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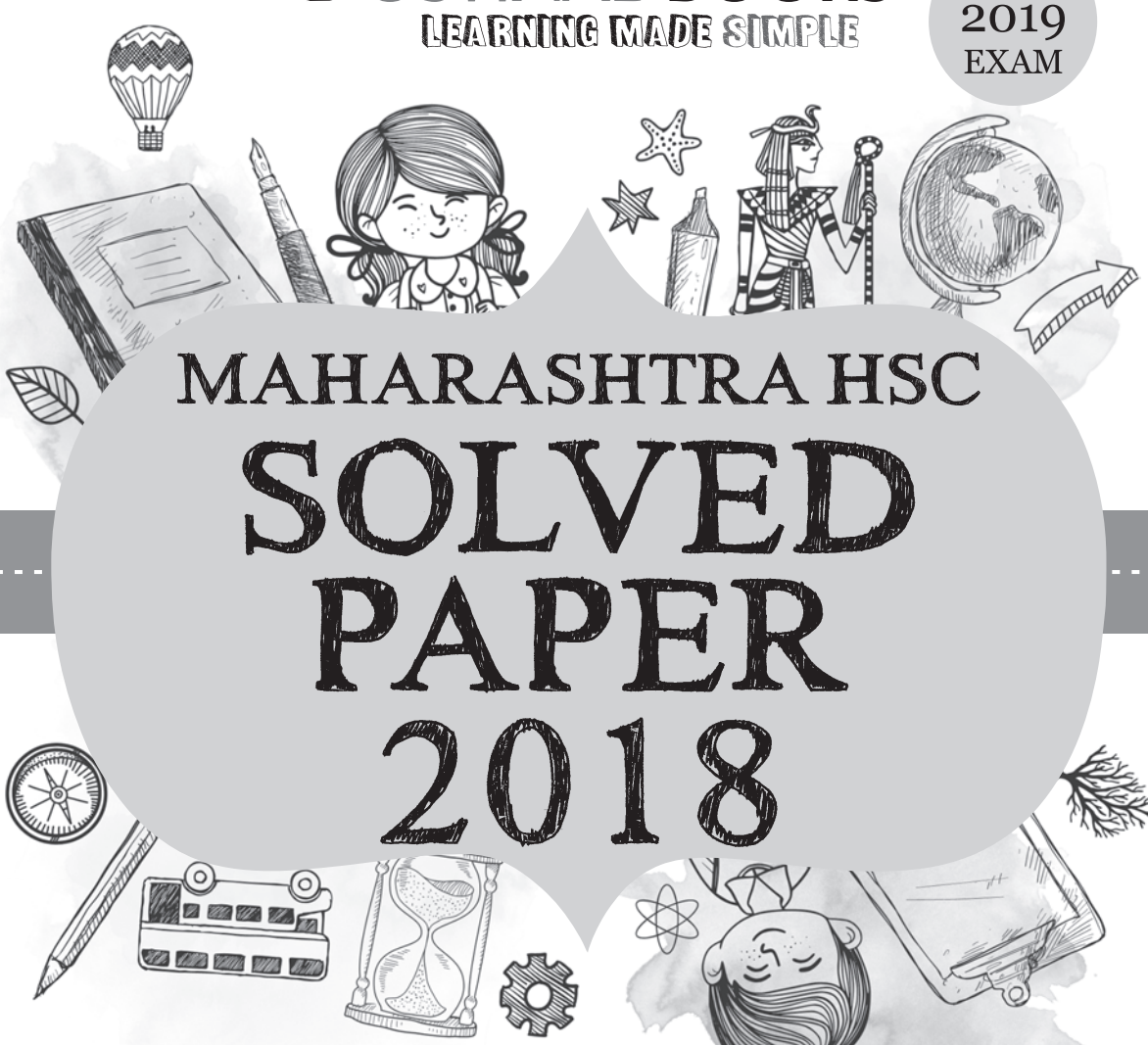

MAHARASHTRA HSC SOLVED PAPER 2018

CLASS 12

CHEMISTRY

Published by :

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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.

...Contd.

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 February 2018 Set No. J-255	Chemistry (55)

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

General Instructions :

(i) All questions are compulsory.
(ii) Answers to the questions of Section - I and Section - II should be written in the same answer book.
(iii) Draw neat labelled diagrams and write balanced chemical equations wherever necessary.
(iv) Figures to the right indicate full marks.
(v) Use of logarithmic table is allowed.
(vi) Answer to every new question must be started on a new page.

SECTION-I

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

(i) The process in which the value of $\Delta U = 0$ is :
(a) Adiabatic **(b)** Isothermal **(c)** Isobaric **(d)** Isochoric

(ii) An ionic crystal lattice has $\frac{r^+}{r^-}$ radius ratio of 0.320, its co-ordination number is :
(a) 3 **(b)** 4 **(c)** 6 **(d)** 8

(iii) In hydrogen-oxygen fuel cell the carbon rods are immersed in hot aqueous solution of :
(a) KCl **(b)** KOH **(c)** H_2SO_4 **(d)** NH_4Cl

(iv) The chemical formula of willemite is :
(a) ZnS **(b)** $ZnCO_3$ **(c)** ZnO **(d)** Zn_2SiO_4

(v) The oxidation state of nitrogen in dinitrogen trioxide is :
(a) +1 **(b)** +2 **(c)** +3 **(d)** +4

(vi) Which of the following 0.1 M aqueous solutions will exert highest osmotic pressure ?
(a) $Al_2(SO_4)_3$ **(b)** Na_2SO_4 **(c)** $MgCl_2$ **(d)** KCl

(vii) The half-life period of zero order reaction A → product is given by :
(a) $\frac{[A]_0}{k}$ **(b)** $\frac{0.693}{k}$ **(c)** $\frac{[A]_0}{2k}$ **(d)** $\frac{2[A]_0}{k}$

Q. 2. Answer any Six of the following : **12**

(i) Derive the relation between elevation of boiling point and molar mass of solute.
(ii) State third law of thermodynamics. Give 'two' uses.
(iii) Draw a neat and labelled diagram of lead storage battery.
(iv) Ionic solids are hard and brittle. Explain.
(v) A certain reaction occurs in the following steps :
(i) $Cl_{(g)} + O_{3(g)} \longrightarrow ClO_{(g)} + O_{2(g)}$
(ii) $ClO_{(g)} + O_{(g)} \longrightarrow Cl_{(g)} + O_{2(g)}$
(a) What is the molecularity of each of the elementary steps ?
(b) Identify the reaction intermediate and write the chemical equation for overall reaction.
(vi) Define :
(a) Semipermeable membrane **(b)** Reference electrode
(vii) What is the action of chlorine on :
(a) CS_2 (b) Excess NH_3
(viii) Write the chemical equations involved in van Arkel method for refining zirconium metal.

Q. 3. Answer any THREE of the following :

(i) Write balance chemical equations for the following :
(a) Phosphorus reacts with magnesium.
(b) Flowers of sulphur boiled with calcium hydroxide.
(c) Action of ozone on hydrogen peroxide.

(ii) The density of iron crystal is 8.54 gram cm^{-3}. If the edge length of unit cell is 2.8 A° and atomic mass is 56 gram mol^{-1}. Find the number of atoms in the unit cell.
(Given : Avogadro's number = 6.022×10^{23}. 1A° = 1×10^{-8} cm)

(iii) How many Faradays of electricity are required to produce 13 gram of aluminium from aluminium chloride solution ?
(Given : Molar mass of Al = 27.0 gram mol^{-1})

(iv) Calculate the internal energy at 298 K for the formation of one mole of ammonia, if the enthalpy change at constant pressure is – 42.0 kJ mol^{-1}.
(Given : R = 8.314 J K^{-1} mol^{-1})

Q. 4. (i) Define :
(a) Enthalpy of atomization **(b)** Enthalpy of vaporization

(ii) Draw the structure of IF_7. Write its geometry and the type of hybridization.

(iii) (a) State Henry's law.

(b) 22.22 gram of urea was dissolved is 300 grams of water. Calculate the number of moles of urea and molality of the urea solution.
(**Given :** Molar mass of urea = 60 gram mol^{-1})

OR

(i) What is the action of carbon on the following metal oxides :
(a) Fe_2O_3 in blast furnace **(b)** ZnO in vertical retort furnace

(ii) Write the molecular and structural formulae of :
(a) Thiosulphuric acid **(b)** Dithionous acid

(iii) The reaction A + B ⟶ products is first order in each of the reactants.
(a) How does the rate of reaction change if the concentration of A is increased by factor 3 ?
(b) What is the change in the rate of reaction if the concentration of A is halved and concentration of B is doubled ?

SECTION-II

Q. 8. Select and write the most appropriate answer from the given alternatives for each sub-question : 7

(i) A polymer used in paints is :
(a) Nomex **(b)** Thiokol **(c)** Saran **(d)** Glyptal

(ii) The number of primary and secondary hydroxyl groups in ribose are :
(a) 1, 3 **(b)** 2, 3 **(c)** 3, 1 **(d)** 3, 2

(iii) The ligand diethylene triamine is :
(a) monodentate **(b)** bidentate **(c)** tridentate **(d)** tetradentate

(iv) Propene on oxidation with diborane in presence of alkaline hydrogen peroxide gives :
(a) propan-1-ol **(b)** propan-2-ol **(c)** allylalcohol **(d)** propan-1, 2-diol

(v) Baeyer's reagent is :
(a) acidified potassium dichromate **(b)** alkaline potassium dichromate
(c) alkaline potassium permanganate **(d)** acidified potassium permanganate

(vi) Identity 'A' in the following reaction :

$$A + 2Na \xrightarrow[ether]{Dry} 2, 2, 5, 5, - \text{Tetramethylhexane} + 2NaBr.$$

(a) 2-Bromo-2-methylbutane **(b)** 1-Bromo-2, 2-dimethylpropane
(c) 1-Bromo-3-methylbutane **(d)** 1-Bromo-2-methylpropane

(vii) An antifertility drug is :
(a) Novestrol **(b)** Histamine **(c)** Veranal **(d)** Equanil

Q. 6. Answer any SIX of the following : **12**

(i) Write balanced chemical equations for the conversion of CrO_4^{2-} to $Cr_2O_7^{2-}$ in acidic medium and $Cr_2O_7^{2-}$ to CrO_4^{2-} in basic medium.

(ii) Explain the geometry of $[Co(NH_3)_6]^{3+}$ on the basis of hybridisation.
(Z of Co = 27)

(iii) Why ethanol has higher boiling point than ethane ?

(iv) Write only reactions for the preparation of benzophenone from benzonitrile.

(v) What is the action of p-tolunesulphonychloride on ethylamine and diethylamine ?

(vi) What are amino acids ? Write the correct reaction for formation of peptide bond between amino acids.

(vii) Define :
(a) Antiseptics (b) Antioxidants

(viii) Explain only reaction mechanism for the alkaline hydrolysis of tert-butylbromide.

Q. 7. Answer any THREE of the following : **9**

(i) Complete and rewrite the balanced chemical equations :

(a) Chlorobenzene $\xrightarrow[473K,\ pressure]{NaCN + CuCN}$?

(b) Isobutyraldehyde $\xrightarrow{50\%\ KOH}$?

(c) Butanone + 2, 4 dinitro-phenyl hydrazine $\xrightarrow{H^+}$?

(ii) Prepare carbolic acid from benzene sulphonic acid. Write a chemical equation for the action of neutral ferric chloride on phenol.

(iii) Explain the preparation and uses of nylon-2-nylon-6.

(iv) How glucose is prepared from cane sugar ?

Write the formula of the complex copper (II) hexacyano ferrate (II).

Q. 8. What is lanthanide contraction ?

Explain the cause of lanthanide contraction.

Draw the structures of chloroxylenol and adenine.

How are ethylamine and ethyl methyl amine distinguished by using nitrous acid ?

OR

What is the action of the following reagents on ethanoic acid ?

(a) $LiAlH_4/H_3O^+$ (b) PCl_3.heat (c) P_2O_5.heat

Identify 'A' and 'B' in the following reaction and rewrite the complete reaction :

$$CH_3 — CH_2 — Br + AgCN \xrightarrow{\Delta} A \xrightarrow[C_2H_5OH]{Na} B$$

Explain Hoffmann bromamide degradation reaction.

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SOLUTIONS

SECTION-I

1. (i) (b) Isothermal **1**

(ii) (b) 4 **1**

(iii) (b) KOH **1**

(iv) (d) Zn_2SiO_4 **1**

(v) (c) 3

$[2x + 3(-2) = 0 \Rightarrow 2x - 6 = 0 \Rightarrow 2x = 6 \Rightarrow x = 3]$ **1**

(vi) (a) $Al_2(SO_4)_3$

$[Al_2SO_4 \longrightarrow 2Al^{3+} + 3SO_4^{2-}$ (5 particles),

$Na_2SO_4 \longrightarrow 2Na^+ + SO_4^{2-}$ (3 particles),

$MgCl_2 \longrightarrow Mg^{2+} + 2Cl^-$ (3 particles),

$KCl \longrightarrow K^+ + Cl^-$ (2 particles)]

(vii) (c) $\frac{[A]_0}{2k}$

2. (i) Increase in boiling point = ΔT_b

Molality = m

$\Delta T_b \propto m$

Therefore, $\Delta T_b = K_b m$ (where K_b = boiling point elevation constant)

$$m = \frac{w_2 \times 1000}{w_1 M_2}$$

So, $$\Delta T_b = K_b \times \frac{w_2 \times 1000}{w_1 \times M_2}$$

where, w_1 = Mass of a solvent in gram,

w_2 = Mass of solute in gram,

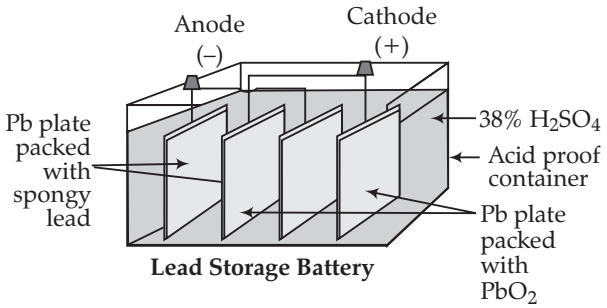
M_2 = Molecular mass of the solute. **2**

(ii) Third law of thermodynamics states that the entropy of a perfectly ordered crystalline substance is zero at absolute zero of temperature. Its two uses are : **1**

(a) To determine the absolute entropy of any substance either in solid, liquid or gaseous state at any desired temperature.

(b) To calculate thermodynamic properties. **1**

(iii)



Lead Storage Battery **2**

(iv) Ionic solids are formed by the force of attraction between ions of opposite charges and force of repulsion between ions of same charges. These opposite forces result into ordered 3D arrangement which is hard. Due to absence of free electrons, they are brittle. **2**

(v) (a) (i) Biomolecular

(ii) Biomoleuclar

(b) Intermediate : ClO

$$Cl_{(g)} + O_{3(g)} \longrightarrow ClO_{(g)} + O_{2(g)}$$
$$ClO_{(g)} + O_{(g)} \longrightarrow Cl_{(g)} + O_{2(g)}$$
$$O_{3(g)} + O_{(g)} \longrightarrow 2O_{2(g)} \text{ Net reaction.}$$ **1**

(vi) (a) Semipermeable membrane is a membrane which allows the solvent molecules, but not the solute molecules, to pass through it, Example, cellulose. **1**

(b) Reference electrode is an electrode whose potential is arbitrarily taken as zero or is exactly known. **1**

(vii) (a) With CS_2

$$3Cl_2 + CS_2 \longrightarrow CCl_4 + S_2Cl_2$$ **1**

(b) excess NH_3

$$3Cl_2 + NH_3 \longrightarrow NCl_3 + 3HCl$$

(viii) $Zr + 2I_2 \xrightarrow{570K} ZrI_4$

(Impure)

$$ZrI_4 \xrightarrow[\text{Tungsten filament}]{2075K} Zr + 2I_2$$ **2**

3. (i) (a) $6Mg + P_4 \longrightarrow 2Mg_3P_2$

(b) $3Ca(OH)_2 + 12S \longrightarrow 2CaS_5 + CaS_2O_3 + 3H_2O$

(c) $H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$

(ii) $a = 2.8\ Å = 2.8 \times 10^{-8}$ cm, Molar mass = 56g, Density = 8.54 g cm^{-3} Volume = $a_3 = (2.8 \times 10^{-8})^3 = 21.95 \times 10^{-24}\ cm^3$

$$D = \frac{M}{V}$$
$$M = D \times V = 8.54 \times 21.95 \times 10^{-24}$$
$$= 187.46 \times 10^{-24}$$

56g of Fe contains 6.022×10^{23} atoms

$$187.46 \times 10^{-24} \text{ g Fe contains} = \frac{6.022 \times 10^{23} \times 187.46 \times 10^{-24}}{56}$$
$$= 20.15 \times 10^{-1} = 2.01 = 2$$

Number of atoms in cell is 2. **3**

(iii) $AlCl_3 \longrightarrow Al^{3+} + 3Cl^-$

$Al^{3+} + 3e^- \longrightarrow Al$

1 mole of Al requires passage of 3 mole of electrons. Charge on 3 mole of e^- is 3 Faraday.

$$\text{Moles of Al produced} = \frac{\text{Mass of Al}}{\text{Molar mass of Al}}$$
$$= \frac{13}{27} = 0.48 \text{ Moles}$$

3F of electricity produces 1 mole of Al.

∴ Number of Faradays of electricity required to produce 0.48 moles of Al.

$$= 0.48 \times 3$$
$$= 1.44 \text{ Faraday.}$$ **3**

(iv) Formation of 1 mole of ammonia.

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow 2NH_3(g)$$

Δn = Number of moles of gaseous product – number of moles of gaseous reactant

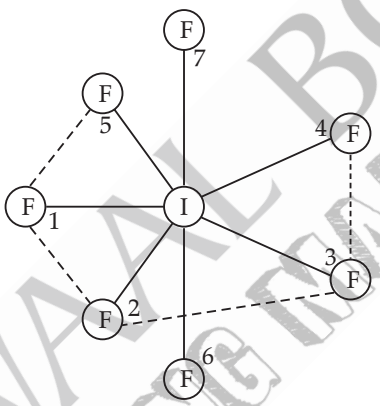
$$= 1 - \left(\frac{1}{2} + \frac{3}{2}\right) = -1$$

$$P\Delta V = -\Delta nRT$$
$$= -(-1) \times 8.314 \times 298$$
$$= 2477\ J = 2.477\ kJ$$
$$\Delta H = \Delta U + P\Delta V$$
$$-42.0 = \Delta U + 2.477$$
$$\Delta U = -42 - 2.477$$
$$= -44.47\ kJ$$ **3**

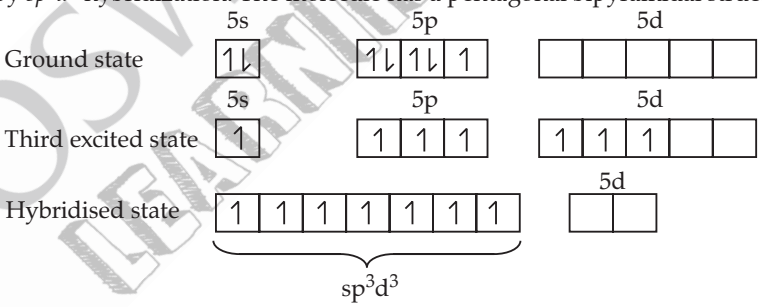
4. (i) (a) Enthalpy of atomization is the enthalpy change accompanying the dissociation of all the molecules in one mole of a gas phase substance into gaseous atoms.

(b) Enthalpy of vapourization is the enthalply change that accompanies the vapourization of one mole of liquid without changing its temperature at constant pressure.

(ii) IF_7



It is formed by sp^3d^3 hybridization. The molecule has a pentagonal bipyramidal structure.



(ii) (a) Henry's law states that the mass of a gas dissolved in given volume of the liquid at a constant temperature depends upon the pressure which is applied.

(b) Number of moles of urea $= \frac{22.22}{60}$

$$= 0.370 \text{ moles}$$

$$\text{Molality} = \frac{\text{Moles of urea}}{\text{Mass of water}} \times 1000$$

$$= 1.23 \text{ moles/kg}$$ **7**

OR

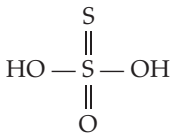
(i) (a) Action of carbon on Fe_2O_3 in blast furnace :

$$Fe_2O_3 + 3C \xrightarrow{>1123K} 2Fe + 3CO(g)$$

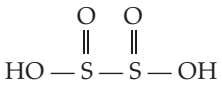
(b) Action of carbon on ZnO in vertical retort furnace :

$$ZnO + C \xrightarrow{\Delta} Zn + CO(g)$$

(ii) **(a)** Thiosulphuric acid ($H_2S_2O_3$)



(b) Dithionous acid ($H_2S_2O_4$)



(iii) **(a)** Rate of reaction = k[A] [B]
If the concentration of A is increased by factor 3, then rate of reaction also increases 3 times.
(b) Rate of reaction = k [A] [B]
If concentration of A is halved and concentration of B is doubled then,

$$\text{Rate of reaction} = k\left[\frac{1}{2}\text{A}\right][2\text{B}] \quad \textit{i.e.,} \text{ remains unchanged.}$$ **7**

SECTION-II

5. **(i)** **(d)** Glyptal **1**
(ii) **(a)** 1, 3 **1**
(iii) **(c)** Tridentate **1**
(iv) **(a)** propan-1-ol **1**
(v) **(c)** alkaline potassium permanganate **1**
(vi) **(b)** 1-Bromo-2, 2-dimethylpropane. **1**
(vii) **(a)** Novestrol **1**

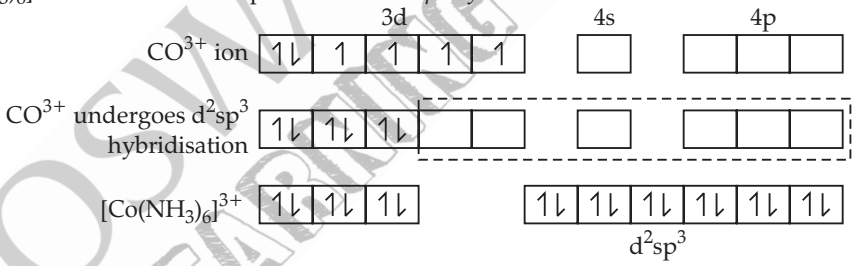
6. **(i)** In acidic medium :

$$K_2Cr_2O_7 + 2KOH \longrightarrow 2Kr_2CrO_4 + H_2O$$

In basic medium :

$$2K_2CrO_4 + 2HCL \longrightarrow K_2Cr_2O_7 + 2KCl + H_2O$$ **2**

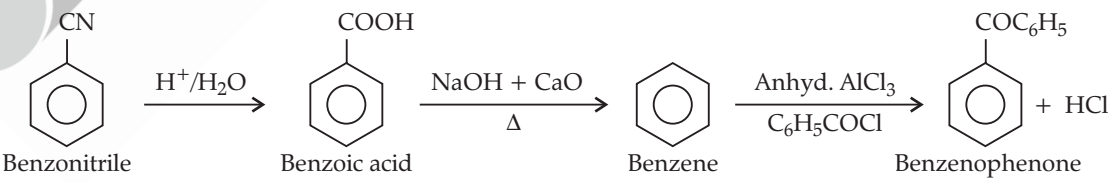
(ii) $[Co(NH_3)_6]^{3+}$ is octahedral complex involves d^2sp^3 hybridisation.



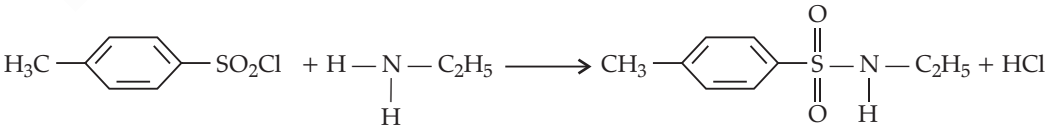
The six pairs of electrons from each NH_3 molecule occupy six hybrid orbitals. **2**

(iii) The molecules of ethane are joined together by weak van der waals force of attraction while ethanol are held by stronger intermolecular hydrogen bonding. Therefore, ethanol has higher boiling point than ethane. **2**

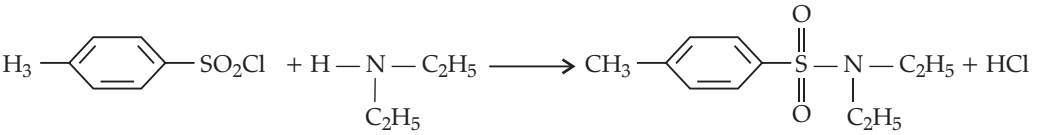
(iv)



(v)

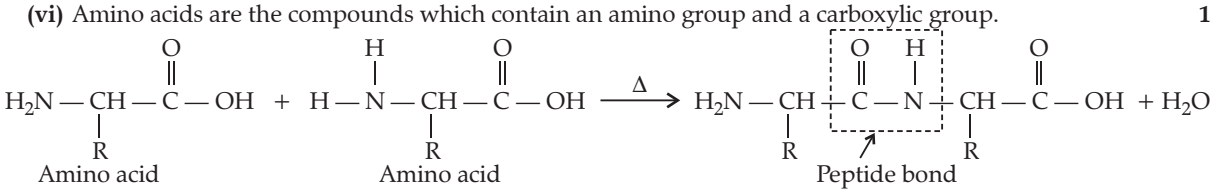


N-ethyltoluenesulphonylamide



N,N-diethyltoluenesulphonylamide

(vi) Amino acids are the compounds which contain an amino group and a carboxylic group. **1**

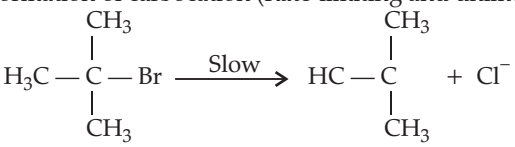


(vii)(1) Antiseptics are the chemicals which prevent the growth of micro-organisms or kill them and are not harmful to human beings. **1**

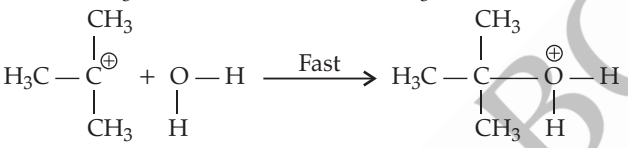
(2) Antioxidants are the substances which when added to food, retards or prevents oxidative deterioration of food. **1**

(viii) Tertiary-butyl bromide on alkaline hydrolysis forms tertiary-butyl alcohol and hydrobromic acid according to the mechanism shown below.

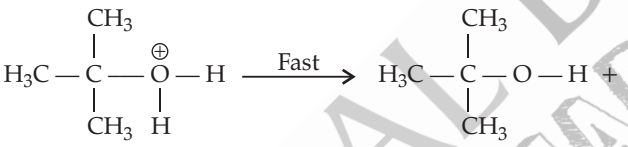
Step 1 : Formation of carbocation (Rate-limiting and unimolecular)



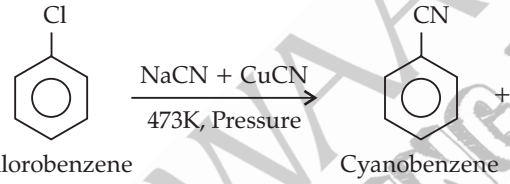
Step 2 :



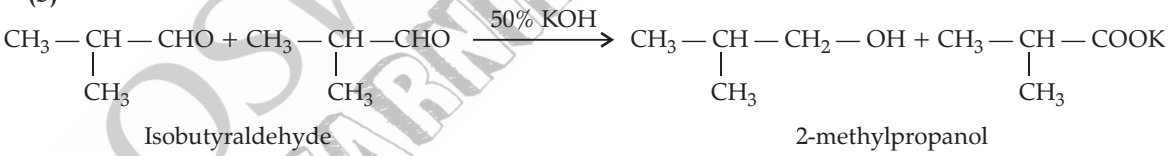
Step 3 :



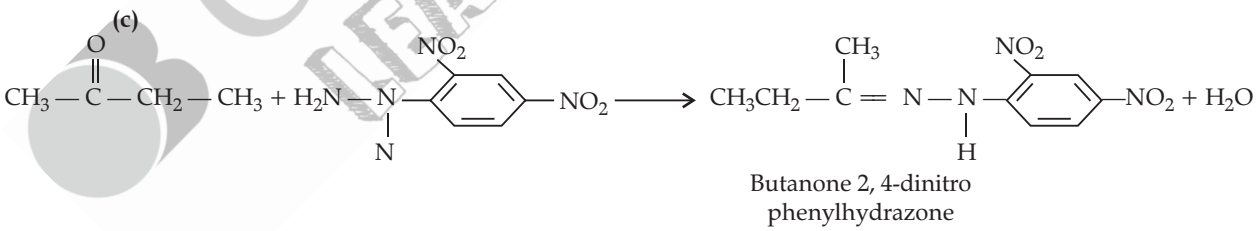
7. (i) (a)



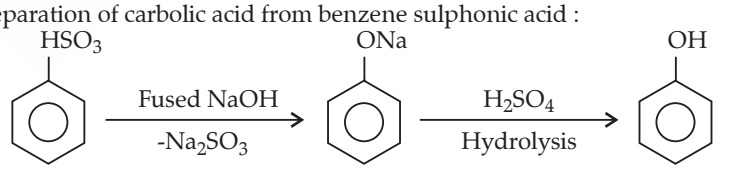
(b)



(c)



(ii) Preparation of carbolic acid from benzene sulphonic acid :



Chemical equation for the action of neutral ferric chloride on phenol :

$$3C_6H_5OH + FeCl_3 \longrightarrow (C_6H_5O)_3Fe + 3HCl$$

(neutral) Ferric phenoxide (Violet)

(iii) Preparation of Nylon-2-nylon-6 : It is obtained by condensation polymerisation of the monomers, glycine and amino caproic acid.

$$n H_2N-CH_2-COOH + n NH_2-(CH_2)_5-COOH \xrightarrow{H_2O} \left[-C(=O)-CH-NH-C(=O)-(CH_2)_5-NH_2-\right]_n$$

Glycine

Nylon-2-nylon-6

They are used as orthopaedic devices, implants, sutures and drug release matrices. **3**

(iv) When cane sugar is boiled with dilute hydrochloric acid or sulphuric acid, it undergoes hydrolysis to give glucose and fructose in equal amounts. While cooling alcohol is added, glucose being almost insoluble in alcohol. Crystallizes out first. Crystals of glucose are separated by filtration.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{dil.HCl or } H_2SO_4} C_6H_{12}O_6 + C_6H_{12}O_6$$

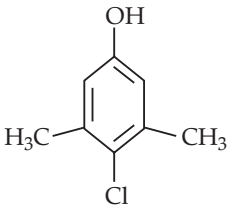
Glucose Fructose

Copper (II) hexacyanoferrate (II) : $Cu_2[Fe(CN)_6]$ **3**

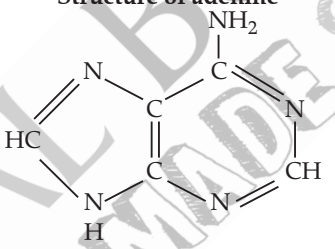
8. The gradual decrease in atomic and ionic size of lanthanoids with increase in atomic number is known as lanthanoid contraction.

Cause of lanthanoid contraction : As the atomic number increases, the positive charge on nuclear increases by +1 unit and one more electron enters in the same 4*f* subshell. There is imperfect shielding of one electron by another electron in the same 4*f* subshell. The extent of shielding for electrons is less in 4*f* subshell as compared to electrons in *d* subshell. Hence, with increase of nuclear charge the valence shell is pulled slightly towards nucleus. Due to this pull, the size of M^{3+} ions go on decreasing with increasing atomic number. **2**

Structure of chloroxylenol



Structure of adenine



2

Test to distinguish between ethylamine and ethyl methyl amine :

$$C_2H_5-NH_2 + OH-N=O \xrightarrow{NaNO_2 + HCl} C_2H_5OH + N_2(g) + H_2O$$

Ethylamine Nitrous acid Ethanol

$$C_2H_5-NH-CH_3 + OH-N=O \xrightarrow{NaNO_2 + HCl} C_2H_5-N(CH_3)-N=O + H_2O$$

Ethyl methyl amine Nitrous acid N-nitrosoethyl-methylamine (Yellow precipitate)

1

OR

$$CH_3COOH \xrightarrow{LiAlH_4 H_3O^+} CH_3CH_2OH$$

Ethanoic acid Ethanol

Ethanoic acid on reacting with $LiAlH_4$ undergoes reduction to form ethanol.

$$CH_3COOH + PCl_3 \xrightarrow{\Delta} 3CH_3COCl + H_3PO_3$$

Ethanoic acid Acetylchloride

Ethanoic acid on heating with PCl_3 forms acetylchloride .

$$CH_3COOH + CH_3COOH \xrightleftharpoons{P_2O_5, \Delta} CH_3-C(=O)-O-C(=O)-CH_3 + H_2O$$

Acetic anhydride

1

Ethanoic acid on treatment with P_2O_5 undergoes condensation with a loss of a water molecule to form acid anhydride.

$$CH_3-CH_2-Br + AgCN \xrightarrow{\Delta} C_2H_5NC \xrightarrow[C_2H_5OH]{Na} CH_3CH_2NH-CH_3$$

Ethyl isocyanide [A] Ethyl methylamine [B]

Hoffman bromamide degradation reaction : When an amide is treated with bromine and aqueous or alcoholic Sodium hydroxide, it gives a primary amine.

$$R-C(=O)-NH_2 + Br_2 + 4NaOH \longrightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

1

❑❑❑