ICSE 2024 EXAMINATION

CHEMISTRY

SAMPLE PAPER - 9

Time allowed: Two hours ***Max. Marks : 80***

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 A** is compulsory. Attempt **any four** questions from **Section B**.*
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION A

(Attempt all questions from this Section.)

Question 1 : Choose one correct answer to the questions from the given options : **[15]**

(i) A particular solution contains molecules and ions of the solute so it is a :
(a) weak acid (b) strong acid (c) strong base (d) salt solution.

(ii) A compound which liberates reddish brown gas around the anode during electrolysis in its molten state is :
(a) Sodium chloride (b) Copper (II) oxide (c) Copper (II) sulphate (d) Lead(II) bromide

(iii) An organic compound undergoes addition reactions and gives a red colour precipitate with ammoniacal cuprous chloride. Therefore, the organic compound could be :
(a) Ethane (b) Ethene (c) Ethyne (d) Ethanol

(iv) An organic weak acid is :
(a) Formic acid (b) Sulphuric acid (c) Nitric acid (d) Hydrochloric acid

(v) During ionization metals lose electrons, this change can be called :
(a) Oxidation (b) Reduction (c) Redox (d) Displacement

(vi) Which one of the following is **not** true of metals :
(a) Metals are good conductors of electricity
(b) Metals are malleable and ductile.
(c) Metals from non-polar covalent compounds.
(d) Metal will have 1 or 2 or 3 electrons in their valence shell.

(vii) An example of a complex salt is :
(a) Zinc sulphate (b) Sodium hydrogensulphate
(c) Iron (II) ammonium sulphate (d) Tetrammine copper (II) sulphate.

(viii) Aqua regia is a mixture of :
(a) Dilute hydrochloric acid and concentrated nitric acid.
(b) Concentrated hydrochloric acid and dilute nitric acid.
(c) Concentrated hydrochloric acid [1 part] and concentrated nitric acid [3 parts]
(d) Concentrated hydrochloric acid [3 parts] and concentrated nitric acid [1 part]

(ix) The organic compound mixed with ethanol to make it spurious is :

(a) Methanol (b) Methanoic acid (c) Methanal (d) Ethanoic acid

(x) The number of electrons present in the valence shell of a halogen is :

(a) 1 (b) 3 (c) 5 (d) 7

(xi) An element in period-3 whose electron affinity is zero

(a) Neon (b) Sulphur (c) Sodium (d) Argon

(xii) An alkaline earth metal

(a) Potassium (b) Calcium (c) Lead (d) Copper

(xiii) The vapour density of carbon dioxide [C = 12, O = 16]

(a) 32 (b) 16 (c) 44 (d) 22

(xiv) Identify the weak electrolyte from the following :

(a) Sodium Chloride solution (b) Dilute Hydrochloric acid

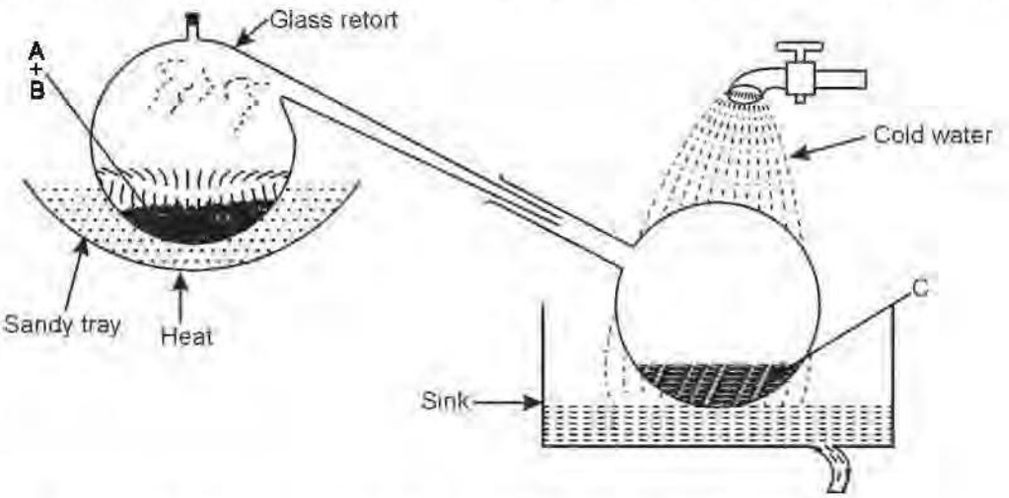
(c) Dilute Sulphuric acid (d) Aqueous acetic acid

(xv) 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

Question 2

(i) The figure given below illustrates the apparatus used in the laboratory preparation of nitric acid. [5]



(a) Name A (a liquid), B (a solid) and C (a liquid). (Do not give the formulae)

(b) Write an equation to show how nitric acid undergoes decomposition.

(c) Write the equation for the reaction in which copper is oxidised by concentrated nitric acid.

(ii) Match the following Column A with Column B : [5]

Column A	Column B
(a) Acid salt	1. Ferrous ammonium sulphate
(b) Double salt	2. Contains only ions
(c) Ammonium hydroxide solution	3. Sodium hydrogen sulphate
(d) Dilute hydrochloric acid	4. Contains only molecules
(e) Carbon tetrachloride	5. Contains ions and molecules

(iii) Complete the following by choosing the correct answers from the bracket : [5]

(a) The catalyst commonly used for conversion of ethene to ethane is _____ (nickel/iron/cobalt)

(b) When acetaldehyde is oxidised with acidified potassium dichromate, it forms _____ (ester/ethanol/acetic acid)

(c) The basicity of acetic acid is _____. (3, 1, 4)

(d) Substitution reactions are characteristic reactions of _____ (alkynes/alkenes/alkanes).

(e) The product formed when ethene gas reacts with water in the presence of sulphuric acid is _____ (Ethanol/ethanal/ethanoic acid)

(iv) Identify the following : [5]

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

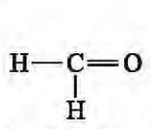
(b) Process of formation of ions from molecules which are not in ionic state.

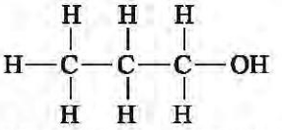
(c) The most common ore of iron.

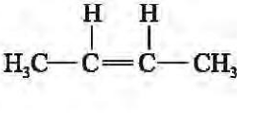
(d) The property by which certain hydrated salts, when left exposed to atmosphere, lose their water of crystallization and crumble into powder.

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

(v) (a) Give the IUPAC name for each of the following : [5]

1. 

2. 

3. 

(b) Write the structural formula of the two isomers of butane.

Section B

*(Attempt **any four** questions.)*

Question 3

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

(a) Copper carbonate

(b) Ammonium sulphate crystals

(ii) Write the products and balance the equation. [2]

(a) C + conc. $H_2SO_4 \longrightarrow$

(b) Cu + dil. $HNO_3 \longrightarrow$

(iii) Arrange the following according to the instructions given in brackets : [3]

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

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

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

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

(a) pH of acetic acid is greater than dilute sulphuric acid. So acetic acid contains _____ concentration of H^{+} ions. (greater, same, low)

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

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

Question 4

(i) Give the chemical formula of : [2]

(a) Bauxite (b) Cryolite

(ii) The solutions P, Q and R have pH value of 3.5, 5.2 and 12.2 respectively. Which one of these is a : [2]

(a) Weak acid? (b) Strong alkali?

(iii) Explain the following : [3]

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

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

(c) Hydrated copper sulphate crystals turn white on heating.

(iv) Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction : [3]

(a) Give the balanced chemical equation for the reaction with suitable condition(s) if any.

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

(c) How is the gas collected?

(b) Conc. sulphuric acid is used since it is non-volatile and has a high boiling point. So it displaces the volatile hydrogen chloride from the salt sodium chloride.

(c) Dry hydrogen chloride gas is collected by the upward displacement of air in dry gas cylinder.

Question 5

(i) (a) Name a drying agent for ammonia. [2]

(b) Name a nitrate of a metal which on heating does not give nitrogen dioxide.

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

(a) What is the cathode made up of?

(b) Write the reaction that takes place at the anode.

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

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

(b) Action of heat on aluminium hydroxide.

(c) Reaction of zinc with potassium hydroxide solution.

(iv) State **one** relevant observation for each of the following : [3]

(a) Lead nitrate solution is treated with sodium hydroxide solution dropwise till it is in excess.

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

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

Question 6

(i) Give one word/words for the following statements : [2]

(a) The molecular weight of an element expressed in grams.

(b) A formula of a chemical substance which tells the actual number of atoms in one molecule of a substance.

(ii) Given: $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ [2]

2000 cc of O_2 was burnt with 400 cc of ethane.

Calculate the volume of CO_2 formed and unused O_2.

(iii) Study the flow chart given and give balanced equations to represent the reactions ***A, B and C***: [3]

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

(iv) Some properties of sulphuric acid are listed below. Choose the role played by sulphuric acid as **A, B or C** which is responsible for the reactions (a) to (c). [3]

(A) Dehydrating agent (B) Non-volatile acid (C) Oxidising agent

(a) $CuSO_4.5H_2O \xrightarrow{conc.\ H_2SO_4} CuSO_4 + 5H_2O$

(b) $S + 2H_2SO_4$ (conc.) $\rightarrow 3SO_2 + 2H_2O$

(c) $NaCl + H_2SO_4$ (conc.) $\xrightarrow{<200°C} NaHSO_4 + HCl$

Question 7

(i) A gaseous hydrocarbon of vapour density 29, contains 82.76% of carbon. Calculate its empirical formula and molecular formula. [C = 12, H = 1] [2]

(ii) Write equations for : [2]

(a) Preparation of ethanol by hydration of C_2H_4.

(b) Preparation of acetic acid from ethanol.

(iii) Write equations for the **reactions taking place at the two electrodes** (mentioning clearly the name of the electrode) during the electrolysis of : [3]

(a) Acidified copper sulphate solution with copper electrodes.

(b) Molten lead bromide with inert electrodes.

(iv) A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure : [3]

(a) Find the number of moles of hydrogen present.

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

(c) 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.

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

Question 8

(i) Draw the electron dot diagram for the compounds given below. Represent the electrons by (.) and (×) in the diagram. [Atomic No. : O = 8, Cl = 17, H = 1] [2]

(a) Chlorine molecule (b) Water molecule

(ii) Distinguish between the following pairs of compounds using the reagent given in the bracket. [2]

(a) Ferrous sulphate solution and ferric sulphate solution. (using sodium hydroxide solution)

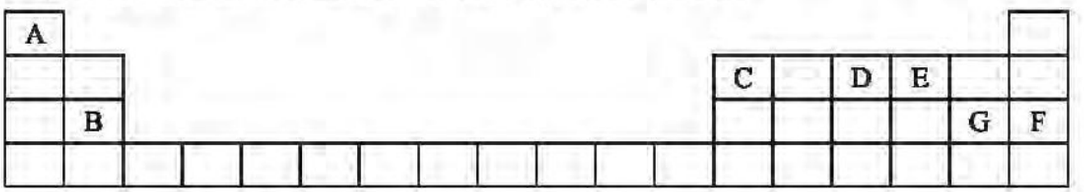
(b) Dilute hydrochloric acid and dilute sulphuric acid. (using lead nitrate solution)

(iii) State the observations at the anode and at the cathode during the electrolysis of : [3]

(a) fused lead bromide using graphite electrodes.

(b) copper sulphate solution using copper electrodes.

(iv) Study the extract of the Periodic Table given below and answer the questions that follow. Give the alphabet corresponding to the element in question. DO NOT repeat an element. [3]



(a) Which element forms electrovalent compound with G?

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

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

SOLUTION

Time allowed: Two hours ***Max. Marks* : 80**

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Section A** is compulsory. Attempt **any four** questions from **Section B.
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION A

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

Question 1 : Choose one correct answer to the questions from the given options : **[15]**

(i) A particular solution contains molecules and ions of the **solute** so it is a :
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(iii) An organic compound undergoes addition reactions and gives a red colour precipitate with ammoniacal cuprous chloride. Therefore, the organic compound could be :
(a) Ethane (b) Ethene (c) Ethyne (d) Ethanol

(iv) An organic weak acid is :
(a) Formic acid (b) Sulphuric acid (c) Nitric acid (d) Hydrochloric acid

(v) During ionization metals lose electrons, this change can be called :
(a) Oxidation (b) Reduction (c) Redox (d) Displacement

(vi) Which one of the following is **not** true of metals :
(a) Metals are good conductors of electricity
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(ix) The organic compound mixed with ethanol to make it spurious is :

(a) Methanol (b) Methanoic acid (c) Methanal (d) Ethanoic acid

(x) The number of electrons present in the valence shell of a halogen is :

(a) 1 (b) 3 (c) 5 (d) 7

(xi) An element in period-3 whose electron affinity is zero

(a) Neon (b) Sulphur (c) Sodium (d) Argon

(xii) An alkaline earth metal

(a) Potassium (b) Calcium (c) Lead (d) Copper

(xiii) The vapour density of carbon dioxide [C = 12, O = 16]

(a) 32 (b) 16 (c) 44 (d) 22

(xiv) Identify the weak electrolyte from the following :

(a) Sodium Chloride solution (b) Dilute Hydrochloric acid

(c) Dilute Sulphuric acid (d) Aqueous acetic acid

(xv) Which of the following metallic oxides cannot be reduced by normal reducing agents?

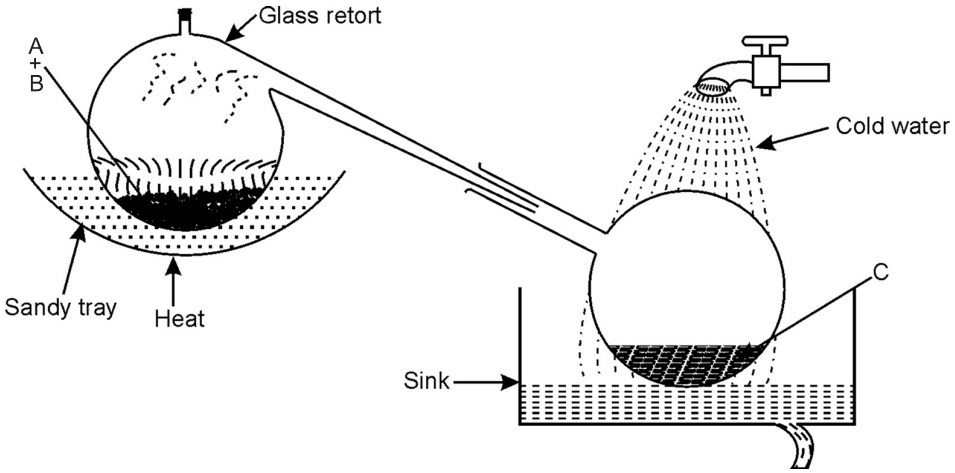
(a) Magnesium oxide (b) Copper(II) oxide (c) Zinc oxide (d) Iron(III) oxide

ANSWERS

(i) (d)	**(ii)** (d)	**(iii)** (c)	**(iv)** (a)	**(v)** (a)	**(vi)** (c)	**(vii)** (d)	**(viii)** (d)
(ix) (a)	**(x)** (d)	**(xi)** (d)	**(xii)** (b)	**(xiii)** (d)	**(xiv)** (d)	**(xv)** (a)	

Question 2

(i) The figure given below illustrates the apparatus used in the laboratory preparation of nitric acid. [5]



(a) Name A (a liquid), B (a solid) and C (a liquid). (Do not give the formulae)

(b) Write an equation to show how nitric acid undergoes decomposition.

(c) Write the equation for the reaction in which copper is oxidised by concentrated nitric acid.

Ans. (a) Liquid A is concentrated sulphuric acid.
Solid B is potassium nitrate.
Liquid C is concentrated nitric acid

(b) $4HNO_3(l) \xrightarrow{\text{heat}} 2H_2O(l) + 4NO_2(g) + O_2(g)$

(c) $Cu(s) + 4HNO_3(conc.) \longrightarrow Cu(NO_3)_2(aq) + 2H_2O(l) + 2NO_2(g)$

(ii) Match the following Column A with Column B : [5]

Column A	Column B
(a) Acid salt	1. Ferrous ammonium sulphate
(b) Double salt	2. Contains only ions
(c) Ammonium hydroxide solution	3. Sodium hydrogen sulphate
(d) Dilute hydrochloric acid	4. Contains only molecules
(e) Carbon tetrachloride	5. Contains ions and molecules

Ans. (a) Acid salt— Sodium hydrogen sulphate (3)

(b) Double salt— Ferrous ammonium sulphate (1)

(c) Ammonium hydroxide solution— Contains ions and molecules (5)

(d) Dilute hydrochloric acid— Contains only ions (2)

(e) Carbon tetrachloride— Contains only molecules (4)

(iii) Complete the following by choosing the correct answers from the bracket : [5]

(a) The catalyst commonly used for conversion of ethene to ethane is _____ (nickel/iron/cobalt)

(b) When acetaldehyde is oxidised with acidified potassium dichromate, it forms _____ (ester/ethanol/acetic acid)

(c) The basicity of acetic acid is _____. (3, 1, 4)

(d) Substitution reactions are characteristic reactions of _____ (alkynes/alkenes/alkanes).

(e) The product formed when ethene gas reacts with water in the presence of sulphuric acid is _____ (Ethanol/ethanal/ethanoic acid)

Ans. (a) Nickel (b) Acetic Acid (c) 1 (d) Alkanes (e) Ethanol.

(iv) Identify the following : [5]

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

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

(c) The most common ore of iron.

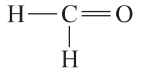
(d) The property by which certain hydrated salts, when left exposed to atmosphere, lose their water of crystallization and crumble into powder.

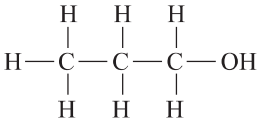
(e) The tendency of an atom to attract electrons to itself when combined in a compound.

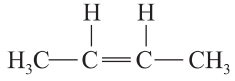
Ans. (a) Electron affinity (b) Ionisation (c) Haematite

(d) Efflorescent (e) Electronegativity

(v) (a) Give the IUPAC name for each of the following : [5]

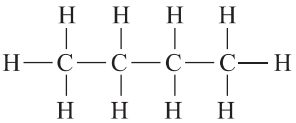
1. 

2. 

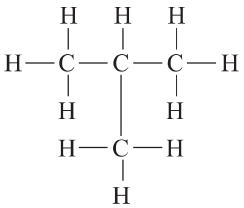
3. 

(b) Write the structural formula of the two isomers of butane.

Ans. (a) **1.** Methanal **2.** Propanol **3.** 2-Butene

(b) **1.** 

Normal butane

2. 

Iso-butane

Section B

*(Attempt **any four** questions.)*

Question 3

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

(a) Copper carbonate

(b) Ammonium sulphate crystals

Ans. (a) $CuSO_4(aq) + Na_2CO_3(aq) \longrightarrow Na_2SO_4(aq) + CuCO_3(s)$

(b) $2NH_4OH(aq) + H_2SO_4(aq) \longrightarrow (NH_4)_2SO_4(aq.) + 2H_2O$

(ii) Write the products and balance the equation. [2]

(a) C + conc. $H_2SO_4 \longrightarrow$

(b) Cu + dil. $HNO_3 \longrightarrow$

Ans. (a) $C + 2H_2SO_4$ (conc.) $\longrightarrow 2H_2O + 2SO_2 + CO_2$

(b) $3Cu + 8HNO_3$ (dil.) $\longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO(g)$

(iii) Arrange the following according to the instructions given in brackets : [3]

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

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

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

Ans. (a) Pb < Zn < Ca < K (b) $Cu^{2+} > H^+ > Mg^{2+} > Na^+$ (c) H > Li > Na > K

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

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

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

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

Ans. (a) Low (b) Phenolphthalein (c) Conc. HCl

Question 4

(i) Give the chemical formula of : [2]

(a) Bauxite (b) Cryolite

Ans. (a) $Al_2O_3.2H_2O$ (b) Na_3AlF_6

(ii) The solutions P, Q and R have pH value of 3.5, 5.2 and 12.2 respectively. Which one of these is a : [2]

(a) Weak acid? (b) Strong alkali?

Ans. (a) Weak acid is Q (5.2).

(b) Strong alkali is R (12.2).

(iii) Explain the following : [3]

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

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

(c) Hydrated copper sulphate crystals turn white on heating.

Ans. (a) Graphite anode is used in preference to platinum because bromine evolved at the anode reacts with platinum but not with graphite.

(b) Sodalime is preferred to sodium hydroxide because it is not deliquescent and does not attack glass.

(c) On heating the blue coloured hydrated copper sulphate crystals start crumbling to form white powder of anhydrous copper sulphate after losing its water of crystallisation.

(iv) Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction : [3]

(a) Give the balanced chemical equation for the reaction with suitable condition(s) if any.
(b) Why is concentrated sulphuric acid used instead of concentrated nitric acid?
(c) How is the gas collected?

Ans. (a) $NaCl(s) + H_2SO_4$ (conc.) $\xrightarrow{< 200°C}$ $NaHSO_4$ (aq) + HCl (g)

(b) Conc. sulphuric acid is used since it is non-volatile and has a high boiling point. So it displaces the volatile hydrogen chloride from the salt sodium chloride.

(c) Dry hydrogen chloride gas is collected by the upward displacement of air in dry gas cylinder.

Question 5

(i) (a) Name a drying agent for ammonia. [2]

(b) Name a nitrate of a metal which on heating does not give nitrogen dioxide.

Ans. (a) Quicklime (CaO) (b) Sodium nitrate ($NaNO_3$)

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

(a) What is the cathode made up of?

(b) Write the reaction that takes place at the anode.

Ans. (a) Thin sheets of pure copper connected in parallel.

(b) $Cu - 2e^- \longrightarrow Cu^{2+}$

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

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

(b) Action of heat on aluminium hydroxide.

(c) Reaction of zinc with potassium hydroxide solution.

Ans. (a) $FeCl_3 + 3NaOH \rightarrow 3NaCl + Fe(OH)_3\downarrow$

(b) $2Al(OH)_3 \xrightarrow{1100°C} Al_2O_3 + 3H_2O$

(c) $Zn + 2KOH \xrightarrow{\text{Boiling}} K_2ZnO_2 + H_2(g)$

(iv) State **one** relevant observation for each of the following : [3]

(a) Lead nitrate solution is treated with sodium hydroxide solution dropwise till it is in excess.

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

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

Ans. (a) A chalky white precipitate of lead (II) hydroxide is formed. But when excess of sodium hydroxide is added the precipitate dissolves to form clear solution.

(b) A thick white precipitate of lead chloride is formed which dissolves on heating.

(c) Anhydrous calcium chloride absorbs moisture from the air then dissolves in the absorbed moisture to change into liquid state.

Question 6

(i) Give one word/words for the following statements : [2]

(a) The molecular weight of an element expressed in grams.

(b) A formula of a chemical substance which tells the actual number of atoms in one molecule of a substance.

Ans. (a) Gram-molecular weight

(b) Molecular formula

(ii) Given: $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ [2]

2000 cc of O_2 was burnt with 400 cc of ethane.

Calculate the volume of CO_2 formed and unused O_2.

Ans. (i) $\underset{\text{2 Vol.}}{2C_2H_6} + \underset{\text{7 Vol.}}{7O_2} \longrightarrow \underset{\text{4 Vol.}}{4CO_2} + 6H_2O$ [By Gay Lussac's law]

2 volumes of ethane require oxygen = 7 volumes

$\therefore$ 400 cc of ethane require oxygen = $\frac{7}{2}$ × 400 cc = 1400 cc

Thus, volume of unused O_2 = 2000 cc – 1400 cc = **600 cc.**

Again, 2 volumes of ethane produce CO_2 = 4 volumes

$\therefore$ 400 cc of ethane produce CO_2 = $\frac{4}{2}$ × 400 cc = **800 cc.**

(iii) Study the flow chart given and give balanced equations to represent the reactions ***A, B and C***: [3]

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

Ans. (a) $Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3(g)$

(b) $NH_3(aq.) + \underset{\text{(vapours)}}{HCl} \rightarrow \underset{\text{Dense white fumes}}{NH_4Cl(s)}$

(c) $NH_4Cl \xrightarrow{\Delta} NH_3 + HCl$

(iv) Some properties of sulphuric acid are listed below. Choose the role played by sulphuric acid as **A, B or C** which is responsible for the reactions (a) to (c). [3]

(A) Dehydrating agent (B) Non-volatile acid (C) Oxidising agent

(a) $CuSO_4.5H_2O \xrightarrow{conc.\ H_2SO_4} CuSO_4 + 5H_2O$

(b) $S + 2H_2SO_4$ (conc.) $\rightarrow 3SO_2 + 2H_2O$

(c) $NaCl + H_2SO_4$ (conc.) $\xrightarrow{<200°C} NaHSO_4 + HCl$

Ans. (a) Dehydrating agent— (A) (b) Oxidising agent— (B) (c) Non-volatile acid— (C)

Question 7

(i) A gaseous hydrocarbon of vapour density 29, contains 82.76% of carbon. Calculate its empirical formula and molecular formula. [C = 12, H = 1] [2]

Ans. %age of carbon = 82.76%.

$\therefore$ %age of hydrogen = (100 – 82.76) = 17.24%

Elements	%age weight	At. wt.	Relative number of atoms	Simple ratio of atoms
C	82.76	12	82.76 ÷ 12 = 6.89	6.89 ÷ 6.89 = 1 or 2
H	17.24	1	17.24 ÷ 1 = 17.24	17.24 ÷ 6.89 = 2.5 or 5

$\therefore$ Empirical formula of hydrocarbon is $\mathbf{C_2H_5}$.

$\therefore$ Empirical formula mass of hydrocarbon = 2(12) + 5(1) = 29

Vapour density of hydrocarbon = 29

$\therefore$ Molecular mass of hydrocarbon = 2 × V.D. = 2 × 29 = 58

Now, n × Empirical formula mass = Molecular mass

$n \times 29 = 58$

$n = 2$

$\therefore$ Molecular formula of hydrocarbon = n × Empirical formula = 2 × C_2H_5 = $\mathbf{C_4H_{10}}$.

(ii) Write equations for : [2]

(a) Preparation of ethanol by hydration of C_2H_4.

(b) Preparation of acetic acid from ethanol.

Ans. (a) $C_2H_4 + H_2SO_4$ (Conc.) $\xrightarrow[30\text{atms}]{80°C} C_2H_5.HSO_4$

$C_2H_5.HSO_4 + H_2O$ (boiling.) $\rightarrow C_2H_5OH + H_2SO_4$

(b) $C_2H_5OH \xrightarrow[K_2Cr_2O_7]{[O]} CH_3CHO + H_2O \xrightarrow[K_2Cr_2O_7]{[O]} CH_3COOH$

(iii) Write equations for the **reactions taking place at the two electrodes** (mentioning clearly the name of the electrode) during the electrolysis of : [3]

(a) Acidified copper sulphate solution with copper electrodes.

(b) Molten lead bromide with inert electrodes.

Ans. (a) 1. At anode the copper atoms dissociate to form Cu^{2+} ions and enter in copper sulphate solution.

$$Cu \longrightarrow Cu^{2+} + 2e^- \text{ (at anode)}$$

2. At cathode the copper ions discharge to form copper atoms deposit at cathode.

$$Cu^{2+} + 2\bar{e} \longrightarrow Cu \text{ (at cathode)}$$

(b) At graphite anode the bromine ions discharge to form bromine atoms, which subsequently join to form bromine molecules.

$$Br^- - \bar{e} \longrightarrow Br \text{ (at anode)}$$

$$Br + Br \longrightarrow Br_2$$

At graphite cathode the lead ions discharge to form lead atoms, which subsequently deposit on the cathode.

$$Pb^{2+} + 2\bar{e} \longrightarrow Pb \text{ (at cathode)}$$

(iv) A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure : [3]

(a) Find the number of moles of hydrogen present.

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

(c) 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.

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

Ans. (a) 2 g of hydrogen gas = 1 mole.

$\therefore$ 1000 g of hydrogen gas = $\frac{1000}{2}$ = **500 moles**.

(b) 1 mole of carbon dioxide = 44 g

$\therefore$ 500 moles of carbon dioxide = 44 × 500 = 22000 g = 22 kg

$\therefore$ Weight of carbon dioxide in cylinder = **22 kg**.

(iii) Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules.

$\therefore$ Molecules in the cylinder of carbon dioxide = X.

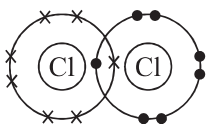
(iv) **Avogadro's law**.

Question 8

(i) Draw the electron dot diagram for the compounds given below. Represent the electrons by (.) and (×) in the diagram. [Atomic No. : O = 8, Cl = 17, H = 1] [2]

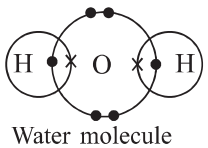
(a) Chlorine molecule (b) Water molecule

Ans. (a)



Chlorine molecule

(b)



Water molecule

(ii) Distinguish between the following pairs of compounds using the reagent given in the bracket. [2]

(a) Ferrous sulphate solution and ferric sulphate solution. (using sodium hydroxide solution)

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

Ans. (a) $\underset{\text{Ferrous sulphate}}{FeSO_4} + 2NaOH \longrightarrow Na_2SO_4 + Fe(OH)_2\downarrow$

In this case dirty green precipitate of $Fe(OH)_2$ is formed which is insoluble in excess of alkali.

$\underset{\text{Ferric sulphate}}{Fe_2(SO_4)_3} + 6NaOH \longrightarrow 3Na_2SO_4 + 2Fe(OH)_3\downarrow$

In this case reddish-brown precipitate of $Fe(OH)_3$ is formed which is insoluble in excess of alkali.

(b) $Pb(NO_3)_2$ (sol.) + 2HCl(dil.) $\longrightarrow$ $2HNO_3 + PbCl_2\downarrow$

In this case, a thick white precipitate of $PbCl_2$ and HNO_3 acid are formed. The precipitate dissolves on heating the mixture.

$Pb(NO_3)_2$ (sol.) + H_2SO_4 $\longrightarrow$ $2HNO_3 + PbSO_4\downarrow$

In this case, a white precipitate of $PbSO_4$ and HNO_3 are formed. This precipitate is insoluble in all acids and the precipitate does not dissolve on heating.

(iii) State the observations at the anode and at the cathode during the electrolysis of : [3]

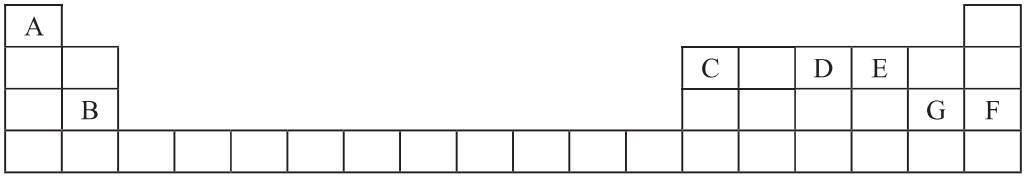
(a) fused lead bromide using graphite electrodes.

(b) copper sulphate solution using copper electrodes.

Ans. (a) At cathode silvery droplets of molten lead appear.
At anode reddish vapours of bromine are given out.

(b) At cathode a fresh layer of reddish copper is deposited
At anode fresh layer of copper is exposed on account of dissolving in copper sulphate solution.

(iv) Study the extract of the Periodic Table given below and answer the questions that follow. Give the alphabet corresponding to the element in question. DO NOT repeat an element. [3]



(a) Which element forms electrovalent compound with G?

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

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

Ans. (a) Element B (Mg) (b) Element A (H) (c) Element E (O)

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