis.

**CLASSIFICATION OF CARBOHYDRATES**

Carbohydrate

Simple sugar Complex sugar

(polysaccharides)

Monosaacharide Disacharides e.g. starch cellulose

e.g. glucose e.g sucrose

**EVALUATION**

1. Define carbohydrates.

2. State one example each of simple sugar and complex sugar.

**MONOSAACHARIDES**

Monosaacharides are simple sugar with three to six carbon atoms per molecule. The most common and important of these are the ones with six carbon atoms per molecule called the HEXOSES. They have the same molecular formula C6H12O6 but different spatial arrangement. Examples include glucose, fructose, galatose and mannose.

**GLUCOSE** (C6H12O6)

Glucose, commonly known as grape sugar or dextrose, is present in grapes, in honey and the sap of plants.

Glucose is synthesized by green plants during photosynthesis.

**PREPARATION**:- Glucose can be prepared in the laboratory by the acid hydrolysis of starch.

The starch is heated with dilute hydrochloric acid or tetraoxosulphate VI acid. The acid functioning as hydrolyzing agent in the reaction.

(C6H10O6)n nH2O nC6H12O6

Starch Dil H­2SO4 glucose

**Physical properties**

1. It is a white crystalline solid.

2. It is soluble in water.

3. It has sweet taste.

**Chemical properties**

1. It dehydrates to black residue of carbon when with conc. H2SO4

C6H12O6 6C + 6H2O

2. It is a strong reducing agent. This is due to the presence of the –CHO group in the             molecule.

3. It is readily fermented to ethanol and carbon VI oxide by the enzyme (ZYMASE) in yeast.

**TEST**: Add a few drops of Fehling’s solution to 5cm3 of glucose solution in a test tube. A brick-            red precipitate is obtained on boiling.

**GLUCOSE STRUCTURAL FORMULA**:

H

C = O the functional groups in the

H C H molecule are:

HO C O -CHO and OH

H C OH But -CHO determines the

H C OH chemical properties

OH C H

H

**FRUCTOSE** (C6H12O6)

An isomer of glucose is fructose. Fructose is a non-reducing sugar (it contains the >CO group)

**FRUCTOSE STRUCTURAL FORMULA**

H

H C OH The functional groups in the molecule are:

C = -C=O and –OH

Chemical properties

HO C H

H C OH

H C OH

H C OH

**EVALUATION**

1. State two (2) physical properties of starch.

2. Give difference between glucose and starch.

**DISACCHARIDES**:-

Disaccharides are simple sugar containing two molecules of monosaccharide per molecules. Their general molecular formula is C12H22O11. Some important disaccharides and the component monosaccharide are;

**DISACCHARIDE COMPONENT MONOSACCHARIDES**

Sucrose (cane sugar) Glucose + fructose

Lactose (milk sugar) Glucose + galactose

Maltose (malt sugar) Glucose + glucose

**SUCROSE**:-

This is the common granulated sugar used at home to sweeten food. It occurs naturally in plant and fruits e.g. pineapple, carrots sorghum, sap and sugar cane.

**Preparation**: Sucrose is prepared industrially by;

1. Extraction of juice from sugar cane,
2. Concentration of the juice by evaporation,
3. Crystallization of the solid sugar from the concentrated juice and
4. Filtration of sugar crystals from the molasses.

**PHYSICAL PROPERTIES**:

1. It is a white crystalline solid.

2. It is dissolves readily in water.

3. It has sweet taste.

**CHEMICAL PROPERTIES:**

1. It chars by dehydration to a black residue of carbon on addition of Conc. H2SO4.

C12H22O11 12C + 6H2O

2. It undergoes hydrolysis to equal quantity of glucose and fructose when boiled with dil.

H2SO4 or HCL (aq)

3. It undergoes inversion under the influence of invertase in yeast

Sucrose invertase Glucose + Fructose

4. It is non-reducing sugar.

**TEST**:

Glucose gives a red precipitate with freshly prepared Seliwanoff’s reagent.

**USES**

1. For sweetening foods and beverages.

2. For ethanol production by fermentation.

**POLYSACCHARIDES**

Polysaccharides are a group of complex carbohydrates composed of very long chains of monosaccharide linked together by condensation polymerization.

Monosaccharide condensation polysaccharides + n/2  water

Hydrolysis

Some important examples of polysaccharides are starch, glycogen, and cellulose. The general molecular formula of polysaccharides is (C6H10O5)n

**EVALUATION**

1. Name three disaccharides and the component monosaccharide.

2. Describe what would be observed on addition of Conc. H2SO4 to sucrose.

**PROTEIN**

Proteins are made up of polypetides chains. Polypeptide chains are products of condensation polymerization of amino acid molecules. The condensation polymerization of amino acid is the interaction between amino groups, -NH2, and Carboxyl groups, -COOH, to form the polypeptide chain.

A polypeptide chain:

H O H O H

O

+H3 N C C [N C C] +nN C

O

R H R H R

Amino end dipeptide Carboxyl end

**OCCURRENCE**

Proteins are found in living cells where they perform different functions. Examples are hemoglobin, collagen and insulin, ribonucleic. The structure have cross linkage between chains which are called disulphide bridges or disulphide cross linkages.

Properties

1. They are denatured easily at a temperature above 400C by variation in PH and by certain organic solvents and chemical reagents.

2. Proteins are hydrolyzed to give amino acids by boiling with dilute acids (e.g. HCI) and alkalis or using enzymes.

**Uses**

1. They are used for building up of tissues and repairing of worn-out tissues in the body.

2. They are necessary for growth especially in infants.

**Tests**

1. Million’s test – A white ppt. is form when a few drops of Million’s reagent are added to some

egg-white in a test-tube. The white ppt. turns brick red on heating (indicating the presence of proteins).

2. Biuret test: when few drops of dilute NaOH solution is added to some egg white solution in

a test tube, and 1% CUSO4 solution is added drop by drop and the test solution is shaken

vigorously after each drop. A violet colour is seen indicating a positive test for proteins.

3. Proteins form an intense yellow colour with a few drops of conc. HNO3 acid.

**EVALUATION**

1. Explain a chemical test for proteins.

2. What is the product of hydrolysis of proteins?

**AMINO-ACIDS**

Amino acids are the basic structural units of proteins.

The functional groups in amino acids are amino group (-NH2) and a carboxyl group (-COOH)

General structure

NH2 α carbon

H C COOH

R

**EVALUATION**

1. Give the functional group of protein.

2. Draw the structural formula of a polypeptide.

α carbons are carbons in amino acids to which the functional groups are attached.

Examples – glycine, phenylalnine, alanine etc. Amino acids are mainly in form of dipolar ions in neutral solution (zwitterions).

**EVALUATION**

1. Name the functional groups present in amino acids molecule.

2. What are proteins?

3. State two properties of protein.

**WEEKEND ASSIGNMENT**

1. One of the following is not a monosaccharide

A. glucose B. maltose C. fructose D. maltose

2. The product obtained when sucrose is treated with dil. HCI are

A. glucose and galatose B. fructose and galatose C. glucose and fructose D. glucose

3. Which of the following is a reducing sugar?

A. fructose B. glucose C. sucrose D. ribose

4. Which one of these substances is not a polysaccaharides?

A. lactose B. starch C. cellulose D. mannose

5. Few drops of conc HNO3 is added to a solution and an intense yellow colour is obtained,

then the solution contained.

A. proteins B. carbohydrates C. fat D. oil

**THEORY**

1. Explain a laboratory test for proteins.

2a. What are carbohydrates?

1. Name the component monosaccaharide of

(i) sucrose (ii) maltose.

**READING ASSIGNMENT**

New School Chemistry by Y.O Ababio page 520 – 531.

**WEEK TEN**

**TOPIC:AMINES AND AMIDES**

**CONTENTS**: General molecular formular/structure, preparation, properties and uses.

**AMINES**:

It has a functional group of NH2.

GENERAL MOLECULAR FORMULAR/STRUCTURE:

It has a general molecular formula of RNH2 or structure of R – N – H

H

**PREPARATION**:

They are derivatives of ammonia where one or more hydrogen atoms have been replaced by alkyl or aryl groups e.g. RNHz, R2NH.

**CLASSIFICATION**:

Amines can be classified according to alkyl group.

1. Primary amine with one alkyl group e.g. RNH2 or

R or CH3

H N H H N H

2. Secondary amine with 2 alkyl groups e.g. R2NH or

R CH3

R N or CH3 N H

H

3. Tertiary amine with 3 alkyl groups e.g. R3N or

R CH3

R1 N R11 or CH3 N CH3

Trimethyl amine

**PHYSICAL PROPERTIES**

1. They can dissolve in water.

2. They are gases and liquid.

3. They have fishy odour.

**CHEMICAL PROPERTIES**

1. As bases they neutralize acids.

2. They dissociate/ionize in water e.g. CH3NH2 + H2O CH3NH3++ OH-

**USES**

1. Used in making nylon

2. They can also be used in making polyamide.

**EVALUATION**

1. State two (2) physical properties and two (2) chemical properties of amine.

2. Give the classes of amine according to the number of their alkyl groups.

**AMIDES**

O

It has functional group of –C which is known as carbonamide group.

NH2

**STRUCTURE**:

O H O

CH3 C or H C C

NH2 H N H

H

**PREPARATION**

- Amide e.g. ethanmide can be derived from ethanoic acid in the presence of ammonia.

O OOO

CH3 C + NH3 C + H2O CH3 – C + NH3 CH3 C +H2O

OH NH2

OH NH2

- Amide is commonly prepared by reacting esters with concentrated aqueous ammonia. E.gCH3COOC2H5 + NH3 Ethanamide CH3CONH2 + C2H5OH

-They can also be prepared by removing a molecule of water from ammonium salt of carboxylic x acids.

e.g. CH3COONH4  CH3CONH2 + H2O

**PHYSICAL PROPERTIES**:

1. Only methanamide is a liquid while others are solid.

2. They have high melting point and high boiling point.

**CHEMICAL PROPERTIES**:

1. Amide can be hydrolysed in the presence of alkali and mineral acid e.g.

CH3CONH2 + H2O CH3COOH + NH3

2. In the presence of sodium hydroxide and bromine, amides produce amines with elimination of one     carbonyl group.

e.g.CH3CONH2 + Br2 + 4NaOH CH3NH2 + 2NaBr + Na2CO3 + 2H2O

**USES**:

1. Used in the preparation of amines.

2. Used in making synthetic resins and plastics.

3. It can also be used in making fertilizer.

**CARBAMIDE/UREA**

This is an amide of hydrogen trioxo carbonate (IV) acid. It is produced by compressing CO2 and NH3 at high pressure at 2000C.

H2CO3 CO(NH2)2

OH NHz

O C O C

OH NHz

Carbonamide/urea

N.B.: Urea is produced in our body and excreted in the urine.

**EVALUATION**

1. Write the structural formula of amide.

2. Give one different between amine and amide.

**READING ASSIGNMENT**

New School Chemistry by O.Y. Ababio pages 520-521

**WEEKEND ASSIGNMENT**

1.Tertiary amine is represented as follow

A. R2NH2 B. (CH3)2NH C.R2NH3 D. R2N

2.Which of the following has fishy odour

A. alkanoic acid B. alkanol C. amide D. amine

3.Amide can be regarded as derivatives of …………

A. alkanol B. policarboxylic acid C. monocarboxylic acid D. carbonxamide group

4.During the hydrolysis of amides, one of the following is produced.

A. monocarboxylic acids B. water C. H2SO4 D.NaOH

5. Carbamide is an example of

A. amine B. alkane C. alkyl D. amide

**THEORY**

1(a). State two (2) physical properties of amide.

 (b). How would you prepare ethanamide from an ester.

2(a). State two (2) chemical properties of amide.

(b). How would you identify an example of amine in the laboratory.