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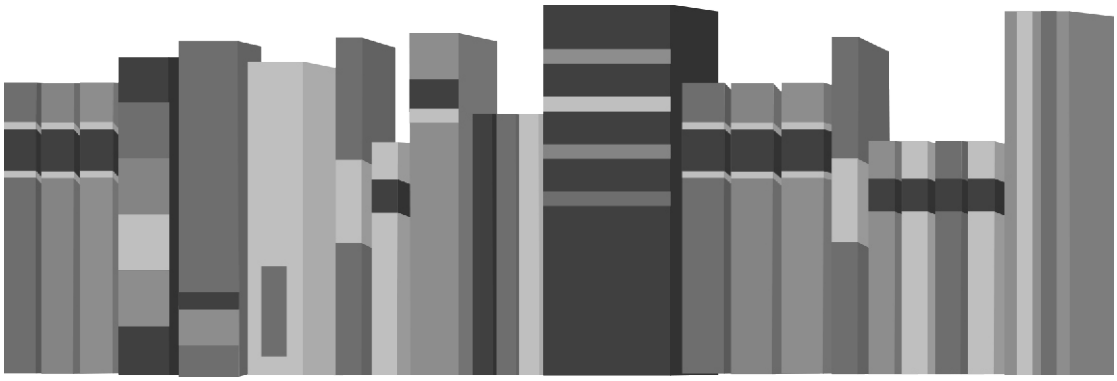

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Note : *Solutions of the Examination Paper are given within the book in their respective chapters / topics.*

PREFACE

Malcolm Forbes said ***"Education's purpose is to replace an empty mind with an open one"*** *and this is something which is always followed by* ***Maharashtra State Board of Secondary & Higher Education (MSBSHSE).*** *The aim of the Board is not just to let learners obtain basic knowledge but to make them life-long learners.*

The purpose of this book is to nurture individuality and thus enhance one's innate potentials which help in increasing the self-study mode for students. This book strengthens knowledge and attitude related to subject. This book is designed in such a way that students can set their own goals and can improve their problem solving and thinking skills.

This book is strictly as per the latest ***Maharashtra Board Curriculum for HSC Exams.*** *It contains variety of questions from latest textbooks. It contains all types of questions like VSA Questions (Very Short Answer), SA Questions (Short Answer), MCQs (Multiple Choice Questions) and LA Questions (Long Answer). A synopsis is given for every chapter which contains important points from that chapter. Each chapter has high quality figures wherever required for better, fast and clear understanding.*

OSWAAL HSC Question Bank *is different and better in terms of High Quality Questions which are developed by 'OSWAAL Expert Panel'. The Question Bank is strictly based on the latest* ***MSBSHSE Textbooks*** *and is arranged* ***'TOPIC-WISE'*** *where each Topic from every Chapter is explained in detail.*

Through OSWAAL Books students are taught how to think, not what to think. We at OSWAAL Books try to use quality content, standard language, creativity and high quality figures, which makes readers to enjoy it because we believe if our readers don't enjoy reading our book then there is no use in reading it at all. This is one of the reasons that the scope of this book extends from students to teachers. Teachers can use this book as a perfect teaching guide and students can use this book for good learning and practice.

At last we would like to thank our authors, editors, reviewers and specially students whom we request to send suggestions regularly which will help in continuous improvement of this book and will make this book "One of the Best". ***Wish you all Happy Learning.***

–Publisher

Why Topic Wise Question Banks Are A Better Choice than Previous Year's Papers ?

Question Bank	Previous Years' Paper
1. Chapter-wise and Topic –wise resentation in Question Banks facilitates systematic study.	1. Year Wise presentation restricts methodical flow of learning.
2. Question Banks can be referred to by the students throughout the year as well as at the completion of each chapter in school.	2. These can be referred to only after the completion of the full syllabus in school.
3. Question Banks, take into account any changes in syllabus or layout and hence are fully updated and aligned as per the latest specifications by the Board.	3. Previous Years' questions cannot be changed and hence fail to be adept with the latest Board specifications

LATEST SYLLABUS

Theory

Unit 1 : Solid State

Classification of solids based on different forces; molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties, **Band theory of metals, conductors and semiconductors and insulators and n and p type semiconductors.**

Unit 2 : Solutions and colligative properties

Types of solutions, expression of concentration of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapor pressure, **Raoult's law** elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass. **Van't Hoff factor and calculations involving it.**

Unit 3 : Chemical thermodynamics and energetic

Concepts of system, types of systems, surroundings. Work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics – internal energy and enthalpy, Hess' law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation. Phase transition, ionization and solution **and dilution** Introduction of entropy as a state function, free energy change for spontaneous and non spontaneous processes, and equilibrium constant. **Second and third law of thermodynamics**

Unit 4 : Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic and galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion. **Relation between Gibb's energy change and emf of a cell.**

Unit 5 : Chemical kinetics

Rate of reaction (average and instantaneous), factors affecting rate of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment). **Activation energy, Arrhenius equation.**

Unit 6 : General principles and processes of isolation of elements

Principles and methods of extraction – concentration, oxidation, reduction electrolytic method and refining; occurrence and principle of extraction of aluminium, copper, zinc and iron

Unit 7 : p-Block elements Group 15 elements

General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen – preparation, properties and uses; compounds of nitrogen; preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only); Phoshorous – allotropic forms; compounds of phosphorous; preparation and properties of phosphine, halides (PCl_3,PCl_5) and oxoacids (elementary idea only).

Group 16 elements : General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen; preparation, properties and uses; **Classification of oxides,** simple oxides; Ozone. Sulphur – allotropic forms; compounds of sulphur; preparation, properties and uses of sulphur dioxide; sulphurc acid; industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only).

Group 17 elements : General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens; preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structure only).

Group 18 elements : General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses.

Unit 8 : *d* and *f* Block Elements

***d*-Block Elements:** General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

***f*-Block elements –**

Lanthanoids – Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction **and its consequences. Actinoids –** Electronic configuration, oxidation states. **Comparison with lanthanoids.**

...Contd.

Unit 9 : Coordination compounds

Coordination compounds – Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds, bonding; **Werner's theory, VBT, CFT**. isomerism, **(structural and stereo)** importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

Unit 10 : Halogen derivatives of alkanes (and arenes)

Haloalkanes : Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions. **Stability of carbocations, R-S and d-l configuration.**

Haloarenes : Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only) **stability of carbocations, R-S and d-l configurations**. Uses and environmental effects of dichloromethane, thrichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit 11 : Alcohols, phenols and ethers Alcohols

Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses of methanol and ethanol.

Phenols : Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols.

Ethers : Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit 12 : Aldehydes, ketones and carboxylic acids

Aldehydes and ketones : Nomenclature, nature of carbonyl group, methods of preparation. Physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic acids : Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit 13 : Organic compounds containing nitrogen

Nitro compounds-General methods of preparation and chemical reactions

Amines : Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and isocyanides : Will be mentioned at relevant places in context.

Diazonium salts : Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit 14 : Biomolecules

Carbohydrates : Classification (aldoses and ketoses), monosaccahrides **d-l configuration** (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen), importance.

Proteins : Elementary idea of a -amino acids, peptide, linkage, polypeptides, proteins; structure of amines primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Lipids and hormones (elementary idea) excluding structure, their classification and functions.

Vitamins : Classification and functions.

Nucleic acids : DNA and RNA

Unit 15 : Polymers

Classification – natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers; natural and synthetic like polythene, nylon, polyesters, bakelite, and rubber. **Biodegradable and non biodegradable polymers.**

Unit 16 : Chemistry in everyday life

1. **Chemicals in medicines :** analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines **elementary idea of antioxidants.**
2. **Chemicals in food :** Preservatives, artificial sweetening agents.
3. **Cleansing agents :** Soaps and detergents, cleansing action.

Practical Syllabus

A. Chemical Kinetics

(Any one of the following) :

(a) Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

(b) Study of reaction rate of any one of the following:

(i) Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.

(ii) Reaction between potassium iodate, KIO_3 and sodium sulphite (Na_2SO_3) using starch solution as indicator (clock reaction).

(c) Acid hydrolysis of ethyl acetate.

B. Thermochemistry

Any one of the following experiments :

i] Enthalpy of dissolution of copper sulphate or potassium nitrate.

ii] Enthalpy of neutralization of strong acid (HCl) and strong base (NaOH).

iii] Determination of enthalpy change during interaction (hydrogen bond formation) between acetone and chloroform.

iv] Heat of displacement of Cu from $CuSO_4$ by Zn.

C. Electrochemistry

Variation of cell potential in $Zn|Zn^{2+}||Cu^{2+}|Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature (demonstration).

D. Chromatography (demonstration)

(i) Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of Rf values.

(ii) Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in Rf values to be provided).

E. Preparation of Inorganic Compounds

(i) Preparation of double salt of ferrous ammonium sulphate or potash alum.

(ii) Preparation of potassium ferric oxalate.

F. Preparation of Organic Compounds

(i) *p*-Nitrocetanilide

(ii) Aniline yellow or 2- Napthol aniline dye.

(iii) Iodoform

(iv) Phthalic or succinic anhydride.

(v) Di-benzal acetone

G. Tests for the functional groups present in organic compounds

Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups.

H. Characteristic tests of arbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

I. Determinaiton of concentration/molarity of $KMnO_4$ solution by titrating it against a standard solution of :

(i) Oxalic acid (ii) Ferrous ammonium sulphate (Students will be required to prepare standard solutions by weighing themselves).

J. Qualitative analysis

1) Determination of two cations from a given mixture of salts.

2) Determination of two anions from a given mixture of salts.

Cations – Pb^{2+}, Cu^{2+}, As^{3+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_{4+},

Anions – Co_3^{2-}, So_3^{2-}, So_4^{2-}, No_2^- No_3, Cl^-, Br^-, I^-, Po_4^{3-} $C_2O_4^{2-}$ CH_3COO^-

(Note : Insoluble salts excluded.)

PROJECT

Scientific investigations involving laboratory testing and collecting information from other sources.

A few suggested Projects :

1 Study of presence of oxalate ions in guava fruit at different stages of ripening.

2 Study of quantity of casein present in different samples of milk.

3 Preparation of soyabean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc.

4 Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc).

5 Study of digestion of starch by salivary amylase and, effect of pH and temperature on it.

6 Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice, etc.

7 Extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom).

8 Study of common food adulterants in fat, butter, sugar, turmeric powder, chilli powder and pepper.

Note :

Any investigatory project, can be chosen with the approval of the teacher.

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Solved Paper	Maharashtra HSC Exam March 2017 Set No. J-555	Chemistry

Time : 3 Hours **Max. Marks : 70**

General Instructions :

1. *All questions are compulsory.*
2. *Answers to the questions of Section-I and Section-II should be written in the same answer book.*
3. *Draw neat, labelled diagrams and write balanced chemical equations wherever necessary.*
4. *Figures to the right indicate full marks.*
5. *Use of logarithmic table is allowed.*
6. *Every new question must be started on a new page.*

SECTION-I

1. Select and write the most appropriate answer from the given alternatives for each sub-question : [7]

(i) An antifriction alloy made up of antimony with tin and copper, which is extensively used in machine bearings is called :
(a) Duralumin (b) Babbitt metal (c) Spiegeleisen (d) Amalgams

(ii) Which of the following pairs is an intensive property ?
(a) Density, viscosity (b) Surface tension, mass
(c) Viscosity, internal energy (d) Heat capacity, volume

(iii) Fe^{2+} ions react with nitric oxide formed from reduction of nitrate and yields a brown coloured complex :
(a) $[Fe(CO)_5NO]^{2+}$ (b) $[Fe(NH_3)_5NO]^{2+}$ (c) $[Fe(CH_3NH_2)_5NO]^{2+}$ (d) $[Fe(H_2O)_5NO]^{2+}$

(iv) MnO_2 and $Ca_3(PO_4)_2$ present in iron ore get reduced to Mn and P in the zone of :
(a) combustion (b) reduction (c) fusion (d) slag formation

(v) An ionic compound crystallises in FCC type structure with 'A' ions at the centre of each face and 'B' ions occupying corners of the cube. The formula of compound is :
(a) AB_4 (b) A_3B (c) AB (d) AB_3

(vi) On passing 1.5 F charge, the number of moles of aluminium deposited at cathode are :
[Molar mass of Al = 27 gram mol^{-1}]
(a) 1.0 (b) 13.5 (c) 0.50 (d) 0.75

(vii) For a chemical reaction, A $\rightarrow$ products, the rate of reaction doubles when the concentration of 'A' is increased by a factor of 4, the order of reaction is :
(a) 2 (b) 0.5 (c) 4 (d) 1

2. Answer any SIX of the following : [12]

(i) What are 'fuel cells' ? Write cathode and anode reaction in a fuel cell.
(ii) Derive the relationship between half-life and rate constant for first order reaction.
(iii) Explain magnetic separation process of ores with the help of a neat, labelled diagram.
(iv) Derive the relationship between relative lowering of vapour pressure and molar mass of solute.
(v) Define the term 'enthalpy'. What will happen to the internal energy if work is done by the system ?
(vi) Nitrogen does not form pentahalides. Give reason.
(vii) Calculate the percentage efficiency of packing in case of simple cubic cell.
(viii) Write the electronic configuration of the following elements :
(a) Sulphur (Z = 16)
(b) Krypton (Z = 36)

3. Answer any THREE of the following : [9]

(i) How is phosphine prepared using the following reagents ?
(a) HCl (b) H_2SO_4 (c) Caustic soda

(ii) 0.05 M NaOH solution offered a resistance of 31.6 Ω in a conductivity cell at 298 K. If the cell constant of the cell is 0.367 cm^{-1}, calculate the molar conductivity of NaOH solution.

(iii) Calculate ΔH° for the reaction between ethene and water to form ethyl alcohol from the following data :
$\Delta_c H° C_2H_5OH_{(l)} = -1368$ kJ
$\Delta_c H° C_2H_{4(g)} = -1410$ kJ
Does the calculated ΔH° represent the enthalpy of formation of liquid ethanol ?

(iv) In the Arrhenius equation for a first order reaction, the values of 'A' and 'E_a' are 4×10^{13} sec^{-1} and 98.6 kJ mol^{-1} respectively. At what temperature will its half-life period be 10 minutes ?
[R = 8.314 JK^{-1} mol^{-1}]

4. State Faraday's first law of electrolysis. **[7]**
Write any 'two' uses of each of the following :
(a) H_2SO_4, (b) Chlorine
Distinguish between crystalline solids and amorphous solids.
A solution of a substance having mass 1.8×10^{-3} kg has the osmotic pressure of 0.52 atm at 280 K. Calculate the molar mass of the substance used.
[Volume = 1 dm^3, R = 8.314 JK^{-1} mol^{-1}]

OR

Define the following :
(a) Leaching (b) Metallurgy (c) Anisotropy
Derive an expession for maximum work.
The boiling point of benzene is 353.23 K. When 1.80 gram of non-volatile solute was dissolved in 90 gram of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of solute.
[K_b for benzene = 2.53 K mol^{-1}]

SECTION-II

5. Select and write the most appropriate answer from the given alternatives for each sub-question : **[7]**
(i) When primary amine reacts with $CHCl_3$ in alcoholic KOH, the product is :
(a) aldehyde (b) alcohol (c) cyanide (d) an-isocyanide
(ii) $CH_3 - CH_2 - Br \xrightarrow[\Delta]{\text{Alco.KOH}} B \xrightarrow{HBr} C \xrightarrow{Na/ether} D$ the compound D is :
(a) ethane (b) propane (c) n-butane (d) n-pentane
(iii) Cisplatin compound is used in the treatment of :
(a) malaria (b) cancer (c) AIDS (d) yellow fever
(iv) A gas when passed through $K_2Cr_2O_7$ and dil. H_2SO_4 solution turns it green, the gas is :
(a) CO_2 (b) NH_3 (c) SO_2 (d) Cl_2
(v) The alcohol used in thermometers is :
(a) Methanol (b) Ethanol (c) Propanol (d) Butanol
(vi) Which of the following vitamins is the vitamin of alicyclic series ?
(a) Vitamin C (b) Vitamin K (c) Vitamin B (d) Vitamin A
(vii) Which of the following is the first oxidation product of secondary alcohol ?
(a) Alkene (b) Aldehyde (c) Ketone (d) Carboxylic acid

6. Answer any SIX of the following : **[12]**
(i) How is diethyl ether prepared by continuous etherification process ?
(ii) Write a note on Hofmann bromamide degradation.
(iii) How is ethanoic acid prepared from dry ice ?
(iv) Write the molecular and structural formula of BHA and BHT.
(v) Explain the preparation of glucose from cane sugar.
(vi) Write the factors which are related to the colour of transition metal ions.
(vii) Explain the following terms :
(a) Homopolymers (b) Elastomers
(viii) Define racemic mixture.
Give IUPAC name of $CH_3 - CH_2 - \underset{}{\overset{CH_3}{\overset{|}{CH}}} - CHO$

7. Answer any THREE of the following : **[9]**
(i) What is 'effective atomic number' (EAN) ?
Calculate the effective atomic number of the central metal atom in the following compounds :
(a) $K_4Fe(CN)_6$ (b) $Cr(CO)_6$
Fe(Z = 26) Cr(Z = 24)
(ii) Write the different oxidation states of iron. Why +2 oxidation state of manganese is more stable ?
(Z of Mn = 25).
(iii) Write a note on 'aldol condensation' ?
(iv) What are nucleic acids?
Define complex lipids. Mention any 'two' functions of lipids.

8. What is the action of mixture of $NaNO_2$ and dil.HCl on : **[7]**
(a) Ethyl amine, (b) Aniline, (c) Diethyl amine
How is nylon 6, 6 prepared ?
Write are 'antacids' ?
Write any 'two' side effects of tranquilizers.

OR

Explain the mechanism of alkaline hydrolysis of tert-butyl bromide with energy profile diagram.
Define carbolic acid.
How carbolic acid is prepared from benzene sulphonic acid ?

■■

Solutions

SECTION-I

1. (i) (b) Babbitt metal (ii) (a) Density, viscosity (iii) (d) $[Fe(H_2O)_5NO]^{2+}$
(iv) (b) Reduction (v) (b) A_3B (vi) (c) 0.50
(vii) (b) 0.5 **[1 × 7 = 7]**

2. (i) Fuel cells are those cells which produce electrical energy directly from the combustion of fuels such as hydrogen, carbon monoxide or methane *e.g.*, $H_2 - O_2$ cell. **1**

Cell reaction :

At anode : $2H_2(g) + 4OH^-(aq) \longrightarrow 4H_2O(l) + 4e^-$

At cathode : $O_2(g) + 2H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$ **1**

(ii) For a first order reaction ,

$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$$ ½

where $[R]_0$ is initial concentration and [R] is the final concentration.

At $$t = t_{1/2}, [R] = \frac{[R]_0}{2}$$

$\therefore$ $$t_{1/2} = \frac{2.303}{k}\log\frac{[R]_0}{[R]_0/2}$$ ½

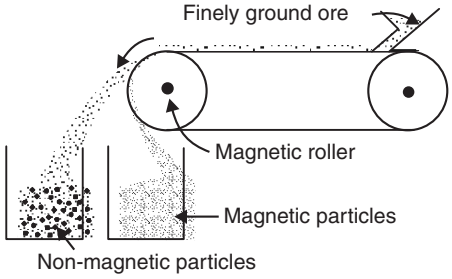
$$= \frac{2.303}{k}\log 2$$

$$t_{1/2} = \frac{2.303}{k}\times 0.3010$$ ½

$$t_{1/2} = \frac{0.693}{k}$$

Therefore, $t_{1/2}$ for a first order reaction is independent of initial concentration. ½

(iii) Magnetic separation is based on differences in magnetic properties of ore and gangue. The powdered ore is dropped on the belt moving on two rollers, one of which is a strong magnet. The magnetic particles attracted by the magnet falls nearer to the roller whereas non-magnetic particles falls away from the roller. It is used for the separation of magnetic ores like magnetite (Fe_3O_4) and pyrolusite (MnO_2). **1**



1

Magnetic separation method

(iv) Let W_2 *g* of solute of molar mass M_2 be dissolved in W_1 *g* of solvent of molar mass M_1. Hence, number of moles of solvent, n_1 and number of moles of solute n_2, in solution are given as,

$$n_1 = \frac{W_1}{M_1} \text{ and } n_2 = \frac{W_2}{M_2}$$

The mole fraction of solute, x_2 is given by,

$$x_2 = \frac{n_2}{n_1+n_2} = \frac{(W_2/M_2)}{[(W_1/M_1)+(W_2/M_2]}$$ ...(i) ½

$$\frac{\Delta P}{P_1^0} = \frac{P_1^0 - P}{P_1^0} = \frac{P_1^0 x_2}{P_1^0} = x_2$$ ...(ii) ½

Combining (i) and (ii) equations :

$$\frac{\Delta P}{P_1^0} = \frac{P_1^0 - P}{P_1^0} = x_2 = \frac{(W_2/M_2)}{[(W_1/M_1)+(W_2/M_2)]}$$ ...(iii) ½

For a dilute solution, $n_1 >> n_2$. Hence, n_2 may be neglected in comparison with n_1 in equation (i) and equation (iii), We have,

$$\frac{\Delta P}{P_1^0} = \frac{n_2}{n_1} = \frac{W_2/M_2}{W_1/M_1} = \frac{W_2 \times M_1}{W_1 \times M_2}$$ ½

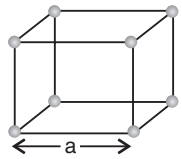
(v) The enthalpy of a system is defined as the sum of the internal energy of the system and the energy that arises due to its pressure and volume. **1**

According to the first law of thermodynamics, internal energy depends on the heat exchanged by the system and work done by the system or on the system. Taking that no heat is exchanged, the internal energy will decrease. Work done by the system is taken negative and thus – W.

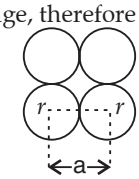
Therefore, Internal energy $\Delta U = q - W$. **1**

(iv) Nitrogen has *s* and *p*-orbitals only. It does not have *d*-orbitals to expand its covalency beyond four. Due to which it does not form pentahalides. **2**

(vii) In a simple cubic cell, the edge length of the unit cell = *a* and radius of the sphere = *r*.



As spheres touch each other along the edge, therefore $a = 2r$



½

$$\text{Number of sphere per unit cell} = \frac{1}{8} \times 8 = 1$$ ½

$$\text{Volume of the sphere} = \frac{4}{3}\pi r^3$$

$$\text{Volume of cube} = a^3 = (2r)^3 = 8r^3$$ ½

$$\text{Therefore, packing fraction} = \left(\frac{4}{3}\pi r^3\right) / 8r^3 = 0.524$$

$$\text{Percentage efficiency} = 52.4\%$$ ½

(viii) (a) Sulphur (Z = 16) **1**

Electronic configuration : $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^4$

(b) Krypton (Z = 36)

Electronic configuration : $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 3d^{10}\, 4s^2\, 4p^6$ **(Any six) 1**

3. (i) (a) Phosphine can be prepared by the reaction of calcium phosphide with dilute HCl.

$$Ca_3P_2 + 6HCl \longrightarrow 3CaCl_2 + 2PH_3$$ **1**

(b) Phosphine can be prepared by the decomposition of aluminium phosphide with dilute sulphuric acid.

$$2AlP + 3H_2SO_4 \longrightarrow 2PH_3 + Al_2(SO_4)_3$$ **1**

(c) Phosphine can be prepared by heating white phosphorous with concentrated sodium hydroxide solution in an inert atmosphere of CO_2.

$$P_4 + 3NaOH + 3H_2O \xrightarrow{\Delta, CO_2} PH_3 + 3NaH_2PO_2$$ **1**

(ii) Conductivity, $$k = \frac{\text{Cell constant}}{\text{Resistance}} = \frac{0.367\ \text{cm}^{-1}}{31.6\ \text{ohm}}$$ **1**

$$= 0.0116\ \text{S cm}^{-1}$$ ½

Molar conductivity, $$\wedge_m = \frac{k}{C_m}$$

$$= \frac{0.0116\ \text{Scm}^{-1}}{0.05\ \text{mol L}^{-1}} = \frac{0.0116\ \text{S cm}^{-1}}{0.05\ \text{mol} \times (1000\ \text{cm}^3)^{-1}}$$ **1**

$$= 232\ \text{S cm}^2\ \text{mol}^{-1}$$ ½

(iii) $$C_2H_4 + H_2O \rightleftharpoons CH_3CH_2OH$$

$$\Delta H^\circ = \Delta_c H^\circ\ (\text{products}) - \Delta_c H^\circ\ (\text{reactants})$$
$$= -1368\ \text{kJ} - (-1410\ \text{kJ})$$
$$= -1368\ \text{kJ} + 1410\ \text{kJ} = 42\ \text{kJ}$$ **2**

No, the enthalpy of formation of liquid is not same as the calculated ΔH° for the reaction. Therefore, it does not represent the enthalpy of formation of liquid ethanol. **1**

(iv) $$t_{1/2} = \frac{0.693}{k}$$

$$k = \frac{0.693}{10 \times 60} \quad \text{[As 10 min = 10 × 60 = 600 seconds]}$$

$$= \frac{0.693}{600} = 0.001155 \quad ½$$

As,

$$\log k = \log A - \frac{E_a}{2.303RT} \quad ½$$

$$\log 0.001155 = \log 4 \times 10^{13} - \frac{98.6 \times 10^3}{2.303 \times 8.314\ T} \quad ½$$

$$-2.937 = 13.602 - \frac{98600}{19.147\ T} \quad ½$$

$$\frac{98600}{19.147\ T} = 13.602 + 2.937 \quad ½$$

$$T = \frac{98600}{19.147 \times 16.539}$$

$$= \frac{98600}{316.672} = 311.36\ K$$ **(Any three)** ½

4. Faraday's first law of electrolysis states that "the amount of any substance deposited or liberated at the electrode is directly proportional to the quantity of electricity passing through the electrolyte. **1**

(a) Uses of H_2SO_4 :
(i) In the manufacture of fertilisers like ammonium sulphate and super phosphate, etc.
(ii) In petroleum refining, manufacture of pigments, paints, dye stuff, intermediates.
(iii) In detergent industry. **(Any two) 1**

(b) Uses of Chlorine :
(i) Bleaching of cotton and textiles.
(ii) Extraction of gold and platinum.
(iii) Sterilising drinking water.

Difference between crystalline solids and amorphous solids : **(Any two) 1**

S. No.	Property	Crystalline Solids	Amorphous Solids
1.	Shape	Definite shape and characteristic geometry.	Irregular shape and lack characteristic geometry.
2.	Melting point	Sharp melting point.	Do not have sharp melting point and melt gradually over a range of temperature.
3.	Nature	True solids	Pseudo solids
4.	Heat of fusion	Definite	Indefinite

2

Osmotic pressure, $\pi = 0.52$ atm, T = 280 K, $W_B = 1.8 \times 10^{-3}$ kg = 1.8 g, V = 1 dm^3 = 1 L, R = 8.314 $JK^{-1}\ mol^{-1}$

$$M_B = \frac{W_B RT}{\pi V} \quad ½$$

$$= \frac{1.8 \times 8.314 \times 280}{0.52 \times 1} \quad ½$$

$$= \frac{4190.256}{0.52} \quad ½$$

$$= 8058.184\ g$$
$$= 8.058\ kg \quad ½$$

OR

(a) Leaching is the process of treating the powdered ore with a suitable reagent which can selectively dissolve the ore but not the impurities and further reprecipitated. **1**

(b) Metallurgy is the process of preparation of pure metal from its ore. **1**

(c) The solids whose some physical properties like electrical resistance, refractive index, dielectric constant, etc. show different values in different directions in the same crystal, this property is called anisotropy. **1**

Expression for maximum work :

When the volume of the gas increases by an infinitesimal amount dV in a single step, the small quantity of work done is given by,

$$dW = -P_{ex}\, dV$$

As the expansion is reversible, the pressure of the gas is greater by a very small amount dP than P_{ex}

Hence, $P - P_{ex} = dP$ ...(i)

or $P_{ex} = P - dP$ ...(ii)

Combining of equations (i) and (ii), we write

$$dW = -(P - dP)\,dV$$
$$= -PdV + dP.dV$$

Neglecting the product $dP.dV$ which is very small, we get

$$dW = -PdV \quad \text{...(iii)}$$

$$\int_1^2 dW = -\int_{V_1}^{V_2} PdV$$

$$W_{max} = -\int_{V_1}^{V_2} PdV \quad \text{...(iv)}$$

Ideal gas equation for n moles is PV = nRT or $P = \frac{nRT}{V}$

Substitution of equation (iv) into equation (iii) gives

$$W_{max} = -\int_{V_1}^{V_2} nRT\frac{dV}{V}$$ **2**

The elevation (ΔT_b) in the boiling point = 354.11 – 353.23 K

= 0.88 K ½

$$M_2 = \frac{1000 \times W_2 \times K_b}{\Delta T_b \times W_1}$$ ½

$$= \frac{2.53 \text{ K kg mol}^{-1} \times 1.8 \text{ g} \times 1000 \text{ g kg}^{-1}}{0.88 \text{ K} \times 90 \text{ g}}$$ ½

$$= 58 \text{ g mol}^{-1}$$

Molar mass of the solute, $M_2 = 58 \text{ g mol}^{-1}$ ½

SECTION-II

5. (i) (d) an-isocyanide (ii) (c) *n*-butane (iii) (b) cancer

(iv) (c) SO_2 (v) (b) Ethanol (vi) (d) Vitamin A

(vii) (c) Ketone **1 × 7 = 7**

6. (i) Equal volumes of ethyl alcohol and cone. sulphuric acid are placed in a distillation flask. Ethyl alcohol reacts with conc. sulphuric acid to give ethyl hydrogen sulphate.

$$C_2H_5\boxed{OH + H}-O-SO_3H \longrightarrow C_2H_5-O-SO_3H + H_2O$$ **1**

Ethyl alcohol Ethyl hydrogen sulphate

Then, excess ethyl alcohol is added to distillation flask. Ethyl hydrogen sulphate reacts with added ethyl alcohol to give diethyl ether.

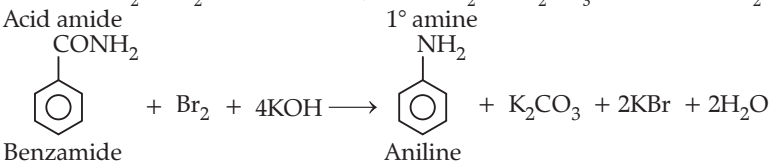
$$C_2H_5-O-SO_3H + H-O-C_2H_5 \xrightarrow{413\text{ K}} C_2H_5-O-C_2H_5 + H_2SO_4$$ **1**

Diethyl ether.

(ii) **Hofmann bromamide reaction :** When a primary acid amide is heated with an aqueous or ethanolic, solution of NaOH or KOH and bromine, it gives a primary amine with one carbon atom less, also known as Hofmann bromamide reaction.

$$R-CONH_2 + Br_2 + 4NaOH \longrightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

Acid amide 1° amine



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(iii) When Grignard reagent is added to solid carbon dioxide (dry ice), a magnesium salt of carboxylic acid is obtained which on acidification gives ethanoic acid.

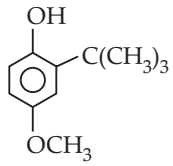
$$CH_3-Mg-X + O=C=O \xrightarrow{\text{Dry ether}} \left[CH_3-\overset{O}{\overset{\|}{C}}-O\,Mg^+X^-\right] \xrightarrow[\text{dil. HCl}]{H_2O} CH_3-\overset{O}{\overset{\|}{C}}-OH + MgXOH$$

Ethyl magnesium halide Ethanoic acid **2**

(iv) Butylated Hydroxy Anisole (BHA) :

Molecular formula : $C_{11}H_{16}O_2$

Structural formula :



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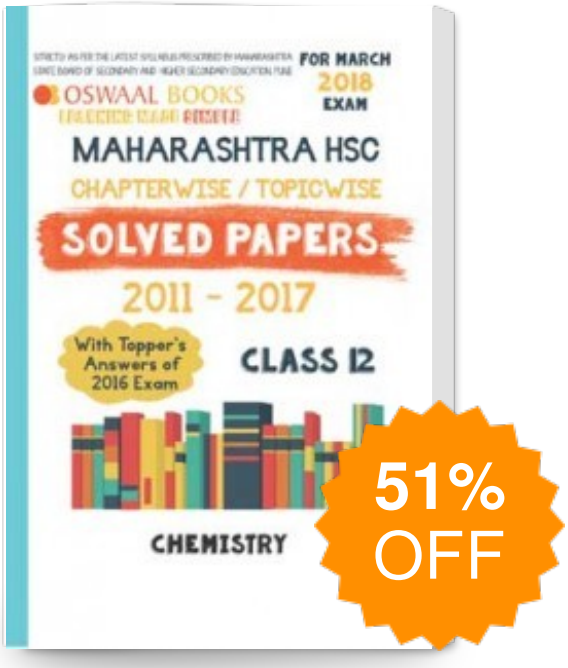

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