

Edo state polytechnic, usen.
Tutorial kit

ND Chemical Engineering Technology

Course: organic and inorganic chemistry

Q1

Differentiate generally between metals and non metals.

Q2

State how the following properties of elements vary across the period and groups in the periodic table

- (i) Ionization potential
- (ii) Atomic radii
- (iii) Ionic radii
- (iv) Electron affinity
- (v) Electronegativity
- (vi) Oxidation state
- (vii) Metallic character
- (viii) Nonmetallic character

Q3

Write down the electronic configuration of sodium and calcium

Q4

State the physical properties of sodium

Q5

Write a chemical equation showing the burning reaction of sodium in carbon dioxide

Q6

Briefly explain in not more than five lines the occurrence of calcium

Q7

What are the physical properties of calcium?

Q8

Write a chemical equation for the reaction of calcium with water

Q9

Define the following terms

- a. Organic chemistry
- b. Hydrocarbons
- c. Structural isomerism
- d. Isomers

Q10

What are the two basic classifications of organic compounds?

Q11

Write down the three groups of hydrocarbons

Q12

Write down the general formula of each of the following
Alkanes, alkenes, alkynes

Q13

Why are alkanes said to be saturated hydrocarbons?

Q14

Write down the names of the first five members of the alkanes

Q15

Write down the molecular formula of the first five members of the alkanes

Q16

What are alkyl radicals?

Q17

Write down the structural isomers of butane with their names

Q18

Write down the isomers of ethane and propane

Q19

Write down the structures of the following:

- 3-methylheptane
- 3,7-diethyl,5-methyldecane
- 3-chloro-hex-2-ene
- 6-chloro-heptyne

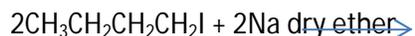
Q20

State Markownikoff's rule and complete the equation:



Q21

Complete the equation below for the wurtz reaction for the preparation of alkanes



Q22

Why are alkanes unreactive? Mention the kind of reactions they undergo

Q23

What is the general formula and the functional group of the alkanols?

Q24

Differentiate between aliphatic alcohol, aromatic alcohol and an enol. Give an example of each

Q25

What do you understand by the following?

- Primary alcohol (1°)
- Secondary alcohol (2°)
- Tertiary alcohol (3°)

Give an example of each.

Q26

What is the general formula of the:

- Alkanals?
- Alkanones?

Q27

Distinguish between the positions of the functional groups in aldehydes and ketones

Q28

Why are alkanols very reactive?

Q29

Write the equation for the addition (reaction) of HCN to aldehydes and ketones to form cyanohydrins

Q30

What is the functional group and general formula of alkanolic (carboxylic) acid?

Q31

Write down the formula, IUPAC and common names of the first two members of the alkanolic acid.

Q32

Name the types of reactions that are usually applied in organic chemistry.

Q33

Define substitution reaction and differentiate between electrophilic and nucleophilic substitution reactions.

Q34

What is the functional group and general formula of esters?

Q35

Write an equation for the hydrolysis of ethyl ethanoate in the presence of a mineral acid

Q36

What are the physical properties of ethyl ethanoate?

Q37

Define each of the following terms

- a. Polymer
- b. Polymerization
- c. Monomer
- d. Homopolymer
- e. Copolymer
- f. Synthetic polymers

Q38

What are aromatic compounds?

Q39

Enumerate the various techniques that are usually employed in polymerization

Q40

Give the Dewar structure of Benzene

Q41

What type of reactions does benzene undergo?

Q42

Define esterification

Q43 Give the structure of the following compounds

- i. Phenol
- ii. 4-amino phenol
- iii. Catechol
- iv. resorcinol

Model answers to above questions

Ans to Q1

Metals are elements that are ductile, malleable and lustrous in appearance and conduct heat Whereas nonmetals do not have these properties.

Ans to Q2

- (i) Ionization potential decreases within the group and increases across the period
- (ii) Atomic radii decreases across the period and increases down the group
- (iii) Ionic radii increases down the group and decreases across a period
- (iv) Electron affinity decreases down the group and increases across the period
- (v) Electronegativity decreases down the group and increases across the period
- (vi) Oxidation state of elements is same down the group but increases across the period
- (vii) Metallic character of elements increases down the group and decreases across the period
- (viii) Non-metallic character increases across the period but decreases down the group

Ans to Q3

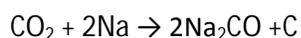
$1s^2 2s^2 2p^6 3s^1$ - sodium

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ – calcium

Ans to Q4

- (a) Sodium is silver white in colour
- (b) It is a lustrous metal which tarnishes when exposed to air leading to the formation of a film oxide.
- (c) It is less dense than water
- (d) It is soft and can be cut with knife
- (e) It melts at 97.7°C , boils at 883°C
- (f) Its specific gravity is 0.93g/cm^3
- (g) Its vapour is purple in colour
- (h) It possesses good electrical conductivity

Ans to Q5



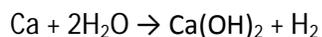
Ans to Q6

Calcium is not found free in nature but occurs in large quantities as calcium carbonate (CaCO_3) in marble and limestone and as calcium phosphate in teeth, bones and seashells

Ans to Q7

- a. Silver white lustrous metal
- b. Low density and specific gravity of 1.55g/cm^3
- c. Melts at 850°C
- d. Tarnishes slowly in air

Ans to Q8



Ans to Q9

- a. Organic chemistry is the chemistry of organic compounds (compounds of carbon)

- Hydrocarbons are compounds that contain carbon and hydrogen atoms only
- Structural isomerism is a phenomenon whereby two or more compounds have the same molecular formula but different structural formula
- Isomers are compound which exhibit isomerism

Ans to Q10

Aliphatic (acyclic) and aromatic organic compounds

Ans11;

Alkanes,alkens and alkynes.

Ans to Q12

C_nH_{2n+2} ----- alkanes

C_nH_{2n} ----- alkenes

C_nH_{2n-2} ----- alkynes

Ans to Q13

Alkanes are saturated hydrocarbons due to the presence of carbon-carbon and carbon-hydrogen single bonds which are sp^3 hybridized.

Ans to Q14

Methane, ethane, propane, butane, pentane.

Ans to Q15

CH_4 -methane

C_2H_6 -ethane

C_3H_8 -propane

C_4H_{10} -butane

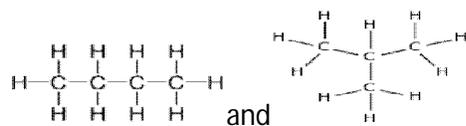
C_5H_{12} -pentane

Ans to Q16

Alkyl radicals are fragments of alkane molecules from which a hydrogen atom has been removed.

Ans to Q17

The isomers of butane are

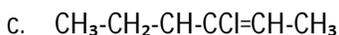
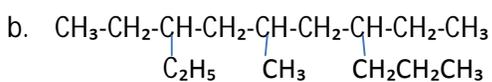
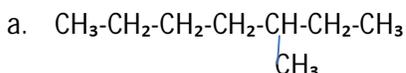


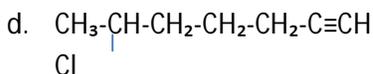
n-butane isobutane (2-methylpropane)

Ans to Q18

Both compounds do not exhibit isomerism.

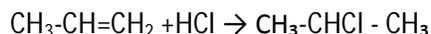
Ans to Q19





Ans to Q20

Markownikoff's rule states that in the ionic addition of H - X in an unsymmetrical molecule, the positive portion of the adding molecule i.e. (H⁺ - X⁻) attach itself to the carbon atom of the double bond that is mostly substituted.



Ans to Q21



Ans to Q22

Alkanes are unreactive because of the presence of carbon-carbon and carbon hydrogen single bonds (saturated). They only undergo substitution reactions in which one hydrogen atom is replaced by another by another atom or group of atoms.

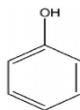
Ans to Q23

General formula of alkanols is C_nH_{2n+1}OH and the functional group is OH

Ans to Q24

The OH is attached to a straight saturated chain for an aliphatic alcohol; e.g. CH₃CH₂CH₂OH

OH is attached to an unsaturated chain for enols e.g. CH₃CH = CHOH.

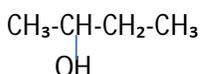


OH is attached to a ring for aromatic alcohols e.g. Phenol

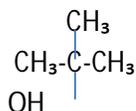
Ans to Q25

a. 1° alcohol is one in which the OH group is bonded to one alkyl group e.g. ethanol. i.e. CH₃CH₂OH

b. 2° alcohol is one in which the OH group is bonded to two alkyl groups e.g. 2-butanol. i.e.



c. 3° alcohol is one in which the OH group is bonded to three alkyl groups e.g. tertiary butyl alcohol or 2-methyl propan-2-ol. i.e.



Ans to Q26

a. C_nH_{2n}O or R-CHO for alkanals

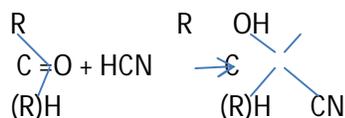
b. R-CO-R for alkanones

Ans to Q27

In ketones (alkanones), the functional group is bonded to two alkyl groups which can be the same or may differ while in aldehydes (alkanals), the functional group is always present at the end of the chain.

Ans to Q28

The presence of the hydroxyl group in alkanols make them to be very reactive.

Ans to Q29**Ans to Q30**

Functional group is $-\text{COOH}$ and general formula is $\text{C}_n\text{H}_{2n+1}\text{COOH}$ or RCOOH

Ans to Q31

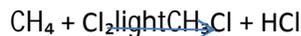
Member	First	second
Formula	HCOOH	CH_3COOH
IUPAC Name	Methanoic acid	Ethanoic acid
Common Name	Formic acid	Acetic acid

Ans to Q32

Substitution, addition, elimination and rearrangement reactions.

Ans to Q33

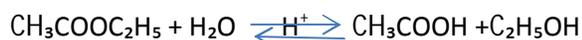
- a. Substitution reaction is one that involves the replacement of an atom or group of atoms by another atom or group on a carbon atom in a reaction. Example is the substitution of hydrogen atom in methane by a chlorine atom.



- b. Electrophilic substitution is a type of substitution reaction in which hydrogen is usually the atom removed by another atom or group, while Nucleophilic substitution involves the removal of an atom or group attached to a compound by another atom or group.

Ans to Q34

Functional group of esters is $-\text{COOR}$, general structural formula is RCOOR where R is alkyl group which may or may not be the same.

Ans to Q35**Ans to Q36**

- Ethyl ethanoate has a melting point of -80°C and a boiling point of 77°C
- Its solubility in water at 25°C is 7.38/100g
- It is a liquid at room temperature

Ans to Q37

- A polymer is a large or macro molecule obtained from many small structural units called monomers covalently bonded together in any conceivable pattern
- Polymerization is the chemical process of obtaining polymers
- Monomer is a molecule that can be bonded to other identical molecules to form a polymer
- Homopolymer is a polymer which is obtained from a single or same type of monomers
- Copolymer is a polymer formed from the combination of two different types of monomers
- Synthetic polymers are man made polymers

Ans to Q38

Aromatic compounds are those which possess the ring structure of benzene or other molecular structure that resembles benzene in electronic configuration and chemical behavior.

Ans to Q39

Bulk, solution, suspension and emulsion polymerization techniques

Ans to Q40

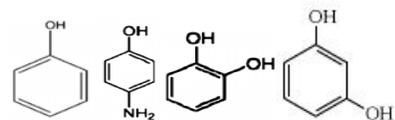
Dewar structures of benzene

Ans to Q41

Addition and substitution reactions

Ans to Q42

Esterification is a chemical reaction between an alkanol and an alkanic acid to form alkylalkanoate (ester) and water.

Ans to Q43

phenol
(p-aminophenol)

catechol
(2-hydroxyphenol)

resorcinol