CHEMISTRY 2020

QUESTIONS

(Two Hours)

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during the first ***15*** *minutes.*

This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section I *is compulsory. Attempt any four questions from* ***Section II.***

The intended marks for questions or parts of questions are given in brackets [].

SECTION-I (40 Marks)

Attempt ***all*** *questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* **[5]**

(i) *The element with highest ionization potential, is :*

(A) Hydrogen (B) Caesium

(C) Radon (D) Helium

(ii) *The inert electrode used in the electrolysis of acidified water, is :*

(A) Nickel (B) Platinum

(C) Copper (D) Silver

(iii) *A compound with low boiling point, is :*

(A) Sodium chloride

(B) Calcium chloride

(C) Potassium chloride

(D) Carbon tetrachloride

(iv) *The acid which can produce carbon from cane sugar, is :*

(A) Concentrated Hydrochloric acid

(B) Concentrated Nitric acid

(C) Concentrated Sulphuric acid

(D) Concentrated Acetic acid

(v) *The organic compound having a triple carbon-carbon covalent bond, is :*

(A) C_3H_4 (B) C_3H_6

(C) C_3H_8 (D) C_4H_{10}

(b) *State one relevant observation for each of the following reactions :* **[5]**

(i) *Action of concentrated nitric acid on copper.*

(ii) *Addition of excess ammonium hydroxide into copper sulphate solution.*

(iii) *A piece of sodium metal is put into ethanol at room temperature.*

(iv) *Zinc carbonate is heated strongly.*

(v) *Sulphide ore is added to a tank containing oil and water, and then stirred or agitated with air.*

(c) *Write a balanced chemical equation for each of the following reactions :* **[5]**

(i) *Reaction of carbon powder and concentrated nitric acid.*

(ii) *Reaction of excess ammonia with chlorine.*

(iii) *Reaction of lead nitrate solution with ammonium hydroxide.*

(iv) *Producing ethane from bromo ethane using Zn/Cu couple in alcohol*

(v) *Complete combustion of ethane.*

(d) **(i)** *Draw the structural formula for each of the following :* **[5]**

1. *2, 2 dimethyl pentane*

2. *Methanol*

3. *Iso propane*

(ii) *Write the IUPAC name for the following compounds :*

1. *Acetaldehyde*

2. *Acetylene*

(e) *State one relevant reason for each of the following :* **[5]**

(i) *Graphite anode is preferred to platinum in the electrolysis of molten lead bromide.*

(ii) *Soda lime is preferred to sodium hydroxide in the laboratory preparation of methane.*

(iii) *Hydrated copper sulphate crystals turn white on heating.*

(iv) *Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle.*

(v) *Hydrogen chloride gas fumes in moist air.*

(f) *Calculate :* **[5]**

(i) *The amount of each reactant required to produce 750 ml of carbon dioxide, when two volumes of carbon monoxide combine with one volume of oxygen to produce two volumes of carbon dioxide :*

$$2CO + O_2 \rightarrow 2CO_2$$

(ii) *The volume occupied by 80 g of carbon dioxide at STP.*

(iii) *Calculate the number of molecules in 4.4 gm of CO_2.*

[Atomic mass of C = 12, O = 16]

(iv) *State the law associated in question no. (f) (i) above.*

(g) *Give one word or a phrase for the following statements :* **[5]**

(i) *The chemical bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.*

(ii) *Electrode used as cathode in electrorefining of impure copper.*

(iii) *The substance prepared by adding other metals to a base metal in appropriate proportions to obtain certain desirable properties.*

(iv) *The tendency of an atom to attract electrons to itself when combined in a compound.*

(v) *The reaction in which carboxylic acid reacts with alcohol in the presence of conc. H_2SO_4 to form a substance having a fruity smell.*

(h) *Fill in the blanks from the choices given in brackets :* **[5]**

(i) *The polar covalent compound in gaseous state that does not conduct electricity is .....*

(carbon tetra chloride, ammonia, methane)

(ii) *A salt prepared by displacement reaction is .....*

(ferric chloride, ferrous chloride, silver chloride)

(iii) *The number of moles in 11 gm of nitrogen gas is .....*

(0.39, 0.49, 0.29) [atomic mass of N = 14]

(iv) *An alkali which completely dissociates into ions is ..... (ammonium hydroxide, calcium hydroxide, lithium hydroxide)*

(v) *An alloy used to make statues is .....*

(bronze, brass, fuse metal)

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) *The following table represent the elements and the atomic number :* **[3]**

With reference to this, answer the following using only the alphabets given in the table.

Element	*Atomic number*
P	*13*
Q	*7*
R	*10*

(i) *Which element combines with hydrogen to form a basic gas ?*

(ii) *Which element has an electron affinity zero ?*

(iii) *Name the element, which forms an ionic compound with chlorine.*

(b) *Draw the electron dot diagram for the compounds given below. Represent the electrons by (.) and (x) in the diagram :* **[3]**

[Atomic No. Ca = 20, O = 8, Cl = 17, H = 1]

(i) *Calcium oxide*

(ii) *Chlorine molecule*

(iii) *Water molecule*

(c) *Choose the correct word which refers to the process of electrolysis from A to E, to match the description (i) to (iv) :* **[4]**

A : Oxidation B : Cathode C : Anode

D : An electrolyte E : Reduction

(i) *Conducts electricity in aqueous or in molten state.*

(ii) *Loss of electron takes place at anode.*

(iii) *A reducing electrode.*

(iv) *Electrode connected to the positive end or terminal of the battery.*

Question 3.

(a) *Baeyer's process is used to concentrate bauxite ore to alumina. :* **[3]**

Give balanced chemical equations for the reaction taking place for its conversion from bauxite to alumina.

(b) *Complete the following by selecting the correct option from the choices given :* **[3]**

(i) *pH of acetic acid is greater than dilute sulphuric acid. So acetic acid contains ..... concentration of H^+ ions. (greater, same, low)*

(ii) *The indicator which does not change colour on passage of HCl gas is ..... (methyl orange, moist blue litmus, phenolphthalein)*

(iii) *The acid which cannot act as an oxidizing agent is .....(conc. H_2SO_4, conc. HNO_3, conc. HCl)*

(c) *Match the gases given in column I to the identification of the gases mentioned in column II :* **[4]**

Column I	*Column II*
(i) Hydrogen sulphide	*A. Turns acidified potassium dichromate solution green.*
(ii) Nitric oxide	*B. Turns lime water milky.*
(iii) Carbon dioxide	*C. Turns reddish brown when it reacts with oxygen.*
(iv) Sulphur dioxide	*D. Turns moist lead acetate paper silvery black.*

Question 4.

(a) *Differentiate between the following pairs based on the information given in the brackets :* **[3]**

(i) *Conductor and electrolyte (conducting particles)*

(ii) *Cations and anions (formation from an atom)*

(iii) *Acid and Alkali (formation of type of ions)*

(b) *Draw the structures of isomers of pentane.* **[3]**

(c) *Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction :* **[4]**

(i) *Give the balanced chemical equation for the reaction with suitable conditions(s) if any.*

(ii) *Why is concentrated sulphuric acid used instead of concentrated nitric acid ?*

(iii) *How is the gas collected ?*

(iv) *Name the drying agent not used for drying the gas.*

Question 5.

(a) *Distinguish between the following pairs of compounds using a reagent as a chemical test :* **[3]**

(i) *Calcium nitrate and Zinc nitrate solution.*

(ii) *Ammonium sulphate crystals and Sodium sulphate crystals.*

(iii) *Magnesium chloride and Magnesium nitrate solution.*

(b) *Calculate the percentage of* **:** **[3]**

(i) *Fluorine*

(ii) *Sodium and*

(iii) *Aluminium*

in sodium aluminium fluoride $[Na_3AlF_6]$, *to the nearest whole number. [Atomic Mass : Na = 23, Al = 27, F = 19]*

(c) **(i)** *State the volume occupied by 40 gm of methane at STP, if its vapour density (V.D.) is 8.* **[4]**

(i) *Calculate the number of moles present in 160 gm of NaOH.*

[Atomic Mass : Na = 23, H = 1, O = 16]

Question 6.

(a) *Identify the salts* **P**, **Q**, **R** *from the following observations* **[3]**

(i) *Salt* **P** *has light bluish green colour. On heating, it produces a black coloured residue. Salt* **P** *produces brisk effervescence with dil. HCl and the gas evolved turns lime water milky, but no action with acidified potassium dichromate solution.*

(ii) *Salt* **Q** *is white in colour. On strong heating, it produces buff yellow residue and liberates reddish brown gas. Solution of salt* **Q** *produces chalky white insoluble precipitate with excess of ammonium hydroxide.*

(iii) *Salt* **R** *is black in colour. On reacting with concentrated HCl, it liberates a pungent greenish yellow gas which turns moist starch iodide paper blue black.*

(b) *Identify the substance underlined in each of the following :* **[3]**

(i) *The electrode that increases in mass during the electro-refining of silver.*

(ii) *The acid that is a dehydrating as well as a drying agent.*

(iii) *The catalyst used to oxidize ammonia into nitric oxide.*

(c) *Copy and complete the following paragraph using the options given in brackets :* **[4]**

Alkenes are a homologous series of (i) ..... (saturated / unsaturated) hydrocarbons characterised by the general formula (ii) ..... (C_nH_{2n+2}/ C_nH_{2n}). *Alkenes undergo (iii) ..... (addition/ substitution) reactions and also undergo (iv) ..... (hydrogenation / dehydrogenation) to form alkanes.*

Question 7.

(a) *Write balanced chemical equations, for the preparation of the given salts :* **[3]**

(i) to (iii) by using the methods A to C respectively :

A : Neutralization B : Precipitation C : Titration

(i) *Copper sulphate*

(ii) *Zinc carbonate*

(iii) *Ammonium sulphate*

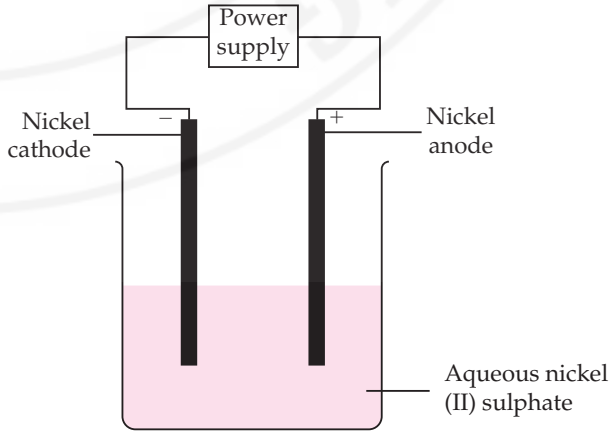
(b) *Name the following elements :* **[3]**

(i) *An alkaline earth metal present in group 2 and period 3.*

(ii) *A trivalent metal used to make light tools.*

(iii) *A monovalent non-metal present in fluorspar.*

(c) *An aqueous solution of nickel (II) sulphate was electrolyzed using nickel electrodes. Observe the diagram and answer the questions that follow :* **[4]**



(i) *What do you observe at the* ***cathode*** *and* ***anode*** *respectively ?*
(ii) *Name the cation that remains as a spectator ion in the solution.*
(iii) *Which equation for the reaction at the anode is correct ?*

1. $Ni \rightarrow Ni^{2+} + 2e^-$
2. $Ni + 2e^- \rightarrow Ni^{2+}$
3. $Ni^{2+} \rightarrow Ni + 2e^-$
4. $Ni^{2+} + 2e^- \rightarrow Ni$

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (D) Helium
(ii) (B) Platinum
(iii) (D) Carbon tetrachloride
(iv) (C) Concentrated Sulphuric acid
(v) (A) C_3H_4

(b) **(i)** Action of concentrated nitric acid on copper :
Reddish brown fumes of NO_2 are produced when copper reacts with conc. nitric acid :

$$Cu\ (s) + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$$

(ii) Addition of excess ammonium hydroxide into copper sulphate solution leads to formation of a deep blue coloured solution.
When ammonium hydroxide is added in the solution of copper sulphate drop-wise, a pale blue precipitate of copper hydroxide is obtained. The equation for this follows :

$$CuSO_4 + 2NH_4OH \rightarrow Cu(OH)_2 + (NH_4)_2SO_4$$

When ammonium hydroxide is added in excess, the precipitate dissolves and gives a deep blue solution of tetraammine copper (II) sulphate. The equation for this follows :

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \rightarrow [Cu(NH_3)_4]SO_4 + H_2O$$

Hence, the product formed is a complex named as tetraammine copper (II) sulphate.
(iii) When a piece of sodium metal is put into ethanol at room temperature hydrogen gas is produced which can be identified by a pop sound and it extinguishes a burning splinter.

$$2Na(s) + 2C_2H_5OH(l) \rightarrow 2C_2H_5ONa(l) + H_2(g)$$

Sodium + Ethanol → Sodium ethoxide + Hydrogen

(iv) White coloured zinc carbonate is heated strongly to give pale yellow zinc oxide and carbon dioxide gas which extinguishes wooden splinter.

$$ZnCO_3 \rightarrow ZnO + CO_2 \uparrow$$

(v) Sulphide ore is added to a tank containing oil and water and then stirred or agitated with air to generate a froth.
This is known as froth floatation where the sulphide ore particles are preferentially wetted by oil while gangue particles are preferentially wetted by water. A mixture of water and pine oil is taken in the tank. The powdered Sulphide ore is dropped in. Compressed air is blown in through the agitator. The agitator is rotated several times. Froth containing ore starts rising up.

(c) **(i)** Carbon powder reacts with concentrated nitric acid to give carbon dioxide, nitrogen dioxide and water.

$$C(s) + 4HNO_3(l) \rightarrow CO_2(g) + 4NO_2(g) + 2H_2O(l)$$

(ii) Excess of ammonia reacts with chlorine to give nitrogen and ammonium chloride.

$$8NH_3(g) + 3Cl_2(g) \rightarrow N_2(g) + 6NH_4Cl$$

Solid white fog

(iii) Lead nitrate solution reacts with ammonium hydroxide to give lead hydroxide and ammonium nitrate.

$$Pb(NO_3)_2 + 2NH_4OH \rightarrow Pb(OH)_2 + 2NH_4NO_3$$

(iv) Production of ethane from bromoethane using Zn/Cu couple in ethanol gives H_2 gas for the reaction.

$$C_2H_5Br + H_2 \xrightarrow{Zn/Cu,\ C_2H_5OH} C_2H_6 + HBr$$

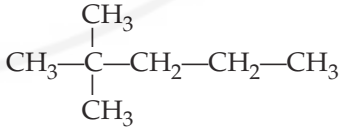
Bromoethane → Ethane

(v) Complete combustion of ethane gives carbon dioxide and water.

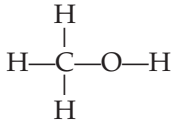
$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

Ethane + Oxygen → Carbon dioxide + Water

(d) **(i)** **1.** 2, 2-Dimethyl pentane



2. Methanol



3. Isopropane

$$H_3C—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}—CH_3$$

(ii) 1. IUPAC name of acetaldehyde (CH_3CHO) is Ethanal.

2. IUPAC name of acetylene ($HC \equiv CH$) is Ethyne.

(e) **(i)** Graphite anode is preferred in the electrolysis of molten lead bromide, because graphite remains unaffected by the reactive bromine vapours which are released at the anode.

(ii) Soda lime is preferred to sodium hydroxide in the laboratory preparation for methane because Sodium hydroxide is deliquescent and absorbs water from atmosphere.

$$CH_3COONa \xrightarrow{NaOH/CaO} CH_4 + Na_2CO_3$$

(iii) Hydrated copper sulphate crystals turn white on heating due to the loss of water molecules upon heating.

$$CuSO_4 . 5H_2O \underset{\text{add } H_2O}{\overset{\Delta}{\rightleftharpoons}} CuSO_4 + 5H_2O$$

(iv) Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle because Nitric acid has tendency to decompose slowly in presence of sunlight and produce nitrogen dioxide gas, which is reddish brown in colour. This liberated NO_2 gas dissolves in nitric acid and gives it a yellowish colour.

$$4HNO_3 \rightarrow 4NO_2 + 2H_2O + O_2$$

(v) Hydrogen chloride gas fumes in moist air because it is highly soluble in water and when it comes in contact with air containing water droplets it dissolves in water and forms mist, which appears as white fumes.

(f) **(i)** $2CO + O_2 \rightarrow 2CO_2$

Here, 2 moles of CO react with 1 mole of O_2

At STP, 1 mole of any ideal gas takes up 22.4 L.

So, 44.8 L of CO reacts with 22.4 L of O_2 to give 44.8 L of CO_2.

So, 750 ml of CO_2 production will need 750 ml of CO and 375 ml of O_2

(ii) Molecular weight of CO_2 = 44 g

So, weight of one mole CO_2 gas is 44 g

Or, 44 g of CO_2 occupies 22.4 L at STP

$\therefore$ 80 g will occupy $\frac{22.4}{44} \times 80$

$= 40.72$ L

or $= 40720$ mL

(iii) Weight of one mole CO_2 gas is 44 g

Or, 44 g CO_2 contains 6.02×10^{23} CO_2 molecules.

So, 4.4 g of CO_2 will contain 6.023×10^{22} CO_2 molecules.

(iv) Gay Lussac's law of combining volumes of gases is associated here and it states that : "When gases react, they do so in volumes which bears a simple whole number ratio to one another and to the volumes of the products, if gaseous, provided the temperature and pressure of the reacting gases and their products remain constant".

(g) **(i)** Covalent bond

(ii) Pure (thin block) of copper

(iii) Alloys

(iv) Electronegativity

(v) Esterification

(h) **(i)** ammonia

(ii) ferric chloride

(iii) 0.39

(iv) calcium hydroxide

(v) bronze

SECTION-II

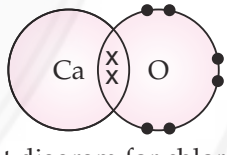
Answers 2.

(a) **(i)** Q (QH_3 is the basic gas) with Z = 7

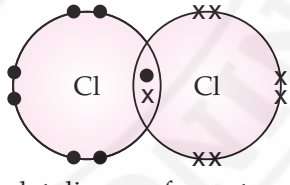
(ii) R with Z = 10

(iii) P with Z = 18

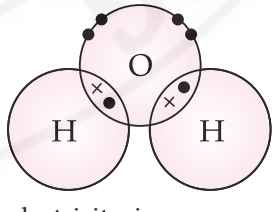
(b) **(i)** Electron dot diagram for Calcium oxide



(ii) Electron dot diagram for chlorine molecule



(iii) Electron dot diagram for water molecule



(c) **(i)** Conducts electricity in aqueous or in molten state – D: An electrolyte

(ii) Loss of electron takes place at anode – A: Oxidation

(iii) A reducing electrode – B: Cathode

(iv) Electrode connected to the positive end or terminal of the battery – C: Anode

Answers 3.

(a) Chemical reactions related to Baeyer's process for the conversion from bauxite to alumina:

1. $Al_2O_3.2H_2O(s) + 2NaOH \xrightarrow{150° - 200° C} 2NaAlO_2 + H_2O$

2. $NaAlO_2 + 2H_2O \xrightarrow{50° - 60° C} Al(OH)_3 + NaOH$

3. $2Al(OH)_3 \xrightarrow[\text{Alumina}]{\text{Heat}} Al_2O_3 + 3H_2O$

(b) **(i)** low **(ii)** phenolphthalein
(iii) conc. HCl

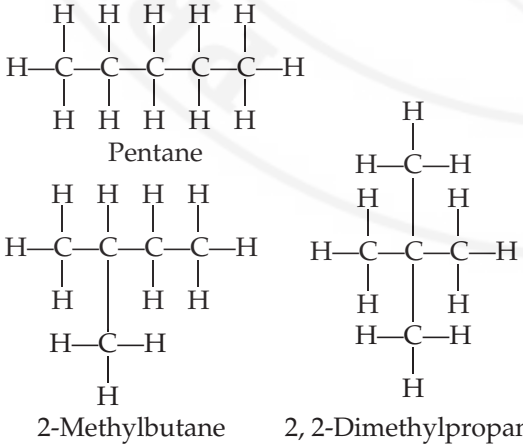
(c)

Column I	Column II
(i) Hydrogen sulphide	D. Turns moist lead acetate paper silvery black.
(ii) Nitric oxide	C. Turns reddish brown when reacts with oxygen.
(iii) Carbon dioxide	B. Turns lime water milky.
(iv) Sulphur dioxide	A. Turns acidified potassium dichromate solution green.

Answers 4.

(a) **(i)** Conductor has electrons as the conduction particles whereas ions are the conducting species in electrolyte.
(ii) Cations are formed when a neutral atom loses electrons whereas anions are formed when a neutral atom gains electron.
(iii) An acid dissociates to furnish H^+ ions and the conjugate base which is negatively charged and a base dissociates to give OH^- ions and a conjugate acid which is positively charged.

(b) Structures of isomers of pentane are as follows :



Pentane

2-Methylbutane

2, 2-Dimethylpropane

Structural isomers of C_5H_{12}

(c) **(i) 1.** $NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{below 200°C}]{\text{Heated}} NaHSO_4 + HCl\uparrow$

2. $2NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{above 200°C}]{\text{Heated}} Na_2SO_4 + 2HCl\uparrow$

(ii) Concentrated nitric acid is not used for preparation of HCl gas as it is very strong oxidising agent and will end up oxidising HCl gas.

(iii) HCl is collected by the upward displacement of air.

(iv) Calcium oxide.

Answers 5.

(a) **(i)** Calcium nitrate and Zinc nitrate solutions can be distinguish by reacting with ammonium hydroxide solution :

1. On adding ammonium hydroxide gelatinous white precipitates of zinc hydroxide are formed.

$Zn(NO_3)_2 + 2NH_4OH \longrightarrow Zn(OH)_2 + 2NH_4NO_3$

2. On adding excess of ammonium hydroxide, the precipitates dissolve forming a soluble complex.

$Zn(NO)_2 + 2NH_4NO_3 \longrightarrow 2NH_4OH + [Zn(NH_3)_4](NO_3)_2 + 4H_2O$

No visible reaction occurs when we add calcium nitrate to ammonium hydroxide.

$CaNO_3 + NH_4OH \longrightarrow$ No reaction

(ii) Ammonium sulphate crystals give pungent colourless gas Ammonia (NH_3) when heated. When NH_3 gas comes in contact with a glass rod dipped in HCl white fumes of NH_4Cl are produced. Sodium sulphate crystals do no undergo the above reaction sequence, hence can be differentiated from ammonium sulphate crystals.

(iii) Magnesium chloride reacts with silver nitrate solution to give precipitate of silver chloride, whereas magnesium nitrate does not react with silver nitrate solution to give a precipitate.

$MgCl_2\,(aq) + 2AgNO_3\,(aq) \longrightarrow Mg(NO_3)_2\,(aq) + 2AgCl\,(s)\downarrow$

$MgNO_3 + AgNO_3 \longrightarrow$ No reaction

(b) Molecular weight of Na_3AlF_6

$3 \times 23 + 27 + 6 \times 19 = 210$

Now,

(i) Percentage of fluorine $= \frac{(6\times19)}{210} \times 100$

$= 54.2\%$

(ii) Percentage of sodium = $\frac{(3\times23)}{210}\times100$

= 32.8 %

(iii) Percentage of aluminium = $\frac{27}{210}\times100$

= 12.8 %

(c) **(i)** Molecular weight = 2 × Vapour density at STP

In case of methane, substituting the given information –

Molecular weight = 2 × 8

= 16

Molecular weight of methane = 16 which means 16 g of methane occupy 22.4 L volume at STP.

So, 40 g of methane will occupy = $\frac{22.4}{16}\times40$

= 56 L

(ii) Number of moles

$$= \frac{\text{Given weight of substance}}{\text{Molecular weight of substance}}$$

Molecular weight of NaOH = 23 + 16 + 1

= 40

No. of moles = $\frac{160}{40}$ = 4

There are 4 moles of NaOH in 160 g of NaOH

Answers 6.

(a) **(i)** P is Copper carbonate.

$CuCO_3(s) \rightarrow CuO(s)$

Copper II carbonate → Copper (II) oxide

Bluish green → Black

$+ CO_2(g)$

+ Carbon dioxide(g)

$CuCO_3 + HCl \rightarrow CuCl_2 + CO_2 + H_2O$

(P) Effervescence

$CuCO_3 + K_2Cr_2O_7 \rightarrow$ No reaction

(ii) The salt Q is Lead nitrate

$$2Pb(NO_3)_2(s) \xrightarrow{\text{heat}} 2PbO(s) + 4NO_{2(g)} + O_2(g)$$

Lead nitrate (Colourless) (Q) → Lead monoxide (Yellow) + Nitrogen dioxide (Reddish brown) + Oxygen

When reacted with ammonium hydroxide solution it gives a chalky white precipitate of lead hydroxide :

$Pb(NO_3)_2 + 2NH_4OH \rightarrow 2NH_4NO_3 + Pb(OH)_2\downarrow$

(Q) Chalky white ppt.

(iii) The salt R is MnO_2, which is black in colour and reacts with HCl to give Cl_2 gas

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

Chlorine gas is pungent and greenish yellow in colour. The chlorine gas oxidises some of the iodide ions in the starch iodide paper to create iodine diatomic molecules. These molecules react with the iodide ions and the starch to form a charge-transfer complex of blue colour.

(b) **(i)** Cathode

(ii) Conc. H_2SO_4

(iii) Platinum Rhodium catalyst in Ostwald's process.

(c) **(i)** unsaturated

(ii) C_nH_{2n}

(iii) addition

(iv) hydrogenation

Answers 7.

(a) **(i)** Copper sulphate by neutralization

$Cu(OH)_2 + H_2SO_4 \rightarrow CuSO_4\downarrow + 2H_2O$

Copper hydroxide + Sulphuric acid → Copper sulphate

(ii) Zinc carbonate by precipitation

$Zn(NO_3)_2(aq) + 2NaCO_3 \rightarrow Zn(CO_3)_2 + 2NaNO_3(aq)$

Zinc nitrate (aq) + Sodium carbonate → Zinc carbonate

(iii) Ammonium sulphate can be prepared by titration of NH_3 solution with dil. H_2SO_4 solution.

$2NH_4OH(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4 + 2H_2O(l)$

White powder

(b) **(i)** Magnesium or Mg

(ii) Aluminium or Al

(iii) Fluorine or F

(c) **(i)** At cathode reduction takes place and deposition of Ni takes place as Ni^{2+} ions from solution convert to Ni metal.

$Ni^{2+} + 2e^- \rightarrow Ni$

At anode oxidation takes place and Ni metal converts to Ni^{2+} ions.

$Ni \rightarrow Ni^{2+} + 2e^-$

(ii) H^+ is the spectator cation.

(iii) **1.** $Ni \rightarrow Ni^{2+} + 2e^-$

CHEMISTRY 2019

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* [5]

(i) *An electrolyte which completely dissociates into ions is :*

(A) Alcohol *(B) Carbonic acid*
(C) Sucrose *(D) Sodium hydroxide*

(ii) *The most electronegative element from the following elements is :*

(A) Magnesium *(B) Chlorine*
(C) Aluminium *(D) Sulphur*

(iii) *The reason for using aluminium in the alloy duralumin is :*

(A) Aluminium is brittle.
(B) Aluminium gives strength.
(C) Aluminium brings lightness.
(D) Aluminium lowers melting point.

(iv) *The drying agent used to dry HCl gas is :*

(A) Conc. H_2SO_4 *(B) ZnO*
(C) Al_2O_3 *(D) CaO*

(v) *A hydrocarbon which is a greenhouse gas is :*

(A) Acetylene *(B) Ethylene*
(C) Ethane *(D) Methane*

(b) *Fill in the blanks with the choices given in brackets :* [5]

(i) *Conversion of ethanol to ethene by the action of concentrated sulphuric acid is an example of ..... . (dehydration/dehydrogenation/ dehydrohalogenation)*

(ii) *When sodium chloride is heated with concentrated sulphuric acid below 200°C, one of the products formed is ..... . (sodium bisulphate/sodium sulphate/ chlorine)*

(iii) *Ammonia reacts with excess chlorine to form ..... . (nitrogen/nitrogen trichloride/ammonium chloride)*

(iv) *Substitution reaction are characteristic reactions of ..... . (alkynes/alkenes/alkanes)*

(v) *In period 3, the most metallic element is ..... . (Sodium / magnesium / aluminium)*

(c) *Write a balanced chemical equation for each of the following reactions :* [5]

(i) *Reduction of copper (II) oxide by hydrogen.*

(ii) *Action of dilute sulphuric acid on sodium hydroxide.*

(iii) *Action of dilute sulphuric acid on zinc sulphide.*

(iv) *Ammonium hydroxide is added to ferrous sulphate solution.*

(v) *Chlorine gas is reacted with ethene.*

(d) *State one observation for each of the following :* [5]

(i) *Concentrated nitric acid is reacted with sulphur.*

(ii) *Ammonia gas is passed over heated copper (II) oxide.*

(iii) *Copper sulphate solution is electrolysed using copper electrodes.*

(iv) *A small piece of zinc is added to dilute hydrochloric acid.*

(v) *Lead nitrate is heated strongly in a test tube.*

(e) **(i)** *Calculate :* [5]

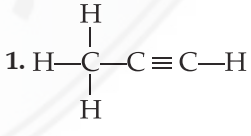
1. *The number of moles in 12g of oxygen gas.*
[O = 16]

2. *The weight of 10^{22} atoms of carbon.*
[C = 12, Avogadro's No. = 6×10^{23}]

(ii) *Molecular formula of a compound is $C_6H_{18}O_3$. Find its empirical formula.*

(f) **(i)** *Give the IUPAC name of the following organic compounds :* [5]

1.



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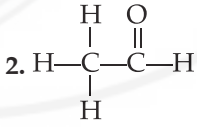


(ii) *What is the special feature of the structure of ethyne ?*

(iii) *Name the saturated hydrocarbon containing two carbon atoms.*

(iv) *Give the structural formula of acetic acid.*

(g) *Give the appropriate term defined by the statements given below :* [5]

(i) *The formula that represents the simplest ratio of the various elements present in one molecule of the compound.*

(ii) *The substance that releases hydronium ion as the only positive ion when dissolved in water.*

(iii) *The tendency of an atom to attract electrons towards itself when combined in a covalent compound.*

(iv) *The process by which certain ores, specially carbonates are converted to oxide in the absence of air.*

(v) *The covalent bond in which the electrons are shared equally between the combining atoms.*

(h) *Arrange the following according to the instructions given in brackets :* **[5]**

(i) *K, Pb, Ca, Zn. (In the increasing order of the reactivity)*

(ii) *Mg^{2+}, Cu^{2+}, Na^{+}, H^{+} (In the order of preferential discharge at the cathode)*

(iii) *Li, K, Na, H (In the decreasing order of their ionization potential)*

(iv) *F, B, N, O (In the increasing order of electron affinity)*

(v) *Ethane, methane, ethene, ethyne. (In the increasing order of the molecular weight) [H = 1, C = 12]*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) *Draw the electron dot structure of :* **[3]**

(i) *Nitrogen molecule [N = 7]*

(ii) *Sodium chloride [Na = 1, Cl =17]*

(iii) *Ammonium ion [N = 7, H = 1]*

(b) *The pH values of three solution, A, B and C are given in the table. Answer the following questions :* **[3]**

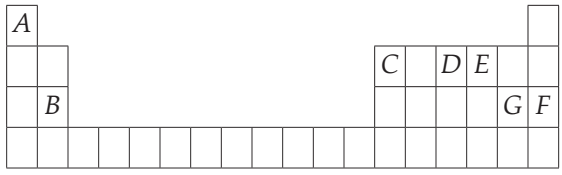
Solution	*pH value*
A	*12*
B	*2*
C	*7*

(i) *Which solution will have no effect on litmus solution ?*

(ii) *Which solution will liberate CO_2 when reacted with sodium carbonate ?*

(iii) *Which solution will turn red litmus solution blue ?*

(c) *Study the extract of the Periodic Table given below and answer the questions that follow. Give the alphabet corresponding to the elements in question. DO NOT repeat an element.* **[4]**



(i) *Which element forms electrovalent compound with G ?*

(ii) *The ion of which element will migrate towards the cathode during electrolysis ?*

(iii) *Which non-metallic element has the valency of 2 ?*

(iv) *Which is an inert gas ?*

Question 3.

(a) *Name the particles present in :* **[3]**

(i) *Strong electrolyte*

(ii) *Non-electrolyte*

(iii) *Weak electrolyte*

(b) *Distinguish between the following pairs of compounds using the reagent given in the bracket.* **[3]**

(i) *Manganese dioxide and copper (II) oxide. (using concentrated HCl)*

(ii) *Ferrous sulphate solution and ferric sulphate solution. (using sodium hydroxide solution)*

(iii) *Dilute hydrochloric acid and dilute sulphuric acid. (using lead nitrate solution)*

(c) *Choose the method of preparation of the following salts, from the methods given in the list.* **[4]**

[List : A. Neutralization B. Precipitation C. Direct combination D. Substitution]

(i) *Lead chloride*

(ii) *Iron (II) sulphate*

(iii) *Sodium nitrate*

(iv) *Iron (III) chloride*

Question 4.

(a) *Complete the following equations :* **[3]**

(i) *$S + conc.\ HNO_3 \rightarrow$*

(ii) *$C + conc.\ H_2SO_4 \rightarrow$*

(iii) *$Cu + dil.\ HNO_3 \rightarrow$*

(b) *Write a balanced chemical equation for the preparation of* **[3]**

(i) *Ethene from bromoethane.*

(ii) *Ethyne using calcium carbide.*

(iii) *Methane from sodium acetate.*

(c) *Name the following organic compounds :* **[4]**

(i) *The compound with 3 carbon atoms functional group is a carboxyl.*

(ii) *The first homologue whose general formula is C_nH_{2n}.*

(iii) *The compound that reacts with acetic acid to form ethyl ethanoate.*

(iv) *The compound formed by complete chlorination of ethyne.*

Question 5.

(a) *Give the chemical formula of :* **[6]**

(i) *Bauxite*

(ii) *Cryolite*

(iii) *Sodium aluminate.*

(b) *Answer the following question based on the extraction of aluminium from alumina by* ***Hall-Heroult's Process :*** **[3]**

(i) *What is the function of cryolite used along with alumina as the electrolyte ?*

(ii) *Why is powdered coke sprinkled on top of the electrolyte ?*

(iii) *Name the electrode, from which aluminium is collected.*

(c) *Match the alloys given in column I to the uses given in column II.* **[4]**

COLUMN I	COLUMN II
(i) Duralumin	A. Electrical fuse
(ii) Solder	B. Surgical instrument
(iii) Brass	C. Aircraft body
(iv) Stainless Steel	D. Decorative articles

Question 6.

(a) *Identify the substances underlined.* **[3]**

(i) *The <u>catalyst</u> used to oxidise ammonia.*

(ii) *The <u>organic compound</u> which when solidified, forms an ice like mass.*

(iii) *The <u>dilute acid</u> which is an oxidizing agent.*

(b) *Copper sulphate solution reacts with sodium hydroxide solution to form a precipitate of copper hydroxide according to the equation :* **[3]**

$$2NaOH + CuSO_4 \rightarrow Na_2SO_4 + Cu(OH)_2 \downarrow$$

(i) *What mass of copper hydroxide is precipitated by using 200 gm of sodium hydroxide ?*

[H = 1, O = 16, Na = 23, S = 32, Cu = 64]

(ii) *What is the colour of the precipitate formed ?*

(c) *Find the* ***empirical formula*** *and the* ***molecular formula*** *of an organic compound from the data given below :* **[4]**

C = 75.92%, H = 6.32% and N = 17.76%

The vapour density of the compound is 39.5

[C = 12, H = 1, N = 14]

Question 7.

(a) *Name the gas evolved in each of the following cases :* **[3]**

(i) *Alumina undergoes electrolytic reduction.*

(ii) *Ethene undergoes hydrogenation reaction.*

(iii) *Ammonia reacts with heated copper oxide.*

(b) *Study the flow chart given and give balanced equations to represent the reactions A, B and C :*

$$Mg_3N_2 \xrightarrow{A} NH_3 \underset{C}{\overset{B}{\rightleftharpoons}} NH_4Cl$$

[3]

(c) *Copy and complete the following table which refers to the industrial method for the preparation of ammonia and sulphuric acid.* **[4]**

Name of the compound	Name of the process	Catalytic equation (with the catalyst)
Ammonia	(i).....	(ii).....
Sulphuric acid	(iii).....	(iv).....

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (D) sodium hydroxide

(ii) (B) Chlorine

(iii) (C) Aluminium brings lightness

(iv) (A) Conc. H_2SO_4

(v) (D) Methane

(b) **(i)** dehydration

(ii) sodium bisulphate or sodium hydrogen Sulphate

(iii) ammonium chloride

(iv) Alkanes

(v) Sodium

(c) **(i)** Reduction of copper (II) oxide by hydrogen-

$$CuO\ (s) + H_2\ (g) \rightarrow Cu\ (s) + H_2O\ (g)$$

(ii) Action of dilute sulphuric acid on sodium hydroxide-

$$H_2SO_4\ (aq) + 2NaOH\ (aq) \rightarrow Na_2SO_4\ (aq) + 2H_2O\ (l)$$

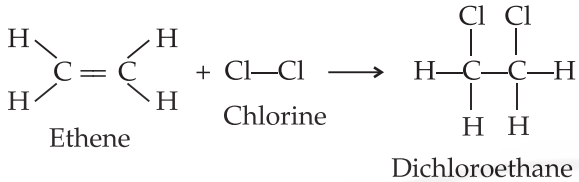
(iii) Action of dilute sulphuric acid on zinc sulphide-

$$ZnS + H_2SO_4 \rightarrow ZnSO_4 + H_2S\uparrow$$

(iv) Ammonium hydroxide is added to ferrous sulphate solution –

$$FeSO_4 + 2NH_4OH \rightarrow (NH_4)_2SO_4 + Fe(OH)_2$$

(v) Chlorine gas is reacted with ethene :



(d) **(i)** Concentrated nitric acid is reacted with sulphur to give reddish brown nitrogen oxide gas.

$$6HNO_3(Conc.) + S\ (s) \rightarrow H_2SO_4\ (g) + 6NO_2\uparrow(g) + 2H_2O\ (l)$$

(ii) When ammonia gas is passed over heated copper (II) oxide, reddish brown copper metal is obtained and black CuO is used up.

$$2NH_3 + 3CuO \xrightarrow{\text{Heat}} 3Cu + 3H_2O + N_2$$

(iii) Copper sulphate solution is electrolysed using copper electrodes and the cathode increases in size due to deposition of copper metal, whereas the copper anode gets thin due to loss of copper metal into the solution as Cu^{2+} ions.

The electrolytic solution contains following ions-

$$CuSO_4(s) + H_2O \rightarrow Cu^{2+}(aq) + SO_4^{2-}(aq) + H^+(aq) + OH^-(aq)$$

At cathode-

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu\ (s)$$

At anode made up of copper –

$$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$$

(iv) A small piece of zinc is added to dilute hydrochloric acid to give bubbles in solution due to evolution of hydrogen gas.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2\ (s) + H_2\ (g)\uparrow$$

(v) Lead nitrate is heated strongly in a test tube to give a cracking sound and a reddish brown gas (NO_2).

$$2Pb(NO_3)_2\ (s) \xrightarrow{\text{Heat}} 2PbO + 4NO_2\uparrow + O_2(g)$$

Reddish brown gas is evolued.

(e) **(i) 1.** The number of moles in 12 g of oxygen gas can be calculated as below-

Given atomic mass of oxygen is 16 g,

Hence molar mass of O_2 gas = 16 × 2 = 32 g

That is, 32 g oxygen gas has one molecule of O_2 molecules.

Therefore, 12 g of oxygen gas would contain = (1/32) × 12 = 0.375 moles

2. The weight of 10^{22} atoms of carbon can be calculated as follows –

Given – atomic weight of carbon = 12, and Avogadro's number = 6.023×10^{23}

Weight of one mole of carbon is 12 g,

Weight of 6.023×10^{23} carbon atoms is 12 g

Hence, weight of 10^{22} carbon atoms is $(12\ g/6.023 \times 10^{23}) \times 10^{22} = 0.199 \approx 0.2\ g$

(ii) Empirical formula can be obtained by dividing the number of atoms in molecule by the smallest number in the molecular formula –

Given molecular formula – $C_6H_{18}O_3$

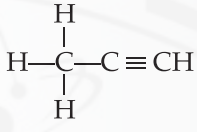
Smallest number in formula is 3

Dividing all the atoms by 3,

Empirical formula comes to be – C_2H_6O

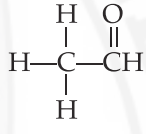
(f) **(i)** IUPAC name-

1.



Propyne

2.

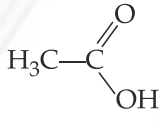


Ethanal

(ii) Special feature of ethyne structure is that ethyne (C_2H_2) contains a triple bond between the two carbon atoms and it is linear in shape due to *sp* hybridisation in carbon atoms.

(iii) The saturated hydrocarbon containing two carbon atoms is Ethane, C_2H_6.

(iv) The structural formula of acetic acid is –



Ethanoic acid (acetic acid)

(g) **(i)** The formula that represents the simplest ratio of various elements present in one molecule of a compound is known as **Empirical formula.**

(ii) The substance that releases hydronium ion as the only positive ion when dissolved in water is **protic acid**.

(iii) The tendency of an atom to attract electrons towards itself when combined in a covalent compound is known as **electronegativity.**

(iv) The process by which certain ores, specially carbonates, are converted to oxides in absence of air is known as **calcination.**

(v) The covalent bond in which the electrons are shared equally between the combining atoms is known as **Non-polar covalent bond.**

(h) **(i)** The given elements can be arranged in increasing order of reactivity as follows –

$$Pb < Zn < Ca < K$$

(ii) In the order of preferential discharge at the cathode –

$$Na^+ > Mg^{2+} > H^+ > Cu^{2+}$$

(iii) In the decreasing order of their ionization potential-

$$H > Li > Na > K$$

(iv) In the increasing order of electron affinity –

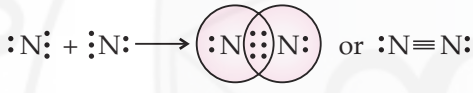
$$B < N < O < F$$

(v) In the increasing order of molecular weight – Methane (CH_4) < ethyne (C_2H_2) < ethene (C_2H_4) < ethane (C_2H_6)

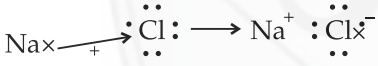
SECTION-II

Answers 2.

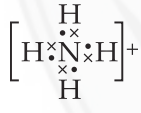
(a) **(i)** Electron dot structure of nitrogen molecule –



(ii) Electron dot structure of Sodium chloride –



(iii) Electron dot structure of Ammonium ion –



(b) **(i)** Solution C would have no effect on litmus solution as its pH is 7 and hence it is neutral.

(ii) Solution B would liberate CO_2 when reacted with sodium carbonate as it is acidic solution and has pH 2.

(iii) Solution A would turn red litmus solution blue as it is basic in nature and has pH 12.

(c) **(i)** A would form electrovalent compound with G.

(ii) B ion would travel to cathode during electrolysis.

(iii) E has valency of 2.

(iv) F is an inert gas.

Answers 3.

(a) **(i)** The particles present in strong electrolyte are molecules which easily and completely dissociate into ions. Example: Strong electrolyte such as NaCl which dissociates strongly into Na^+ and Cl^- ions.

(ii) The particles present in non-electrolyte are molecules which do not dissociate into ions. Example: Non-electrolyte such as urea. NH_2CONH_2 which do not dissociate.

(iii) The particles present in weak electrolyte are both molecules and ions which dissociate into ions to a very less extent. Example: CH_3COOH which dissociates feebly into CH_3COO^- and H^+ ions.

(b) **(i)** Manganese dioxide reacts with concentrated hydrochloric acid to give chlorine gas, which is greenish yellow in colour, whereas copper (II) oxide reacts with concentrated hydrochloric acid to give $CuCl_2$, but no chlorine gas is evolved.

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2\uparrow + 2H_2O$$

(ii) A reddish precipitate of Iron(III) hydroxide is obtained when ferric sulphate reacts with sodium hydroxide solution, whereas dirty green precipitate is obtained when ferrous sulphate is mixed with sodium hydroxide.

$$Fe_2(SO_4)_3\,(aq) + 6NaOH\,(aq) \rightarrow 2Fe(OH)_3\,(s) + 3Na_2SO_4\,(aq)$$

(iii) Lead nitrate reacts with dilute HCl to form the insoluble salt lead chloride, which appears as the white precipitate. The insoluble lead chloride reacts with excess Cl^- ions (of HCl) to form a soluble complex, the tetrachloroplumbate(II) ion,

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2\downarrow + 2HNO_3$$

$$PbCl_2 + 2HCl \rightarrow [PbCl_4]^{2-} + 2H^+(aq)$$

Soluble

Lead nitrate solution reacts with H_2SO_4 to give lead sulphate precipitate, which does not dissolve further in sulphuric acid solution.

$$Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4\downarrow + HNO_3$$

(c) **(i)** (B) Lead chloride can be prepared by precipitation.

$$Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$$

(ii) (D) Iron (II) Sulphate can be prepared by substitution.

(iii) (A) Sodium nitrate can be prepared by Neutralization.

$$2HNO_3 + Na_2CO_3 \rightarrow 2\,NaNO_3 + H_2O + CO_2$$

(iv) (C) Iron (III) chloride can be prepared by direct combination.

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

Answers 4.

(a) **(i)** $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$

(ii) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

(iii) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(b) **(i)** Ethene from bromoethane

$H_2CBr\text{-}CH_3 + KOH \rightarrow H_2C{=}CH_2 + KBr + H_2O$

Bromoethane — Ethene

(ii) Ethyne using calcium carbide

$CaC_2 + 2H_2O \rightarrow HC \equiv CH + Ca(OH)_2$

Calcium Carbide — Ethyne

(iii) Methane from sodium acetate

$CH_3COONa + NaOH \xrightarrow[CaO]{\Delta} CH_4 + Na_2CO_3$

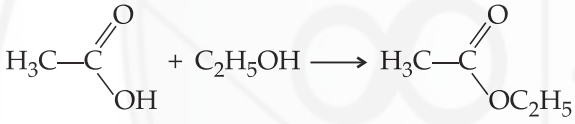
Sodium acetate — Sodium Hydroxide — Methane — Sodium carbonate

(c) **(i)** The compound with three carbon atoms whose functional group is carboxyl-

Propanoic acid, CH_3CH_2COOH

(ii) The first homologue whose general formula is C_nH_{2n} is C_2H_4 that is Ethene.

(iii) The compound that reacts with acetic acid to form ethyl ethanoate is ethanol-



Ethanoic acid (acetic acid) — Ethyl ethanoate

(iv) The compound formed by complete chlorination of ethyne is tetrachloroethane, $C_2H_2Cl_4$.

Answers 5.

(a) **(i)** The chemical formula of Bauxite is $Al_2O_3.2H_2O$ [where, $O < x < 1$]

(ii) The chemical formula of Cryolite is Na_3AlF_6.

(iii) The chemical formula of Sodium aluminate is $NaAlO_2$.

(b) **(i)** Cryolite (Na_3AlF_6) is mixed with alumina to bring down the melting point of electrolyte mixture and to increase its electrical conductivity.

(ii) The electrolytic mixture is sprinkled with coke to prevent the anode's oxidation by the oxygen evolved.

(iii) Aluminium is collected at cathode which is carbon lining covering the inside portion of vessel.

(c) **(i)** Duralumin – C. Aircraft body

(ii) Solder – A. Electrical fuse

(iii) Brass – D. Decorative articles

(iv) Stainless steel – B. Surgical instruments

Answers 6.

(a) **(i)** Platinum

(ii) Acetic acid or ethanoic acid CH_3COOH

(iii) Dilute nitric acid or HNO_3

(b) **(i)** The given equation is

$2NaOH + CuSO_4 \rightarrow Na_2SO_4 + Cu(OH)_2\downarrow$

Molecular weight of NaOH, Sodium hydroxide = 23 + 16 + 1 = 40

Molecular weight of $Cu(OH)_2$, Copper hydroxide = 64 + 16 + 1 + 16 + 1 = 98

2 × 40 = 80 g of NaOH is used to precipitate 98 g of $Cu(OH)_2$

Hence, 200 g of NaOH will be used to precipitate (98/80) 200 g of $Cu(OH)_2$ = 245 g of $Cu(OH)_2$

So, 245 g of copper hydroxide would be prepared using 200 g of sodium hydroxide.

(ii) The precipitate of copper hydroxide is bluish green solid or Pale blue solid.

(c) Given : C=75.92%, H = 6.32% and N = 17.76%

Let us assume that the weight of compound is 100 g. So, in that 100 g C is 75.92 g, H is 6.32 g and N is 17.76 g.

Now, lets calculate the moles of each element present in the compound-

75.92 g C × (1 mol C/12 g C) = 6.32

6.32 g H × (1 mol H/1 g H) = 6.32

17.76 g N × (1 mol N/14 g N) = 1.26

Next, dividing all the mole numbers by the smallest among them, which is 1.26. This division yields –

5 mol C, 5 mol H and 1 mol N

So, the compound has the empirical formula – C_5H_5N.

Now, we know that

Molecular mass of a gas = 2 × vapour density of the gas

= 2 × 39.5

= 79

So, Molecular mass of the given compound is 79.

Empirical formula mass = (12 × 5) + (1 × 5) + (14 × 1) = 79

As, Empirical formula mass = Molecular mass

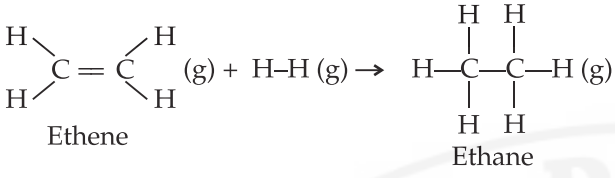
So, in this case Empirical formula = Molecular formula = C_5H_5N.

Answers 7.

(a) (i) Oxygen gas (O_2) is evolved when alumina undergoes electrolysis.

$Al_2O_3 \rightleftharpoons 2Al^{3+} + 3O^{2-}$

(ii) Ethane gas (C_2H_6) is evolved when ethene undergoes hydrogenation reaction.



Ethene Ethane

(iii) Nitrogen gas (N_2) is evolved when ammonia is treated with copper oxide.

$$2NH_3 + 3CuO \xrightarrow{\Delta} 3\,Cu + 3H_2O + N_2$$

Ammonia Nitrogen gas

(b) The flow chart can be completed as follows-

$$Mg_3N_2 \xrightarrow{H_2O(A)} NH_3 \underset{Ca(OH)_2(C)}{\overset{HCl(B)}{\rightleftharpoons}} NH_4Cl$$

The full reactions are as follows-

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$

(A)

$$NH_3 + HCl \rightarrow NH_4Cl$$

(B)

$$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + 2H_2O + CaCl_2$$

(C)

(c) Details of industrial processes-

Name of the compound	Name of the process	Catalytic equation (with the catalyst)
Ammonia	(i) Haber's Process	(ii) $N_2(g) + 3H_2(g) \underset{K_2O + Al_2O_3}{\overset{\text{Iron oxide}}{\rightleftharpoons}} 2\,NH_3\,(g)$ Ammonia
Sulphuric acid	(iii) Contact process	(iv) $2SO_2 + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$ $\xrightarrow{H_2SO_4} H_2S_2O_7$ Oleum

CHEMISTRY

2018

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* [5]

(i) *The salt solution which does not react with ammonium hydroxide is :*

(A) Calcium nitrate (B) Zinc nitrate

(C) Lead nitrate (D) Copper nitrate

(ii) *The organic compound which undergoes substitution reaction is :*

(A) C_2H_2 (B) C_2H_4

(C) $C_{10}H_{18}$ (D) C_2H_6

(iii) *The electrolysis of acidified water is an example of :*

(A) Reduction (B) Oxidation

(C) Redox reaction (D) Synthesis

(iv) *The IUPAC name of dimethyl ether is :*

(A) Ethoxy methane (B) Methoxy methane

(C) Methoxy ethane (D) Ethoxy ethane

(v) *The catalyst used in the Contact Process is :*

(A) Copper (B) Iron

(C) Vanadium pentoxide (D) Manganese dioxide

(b) *Give **one word** or a **phrase** for the following statements :* [5]

(i) *The energy released when an electron is added to a neutral gaseous isolated atom to form a negatively charged ion.*

(ii) *Process of formation of ions from molecules which are not in ionic state.*

(iii) *The tendency of an element to form chains of identical atoms.*

(iv) *The property by which certain hydrated salts, when left exposed to atmosphere, lose their water of crystallization and crumble into powder.*

(v) *The process by which sulphide ore is concentrated.*

(c) *Write a balanced chemical equation for each of the following :* [5]

(i) *Action of concentrated sulphuric acid on carbon.*

(ii) *Reaction of sodium hydroxide solution with iron (III) chloride solution.*

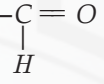
(iii) *Action of heat on aluminium hydroxide.*

(iv) *Reaction of zinc with potassium hydroxide solution.*

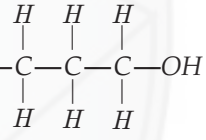
(v) *Action of dilute hydrochloric acid on magnesium sulphite.*

(d) **(i)** *Give the IUPAC name for each of the following :*

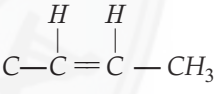
(1)



(2)



(3)



(ii) *Write the structural formula of the two isomers of butane.*

(e) *State one relevant observation for each of the following reactions :* [5]

(i) *Lead nitrate solution is treated with sodium hydroxide solution drop wise till it is in excess.*

(ii) *At the anode, when molten lead bromide is electrolyzed using graphite electrodes.*

(iii) *Lead nitrate solution is mixed with dilute hydrochloric acid and heated.*

(iv) *Anhydrous calcium chloride is exposed to air for some time.*

(v) *Barium chloride solution is slowly added to sodium sulphate solution.*

(f) *Give a reason for each of the following :* [5]

(i) *Ionic compounds have a high melting point.*

(ii) *Inert gases do not form ions.*

(iii) *Ionisation potential increases across a period, from left to right.*

(iv) *Alkali metals are good reducing agents.*

(v) *Conductivity of dilute hydrochloric acid is greater than that of acetic acid.*

(g) *Name the gas that is produced in each of the following cases :* **[5]**

(i) *Sulphur is oxidized by concentrated nitric acid.*

(ii) *Action of dilute hydrochloric acid on sodium sulphide.*

(iii) *Action of cold and dilute nitric acid on copper.*

(iv) *At the anode during the electrolysis of acidified water.*

(v) *Reaction of ethanol and sodium.*

(h) *Fill up the blanks with the correct choice given in brackets :* **[5]**

(i) *Ionic or electrovalent compounds do not conduct electricity in their _____ state.*

(fused/solid)

(ii) *Electrolysis of aqueous sodium chloride solution will form _____ at the cathode.*

(hydrogen gas/sodium metal)

(iii) *Dry hydrogen chloride gas can be collected by_____ displacement of air.*

(downward/upward)

(iv) *The most common ore of iron is_____ .*

(calamine/haematite)

(v) *The salt prepared by the method of direct combination is _____*

(iron (II) chloride/iron (III) chloride).

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) **(i)** *What do you understand by a lone pair of electrons ?* **[3]**

(ii) *Draw the electron dot diagram of hydronium ion. (H =1; O = 8)*

(b) *In Period 3 of the Periodic Table, element **B** is placed to the left of element **A**. On the basis of this information, choose the correct word from the brackets to complete the following statements :* **[3]**

(i) *The element **B** would have (lower/higher) metallic character than **A**.*

(ii) *The element **A** would probably have (lesser/higher) electron affinity than **B**.*

(iii) *The element **A** would have (greater/smaller) atomic size than **B**.*

(c) *Copy and complete the following table which refers to the conversion of ions to neutral particles :* **[4]**

Conversion	*Ionic Equation*	*Oxidation/ Reduction*
Chloride ion to chlorine molecule	*(i) _____*	*(ii) _____*
Lead (II) ion to lead	*(iii) _____*	*(iv) _____*

Question 3.

(a) *(i) Write the balanced chemical equation to prepare ammonia gas in the laboratory by using an alkali.* **[3]**

(ii) State why concentrated sulphuric acid is not used for drying ammonia gas.

(iii) *Why is ammonia gas not collected over water ?*

(b) **(i)** *Name the acid used for the preparation of hydrogen chloride gas in the laboratory. Why is this particular acid preferred to other acids ?* **[3]**

(ii) *Write the balanced chemical equation for the laboratory preparation of hydrogen chloride gas.*

(c) *For the preparation of hydrochloric acid in the laboratory :* **[2]**

(i) *Why is direct absorption of hydrogen chloride gas in water not feasible ?*

(ii) *What arrangement is done to dissolve hydrogen chloride gas in water ?*

(d) *For the electro-refining of copper :* **[2]**

(i) *What is the cathode made up of ?*

(ii) *Write the reaction that takes place at the anode.*

Question 4.

(a) *The percentage composition of a gas is :* **[2]**

Nitrogen 82.35%, Hydrogen 17.64%.

Find the empirical formula of the gas.

[N = 14, H = 1]

(b) *Aluminium carbide reacts with water according to the following equation :* **[4]**

$$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$$

(i) *What mass of aluminium hydroxide is formed from 12 g of aluminium carbide ?*

(ii) *What volume of methane at S.T.P. is obtained from 12 g of aluminium carbide ?*

[Relative molecular weight of Al_4C_3 = 144; $Al(OH)_3$ = 78]

(c) **(i)** *If 150 cc of gas A contains X molecules, how many molecules of gas B will be present in 75 cc of B ?* **[2]**

The gases A and B are under the same conditions of temperature and pressure.

(ii) *Name the law on which the above problem is based.*

(d) *Name the main component of the following alloys :* **[2]**

(i) *Brass*

(ii) *Duralumin*

Question 5.

(a) *Complete the following table which relates to the homologous series of hydrocarbons :* **[6]**

General formula	*IUPAC name of the homologous series*	*Characteristic bond type*	*IUPAC name of the first member of the series*
C_nH_{2n-2}	(A)	(B)	(C) .....
C_nH_{2n+2}	(D)	(E)	(F) .....

(b) **(i)** *Name the most common ore of the metal aluminium from which the metal is extracted. Write the chemical formula of the ore.*

(ii) *Name the process by which impure ore of aluminium gets purified by using concentrated solution of an alkali.*

(iii) *Write the equation for the formation of aluminium at the cathode during the electrolysis of alumina.* **[4]**

Question 6.

(a) *A compound* ***X*** *(having vinegar like smell) when treated with ethanol in the presence of the acid* ***Z****, gives a compound* ***Y*** *which has a fruity smell. The reaction is :*

$$C_2H_5OH + X \xrightarrow{Z} Y + H_2O$$

(i) *Identify* ***Y*** *and* ***Z****.*

(ii) *Write the structural formula of* ***X****.*

(iii) *Name the above reaction.* **[4]**

(b) *Ethane burns in oxygen to form CO_2 and H_2O according to the equation :*

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

If 1250 cc of oxygen is burnt with 300 cc of ethane. Calculate :

(i) *the volume of CO_2 formed.*

(ii) *the volume of unused O_2.* **[4]**

(c) *Three solutions P, Q and R have pH value of 3.5, 5.2 and 12.2 respectively. Which one of these is a :*

(i) *Weak acid ?*

(ii) *Strong alkali ?* **[2]**

Question 7.

(a) *Give a chemical test to distinguish between the following pairs of chemicals :*

(i) *Lead nitrate solution and zinc nitrate solution.*

(ii) *Sodium chloride solution and sodium nitrate solution.* **[4]**

(b) *Write a balanced equation for the preparation of each of the following salts :*

(i) *Copper sulphate from copper carbonate.*

(ii) *Zinc carbonate from zinc sulphate.* **[2]**

(c) **(i)** *What is the type of salt formed when the reactants are heated at a suitable temperature for the preparation of nitric acid ?*

(ii) *State why for the preparation of nitric acid, the complete apparatus is made up of glass.* **[2]**

(d) *Which property of sulphuric acid is shown by the reaction of concentrated sulphuric acid with :*

(i) *Ethanol ?*

(ii) *Carbon ?* **[2]**

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (A) Calcium nitrate

(ii) (D) C_2H_6 [As saturated hydrocarbons undergo substitution reaction.]

(iii) (C) Redox reaction

(iv) (B) Methoxy methane

(v) (C) Vanadium pentoxide

(b) **(i)** Electron affinity

(ii) Ionization

(iii) Catenation

(iv) Efflorescence or Efflorescent

(v) Froth floatation method

(c) **(i)** $C + 2H_2SO_4$ (conc.) $\rightarrow CO_2 + 2SO_2 + 2H_2O$

(ii) $FeCl_3 + 3NaOH \rightarrow \underset{\text{Iron (III) hydroxide}}{Fe(OH)_3} + 3NaCl$

(iii) Aluminium hydroxide on heating decomposes into aluminium oxide along with water.

$$2Al(OH)_3 \rightarrow \underset{\text{Aluminium oxide}}{Al_2O_3} + 3H_2O$$

(iv) Zinc reacts with potassium hydroxide solution to form potassium zincate

$$Zn + 2KOH \rightarrow \underset{\text{Potassium Zincate}}{K_2ZnO_2} + H_2$$

(v) Magnesium sulphite reacts with dilute hydrochloric acid to give magnesium chloride :

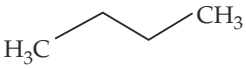
$$MgSO_3 + 2HCl \rightarrow MgCl_2 + H_2O + SO_2\uparrow$$

(d) **(i)** (1) Methanal

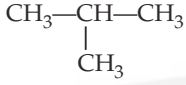
(2) Propan-1-ol

(3) But-2-ene

(ii)



n-Butane



Iso-Butane

(e) **(i)** On dropwise addition of sodium hydroxide solution to lead nitrate solution it first gives a white precipitate and then on adding excess of sodium hydroxide solution, a clear solution is obtained due to formation of sodium plumbate (Na_2PbO_2) which is colourless and soluble.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2\,(\downarrow) + 2NaNO_3$$

$$Pb(OH)_2 + 2NaOH\ (Excess) \longrightarrow Na_2PbO_2$$

(ii) At the anode, when lead bromide is electrolyzed using graphite electrodes following reaction occurs at the anode during electrolysis and red brown vapours are evolved at anode.

$$2Br^- - 2e^- \rightarrow 2Br$$

$$2Br \rightarrow Br_2(\uparrow)$$

(iii) Lead nitrate solution is mixed with dilute hydrochloric acid and heated to give lead chloride and nitric acid :

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2 \downarrow + 2HNO_3$$

Lead chloride is a white precipitate solution in warm water but on heating colourless solution is observed.

(iv) Anhydrous calcium chloride is exposed to air for some time and it absorbs moisture from air as it has a strong affinity for water.

$$CaCl_2 + 2H_2O \rightarrow Ca(OH)_2 + 2HCl$$

(v) Barium chloride solution is slowly added to sodium sulphate solution to obtain white precipitate of barium sulphate :

$$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

(f) **(i)** Ionic compounds have high melting points because the ionic bonds are formed by transfer of electrons which are held by strong electrostatic force of attraction and require a great deal of energy to break the bond.

(ii) Inert gases do not form ions because their outermost shell is complete and they have a stable electronic configuration.

(iii) Ionisation potential increases across a period from left to right because size of atom decreases and effective nuclear charge increases per electron, hence making it difficult to remove electron.

(iv) Alkali metals are good reducing agents because alkali metals have ns^1 outer electron configuration and they achieve the nearest stable configuration by losing one electron, hence they have a great tendency to loose electrons or get oxidized therefore, they are good reducing agents.

(v) Conductivity of dilute hydrochloric acid is greater than that of acetic acid because hydrochloric acid is a strong acid and it dissociates completely in aqueous solution to form H^+ and Cl^- ions (a higher concentration of ions). Acetic acid, on the other hand, is a weak acid and it partially dissociates forming H^+ and CH_3COO^- ions (concentration of ions is low).

(g) **(i)** H_2SO_4 and NO_2 are produced when sulphur reacts with conc. HNO_3.

$$S + 6HNO_3(conc.) \rightarrow H_2SO_4 + 6NO_2\uparrow + 2H_2O$$

(ii) Hydrogen sulphide (H_2S) gas is produced when dilute hydrochloric acid reacts with sodium sulphide.

$$Na_2S(aq) + 2HCl(aq) \rightarrow H_2S(g) + 2NaCl(aq)$$

(iii) NO gas is evolved when cold and dilute nitric acid reacts with copper.

$$3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq)\uparrow + 2NO(g)\downarrow + 4H_2O(l)$$

(iv) Oxygen is evolved at the anode during the electrolysis of acidified water.

$$OH^- - 1e^- \rightarrow OH$$

$$4OH \rightarrow 2H_2O + O_2\uparrow$$

(v) Hydrogen gas is produced during the reaction of ethanol and sodium.

$$C_2H_5OH + Na \rightarrow C_2H_5ONa + \frac{1}{2}\,H_2(g)\uparrow$$

(h) **(i)** solid

(ii) hydrogen gas

(iii) upward (HCl gas is heavy than air)

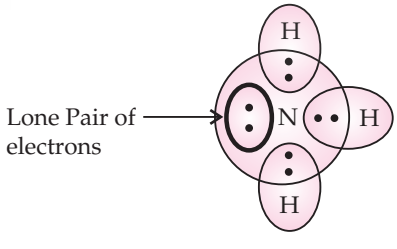
(iv) haematite

(v) iron (III) chloride

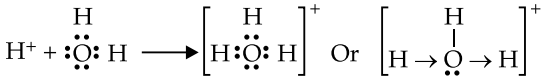
SECTION-II

Answers 2.

(a) **(i)** A lone pair is an electron pair in the outermost shell of an atom that is not shared or bonded to another atom. Below is the example of lone pair on nitrogen atom of ammonia molecule (NH_3).



(ii) Electron dot diagram of hydronium ion :



(b) **(i)** The element **B** would have *higher* metallic character than element **A.**

(ii) The element **A** would have probably *higher* electron affinity than element **B**.

(iii) The element **A** would have *smaller* atomic size than element **B.**

(c)

Conversion	Ionic Equation	Oxidation/ Reduction
Chloride ion to chlorine molecule	(i) $Cl^- - e^- \rightarrow \frac{1}{2} Cl_2(g)$	(ii) Oxidation
Lead(II) ion to lead	(iii) $Pb^{2+} + 2e^- \rightarrow Pb(s)$	(iv) Reduction

Answers 3.

(a) **(i)** Preparation of NH_3 gas using alkali can be done by reacting ammonium sulphate with sodium hydroxide.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4$$

(ii) Concentrated sulphuric acid is not used for drying ammonia gas because concentrated sulphuric acid (H_2SO_4) being acidic in nature reacts with basic ammonia gas to give ammonium sulphate [$(NH_4)_2SO_4$].

(iii) Ammonia gas is not collected over water because it has a high solubility in water and it dissolves in water to give a basic solution.

$$NH_3(g) + H_2O(l) \longrightarrow NH_4^+(aq) + OH^-(aq)$$

(b) **(i)** Conc. sulphuric acid is used for preparation of hydrogen chloride gas in laboratory. This is preferred over other acids because of the following reasons :

1. It has low volatility than HCl gas (so that the produced HCl gas is collected easily).

2. It has dehydrating properties, so the HCl gas produced can be effectively dehydrated to remove traces of water.

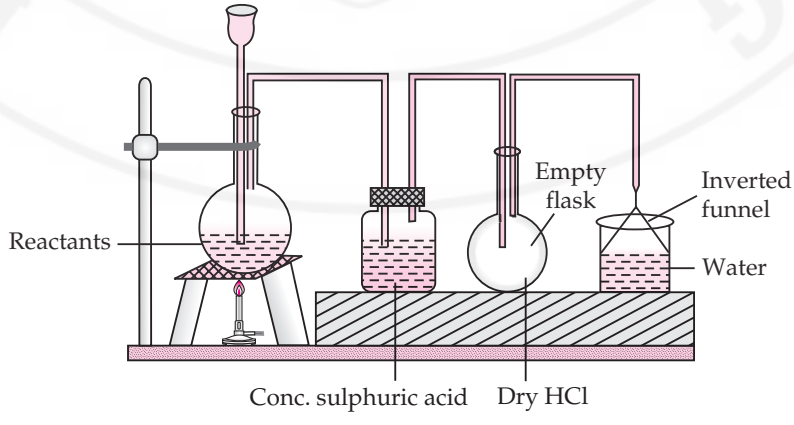
(ii) Laboratory preparation of hydrogen chloride gas can be done by heating NaCl with concentrated sulphuric acid :

$$NaCl + H_2SO_4 \xrightarrow{420\ K\ or\ 200^\circ C} \underset{\text{Sodium hydrosulphate}}{NaHSO_4} + HCl(\uparrow)$$

(conc.)

(c) **(i)** Hydrogen chloride gas is not directly absorbed in water because hydrogen chloride gas is higly soluble in water and causes back suction.

(ii) Hydrogen chloride gas is produced by reacting sodium chloride and sulphuric acid in a reaction vessel, the outlet from the vessel containing hydrogen chloride gas is put into another vessel containing sulphuric acid which helps to obtain dry hydrogen chloride gas. The dry gas then reaches to the vessel containing water through an empty vessel (this empty vessel is kept for accommodation of any back suction of water during absorption of hydrogen chloride gas in water). After travelling the empty vessel, hydrogen chloride gas is introduced to the vessel containing water through a pipe fitted with a funnel at the end and over the water vessel, this ensures maximum surface area for hydrochloric acid gas absorption in water.



(d) **(i)** For electro-refining of copper the cathode is made up of a strip of pure copper metal.

(ii) The reaction taking place at anode (made up of impure copper) is :

$$Cu - 2e^- \longrightarrow Cu^{2+}$$

Answers 4.

(a) Nitrogen : 82.35% and Hydrogen : 17.64%

Element	N	H
Percentage	82.35	17.64
Relative Ratio	82.35/14 = 5.88	17.64/1 = 17.64
Simple Ratio	$\frac{5.88}{5.88} = 1$	$\frac{17.64}{5.88} = 3$

So, the empirical formula of the gas would be NH_3.

(b) **(i)** $Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$

One mole of Al_4C_3 gives 4 moles of $Al(OH)_3$.

i.e., 144 g of Al_4C_3 gives 4×78 g of $Al(OH)_3$

So, 12 g of Al_4C_3 gives $\frac{312 \times 12}{144}$ g of $Al(OH)_3$

$= 26$ g of $Al(OH)_3$.

(ii) One mole of Al_4C_3 gives 3 moles of methane

12 g of Al_4C_3 gives $\frac{48 \times 12}{144}$ g of $CH_4 = 4$ g

Now, 16 g of methane has volume 22.4 L (at STP, the volume of one mole of any gas is 22.4 L)

4 g of methane would occupy 5.6 L.

So, 5.6 L of methane would be obtained from 12 g of Al_4C_3.

(c) **(i)** There will be X/2 molecules of gas B in 75 cc volume.

(ii) The above problem is based on Avogadro's law, which states that :

'Equal volumes of all gases under similar conditions of temperature and pressure contain the same number of molecules.'

(d) **(i)** Main components of brass are copper and zinc.

(ii) Main components of duralumin are aluminium (95%), copper (4%), manganese (0.5%) and magnesium (0.5%).

Answers 5.

(a)

General formula	IUPAC names of the homologous series	Characteristic bond type	IUPAC name of the first member of the series
C_nH_{2n-2}	(A) Alkyne	(B) Triple covalent bond —C ≡ C—	(C) Ethyne
C_nH_{2n+2}	(D) Alkane	(E) Single covalent bond —C—C—	(F) Methane

(b) **(i)** Most common ore of aluminium metal is bauxite, $Al_2O_3.2H_2O$.

(ii) The process by which impure ore of aluminium gets purified by using concentrated solution of an alkali is known as 'Baeyer's process'.

$$Al_2O_3.\ 2H_2O + 2NaOH \rightarrow 2NaAlO_2 + 3H_2O$$

(iii) During electrolysis of alumina, the cathode reaction is :

$$Al^{3+}\ (melt) + 3e^- \rightarrow Al\ (Pure\ Al)$$

Answers 6.

(a) **(i)** Compound X is acetic acid (CH_3COOH) as it has vinegar like smell. Compound Y is a ester *i.e.*, $CH_3COOC_2H_5$ ethyl ethanoate.

Z is a protic acid for example HCl (aq) or conc. H_2SO_4.

(ii) The structural formula of X is CH_3COOH acetic acid.

(iii) The above reaction is known as 'Esterification' reaction.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Acetic acid}}{CH_3COOH} \xrightarrow[\text{Esterification}]{H_3O^+} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5}$$

(b) The given equation is :

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

(i) So, according to above equation, 2 V (volumes) of ethane reacts to give 4 V of carbon dioxide. So, 300 cc of ethane would give 600 cc of carbon dioxide.

(ii) Also, 2 V (volumes) of ethane reacts with 7 V of oxygen.

300 cc of ethane is 2 V, so oxygen required for 300 cc of ethane is

$$\frac{300 \times 7}{2} = 1050 \text{ cc}$$

The remaining oxygen would be :

1250 cc – 1050 cc = 200 cc

(c) **(i)** Solution Q is a weak acid as its pH is 5.2

(ii) Solution R is a strong alkali as its pH is 12.2.

Answers 7.

(a) **(i)** Add aqueous hydrochloric acid solution to the solution of lead nitrate and solution of zinc nitrate prepared separately. The solution of lead nitrate would give a white precipitate of $PbCl_2$ whereas there would be no precipitate formed with zinc nitrate solution.

$$Pb^{2+} + 2\,Cl^- \rightarrow PbCl_2(\downarrow)$$

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2(\downarrow) + 2HNO_3$$

$$Zn(NO_3)_2 + 2HCl \rightarrow ZnCl_2 + 2HNO_3$$

(ii) Add aqueous solution of silver nitrate ($AgNO_3$) to the solution of sodium chloride and solution of sodium nitrate prepared separately. The solution of sodium chloride would give a white precipitate of AgCl whereas there would be no precipitate only colourless solution is formed with sodium nitrate solution.

(b) **(i)** Preparation of copper sulphate from copper carbonate can be done by reacting copper carbonate with sulphuric acid.

$$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + CO_2\uparrow + H_2O$$

(ii) Zinc carbonate from zinc sulphate can be prepared by reacting zinc sulphate with sodium carbonate.

$$ZnSO_4 + Na_2CO_3 \rightarrow ZnCO_3 + Na_2SO_4$$

(c) **(i)** Sodium sulphate is formed if the reactants (sulphuric acid and sodium nitrate) for the preparation of nitric acid are heated above 200°C. The sodium sulphate formed deposits as a hard crust and is difficult to remove.

$$NaNO_3 + NaHSO_4 \xrightarrow{200^\circ C} Na_2SO_4 + HNO_3$$

(ii) All glass apparatus should be used while preparing nitric acid as the nitric acid vapours are highly corrosive and they corrode the cork or rubber fittings used in the apparatus.

(d) **(i)** Reaction of concentrated sulphuric acid with ethanol leads to formation of ethene, which shows that it is dehydrating in nature.

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[\text{Dehydration}]{H_2SO_4} \underset{\text{Ethene}}{C_2H_4} + H_2O$$

(ii) Reaction of concentrated sulphuric acid with carbon shows its oxidizing nature, where it oxidizes carbon to carbon dioxide.

$$C + 2H_2SO_4 \rightarrow CO_2 + 2H_2O + 2SO_2$$

CHEMISTRY 2017

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Fill in the blanks with the choices given in brackets.* **[5]**

(i) *The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion is called _____.*
(electron affinity, ionisation potential, electronegativity)

(ii) *The compound that does not have a lone pair of electrons is _____ .*
(water, ammonia, carbon tetra chloride).

(iii) *When a metallic oxide is dissolved in water, the solution formed has a high concentration of _____ ions.* *(H^+, H_3O^+, OH^-).*

(iv) *Potassium sulphite on reacting with hydrochloric acid releases _____ gas.*
(Cl_2, SO_2, H_2S).

(v) *The compound formed when ethene reacts with hydrogen is _____ .* *(CH_4, C_2H_6, C_3H_8).*

(b) *Choose the correct answer from the options given below :* **[5]**

(i) *A chloride which forms a precipitate that is soluble in excess of ammonium hydroxide, is :*
(A) Calcium chloride *(B) Ferrous chloride*
(C) Ferric chloride *(D) Copper chloride*

(ii) *If the molecular formula of an organic compound is $C_{10}H_{18}$ it is :*
(A) alkene *(B) alkane*
(C) alkyne *(D) not a hydrocarbon*

(iii) *Which of the following is a common characteristic of a covalent compound ?*
(A) high melting point
(B) consists of molecules
(C) always soluble in water
(D) conducts electricity when it is in the molten state

(iv) *To increase the pH value of neutral solution, we should add :*
(A) an acid *(B) an acid salt*
(C) an alkali *(D) a salt*

(v) *Anhydrous iron (III) chloride is prepared by :*
(A) direct combination
(B) simple displacement
(C) decomposition
(D) neutralization

(c) *Identify the substance underlined, in each of the following cases :* **[5]**

(i) *Cation that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide.*

(ii) *The electrolyte used for electroplating an article with silver.*

(iii) *The particles present in a liquid such as kerosene, that is a non-electrolyte.*

(iv) *An organic compound containing —COOH functional group.*

(v) *A solid formed by reaction of two gases, one of which is acidic and the other basic in nature.*

(d) *Write a balanced chemical equation for each of the following :* **[5]**

(i) *Action of cold and dilute nitric acid on copper.*

(ii) *Reaction of ammonia with heated copper oxide.*

(iii) *Preparation of methane from iodomethane.*

(iv) *Action of concentrated sulphuric acid on sulphur.*

(v) *Laboratory preparation of ammonia from ammonium chloride.*

(e) *State one relevant observation for each of the following reactions :* **[5]**

(i) *Addition of ethyl alcohol to acetic acid in the presence of concentrated sulphuric acid.*

(ii) *Action of dilute hydrochloric acid on iron (II) sulphide.*

(iii) *Action of sodium hydroxide solution on ferrous sulphate solution.*

(iv) *Burning of ammonia in air.*

(v) *Action of concentrated sulphuric acid on hydrate copper sulphate.*

(f) **(i)** *Draw the structural formula for each of the following :*
1. 2, 3-dimethyl butane
2. diethyl ether
3. propanoic acid

(ii) *From the list of terms given, choose the most appropriate term to match the given description.*

(calcination, roasting, pulverisation, smelting).

1. Crushing of the ore into a fine powder.

2. Heating of the ore in the absence of air to a high temperature. **[5]**

(g) **(i)** *Calculate the number of gram atoms in 4.6 grams of sodium (Na = 23).*

(ii) *Calculate the percentage of water of crystalization in $CuSO_4.5H_2O$*

(H = 1, O = 16, S = 32, Cu = 64)

(iii) *A compound of X and Y has the empirical formula XY_2. Its vapour density is equal to its empirical formula weight. Determine its molecular formula.* **[5]**

(h) *Match the atomic number 2, 4, 8, 15 and 19 with each of the following :*

(i) *A solid non-metal belonging to the third period.*

(ii) *A metal of valency 1.*

(iii) *A gaseous element with valency 2.*

(iv) *An element belonging to Group 2.*

(v) *A rare gas.* **[5]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Arrange the following as per the instruction given in the brackets :* **[4]**

(i) *He, Ar, Ne (Increasing order of the number of electron shells)*

(ii) *Na, Li, K (Increasing Ionisation Energy)*

(iii) *F, Cl, Br (Increasing electronegativity)*

(iv) *Na, K, Li (Increasing atomic size)*

(b) *State the type of Bonding in the following molecules :* **[2]**

(i) *Water* **(ii)** *Calcium oxide*

(c) *Answer the following questions :* **[2]**

(i) *How will you distinguish between ammonium hydroxide and sodium hydroxide using copper sulphate solution ?*

(ii) *How will you distinguish between dilute hydrochloric acid and dilute sulphuric acid using lead nitrate solution ?*

(d) *Identify the salts P and Q from the observations given below :* **[2]**

(i) *On performing the flame test salt P produces a lilac coloured flame and its solution gives a white precipitate with silver nitrate solution, which is soluble in Ammonium hydroxide solution.*

(ii) *When dilute HCl is added to salt Q, a brisk effervescence is produced and the gas turns lime water milky.*

When NH_4OH solution is added to the above mixture (after adding dilute HCl), it produces a white precipitate which is soluble in excess NH_4OH solution.

Question 3.

(a) *Draw an electron dot diagram to show the formation of each of the following compounds :* **[4]**

(i) *Methane*

(ii) *Magnesium Chloride*

[H = 1, C = 6, Mg = 12, Cl = 17]

(b) *State the observations at the anode and at the cathode during the electrolysis of :* **[4]**

(i) *fused lead bromide using graphite electrodes.*

(ii) *copper sulphate solution using copper electrodes.*

(c) *Select the ion in each case, that would get selectively discharged from the aqueous mixture of the ions listed below :* **[2]**

(i) *SO_4^{2-}, NO_3^- and OH^-*

(ii) *Pb^{2+}, Ag^+ and Cu^{2+}*

Question 4.

(a) *Certain blank spaces are left in the following table and these are labelled as A, B, C, D and E. Identify each of them :* **[5]**

	Lab preparation of	*Reactants used*	*Products formed*	*Drying agent*	*Method of collection*
(i)	*HCl gas*	*$NaCl + H_2SO_4$*	*A*	*conc. H_2SO_4*	*B*
(ii)	*NH_3 gas*	*C*	*$Mg(OH)_2 + NH_3$*	*D*	*E*

(b) *Write balanced chemical equations to show :* **[3]**

(i) *The oxidizing action of conc. Sulphuric acid on Carbon.*

(ii) *The behavior of H_2SO_4 as an acid when it reacts with magnesium.*

(iii) *The dehydrating property of conc. Sulphuric acid with sugar.*

(c) *Write balanced chemical equations to show how SO_3 is converted to sulphuric acid in the contact process.* **[2]**

Question 5.

(a) **(i)** *Propane burns in air according to the following equation :*

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O.$$ **[4]**

What volume of propane is consumed on using 1000 cm^3 of air, considering only 20% of air contains oxygen ?

(ii) *The mass of 11.2 litre of a certain gas at S.T.P. is 24 g. Find the gram molecular mass of the gas.*

(b) *A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :* **[4]**

(i) *Find the number of moles of hydrogen present.*

(ii) *What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure ? (H = 1, C = 12, O = 16)*

(iii) *If the number of molecules of hydrogen in the cylinder is X, calculate the number of CO_2 molecules in the cylinder under the same conditions of temperature and pressure.*

(iv) *State the law that helped you to arrive at the above result.*

(c) *Write a balanced chemical equation for the preparation of each of the following salts :* **[2]**

(i) *Copper carbonate*

(ii) *Ammonium sulphate crystals*

Question 6.

(a) *Give a balanced chemical equation for each of the following :* **[4]**

(i) *Action of conc. nitric acid on sulphur.*

(ii) *Catalytic oxidation of ammonia.*

(iii) *Laboratory preparation of nitric acid.*

(iv) *Reaction of ammonia with nitric acid.*

(b) *Identify the term or substance based on the descriptions given below :* **[4]**

(i) *Ice like crystals formed on cooling an organic acid sufficiently.*

(ii) *Hydrocarbon containing a triple bond used for welding purposes.*

(iii) *The property by virtue of which the compound has the same molecular formula but different structural formulae.*

(iv) *The compound formed where two alkyl groups are linked by* $-\overset{\overset{O}{\|}}{C}-$ *group.*

(c) *Give a balanced chemical equation for each of the following :* **[3]**

(i) *Preparation of ethane from sodium propionate.*

(ii) *Action of alcoholic KOH on bromoethane.*

Question 7.

(a) *Name the following :* **[4]**

(i) *The process of coating of iron with zinc.*

(ii) *An alloy of lead and tin that is used in electrical circuits.*

(iii) *An ore of zinc containing its sulphide.*

(iv) *A metal oxide that can be reduced by hydrogen.*

(b) *Answer the following questions with respect to the electrolytic process in the extraction of aluminium :* **[3]**

(i) *Identify the components of the electrolyte other than pure alumina and the role played by each.*

(ii) *Explain why powdered coke is sprinkled over the electrolytic mixture.*

(c) *Complete the following by selecting the correct option from the choices given :* **[3]**

(i) *The metal which does not react with water or dilute H_2SO_4 but reacts with concentrated H_2SO_4 is————. (Al/Cu/Zn/Fe)*

(ii) *The metal whose oxide, which is amphoteric, is reduced to metal by carbon reduction————. (Fe/Mg/Pb/Al)*

(iii) *The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is————. (Al/Na/Mg/K)*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion is called **ionisation potential**.

(ii) The compound that does not have a lone pair of electron is **carbon tetrachloride.**

(iii) When a metallic oxide is dissolved in water, the solution formed has a high concentration of $\mathbf{OH^-}$ ions.

(iv) Potassium sulphite on reacting with hydrochloric acid releases $\mathbf{SO_2}$ gas.

(v) The compound formed when ethene reacts with hydrogen is $\mathbf{C_2H_6}$.

(b) **(i)** (D) Copper chloride

(ii) (C) Alkyne

(iii) (B) Consists of molecules

(iv) (C) An alkali

(v) (A) Direct combination

(c) **(i)** **Cation** that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide — $\mathbf{Ca^{2+}}$

(ii) The **electrolyte** used for electroplating an article with silver — **Solution of sodium argentocyanide** *i.e.*, **$Na[Ag(CN)_2]$**

(iii) The **particles** present in a liquid such as kerosene, that is a non-electrolyte — **Free Molecules**

(iv) An **organic compound** containing — COOH functional group — **Carboxylic acid**

(v) A **solid** formed by reaction of two gases, one of which is acidic and the other basic in nature — **Ammonium chloride** (NH_4Cl) (formed by combining vapours of ammonia with hydrogen chloride gas)

(d) **(i)** Copper reacts with cold and dilute nitric acid to form copper nitrate, water and nitric oxide.

$$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO\uparrow$$

Copper; Nitric acid; Copper nitrate; Nitric oxide

(ii) $3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$

Copper oxide; Ammonia

(iii) $CH_3I + 2H \xrightarrow[\text{Alcohol}]{Zn/Cu} CH_4 + HI$

Methane

(iv) $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

(v) $2NH_4Cl + Ca(OH)_2 \xrightarrow{Heat} CaCl_2 + 2NH_3 + 2H_2O$

(e) **(i)** Ethanoic or acetic acid reacts with ethanol in the presence of concentrated sulphuric acid to produce the ester, ethyl ethanoate having a fruity smell and turns blue litmus paper red.

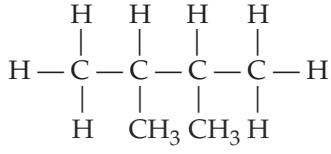
(ii) Iron sulphide reacts with hydrochloric acid, releasing a highly toxic gas hydrogen sulphide having rotten egg smell and turns blue litmus paper red.

(iii) A dirty green precipitate of ferrous hydroxide is formed which is insoluble in excess of NaOH solution.

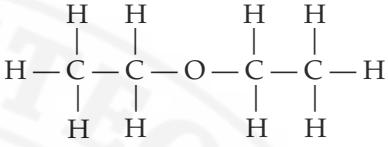
(iv) Ammonia burns in air to form greenish-yellow vapours of nitric oxide.

(v) The blue crystals are changed into white powder as water is removed. Concentrated sulphuric acid takes away the water molecules and the copper sulphate becomes anhydrous.

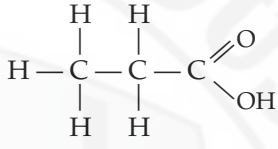
(f) **(i)** **1.** 2, 3-dimethyl butane



2. Diethyl ether



3. Propanoic acid



(ii) **1.** Pulverisation

2. Calcination

(g) **(i)** 1 g atom is the mass of 1 mole of monoatomic element.

1 mole of Na is equal to 23 g atom of Na.

23 g of Na = 1 mole of Na

4.6 g of Na = $4.6 \times 1/23 = 0.2$ mole

So, number of gram atoms

$= 0.2 \times 6.022 \times 10^{23}$ atoms

$= 1.204 \times 10^{23}$ atoms

(ii) Molar mass of $CuSO_4.5H_2O$

$= [64 + 32 + (16 \times 4) + 5(2 \times 1 + 16)]$

$= 250$

Mass of water of crystallisation

$= 5(2 \times 1 + 16) = 90$

$\therefore$ Percentage of water of crystallisation

$$= \frac{90}{250} \times 100 = 36\%$$

(iii) Molecular weight = 2 × Vapour density

= 2 × Empirical formula weight

(Given, Vapour density

= empirical formula weight)

Also,

Molecular Weight = Empirical formula weight × n

Therefore, 2 × Empirical formula weight

= Empirical formula weight × n

$n = 2$

Now, Molecular Formula

= (Empirical Formula) × n

$= (XY_2)_2$

$= X_2Y_4$

(h) **(i)** Z = 15 **(ii)** Z = 19
(iii) Z = 8 **(iv)** Z = 4
(v) Z = 2

SECTION-II

Answer 2.

(a) **(i)** He < Ne < Ar **(ii)** K < Na < Li
(iii) Br < Cl < F **(iv)** Li < Na < K

(b) **(i)** Covalent bonding
(ii) Ionic or electrovalent bonding

(c) **(i)** When ammonium hydroxide solution is added drop by drop to copper sulphate solution, a pale blue or bluish white precipitate is formed which is soluble in excess of ammonium hydroxide and a deep blue or inky blue solution is formed with excess of ammonium hydroxide.

$$CuSO_4 + 2NH_4OH \rightarrow Cu(OH)_2\downarrow + (NH_4)_2SO_4$$

$$Cu(OH)_2 + 4NH_4OH \rightarrow [Cu(NH_3)_4](OH)_2 + 4H_2O$$

Copper solution forms a blue precipitate with sodium hydroxide solution. It is insoluble in excess of NaOH.

$$\underset{\text{Copper sulphate}}{CuSO_4} + \underset{\text{Sodium hydroxide}}{2NaOH} \rightarrow \underset{\text{Copper hydroxide}}{Cu(OH)_2} + \underset{\text{Sodium sulphate}}{Na_2SO_4}$$

(ii) On adding lead nitrate to both acids, we will get a white precipitate. On heating the solution, the one whose precipitate will redissolve will be dil. HCl and the one with insoluble precipitate will be dil. H_2SO_4.

Actually on adding lead nitrate to HCl, $PbCl_2$ precipitates out and on heating the solution it redissolves. But in case of H_2SO_4, $PbSO_4$ is formed which is insoluble even on heating it and white in colour.

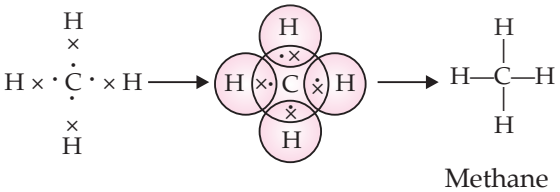
$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{2HCl} \longrightarrow PbCl_2 + 2HNO_3$$

$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{H_2SO_4} \longrightarrow PbSO_4 + 2HNO_3$$

(d) **(i)** Potassium chloride **(ii)** Zinc carbonate

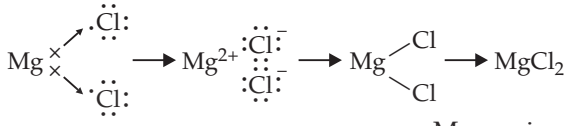
Answer 3.

(a) **(i)**



Methane

(ii) Magnesium chloride



Magnesium chloride

(b) **(i)** At anode, the Br^- ion gives up electrons. Red brown bromine gas bubbles can be seen. At cathode, the Pb^{2+} ion accepts electrons. The electrolysis of lead bromide using graphite electrodes produces lead metal at the cathode as silvery grey deposits and bromine gas at the anode.

At the cathode : $Pb^{2+} + 2e^- \rightarrow Pb$

At the anode : $2Br^- - 2e^- \rightarrow 2Br$

$2Br \rightarrow Br_2\uparrow$

(ii) At the cathode, Cu^{2+} ions are discharged and deposited on the cathode. At the anode, however, copper ions go into solution in preference to the discharge of either OH^- or SO_4^{2-} ions. As the electrolysis continues, the cathode increases in thickness by reddish brown deposit of copper while the anode slowly dissolves away.

At the cathode : $Cu^{2+} + 2e^- \rightarrow Cu$

At the anode : $Cu - 2e^- \rightarrow Cu^{2+}$

(c) **(i)** OH^- ions **(ii)** Ag^+ ions

Answer 4.

(a) **(i)** **(A)** $NaHSO_4 + HCl$
(B) Upward displacement of air
(ii) **(C)** $Mg_3N_2 + H_2O$
(D) CaO
(E) Downward displacement of air.

(b) **(i)** $C + 2H_2SO_4 \longrightarrow CO_2\uparrow + 2SO_2\uparrow + 2H_2O$

(ii) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2\uparrow$

(iii) $C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O$
(Cane sugar)

(c) **1.** Conversion of sulphur trioxide into sulphuric acid :

$$\underset{\text{Sulphur trioxide}}{SO_3} + \underset{\text{(conc.)}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

2. Dilution of oleum :

$$\underset{\text{Oleum}}{H_2S_2O_7} + H_2O \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

Answer 5.

(a) **(i)** For every 5 moles of O_2, 1 mole of propane is burnt.

20% of 1000 = $20 \times 1000/100 = 200\ cm^3$ of O_2.

$$\left(\frac{1}{5} \times 200\right)\ cm^3 = 40\ cm^3$$

Thus, volume of propane = $40\ cm^3$

(ii) Mass of gas = 24 g

Volume of gas = 11.6 litre

22.4 L of gas at STP = 1 mole

11.2 L of gas at STP = 11.2 / 22.4 = 0.5 moles

Mass of 0.5 moles of gas = 24 g

Mass of 1 mole of gas or molar mass = 24/0.5

= 48 g

(b) **(i)** 1 kg = 1000 gram

2 g of hydrogen molecules = 1 mole

1 g of hydrogen molecules = 1/2 mole

1000 g of hydrogen molecules = $1/2 \times 1000$

= 500 moles

(ii) Molecular weight of carbon dioxide = 44 g

Vapour density = $\frac{44}{2} = 22$

Now, Vapour density

$$= \frac{\text{Weight of carbon dioxide at cetain temperature}}{\text{Weight of same volume of hydrogen at same temperature and pressure}}$$

22 = Weight of carbon dioxide / 1 kg

Weight of carbon dioxide = 22 kg

(iii) If the number of molecules of hydrogen is X, then number of molecules of carbon dioxide will also be X.

(iv) This is according to the ***Avoqadro's Law*** which states that "Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules."

(c) **(i)** $CuCl_2 + NaCO_3 \longrightarrow CuCO_3 + 2NaCl$

(ii) $2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O$

Answer 6.

(a) **(i)** $S(s) + 6HNO_3(aq) \rightarrow 2H_2O(l) +$

Sulphur, Nitric acid, Water

$H_2SO_4(aq) + 6NO_2(g)$

Sulphuric acid, Nitrogen dioxide

(ii) The equation for catalytic oxidation of ammonia is :

$$4NH_3 + 5O_2 \xrightarrow[700-800°C]{Pt} 4NO + 6H_2O + Heat$$

Ammonia — Nitric oxide

Catalyst is a wire mesh consisting of platinum and rhodium.

(iii) $KNO_3(s) + H_2SO_4(l) \rightarrow HNO_3(l)$

Potassium nitrate, Conc. Sulphuric acid, Nitric acid

$+ KHSO_4(s)$ $(T < 200°C)$

Potassium hydrogen sulphate

(iv) Ammonia reacts with nitric acid to produce ammonium nitrate

$NH_{3(g)} + HNO_{3(aq)} \rightarrow NH_4NO_{3(s)}$

Ammonia, Nitric acid, Ammonium nitrate

(b) **(i)** Glacial acetic acid

(ii) Acetylene or ethyne

(iii) Isomerism **(iv)** Ketone

(c) **(i)** $C_2H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_2H_6 + Na_2CO_3$

Sodium propionate, Sodium hydroxide, Ethane, Sodium carbonate

(ii) $CH_3CH_2Br + \text{alc. } KOH \xrightarrow{\Delta} C_2H_4 + KBr + H_2O$

Bromo ethane, Ethene, Potassium Bromide

Answer 7.

(a) **(i)** Galvanization

(ii) Solder or fuse metal

(iii) Zinc blende

(iv) Copper oxide

(b) **(i)** The electrolyte is a solution of aluminium oxide (Al_2O_3) dissolved in cryolite (sodium hexafluoroaluminate(III), Na_3AlF_6). The use of cryolite reduces the melting point of alumina and fluorspar increases the conductivity of solution.

(ii) To prevent the heat loss due to radiation from molten electrolyte. It also prevents carbon anode from burning in air.

(c) **(i)** The metal which does not react with water or dilute H_2SO_4 but reacts with concentrated H_2SO_4 is **Cu**.

(ii) The metal whose oxide, which is amphoteric, is reduced to metal by carbon reduction **Pb.**

(iii) The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is **Mg**.

CHEMISTRY 2016

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Fill in the blanks with the choices given in brackets.* **[5]**

(i) *Metals are good _____ .*
(oxidizing agents/ reducing agents)
because they are electron_____ .
(acceptors/donors).

(ii) *Electrovalent compounds have _____ (high/ low) melting points.*

(iii) *Higher the pH value of a solution, the more _____ (acidic/ alkaline) it is.*

(iv) *_____(AgCl/$PbCl_2$), a white precipitate is soluble in excess NH_4OH.*

(v) *Conversion of ethene to ethane is an example of _____ .* *(hydration/hydrogenation)*

(b) *Choose the correct answer from the options given below :* **[5]**

(i) *An element with the atomic number 19 will most likely combine chemically with the element whose atomic number is :*

(A) 17 *(B) 11*
(C) 18 *(D) 20*

(ii) *The ratio between the number of molecules in 2 g of hydrogen and 32 g of oxygen is :*

(A) 1 : 2
(B) 1 : 0.01
(C) 1 : 1
(D) 0·01 : 1 [Given that H = 1, O = 16]

(iii) *The two main metals in bronze are :*

(A) Copper and zinc *(B) Copper and lead*
(C) Copper and nickel *(D) Copper and tin*

(iv) *The particles present in strong electrolytes are :*

(A) only molecules *(B) mainly ions*
(C) ions and molecules *(D) only atoms*

(v) *The aim of the fountain experiment is to prove that :*

(A) HCl turns blue litmus red
(B) HCl is denser than air
(C) HCl is highly soluble in water
(D) HCl fumes in moist air

(c) *Write balanced chemical equations for each of the following :* **[5]**

(i) *Action of warm water on AlN.*

(ii) *Action of hot and concentrated nitric acid on copper.*

(iii) *Action of hydrochloric acid on sodium bicarbonate.*

(iv) *Action of dilute sulphuric acid on sodium sulphite.*

(v) *Preparation of ethanol from ethyl chloride.*

(d) *State your observations when :* **[5]**

(i) *Dilute hydrochloric acid is added to lead nitrate solution and the mixture is heated.*

(ii) *Barium chloride solution is mixed with sodium sulphate solution.*

(iii) *Concentrated sulphuric acid is added to sugar crystals.*

(iv) *Dilute hydrochloric acid is added to copper carbonate.*

(v) *Dilute hydrochloric acid is added to sodium thiosulphate.*

(e) *Identify the term/substance in each of the following :* **[5]**

(i) *The tendency of an atom to attract electrons to itself when combined in a compound.*

(ii) *The method used to separate ore from gangue by preferential wetting.*

(iii) *The catalyst used in the conversion of ethyne to ethane.*

(iv) *The type of reactions alkenes undergo.*

(v) *The electrons present in the outermost shell of an atom.*

(f) **(i)** *A gas of mass 32 gm has a volume of 20 litre at S.T.P. Calculate the gram molecular weight of the gas.* **[5]**

(ii) *How much calcium oxide is formed when 82 g of calcium nitrate is heated ? Also find the volume of nitrogen dioxide evolved :*

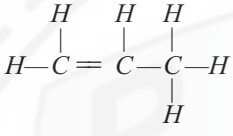
$$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$$

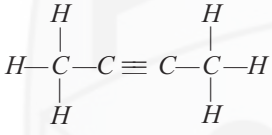
(Ca = 40, N = 14, O = 16)

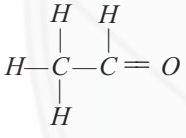
(g) *Match the salts given in column I with their method of preparation given in column II :* **[5]**

Column I		Column II	
(i)	$Pb(NO_3)_2$ from PbO	(A)	Simple displacement
(ii)	$MgCl_2$ from Mg	(B)	Titration
(iii)	$FeCl_3$ from Fe	(C)	Neutralization
(iv)	$NaNO_3$ from NaOH	(D)	Precipitation
(v)	$ZnCO_3$ from $ZnSO_4$	(E)	Combination

(h) **(i)** *Write the IUPAC names of each of the following :* **[5]**

1. 

2. 

3. 

(ii) *Rewrite the following sentences by using the correct symbol > (greatert than) or < (less than) in the blanks given :*

1. *The ionization potential of potassium is ——— that of sodium.*

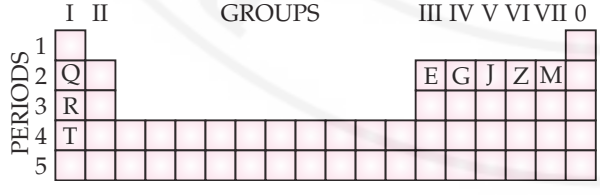
2. *The electronegativity of iodine is ——— that of chlorine.*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Use the letters only written in the Periodic Table given below to answer the questions that follow :* **[4]**



(i) *State the number of valence electrons in atom J.*

(ii) *Which element shown forms ions with a single negative charge ?*

(iii) *Which metallic element is more reactive than R ?*

(iv) *Which element has its electrons arranged in four shells ?*

(b) *Fill in the blanks by selecting the correct word from the brackets :* **[2]**

(i) *If an element has a low ionization energy then it is likely to be——— (metallic/non-metallic).*

(ii) *If an element has seven electrons in its outermost shell then it is likely to have the ——— (largest/smallest) atomic size among all the elements in the same period.*

(c) *The following table shows the electronic configuration of the elements W, X, Y, Z :*

Element	W	X	Y	Z
Electronic configurations	2, 8, 1	2, 8, 7	2, 5	1

Answer the following questions based on the table above :

(i) *What type of Bond is formed between :* **[2]**

1. *W and X* 2. *Y and Z*

(ii) *What is the formula of the compound formed between :* **[2]**

1. *X and Z* 2. *W and X*

Question 3.

(a) *Write a balanced chemical equation for each of the following :* **[3]**

(i) *Burning of ethane in plentiful supply of air.*

(ii) *Action of water on calcium carbide.*

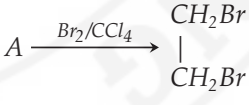
(iii) *Heating of ethanol at 170°C in the presence of conc. sulphuric acid.*

(b) *Give the structural formulae of each of the following :* **[3]**

(i) *2-methyl propane* **(ii)** *Ethanoic acid*

(iii) *Butan-2-o1*

(c) *Equation for the reaction when compound A is bubbled through bromine dissolved in carbon tetrachloride is as follows :* **[2]**



(i) *Draw the structure of A.*

(ii) *State your observation during this reaction.*

(d) *Fill in the blanks using the appropriate words given below :* **[2]**

(Sulphur dioxide, Nitrogen dioxide, Nitric oxide, Sulphuric acid)

(i) *Cold, dilute nitric acid reacts with copper to give ———.*

(ii) *Hot, concentrated nitric acid reacts with sulphur to form ———.*

Question 4.

(a) *Identify the gas evolved and give the chemical test in each of the following cases :* **[2]**

(i) *Dilute hydrochloric acid reacts with sodium sulphite.*

(ii) *Dilute hydrochloric acid reacts with iron (II) sulphide.*

(b) *State your observations when ammonium hydroxide solution is added drop by drop and then in excess to each of the following solutions :* **[2]**

(i) *Copper sulphate solution.*

(ii) *Zinc sulphate solution.*

(c) *Write equations for the reactions taking place at the two electrodes (mentioning clearly the name of the electrode) during the electrolysis of :* **[4]**

(i) *Acidified copper sulphate solution with copper electrodes.*

(ii) *Molten lead bromide with inert electrodes.*

(d) **(i)** *Name the product formed at the anode during the electrolysis of acidified water using platinum electrodes.* **[2]**

(ii) *Name the metallic ions that should be present in the electrolyte when an article made of copper is to be electroplated with silver.* **[2]**

Question 5.

(a) *A gas cylinder contains* 12×10^{24} *molecules of oxygen gas.*

If Avogadro's number is 6×10^{23}*. Calculate :* **[2]**

(i) *The mass of oxygen present in the cylinder.*

(ii) *The volume of oxygen at S.T.P. present in the cylinder.* *[O = 16]*

(b) *A gaseous hydrocarbon contains 82.76% of carbon. Given that its vapour density is 29, find its molecular formula. [C = 12, H = 1]* **[3]**

(c) *The equation* $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$*, represents the catalytic oxidation of ammonia. If 100* cm^3 *of ammonia is used, calculate the volume of oxygen required to oxidise the ammonia completely.* **[3]**

(d) *By drawing an electron dot diagram show the formation of Ammonium Ion [Atomic No. : N = 7 and H = 1]* **[2]**

Question 6.

(a) *Name the gas evolved when the following mixtures are heated :* **[2]**

(i) *Calcium hydroxide and ammonium chloride.*

(ii) *Sodium Nitrite and ammonium chloride.*

(b) *Write balanced chemical equations for each of the following :* **[2]**

(i) *When excess of ammonia is treated with chlorine.*

(ii) *An equation to illustrate the reducing nature of ammonia.*

(c) *A, B, C and D summarize the properties of sulphuric acid depending on whether it is dilute or concentrated.* **[3]**

A = Typical acid property B = Non-volatile acid

C = Oxidizing agent D = Dehydrating agent

Choose the property (A, B, C or D) depending on which is relevant to each of the following :

(i) *Preparation of hydrogen chloride gas.*

(ii) *Preparation of copper sulphate from copper oxide.*

(iii) *Action of conc. sulphuric acid on sulphur.*

(d) *Give reasons why :* **[3]**

(i) *Sodium chloride will conduct electricity only in fused or aqueous solution state.*

(ii) *In the electroplating of an article with silver, the electrolyte sodium argento-cyanide solution is preferred over silver nitrate solution.*

(iii) *Although copper is a good conductor of electricity, it is a non-electrolyte.*

Question 7.

(a) **(i)** *Name the solution used to react with Bauxite as a first step in obtaining pure aluminium oxide, in the Baeyer's process.* **[5]**

(ii) *Write the equation for the reaction where the aluminium oxide for the electrolytic extraction of aluminium is obtained by heating aluminium hydroxide.*

(iii) *Name the compound added to pure alumina to lower the fusion temperature during the electrolytic reduction of alumina.*

(iv) *Write the equation for the reaction that occurs at the cathode during the extraction of aluminium by electrolysis.*

(v) *Explain why it is preferable to use a number of graphite electrodes as anode instead of a single electrode, during the above electrolysis.*

(b) *State what would you observe when :* **[2]**

(i) *Washing soda crystals are exposed to the atmosphere.*

(ii) *The salt ferric chloride is exposed to the atmosphere.*

(c) *Identify the cations in each of the following case :* **[3]**

(i) *NaOH solution when added to the solution (A) gives a reddish brown precipitate.*

(ii) NH_4OH *solution when added to the solution (B) gives white ppt. which does not dissolve in excess.*

(iii) *NaOH solution when added to solution (C) gives white ppt. which is insoluble in excess.*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Reducing agents, donors
(ii) High
(iii) Alkaline
(iv) AgCl
(v) Hydrogenation

(b) **(i)** (A) 17
(ii) (C) 1 : 1
(iii) (D) Copper and tin
(iv) (B) Mainly ions
(v) (C) HCl is highly soluble in water.

(c) **(i)** $AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3\uparrow$
Ammonia gas

(ii) $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2\uparrow + 2H_2O$

(iii) $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2\uparrow$

(iv) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

(v) $C_2H_5Cl + KOH \xrightarrow{\Delta} C_2H_5OH + KCl$

(d) **(i)** When dilute hydrochloric acid is added to lead nitrate and the mixture is heated, insoluble white precipitate of lead chloride is formed but is soluble on heating.

$$Pb(NO_3)_2 + 2HCl \xrightarrow{\Delta} 2HNO_3 + PbCl_2\downarrow$$
(white ppt.)

(ii) When barium chloride is added to sodium sulphate, the products are sodium chloride (which remains in the solution) and barium sulphate precipitate (which settles down as a white precipitate).

$$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4\downarrow + 2NaCl$$
(white ppt.)

(iii) When concentrated sulphuric acid is added to sugar crystals, it leaves behind residue of black carbon.

$$C_{12}H_{22}O_{11} \xrightarrow[H_2SO_4]{\text{Conc.}} 12C + 11H_2O$$

(iv) When dilute hydrochloric acid is added to copper carbonate, a brisk effervescence is seen due to the evolution of CO_2, with the formation of copper chloride and it turns lime water milky.

$$CuCO_3(s) + 2HCl\ (aq) \longrightarrow CuCl_2(aq) + H_2CO_3(aq)$$
$$\longrightarrow CuCl_2\ (aq) + H_2O(l) + CO_2(g)\uparrow$$

(v) Sodium thiosulphate reacts with dilute hydrochloric acid to produce sodium chloride, gas of sulphur dioxide, water and sulphur in a yellow solid form.

$$Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + S\downarrow + H_2O + SO_2\uparrow$$

(e) **(i)** Electronegativity
(ii) Froth Floatation
(iii) Nickel or Platinum
(iv) Addition reaction or hydrogenation reaction
(v) Valence electrons

(f) **(i)** Given,
Mass of 20 l of a gas at STP = 32 g
$\therefore$ Mass of 1 l of gas at STP would be

$$= \frac{32}{20}\text{ g}$$

We know that,
Gas at STP has volume

$$= 22.4\ l$$

$\therefore$ Gram molecular weight of the gas

$$= \frac{32}{20} \times 22.4$$
$$= 35.84\text{ g}$$

(ii) $2Ca(NO_3)_2 \longrightarrow 2CaO + 4NO_2 + O_2$
(2×164) g (2×56)g 4 vol. 1 vol.

From the above given chemical reaction
328 g of $Ca(NO_3)_2$ decomposes to form 112 g of CaO
$\therefore$ 1 g of $Ca(NO_3)_2$ will decompose

$$= \frac{112}{328}\text{ g}$$

And thus 82 g of $Ca(NO_3)_2$ will decompose

$$= \frac{112}{328} \times 82\text{ g}$$
$$= 28\text{ g of CaO}$$

From given chemical equation :
328 g of $Ca(NO_3)_2$ gives 4 vol. of NO_2
And we know that a gas at STP has volume

$$= 22{\cdot}4\ l$$

$\therefore$ Volume of NO_2 evolved when 82 g of $Ca(NO_3)_2$ is heated

$$= \frac{4 \times 22.4}{328} \times 82$$
$$= 22.4\ l$$

(g) **(i)** $Pb(NO_3)_2$ from PbO — (C) Neutralization
(ii) $MgCl_2$ from Mg — (A) Simple displacement
(iii) $FeCl_3$ from Fe — (E) Combination

(iv) $NaNO_3$ from NaOH (B) Titration
(v) $ZnCO_3$ from $ZnSO_4$ (D) Precipitation

(h) **(i)** 1. Propene 2. But-2-yne
3. Ethanal
(ii) 1. less than (<) 2. less than (<)

SECTION-II

Answer 2.

(a) **(i)** Five valence electrons **(ii)** M
(iii) T **(iv)** T

(b) **(i)** Metallic **(ii)** Smallest

(c) **(i)** 1. Ionic bond or electrovalent bond
2. Covalent Bond
(ii) 1. ZX 2. WX

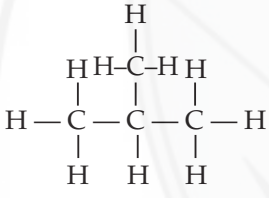
Answer 3.

(a) **(i)** $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 \uparrow + 6H_2O$

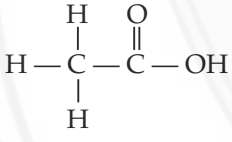
(ii) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$
ethyne

(iii) $C_2H_5OH \xrightarrow[170°C]{\text{conc. } H_2SO_4} C_2H_4 + H_2O$
ethene

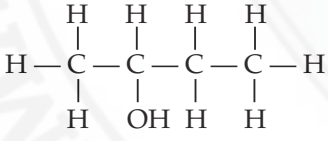
(b) **(i)**



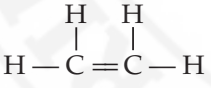
(ii)



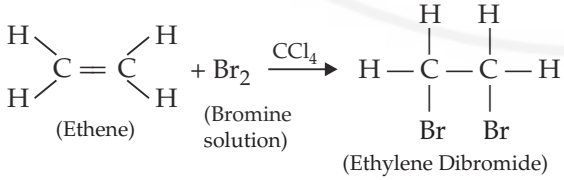
(iii)



(c) **(i)**



(ii) Bromine solution in CCl_4 has an reddish-brown colour. When added dropwise to ethene, the reddish-brown colour of bromine disappears, due to the formation of the colourless ethylene dibromide.



(d) **(i)** Nitric oxide
(ii) Sulphuric acid

Answer 4.

(a) **(i)** **Gas evolved :** SO_2 (Sulphur dioxide)
Chemical test : It changes orange acidified potassium dichromate green.
(ii) **Gas evolved :** H_2S (Hydrogen sulphide)
Chemical test : Turns lead acetate paper silvery black and turns moist blue litmus paper red.

(b) **(i)** A pale blue precipitate is formed and the precipitate dissolves when excess of ammonium hydroxide is added, giving clear deep blue solution of tetra amine copper sulphate.
(ii) White gelatinous precipitate of $Zn(OH)_2$ is formed and the ppt. dissolves in excess of ammonium hydroxide to give a clear transparent solution.

(c) **(i)** $CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^-$
$\therefore CuSO_4$ undergoes dissociation reaction.
Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$ (Readuction)
Anode : $Cu - 2e^- \longrightarrow Cu^{2+}$ (Oxidation)
(ii) $PbBr_2 \rightleftharpoons Pb^{2+} + 2Br^-$
Cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$ (Reduction)
Anode : $2Br^- - 2e^- \longrightarrow Br_2$ (Oxidation)

(d) **(i)** O_2 (oxygen) gas
(ii) Ag^+ ions and Cu^+ ions

Answer 5.

(a) **(i)** 12×10^{24} molecules of O_2

$$\text{Number of mole} = \frac{12\times10^{24}}{6\times10^{23}} = 20 \text{ mole}$$

1 mole of oxygen has the atomic weight $\rightarrow 32$ g

20 mole $\longrightarrow 32 \times 20 = 640$ g

(ii) The volume of one mole gas at STP
$= 22{\cdot}4\ l$
$\therefore$ 20 mole of gas at STP will have the volume of oxygen
$= 20 \times 22{\cdot}4\ l$
$= 448\ l$

(b)

Element	Percentage	Molecules	Simple ratio	Simple whole ratio
C	82.76	$\frac{82.76}{12} = 6.89$	$\frac{6.89}{6.89} = 1$	2
H	17.24	$\frac{17.24}{1} = 17.24$	$\frac{17.24}{6.89} = 2{\cdot}5$	5

$\therefore$ Empirical formula $= C_2H_5$

Empirical formula mass $= (12 \times 2) + (1 \times 5)$

$= 24 + 5 = 29$

Vapour density $\longrightarrow$ 29 (Given)

Molecular mass = V.D. $\times$ 2 $= 29 \times 2$

$= 58$ gm

Molecular formula mass $= n \times$ Empirical formula mass

$\Rightarrow \quad n = \dfrac{\text{Molecular Formula mass}}{\text{Emprirical Formula mass}}$

$= \dfrac{58}{29} = 2$

Molecular formula = $n \times$ Empirical formula

$= 2 \times C_2H_5$

$= C_4H_{10}$

(c) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

Given : Ammonia used in the reaction

$= 100\ cm^3$

From the equation, 4 vol. of NH_3 requires 5 vol. of O_2 for its oxidation.

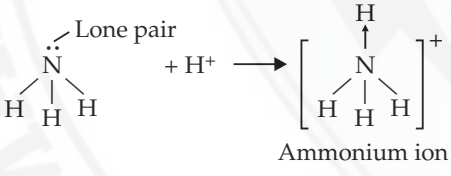
$\therefore$ 1 vol. will require $= \dfrac{5}{4}$

Thus 100 cm^3 of ammonia will require

$= \dfrac{5}{4} \times 100$

$= 125\ cm^3$ of oxygen

(d)



Answer 6.

(b) **(i)** Ammonia : $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3\uparrow$

(ii) Nitrogen : $NH_4Cl + NaNO_2 \longrightarrow NaCl + 2H_2O + N_2\uparrow$

(b) **(i)** $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2\uparrow$

(ii) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2\uparrow$

(c) **(i)** B = Non-volatile acid

(ii) A = Typical acid property

(iii) C = Oxidizing agent

(d) **(i)** NaCl is an ionic compound. Sodium chloride ions in the solid state are held by the electrostatic force of attraction, thus are not free to move and conduct electricity but in the fused state, the crystal lattice breaks down and the charged particles (ions) are free to move and thus are able to conduct electricity.

(ii) In aqueous solution of sodium argentocyanide, silver ions migrate slowly as compared to that in silver nitrate. Thereby, ensuring even deposition of silver metal on the articles to be electroplated.

(iii) Copper is a good conductor of electricity but it is a non-electrolyte because it is a solid metal and has no mobile ions which act as charge carriers to conduct electricity.

Answer 7.

(a) **(i)** NaOH (sodium hydroxide)

(ii) $2Al(OH)_3 \xrightarrow[1000°C]{\Delta} Al_2O_3 + 3H_2O$

(iii) Cryolite and fluorspar

(iv) **At cathode :** $Al^{3+} + 3e^- \longrightarrow Al$

(v) During the electrolysis process, aluminium is deposited at the cathode and oxygen is liberated at the anode. Some of the oxygen reacts with the carbon in the graphite to form carbon dioxide, by consuming the anode slowly. Thus, the anodes have to be replaced periodically or a number of graphite electrode as anodes have to be used.

(b) **(i)** When crystals of washing soda are exposed to air, they lose 9 water molecules of crystallization and becomes monohydrate forming a white powder. Thus, shows the phenomenon of efflorescence.

$Na_2CO_3 \cdot 10H_2O \xrightarrow{\text{Dry air}} Na_2CO_3 \cdot H_2O + 9H_2O$

(ii) The salt ferric chloride, when exposed to the atmosphere, absorbs water molecules to become moist and show the phenomenon of deliquescence.

(c) **(i)** Fe^{3+} **(ii)** Pb^{2+}

(iii) Ca^{2+}

CHEMISTRY

2015

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Select from the list the gas that matches the description given in each case:*
[ammonia, ethane, hydrogen chloride, hydrogen sulphide, ethyne] **[5]**

(i) *This gas is used as a reducing agent in reducing copper oxide to copper.*

(ii) *This gas produces dense white fumes with ammonia gas.*

(iii) *This gas is used for welding purposes.*

(iv) *This gas is also a saturated hydrocarbon.*

(v) *This gas has a characteristic rotten egg smell.*

(b) *Choose the most appropriate answer for each of the following :* **[5]**

(i) *Among the elements given below, the element with the least electronegativity is :*

(A) Lithium *(B) Carbon*
(C) Boron *(D) Fluorine*

(ii) *Identify the statement which does not describe the property of alkenes :*

(A) They are unsaturated hydrocarbons

(B) They decolourise bromine water

(C) They can undergo addition as well as substitution reactions.

(D) They undergo combustion with oxygen forming carbon dioxide and water.

(iii) *This is not an alloy of copper :*

(A) Brass *(B) Bronze*
(C) Solder *(D) Duralumin*

(iv) *Bonding in this molecule can be understood to involve coordinate bonding :*

(A) Carbon tetrachloride *(B) Hydrogen*
(C) Hydrogen chloride *(D) Ammonium chloride*

(v) *Which of the following would weigh the least ?*

(A) 2 gram atoms of Nitrogen

(B) 1 mole of silver

(C) 22.4 litre of oxygen gas at 1 atmospheric pressure and 273 K

(D) 6.02×10^{23} atoms of carbon

[Atomic masses : Ag = 108, N = 14, O = 16, C = 12]

(c) *Complete the following calculations. Show working for complete credit :*

(i) *Calculate the mass of calcium that will contain the same number of atoms as are present in 3.2 gm of sulphur.*
[Atomic masses : S = 32, Ca = 40] **[2]**

(ii) *If 6 litre of hydrogen and 4 litre of chlorine are mixed and exploded and if water is added to the gases formed, find the volume of the residual gas.* **[2]**

(iii) *If the empirical formula of a compound is CH and it has a vapour density of 13, find the molecular formula of the compound.* **[1]**

(d) *State one relevant observation for each of the following :* **[5]**

(i) *When crystals of copper nitrate are heated in a test tube.*

(ii) *When the gaseous product obtained by dehydration of ethyl alcohol is passed through bromine water.*

(iii) *When hydrogen sulphide gas is passed through lead acetate solution.*

(iv) *When ammonia gas is burnt in an atmosphere of excess oxygen.*

(v) *At the anode when aqueous copper sulphate solution is electrolysed using copper electrodes.*

(e) *Identify the acid which matches the following description (i) to (v) :* **[5]**

(i) *The acid which is used in the preparation of a non-volatile acid.*

(ii) *The acid which produces sugar charcoal from sugar.*

(iii) *The acid which is prepared by catalytic oxidation of ammonia.*

(iv) *The acid on mixing with lead nitrate solution produces a white precipitate which is insoluble even on heating.*

(v) *The acid on mixing with silver nitrate solution produces a white precipitate which is soluble in excess ammonium hydroxide.*

(f) *Give appropriate scientific reasons for the following statements :* **[5]**

(i) *Zinc oxide can be reduced to zinc by using carbon monoxide, but aluminium oxide cannot be reduced by a reducing agent.*

(ii) *Carbon tetrachloride does not conduct electricity.*

(iii) *During electrolysis of molten lead bromide graphite anode is preferred to other electrodes.*

(iv) *The electrical conductivity of acetic acid is less in comparison to the electrical conductivity of dilute sulphuric acid at a given concentration.*

(v) *Electrolysis of molten lead bromide is considered to be a redox reaction.*

(g) **(i)** *Give balanced chemical equations for the following conversions A, B and C :*

$$Fe \xrightarrow{A} FeCl_3 \xrightarrow{B} FeCO_3$$
$$\xrightarrow{C} Fe(NO_3)_2$$ **[3]**

(ii) *Differentiate between the terms strong electrolyte and weak electrolyte. (stating any two differences)* **[2]**

(h) *Answer the following questions :*

(i) *Explain the bonding in methane molecule using electron dot structure.* **[2]**

(ii) *The metals of Group 2 from top to bottom are Be, Mg, Ca, Sr, and Ba.*

(1) *Which one of these elements will form ions most readily and why ?*

(2) *State the common feature in the electronic configuration of all these elements.* **[3]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Arrange the following as per the instructions given in the brackets :* **[4]**

(i) *Cs, Na, Li, K, Rb (increasing order of metallic character).*

(ii) *Mg, Cl, Na, S, Si (decreasing order of atomic size).*

(iii) *Na, K, Cl, S, Si (increasing order of ionization energy)*

(iv) *Cl, F, Br, I (increasing order of electron affinity)*

(b) *Choose the most appropriate answer from the following list of oxides which fit the description. Each answer may be used only once :* **[4]**

[SO_2, SiO_2, Al_2O_3, MgO, CO, Na_2O]

(i) *A basic oxide.*

(ii) *An oxide which dissolves in water forming an acid.*

(iii) *An amphoteric oxide.*

(iv) *A covalent oxide of a metalloid.*

(c) *Element X is a metal with a valency 2, Y is a non-metal with a valency 3.* **[2]**

(i) *Write an equation to show how Y forms an ion.*

(ii) *If Y is a diatomic gas, write an equation for the direct combination of X and Y to form a compound.*

Question 3.

(a) *Give balanced chemical equations for the following conversions:* **[3]**

(i) *Ethanoic acid to ethyl ethanoate.*

(ii) *Calcium carbide to ethyne*

(iii) *Sodium ethanoate to methane.*

(b) *Using their structural formulae identify the functional group by circling them :* **[2]**

(i) *Dimethyl ether* **(ii)** *Propanone.*

(c) *Name the following :* **[5]**

(i) *Process by which ethane is obtained from ethene.*

(ii) *A hydrocarbon which contributes towards the greenhouse effect.*

(iii) *Distinctive reaction that takes place when ethanol is treated with acetic acid.*

(iv) *The property of elements by virtue of which atoms of the element can link to each other in the form of a long chain or ring structure.*

(v) *Reaction when an alkyl halide is treated with alcoholic potassium hydroxide.*

Question 4.

(a) *Identify the anion present in each of the following compounds :* **[3]**

(i) *A salt M on treatment with concentrated sulphuric acid produces a gas which fumes in moist air and gives dense fumes with ammonia.*

(ii) *A salt D on treatment with dilute sulphuric acid produces a gas which turns lime water milky but has no effect on acidified potassium dichromate solution.*

(iii) *When barium chloride solution is added to salt solution E a white precipitate insoluble in dilute hydrochloric acid is obtained.*

(b) *The following table shows the tests a student performed on four different aqueous solutions which are X, Y, Z and W. Based on the observations provided, identify the cation present :* **[4]**

Chemical test	*Observation*	*Conclusion*
To solution X, ammonium hydroxide is added in minimum quantity first and then in excess.	*A dirty white precipitate is formed which dissolves in excess to form a clear solution.*	*(i)*
To solution Y ammonium hydroxide is added in minimum quantity first and then in excess.	*A pale blue precipitate is formed which dissolves in excess to form a clear inky blue solution.*	*(ii)*

To solution W a small quantity of sodium hydroxide solution is added and then in excess.	*A white precipitate is formed which remains insoluble.*	*(iii)*
To a salt Z calcium hydroxide solution is added and then heated.	*A pungent smelling gas turning moist red litmus paper blue is obtained.*	*(iv)*

(c) *Give balanced chemical equations for each of the following :* **[3]**

(i) *Lab preparation of ammonia using an ammonium salt.*

(ii) *Reaction of ammonia with excess chlorine.*

(iii) *Reaction of ammonia with sulphuric acid.*

Question 5.

(a) *Consider the following reaction and based on the reaction answer the questions that follow :*

$(NH_4)_2Cr_2O_7 \xrightarrow{Heat} N_2(g) + 4H_2O(g) + Cr_2O_3$

Calculate :

(i) *The quantity in moles of $(NH_4)_2Cr_2O_7$ if 63 gm of $(NH_4)_2Cr_2O_7$ is heated.* **[1]**

(ii) *The quantity in moles of nitrogen formed.* **[1]**

(iii) *The volume in litres or dm^3 of N_2 evolved at S.T.P.* **[1]**

(iv) *The mass in gram of Cr_2O_3 formed at the same time.* **[2]**

[Atomic masses : H = 1, Cr = 52, N = 14]

(b) **(i)** *For each of the substance listed below, describe the role played in the extraction of aluminium :* **[3]**

(1) Cryolite

(2) Sodium hydroxide *(3) Graphite*

(ii) *Explain why :* **[2]**

(1) In the electrolysis of alumina using the Hall Heroult's process the electrolyte is covered with powdered coke.

(2) Iron sheets are coated with zinc during galvanization.

Question 6.

(a) **(i)** *Give balanced chemical equations for the action of sulphuric acid on each of the following :* **[2]**

(1) *Potassium hydrogen carbonate.*

(2) *Sulphur.*

(ii) *In the contact process for the manufacture of sulphuric acid give the equations for the conversion of sulphur trioxide to sulphuric acid.* **[2]**

(b) **(i)** *Copy and complete the following table :* **[2]**

	Anode	*Electrolyte*
Purification of copper		

(ii) *Write the equation taking place at the anode.* **[1]**

(c) *Explain the following :* **[3]**

(i) *Dilute nitric acid is generally considered a typical acid but not so in its reaction with metals.*

(ii) *Concentrated nitric acid appears yellow when it is left standing in a glass bottle.*

(iii) *An all glass apparatus is used in the laboratory preparation of nitric acid.*

Question 7.

(a) *The following questions are pertaining to the laboratory preparation of hydrogen chloride gas :*

(i) *Write the equation for its preparation mentioning the condition required.* **[1]**

(ii) *Name the drying agent used and justify your choice.* **[2]**

(iii) *State a safety precaution you would take during the preparation of hydrochloric acid.* **[1]**

(b) *An element L consists of molecules :* **[2]**

(i) *What type of bonding is present in the particles that make up L ?*

(ii) *When L is heated with iron metal, it forms a compound FeL. What chemical term would you use to describe the change undergone by L ?*

(c) *From the list of the following salts choose the salt that most appropriately fits the description given in the following :*

[AgCl, $MgCl_2$, $NaHSO_4$, $PbCO_3$, $ZnCO_3$, KNO_3, $Ca(NO_3)_2$]

(i) *A deliquescent salt.*

(ii) *An insoluble chloride.*

(iii) *On heating, this salt gives a yellow residue when hot and white when cold.*

(iv) *On heating this salt, a brown coloured gas is evolved.* **[4]**

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Ammonia **(ii)** Hydrogen chloride
(iii) Ethyne **(iv)** Ethane
(v) Hydrogen sulphide.

(b) **(i)** (A) Lithium
(ii) (C) They can undergo addition as well as substitution reactions.
(iii) (C) Solder
(iv) (D) Ammonium chloride
(v) (D) 6.02×10^{23} atoms of carbon

(c) **(i)** 32 g of sulphur contain
$= 6.023 \times 10^{23}$ atoms

∴ 3.2 g of sulphur contain

$$= \frac{6.023 \times 10^{23}}{32} \times 3{\cdot}2$$

$$= 6.023 \times 10^{22}$$

Now, 6.023×10^{23} atom of calcium have mass

$$= 40 \text{ g}$$

∴ 6.023×10^{22} atoms of calcium have mass

$$= \frac{40}{6.023 \times 10^{23}} \times 6.023 \times 10^{22}$$

$$= 4 \text{ g}$$

Hence, the mass of calcium is 4 g.

(ii) $H_2 + Cl_2 \longrightarrow HCl$

1 vol. 1 vol. 2 vols.

Since, 1 volume of chlorine reacts with 1 volume of hydrogen.

∴ 4 litre of chlorine will react with only 4 volumes of hydrogen.

∴ (6 – 4) *i.e.*, 2 litre of hydrogen will remain unreacted.

HCl formed will get dissolved in water.

∴Volume of residual gas hydrogen is 2 litre.

(iii) Given,

Empirical formula = CH

Now, Empirical formula mass

$$= 12 \times 1 + 1 \times 1 = 13$$

Molecular mass = 2 × Vapour density

$$= 2 \times 13 = 26$$

Molecular formula mass

$$= n \times \text{Empirical formula mass}$$

$$\therefore \quad n = \frac{\text{Molecular formula mass}}{\text{Empirical formula mass}}$$

$$= \frac{26}{13} = 2$$

Molecular formula = n × Empirical formula

$$= 2 \times (CH)$$

$$= C_2H_2$$

Hence, the molecular formula of the compound is C_2H_2.

(d) **(i)** The blue coloured copper nitrate crystals changes into black powdery residue CuO with the release of reddish brown NO_2 gas.

(ii) The reddish brown colour of bromine water disappears.

(iii) Lead acetate solution becomes black due to the formation of lead sulphide.

(iv) Ammonia burns with a yellowish green flame in the atmosphere of excess oxygen.

(v) The copper of the anode dissolves and, therefore, it becomes thin gradually.

(e) **(i)** Conc. nitric acid

(ii) Conc. sulphuric acid

(iii) Conc. nitric acid

(iv) Dil. sulphuric acid

(v) Dil. hydrochloric acid.

(f) **(i)** This is because of the fact that aluminium has great affinity towards oxygen than zinc and so aluminium oxide cannot be reduced by reducing agents such as carbon monoxide or carbon or hydrogen.

(ii) This is because of the absence of free ions in the carbon tetrachloride molecule.

(iii) This is because graphite rod is unaffected by the reactive bromine vapours formed during electrolysis at anode. Graphite is inert in nature.

(iv) This is because acetic acid being a weak acid partially dissociates and produces less ions in solution whereas sulphuric acid being a strong acid completely dissociates and produces more free ions in solution. Hence, conduction of electric current in acetic acid is less as compared to dil. H_2SO_4 at given concentration.

(v) This is because of the fact that during electrolysis of molten lead bromide, both reduction (at cathode) and oxidation (at anode) takes place. At cathode, Pb^{2+} ions gain electrons and get reduced while at anode, Br^- ions lose electrons and get oxidised.

$$PbBr_2 \rightleftharpoons Pb^{2+} + 2Br^-$$

(Lead Bromide)

Cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$

Anode : $2Br^- - 2e^- \longrightarrow 2Br$

(g) **(i)** $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$

Chlorine gas (Dry) (A) — Iron (III) Chloride

$2FeCl_3 + 3Na_2CO_3 \longrightarrow Fe_2(CO_3)_3 + 6NaCl$

Sodium carbonate solution (B)

$FeCO_3 + 2HNO_3 \longrightarrow Fe(NO_3)_2 + H_2O + CO_2$

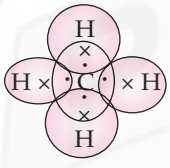
Nitric acid (C)

(ii)

Strong Electrolyte	Weak Electrolyte
They allow a large amount of electricity to flow through them *i.e.*, they are good conductors of electricity.	They allow small amount of electricity to flow through them *i.e.*, they are poor conductors of electricity.

They are completely dissociated into the fused or aqueous solution state and contains only free mobile ions.	They are partially dissociated into their fused or aqueous solution state and contain ions as well as molecules.

(h) **(i)** To attain the stable electronic configuration of the nearest noble gas, carbon needs four electrons and hydrogen needs one electron. Therefore, in the methane molecule formation, one atom of carbon shares four electron pairs, one with each of the four atoms of hydrogen resulting in the formation of four single covalent bond between them. The electron sharing can be illustrated using electron dot structure which is as follows :



Electron dot structure of methane molecule
where × = electron of carbon atom
· = electron of hydrogen atom

(ii) 1. Barium (Ba) will form ions most readily because its ionisation potential is lowest in the group. Hence, the removal of electrons is easy.

2. All these elements have two electrons in their valence or outer most shell.

SECTION-II

Answer 2.

(a) **(i)** $Li < Na < K < Rb < Cs$

(ii) $Na > Mg > Si > S > Cl$

(iii) $K < Na < Si < S < Cl$

(iv) $I < Br < F < Cl$

(b) **(i)** Na_2O, MgO **(ii)** SO_2

(iii) Al_2O_3 **(iv)** SiO_2.

(c) **(i)** $Y + 3e^- \longrightarrow Y^{3-}$

(ii) $3X + Y_2 \longrightarrow X_3Y_2$.

Answer 3.

(a) **(i)** $CH_3COOH(l) + C_2H_5OH(l) \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5(l) + H_2O(l)$

Ethanoic acid; Ethanol; Ethyl ethanoate (ester); Water

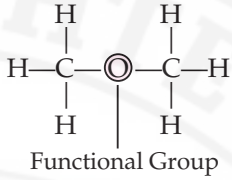
(ii) $CaC_2(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(s) + C_2H_2(g)$

Calcium carbide; Calcium hydroxide; Ethyne

(iii) $CH_3COONa(s) + NaOH(s) \xrightarrow[300°C]{CaO} Na_2CO_3(s) + CH_4(g)$

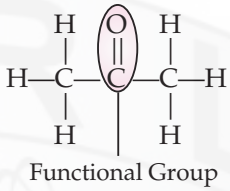
Sodium ethanoate; Sodium hydroxide (from soda lime); Sodium carbonate; Methane

(b) **(i)**



Functional Group

(ii)



Functional Group

(c) **(i)** Hydrogenation **(ii)** Methane (CH_4)

(iii) Esterification **(iv)** Catenation

(v) Dehydrohalogenation

Answer 4.

(a) **(i)** Cl^- **(ii)** CO_3^{2-} or HCO_3^-

(iii) SO_4^{2-}

(b) **(i)** $X — Zn^{2+}$ **(ii)** $Y — Cu^{2+}$

(iii) $W — Ca^{2+}$ or Mg^{2+}

(iv) $Z — NH_4^+$

(c) **(i)** $2NH_4Cl(s) + Ca(OH)_2(s) \xrightarrow{\Delta} CaCl_2(s) + 2H_2O + 2NH_3\uparrow$

Ammonium salt; Slaked lime; Calcium chloride; Water; Ammonia

(ii) $NH_3 + 3Cl_2 \longrightarrow 3HCl + NCl_3$

Hydrochloric acid; Nitrogen chloride

(iii) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$

Ammonium sulphate

Answer 5.

(a) $(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_2(g) + 4H_2O(g) + Cr_2O_3$

$2(14 + 4) + (52 \times 2) + (16 \times 7)$
$= 36 + 104 + 112 = 252$ g

$(2 \times 52) + (16 \times 3)$
$= 104 + 48 = 152$ g

(i) 252 g $(NH_4)_2Cr_2O_7$ = 1 mole

$\therefore$ 63 g $(NH_4)_2Cr_2O_7 = \frac{63}{252}$ = 0.25 mole

Hence, 0.25 mole of $(NH_4)_2Cr_2O_7$ is heated

(ii) From the chemical equation

1 mole of $(NH_4)_2Cr_2O_7$ liberates 1 mole of N_2

$\therefore$ 0·25 mole of $(NH_4)_2Cr_2O_7$ liberates 0·25 moles of N_2

(iii) Volume of 1 mole of N_2 at S.T.P. is 22·4 *l*.

$\therefore$ 0.25 mole of N_2 at S.T.P. has volume = 22·4 × 0·25 = 5.6 *l*

(iv) 252 g $(NH_4)_2Cr_2O_7$ gives 152 g Cr_2O_3

$\therefore$ 63 g $(NH_4)_2Cr_2O_7$ gives $= \frac{152 \times 63}{252}$ g

Cr_2O_3 = 38 g Cr_2O_3

Hence, the mass of Cr_2O_3 formed is 38 g.

(b) **(i)** (1) Cryolite acts as a solvent for the electrolytic mixture and also lowers the fusion temperature from 2050°C to 950°C which saves electrical energy. It increases the electrical conductivity and acts as a solvent.

(2) Sodium hydroxide is used to remove insoluble impurities from the ore. When bauxite ore is treated with sodium hydroxide, it dissolves and forms sodium aluminate leaving behind insoluble impurities called red mud (consists of ferric oxide, sand etc.)

(3) Graphite is used as an electrode in the extraction of aluminium because it has a very high melting point and is a good conductor of electricity.

(ii) (1)To reduce the heat loss by radiation and to prevent burning of anode in air at the point above the electrolyte. It also prevents the oxidation of the anode.

(2) Iron sheets are coated with zinc during galvanization to prevent them from rusting as zinc is more reactive than iron.

Answer 6.

(a) **(i)** (1) $2KHCO_3 + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O + 2CO_2\uparrow$

Potassium hydrogen carbonate; Sulphuric acid (dil.); Potassium sulphate; Water; Carbon dioxide

(2) $S + 2H_2SO_4 \longrightarrow 3SO_2\uparrow + 2H_2O$

Sulphur; Sulphuric acid (conc.); Sulphur dioxide; Water

(ii) Refer to ICSE Paper 2017, Answer 4 (c).

(b) **(i)**

	Anode	Electrolyte
Purification of copper	Impure copper	Copper sulphate solution with little amount of sulphuric acid

(ii) $Cu \longrightarrow Cu^{2+} + 2e^-$ (At anode)

$Cu - 2e^- \longrightarrow Cu^{2+}$ (At anode)

(c) **(i)** Dilute nitric acid is generally considered a typical acid but not so in its reaction with metals because it does not liberate hydrogen with all metals except Mg and Mn. It is a powerful oxidising agent and the nascent oxygen formed oxidises the hydrogen to water.

(ii) Concentrated nitric acid appears yellow when it is left standing in a glass bottle because when nitric acid is left standing in a glass bottle, it decomposes to give reddish brown NO_2 gas which dissolves in undecomposed nitric acid to give a yellow colour.

(iii) An all glass apparatus is used in the laboratory preparation of nitric acid because nitric acid vapours are corrosive and destroy materials like rubber, cork or metal.

Answer 7.

(a) **(i)** $NaCl + H_2SO_4 \xrightarrow{200°C} NaHSO_4 + HCl\uparrow$

Sodium chloride; Sulphuric acid (conc.); Sodium hydrogen sulphate; Hydrogen chloride

When metal chlorides react with conc. H_2SO_4, hydrogen chloride gas is liberated. The temperature is kept less than 200°C, because if temperature increases then sodium sulphate is formed.

(ii) It is dried by passing through conc. sulphuric acid because it does not react with hydrogen chloride gas.

(iii) While preparing hydrochloric acid, HCl gas is dissolved in water by inverted funnel arrangement as HCl gas is highly soluble in water and causes back suction. Back suction is undesired as it breaks the apparatus. It is prevented by using funnel arrangement.

(b) **(i)** Covalent bonding since L consists of molecules.

(ii) L is getting reduced.

(c) **(i)** $MgCl_2$ **(ii)** AgCl

(iii) $ZnCO_3$ **(iv)** $Ca(NO_3)_2$.

CHEMISTRY

2014

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* **[10]**

(i) *Ionization potential increases over a period from left to right because the :*

(A) Atomic radius increases and nuclear charge increases

(B) Atomic radius decreases and nuclear charge decreases

(C) Atomic radius increases and nuclear charge decreases

(D) Atomic radius decreases and nuclear charge increases.

(ii) *A compound X consists of only molecules. Hence X will have :*

(A) A crystalline hard structure.

(B) A low melting point and low boiling point.

(C) An ionic bond.

(D) A strong force of attraction between its molecules.

(iii) *When fused lead bromide is electrolyzed we observe :*

(A) a silver grey deposit at anode and a reddish brown deposit at cathode.

(B) a silver grey deposit at cathode and a reddish brown deposit at anode.

(C) a silver grey deposit at cathode and reddish brown fumes at anode.

(D) silver grey fumes at anode and reddish brown fumes at cathode.

(iv) *The main ore used for the extraction of iron is :*

(A) Haematite *(B) Calamine*

(C) Bauxite *(D) Cryolite*

(v) *Heating an ore in a limited supply of air or in the absence of air at a temperature just below its melting point is known as :*

(A) smelting *(B) ore dressing*

(C) calcination *(D) bessemerisation*

(vi) *If an element A belongs to Period 3 and Group II then it will have :*

(A) 3 shells and 2 valence electrons.

(B) 2 shells and 3 valence electrons.

(C) 3 shells and 3 valence electrons.

(D) 2 shells and 2 valence electrons.

(vii) *The molecule containing a triple co-valent bond is :*

(A) ammonia *(B) methane*

(C) water *(D) nitrogen*

(viii) *The electrolyte used for electroplating an article with silver is :*

(A) silver nitrate solution

(B) silver cyanide solution

(C) sodium argentocyanide solution

(D) nickel sulphate solution.

(ix) *Aluminium powder is used in thermite welding because :*

(A) it is a strong reducing agent.

(B) it is a strong oxidising agent.

(C) it is corrosion resistant.

(D) it is a good conductor of heat.

(x) *The I.U.P.A.C. name of acetylene is :*

(A) propane *(B) propyne*

(C) ethene *(D) ethyne.*

(b) *Fill in the blanks from the choices given within brackets :* **[5]**

(i) *The basicity of acetic acid is .....(3, 1, 4).*

(ii) *The compound formed when ethanol reacts with sodium is ..... (sodium ethanoate, sodium ethoxide, sodium propanoate).*

(iii) *Quicklime is not used to dry HCl gas because.....(CaO is alkaline, CaO is acidic, CaO is neutral).*

(iv) *Ammonia gas is collected by .....(an upward displacement of air, a downward displacement of water, a downward displacement of air).*

(v) *Cold, dilute nitric acid reacts with copper to form.....(Hydrogen, nitrogen dioxide, nitric oxide).*

(c) *Give one word or phrase for the following :* **[5]**

(i) *The ratio of the mass of a certain volume of gas to the mass of an equal volume of hydrogen under the same conditions of temperature and pressure.*

(ii) *Formation of ions from molecules.*

(iii) *Electrolytic deposition of a superior metal on a baser metal.*

(iv) *Hydrocarbons containing a* $-\overset{\overset{O}{\|}}{C}-$ *functional group.*

(v) *The amount of energy released when an atom in the gaseous state accepts an electron to form an anion.*

(d) *Match the options A to E with the statements (i) to (v) :* **[5]**

A	*alkynes*	*(i)*	*No. of molecules in 22.4 dm^3 of carbon dioxide at S.T.P.*
B	*alkane*	*(ii)*	*An element with electronic configuration 2, 8, 8, 3.*
C	*iron*	*(iii)*	$C_n H_{2n+2}$
D	6.023×10^{23}	*(iv)*	$C_n H_{2n-2}$
E	*metal*	*(v)*	*The metal that forms two types of ions.*

(e) *Write balanced equations for the following :* **[5]**

(i) *Action of heat on a mixture of copper and concentrated nitric acid.*

(ii) *Action of warm water on magnesium nitride.*

(iii) *Action of concentrated sulphuric acid on carbon.*

(iv) *Action of dilute hydrochloric acid on sodium sulphide.*

(v) *Preparation of ethane from sodium propionate.*

(f) *Distinguish between the following pairs of compounds using the test given within brackets :* **[5]**

(i) *Iron (II) sulphate and iron (III) sulphate (using ammonium hydroxide).*

(ii) *A lead salt and a zinc salt (using excess ammonium hydroxide).*

(iii) *Sodium nitrate and sodium sulphite (using dilute sulphuric acid).*

(iv) *Dilute sulphuric acid and dilute hydrochloric acid (using barium chloride solution).*

(v) *Ethane and ethene (using alkaline potassium permanganate solution).*

(g) **(i)** *Oxygen oxidizes ethyne to carbon dioxide and water as shown by the equation :* **[5]**

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$

What volume of ethyne gas at S.T.P. is required to produce 8·4 dm^3 of carbon dioxide at S.T.P. ? [H = 1, C = 12, O = 16]

(ii) *A compound made up of two elements X and Y has an empirical formula X_2Y. If the atomic weight of X is 10 and that of Y is 5 and the compound has a vapour density 25, find its molecular formula.*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *State your observation in each of the following cases :* **[5]**

(i) *When dilute hydrochloric acid is added to sodium carbonate crystals.*

(ii) *When excess sodium hydroxide is added to calcium nitrate solution.*

(iii) *At the cathode when acidified aqueous copper sulphate solution is electrolyzed with copper electrodes.*

(iv) *When calcium hydroxide is heated with ammonium chloride crystals.*

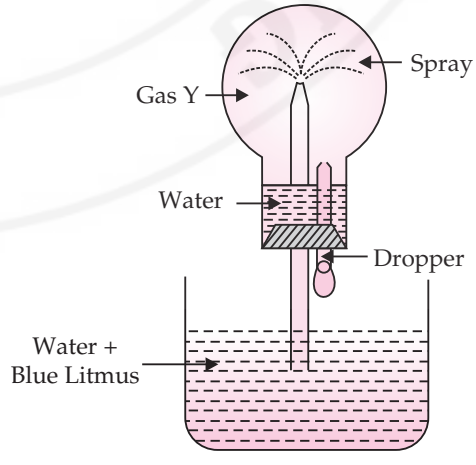
(v) *When moist starch iodide paper is introduced into chlorine gas.*

(b) *Study the figure given below and answer the questions that follow :* **[3]**

(i) *Identify the gas Y.*

(ii) *What property of gas Y does this experiment demonstrate ?*

(iii) *Name another gas which has the same property and can be demonstrated through this experiment.*



(c) (i) *Name the other ion formed when ammonia dissolves in water.*

(ii) *Give one test that can be used to detect the presence of the ion produced.* [2]

Question 3.

(a) *State the conditions required for the following reactions to take place :* [5]

(i) *Catalytic hydrogenation of ethyne.*

(ii) *Preparation of ethyne from ethylene dibromide.*

(iii) *Catalytic oxidiation of ammonia to nitric oxide.*

(iv) *Any two conditions for the conversion of sulphur dioxide to sulphur trioxide.*

(b) *State the main components of the following alloys :* [3]

(i) *Brass.* (ii) *Duralumin.*

(iii) *Bronze.*

(c) *Give balanced equations for the following :* [2]

(i) *Laboratory preparation of nitric acid.*

(ii) *Preparation of ethanol from monochloroethane and aq. sodium hydroxide.*

Question 4.

(a) *Give the structural formula of the following :* [4]

(i) *ethanol*

(ii) *1-propanal*

(iii) *ethanoic acid*

(iv) *1, 2-dichloroethane.*

(b) *Draw the structure of the stable positive ion formed when an acid dissolves in water.* [2]

(c) *State the inference drawn from the following observations :* [4]

(i) *On carrying out the flame test with a salt P a brick red flame was obtained. What is the cation in P ?*

(ii) *A gas Q turns moist lead acetate paper silvery black. Identify the gas Q.*

(iii) *pH of liquid R is 10. What kind of substance is R ?*

(iv) *Salt S is prepared by reacting dilute sulphuric acid with copper oxide. Identify S.*

Question 5.

(a) *Name the following :* [3]

(i) *The property possessed by metals by which they can be beaten into sheets.*

(ii) *A compound added to lower the fusion temperature of electrolytic bath in the extraction of aluminium.*

(iii) *The ore of zinc containing its sulphide.*

(b) *Give one equation each to show the following properties of sulphuric acid :* [3]

(i) *Dehydrating property.*

(ii) *Acidic nature.*

(iii) *As a non-volatile acid.*

(c) *Give balanced chemical equations to prepare the following salts :* [4]

(i) *Lead sulphate from lead carbonate.*

(ii) *Sodium sulphate using dilute sulphuric acid.*

(iii) *Copper chloride using copper carbonate.*

Question 6.

(a) (i) *State Avogadro's Law.*

(ii) *A cylinder contains 68 g of ammonia gas at S.T.P.*

(1) *What is the volume occupied by this gas ?*

(2) *How many moles of ammonia are present in the cylinder ?*

(3) *How many molecules of ammonia are present in the cylinder ? [N–14, H–1]* [4]

(b) (i) *Why do covalent compounds exist as gases, liquids or soft solids ?*

(ii) *Which electrode : anode or cathode is the oxidising electrode ? Why ?* [3]

(c) *Name the kind of particles present in :* [3]

(i) *Sodium Hydroxide solution.*

(ii) *Carbonic acid.*

(iii) *Sugar solution.*

Question 7.

(a) *An element Z has atomic number 16. Answer the following questions on Z :* [5]

(i) *State the period and group to which Z belongs.*

(ii) *Is Z a metal or a non-metal ?*

(iii) *State the formula between Z and hydrogen.*

(iv) *What kind of a compound is this ?*

(b) *M is a metal above hydrogen in the activity series and its oxide has the formula M_2O. This oxide when dissolved in water forms the corresponding hydroxide which is a good conductor of electricity. In the above context answer the following :* [5]

(i) *What kind of combination exists between M and O ?*

(ii) *How many electrons are there in the outermost shell of M ?*

(iii) *Name the group to which M belongs.*

(iv) *State the reaction taking place at the cathode.*

(v) *Name the product at the anode.* [5]

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** (D) Atomic radius decreases and nuclear charge increases.

(ii) (B) A low melting point and low boiling point.

(iii) (C) A silvery grey deposit at cathode and reddish brown fumes at anode.

(iv) (A) Haematite

(v) (C) Calcination

(vi) (A) 3 shells and 2 valence electrons.

(vii) (D) Nitrogen.

(viii) (C) Sodium argentocyanide solution.

(ix) (A) It is a strong reducing agent.

(x) (D) Ethyne.

(b) **(i)** 1

(ii) Sodium ethoxide

(iii) CaO is alkaline

(iv) A downward displacement of air

(v) Nitric oxide.

(c) **(i)** Vapour density **(ii)** Ionization

(iii) Electroplating **(iv)** Ketones

(v) Electron affinity.

(d) **(A)** (iv) **(B)** (iii)

(C) (v) **(D)** (i)

(E) (ii)

(e) **(i)** $Cu + \underset{\text{Conc. nitric acid}}{4HNO_3} \xrightarrow{\Delta} \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + 2H_2O + 2NO_2\uparrow$

(ii) $\underset{\text{Magnesium nitride}}{Mg_3N_2} + \underset{\text{Warm}}{6H_2O} \longrightarrow \underset{\text{Magnesium hydroxide}}{3Mg(OH)_2} + 2NH_3\uparrow$ (Ammonia gas)

(iii) $C + \underset{\text{Conc.}}{2H_2SO_4} \rightarrow \underset{\text{Carbon dioxide}}{CO_2} + 2H_2O + \underset{\text{Sulphur dioxide}}{2SO_2}\uparrow$

(iv) $\underset{\text{Sodium sulphide}}{Na_2S} + \underset{\text{Dil.}}{2HCl} \rightarrow \underset{\text{Sodium chloride}}{2NaCl} + \underset{\text{Hydrogen sulphide gas}}{H_2S}\uparrow$

(v) $\underset{\text{Sodium propionate}}{C_2H_5COONa} + NaOH \xrightarrow[300°C]{CaO} \underset{\text{Ethane}}{C_2H_6} + \underset{\text{Sodium carbonate}}{Na_2CO_3}$

(f) **(i)** Using ammonium hydroxide :

Iron (II) Sulphate	Iron (III) Sulphate
Dirty green precipitate.	Reddish Brown precipitate.

(ii) Using excess ammonium hydroxide :

Lead Salt	Zinc Salt
White precipitate, insoluble in excess of NH_4OH solution.	Gelatinous white ppt., dissolves in excess of NH_4OH solution.

(iii) Using dilute sulphuric acid :

Sodium Nitrate	Sodium Sulphite
No effect.	Colourless gas *i.e.*, SO_2 with smell of burning sulphur is liberated which turns moist blue litmus paper red.

(iv) Using barium chloride solution :

Dilute Sulphuric acid	Dilute hydrochloric acid
Thick white precipitate is obtained which remains insoluble in nitric acid.	No effect.

(v) Using alkaline potassium permanganate solution :

Ethane	Ethene
No effect as potassium permanganate remain purple	Solution of potassium permanganate gets decolourised. The purple colour gets decolourised.

(g) **(i)** Given,

$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

2 vol. 4 vol.

$\therefore$ 1 vol. 2 vol.

According to Gay Lussac's law :

2 volume of CO_2 is produced from 1 vol. of C_2H_2

$\therefore$ 8.4 dm^3 of CO_2 at S.T.P. produced from

$$= \frac{1 \times 8.4}{2}$$

$= 4.2\ dm^3$ of C_2H_2

At S.T.P. 4.2 dm^3 of ethyne is required.

Empirical formula weight

$= X_2Y = 2 \times 10 + 5$

$= 25$

(ii) Molecular formula

$= (\text{Empirical formula}) \times n$

$$n = \frac{\text{Molecular formula weight}}{\text{Empirical formula weight}}$$

$$= \frac{2 \times \text{V.D.}}{(2 \times 10 + 5)}$$

(V.D. = Vapour Density)

$$= \frac{2 \times 25}{25} = 2$$

$\therefore$ Molecular formula

$= (X_2Y) \times 2 = X_4Y_2$

SECTION-II

Answer 2.

(a) **(i)** A colourless, odourless gas with brisk effervescence is evolved and when tested turns moist blue litmus red and lime water milky.

(ii) A chalky white ppt. is obtained which is insolube in excess sodium hydroxide.

(iii) Cathode becomes thick due to deposition of red copper metal.

(iv) A colourless gas with characteristic pungent smell of ammonia is evolved.

(v) Starch iodide paper turns blue-black.

(b) **(i)** Y is hydrochloride (HCl) gas.

(ii) Gas Y is highly soluble in water.

(iii) Ammonia gas.

(c) **(i)** Hydroxide ion.

(ii) It will turn moist red litmus to blue.

Answer 3.

(a) **(i)** In the presence of catalyst like finely divided nickel, platinum, etc., and on heating upto 473 K or about 300°C hydrogenation takes place.

(ii) Hot and concentrated ethanolic solution of potassium hydroxide.

(iii) Platinum gauze is used as catalyst at 800°C in presence of oxygen.

(iv) Vanadium pentaoxide acts as catalyst and temperature of 450 – 500 °C and 2 atm. pressure.

(b) **(i)** Copper and zinc.

(ii) Aluminium and copper.

(iii) Copper and tin.

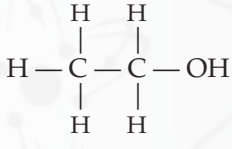
(c) **(i)** $NaNO_3$ (Sodium nitrate) + H_2SO_4 (Conc.) $\xrightarrow[\Delta]{200°C}$ $NaHSO_4$ (Sodium hydrogen sulphate) + HNO_3 (Nitric acid)

(ii) $C_2H_5Cl + NaOH(aq.) \xrightarrow[450°C]{\text{Catalyst}} C_2H_5OH + NaCl$

(Monochloro ethane → Ethanol; Sodium chloride)

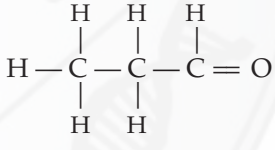
Answer 4.

(a) **(i)**



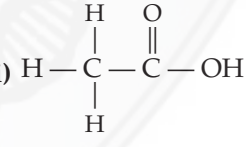
Ethanol

(ii)



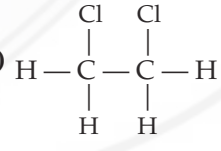
1-Propanal

(iii)



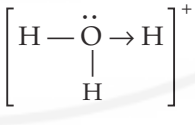
Ethanoic acid

(iv)



1,2-dichloroethane

(b)



(H_3O^+) Hydronium ion.

(c) **(i)** Cation in P is Ca^{2+}.

(ii) Gas Q is hydrogen sulphide (H_2S).

(iii) Substance R is alkaline.

(iv) Salt S is copper sulphate ($CuSO_4$).

Answer 5.

(a) **(i)** Malleability

(ii) Cryolite or Na_3AlF_6

(iii) Zinc blende.

(b) **(i)** $CuSO_4.5H_2O \xrightarrow[H_2SO_4]{\text{Conc.}} CuSO_4 + 5H_2O$

or $C_{12}H_{22}O_{11} \xrightarrow{\text{Conc. } H_2SO_4} 12C + 11H_2O$

Sucrose

(ii) $H_2SO_4 + Na_2CO_3 \longrightarrow Na_2SO_4 + CO_2\uparrow + H_2O$

Dil. Sodium carbonate — Sodium sulphate

(iii) $NaCl + H_2SO_4 \xrightarrow[\Delta]{200°C} NaHSO_4 + HCl\uparrow$

Sodium chloride — Conc. — Sodium hydrogen sulphate

(c) **(i)** $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2\uparrow$

Lead carbonate — Lead nitrate

$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4\downarrow + 2HNO_3$

Lead nitrate — Dil. — Lead sulphate

(ii) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

Sodium hydroxide — Dil. — Sodium sulphate

(iii) $CuCO_3 + 2HCl \longrightarrow CuCl_2 + H_2O + CO_2\uparrow$

Copper carbonate — Copper chloride

Answer 6.

(a) **(i)** **Avogadro's Law :** "Under same temperature and pressure conditions, equal volumes of different gases contain equal number of molecules."

(ii) Molecular weight of $NH_3 = (14 + 3 \times 1) = 17g$

(1) At S.T.P., 17 g of ammonia occupies 22·4 *l*

$\therefore$ Volume occupied by 68 g of ammonia

$$= 22.4 \times \frac{68}{17}$$

$$= 89.6\ l$$

(2) At S.T.P., 17 g of ammonia contains 1 mole

68 g of ammonia contains

$$= 1 \times \frac{68}{17}$$

$$= 4 \text{ moles}$$

(3) Number of molecules

$$= \text{No. of moles} \times N_A$$

$$= 4 \times 6.023 \times 10^{23}$$

$$= 24.092 \times 10^{23}.$$

(b) **(i)** Covalent compounds exists as gases, liquids or soft solids because they are held by relatively weaker forces that are known as van der waal's forces.

(ii) Anode is the oxidising electrode because anions lose electrons at anode.

(c) **(i)** NaOH – Ions only.

(ii) Carbonic acid – Ions and molecules both.

(iii) Sugar Solution – Molecules only.

Answer 7.

(a) **(i)** 3^{rd} period, 16^{th} group.

(ii) Z is a non-metal.

(iii) H_2Z

(iv) Covalent compound.

(b) **(i)** Electrovalent bond exists between M and O.

(ii) One electron is there in the outermost shell.

(iii) M belongs to first group or alkali metals.

(iv) $M^+ + e^- \longrightarrow M$ (at cathode).

(v) Oxygen gas is liberated at anode.

●●

CHEMISTRY

2013

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *From the list given below, select the word(s) required to correctly complete blanks (i) to (v) in the following passage. The words from the list are to be used only once. Write the answers as (a) (i), (ii), (iii) and so on. Do not copy the passage.*

[ammonia, ammonium carbonate, carbon dioxide, hydrogen, hydronium, hydroxide, precipitate, salt, water] **[5]**

(i) *A solution M turns blue litmus red, so it must contain (i) _____ ions; another solution O turns red litmus blue and hence, must contain (ii) _____ ions.*

(ii) *When solutions M and O are mixed together, the products will be (iii) _____ and (iv) _____ .*

(iii) *If a piece of magnesium was put into a solution M, (v) _____ gas would be evolved.*

(b) *Identify the gas evolved in the following reactions when :* **[5]**

(i) *Sodium propionate is heated with soda lime.*

(ii) *Potassium sulphite is treated with dilute hydrochloric acid.*

(iii) *Sulphur is treated with concentrated nitric acid.*

(iv) *A few crystals of KNO_3 are heated in a hard glass test tube.*

(v) *Concentrated hydrochloric acid is made to react with manganese dioxide.*

(c) *State one appropriate observation for each of the following :* **[5]**

(i) *Concentrated sulphuric acid is added drop wise to a crystal of hydrated copper sulphate.*

(ii) *Copper sulphide is treated with dilute hydrochloric acid.*

(iii) *Excess of chlorine gas is reacted with ammonia gas.*

(iv) *A few drops of dilute hydrochloric acid are added to silver nitrate solution, followed by addition of ammonium hydroxide solution.*

(v) *Electricity is passed through molten lead bromide.*

(d) *Give suitable chemical terms for the following :* **[5]**

(i) *A bond formed by a shared pair of electrons with both electrons coming from the same atom.*

(ii) *A salt formed by incomplete neutralization of an acid by a base.*

(iii) *A reaction in which hydrogen of an alkane is replaced by a halogen.*

(iv) *A definite number of water molecules bound to some salts.*

(v) *The process in which a substance absorbs moisture from the atmospheric air to become moist, and ultimately dissolves in the absorbed water.*

(e) *Give a chemical test to distinguish between the following pairs of compounds :* **[5]**

(i) *Sodium chloride solution and sodium nitrate solution.*

(ii) *Hydrogen chloride gas and hydrogen sulphide gas.*

(iii) *Ethene gas and ethane gas.*

(iv) *Calcium nitrate solution and zinc nitrate solution.*

(v) *Carbon dioxide gas and sulphur dioxide gas.*

(f) *Choose the most appropriate answer from the following options :* **[10]**

(i) *Among the period 2 elements, the element which has high electron affinity is :*

(A) Lithium *(B) Carbon*

(C) Chlorine *(D) Fluorine*

(ii) *Among the following compounds identify the compound that has all three bonds (ionic, covalent and coordinate bond).*

(A) Ammonia

(B) Ammonium chloride

(C) Sodium hydroxide

(D) Calcium chloride.

(iii) *Identify the statement that is incorrect about alkanes :*

(A) They are hydrocarbons.

(B) There is a single covalent bond between carbon and hydrogen.

(C) They can undergo both substitution as well as addition reactions.

(D) On complete combustion they produce carbon dioxide and water.

(iv) Which of these will act as a non-electrolyte ?

(A) Liquid carbon tetrachloride

(B) Acetic acid

(C) Sodium hydroxide aqueous solution acid

(D) Potassium chloride aqueous solution

(v) Which one of the following will not produce an acid when made to react with water ?

(A) Carbon monoxide (B) Carbon dioxide

(C) Nitrogen dioxide (D) Sulphur trioxide

(vi) Identify the metallic oxide which is amphoteric in nature :

(A) Calcium oxide (B) Barium oxide

(C) Zinc oxide (D) Copper(II) oxide

(vii) In the given equation identify the role played by concentrated sulphuric acid

$S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$:

(A) Non-volatile acid (B) Oxidising agent

(C) Dehydrating agent (D) None of the above

(viii) Nitrogen gas can be obtained by heating :

(A) Ammonium nitrate (B) Ammonium nitrite

(C) Magnesium nitride (D) Ammonium chloride

(ix) Which of the following is not a typical property of an ionic compound ?

(A) High melting point

(B) Conducts electricity in the molten and in the aqueous solution state.

(C) They are insoluble in water.

(D) They exist as oppositely charged ions even in the solid state.

(x) The metals zinc and tin are present in the alloy :

(A) Solder (B) Brass

(C) Bronze (D) Duralumin

(g) Solve the following :

(i) What volume of oxygen is required to burn completely 90 dm^3 of butane under similar conditions of temperature and pressure ?

$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ **[2]**

(ii) The vapour density of a gas is 8. What would be the volume occupied by 24.0 g of the gas at STP ? **[2]**

(iii) A vessel contains X number of molecules of hydrogen gas at a certain temperature and pressure. How many molecules of nitrogen gas would be present in the same vessel under the same conditions of temperature and pressure ? **[1]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a)

Group number	IA 1	IIA 2	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	0 18
2^{nd} period	Li		D			O	J	Ne
	A	Mg	E	Si		H	M	
	R	T	I		Q	u		y

- In this table H does not represent hydrogen.
- Some elements are given in their own symbol and position in the periodic table.
- While others are shown with a letter.

With reference to the table answer the following questions :

(i) Identify the most electronegative element. **[1]**

(ii) Identify the most reactive element of group 1. **[1]**

(iii) Identify the element from period 3 with least atomic size. **[1]**

(iv) How many valence electrons are present in Q ? **[1]**

(v) Which element from group 2 would have the least ionization energy ? **[1]**

(vi) Identify the noble gas of the fourth period. **[1]**

(vii) In the compound between A and H what type of bond would be formed and give the molecular formula for the same. **[2]**

(b) Compare the compounds carbon tetrachloride and sodium chloride with regard to solubility in water and electrical conductivity. **[2]**

Question 3.

(a) Choosing the substances from the list given below, write balanced chemical equations for the reactions which would be used in the laboratory to obtain the following salts :

Dilute Sulphuric acid	*Copper*	*Copper(II) carbonate*
	Iron	*Sodium carbonate*
	Sodium	*Sodium chloride*
		Zinc nitrate

(i) *Sodium sulphate*
(ii) *Zinc carbonate*
(iii) *Copper(II) sulphate*
(iv) *Iron(II) sulphate.* **[4]**

(b) *State two relevant observations for each of the following :* **[6]**

(i) *Ammonium hydroxide solution is added to copper (II) nitrate solution in small quantities and then in excess.*

(ii) *Ammonium hydroxide solution is added to zinc nitrate solution in minimum quantities and then in excess.*

(iii) *Lead nitrate crystals are heated in a hard glass test tube.*

Question 4.

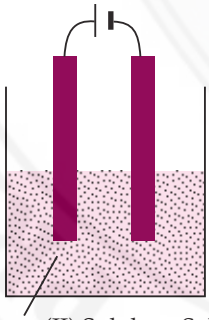
(a) *Copper sulphate solution is electrolysed using copper electrodes.*

Study the diagram given below and answer the question that follows :

(i) *Which electrode to your left or right is known as the oxidising electrode and why ?* **[2]**

(ii) *Write the equation representing the reaction that occurs.* **[1]**

(iii) *State two appropriate observations for the above electrolysis reaction.* **[2]**



Copper (II) Sulphate Solution

(b)

	X	*Y*
Normal Electronic Configuration	*2, 8, 7*	*2, 8, 2*
Nature of oxide	*Dissolves in water and turns blue litmus red.*	*Very low solubility in water. Dissolves in hydrochloric acid.*
Tendency for oxidising and reducing reactions	*Tends to oxidise elements and compounds.*	*Tends to act as a reducing agent.*
Electrical and Thermal conductivity	*Very poor electrical conductor poor thermal conductivity.*	*Good electrical conductor good thermal conductor.*
Tendency to form alloys and amalgams	*No tendency to form alloys.*	*Forms alloys.*

Using the information above, complete the following : **[5]**

(i) _____ *is the metallic element.*

(ii) *Metal atoms tend to have a maximum of* _____ *electrons in the outermost energy level.*

(iii) *Non-metallic elements tend to form* _____ *oxides while metals tend to form* _____ *oxides.*

(iv) *Non-metallic elements tend to be* _____ *conductors of heat and electricity.*

(v) *Metals tend to* _____ *electrons and act as* _____ *agents in their reactions with elements and compounds.*

Question 5.

(a) *Give balanced equations for each of the following :*

(i) *Reduction of hot copper (II) oxide to copper using ammonia gas.*

(ii) *Oxidation of carbon with concentrated nitric acid.*

(iii) *Dehydration of concentrated sulphuric acid with sugar crystals.* **[3]**

(b) *Copy and complete the following table relating to important industrial process :*

Name of the process	*Temperature*	*Catalyst*	*Equation for the catalyzed reaction*
Haber's process			

[3]

(c) *The following questions relate to the extraction of aluminium by electrolysis :* **[4]**

(i) *Name the other aluminium containing compound added to alumina and state its significance.*

(ii) *Give the equation for the reaction that takes place at the cathode.*

(iii) *Explain why is it necessary to renew the anode periodically ?*

ICSE Chemistry–2013

Question 6.

(a) *Give balanced equations for the laboratory preparations of the following organic compounds :* **[4]**

(i) *A saturated hydrocarbon from iodomethane.*

(ii) *An unsaturated hydrocarbon from an alcohol.*

(iii) *An unsaturated hydrocarbon from calcium carbide.*

(iv) *An alcohol from ethyl bromide.*

(b) *Give the structural formulae for the following :* **[3]**

(i) *An isomer of n-butane.*

(ii) *2-propanol.*

(iii) *Diethyl ether.*

(c) *Give reasons for the following :* **[3]**

(i) *Methane does not undergo addition reactions, but ethene does.*

(ii) *Ethyne is more reactive than ethane.*

(iii) *Hydrocarbons are excellent fuels.*

Question 7.

(a) *O_2 is evolved by heating $KClO_3$ using MnO_2 as a catalyst*

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$

(i) *Calculate the mass of $KClO_3$ required to produce 6.72 litre of O_2 at S.T.P. [atomic masses of K = 39, Cl = 35.5, O = 16].* **[2]**

(ii) *Calculate the number of moles of oxygen present in the above volume and also the number of molecules.* **[2]**

(iii) *Calculate the volume occupied by 0.01 mole of CO_2 at S.T.P.* **[1]**

(b) *Identify the following substances which are underlined :*

(i) *An alkaline gas which produces dense white fumes when reacted with hydrogen chloride gas.*

(ii) *An acid which is present in vinegar.*

(iii) *A gas which does not conduct electricity in the liquid state but conducts electricity when dissolved in water.*

(iv) *A dilute mineral acid which forms a white precipitate when treated with barium chloride solution.*

(v) *The element which has the highest ionization potential.* **[5]**

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Hydronium **(ii)** Hydroxide **(iii)** Salt **(iv)** Water **(v)** Hydrogen

(b) **(i)** Ethane **(ii)** Sulphur dioxide **(iii)** Nitrogen dioxide **(iv)** Oxygen **(v)** Chlorine

(c) **(i)** Crystals of hydrated copper sulphate turn into white amorphous copper sulphate powder.

(ii) Rotten egg smell of hydrogen sulphide gas will be given out. Hydrogen sulphide gas will be given out which smells like rotten eggs and turns moist blue litmus paper red.

(iii) Yellow coloured highly explosive liquid nitrogen trichloride and hydrogen chloride gas is given out.

(iv) A white precipitate of silver chloride is formed which dissolves in NH_4OH.

(v) Red coloured bromine vapours with high irritating smell evolve at anode and a white lead metal deposits at cathode.

(d) **(i)** Co-ordinate bond **(ii)** Acid salt **(iii)** Halogenation **(iv)** Water of crystallisation **(v)** Deliquescence

(e) **(i)**

Test	Sodium Chloride Solution	Sodium Nitrate Solution
On adding silver nitrate solution.	White ppt. of AgCl is formed which dissolves in NH_4OH.	No reaction takes place.

(ii)

Test	Hydrogen Chloride Gas	Hydrogen Sulphide Gas
A rod dipped in ammonium hydroxide is brought near the gas.	Dense white fumes of ammonium chloride are formed.	No reaction takes place.

(iii)

Test	Ethene	Ethane
On pouring few drops of bromine solution in carbon tetrachloride with the hydrocarbon.	The reddish brown bromine solution gets decolourised.	No change is observed.

(iv)

Test	Calcium Nitrate Solution	Zinc Nitrate Solution
Ammonium hydroxide is added first dropwise and then in excess.	No precipitation of $Ca(OH)_2$ occurs even with addition of excess of NH_4OH.	Gelatinous white ppt. of $Zn(OH)_2$ is formed which is soluble in excess of NH_4OH.

(v)

Test	Carbon dioxide Gas	Sulphur dioxide Gas
The gas is passed into acidified solution of orange coloured $K_2Cr_2O_7$ solution.	No change is observed.	Orange solution of $K_2Cr_2O_7$ turns green.

(f) **(i)** (D) Fluorine

(ii) (B) Ammonium chloride

(iii) (C) They can undergo both substitution as well as addition reactions.

(iv) (A) Liquid carbon tetrachloride

(v) (A) Carbon monoxide

(vi) (C) Zinc oxide

(vii) (B) Oxidising agent

(viii) (B) Ammonium nitrite

(ix) (C) They are insoluble in water

(x) (C) Bronze

(g) **(i)** $2C_4H_{10} + 13O_2 \longrightarrow 8CO_2 + 10H_2O$

2 vol. 13 vol.

$\because$ 2 vol. of butane require 13 vol. of oxygen (according to Gay Lussac's Law)

$\therefore$ 90 dm^3 of butane require $= \frac{13 \times 90}{2} = 585\ dm^3$

585 dm^3 of oxygen is required to burn 90 dm^3 of butane.

(ii) Given, (Vapour Density) V.D. = 8

$\therefore$ Molecular weight = 2 × V.D. = 2 × 8 = 16

No. of moles in 24.0 g of gas

$$= \frac{\text{Wt.}}{\text{Mol.wt}} = \frac{24.0}{16} = 1.5 \text{ moles}$$

At S.T.P., 1 mole of a gas occupies 22.4 *l*.

$\therefore$ 1.5 moles (or 24.0 g) of the gas will occupy $= \frac{22.4 \times 1.5}{1} = 33.6\ l$.

(iii) 'X' number of molecules. (According to Avogadro's law)

SECTION-II

Answer 2.

(a) **(i)** J **(ii)** R **(iii)** M **(iv)** Five (v) T

(vi) *y*-Krypton

(vii) Ionic bond. Molecular formula → A_2H

(b)

S. No.	Carbon Tetrachloride (forms covalent bond)	Sodium Chloride (forms ionic bond)
Solubility in water	Insoluble in water.	Soluble in water.
Electrical conductivity	Non conductor of electricity.	Good conductor of electricity in molten state and in aqueous solution.

Answer 3.

(a) **(i)** $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2\uparrow$

Sodium carbonate; Dil sulphuric acid; Sodium sulphate

(ii) $Zn(NO_3)_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2NaNO_3$

Zinc nitrate; Sodium carbonate; Zinc carbonate; Sodium nitrate

(iii) $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2\uparrow$

Copper Carbonate; Dil. sulphuric acid; Copper (II) Sulphate

(iv) $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

Iron; Dil. Sulphuric acid; Iron (II) sulphate

(b) **(i)** Initially a light blue ppt. is formed which on addition of excess of ammonium hydroxide dissolves and a deep inky blue solution is formed.

(ii) Initially a white ppt. is formed which disappears (dissolves) in excess of ammonium hydroxide.

(iii) A reddish brown gas is evolved and a yellow residue is left in the test tube.

Answer 4.

(a) **(i)** Electrode on the left side is the oxidising electrode because copper atoms lose electrons at this electrode. *i.e.*, it is called anode.

(ii) At anode : $Cu - 2e^- \rightarrow Cu^{2+}$

At cathode : $Cu^{2+} + 2e^- \rightarrow Cu$

(iii) 1. Reddish brown copper metal is deposited at cathode so anode becomes thin and cathode grows thick gradually.
2. Blue colour of aqueous copper (II) sulphate solution remains unchanged because the effective concentration of copper ions in solution remains the same.

(b) **(i)** Y **(ii)** eight
(iii) Acidic, Basic **(iv)** Bad
(v) Lose, Reducing

Answer 5.

(a) **(i)** $3CuO + 2NH_3 \longrightarrow 3Cu + 3H_2O + N_2\uparrow$

(ii) $C + 4HNO_3 \longrightarrow CO_2 + 2H_2O + 4NO_2\uparrow$

(iii) $C_{12}H_{22}O_{11} \xrightarrow{\text{Conc. } H_2SO_4} 12C + 11H_2O$

(b)

Name of process	Temperature	Catalyst	Equation for the catalysed reaction
Haber's process	(450–500) °C	Finely divided iron	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ + Heat

(c) **(i)** Cryolite. Molten cryolite acts as solvent for alumina and also lowers the fusion temperature from 2050°C to 950°C and enhances conductivity and thereby saves electrical energy.

(ii) $2Al^{3+} + 6e^- \rightarrow 2Al$.

(iii) During electrolysis oxygen gas is formed at anode which oxidises graphite or carbon anode to carbon dioxide, so it is necessary to replace anode periodically.

Answer 6.

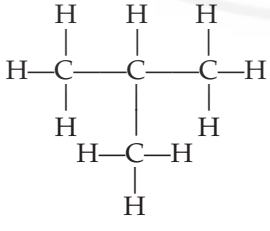
(a) **(i)** $CH_3I + 2[H] \xrightarrow[C_2H_5OH]{Zn/Hg} CH_4 + HI$
Iodomethane or methyl iodide — Methane

(ii) $C_2H_5OH \xrightarrow[\text{Conc. } H_2SO_4]{170°C} C_2H_4 + H_2O$
Ethanol — Ethene

(iii) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$
Calcium carbide — Ethyne

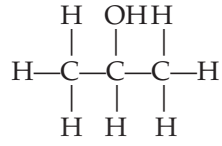
(iv) $C_2H_5Br + KOH(aq) \longrightarrow C_2H_5OH + KBr$
Ethyl bromide — Ethanol

(b) **(i)**



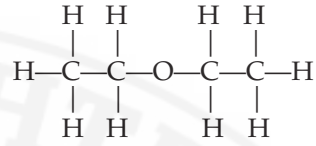
2-methyl propane (an isomer of *n*-butane)

(ii)



2-propanol

(iii)



Diethyl ether

(c) **(i)** Methane does not undergo addition reactions, but ethene does because methane is saturated hydrocarbon while ethene is an unsaturated hydrocarbon. Addition reactions are characteristic properties of unsaturated hydrocarbons.

(ii) Ethane is a saturated hydrocarbon, while ethyne is an unsaturated hydrocarbon with triple bond which can undergo addition reaction, hence is more reactive than ethane.

(iii) Hydrocarbons are excellent fuels because they ignite easily at low temperature and liberate large amount of heat without leaving any residue.

Answer 7.

(a) **(i)** Molecular weight of $KClO_3$
$= 39 + 35{\cdot}5 + 16 \times 3 = 122.5$

$2\,KClO_3 \longrightarrow 2KCl + 3O_2$

2 moles — 3 moles

2×122.5 g — 3×22.4 *l* at S.T.P

$\because$ 3×22.4 *l* of oxygen is produced from 2×122.5 g of $KClO_3$

$\therefore$ 6.72 *l* of oxygen is produced from

$$\frac{2 \times 122.5 \times 6.72}{3 \times 22.4} = 24{\cdot}5 \text{ g}$$

24.5 g of $KClO_3$ is required to produce 6.72 *l* of O_2 at S.T.P.

(ii) At S.T.P., 22·4 *l* of a gas = 1 mole

$$\therefore\ 6.72\ l = \frac{1 \times 6.72}{22.4} = 0.3 \text{ moles}$$

One mole contains $= 6 \times 10^{23}$ molecules

$\therefore$ 0.3 mole contains $= 6 \times 10^{23} \times 0{\cdot}3$
$= 1.8 \times 10^{23}$ molecules.

6.72 *l* of oxygen contains 0·3 moles and hence contains 1.8×10^{23} molecules.

(iii) At S.T.P., one mole of CO_2 occupies 22.4 *l*

$\therefore$ 0.01 mole of CO_2 occupies
$= 22.4 \times 0.01 = 0.224\ l$

0.01 mole of CO_2 will occupy 0.224 *l* at S.T.P.

(b) **(i)** Ammonia **(ii)** Acetic acid
(iii) Hydrogen chloride gas
(iv) Dilute sulphuric acid **(v)** Helium

CHEMISTRY

2012

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Name the gas in each of the following :* **[5]**

(i) *The gas evolved on reaction of aluminium with boiling concentrated caustic alkali solution.*

(ii) *The gas produced when excess ammonia reacts with chlorine.*

(iii) *A gas which turns acidified potassium dichromate clear green.*

(iv) *The gas produced when copper reacts with concentrated nitric acid.*

(v) *The gas produced on reaction of dilute sulphuric acid with a metallic sulphide.*

(b) *State one observation for each of the following :* **[5]**

(i) *Excess ammonium hydroxide solution is added to lead nitrate solution.*

(ii) *Bromine vapours are passed into a solution of ethyne in carbon tetrachloride.*

(iii) *A zinc granule is added to copper sulphate solution.*

(iv) *Zinc nitrate crystals are strongly heated.*

(v) *Sodium hydroxide solution is added to ferric chloride solution at first a little and then in excess.*

(c) *Some word/words are missing in the following statements. You are required to rewrite the statements in the correct form using the appropriate word/words :* **[5]**

(i) *Ethyl alcohol is dehydrated by sulphuric acid at a temperature of about 170°C.*

(ii) *Aqua regia contains one part by volume of nitric acid and three parts by volume of hydrochloric acid.*

(iii) *Magnesium nitride reacts with water to liberate ammonia.*

(iv) *Cations migrate during electrolysis.*

(v) *Magnesium reacts with nitric acid to liberate the hydrogen gas.*

(d) *Choose the correct answer from the options given below :* **[5]**

(i) *An element in period-3 whose electron affinity is zero.*

(A) *Neon* (B) *Sulphur*
(C) *Sodium* (D) *Argon*

(ii) *An alkaline earth metal.*

(A) *Potassium* (B) *Calcium*
(C) *Lead* (D) *Copper*

(iii) *The vapour density of carbon dioxide [C = 12, O = 16]*

(A) *12* (B) *16*
(C) *44* (D) *22*

(iv) *Identify the weak electrolyte from the following :*

(A) *Sodium chloride solution*
(B) *Dilute hydrochloric acid*
(C) *Dilute sulphuric acid*
(D) *Aqueous acetic acid*

(v) *Which of the following metallic oxides cannot be reduced by normal reducing agents ?*

(A) *Magnesium oxide*
(B) *Copper(II) oxide*
(C) *Zinc oxide*
(D) *Iron(III) oxide*

(e) *Match the following :* **[5]**

Column A	*Column B*
1. *Acid salt*	A. *Ferrous ammonium sulphate*
2. *Double salt*	B. *Contains only ions*
3. *Ammonium hydroxide solution*	C. *Sodium hydrogen sulphate*
4. *Dilute hydrochloric acid*	D. *Contains only molecules*
5. *Carbon tetrachloride*	E. *Contains ions and molecules*

(f) *Give the structural formula for the following :*

(i) *Methanoic acid* **(ii)** *Ethanal*
(iii) *Ethyne* **(iv)** *Acetone*
(v) *2-methyl propane.* **[5]**

(g) *Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation :*

$$P + 5HNO_3(conc.) \rightarrow H_3PO_4 + H_2O + 5NO_2$$

If 9.3 g of phosphorus was used in the reaction, calculate :

(i) *Number of moles of phosphorus taken.* [1]

(ii) *The mass of phosphoric acid formed.* [2]

(iii) *The volume of nitrogen dioxide produced at S.T.P.*

[H = 1, N = 14, P = 31, O = 16] [2]

(h) *Give reasons for the following :* [5]

(i) *Iron is rendered passive with fuming nitric acid.*

(ii) *An aqueous solution of sodium chloride conducts electricity.*

(iii) *Ionization potential of the element increases across a period.*

(iv) *Alkali metals are good reducing agents.*

(v) *Hydrogen chloride gas cannot be dried over quick lime.*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Some properties of sulphuric acid are listed below. Choose the role played by sulphuric acid as A, B, C or D which is responsible for the reactions (i) to (v). Some role/s may be repeated.* [5]

(A) Dilute acid

(B) Dehydrating agent

(C) Non-volatile acid

(D) Oxidising agent.

(i) $CuSO_4.5H_2O \xrightarrow{Conc.\ H_2SO_4} CuSO_4 + 5H_2O$

(ii) $S + H_2SO_4\,(conc.) \longrightarrow 3SO_2 + 2H_2O$

(iii) $NaNO_3 + H_2SO_4\,(conc.) \xrightarrow{200^\circ C} NaHSO_4 + HCl$

(iv) $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$

(v) $Zn + 2H_2SO_4\,(conc.) \longrightarrow ZnSO_4 + SO_2 + 2H_2O$

(b) *Give balanced equations for the following reactions :*

(i) *Dilute nitric acid and copper carbonate.* [5]

(ii) *Concentrated hydrochloric acid and potassium permanganate solution.*

(iii) *Ammonia and oxygen in the presence of a catalyst.*

(iv) *Silver nitrate solution and sodium chloride solution.*

(v) *Zinc sulphide and dilute sulphuric acid.*

Question 3.

(a) *Select the correct answer from the list given in brackets :* [5]

(i) *An aqueous electrolyte consists of the ions mentioned in the list, the ion which could be discharged most readily during electrolysis.*

[Fe^{2+}, Cu^{2+}, Pb^{2+}, H^+].

(ii) *The metallic electrode which does not take part in an electrolytic reaction. [Cu, Ag, Pt, Ni].*

(iii) *The ion which is discharged at the cathode during the electrolysis of copper sulphate solutions using copper electrodes as anode and cathode.*

[Cu^{2+}, OH^-, SO_4^{2-}, H^+].

(iv) *When dilute sodium chloride is electrolysed using graphite electrodes, the cation is discharged at the cathode most readily.* *[Na^+, OH^-, H^+, Cl^-]*

(v) *During silver plating of an article using potassium argentocyanide as an electrolyte, the anode material should be [Cu, Ag, Pt, Fe].* [5]

(b) *Match the properties and uses of alloys in List I with the appropriate answer from List 2 :* [5]

	List 1		List 2
(i)	*The alloy contains Cu and Zn, is hard, silvery and is used in decorative articles.*	A.	*Duralumin*
(ii)	*It is stronger than aluminium, light and is used in making light tools.*	B.	*Brass*
(iii)	*It is lustrous, hard, corrosion resistant and used in surgical instruments.*	C.	*Bronze*
(iv)	*Tin lowers the melting point of the alloy and is used for soldering purpose.*	D.	*Stainless steel*
(v)	*The alloy is hard, brittle, takes up polish and is used for making statues.*	E.	*Solder*

Question 4.

(a) *Identify the anion present in the following compounds :* [4]

(i) *Compound X on heating with copper turnings and concentrated sulphuric acid liberates a reddish brown gas.*

(ii) *When a solution of compound Y is treated with silver nitrate solution a white precipitate is obtained which is soluble in excess of ammonium hydroxide solution.*

(iii) *Compound Z which on reacting with dilute sulphuric acid liberates a gas which turns lime water milky, but the gas has no effect on acidified potassium dichromate solution.*

(iv) *Compound L on reacting with barium chloride solution gives a white precipitate insoluble in dilute hydrochloric acid or dilute nitric acid.*

(b) *State one chemical test between each of the following pairs :* **[3]**

(i) *Sodium carbonate and sodium sulphite.*

(ii) *Ferrous nitrate and lead nitrate*

(iii) *Manganese dioxide and copper (II) oxide.*

(c) *Draw an electron dot diagram to show the structure of hydronium ion. State the type of bonding present in it.* **[3]**

Question 5.

(a) **(i)** *67.2 litre of hydrogen combines with 44.8 litres of nitrogen to form ammonia under specific conditions as :*

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

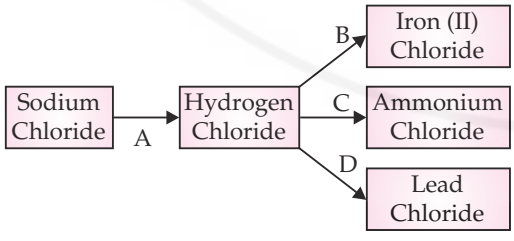
Calculate the volume of ammonia produced. What is the other substance, if any, that remains in the resultant mixture ? **[2]**

(ii) *The mass of 5.6 dm^3 of a certain gas at S.T.P. is 12.0 g. Calculate the relative molecular mass of the gas.* **[2]**

(iii) *Find the total percentage of magnesium in magnesium nitrate crystals, $Mg(NO_3)_2.6H_2O$.*

[Mg = 24, N = 14, O = 16 and H = 1] **[2]**

(b) *Refer to the flow chart diagram below and give balanced equations with conditions, if any, for the following conversions A to D.* **[4]**



Question 6.

(a) *Name the following metals :* **[3]**

(i) *A metal present in cryolite other than sodium.*

(ii) *A metal which is unaffected by dilute or concentrated acids.*

(iii) *A metal present in period 3, group 1 of the periodic table.*

(b) *The following questions are relevant to the extraction of aluminium :* **[3]**

(i) *State the reason for addition of caustic alkali to bauxite ore during purification of bauxite.*

(ii) *Give a balanced chemical equation for the above reaction.*

(iii) *Alongwith cryolite and alumina, another substance is added to the electrolyte mixture. Name the substance and give one reason for the addition.*

(c) *The following questions are based on the preparation of ammonia gas in the laboratory :* **[3]**

(i) *Explain why ammonium nitrate is not used in the preparation of ammonia.*

(ii) *Name the compound normally used as a drying agent during the process.*

(iii) *How is ammonia gas collected ?*

(iv) *Explain why it is not collected over water ?* **[4]**

Question 7.

(a) *From the following organic compounds given below, choose one compound in each case which relates to the description [i] to [iv] :*

[Ethyne, ethanol, acetic acid, ethene, methane] **[4]**

(i) *An unsaturated hydrocarbon used for welding purposes.*

(ii) *An organic compound whose functional group is carboxyl.*

(iii) *A hydrocarbon which on catalytic hydrogenation gives a saturated hydrocarbon.*

(iv) *An organic compound used as a thermometric liquid.*

(b) **(i)** *Why is pure acetic acid known as glacial acetic acid ?*

(ii) *Give a chemical equation for the reaction between ethyl alcohol and acetic acid.* **[2]**

(c) *There are three elements E, F, G with atomic numbers 19, 8 and 17 respectively.*

(i) *Classify the elements as metals and non-metals.* **[3]**

(ii) *Give the molecular formula of the compound formed between E and G and state the type of chemical bond in this compound.* **[1]**

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Hydrogen gas
(ii) Nitrogen gas
(iii) Sulphur dioxide gas
(iv) Nitrogen dioxide gas
(v) Hydrogen sulphide gas

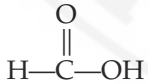
(b) **(i)** A white ppt. of lead hydroxide is formed which is soluble in excess of NH_4OH.
(ii) A colourless solution is obtained and brown colour of bromine vapours disappears.
(iii) A red metal starts precipitating and the blue colour of the copper sulphate solution fades due to the formation of colourless zinc sulphate.
(iv) A reddish brown gas is liberated.
(v) A reddish brown ppt. of ferric hydroxide is formed which remains insoluble in excess of sodium hydroxide.

(c) **(i)** Ethyl alcohol is dehydrated by concentrated sulphuric acid at a temperature of about 170°C to form ethylene.
(ii) Aqua regia contains a mixture of one part by volume of concentrated nitric acid and three parts by volume of concentrated hydrochloric acid.
(iii) Magnesium nitride reacts with warm water to liberate ammonia.
(iv) Cations migrate to cathode during electrolysis.
(v) Magnesium reacts with very dilute and cold nitric acid to liberate hydrogen gas.

(d) **(i)** (D) Argon **(ii)** (B) Calcium
(iii) (D) 22
(iv) (D) Aqueous acetic acid
(v) (A) Magnesium oxide

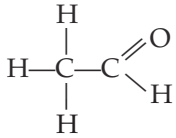
(e) **1.** (C), **2.** (A), **3.** (E), **4.** (B), **5.** (D)

(f) **(i)**



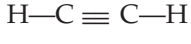
Methanoic acid

(ii)



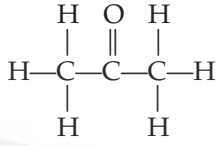
Ethanal

(iii)



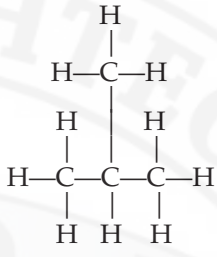
Ethyne

(iv)



Acetone

(v)



2-methyl propane

(g) **(i)** Number of moles

$$= \frac{\text{Given weight}}{\text{Molecular wt. of substance}}$$

$$= \frac{9.3}{31} = 0.3$$

0·3 moles of phosphorus is taken.

(ii) Molecular weight of H_3PO_4

$= (1 \times 3) + (31) + (4 \times 16)$

$= 3 + 31 + 64 = 98$ g

$\because$ 31 g of phosphorus gives 98 g of phosphoric acid

$\therefore$ 9.3 g of phosphorus gives

$$= \frac{98 \times 9.3}{31}$$

= 29.4 g of phosphoric acid

(iii) From the equation :

1 mole of phosphorus liberates 5 moles of nitrogen dioxide

0·3 mole of phosphorus liberates

$= 5 \times 0.3$

$= 1.5$ moles of NO_2

Now, at S.T.P. 1 mole of NO_2 occupies 22.4 *l*.

$\therefore$ 1.5 mole of NO_2 occupies

$= 22.4 \times 1.5 = 33.6$ *l*

(h) **(i)** Due to the formation of a thin protective layer of insoluble iron oxide (Fe_3O_4) which stops the reaction.

(ii) An aqueous solution of sodium chloride conducts electricity because in aqueous solution, Na^+ and Cl^- ions become free and mobile.

(iii) Ionization potential of the element increases across a period because across a period, atomic

size decreases and nuclear charge increases, so more energy is required to remove a valence electron.

(iv) Alkali metals are good reducing agents because they combine exothermically with electronegative elements to form very stable compounds.

(v) Hydrogen chloride gas cannot be dried over quick lime because quick lime is basic in nature and combines with moist hydrogen chloride gas to form calcium chloride.

SECTION-II

Answer 2.

(a) **(i)** (B) Dehydrating agent
(ii) (D) Oxidising agent
(iii) (C) Non-volatile acid
(iv) (A) Dilute acid
(v) (D) Oxidising agent

(b) **(i)** $CuCO_3 + 2HNO_3 \longrightarrow Cu(NO_3)_2 + H_2O$
Copper carbonate — Copper nitrate
$+ CO_2\uparrow$

(ii) $2KMnO_4 + 16HCl \longrightarrow$
Potassium permanganate — Conc.
$2MnCl_2 + 2KCl + 8H_2O + 5Cl_2$
Manganese chloride — Potatssium chloride
$+ 8H_2O + 5Cl_2$

(iii) $4NH_3 + 5O_2 \xrightarrow{Pt,\ 800°C} 4NO + 6H_2O$
Nitric oxide
$+$ Heat

(iv) $AgNO_3 + NaCl \longrightarrow AgCl\downarrow + NaNO_3$
Silver Nitrate — Silver chloride — Sodium Nitrate

(v) $ZnS + H_2SO_4 \longrightarrow ZnSO_4 + H_2S\uparrow$
Zinc sulphide — Zinc sulphate — Hydrogen sulphide gas

Answer 3.

(a) **(i)** Cu^{2+} **(ii)** Pt
(iii) Cu^{2+} at cathode **(iv)** H^+
(v) Ag (Pure silver)

(b) **(i)** B **(ii)** A **(iii)** D
(iv) E **(v)** C

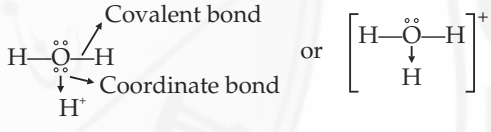
Answer 4.

(a) **(i)** NO_3^- ion, **(ii)** Cl^- ion,
(iii) CO_3^{2-} ion, **(iv)** SO_4^{2-} ion

(b) **(i)** Sodium carbonate when treated with dil. H_2SO_4 will liberate colourless odourless gas with brisk effervescence. The gas will turn lime water milky and will have no effect on acidified potassium permanganate solution.
Sodium sulphite when treated with dil. H_2SO_4 will liberate a colourless gas having suffocating smell of burning sulphur. The gas will turn acidified potassium permanganate solution from pink to colourless.

(ii) Aqueous ferrous nitrate when treated with NaOH solution gives a dirty green ppt. and is insoluble in excess of NaOH.
Aqueous lead nitrate when treated with NaOH solution gives a white ppt. which dissolves in excess of NaOH.

(iii) When manganese dioxide is heated with conc. HCl, a pungent smelling greenish yellow chlorine gas is evolved which turns iodide paper blue-black.
When copper oxide is heated with conc. HCl, no such gas is evolved.

(c) 

Structure of hydronium ion

The type of bonding in hydronium ion is coordinate bonding.

Answer 5.

(a) **(i)** $N_2 + 3H_2 \longrightarrow 2NH_3$
1 vol. — 3 vol. — 2 vol.
22.4 *l* — 67.2 *l* — 44.8 *l*
According to Gay-Lussac's law :
3 volumes of H_2 will give 2 vol. of NH_3.
$\therefore$ 67.2 *l* of H_2 will give

$$= \frac{2 \times 67.2}{3}$$

$= 44.8\ l$ of NH_3

At the same time
3 vol. of H_2 will react with 1 vol. of N_2
$\therefore$ 67.2 *l* of H_2 will react

$$= \frac{1}{3} \times 67.2$$

$= 22.4\ l$ of N_2

$\therefore$ (44.8 – 22·4) = 22.4 *l* of N_2 will be left unreacted in the mixture.

(ii) According to molar volume concept, weight of 22.4 *l* of a gas at S.T.P. is equal to molecular mass of the gas. Now,

$\because$ 5.6 *l* of gas at S.T.P. weight 12.0 g

$\therefore$ 22.4 *l* of gas at S.T.P. weight

$$= \frac{12 \times 22.4}{5.6} = 48 \text{ g}$$

Hence, molecular mass of the gas is 48 g.

(iii) Relative molecular mass of $Mg(NO_3)_2 \cdot 6H_2O$

$= (24) + (14 \times 2) + (16 \times 6) + (12 \times 1) + (6 \times 16)$

$= 24 + 28 + 96 + 12 + 96 = 256$

Amount of Mg in 256 g of magnesium nitrate is 24 g

$\therefore$ % of Mg in $Mg(NO_3)_2 \cdot 6H_2O$

$$= \frac{24}{256} \times 100 = 9.38\%$$

(b) A. $NaCl + H_2SO_4 \xrightarrow{\Delta \ 200°C} Na_2SO_4 + HCl\uparrow$

conc. — Hydrogen chloride

B. $2HCl(g) + Fe \longrightarrow FeCl_2 + H_2\uparrow$

Iron (II) chloride

C. $HCl(g) + NH_3(g) \longrightarrow NH_4Cl$

Ammonium chloride

D. $2HCl + Pb(NO_3)_2 \longrightarrow PbCl_2\downarrow + 2HNO_3$

dil. aq. — Lead chloride

Answer 6.

(a) (i) Aluminium

(ii) Platinum

(iii) Sodium

(b) (i) Caustic alkali : Caustic soda or sodium hydroxide dissolves aluminium oxide forming soluble sodium aluminate while impurities remain insoluble and precipitate as red mud.

(ii) $Al_2O_3 \cdot 2H_2O + 2NaOH \xrightarrow{\Delta} 2NaAlO_2 + 3H_2O$

Bauxite ore — Sodium Aluminate

(iii) The name of substance is Fluorspar (CaF_2) and it increases conductivity of the electrolyte, since alumina is almost a non-conductor of electricity.

(c) (i) Pure acetic acid is known as glacial acetic acid because ammonium nitrate is explosive in nature and dissociates into nitrous oxide and water on heating.

(ii) Quick lime or calcium oxide (CaO).

(iii) By downward displacement of air.

(iv) Ammonium nitrate is not collected over water because it is highly soluble in water.

Answer 7.

(a) (i) Ethyne, **(ii)** Aceticacid, **(iii)** Ethene, **(iv)** Ethanol.

(b) (i) Ammonium nitrate is not used in the preparation of ammonia because on cooling below its melting point (17 °C) or below room temperature, it solidifies and forms little ice-like crystals.

(ii) $CH_3COOH + C_2H_5OH \longrightarrow CH_3COOC_2H_5 + H_2O$

Acetic acid — Ethyl alcohol — Ethyl acetate (ester)

(c) (i) $_{19}E$ is a metal.

$_8F$ and $_{17}G$ are non-metals.

(ii) Molecular formula—EG.

Type of bond—Ionic bond.

●●

CHEMISTRY

2011

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose from the following list of substances, as to what matches the description from (i) to (v) given below :* **[5]**

[Acetylene gas, aqua fortis, coke, brass, barium chloride, bronze, platinum].

(i) *An aqueous salt solution used for testing sulphate radical.*

(ii) *A catalyst used in the manufacture of nitric acid by Ostwald's process.*

(iii) *A black powdery substance used for the reduction of zinc oxide during its extraction.*

(iv) *A gaseous hydrocarbon commonly used for welding purposes.*

(v) *The substance is an alloy of zinc, copper and tin.*

(b) *What would you observe in each of the following cases ?* **[5]**

(i) *Ammonium hydroxide is first added in a small quantity and then in excess to a solution of copper sulphate.*

(ii) *Sugar crystals are added to a hard glass test tube containing concentrated sulphuric acid.*

(iii) *Copper is heated with concentrated nitric acid in a hard glass test tube.*

(iv) *Water is added to the product formed, when aluminium is burnt in a jar of nitrogen gas.*

(v) *When carbon monoxide is passed over heated copper oxide.*

(c) *Give reasons as to why :* **[5]**

(i) *the electrolysis of acidulated water is considered to be an example of catalysis.*

(ii) *almost 90% of all known compounds are organic in nature.*

(iii) *it is dangerous to burn methane in an insufficient supply of air.*

(iv) *hydrogen chloride can be termed as a polar covalent compound.*

(v) *the oxidising power of elements increases on moving from left to right along a period in the periodic table.*

(d) *Fill in the blanks from the choices given below :* **[5]**

(i) *In covalent compounds, the bond is formed due to the …… (sharing/transfer) of electrons.*

(ii) *Electrovalent compounds have a…… (low/high) boiling point.*

(iii) *A molecule of……contains a triple bond. (hydrogen, ammonia, nitrogen).*

(iv) *Across a period, the ionization potential…….. (increases, decreases, remains same).*

(v) *Down the group, electron affinity…… (increases, decreases, remains same).*

(e) **(i)** *Calculate the volume of 320 g of SO_2 at S.T.P. (Atomic mass : S = 32 and O = 16).*

(ii) *State Gay-Lussac's Law of combining volumes.*

(iii) *Calculate the volume of oxygen required for the complete combustion of 8.8 g of propane (C_3H_8). (Atomic mass : C = 14, O = 16, H = 1, Molar Volume = 22.4 dm^3 at S.T.P).* **[5]**

(f) *Choose the correct answer from the options given below :* **[10]**

(i) *This metal is a liquid at room temperature :*

(A) Potassium (B) Zinc
(C) Gold (D) Mercury

(ii) *Hydroxide of this metal is soluble in sodium hydroxide solution :*

(A) Magnesium (B) Lead
(C) Silver (D) Copper

(iii) *In the periodic table alkali metals are placed in the group :*

(A) 1 (B) 11
(C) 17 (D) 18

(iv) *Hydrogen chloride gas being highly soluble in water is dried by :*

(A) Anhydrous calcium chloride
(B) Phosphorous penta oxide
(C) Quick lime
(D) Concentrated sulphuric acid

(v) *The brown ring test is used for detection of :*

(A) CO_3^{2-} (B) NO_3^-
(C) SO_3^{2-} (D) Cl^-

(vi) *When dilute sulphuric acid reacts with iron sulphide, the gas evolved is :*

(A) Hydrogen sulphide
(B) Sulphur dioxide
(C) Sulphur trioxide
(D) Vapour of sulphuric acid

(vii) *The functional group present in acetic acid is :*

(A) Ketonic $>C=O$ (B) Hydroxyl —OH

(C) Aldehydic —CHO (D) Carboxyl —COOH

(viii) *The unsaturated hydrocarbons undergo :*

(A) a substitution reaction

(B) an oxidation reaction

(C) an addition reaction

(D) none of the above

(ix) *The number of C–H bonds in ethane molecule are :*

(A) Four (B) Six

(C) Eight (D) Ten

(x) *Which of the following properties do not match with elements of the halogen family ?*

(A) They have seven electrons in their valence shell.

(B) They are highly reactive chemically.

(C) They are metallic in nature.

(D) They are diatomic in their molecular form.

(g) *Write the balanced chemical equation for each of the following reactions :* **[5]**

(i) *Sodium thiosulphate is reacted with dilute hydrochloric acid.*

(ii) *Calcium bicarbonate reacts with dilute hydrochloric acid.*

(iii) *Dilute sulphuric acid is poured over sodium sulphite.*

(iv) *Lead nitrate solution is added to sodium chloride solution.*

(v) *Zinc is heated with sodium hydroxide solution.*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Differentiate between electrical conductivity of copper sulphate solution and copper metal.* **[3]**

(b) *Sodium hydroxide solution is added to the solutions containing the ions mentioned in List X. List Y gives the details of the precipitate. Match the ions with their coloured precipitates.* **[3]**

List X	List Y
(i) Pb^{2+}	A. *Reddish brown*
(ii) Fe^{2+}	B. *White insoluble in excess*
(iii) Zn^{2+}	C. *Dirty green*
(iv) Fe^{3+}	D. *White soluble in excess*
(v) Cu^{2+}	E. *White soluble in excess*
(vi) Ca^{2+}	F. *Blue*

(c) *During the electrolysis of copper (II) sulphate solution using platinum as cathode and carbon as anode :*

(i) *What do you observe at the cathode and at the anode ?* **[1]**

(ii) *What change is noticed in the electrolyte ?* **[1]**

(iii) *Write the reactions at the cathode and at the anode.* **[2]**

Question 3.

(a) *Answer the following questions :* **[5]**

(i) *Name a metal which is found abundantly in the earth's crust.*

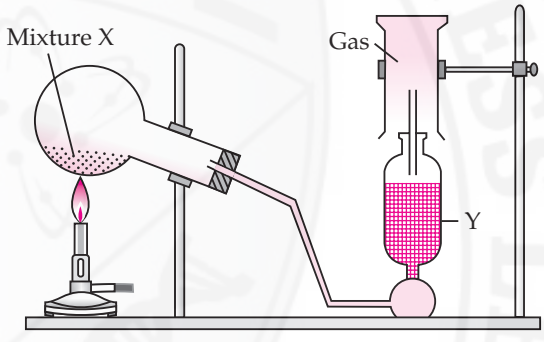
(ii) *What is the difference between calcination and roasting ?*

(iii) *Name the process used for the enrichment of sulphide ore.*

(iv) *Write the chemical formulae of one main ore of iron and aluminium.*

(v) *Write the constituents of electrolyte for the extraction of aluminium.*

(b) *The diagram shows an experimental set up for the laboratory preparation of a pungent smelling gas. The gas is alkaline in nature.* **[5]**



(i) *Name the gas collected in the jar.*

(ii) *Write the balanced equation for the above preparation.*

(iii) *How is the gas being collected ?*

(iv) *Name the drying agent used.*

(v) *How will you find that the jar is full of gas ?*

Question 4.

(a) *An organic compound with vapour density = 94 contains*

C = 12·67%, H = 2·13%, and Br = 85·11%. Find the molecular formula.

[Atomic mass : C = 12, H = 1, Br = 80] **[3]**

(b) *Calculate the mass of*

(i) *10^{22} atoms of sulphur.*

(ii) *0·1 mole of carbon dioxide.*

[Atomic mass : S = 32, C = 12 and O = 16 and Avogadro's Number = 6×10^{23}] **[2]**

(c) *In the laboratory preparation of hydrochloric acid, HCl gas is dissolved in water.* **[5]**

(i) *Draw a diagram to show the arrangement used for the absorption of HCl in water.*

(ii) *Why is such an arrangement necessary ? Give two reasons.*

(iii) *Write the chemical equations for the laboratory preparation of HCl gas when the reactants are :*

(A) *below 200°C*

(B) *above 200°C*

Question 5.

(a) *Choose the correct word/phrase from within the brackets to complete the following sentences :* **[5]**

(i) *The catalyst used for conversion of ethene to ethane is commonly …… (nickel/iron/cobalt).*

(ii) *When acetaldehyde is oxidized with acidified potassium dichromate, it forms……*

(ester/ethanol/acetic acid).

(iii) *Ethanoic acid reacts with ethanol in presence of concentrated H_2SO_4, so as to form a compound and water. The chemical reaction which takes place is called…… .*

(dehydration/ hydrogenation/ esterification)

(iv) *Write the equation for the reaction taking place between 1, 2-dibromoethane and alcoholic potassium hydroxide.*

(v) *The product formed when ethene gas reacts with water in the presence of sulphuric acid is……*

(ethanol/ethanal/ethanoic acid).

(b) *Write balanced chemical equations for the following :* **[5]**

(i) *Monochloro ethane is hydrolysed with aqueous KOH.*

(ii) *A mixture of sodalime and sodium acetate is heated.*

(iii) *Ethanol under high pressure and low temperature is treated with acidified potassium dichromate.*

(iv) *Water is added to calcium carbide.*

(v) *Ethanol reacts with sodium at room temperature.*

Question 6.

(a) **(i)** *With the help of equations, give an outline for the manufacture of sulphuric acid by the contact process.*

(ii) *What property of sulphuric acid is shown by the reaction of concentrated sulphuric acid when heated with*

(A) *Potassium nitrate* **(B)** *Carbon ?* **[5]**

(b) **(i)** *What is the special feature of the apparatus that is used in the laboratory preparation of nitric acid ?*

(ii) *Why should the temperature of the reaction mixture of nitric acid not be allowed to rise above 200°C ?* **[2]**

(c) *Write balanced chemical equations for the following :* **[3]**

(i) *Chlorine reacts with excess of ammonia.*

(ii) *Ferric hydroxide reacts with nitric acid.*

(iii) *Zinc oxide dissolves in sodium hydroxide.*

Question 7.

(a) **(i)** *Give the number of the group and the period, of the element having three shells with three electrons in valence shell.*

(ii) *By drawing an electron dot diagram, show the lone pair effect leading to the formation of ammonium ion from ammonia gas and hydrogen ion.*

(iii) *What happens to the crystals of washing soda when exposed to air ? Name the phenomenon exhibited.* **[5]**

(b) *Name the method used for preparation of the following salts from the list given below :*

(i) *Sodium nitrate*

(ii) *Iron (III) chloride*

(iii) *Lead chloride*

(iv) *Zinc sulphate*

(v) *Sodium hydrogen sulphate*

List : **[5]**

(A) *Simple displacement*

(B) *Neutralization*

(C) *Decomposition by acid*

(D) *Double decomposition*

(E) *Direct synthesis.*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Barium Chloride **(ii)** Platinum

(iii) Coke **(iv)** Acetylene

(v) Bronze

(b) **(i)** First a light blue ppt. appears then ppt. dissolves and solution turns inky blue.

(ii) Sugar crystals first turn brown then to a black spongy mass. Steam is also evolved.

(iii) A reddish brown pungent smelling gas is evolved.

(iv) A colourless gas with characteristic pungent smell of ammonia is formed.

(v) Black powdery copper oxide changes to red shiny copper metal.

(c) **(i)** It is because during electrolysis of acidulated water, quantity of acid present remains unchanged throughout and the rate of electrolysis of water gets increased.

(ii) It is because in all the living world compounds are mainly made of carbon and hydrogen and carbon has the ability to form maximum number of compounds than those of other elements put together.

(iii) It is because it will form carbon monoxide which is poisonous in nature.

(iv) It is because there is large difference between electro negativities of H and Cl.

(v) It is because on moving from left to right along a period in the periodic table, the electron affinity of elements increases.

(d) **(i)** Sharing **(ii)** High

(iii) Nitrogen **(iv)** Increases

(v) Decreases

(e) **(i)** Gram molar mass of SO_2

$= 32 + (2 \times 16) = 64$ g.

No. of moles in 64 g = 1 mole

$\therefore$ No. of moles in 320 g of SO_2

$= \frac{320}{64} = 5$ moles

At S.T.P. 1 mole of SO_2 occupies 22.4 *l*

$\therefore$ 5 moles of SO_2 will occupy $5 \times 22.4 = 112$ *l*

(ii) Gay-Lussac's Law of combining volumes: Under same conditions of temperature and pressure, the volume of gases taking part in a chemical reaction show simple whole number ratio to one another and to the volume of products if gaseous.

(iii) Chemical equation for the complete combustion of propane is :

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

1 mole 5 mole

1 mole $5 \times 22{\cdot}4$ *l* at S.T.P.

$(12 \times 3) + (1 \times 8) = 44$ g

Molecular weight of C_3H_8

$= 12 \times 3 + 1 \times 8$

$= 44$ g

44 g of C_3H_8 requires $= 5 \times 22.4$ *l* of oxygen

1 g of C_3H_8 requires $= \frac{5 \times 22.4}{44}$

$\therefore$ 8.8 g of propane would require

$\frac{5 \times 22.4 \times 8.8}{44} = 22.4$ *l* of oxygen.

(f) **(i)** (D) Mercury **(ii)** (B) Lead

(iii) (A) 1

(iv) (D) Concentrated sulphuric acid

(v) (B) NO_3^-

(vi) (A) Hydrogen sulphide

(vii) (D) Carboxyl —COOH

(viii) (C) An addition reaction

(ix) (B) Six

(x) (C) They are metallic in nature.

(g) **(i)** $Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + SO_2\uparrow$ (Dil.) Sodium chloride $+ H_2O + S\downarrow$

(ii) $Ca(HCO_3)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O + 2CO_2\uparrow$ (Dil.) Calcium chloride

(iii) $Na_2SO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + SO_2\uparrow$ Sodium sulphate

(iv) $Pb(NO_3)_2 + 2NaCl \rightarrow PbCl_2\downarrow + 2NaNO_3$ Lead chloride

(v) $Zn^{2+} + NaOH \rightarrow Za(OH)_2 + 2Na^+$

OR

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

SECTION-II

Answer 2.

(a) Difference between electrical conductivity of copper sulphate solution and copper metal :

	Copper sulphate solution	Copper metal
1.	Electric current is by flow of ions.	Electric current is by flow of electrons.
2.	It is aqueous solution of ionic compound.	It is a metal in solid state.
3.	Copper sulphate undergoes a chemical change.	Copper metal remains unchanged chemically.

(b)

List X	List Y
(i) Pb^{2+}	**D.** White soluble in excess.
(ii) Fe^{2+}	**C.** Dirty green.
(iii) Zn^{2+}	**E.** White soluble in excess.
(iv) Fe^{3+}	**A.** Reddish brown.
(v) Cu^{2+}	**F.** Blue.
(vi) Ca^{2+}	**B.** White insoluble in excess.

(c) **(i)** At cathode, reddish brown shiny metal deposits are seen. At anode, bubbles of a colourless odourless gas seens to come out.

(ii) Colour of electrolyte gradually fades from blue to colourless because effective concentration of copper ions in solution decreases.

(iii) At cathode :

$Cu^{2+} + 2e^- \rightarrow Cu\downarrow$

At anode :

$OH^- - e^- \rightarrow OH$

$4OH \rightarrow 2H_2O + O_2\uparrow$

Answer 3.

(a) **(i)** Aluminium.

(ii) Calcination is used in the decomposition of hydroxide and carbonate ores generally by heating them in absence of air whereas Roasting is the oxidation of sulphide ores generally by heating them in excess of air.

(iii) Froth floatation process.

(iv) Main ore of iron → Haematite – Fe_2O_3.

Main ore of aluminium → Bauxite – $Al_2O_3.2H_2O$.

(v) Molten alumina + cryolite + fluorspar.

(b) **(i)** Ammonia.

(ii) $Ca(OH)_2 + 2NH_4Cl \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3\uparrow$

Calcium hydroxide; Ammonium chloride; Calcium chloride; Ammonia gas

(iii) By downward displacement of air because it is lighter than air.

(iv) Quick lime (CaO).

(v) By bringing a wet red litmus paper near the brim (mouth) of the gas jar. When jar is full of gas, litmus will turn blue.

Answer 4.

(a)

Elements	Percentage ratio	Atomic mass	Relative number of atoms	Simplest ratio
C	12·67	12	12·67/12 = 1·055	$\frac{1.055}{1.055} = 1$
H	2·13	1	2·13/1 = 2·13	$\frac{2.13}{1.055} \approx 2$
Br	85·11	80	85·11/80 = 1·063	$\frac{1.063}{1.055} = 1$

∴ Empirical formula of the compound is CH_2Br

Molecular formula = (Empirical formula) × n

$$n = \frac{\text{M.W.}}{\text{Empirical formula Weight}} = \frac{2 \times \text{V.D}}{\text{Empirical formula weight}} = \frac{2 \times 94}{(12+2+80)} = \frac{2 \times 94}{94} = 2$$

∴ Molecular formula = $(CH_2Br) \times 2 = C_2H_4Br_2$

(b) **(i)** 1 mole of sulphur = 6×10^{23} atoms

= 32 g of sulphur

∴ 10^{22} atoms = $\frac{32 \times 10^{22}}{6 \times 10^{23}} = \frac{32}{60}$

= 0.533 g

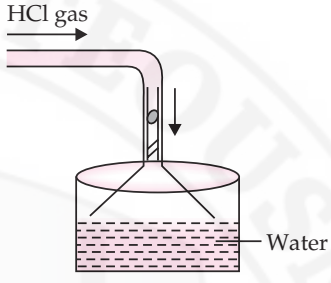
(ii) 1 mole of carbon dioxide (CO_2)

= 12 + (2 × 16) = 44 g

∴ 0·1 mole of carbon dioxide

= 0.1 × 44 = 4.4 g

(c) **(i)**



Inverted funnel arrangement.

(ii) **1.** The funnel arrangement provides a large surface area, which checks back suction.

2. To check its escape in the air.

(iii) **(A)** $NaCl + H_2SO_4 \xrightarrow[\text{below } 200°C]{\Delta} NaHSO_4 + HCl\uparrow$ (conc.)

(B) $NaCl + NaHSO_4 \xrightarrow{200°C} Na_2SO_4(aq) + HCl\uparrow$

Sodium Hydrosulphate; Sodium sulphate

Answer 5.

(a) **(i)** Nickel **(ii)** Acetic acid

(iii) Esterification

(iv) $CH_2BrCH_2Br + 2KOH \xrightarrow{\text{(alc.)}} C_2H_2 + 2KBr + 2H_2O$

Ethyne

(v) Ethanol

(b) **(i)** $C_2H_5Cl + KOH(aq) \longrightarrow C_2H_5OH + KCl$

Ethanol

(ii) $CH_3COONa + NaOH \xrightarrow[300°C\,(\text{soda lime})]{CaO} CH_4 + Na_2CO_3$

Methane

(iii) $CH_3CH_2OH + 2[O] \xrightarrow[K_2Cr_2O_7]{\text{Acidified}} CH_3COOH + H_2O\uparrow$

Acetic acid

(iv) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2\uparrow$

Calcium hydroxide; Ethyne

(v) $2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2\uparrow$

Sodium ethoxide

Answer 6.

(a) **(i)** $S + O_2 \longrightarrow SO_2$

Sulphur dioxide

$2SO_2 + O_2 \xrightarrow[450°C]{V_2O_5} 2SO_3$

Sulphur dioxide — Sulphur trioxide

$SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7$

(Conc.) — Oleum

$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$

Sulphuric acid

(ii) **(A)** Less volatile nature.

(B) Oxidising property.

(b) **(i)** It is an all glass retort. The apparatus is made of glass because vapours of nitric acid are corrosive.

(ii) The temperature of the reaction mixture of nitric acid not be allowed to rise above 200°C because above 200°C, nitric acid will decompose and glass apparatus may break.

(c) **(i)** $3Cl_2 + 8NH_3 \longrightarrow 6NH_4Cl + N_2$

Ammonium chloride

(ii) $Fe(OH)_3 + 3HNO_3 \longrightarrow Fe(NO_3)_3 + 3H_2O$

Iron (III) nitrate

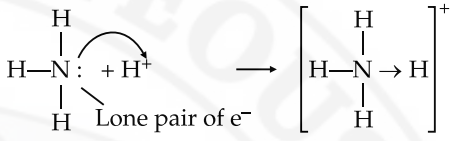
(iii) $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$

Sodium zincate

Answer 7.

(a) **(i)** Thirteenth group, third period.

(ii)



(iii) When exposed to air, washing, soda crystals lose their water of crystallisation and become amorphous.

The phenomenon is called efflorescence.

(b) **(i)** (B) Neutralisation

(ii) (E) Direct synthesis

(iii) (D) Double decomposition

(iv) (A) Simple displacement

(v) (C) Decomposition by acid.