Version No.			

ROLL NUMBER						

Answer Sheet No._____

Sign. of Candidate _____

Sign. of Invigilator _____

CHEMISTRY SSC–II

SECTION – A (Marks 12)

Time allowed: 20 Minutes

Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. **Do not use lead pencil.**

Q.1 Fill the relevant bubble for each part. Each part carries one mark.

(1) Which one of the following compounds is formed by the reaction of Aluminium Hydroxide $Al(OH)_3$ with Sulphuric Acid (H_2SO_4)?

A. $Al(SO_4)_3$ ◯ B. Al_2CO_3 ◯

C. $Al_2(SO_4)_3$ ◯ D. $AlCl_3$ ◯

(2) Marble Buildings are disintegrated by acid rain because of the reaction of acid with:

A. Calcium Sulphate ◯ B. Calcium Nitrate ◯

C. Calcium Carbonate ◯ D. Calcium Oxalate ◯

(3) Dipeptide is formed by joining of two molecules of:

A. Amino acids ◯ B. Alcohols ◯

C. Carboxylic acids ◯ D. Amines ◯

(4) Two products obtained from the carbonating tower during the Solvay Process are:

A. NH_4Cl and CO_2 ◯ B. NH_4HCO_2 and NH_4Cl ◯

C. $NaHCO_3$ and NH_4Cl ◯ D. $NaHCO_3$ and NH_3 ◯

(5) The end product of the reaction of acetylene with concentrated alkaline $KMnO_4$ is oxalic acid. In this reaction acetylene undergoes:

A. Reduction ◯ B. Oxidation ◯

C. Substitution ◯ D. Rearrangement ◯

(6) One mole of an unsaturated hydrocarbon reacts with one mole of hydrogen to form a saturated compound. Predict the formula of unsaturated compound.

A. C_3H_4 ◯ B. C_6H_{12} ◯

C. C_4H_{10} ◯ D. C_7H_{16} ◯

(7) F^- is a base, because it:

A. Contains OH group ◯
B. Ionizes in water to give OH^- ions ◯
C. Can accept an election pair ◯
D. Can accept proton ◯

(8) Which one of the following compounds is an aldehyde?

A. $CH_3 - CH_2 - OH$ ◯ B. $CH_3 - COOH$ ◯
C. $CH_3 - CHO$ ◯ D. $CH_3 - COCH_3$ ◯

(9) The pH of 10^{-3}M aqueous solution of NaOH is:

A. 3 ◯ B. 11 ◯
C. 2 ◯ D. 9 ◯

(10) Which one of the following pollutant is **NOT** produced by the burning of fossil fuel?

A. CO ◯ B. NO_x ◯
C. CFC_s ◯ D. SO_x ◯

(11) For a reversible reaction given below the unit of Kc is:

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

A. $mol^{-1}\ dm^3$ ◯ B. $mol^{-1}\ dm^{-3}$ ◯
C. $mol.dm^{-3}$ ◯ D. $mol.dm^3$ ◯

(12) The composition of matte produced during the metallurgy of copper is:

A. $FeSiO_3$ ◯ B. FeS & Cu_2S ◯
C. Cu_2O & FeS ◯ D. Cu_2O & Cu_2S ◯

Solution of Chemistry Model Paper 2021-2022 SSC-II

MCQ'S KEY

1. C	2. C	3. A	4. C	5.B	6.B	7.D	8. C	9.B	10.C	11.A	12.A

Section-B

i. Classify the following substances as Lewis acids or Lewis bases.
a. $AlBr_3$ b. CH_3-CH_2- OH c. CN^{-1}

Ans: a. $AlBr_3$ is a Lewis acid. Al in AlBr3 has an incomplete octet.so it needs an electron pair to complete its octet.

b. CH_3-CH_2- OH is a Lewis base. CH_3-CH_2- OH has a lone pair on O-atom so it is an electron pair donor.
c. CN^{-1} is a Lewis base. CN^{-1} has a lone pair on N-atom so it is an electron pair donor.

ii. How has Le-Chatlier's principle made it possible to get maximum amount of product from Habers process?
Ans:
With application of Le-Chatlier principle ammonia can be produced with 98% yield. First equilibrium is established with help of catalyst in minimum time and then by increasing pressure and decreasing temperature equilibrium is shifted towards right.

iii. Concentration of an aqueouss solution of potassium hydroxide 1.0×10^{-3} mol/dm^3 . What is its pH? Is this solution acidic, basic or neutral?

Sol. [KOH] = 1.0 x 10^{-3} mol/dm^3

$$KOH \rightleftharpoons K^+ + OH^-$$

Since 1 mole of KOH gives 1 mole of OH^- , therefore

$[OH^-] = [KOH] = 1.0 \times 10^{-3}$ mol/dm^3

Now $[H^+][OH^-] = 1.0 \times 10^{-14}$ mol/dm^3

$$[H^+] = \frac{1.0 \times 10^{-14}}{[OH^-]} \text{ mol/dm}^3$$

$$[H^+] = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-3}} \text{ mol/dm}^3$$

$$[H^+] = 1.0 \times 10^{-11} \text{ mol/dm}^3$$

Finally,

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

$$pH = -\log (1.0 \times 10^{-11})$$

$$\mathbf{pH = 11}$$

The solution will be Basic as pH>7.

iv. What is slaked lime? How is it produced during Solvay process?

Ans:

Slaked lime is Calcium Hydroxide. Calcium Hydroxide is produced heating limestone in a kiln.

$$CaCO_3 + heat \rightarrow CaO + CO_2$$

Equal amount of water and lime are mixed to produced slaked lime.

$$CaO + H_2O \rightarrow Ca(OH)_2$$

v. Write the name and formulas of the three Nitrogen containing fertilizers.

Ans:

Ammonium Sulfate	$(NH_4)_2\ SO_4$
Ammonium Nitrate	NH_4NO_3
Urea	NH_2CONH_2

vi. Describe ion exchange method for removal of hardness of water.

Ans:

The hardwater is passed through container filled with a suitable resin containing sodium ion. Zeolite is one of natural ion exchanger. Chemically it is sodium aluminium silicate.it is usually written as NaZ. The calcium and magnesium ions causing hardness are exchanged with sodium ion in resin.

$$M^{2+}(aq) + Na_2Z \rightarrow 2Na(aq) + \ +MZ$$

The used up zeolite can be regenerated by heating with concentrated solution of NaCl. This makes the process economical.

$$CaZ + 2NaCl \rightarrow 2Na+ \ + MZ$$

vii. For the given reversible reaction equilibrium concentration are: N2(g) + 3H2(g) 2NH3(g) N2 = 0.602mol/dm-3 H2 = 0.420 mol/dm-3 and NH3 = 0.113 mol/dm-3. Calculate the value of Kc and determine Kc unit

Ans:

$$Kc = \frac{[NH_3]_2}{[N_2][H_2]_3}$$

$=(0.113)^2/(0.602)(0.42)^3$

$=0.013/(0.602)(0.074)$

$=0.292\ dm^6mol^{-2}$

Units of Kc

$$Kc = \frac{[NH_3]_2}{[N_2][H_2]_3} = (mol\ dm^{-3})^2/(mol\ dm^{-3})(mol\ dm^{-3})^3$$

$=1/(mol\ dm^{-3})^2 = (mol\ dm^{-3})^{-2}$

$=dm^6\ mol^{-2}$

viii. Write down balanced chemical equations showing the formation of salt: a. reaction of HCl acid with Al metal b. reaction of HCl acid with calcium carbonate

Ans:

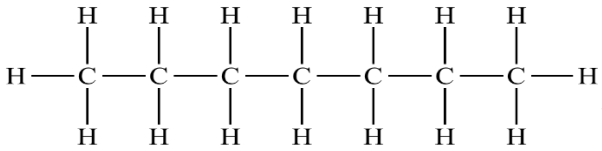
$2Al + 6HCl \rightarrow AlCl_3 + 3H_2$

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

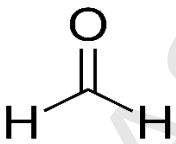
ix. Write the structural formulas of the following

Ans:

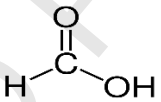
a. n-Heptane



b. Methanal



c. Methanoic acid



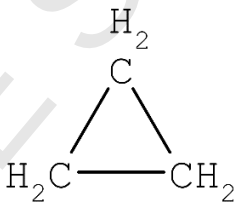
x. Differentiate between homocyclic and heterocyclic compound with the help of structural formula.

Ans:

Homocyclic compounds

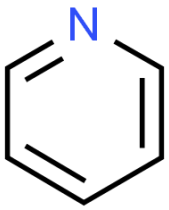
Cyclic compounds which contain rings of carbon atoms are homocyclic compounds.

For example cyclopropane contain ring of carbon atoms.



Cyclic compounds which contain one more atom other than carbon in ring are called heterocyclic compounds.

For example pyridine contains nitrogen in addition to carbon.

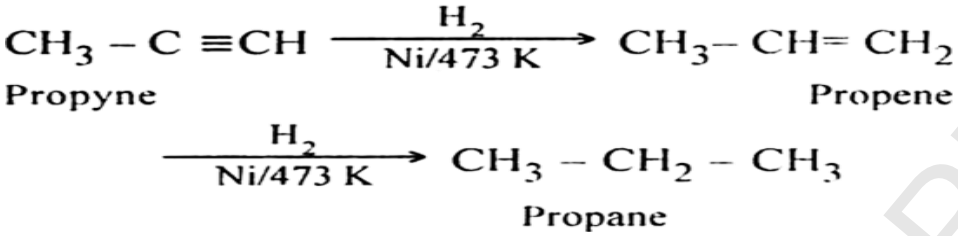


Heterocyclic compounds

xi. Write two methods of the preparation of propane. Give chemical equation with conditions.

Ans:

Propane can be prepared by hydrogenation of propene and propyne



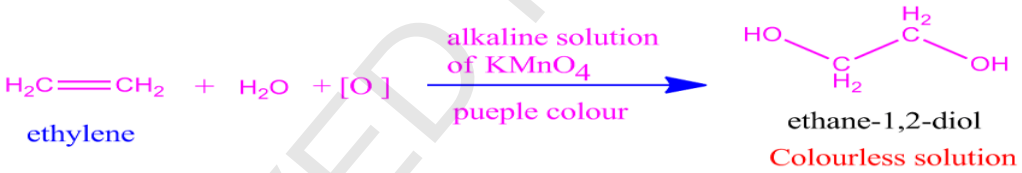
Hydrogenation can also be done in presence of Pt or Pd at room temperature.

xii. How will you differentiate between Ethane and Ethene using a chemical test.

Ans:

Ethene and Ethane can be differentiated using bayers test.

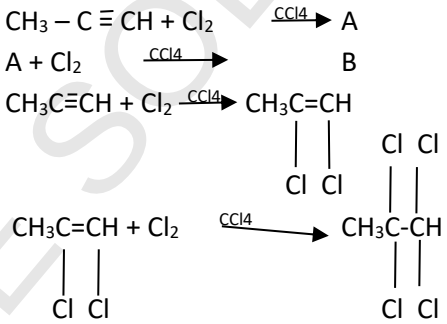
When ethene id treated with dilute alkaline solution of KMnO4 (1%), addition of two hydroxyl groups occur across the double bond. The pink color of KMnO4 solution is discharged.



Ethane does not give this test.

xiii. Identify A and B in the following chemical reaction

Ans:



A= 1,2 dichloropropene

B=1,1,2,2, tetrachloropropane

xiv. Discuss ways by which global warming can be decreased?

Ans:

Following are some of the ways through which global warming can be decreased:

Use of catalytic convertors in cars to reduce carbon dioxide emissions.

Planting trees can also capture carbon dioxide emissions.
Switch to renewable energy resources, thus emitting far less heat-trapping gases into atmosphere.
Use vehicles such as bicycle instead of those burning fossil fuels or use mass transport system.

xv. Define the following with examples: a. Lipids b. Fats c. Oils

Ans: Lipid: A lipid is any component of plant or animal tissues that is insoluble in water, but soluble in solvents of low polarity such as ether, hexane,benzene, and carbon tetra chloride.
For example, fats and oils.
Fats: A lipid is called fat if it is solid at room temperature.
For example, butter and beef fat.
Oils: A lipid is called oil if it is liquid at room temperature.
For example, palm oil and olive oil.

(SECTION : C)

Q:3(a): State law of mass action. Derive Kc expression for the following reaction:

Ans: Law of Mass Action

Statement

"The rate at which a substance reacts is directly proportional to its active mass. The rate at which the reaction proceeds, is directly proportional to the product of the active masses of the reactants".

The term active mass means concentration of reactants and products in the units of mol/dm^3 and is expressed in terms of square bracket[ ].

Derivation of Kc Expression for the Given reaction

$$4\,HCl_{(g)} + O_{2\,(g)} \rightleftharpoons 2Cl_{2\,(g)} + 2\,H_2O_{(g)}$$

Rate of forward reaction $\propto [HCl]^4.[O_2]$

Rate of forward reaction $(R_f) = k_f\,[HCl]^4\,.\,[O_2]$

Rate of reverse reaction $\propto [Cl_2]^2\,.\,[H_2O]^2$

Rate of reverse reaction $(R_r) = k_r\,[Cl_2]^2.\,[H_2O]^2$

As we know that at equilibrium.

$$R_f = R_r$$

$$k_f\,[HCl]^4.[O_2] = k_r\,[Cl_2]^2.[H_2O]^2$$

$$\frac{k_f}{k_r} = \frac{[Cl_2]^2.[H_2O]^2}{[HCl]^4.[O_2]}$$

$$K_c = \frac{[Cl_2]^2.[H_2O]^2}{[HCl]^4.[O_2]}$$

Q:3 b) **$4HCl(g) + O_2(g) \rightleftharpoons 2Cl_2(g) + 2H_2O(g)$**

Identify Lowery – Bronsted acids and bases in the following reactions. Justify your answer.

(i) **$HCO_3^- + H_2O(l) \rightleftharpoons CO_3^{-2}(aq) + H_3O^+(aq)$**

(ii) **$NH_3(g) + HNO_3 \rightleftharpoons NH_4NO_3$**

(iii) **$F^- + BF_3 \rightleftharpoons BF_4^-$**

(iv) **$CH_3COOH + H_2O(l) \rightleftharpoons CH_3COO^- + H_3O^+(aq)$**

Ans: <u>Identification of Lowry – Bronsted</u>

<u>Acids and Bases</u>

i. $HCO_3^- + H_2O_{(l)} \rightleftharpoons CO_3^{-2}{}_{(aq)} + H_3O^+{}_{(aq)}$

HCO_3^- is a Lowry acid as it is donating proton in this reaction, whereas H_2O is behaving as a Lowry – Bronsted base as it is accepting a proton.

ii. $NH_3(g) + HNO_3 \rightleftharpoons NH_4NO_3$

$NH_3(g) + HNO_3 \rightleftharpoons NH_4^+{}_{(aq)} + NO_3^-{}_{(aq)}$

NH_3 is a Lowry Bronsted base due to accepting proton and HNO_3 is a Lowry Bronsted Acid as it is acting as a proton donor.

iii. $F^- + BF_3 \rightleftharpoons BF_4$

Above is a lewis Acid-Base pair as it accepts an electron (BF_3) and donates electron pair (F^-)
No Lowry Acid – Base found.

iv. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

CH_3COOH Lowry – Bronsted Acid (Proton donor)

H_2O Lowry - Bronstd Base (Proton Acceptor)

Q:4(a) What is hard water? Explain the methods for removing temporary hardness of water.

Ans: Hard Water

Ans: "Water that gives a little lather or form scum with soap is called hard water".

Methods of removing temporary hardness

i) By boiling

Temporary hardness of water can simply be removed by boiling . During boiling the soluble calcium and magnesuim hydrogen carbonates are decomposed forming insoluble carbonates.

Since $Ca^{+2}$and Mg^{+2} ions are removed as insoluble carbonates, water becomes soft.

$M(HCO_3)_{2\ (aq)} \rightarrow MCO_{3(s)} + CO_2\ (g) + H_2O\ (l)$

Where M = Ca^{+2} or Mg^{+2}

Unfortunately ,this method is too expensive to remove temporary hardness of water on the large scale.

ii) By adding slaked lime(Clark's method)

Temporary hardness in water on the large scale can be removed by adding an estimated amount of Slaked line in it.

The slaked line reacts with the hydrogen carbonates to form insoluble carbonates.

$Ca(HCO_3)_{2\ (aq)} + Ca(OH)_2 \rightarrow 2CaCO_{3\ (s)} + 2H_2O\ (l)$

$Mg(HCO_3)_{2\ (aq)} + Ca(OH)_2 \rightarrow CaCO_3 + MgCO_3 + H_2O$

Q:4 (b) What are nucleic Acid? Describe structure and function of DNA.

Ans: Nucleic Acid

Nucleic acids are vital components of all life. They are found in every living cell. They serve as the information and control centre of the cell. They are long chain of nucleotides each nucleotide consist of three components.

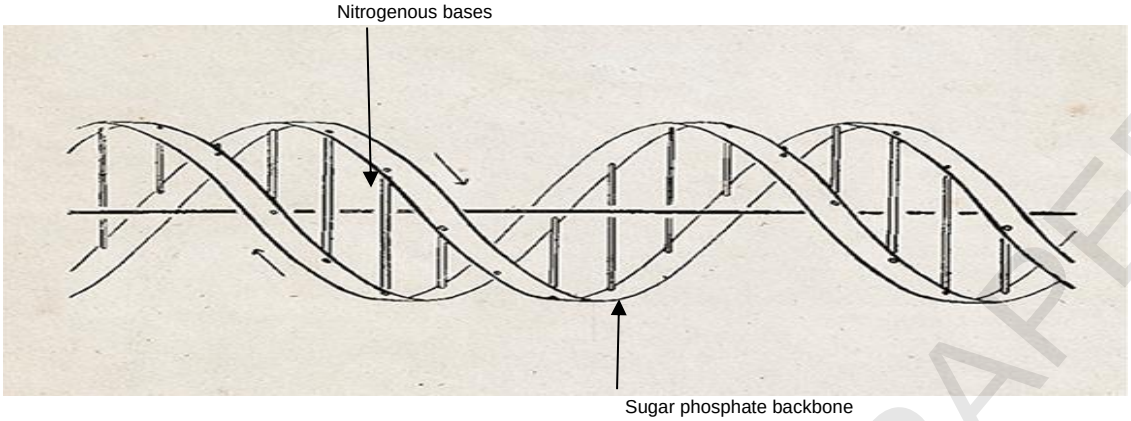
i. Nitrogenous base
ii. A pentose sugar or five carbon sugar
iii. Phosphate group.

DEOXYRIBONUCLEIC ACID (DNA)

Structure of DNA

DNA exists in the form of two strands twisted around each other in a spiral formation called a double tlelix.

Each chair or strand is made up of a deoxyribose sugar, phosphate unit and nitrogenous base. The strands are held together by hydrogen bonds.



STRUCTURE OF DNA

Function of DNA

1. Stores Information which is used to produce proteins.
2. It stores genetic information and passes it on from generation to generation due to it's double strand.

Q:5 (a) What is functional group? Identify the functional group in the following organic compound:

(i) CH_3COCH_3 (ii) CH_3COOH (iii) $HCOCH_3$

Ans: Functional Group

An atom or a group of atom that determines the characteristic properties of an organic compound is called a functional group.

i. CH_3COCH_3

$$CH_3 - \overset{\overset{O}{||}}{C} - CH_3$$

Carbony$l$ group (class of compound Ketone)

ii. CH_3COOH

$$CH_3 - \overset{\overset{O}{||}}{C} - OH$$

Carboxy$l$ group (Carboxylic acid)

iii. $CH_3 - \overset{\overset{O}{||}}{C} - H$ Formyl group (A*l*dehyde)

b). How will you convert propene into propyne. Name the products formed in each step.

Ans: Starting material → propene

$CH_3 - CH = CH_2$

End product → propyne

$CH_3 - C \equiv CH$

Conversion

$$CH_3 - CH = CH_2 + Br_2 \xrightarrow{CCl_4} CH_3 - \underset{Br}{\overset{|}{CH}} - \underset{Br}{\overset{|}{CH_2}}$$

1,2 – Dibromo propane

$$CH_3 - \underset{Br}{\overset{|}{CH}} - \underset{Br}{\overset{|}{CH_2}} + KOH \xrightarrow[-HBr]{alcohol} CH_3 - \underset{Br}{\overset{|}{C}} = CH_2$$

2 - Bromo Propene

$$CH_3 - \underset{Br}{\overset{|}{C}} = CH_2 + KOH \xrightarrow[-HBr]{alcohol} CH_3 - C \equiv CH$$

Propyne