SMART SKILLS

SYLLABUS 2020 -2021

CHEMISTRY

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SYLLABUS FOR SECOND TERM

Class XI (Theory)

UNIT No.	TITLE	MARKS
I	Some basic concepts of chemistry	5
II	Structure of atom	6
III	Classification of elements and periodicity in properties	4
IV	Chemical bonding and molecular structure	5
V	States of matter: Gases and liquids	7
VI	Thermodynamics	5
VII	Equilibrium	8
VIII	Redox reactions	4
IX	s- block elements	3
X	Some p-block elements	4
XI	Organic chemistry: some basic principles and techniques	9
XII	Hydrocarbons	10
TOTAL		70

PRACTICALS

Evaluation Scheme for Examination	Marks
Volumetric Analysis	10
Salt Analysis	10
Class record and viva	10
Total	**30**

PROJECT WORK (To be done in summer holidays)

Students are required to do a group google slide presentation on ONE of the following topics as allotted by the teacher.
Each student of the group must have contributed to the google slide. And every child has to participate while presenting .
Presentation: In July.
Marks : 5

TOPICS:

1) Stratospheric pollution – ozone and its effects.
2) Green chemistry as an alternate tool for reducing pollution
3) Chromatography and its various kinds
4) Environmental pollution: (a) Air- tropospheric pollution (b) Water (c) Soil
5) Acid rain, greenhouse effect and global warming
6) Hydrogen- Position, isotopes, preparation, properties, use
7) Water- structure, physical and chemical properties, hard and soft water, heavy water, method of removing hardness.
8) Hydrogen peroxide- structure, preparation, physical and chemical properties, storage and use.
9) Methods of purification of organic compounds (excluding chromatography)
10) Some important compounds of sodium: Washing soda, sodium chloride, caustic soda, baking soda
11) Some important compounds of calcium: Quick lime , Calcium carbonate, slaked lime, Plaster of Paris.
12) Some important compounds of Boron: Borax, Orthoboric acid, diborane.
13) Allotropes of Carbon and Some important compounds of Carbon: CO , CO2
14) Some important compounds of Silicon : SiO2, Silicones, Silicates, Zeolites.

Suggested Resource Material: NCERT Text book/ Internet
1) Environmental Chemistry
2) Hydrogen
3) s- block Elements
4) p- block Elements

Criteria for evaluation will be:

(a) Relevant content and its organisation	1
(b) Information and research	1
(c) Creativity (pictures, diagrams etc.)	1
(d) Overall presentation	2

SYLLABUS

MARCH - MAY

Unit I: Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry. Nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules. Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

Unit V: States of Matter: Gases and Liquids.

Three states of matter, intermolecular interactions, types of bonding, role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number.

Unit XIV: Environmental Chemistry

14.1 Environmental pollution
14.2 Atmospheric Pollution 14.2.1 Tropospheric Pollution, Global warming and Greenhouse Effect, Acid Rain. 14.2.2 Stratospheric Pollution: formation and breakdown of Ozone, The ozone hole, Effects of Depletion of the Ozone layer (without equations).
14.3 Water Pollution 14.3.1 Causes of water pollution (i) Pathogens (ii) Organic wastes (iii) Chemical Pollutants.
14.6 Strategies to control Environmental Pollution 14.6.1 Waste management, Collection and Disposal
14.7 Green Chemistry 14.7.1 Introduction 14.7.2 Green Chemistry in day-to-day life.

JULY -AUGUST

Unit V: States of Matter: Gases and Liquids (continued..)

Ideal gas equation. Deviation from ideal behaviour, Kinetic molecular theory of gases, liquefaction of gases, critical temperature,
Liquid State: vapour pressure (qualitative idea only, no mathematical derivations)
Solid state: Classification of solids based on different binding 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, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.

Unit II: Structure of Atom

Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

Unit III: Classification of Elements and Periodicity in Properties

Modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100

Unit X : s-Block Elements (Alkali and Alkaline earth metals)

Group 1 and Group 2 elements: General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii)

Unit IV: Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, covalent bond: bond parameters. Lewis structure, polar character of covalent bond, covalent character of ionic bond,

PRACTICALS:

Quantitative estimation:

(i) Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

Anion analysis: , **CH_3COO^- , SO_4^{2-}, PO_4^{3-},**

Quantitative estimation:

(ii) Preparation of standard solution of oxalic acid .

Determination of strength of NaOH solution by titrating it a against standard solution of oxalic acid.

(iii) Preparation of standard solution of sodium carbonate.

Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

TERM I Examination

SEPTEMBER –OCTOBER

Unit IV: Chemical Bonding and Molecular Structure (continued)

Valence bond theory, resonance, geometry of covalent molecules, VSEPR theory. Concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homo nuclear diatomic molecules (qualitative idea only), hydrogen bond

NOVEMBER

Unit VII: Equilibrium

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le

Chatelier's principle; ionic equilibrium - ionization of acids and bases, strong and weak electrolytes, degree of ionization, concept of pH. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common .ion effect (with illustrative examples).

PRACTICALS: **Cation analysis- NH_4^+, Pb^{2+},Cu^{+2} ,Cd^{2+}, As^{+3} , Al^{+3} , Fe^{+3},Zn^{+2}, Mn^{+2}**

DECEMBER

Unit VI: Thermodynamics

Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics -internal energy and enthalpy, heat capacity and specific heat, measurement of ΔU and ΔH, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution.
Second law of Thermodynamics (brief introduction). Introduction of entropy as a state function, Gibb's energy change for spontaneous and non- spontaneous processes, criteria for equilibrium.
Third law of thermodynamics (brief introduction)

Unit XI: Some p-Block Elements

General Introduction to p-Block Elements
Group 13 elements: General introduction, electronic configuration, occurrence. Variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; Boron- physical and chemical properties.
Group 14 elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element, Carbon - catenation, allotropic forms, physical and chemical properties.
Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical properties; Nitrogen - properties Phosphorus - allotropic forms, compounds of Phosphorus: Oxoacids (elementary idea only).

Unit VIII: Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, applications of redox reactions.

PRACTICALS: Cation analysis- , Ni^{+2} , Co^{+2} , Ca^{+2} , Sr^{+2}, Ba^{2+}, Mg^{2+}

JANUARY-FEBRUARY

Unit XII: Organic Chemistry - Some Basic Principles and Techniques

General introduction, methods of qualitative and quantitative analysis, classification and IUPAC .Nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions

Unit XIII: Hydrocarbons

Classification of hydrocarbons

A1kanes - Nomenclature, isomerism, confonnations (ethane only), physical properties, chemical reactions including halogenation, free radical mechanism, combustion and pyrolysis.

Alkenes - Nomenclature, structure of double bond (ethene) geometrical isomerism, physical properties, methods of preparation; chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties. Methods of preparation, chemical reactions: acidic character of alkynes, addition reaction, hydrogen, halogens, hydrogen halides and water.

Aromatic hydrocarbons: Introduction, IUPAC nomenclature; Benzene: resonance aromaticity; chemical properties: mechanism of electrophilic substitution. – nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation: directive influence of functional group in mono-substituted benzene; carcinogenicity and toxicity.

PRACTICALS : Unknown salt

CHEMISTRY (CODE-043)
QUESTION PAPER DESIGN
CLASS - XI

S. No	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer -I (SA-I) (2 marks)	Short Answer-II (SA-II) (3 marks)	Long Answer question (L.A.) (5 marks)	Total Marks	% weightage
1.	**Remembering-** **(Knowledge based** Simple recall questions, to know specific facts, terms, concepts, principles, or theories, Identify, define, or recite, information)	2	1	1	-	7	10%
2.	**Understanding-** **(Comprehension -**to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	6	2	2	1	21	30%
3.	**Application**(Use abstract information in concrete situation, to apply knowledge to new situations, Use given content to interpret a situation, provide an example, or solve a problem)	6	2	2	1	21	30%
4.	**High Order Thinking Skills (Analysis & Synthesis-** Classify, compare, contrast, or differentiate between different pieces of information, Organize and/or integrate unique pieces of information from a variety of sources)	6	**1**	2	-	14	20%
5.	**Evaluation and Multi-Disciplinary-** (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	-	1	-	1	7	10%
	TOTAL marks	**20x1=20**	**7x2=14**	**7x3=21**	**3x5=15**	**70(37)**	**100%**

QUESTION WISE BREAK UP

Type of Question(s)	Mark(s) per Question	Total No. of Questions	Total Marks
VSA	1	20	20
SA-I	2	7	14
SA-II	3	7	21
LA	5	3	15
Total		**37**	**70**

SOME BASIC CONCEPTS OF CHEMISTRY

Assignment No. 1

1. What will be the molarity of a solution, which contains 5.85 g of NaCl (g) per 500 mL?
   (i) 4 mol L^{-1}
   (ii) 20 mol L^{-1}
   (iii) 0.2 mol L^{-1}
   (iv) 2 mol L^{-1}

2. If 500 ml of a 5 M solution is diluted to 1500 mL, what will be the molarity of the solutions obtained?
   (i) 1.5 M
   (ii) 1.66 M
   (iii) 0.017 M
   (iv) 1.59 M

3. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each questions.
   (a) Both A and R are true and R is the correct explanation of A.
   (b) A is true but R is false.
   (c) A is false but R is true
   (d) Both A and R are false.

   Assertion (A) : The empirical mass of ethene is half of its molecular mass.
   Reason (R) : The empirical formula represents the simplest whole number ratio of various atoms present in a compound.

4. Assertion (A) : One atomic mass unit is defined as one twelfth of the mass of one carbon-12 atom.
   Reason (R) : Carbon-12 isotope is the most abundant isotope of carbon and has been chosen as standard.
5. State the law of multiple proportion and explain it with the help of an example.

6. Two substances X and Y combine to give a substance Z . The process is exothermic and Z has properties different from those of X and Y. Is the substance Z an element, a mixture or a compound. Give explanation in support of your answer.

7. Calculate number of moles in (i) 45.4 litres of sulphur dioxide at N.T.P. (ii) $6.022X10^{22}$ molecules of oxygen (iii) 9g of Aluminium.
   [2mol, 0.1 mol, 0.33mol]
8. Calculate (a) Mass of 5g atoms of nittogen. (At mass of N = 14u)
   (b) Mass of 0.72 gram molecules of CO_2 (at mass of C=12u , O = 16u)
   (c) Number of molecules in 22g of CO_2?
   [70.0g, 31.68g, $3.011X10^{23}$molecules]
9. How many atoms and molecules of sulphur are present in 64.0g of sulphur (S_8)?
   [$1.2048X10^{24}$ atoms, $1.506X10^{23}$ molecules]
10. How many molecules of CO_2 are present in one litre of air containing 0.03% volume of CO_2 at N.T.P?
    [$7.9X10^{18}$ molecules]

11. What is the mass of carbon present in 0.5 mole of $K_4[Fe(CN)_6]$(At mass of Fe=56u, K=39u C=12u, N=14u, H=1u)

[36 g]

12. A coating of cobalt that is 0.005 cm thick is deposited on a plate that is 0.5 m^2 in total area. How many atoms of cobalt were deposited on the plate? (Density of Co= 8.9g/cc, atomic mass of Co= 59u)

[2.27 $x10^{24}$ atoms]

13. Hemoglobin contains 0.25%iron by mass. The molecular mass of hemoglobin is 89600. Calculate the number of iron atoms per molecule of hemoglobin.(atomic mass of Fe=56u)

[4 atoms]

14. An organic compound on analysis gave the following percentage composition; C=57.8%, H=3.6% and the rest is oxygen. The molecular mass of the compound was found to be 166. Find out the molecular formula of the compound.

[$C_8H_6O_4$]

15. A solution has been prepared by dissolving 60g of methyl alcohol in 120g of water. What is the mole fraction of methyl alcohol and water?
[X_{CH3OH}= 0.22, X_{H20} =0.78]

16. 3.0 g of H_2 reacts with 29.0 g of O_2 to yield H_2O.
(i) Which is the limiting reactant?
(ii) Calculate the maximum amount of H_2O that can be formed.
(iii) Calculate the amount of one of the reactants which remains unreacted .

(H_2, 1.50 mol, 0.156 mol)

17. Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ And CO_2 according to the equation: $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + CO_2 (g) + H_2O (l)
What mass and moles of $CaCl_2$ will be formed when 250ml of 0.76 M HCl reacts with 1000g of $CaCO_3$? What is the limiting reagent?
[LR- HCl, 0.095 moles of $CaCl_2$]

18. 3M solution of $NaNO_3$ has density 1.25g/ml. Calculate its molality.

(M M of $NaNO_3$=85$gmol^{-1}$)
[3.01m]

19. Calculate the molarity and molality of 16% aqueous methanol (CH_3OH) solution by volume. The density of the solution is 0.9 g mL^{-1}.
[1.875 M, 2.232 m]

20. Commercially available concentrated hydrochloric acid contains 38% HCl by mass.
    (a) What is the molarity of this solution if its density is 1.19 g cm^{-1}?
    (b) What volume of concentrated hydrochloric acid is required to make 1.0 L of 0.10 M HCl?

[12.38 M, 8.1 cm^3]

Hands-on/ IT

1. Mole concept - https://www.topperlearning.com/study/cbse/class-11-science/chemistry/video-lessons/some-basic-concepts-of-chemistry/mole-concept/1224/b101c3s2e5ch27t30

2. Teacher will explain Laws of Chemical combination with examples using a video.

Practice Assignment-1

SOME BASIC CONCEPTS OF CHEMISTRY

Q1. Calculate number of moles in 1.6g of S (Atomic mass of S=32u)

[0.05]

Q2. Calculate number of atoms present in 18g of glucose($C_6H_{12}O_6$)

[$6.02X10^{22}$]

Q3. How many moles of gold are present in 49.25g of gold rod? (atomic mass of gold=197u)

[0.25]

Q4. What is the number of molecules of CO_2 which contain 8g of O_2?

[$1.505 x10^{23}$ molecules]

Q5. A compound contains 42.3913% K, 15.2173% Fe, 19.5652% C and 22.8260%N. The molecular mass of the compound is 368u. Find the molecular formula of the compound. (Given At mass of K=39u, Fe=56u, C=12u, N=14u)

[$K_4Fe(CN)_6$]

Q6. How many moles of Nitrogen are needed to produce 8.2 moles of Ammonia by reaction with Hydrogen?

[4.1mol]

Q7. 250 ml of 0.5M Na_2SO_4 solution is added to an aqueous solution containing 10g of $BaCl_2$ resulting in the formation of white precipitate of $BaSO_4$.

a) Which is the limiting reagent?
b) How many moles of $BaSO_4$ will be obtained?
How many grams of $BaSO_4$ will be obtained? [$BaCl_2$, 0.047, 11.2g]

Q8. Calculate molarity of a solution containing 13.8g of potassium carbonate (molar mass =138g/mol) dissolved in 500ml of solution.

[0.2M]

Q9. The density of water at room temperature is 1g/cc. How many molecules are there in a drop of water if its volume is 0.05 mL?

[$1.67 x 10^{21}$ molecules]

Q10. Calculate the weight of carbon monoxide having same number of oxygen atoms as are present in 88g of carbon dioxide.

[112g]

Q11. An organic compound on analysis gave the following percentage composition; C=40%, H=6.67% and the rest is oxygen. The molecular mass of the compound was found to be 166. Find out the molecular formula of the compound.

[$C_6H_{12}O_6$]

Q12. 1M solution of $NaNO_3$ has density 1.25g/cc. Calculate its molality.
(M M of $NaNO_3$=$85gmol^{-1}$)

[0.858m]

Q13. Zinc and HCl react according to the equation: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
If 0.8 mol of Zn is added to HCl containing 0.62 mol of HCl, how many moles of hydrogen are produced? What is the limiting reagent? [LR- HCl, 0.31 moles of H_2]

Assignment No. 2

STRUCTURE OF ATOM

1. Which of the following options does not represent ground state electronic configuration of an atom?
   (i) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$
   (ii) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$
   (iii) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$
   (iv) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
2. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons?
   (i) Pauli's exclusion principle.
   (ii) Heisenberg's uncertainty principle
   (iii) Hund's rule of maximum multiplicity
   (iv) Aufbau principle

3. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each questions.
   (e) Both A and R are true and R is the correct explanation of A.
   (f) A is true but R is false.
   (g) A is false but R is true
   (h) Both A and R are false.

   Assertion (A) : It is impossible to determine the exact position and exact momentum of an electron simultaneously.
   Reason(R) : The path of an electron in an atom is clearly defined.

4. Assertion (A) : All isotopes of a given element show the same type of chemical behviour
   Reason(R) : The chemical properties of an atom are controlled by the number of electrons in the atom

5. Calculate the wavelength and energy of radiation emitted for the electronic transition from infinity to stationary state one of the H-atom. (Rydberg const = 1.09678 X 10^7 m^{-1}, h= 6.6256 X 10^{-34} J s) (9.12 x 10^{-8} m, 2.179 x 10^{-18} J)
6. What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from n=5 to n=2? In what region of the electromagnetic spectrum will this radiation lie? [434nm]

7. Calculate the wave number for the longest wavelength transition in the Balmer series of atomic hydrogen. [1.523 X $10^5 m^{-1}$]

8. The radius of first Bohr orbit of hydrogen atom is 0.529 Å. Calculate the radii of (i) the third orbit of He^+ ion and (ii) the second orbit of Li^{2+} ion. (2.380 Å, 0.7053Å)
9. State the De Broglie principle . Can it applied to a moving cricket ball. Why/ Why not?
10. How many electrons in an atom may have the following quantum numbers.
    n =3, m_s = -1/2
11. a) What is meant by quantization of energy?

b) Draw the shapes of d orbitals.

12. Explain why electronic energy is negative.

13. Calculate the wavelength of an electron moving with a velocity of 10^3 m/s
[7.25×10^{-7} m]

14. A moving electron has 3 $x10^{-25}$ joules of kinetic energy. What is the de Broglie wavelength?
[8967 $X10^{-10}$m]

15. What is the uncertainty in the position of a wagon of mass 1500 kg moving with velocity with a level of accuracy of 10 m/s? (3.5×10^{-39} m)

16. Write short notes on:
(a) Heisenberg's uncertainity principle
(b) Pauli's Exclusion principle
(c) Hund's rule of maximum multiplicity

17. (a) Which quantum no. determines (i) energy of an electron, (ii) orientation of orbital?
(b) Which shell would be the first to have 'g' sub shell?
(c) Which orbital is non directional?

18. Explain why atoms with half filled and full filled orbitals have extra stability. Write down the electronic configuration of: Si(14), Cr (24), Cu(29), Xe (54)

19. Write the electronic configuration of Cu^+, Ca^{2+}, Ni^{2+}, Cr^{3+}. Also indicate the no. of unpaired electrons present in each case.

20. Write the designation for orbital with the following quantum numbers:
a) n = 4; l = 1 b) n = 2; l = 0 c) n = 5; l = 2

Practice Assignment-2

STRUCTURE OF ATOM

Q1. Write the correct set of four quantum number for the valence electron of potassium (Z =19).

Q2. If the electron is to be located within $5x10^{-5}$ A^0, what will be the uncertainty in its velocity? [1.16×10^{10} m/s]

Q3. What is the energy in joules required to shift the electron of the hydrogen atom from the first Bohr orbit to the fifth Bohr orbit and what is the wave length of light emitted when the electron returns to the ground state? The ground state electronic energy is -2.18×10^{-18} J. [$9.5X10^{-8}$ m]

Q4. Energy associated with the 1st orbit in the H atom is -13.12×10^5 J/mol. What is the energy required for excitation to 2nd Bohr's orbit? [$9.84x10^5$ J/mol]

Q5. Using Aufbau's principle, write the ground state electronic configuration of the following:
a) Ca (Z=20) b) Mn (Z=25) c) Cu (Z=29) d) Rb (Z=37)

Q6. Give the values of all the four quantum numbers for 2p electrons in Nitrogen (Z=7)

Q7. Write the electronic configuration of the elements with Z=17 and predict the a) number of p electrons b) number of filled orbitals c) number of half filled orbitals

Q8. Write the electronic configuration of the following and report the number of unpaired electrons in each case:
a) Mn^{4+} (Z=25) b) F^- (Z=9) c) Zn^{2+} (Z=30) d) Fe^{2+}

Q9. a) Write the values of azimuthal and magnetic quantum numbers for n=2.
b) Write the four quantum numbers for 21st electron of Sc (Z=21)

Q10. a) What physical meaning is attributed to the square of the absolute value of wave function $|\psi 2|$?
b) What is the lowest shell which has f-subshell?
c) Which quantum number indicate the size of the orbital?

Assignment No.3

CLASSIFICATION OF ELEMENTS

1. The order of screening effect of electrons of s, p, d, f orbitals of a given shell of an atom on its outer shell electrons is
   (a) s > p > d > f
   (b) f > d > p > s
   (c) p < d < s < f
   (d) f > p > s > d
2. Comprehension given below is followed by some multiple choice questions. Each question has one correct option.
   In the modern periodic table, elements are arranged in order of increasing atomic numbers which is related to the electronic configuration. Depending upon the type of orbitals receiving the last electron, the elements in the periodic table have been divided into four blocks, viz, s, p, d and f. The modern periodic table consists of 7 periods and 18 groups. Each period begins with the filling of a new energy shell. In accordance with the Aufbau principle, the seven periods (1 to 7) have 2, 8, 8,18,18, 32,32 elements respectively. The seventh period is still incomplete. To avoid the periodic table being too lond, the two series of f- block elements, called lanthanoids and actinoids are placed at the bottom of the main body of the periodic table.
   (i) The element with atomic number 57 belongs to
   (a) s- block (b) p-block (c) d-block (d) f- block
   (ii) The last element of the p- block in 6 th period is represented by the outermost electronic configuration
   (a) $7s^27p^6$ (b) $5f^{14}6d^{10}7s^27p^0$ (c) $4f^{14}5d^{10}6s^26p^6$ (d) $4f^{14}5d^{10}6s^26p^4$
   (iii) Which of the elements whose atomic numbers are given below, cannot be accommodated in the present set up of the long form of the periodic table?
   (a) 107 (b) 118 (c) 126 (d) 102
   (iv) The electronic configuration of the element which is just above the element with atomic number 43 in the same group is …..
   (a) $1s^22s^22p^63s^23p^63d^54s^2$
   (b) $1s^22s^22p^63s^23p^63d^54s^24p^6$
   (c) $1s^22s^22p^63s^23p^63d^64s^2$
   (d) $1s^22s^22p^63s^23p^63d^74s^2$
   (v) The elements with atomic numbers 35, 53, and 85 are all ….
   (a) Noble gases
   (b) Halogens
   (c) Heavy metals
   (d) Light metals
3. What is the IUPAC name and symbol of an element with atomic number 117? Also predict the electronic configuration.
4. An element 'X' belongs to the third period of the p-block. It has four electrons in the outermost shell. Deduce the atomic number of element 'X'.
5. What is the general electronic configuration of lanthanides and actinides? Why they are placed in separate rows at the bottom of periodic table?
6. Consider the following species : N^{-3} , O^{-2} ,F^- , Na^+ , Mg^{2+} and Al^{+3}

(i) What is common in them?
(ii) Arrange them in increasing order of ionic radii. Give reason also.

7. Elements A , B, C and D have the atomic numbers 12, 19, 29 and 36 respectively. Write down their electronic configuration and predict
(i) group (ii) period (iii) block to which they belong.

8. The elements Na, Mg, Al, Si, P, S, Cl and Ar are arranged in the increasing order of their atomic numbers.
(i) Which element is most electropositive?
(ii) Which element is least reactive?
(iii) Which element is most electronegative?
(iv) Which element exists as a gas at room temperature?

9. (i) Arrange F, Cl, Br, I in increasing order of negative electron gain enthalpy. Also explain the reason of that arrangement.
(ii) Which is largest in size—Cu^+, Cu^{2+}, Cu and why?

10. Account for the following:
(i) Mg has higher value of first ionization energy than Al atom.
(ii) The ionization energy of Na^+ is higher than that of Ne although they have the same configuration.
(iii) Electron gain enthalpy of O is less negative than that of S.
(iv) Mg^{+2}ion is smaller than O^{-2} ion although both have the same electronic structure.

11. Give reasons:
(i) Noble gases are less reactive.
(ii) First ionization energy of Mg is more than that of Na but second ionization energy of Mg is less than Na.
(iii) Ionization enthalpy of oxygen is less than N.

12. Arrange the following in the increasing order of the property indicated:
(i) P, S, Cl, F (electron gain enthalpy)
(ii) Mg, Al, Si, Na (ionizationenthalpy)
(iii) I, I^+, I^-(atomic radii)

Practice Assignment-3

CLASSIFICATION OF ELEMENTS

Q1. Give the IUPAC name and the symbol of an element with Z=109.

Q2. Elements A and B have the atomic numbers 12 and 29 respectively. Write down their electronic configuration and predict
(i) group (ii) period (iii) block to which they belong.

Q3. Which is largest in size Al^{+}, Al^{2+} and Al, why?

Q4. Among the elements with atomic number 9, 12 and 36. Identify the element which is
a) highly electronegative b) an inert gas in nature c) highly electropositive in nature. Give reason for your answer.

Q5. Arrange the following in increasing order of the property indicated:
a) F, Cl , Br, I (Electron gain enthalpy)
b) Mg^{2+}, O^{2-}, Na^{+}, F^{-}, N^{3-} (Ionic size)
c) Mg, Al, Si, Na (Ionization enthalpy)
d) C, N, O,F (Second Ionization enthalpy)

Q6. Name a species that will be isoelectronic with each of the following atoms or ions,
(a) Ar (b) Cl^{-} (c) F^{-} (d) Rb^{+} (e) Ca^{2+}

Q7. The first ionization enthalpy of B is less than that of C. On the other hand, the second ionization enthalpy of boron is very much higher than that of carbon. Explain.

Q8. Among the elements of the second period Li to Ne and pick out the element:
(i) with highest first ionization energy.
(ii) that is most reactive non -metal
(iii) that is most reactive metal.
(iv) with largest atomic radius
(v) with highest electronegativity.

Q 9 Give the reasons for the following:
(vi) Electron gain enthalpy of fluorine is less negative than that of chlorine
(vii) Be in the second period of periodic table has slightly higher first ionization enthalpy of B.
(viii) Ionization enthalpy of nitrogen is more than that of oxygen.

Assignment No. 4

CHEMICAL BONDING AND MOLECULAR STRUCTURE

1. Which molecule/ion out of the following does not contain unpaired electrons?
   (a) N_2^+ (b) O_2 (c))O_2^{2-} (d) B_2
2. Which of the following statements is not correct from th view point of molecular orbital theory?
   (a) Be_2 is not a stable molecule
   (b) He2 is not stable but He_2^+ is expected to exist.
   (c) Bond strength of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period.
   (d) The order of energies of molecular orbitals in N_2 molecule is

   $\sigma 2s < \sigma^*2s < \sigma 2px < (\pi 2px = \pi 2py) < \pi^*2px = \pi^*2py < \sigma^*2pz$
3. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each questions.
   (a) Both A and R are true and R is the correct explanation of A.
   (b) A is true but R is false.
   (c) A is false but R is true
   (d) Both A and R are false.

   Assertion (A): Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound.
   Reason (R) : This is because sodium and chloride ions acquire octet in sodium chloride formation.
4. Assertion (A): Though the central atom of both NH_3 and H_2O molecules are sp^3 hybridized, yet H—N—H bond angle is greater than that of H—O—H
   Reason (R): This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.
5. Draw Lewis structure of the following molecules:
   H_2, H_2S, CH_4, C_2H_6, CO_2, CN^-, SO_3^{2-}

6. Write the formal charges of the atoms in the following ions: CO_3^{2-}, NO_2^-

7. How many σ and π bonds are there in CH_2= CH—C≡ CH, C_6H_6, C_6H_{12}, HCONHCH$_3$

8. Predict the shapes of $BeCl_2$, SF_6, PCl_5, BF_3 , ClF_3, XeF_4, NH_3 based on VSEPR theory .

9. Which of the compounds in the following pairs have higher dipole moment: NH_3 and NF_3, H_2O and H_2S. Give reason for your answer.

10. Account for the following:
    1. The H—S—H bond angle in H_2S is less than the H—O—H bond angle in H_2O.
    2. Dipole moment of CO_2, BF_3, CCl_4 are zero
    3. NF_3 is pyramidal but BF_3 is triangular planar

11. Draw the resonating structures of NO_3^-, CH_3COO^- , CH_2=CH-CH_2^+ , SO_3^{-2}, O_3

12. Apart from tetrahedral geometry, another possible geometry of CH_4 is square planar, with the four H atoms at the corners of the square and the C atom at its centre. Explain why CH_4 is not square planar?

13. Predict the hybridization state of S in SF_6 and C in C_2H_4. Explain the same with the box diagram.
14. Draw the molecular orbital formed on sideways overlap of $2p_x$ with $2p_x$.

15. Explain why O_2 molecule is paramagnetic in nature? Write Molecular Orbital configuration of O_2.
16. Why does Be_2, He_2 not exist using molecular orbital theory?

17. Draw the molecular orbital diagram of N_2, N_2^+ N_2^-. Write their electronic configuration, find the bond order and predict their magnetic behavior. Arrange the above in increasing order of bond length.
18. Why o-nitrophenol is steam volatile where as p-nitrophenol has higher boiling point. Explain.
19. Give reason:
    (i) Water is a liquid and hydrogen sulphide is a gas though O and S belong to the same group.
    (ii) HF is polar though it has covalent bond.
    (iii) HF has higher boiling point than HCl.

Practice Assignment-4

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Q1. Write Lewis dot structure of CO_2, CN^-, BF_3, PH_3,CO

Q2. Predict the shapes of the following molecules using VSEPR theory:
a) $BeCl_2$ b) $SiCl_4$ c) AsF_5 d) H_2S e) SO_2 f) PH_3

Q3. Arrange NH_3, H_2O, CH_4 in increasing order of bond angles. Give reason for your answer.

Q4. Which out of the following pairs has dipole moment and why?
a) BF_3 and NF_3 b) CO_2 and H_2S

Q5. Calculate the formal charge on every atom of nitrite ion.

Q6. What is the hybridization state of O in H_2O, B in BH_3, C in ethyne and ethane? Draw their orbital pictures specifying sigma and pi bonds.

Q7. Draw resonating structures of NO_3^- and SO_4^{2-}.

Q8. Write molecular orbital configuration of F_2, F_2^+. Calculate their bond order. Comment on the bond length and magnetic behavior.

Q9. Considering x-axis as the internuclear axis, what kind of bond shall be formed in the following?
1s/1s, 1s/2px, 2px/2py, 2py/2py

Q10. a) What are dispersion forces?
b) What type of intermolecular forces of attraction exists between H_2O and C_2H_5OH?

Q11. Describe the shapes of BF_3 and BH^-_4 . Assign the hybridization of boron in these species.

Q12. With the help of VB Theory, explain the formation of H_2 molecule. Draw the graph for the same.

Q.13 Give reason: H_2^+ and H_2^- have the same bond order but H_2^+ is more stable.

Hands-on/ IT

(i) Hybridization
https://youtu.be/g1fGXDRxS6k

(ii) Chapter will be taught by the teacher made presentation

ASSIGNMENT No. 5

STATES OF MATTER

1. Dipole- dipole forces act between the molecules possessing permanent dipole. Ends of dipolespossess 'partial charges'. The partial charge is :
   (a) More than unit electronic charge
   (b) Equal to unit electronic charge
   (c) Less than unit electronic charge
   (d) Double the unit electronic charge.
2. As the temperature increases, average kinetic energy of molecules increases. What would be the effect of increase of temperature on pressure provided the volume is constant?
   (a) Increases (b) Decreases (c) Remains same (d) becomes half
3. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each questions.
   (a) Both A and R are true and R is the correct explanation of A.
   (b) A is true but R is false.
   (c) A is false but R is true
   (d) Both A and R are false.

   Assertion (A) : Three states of matter are the result of balance between intermolecular forces and thermal energy of the molecules.
   Reason (R) : Intermolecular forces tend to keep the molecules together but thermal energy of molecules tends to keep them apart.
4. Assertion (A) : The temperature at which vapour pressure of a liquid is equal to the external pressure is called boiling temperature.
   Reason (R) : At high altitude atmospheric pressure is high.
5. A sample of gas occupies 100dm^3 volume at 1 bar pressure and 35^oC. If the volume of the gas is reduced to 5dm^3 at the same temperature, what is the additional pressure that must be applied? (19 bar)

6. Based upon Boyle's law draw the plot of P Vs V and also PV Vs P.

7. What do you understand by "Absolute Zero temperature"? What is its significance?

8. The density of a gas is found to be 3.43 g/l at 1atm pressure and 300 K. Calculate the molar mass of the gas. (84.5g/mol)

9. Two flasks A and B have equal volume. Flask A contains H_2 and is maintained at 300 K While flask B contains an equal mass of CH_4 and is maintained at 600k.
   (i) Which flask contains greater number of molecules? How many times more? (H_2, 8times)
   (ii) In which flask is pressure greater? How many times greater? (H_2, 4 times)

10. A certain quantity of gas occupies a volume of 919.0 ml at STP in dry conditions . The same gas when collected over water at 15^0 C and a pressure of 750 mm occupied a volume of one litre. Calculate the aqueous tension at 15^{0}C. (13.3mm)

11. A vessel of 5 liters capacity contains 7.0 g of N_2 and 2.0 g of CH_4 at 27^{o}C.
    (a) Calculate the partial pressure of each gas and also the total pressure in the vessel.
    (p_{N2}=1.245 bar, p_{CH4}=0.6235 bar, P_{total}=1.8675 bar)
    (b) 10 g of O_2 are introduced into and evacuated vessel of 5 liters capacity maintained at 27^{o}C. Calculate the pressure of the gas in the vessel. (1.5565 bar)

12. If density of a gas is found to be 3.80 g/l at STP. What will be density at at 27^0C and 0.93 bar pressure? (3.185g/l)

13. What is the significance of the vanderwaal's constants 'a' and 'b' and what are their units.

14. Account for the following-
    a) The size of weather balloon becomes larger and larger as it ascends to higher altitudes.
    b) Mountaineers suffer from altitude sickness at higher altitudes.
    c) Hot air balloons are used for metrological observations.
    d) Automobile tyres are inflated to lesser pressure during summer.
    e) Boiling point of water is less than 100^0C at higher altitude.
    f) Boiling point of water is greater than 100^0C in the pressure cooker.
    g) Ether and acetone are kept at cool temperature during summer

15. A solid is made up of two elements P and Q. Atoms Q are in the ccp arrangement while atoms P occupy all tetrahedral sites. What is the formula of the compound?

16. (a) An element has atomic mass 93 g mol^{-1} and density 11.5 g cm^{-3}. If the edge length of its Unit cell is 300 pm. Identify the type of unit cell.
    (b) Write any two differences between amorphous solids and crystalline solids.

17. Calculate the number of unit cells in 8.1 g of aluminium if it crystallizes in a f.c.c. structure. (Atomic mass of Al= 27u)

18. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom? (r = 137 pm)

19. One mole of CO_2 occupies 1.5L at 25^oC. Calculate the pressure exerted by the gas using Vander waal's gas equation with a=3.6 L^2bar/mol^2 and b=0.04 $Lmol^{-1}$
    (Given R=0.083 Lbar/mol/K)

    [14.9bar]

20. Critical temperature of NH_3 and SO_2 are 405.0 and 430.3 K respectively . Which one will have higher value of Vander Waals constant 'a' and why?

STP: Standard Temperature=273K
Standard Pressure= 1 bar
R = 0.083 barL/K/mol
Relation between various pressure units:
1 bar= 0.987atm= 10^5N/m^2= 10^5 Pa= 75cm of Hg= 750 mm of Hg= 750 torr
1 atm = 76 cm Hg = 760mm Hg = 760 torr

Practice Assignment-5
STATES OF MATTER

Q1. A gas occupies a volume of 250 mL at 745 mm of Hg and 25^{o}C. What additional pressure is required to reduce the volume of the gas to 200 mL at the same temperature?

Q2. A balloon is inflated in a warm living room (24^{o}C) to a volume of 2.5L. It was taken out on a very cold winter day (-30^{o}C). Assuming that mass of air and pressure inside the balloon are constant, find out the volume of the balloon.

Q3. A gas cylinder containing cooking gas can withstand a pressure of 14.9 atm. The pressure gauge of the cylinder indicates 12 atm at 27^{o}C. Due to sudden fire in the building, the temperature starts rising. At what temperature will the cylinder explode?

[99.5^{0}C]

Q4. A sample of gas occupies a volume of 2.74L at 0.9 atm and 27^{o}C. What will be the volume at 0.75 atm and 15^{o}C?

Q5. Calculate the mass of 120mL of N_2 at 150^{o}C and 750mm of Hg pressure. Given: R=0.0821 L atm/K/mol, molar mass of N_2=28 g/mol

Q6. The density of a gas is found to be 5.46 g/dm^3 at 27^{o}C and under 2 bar pressure. What will be its density at STP. [3g/dm^3]

Q7. Potassium chlorate decomposes as:

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

Calculate the volume of oxygen at 0^{0}C and 1atm when 24.50g of $KClO_3$ are heated. (R=0.0821 Latm K^{-1}mol^{-1})

Q8. The drain cleaner "drainex" contains small bits of aluminium which reacts with caustic soda to produce hydrogen gas. What volume of hydrogen at 20^{o}C and 1 bar will be released when 0.15 g of aluminium reacts?

The equation for the reaction is: $Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

[203.0ml]

Q9. In corundum , oxide ions are arranged in hexagonal close packing and aluminium ions occupy two – third of the octahedral voids. What is the formula of corundum?

Q10 The pressure of a mixture of H_2 and N_2 in a container is 1200 torr. The partial pressure of N_2 in the mixture is 300 torr. What is the ratio of H_2 and N_2 molecules in the mixture?

Q11. An element with density 11.2 gcm^{-3}forms f.c.c. lattice with edge length of 4 X 10^{-8} cm. Calculate the atomic mass of the element.

Q12. An element crystallizes in a f.c.c. lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2 X10^{-24} atoms.

Q13. Aluminium metal forms a ccp crystal structure. Its atomic radius is 125 x 10^{-12} m.
i) Calculate the length of the side of the unit cell
ii) How many such unit cells are there in 1.00 m^3 of Aluminium?

Q14. A bulb 'X' of unknown volume containing a gas at one bar pressure is connected to an evacuated bulb of 0.5 liter capacity through a stopcock. On opening the stopcock, the

pressure in the whole system after some time was found to have a constant value of 570 mm at the same temperature . What is the volume of the bulb X? (1.5 L)

Hands-on/ IT

1) Gas laws:
https://www.youtube.com/watch?v=BxUS1K7xu30&authuser=0

2) Teacher made Video shall be shown to understand Solid State.
3) Models made from tennis balls will be used to explain structures of various unit cells and packing in solids.

ASSIGNMENT No. 6
THERMODYNAMICS

1. The state of a gas can be described by quoting the relationship between…..
   (a) Pressure, volume , temperature
   (b) Temperature, amount, pressure
   (c) Amount, volume, temperature
   (d) Pressure, volume, temperature, amount.
2. The entropy change can be calculated by using the expression $\Delta S = q_{rev.}/T$. When water freezes in a glass beaker, choose the correct statement amongst the following:
   (a) ΔS(system) decreases but ΔS (surroundings) remains the same.
   (b) ΔS(system) increases but ΔS (surroundings) decreases.
   (c) ΔS(system) decreases but ΔS (surroundings) increases.
   (d) ΔS(system) decreases but ΔS (surroundings) decreases.

3. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each questions.
   (a) Both A and R are true and R is the correct explanation of A.
   (b) A is true but R is false.
   (c) A is false but R is true
   (d) Both A and R are false.

   Assertion (A) : Combustion of all organic compounds is an exothermic reaction.
   Reason (R) : The enthalpies of all elements in therir standard state are zero.
4. Assertion (A) : Spontaneous process is an irreversible process and may be reversed by some external agency.
   Reason (R): Decrease in enthalpy is a contributory factor for spontaneity.
5. A system does 200J of work and at the same time absorbs 150J of heat. What is the internal energy change?

   [-50 J]
6. 2 mols of ideal gas at 2 atm and 27^0C are compressed isothermally to half the volume against the external pressure of 4 atm. Calculate work done (w), q and ΔU .

   (w= 5150 J, ΔU =0, q= -5150 J)

7. A gas expands against constant external pressure of 1 atm from a volume of 10 dm^3 to a volume of 20 dm^3. In the process, it absorbs 800 J of thermal energy from surroundings. Calculate the value of internal energy change.

   (W = -1013 J, ΔU = -213 J)
8. The heat of combustion of methane ($C_{10}H_8(s)$) at constant volume was measured to be -5130KJ/mol at 298 K. Calculate the value of enthalpy change.

9. Enthalpies of formation of CO(g), CO_2(g), N_2O(g) and N_2O_4(g) are -110, -393, 81 and 9.7 KJ mol^{-1} respectively. Find the value of ΔrH for the reaction:
   N_2O_4 (g) + 3CO(g) → N_2O (g) + 3CO_2(g)

   [-777.7 KJ/mol]
10. The combustion of one mole of benzene takes place at 298 K and 1 atm. After combustion, CO_2(g) and H_2O (g) are produced and 3267 KJ of heat is liberated. Calculate the standard enthalpy of formation of benzene. Standard enthalpies of formation of CO_2 (g) and H_2O (l) are -393.5 KJ mol^{-1} and -285.83 KJ mol^{-1} respectively.

    (48.51 KJ mol^{-1})

11. Calculate the enthalpy change ΔH for the following reaction
C_2H_4 (g) + $3O_2$ (g) → $2CO_2$ (g) + $2H_2O$ (g)
Given average bond enthalpies of various bonds C-H, C=C, O=O, C=O, O-H as 414, 619, 499, 724, 640 KJ/mol respectively.
[-1684 kJ/mol]

12. Calculate the free energy change when 1 mole of NaCl is dissolved in water at 298 K. (Given: Lattice energy of NaCl = 777.8 KJ mol^{-1}, Hydration energy = -774.1 KJ mol^{-1} and ΔS = 0.043 KJ K^{-1} mol^{-1} at 298 K)
[-9.114 KJ/mol]

13. For the reaction ,A + B → C + D , ΔH = -10,000 J mol^{-1} and ΔS = -33.3 J K^{-1} mol^{-1},
(i) At what temperature will the reaction occur spontaneously from left to right?
(ii) At what temperature, the reaction will reverse?
[T<300.3K, T > 300.3 K]

14. The equilibrium constant for a reaction is 10. What will be the value of ΔG^o?
R= 8.314 JK^{-1} mol^{-1}, T = 300K (log 10 = 1)
[-5744.14 J/mol]

15. Give reasons:
(i) Thermodynamically an exothermic reaction is sometimes not spontaneous.
(ii) The entropy of steam is more than that of water at its boiling point.
(iii) The equilibrium constant for a reaction is one or more if ΔrG^o for it is less than zero.
(iv) Entropy of a perfectly crystalline substance is less than that of its imperfect crystal.

16. Predict the entropy change (Positive/Negative) in the following:
(i) A liquid substance crystallizes into a solid.
(ii) H_2O (l) → H_2O(g)
(iii) $CaCO_3$ (s) → CaO (s) + CO_2(g)
(iv) N_2(g) (1 atm) → N_2(g) (0.5 atm)
(v) 2Cl (g) → Cl_2(g)

17. Calculate the electron gain enthalpy of fluorine from the data given below. ΔH_f of KF is -560.8 KJ/mol, dissociation energy of F_2 is 158.9 KJ/mol. Lattice energy of KF is 807.5 KJ/mol , ionization energy of potassium is 414.2KJ/mol and enthalpy of sublimation of K= 87.8 KJ/mol. [-334.7 KJ]

18. Calculate the lattice enthalpy of NaCl from the data $\Delta_{sub}H^o$(Na)= 317.57 KJ/mol, Δ_fH^o of NaCl= -410.87 KJ/mol, $\Delta_{diss}H^o(Cl_2,g)$= 241.84 KJ/mol, Δ_iH^o(Na,g)= 495.8 KJ/mol and $\Delta_{eg}H^o(Cl_2,g)$= -365.26KJ/mol.
[979.9KJ/mol]

Hands on activity/ IT

1. Second law of thermodynamics - https://www.youtube.com/watch?v=WTtxlaeC9PY

PRACTICE ASSIGNMENT -6

THERMODYNAMICS

Q1. In a process 701 J of heat is absorbed by a system and 394 J of work is done by the system. What is the change in internal energy for the process? [307J]

Q2. (a) 2.5 mol of ideal gas at 2 atm and 27^0C expands isothermally t 2.5 times of its original volume against the external pressure of 1 atm. Calculate work done.
(b) If the same gas expands isothermally in a reversible manner, then what will the value of work done be.
(W = -4672.4 J, W= -5701.06 J)

Q3. Which of the two isomers of butane is more stable at 25^0C and why? Given: n-butane ($\Delta_f H^o$ = -120 KJ mol^{-1}) and isobutane ($\Delta_f H^o$= -130 $kJmol^{-1}$)

Q4. A gas absorbs 125 J of heat and expands against the external pressure of 1.2 atm from a volume of 0.5 L to 1.0L. What is the change in internal energy? (100J = 1Latm).
[W= 0.6 L atm or 60.7J, ΔU = 65 J]

Q5. Enthalpy of combustion of carbon to CO_2 is -393.5 KJ mol^{-1}. Calculate the heat released upon formation of 35.2g of CO_2 from carbon and dioxygen gas.
[-314.8 KJ/mol]

Q6. The reaction of cyamamide, $NH_2CN(s)$, with dioxygen was carried out in a bomb calorimeter, and ΔU was found to be -742.7 kJ mol^{-1} at 298 K. Calculate enthalpy change for the reaction at 298 K.
$NH_2CN(s) + 3/2O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O(l)$
[-741.46 KJ/mol]

Q7. The heat of combustion of methane ($C_{10}H_8(s)$) at constant volume was measured to be -5130KJ/mol at 298 K. Calculate the value of enthalpy change.

Q8. Calculate the standard enthalpy of formation of $C_2H_4(g)$ from the following thermochemical equation:
$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$; ΔH^o = -1323 KJ. Given that ΔH_f^o of $CO_2(g)$, $H_2O(g)$ as -393.5 and -249 KJ/mol respectively.

Q9. Calculate the enthalpy change for the process
$CCl_4(g) \rightarrow C(g) + 4Cl(g)$
and calculate bond enthalpy of C—Cl in $CCl_4(g)$
Given, $\Delta_{vap}H^o(CCl_4)$ = 30.5 kJ mol^{-1}
$\Delta_f H^o(CCl_4)$ = -135.5 kJ mol^{-1}
$\Delta_a H^o(C)$ = 715.0 kJ mol^{-1}
$\Delta_a H^o(Cl_2)$ = 242 kJ mol^{-1} (327 KJ/mol)

Q10. Calculate the heat of combustion of glucose from the following data:
(i) $C(graphite) + O_2(g) \rightarrow CO_2(g)$; ΔH=-395 KJ
(ii) $H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(l)$; ΔH =-269.4 KJ
(iii) $6C(graphite) + 6H_2(g) + 3O_2(g) \rightarrow C_6H_{12}O_6(s)$; ΔH = -1169.8 KJ

Q11. $\Delta r H^o$ for the reaction
$H\text{-}C{\equiv}N(g) + 2H_2(g) \rightarrow CH_3NH_2$
Is -150 KJ. Calculate the bond energy of C≡N bond. Given, bond energies of C-H= 414 KJ/mol, H-H= 435 KJ/mol, C-N =293KJ/mol, N-H= 369KJ/mol.

Q13. Calculate the lattice enthalpy of LiF; given that the enthalpy of
(i) Sublimation of lithium is 155.2 KJ/mol.
(i) Dissociation of 1 mole of F_2 at 75.3 KJ/mole.
(ii) Ionization of lithium is 520 KJ/mole.
(iii) Electron gain enthalpy of 1 mole of F(g) is -333 KJ. (v) $\Delta_f H^o$ is -594.1 KJ/mole

[973.95 KJ/mol]

Q14. For a reaction
$M_2O(s) \rightarrow 2M(s) + 1`/2\ O_2(g)$; ΔrH^o=30 KJ/mol, ΔrS^o=0.07 KJ/K/mol at 1 atm. Calculate upto what temperature the reaction would not be spontaneous.

Q15. A gas expands against constant external pressure of 1 atm from a volume of 10 dm^3 to a volume of 20 dm^3. In the process, it absorbs 800 J of thermal energy from surroundings. Calculate the value of internal energy change.

(W = -1013 J, ΔU = -213 J)

Q16. Calculate $\Delta H_{lattice}$ of SnO_2, If ΔH_f of SnO_2 is -588 KJ/mol, Enthalpy of Sublimation (Sn) = 292 KJ/mol, Enthalpy of Dissociation(O_2) = 454 KJ/mol. Total Electron gain enthalpy for O = 636 KJ/mol, Ionization enthalpy ($Sn \rightarrow Sn^{4+}$) = 8990kJ/mol.

[11596 KJ/mol]

ASSIGNMENT No. 7(a)

EQUILIBRIUM

Q1. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the standard free energy is $\Delta G > 0$. The equilibrium constant (K) would be _____.

(i) K = 0 (ii) K > 1 (iii) K = 1 (iv) K < 1

Q2. At 500 K, equilibrium constant, Kc , for the following reaction is 5.
$1/2\ H_2(g) + 1/2\ I_2(g) \rightleftharpoons HI(g)$. What would be the equilibrium constant Kc for the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

(i) 0.04 (ii) 0.4 (iii) 25 (iv) 2.5

Q3. Assertion (A): In the dissociation of PCl_5 at constant pressure and temperature addition of helium at equilibrium increases the dissociation of PCl_5 .
Reason (R) : Helium removes Cl_2 from the field of action.

(i) Both A and R are true and R is correct explanation of A.
(ii) Both A and R are true but R is not correct explanation of A.
(iii) A is true but R is false.
(iv) Both A and R are false.

Q4. On increasing the pressure, in which direction will the gas phase reaction proceed to re-establish equilibrium, is predicted by applying the Le Chatelier's principle.
Consider the reaction. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
Which of the following is correct, if the total pressure at which the equilibrium is established, is increased without changing the temperature?

(i) K will remain same
(ii) K will decrease
(iii) K will increase
(iv) K will increase initially and decrease when pressure is very high.

Q5. The equilibrium constant for gaseous reaction is
$Kc = (NH_3)^4(O_2)^5 / (NO)^4(H_2O)^6$
Write the balanced chemical reaction to this expression

Q6. Write the expression for Kc and Kp for the following processes:

(i) $FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$
(ii) $4\ NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6\ H_2O(g)$

Q7. For the reaction , $CH_4(g) + 2H_2S(g) \rightleftharpoons CS_2(g) + 4H_2(g)$ at 1173 K,

The magnitude of the equilibrium constant, Kc is 3.6. For the following composition, decide whether reaction mixture is at equilibrium. If it is not, decide which direction reaction should go: $(CH_4) = 1.07M$, $(H_2S) = 1.20M$, $(CS_2) = 0.90M$, $(H_2) = 1.78M$

Q8. (a) State Le-Chatelier's principle.

(b) In reaction $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$; $\Delta_f H^o = -92.0$ KJ/mol

What will happen if:

(i) Volume of the reaction vessel in which reactants is reduced to half?
(ii) Some amount of CH_3OH is removed?
(iii) The partial pressure of hydrogen is suddenly doubled?
(iv) An inert gas is added to the system under constant volume conditions?

Q9. In an experiment, 2 moles of HI are introduced in a 10.0 litre container at 720K.the equilibrium constant equals to 0.0156 for the gaseous reaction, $2HI \rightleftharpoons H_2 + I_2$. Calculate the amount of HI, H_2 and I_2 at equilibrium.

[HI=1.6mol,H_2= 0.2 mol, I_2= 0.2 mol]

Q10. 1.5 moles of PCl_5 were heated in a closed 4 litre vessel and when equilibrium was achieved, PCl_5 was found to be 35% dissociated in PCl_3 and Cl_2. Calculate equilibrium constants Kp and Kc for this reaction. [Kc=0.071]

Q11. The equilibrium constant for the following reaction is 1.6×10^5 at 1024 K.
$H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$ Find the equilibrium pressure of all gases if 10.0 bar of HBr is introduced into a sealed container at 1024 K.

[$P_{H2} = P_{Br2}$= 0.025 bar, P_{HBr} = 9.95 bar]

Hands-on activity /IT

1. PPT on examples of physical and chemical equilibrium made by the teacher will be used to begin the chapter.
2. Acid base concept - https://www.youtube.com/watch?v=IIu16dy3ThI

ASSIGNMENT No. 7(b)

EQUILIBRIUM

Q1. Acidity of BF_3 can be explained on the basis of which of the following concepts?
(i) Arrhenius concept
(ii) Bronsted Lowry concept
(iii) Lewis concept
(iv) Bronsted Lowry as well as Lewis concept.

Q2. Assertion (A): The ionisation of hydrogen sulphide in water is low in the presence of hydrochloric acid.
Reason (R) : Hydrogen sulphide is a weak acid.
(i) Both A and R are true and R is correct explanation of A.
(ii) Both A and R are true but R is not correct explanation of A.
(iii) A is true but R is false
(iv) Both A and R are false.

Q3. Assertion (A) : Increasing order of acidity of hydrogen halides is HF < HCl < HBr < HI.
Reason (R) : While comparing acids formed by the elements belonging to the same group of periodic table, H–A bond strength is a more important factor in determining acidity of an acid than the polar nature of the bond.
(i) Both A and R are true and R is the correct explanation of A.
(ii) Both A and R are true but R is not the correct explanation of A.
(iii) A is true but R is false.
(iv) Both A and R are false.

Q4. Write the proton transfer equilibria for the following acids in aqueous solution and identify the conjugate acid base pair in each case.
(i) H_2SO_4 (ii) $H_2PO_4^-$

Q5. Write the conjugate bases for the following Bronsted acids:
HCl, HNO_3, HSO_4^-, H_2S

Q6. Classify the following as Lewis acids and Lewis bases:
Cl^-, H_2O, NH_3, BF_3, Al^{3+}, C_2H_5OH

Q7. What is the ionic product of water? Ionic product of water at 310 K is 2.7×10^{-14}. What is the pH of neutral water at this temperature? [pH =6.19]

Q8. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below:
(i) Human muscle fluid (pH = 6.83) (iii) Human Blood (pH = 7.38)
[1.479×10^{-7}M, 4.169×10^{-8} M]

Q9. Calculate the percentage dissociation of HOCl in its 0.08 M solution. Also calculate the concentration of OCl^- ion in the solution and its pH .
K_a (HOCl) = 2.5×10^{-5} M [1.41×10^{-3}, 2.85]

Q10. 20 ml of 2×10^{-5} M $BaCl_2$ solution is mixed with 20 ml of 1×10^{-5} M Na_2SO_4 solution , will a precipitate form ? (Ksp of $BaSO_4$ is 1.0×10^{-10}).
[no, $K_{IP} = 5 \times 10^{-11}$]

Q11. The solubility of MgC_2O_4 in water is 0.0093 mol^{-1}. Calculate K_{sp}.

[8.6×10^{-5}]

Q12. The solubility product of Al $(OH)_3$ is 2.7×10^{-11}. Calculate its solubility in gL^{-1} and also find out pH of this solution. (Atomic mass of Al = 27 u).

Q13. Give reason for the following :

(i) The precipitation of $Mg(OH)_2$ is prevented by the addition of NH_4Cl prior to addition of NH_4OH but its precipitation by NaOH is not prevented by the prior addition of NaCl.

(ii) In qualitative analysis , NH_4Cl is added before adding NH_4OH for testing Fe^{+3}, Al^{+3}.

(iii) Group IV ions are not precipitated in Group II even though both are precipitated as their sulphides.

Q14. Calculate the pH of 0.1 M solution of pyridine, C_5H_5N. K_b for pyridine is 1.5×10^{-9}.The equation is as given :

$C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$

PRACTICE ASSIGNMENT - 7

EQUILIBRIUM

Q1. The equilibrium constant for gaseous reaction is
$Kc = (NH_3)^4(O_2)^5 / (NO)^4(H_2O)^6$
Write the balanced chemical reaction to this expression.

Q2. Write the conjugate acid of (i) NH_3, (ii) OH^- (iii) CH_3COO^-

Q3. Write the conjugate acids for the following Bronsted bases:
H_2O, CO_3^{2-}, HSO_4^- , I^-

Q4. The dissociation constant of an acid HA is 1.6×10^{-5}. Calculate H_3O^+ ion concentration in its 0.01 M solution.

Q5. Calculate the degree of ionization of 0.01 M solution of HCN, Ka of HCN is 4.8×10^{-10}. Also calculate the pH of the solution.

Q6. Calculate the concentration of H_3O^+ ion in a mixture of 0.02 M of acetic acid and 0.2 M sodium acetate. Given: Ka for acetic acid is 1.8×10^{-5}.

Q7. Calculate the pH value of
(a) 0.01 M HCl (b) 0.001M NaOH (c) 0.001 M $Ba(OH)_2$

Q8. (a) The value of K_w at a certain temperature is 2.5×10^{-14}. What is the pH of pure water at this temperature?
(b) Calculate the pH of a 10^{-7} M solution of H_2SO_4.

Q9. What is the pH of 0.001 M aniline solution? The ionization constant of aniline is 4.27×10^{-10}. Calculate the degree of ionization of aniline in the solution. Also calculate the concentration of the conjugate acid of aniline. The equation is as follows:
$C_6H_5NH_2 + H_2O \rightleftharpoons C_6H_5NH_3^+ + OH^-$
[pH=7.82, degree of ionization=6.53×10^{-4}, $[OH^-] = 6.534 \times 10^{-7}$ mol/L]

Q10. The solubility product of AgBr at a certain temperature is 2.5×10^{-13}. Find out solubility of AgBr in grams per litre at this temperature. Given ; molecular mass of AgBr= 188 g/mol .

Q11. 50 mL of 0.01M solution of $Ca(NO_3)_2$ is added to 150mL of 0.08 M solution of $(NH_4)_2SO_4$. Predict whether $CaSO_4$ will be precipitated or not. Ksp of $CaSO_4 = 4 \times 10^{-5}$.

Q12. The solubility product constant of Ag_2CrO_4 and AgBr are 1.1×10^{-12} and 5.0×10^{-13} respectively. Calculate the ratio of the molarities of their saturated solutions. [91:9]

ASSIGNMENT No. 8

REDOX REACTIONS

1. The largest oxidation number exhibited by an element depends on its outer electronic configuration. With which of the following outer electronic configurations the element will exhibit largest oxidation number?
   (a) $3d^1 4s^2$
   (b) $3d^3 4s^2$
   (c) $3d^5 4s^1$
   (d) $3d^5 4s^2$
2. Which of the following does not show disproportionation tendency?
   (a) Cl
   (b) Br
   (c) F
   (d) I
3. The exhibition of various oxidation states by an element is also related to the outer orbital electronic configuration of its atom. Atom(s) having which of the following outermost one oxidation state in its compounds.
   (a) $3s^2$
   (b) $3d^1 4s^2$
   (c) $3d^2 4s^2$
   (d) $3s^2 3p^3$
4. Identify the correct statement(s) in relation to the following reaction:
   $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
   (a) Zinc is acting as an oxidant.
   (b) Chlorine is acting as a reductant
   (c) Hydrogen ion is acting as an oxidant.
   (d) Zinc is acting as a reductant.
5. Calculate the oxidation number of the element in bold in the following:
   H_2S, $\mathbf{S}_2O_8^{2-}$, $\mathbf{Cr}_2O_7^{2-}$, $\mathbf{Sb}_2O_5$, $H_3\mathbf{P}O_4$, $\mathbf{Br}F_3$
6. Identify the substance oxidized, reduced, oxidizing agent and reducing agent for the following reactions:
   (a) $3N_2H_4(g) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(l)$
   (b) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$
7. Write Stock notation of the following compounds:
   (a) Mercury(II) chloride
   (b) Chromium(III)oxide
   (c) Nickel(II)sulphate
   (d) Tin (IV)oxide
8. Balance the following equation by oxidation number method:
   (i) $MnO_4^- + C_2H_4OH \rightarrow Mn^{2+} + CO_2 + H_2O$ (acidic medium)
   (ii) $N_2H_4 + ClO_3^- \rightarrow NO + Cl^-$ (basic medium)
   (iii) $Al + NO_3^- \rightarrow Al(OH)_4^- + NH_3$ (basic medium)
   (iv) $Cr_2O_7^{2-} + SO_2 \rightarrow Cr^{3+} + SO_4^{2-}$ (acidic)

9. Balance the following equations by ion electron method:
   i) $Cr\ (s) + ClO_4^-\ (aq) \rightarrow Cr(OH)_3(s) + ClO_3^-\ (aq)$ (in basic medium)
   ii) $H_2O_2 + MnO_4^- \rightarrow MnO_2 + O_2^-$ (Basic medium)
   iii) $Cl_2 \rightarrow ClO_3^- + Cl^-$ (Basic medium)
   iv) $Zn + NO_3^- \rightarrow Zn^{2+} + N_2$ (acidic medium)

PRACTICE ASSIGNMENT - 8

REDOX REACTIONS

Q1. Calculate the oxidation number of the element in bold in the following:
BH_3, **S**$_2O_3^{2-}$, **Si**H_4, **B**F_3, , **Br**O_4^-,

Q2. Identify the substance oxidized, reduced, oxidizing agent and reducing agent for the following reactions:

(a) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2\,H_2O(l)$

(b) $N_2H_4(l) + 2\,H_2O_2(l) \rightarrow N_2(g) + 4H_2O(l)$

Q3. Write Stock notation of the following compounds:
(a) Strontium(II) chloride
(b) Iron(III)oxide
(c) Barium(II)sulphate
(d) Tin(IV)Carbonate

Q4. Balance the following equations by ion electron and oxidation number method:
i) $MnO_4^- + I^- \rightarrow MnO_2 + I_2$ (basic)
ii) $Cr_2O_7^{2-} + Cl^- \rightarrow Cr^{3+} + Cl_2$ (acidic medium)
iii) $H_2O_2 + Fe^{2+} \rightarrow Fe^{3+} + H_2O$ (acidic)
iv) $Cr(OH)_4^-(aq) + H_2O_2(aq) \rightarrow CrO_4^{-2}(aq) + H_2O(l)$ (in basic medium)
v) $MnO_4^- + H_2C_2O_4 \rightarrow Mn^{2+} + CO_2$ (acidic medium)

s-Block Elements

The s-block elements of the Periodic Table are those in which the last electron enters the outermost s-orbital. Elements of group 1 & 2 of the Periodic table belong to s-block.

Group-1 Elements

Li, Na, K, Rb, Cs, Fr

Commonly called alkali metals. They are so called because they form hydroxides on reaction with water which are strongly alkaline in nature.

1. General Electronic Configuration: The general electronic config. is [noble gas]ns^1. All alkali metals have one valance electron outside noble gas core. The loosely held s-electron in the outermost shell makes them more electropositive metals. The readily loose an electron to form M^+ ion.

Lithium	Li	[He] $2s^1$
Sodium	Na	[Ne] $2s^1$
Potassium	K	[Ar] $2s^1$
Rubidium	Rb	[Kr] $2s^1$
Caesuium	Cs	[Xe] $2s^1$
Francium	Fr	[Rn] $2s^1$

2. Atomic and ionic Radii
   a) They have the largest sizes in a particular period.
   b) The atomic and ionic radii increase on moving down the group, i.e. from Li to Cs because of increase in no. of shells on moving down the group.
   c) The monovalent ions (M^+) are smaller than the parent atom as on forming cations the nuclear charge per electron increases on forming a cation.
   For example: Na (At No 11) - 2,8,1 Number of e^- - 11
   Na^+ (At No 11) – 2,8 Number of e^- - 10
   So same nuclear charge is acting on less number of electrons hence nuclear charge per electron increases, so atomic radii decreases.

3. Ionization Enthalpy
   Energy required to remove the most loosely bound electron i.e. the outermost e^- from an isolated gaseous atom.
   a) I.E of alkali metals is considerably low due to large size of the atom in a particular period and by losing one e^-, they acquire nearest noble gas config.

b) I.E decreases down the group from Li to Cs. This is because the effect of increasing size outweighs the increasing nuclear charge and the outermost electron is well screened from the nuclear charge.
c) The second ionization enthalpies of alkali metals are very high. This is because when an e^- is removed from alkali metals, they form monovalent cations which have stable noble gas config and to remove second e^-, it has to be removed from a stable noble gas config. Hence IE_2 is high.

4. Hydration Energy

The alkali metal ions are highly hydrated.

a) The hydrated enthalpies of alkali metal ions decrease with increase in ionic sizes.
$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$
The extent of hydration decreases from Li^+ to Cs^+ because of increase in ionic radii from Li^+ to Cs^+.
b) Hydrated Li^+ ion being largest in size has lowest mobility in water. Hence, lithium salts are mostly hydrated, e.g. $LiCl.2H_2O$.
c) Hydrated Cs^+ ion being smallest in size has highest mobility in water.
d) So, due to greater hydration of Li^+, Li is most reducing amongst alkali metals

Physical Properties

1. Alkali metals are silvery white, soft and light metals.
2. The densities of alkali metals are low as compared to other metals. Li, Na and K are even lighter than water. This is because of their large size.
3. The densities increase down the group from Li to Cs due to increase in size. But atomic mass increase as well. But increase in atomic mass is more than compensates the increase in atomic size. Hence mass/volume increase from Li to Cs. Exception – K is lighter than Na probably due to its larger size.
4. All these metals have low m.p&b.p. Because they have only one valance e^- per atom. Hence energy binding the atoms in the crystal lattice of the metal is low. Thus metallic bonding is weak.
5. m.p&b.p decreases as moving down the group from Li to Cs.
6. All alkali metals are strongly electropositive in nature as they have one valence e^- and also have low I.E, so the valance e^- can easily be lost to acquire noble gas config.
7. Alkali metals and their salts impart characteristics colour to an oxidizing flame. This is because alkali metals have low ionization enthalpies. The energy from the flame of bunsen burner is sufficient to excite the electrons of alkali metals to higher energy levels. The excited state is unstable, so excited electrons come back to their original energy levels, they emit extra energy, which falls in the visible region in the electromagnetic spectrum and thus appear coloured.
E.g Li (crimson red), Na (yellow), K (violet), Rb (red violet), Cs(blue)
Thus alkali metals can be detected by their respective flame tests. The different colours are on the basis of the E absorbed for excitation of valance electrons.

8. Alkali metals exhibit photoelectric effect – The phenomenon of emission of electrons when electromagnetic radiation strikes them is called photoelectric effect. Because they have low I.E. and are easily ejected when exposed to light. Cs which has the lowest I.E hs the maximum tendency to show photoelectric effect and hence useful as electrodes in photoelectric cells.
9. Lattice enthalpy of alkali metals is high. IT is defined as the energy required to break one mole of a crystal into its free ions.

   $MX(s) \xrightarrow{\text{Lattice Enthalpy}} M^+(g) + X^-(g)$

   High lattice enthalpy is because of strong electrostatic forces of attraction between cations& anions. Larger is the forces of attraction, greater will be the lattice enthalpy. Lattice enthalpy also depends on size of ions and charge. Larger the size, lesser is the lattice enthalpy.

Group II (Alkaline Earth Metals)

Be, Mg, Ca, Sr, Ba
They are called alkaline earth metals because their oxides and hydroxides are alkaline in nature and metal oxides are found in earth's crust.

1. Electronic Configuration – These elements have two electrons in their valance shell. The general electronic configuration is [noble gas] ns^2.

Beryllium	Be	$1s^2\ 2s^2$	[He] $2s^2$
Magnesium	Mg	$1s^2\ 2s^2\ 2p^6\ 3s^2$	[Ne] $3s^2$
Calcium	Ca	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	[Ar] $4s^2$
Strontium	Sr	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^2$	[Kr] $5s^2$
Barium	Ba	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^6\ 6s^2$	[Xe] $6s^2$
Radium	Ra		[Rn] $7s^2$

2. Atomic and ionic radii-
   a) Radii are smaller than the corresponding alkali metals in the same period. This is because alkaline earth metals have higher nuclear charge and electrons are attracted more towards the nucleus.
   b) On moving down the group, the radii increases due to gradual increase in no of shells and screening effect.
3. Ionization Enthalpies
   a) Alkaline earth metals have low ionization energies id due to large size of the atoms.
   b) Down the group I.E decreases due to increase in atomic radii down the group.

c) I.E of group-2 members is higher than group 1 members because they have smaller size and electrons are more attracted towards the nucleus of the atoms.

d) $I.E_1$ values of alkaline earth metals ar higher than those of alkali metals and $I.E_2$ values of alkaline earth metals are smaller than alkali metals

	$I.E_1$	$I.E_2$
Na	496 $KJmol^{-1}$	4562 $KJmol^{-1}$
Mg	737 $KJmol^{-1}$	1450 $KJmol^{-1}$

In case of alkali metals, (e.g, Na) the second electrons to be removed is removed from a cation which has already acquired noble gas config. On the other hand, in alkaline earth metals (i.e. Mg), second electron is removed from a monovalent cation (Mg^+) ($1s^2\ 2s^2\ 2p^6\ 3s^1$) which has one electron in the outermost shell. So second electron can be removed easily.

Na (g) $\xrightarrow{I.E1}$ Na^+ $\xrightarrow{I.E2}$ Na^{2+}

$1s^2\ 2s^2\ 2p^6\ 3s^1$ $\rightarrow$ $1s^2\ 2s^2\ 2p^6$ $\rightarrow$ $1s^2\ 2s^2\ 2p^5$

Mg (g) Mg^+ Mg^{2+}

$1s^2\ 2s^2\ 2p^6\ 3s^1$ $1s^2\ 2s^2\ 2p^6$ $1s^2\ 2s^2\ 2p^5$

4. Hydration Enthalpies

Decreases with the increase in ionic sizes down the group $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

The hydration enthalpies of alkaline metal ions are larger than those of alkali metal ions. Thus, compounds of alkaline earth metals are more hydrated, e.g. $MgCl_2.6H_2O$ and $CaCl_2.6H_2O$. White NaCl and KCl do not form hydrates.

Physical Properties

1. Alkaline earth metals are generally silvery white, lustrous and relatively soft but harder than alkali metals. Be and Mg are grayish.
2. M.P and B.P are higher than corresponding alali metals. This is because of smaller size of alkaline earth metals. They are more closely packed. M.P and B.P do not show a regular trend.
3. They are strongly electropositive in nature because of their low ionization enthalpy.
4. Electropositive nature is less than alkali metals because of their higher I.E.
5. Electropositive character increases down the group from Be to Ba.
6. Except Be and Mg, the alkaline earth metals impart characteristics colours to flame.

Be	Mg	Ca	Sr	Ba	Ra
-	--	Brick Red	Crimson Red	Grassy Green	

- The alkaline earth metals give characteristics colours because of their low ionization enthalpy. The valance electrons are easily excited to higher energy level by the energy of the flame of Bunsen burner. When these excited electrons come back to ground state they emit radiations which fall in the visible regions. Therefore, they give colours to the flame.

  Be and Mg being smaller in size has higher I.E. The energy of the flame is not sufficient to excite their e^- to higher energy levels. Therefore, they do not give any colour in Bunsen flame.

7. They have <u>high electrical and thermal conductivities</u> which are typical characteristics of metals.

ASSIGNMENT No. 9

s-BLOCK ELEMENTS

1. A substance which gives brick red flame and breaks down on heating to give oxygen and brown gas is
   (a) magnesium nitrate
   (b) calcium nitrate
   (c) barium nitrate
   (d) strontium nitrate
2. The solubility of metal halides depends on their nature, lattice enthalpy and hydration enthalpy of the individual ions. Amongst fluorides of alkali metals, the lowest solubililty of LiF in water is due to
   (a) ionic nature of lithium fluoride
   (b) high lattice enthalpy
   (c) high hydration enthalpy for lithium ion.
   (d) low ionization enthalpy of lithium atom.
3. What is the colour of strontium salt in flame?
4. Why is first ionization energy of alkali metals lower than those of alkaline earth metals?
5. Why alkaline earth metals always form divalent cations even though the second ionization enthalpy of these metals is higher than the first ionization enthalpy?
6. Why are alkali metals not found in free state in nature?
7. Discuss the trends of :
   (i) Ionization enthalpies of alkali metals as we move down the group from Li to Cs.
   (ii) Metallic character of group 2 elements.
8. Why are lithium salts commonly hydrated and those of other alkali metal ions usually anhydrous?
9. Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so .Why?
10. Why potassium and caesium, rather than lithium used in photoelectric cells?
11. Why are alkali metals strong reducing agent?
12. Among the alkali metal ions, Li^+ has the lowest mobility. Why?
13. Lithium has the highest ionization enthalpy in group I elements, yet it is the strongest reducing agent. Why?

p-Block Elements (NOTES)

The elements belonging to group 13 to 18 constitute p-block elements. Their valance shell electronic config. is $ns^2\ np^{1-6}$. In p-block, the last e^- enters into outermost p-orbital. The inner core electronic config. may differ. The difference in inner core elements greatly influence their physical as well as chemical properties.

Gp 13 ns^2np^1	14 ns^2np^2	15 ns^2np^3	16 ns^2np^4	17 ns^2np^5	18 ns^2np^6
Gp O.S +3	+4	+5	+6	+7	+8
Other O.S +1	+2, -4	+3, -3	+4, +2, -2	+5, +3, +1, -1	+6, +4, +2

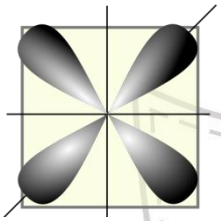
- Oxidation state

The maximum oxidation state shown is equal to total number of valance e^- (i.e. sum of s- and p- electrons)
The number of possible O.S increases towards the right of periodic table.
In addition to group O.S the p-block elements show more O.S.
They can also show O.S less by two units from the group O.S. The O.S less by two units becomes more stable for heavier elements in each group. This is because of a property called inert pair effect- Inert pair effect is the reluctance of s-electrons to participate in chemical combination due to its high penetration effect. Hence, O.S decreases by two units.

- Non-metals and metalloids exist in p-block. The non-metallic character decreases down the group. The heaviest element is most metallic in nature.
- In general, non metals have higher ionization enthalpies and higher electronegativities than metals. In contrast to metals which readily form cations, non- metals form anions.
- First element of each group as compared to the subsequent members of the same group differ because of:
  a) Size and other properties (such as electronegativity, ionization enthalpy) which depend upon size.
  b) Absence of d-orbitals in their valance shell.

1. Due to small size, high electronegativity and high I.E the first member differ from the rest of the members.
2. The first member of each group has four orbitals (one 2s and three 2p orbitals) in the valance shell for bonding and hence it can accomodate8e^-. In the third pd. of p-block (gen. confg. $3s^23p^n$) has vacant 3d orbitals lying between 3p and 4s levels of energy. Using these d-orbitals, the elements of third (and higher) periods can expand their covalency beyond four. For example:
   a) Boron forms only BF_4^- while Al gives AlF_6^{3-} ion.
   b) Carbon forms only tetrahalides while other members form hexahalides $[SiF_6]^{2-}$, $[GeCl_6]^{2-}$ etc.
   c) Nitrogen forms only NF_3 (have an octet of e^- in valance shell) while phosphorous forms both trihalides and pentahalides. E.g PF_5 and PCl_5.
   d) Fluorine does not form FCl_3 while chlorine forms ClF_3.

3. Due to presence of d-orbitals the elements of third and higher pd. are more reactive than elements of second which do not contain d-orbitals. For e.g., tetrahalides of carbon are not hydrolysed by water while tetrahalides of gp14 are readily hydrolysed.
4. The first member shows greater tendency to form pπ- pπ multiple bonds to itself, such as, C=C, C≡C, N≡N and to other second row elements C=O, C≡N, N=O etc. This type of π bonding is not strong in case of heavier p-block. The heavier elements also form π-bonds but these d-orbitals (i.e. dπ- pπ or pπ- dπ). Eg. In SO_2 one of the two π-bonds between S and O involves dπ- pπ bonding while in SO_3, two of three π-bonds involves dπ- pπ bonding. In this, half filled 3d-orbital of s overlaps with half filled 2p orbital of oxygen.



Half filled 3d-orbital

Half filled p-orbital

Group-13 Elements (The Boron Family)

B, Al, Ga, In, Tl

Boron is non-metal and Al is metal but shows many chemical similarities. Ga, In, Tl are almost metallic in character.
Occurrence of Boron: Occurs as orthoboric acid (H_3BO_3), borax $Na_2B_4O_7.10H_2O$ and Kernite $Na_2B_4O_7.4H_2O$
Occurrence of Al: Most abundant metal. Exists as bauxite $Al_2O_3.2H_2O$ and cryolite Na_3AlF_6. Boron, the first member of gp13 differs from other members of group13. Compounds of B has one e^- pair less and hence these electron deficient compounds act as lewis acids.
Electronic Configuration: Electronic Configuration of gp13 elements is ns^2np^1.

Atomic Radii: On moving down the group atomic radii increases as for each successive member one extra shell of electrons is added. Exception - Atomic radius of Ga is less than Al. This is because in the inner core of electronic configuration there are 10 additional d^- electrons which offer only poor screening effect for outer electrons from the increased nuclear charge in gallium. Hence atomic radius of Ga is less than Al.

Ionization enthalpy: Shows variation in trend as we move down the group. I.E decreases from B to Al due to increase in size. From Al to Ga and from In to Tl, the variation is due to inability of d^- and f^- electrons, which have low screening effect, to compensate the increase in nuclear charge. The order of I.E are $\Delta_iH_1 < \Delta_iH_2 < \Delta_iH_3$.
Electronegativity: Down the group, electronegativity first decreases from B to Al and then increases. This is because of the variation in atomic size of the elements.
Physical Properties (General)

1. Boron is non- metallic in nature.

2. It is extremely hard solid next to diamond.
3. Its melting point is very high.
4. Other members are soft metals with low m.p and high electrical conductivity.
5. Gallium has very low m.p 303K and exits in liquid state in summer, but it'sb.p is very high and hence can be used for measuring high temperature.
6. Density of the elements increases down the group from B to Tl.

Electropositive Character – Metallic Nature:

a) The elements in group 13 are less electropositive or metallic as compared to alkali metals or alkaline earth metals due to decrease in size along a pd, they have high I.E.
b) On moving down the group electropositive character first increases from B to Al and then decreases from Al to Tl. This is because as we move from B to Al, there is increase in atomic size and hence Al has high tendency to loose electrons. From Al to Tl electropositive character decreases because of increase in electrode potential.
c) Amongst the elements of gp 13, B has highest I.E and hence it has very less tendency to loose electrons and hence it is a non-metal and poor conduction of electricity.

M.P and B.P: Do not show a regular trend. m.p decreases on moving down the group from B to Ga and then increase from Ga to Tl. This is probably due to unusual crystal structures of B and Ga.

Density: Due to smaller atomic and ionic radii, the elements of group 13 have higher densities as compared to elements of group2. Because increase in atomic mass outweighs increase in atomic size.

Group-14 (Carbon Family)

C, Si are Non metals
Ge is a Metalloid and
Sn, Pb are Metals

The valence shell electronic configuration Is ns^2np^2. The inner core is electronic configuration of the elements in this group also differs.

1. Covalent Radius
    a) The covalent radii of gp14 are smaller than the corresponding elements of gp13. This is because when we move from gp13 to gp14 within the same period, the effective nuclear charge increases and hence covalent radii decreases due to stronger attractive influence of the nucleus on outer electrons.
    b) Covalent radii of gp14 regularly increase on moving down the group. This is because of addition of new shells in each succeeding element.
2. Ionization Enthalpy
    a) The first I.E of gp14 elements is higher than those of corresponding gp13 elements. This is because of greater nuclear charge and smaller size of atoms of gp14 elements.

b) The first ionization enthalpies of gp14 elements follow the order: C>Si> Ge>Sn<Pb
The decrease in I.E is due to increase in atomic size and screening effect of inner electrons which outweighs the effect of increased nuclear charge. Small increase in I.E from Sn to Pb is due to the effect of increased nuclear charge outweighs the shielding effect due to the presence of additional 4f ⁻ and 5d⁻ electrons.

3. Electronegativity
   a) The elements of gp14 are more electronegative than gp13 elements because of small size.
   b) Electronegativity decreases from C to Si remains constant from Si to Sn and then increases for Pb.
4. Metallic Character
   a) They are less electropositive and hence less metallic than gp13 elements because of smaller size and high I.E.
   b) On moving down the group metallic character increases.
5. M.P and B.P
   M.P and B.P of gp14 elements are higher than gp13 elements as gp14 elements form 4 covalent bonds with each other and hence strong binding. M.P and B.P decrease down the group due to decrease in inter atomic forces of attraction.

Group 15 (Nitrogen family)

N	$2s^2 2p^3$	Non Metals	• Solids and show allotropic modifications • s-orbitals in these elements are completely filled and p-orbitals are half filled, making their electronic configuration extra stable.
P	$3s^2 3p^3$		
As	$4s^2 4p^3$	Metalloids	
Sb	$5s^2 5p^3$		
Bi	$6s^2 6p^3$	Metal	

Oxidation State and Trends in group 15

N	**-3, +3**	• Covalent character decreases down the group. • Most common oxidation state are -3, +3 and +5 • -3 O.S decreases down the group due to increase in size and metallic nature.
P	**-3, +3, +5**	
As	**-3, +3, +5**	
Sb	**+3, +5**	
Bi	**+3, +5**	

- The stability of +5 O.S decreases due to inert pair effect down the group. Only Bi(V) compound is BiF_5
- Nitrogen exhibits +1, +2 and +4 O.S also when it reacts with oxygen.
- Nitrogen is restricted to a maximum covalency of 4 since 4 orbitals (one s and three p) are available for bonding.
- Phosphorous exhibits nearly all intermediate O.S from +5 and -3.
- The heavier elements have vacant d-orbitals which can be used for bonding as in PF_6^- .

Anomalous properties of nitrogen

- Nitrogen differs from the rest of the members of this group due to its smaller size, high electro negativity, high ionization enthalpy and non-availability of d-orbitals.
- Nitrogen can form pπ-pπ multiple bond.
- Nitrogen exists as diatomic molecule with a triple bond.
- Heavier elements do not form pπ-pπ bonds as their atomic orbitals are so large and differs that they cannot have effective overlapping.
- P, As and Sb form P-P, As-As and Sb-Sb single bonds whereas Bi forms metallic bonds. However, N-N single bond is weaker than P-P single bond, because of high inter electronic repulsion of non-bonding electrons owing to small bond length.
- Catenation tendency is weaker in N as N-N bond is much weaker than P-P, As-As and Sb-Sb due to inter electronic repulsions because of small bond length.

Dinitrogen

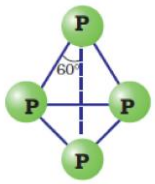
Properties

1. Dinitrogen is a colourless, odourless, tasteless and non-toxic gas.
2. It is inert at room temperature because of the high bond enthalpy of N ≡ N bond.
3. Nitrogen is a gas and phosphorus is a solid. N_2 can form pi bond with itself. So, in N_2 molecule N forms triple bond with itself and force of attraction between N_2 molecules is Van der waal's force of attraction which is very weak. Phosphorus due to larger atomic size does not form pi bonds with itself. Hence, in P4 molecule P forms sigma bond with other phosphorous atoms which is a strong bond. Due to this extensive bonding phosphorus is found in solid state.

Allotropes of phosphorus:

White Phosphorus:

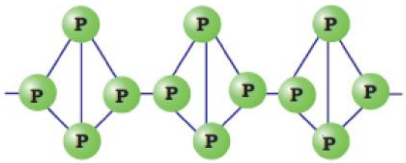
It glows in dark (chemiluminescence).
It is a waxy solid, insoluble in water, soluble in CS_2 and benzene.
It is stored under water as it ignites spontaneously in air.

	• Each 'P' located at the corner of a tetrahedron is attached to 3 other 'P' atoms. • Angle is 60°. P_4 units face lot of angle strain.

1. **Red Phosphorus**:

White P $\xrightarrow{\text{570K, inert atm.}}$ Red P

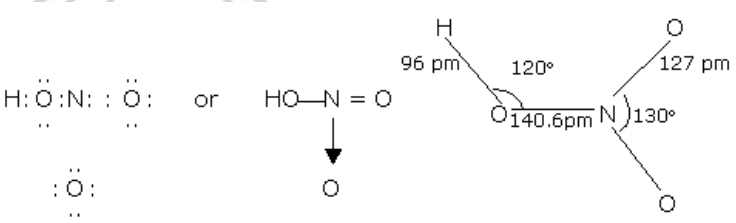
It is insoluble in water and CS_2.
It does not glow in the dark.
It has a high melting point (870K), amorphorus, less reactive.
Red P is less reactive than white P.
Safe to handle and shows a polymeric structure.



2. **Black Phosphorus**: It is the most stable variety with an extended layer structure.

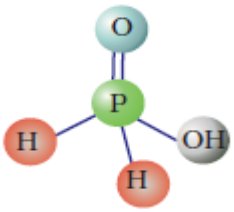
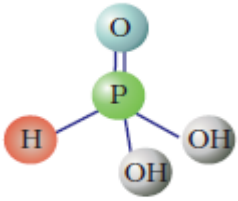
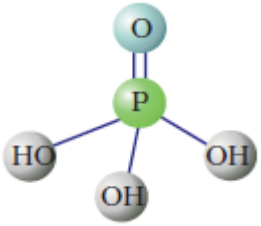
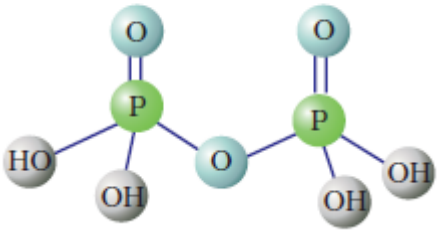
Oxoacids:

Oxoacids of Nitrogen:

HNO_2	HNO_3
	

Oxoacids of Phosphorus:

All oxoacids have at least one P=O and one P-OH bond. They have cyclic or linear structure.

H_3PO_2  • **Monoprotic acid** • **Hypophosphorous or Phosphinic acid**	H_3PO_3  • **Phosphorus acid** • **Diprotic acid, forms 2 series of salts: NaH_2PO_3& Na_2HPO_3**
H_3PO_4  • **Orthophosphoric acid** • **Triprotic acid, Na_2HPO_4, NaH_2PO_4, Na_3PO_4** • **Used for manufacture of phosphatic fertilizers.**	$H_4P_2O_7$  • **Diphosphonic acid or Pyrophosphoric acid**

ASSIGNMENT No. 10

SOME p-BLOCK ELEMENTS

1. Which of the following is a lewis acid?
   (a) $AlCl_3$ (b) $MgCl_2$ (C) $CaCl_2$ (d) $BaCl_2$
2. The reason for small radius of Ga compared to Al is:
   (a) poor screening effect of d- and f- orbitals
   (b) increase in nuclear charge
   (c) presence of higher orbitals
   (d) higher atomic number.
3. The exhibition of highest co-ordination number depends on the availability of vacant orbitals in the central atom. Which of the following elements is not likely to act as central atom in MF63-?
   (a) B (b) Al (C) Ga (d) In
4. Catenation i.e. linking of similar atoms depends on size and electronic configuration of atoms. The tendency of catenation in Group 14 elements follows the order:
   (a) C > Si > Ge > Sn (b) C>> Si> Ge = Sn
   (c) Si > C> Sn > Ge (d) Ge > Sn> Si > C
5. What are electron deficient compounds? Why does boron trifluoride behave as lewis acid?

6. Discuss the pattern of variation in oxidation states :
   (i) B to Tl (ii) C to Pb .

7. How can you explain higher stability of BCl_3 as compared to $TlCl_3$?

8. Give reason:
   a) Lead (IV) chloride is highly unstable towards heat.
   b) CCl_4 is immiscible in water whereas $Sicl_4$ is easily hydrolysed.
   c) Carbon has strong tendency of catenation than Si.
   d) Silicon forms SiF_6^{2-} ion whereas corresponding compound of carbon is not known.
   e) atomic radius of Ga is less than Al.
   f) PbX_2 is more stable than PbX_4.

9. Why carbon forms covalent compounds whereas lead forms ionic compounds?

10. Discuss the trends of :
    (i) Atomic radii of group 13 elements from B to Al.
    (ii)First ionization enthalpy of group 14 elements.

11. Why does elemental silicon not form a graphite like structure whereas carbon does.

12. The +1 oxidation state in group 13 and +2 oxidation state in group14 becomes more and more stable with increasing atomic number. Explain

13. Why Boron does not form B^{3+} ion?

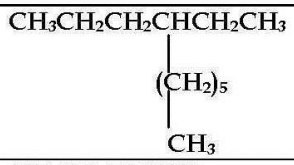
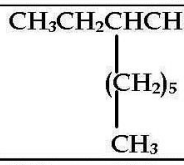
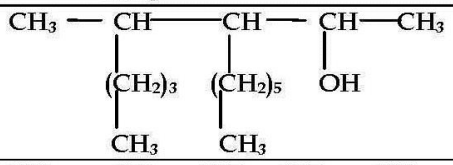
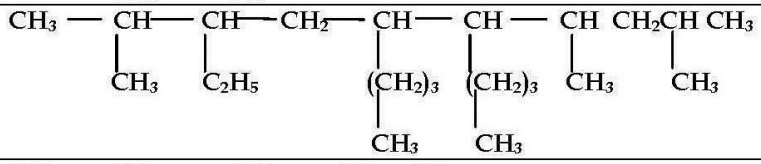
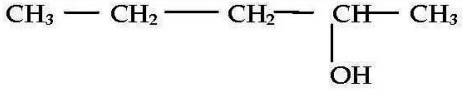
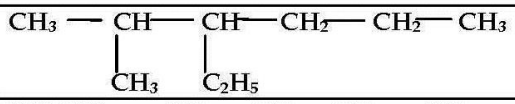
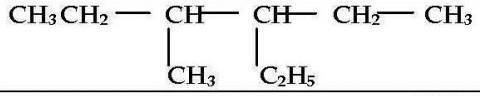
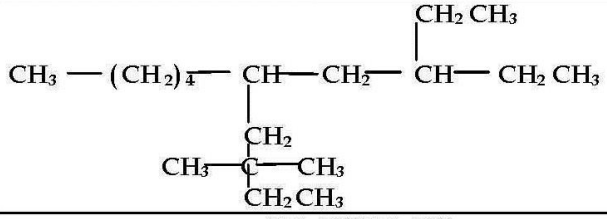
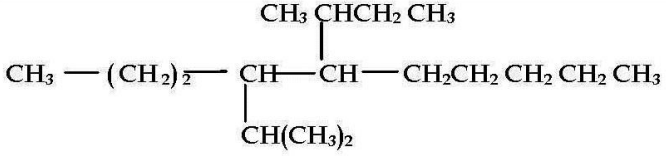
14. Give reason:
    i) Nitrogen a gas and phosphorus a solid.
    ii) Phosphorus acid a monoprotic acid.

iii) White phosphorus is more reactive than red phosphorus.
iv) Nitrogen cannot show catenation whereas phosphorus does.
v) Nitrogen is a unreactive gas.

15. Draw the structure of (i) H_3PO_4 (ii) HNO_3 (iii) H_2PO_3 (iv) HNO_2

ASSIGNMENT NO. 11 (A)

WORK SHEET ON NOMENCLATURE OF ORGANIC COMPOUNDS

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
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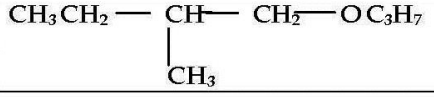
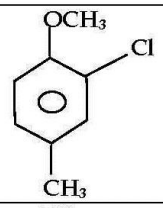
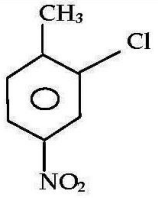
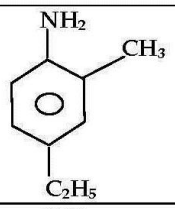
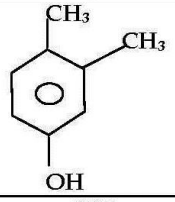
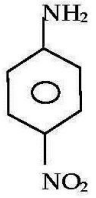
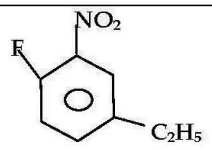
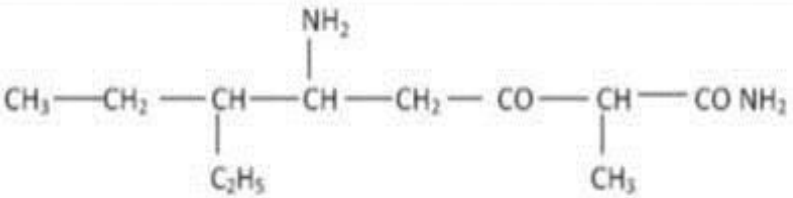
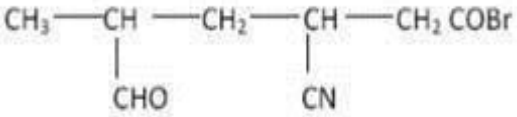
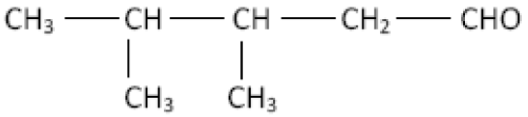
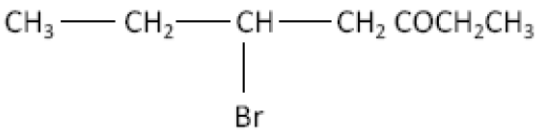
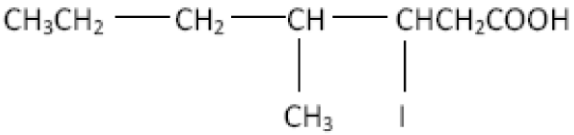
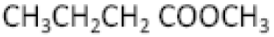
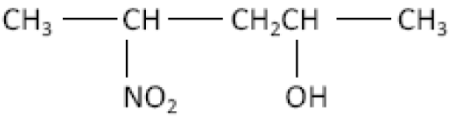
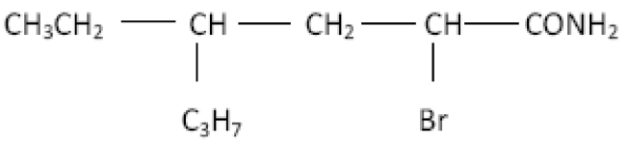
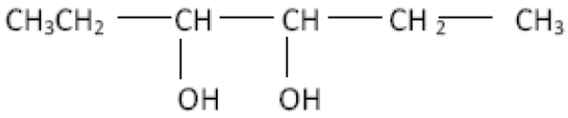
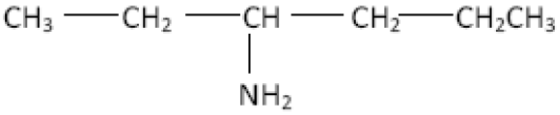
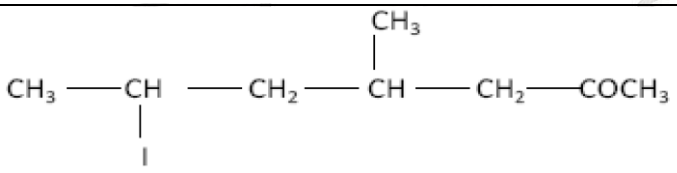
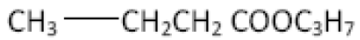
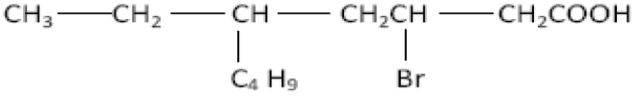
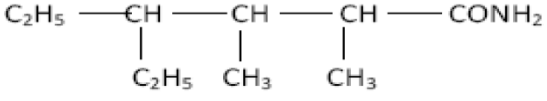
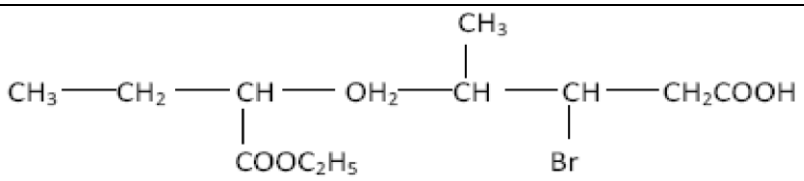
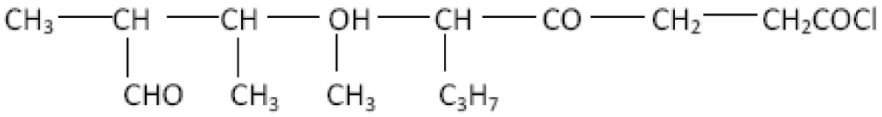
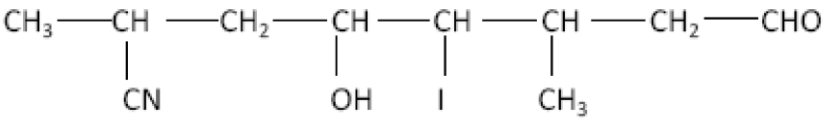
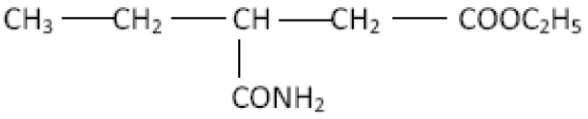
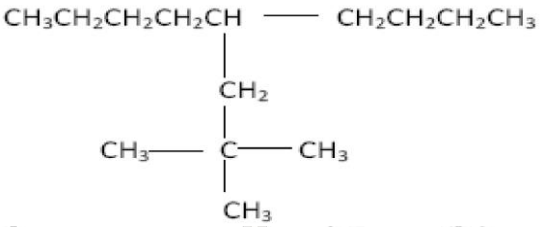
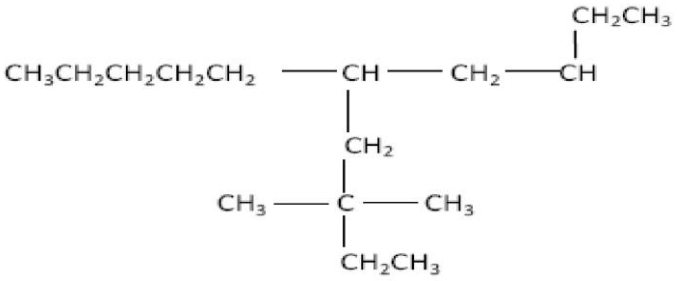
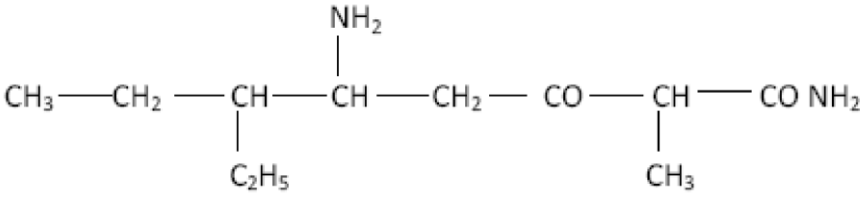
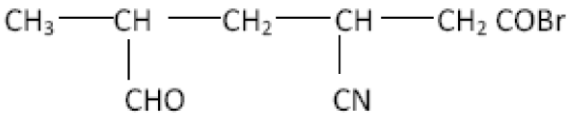
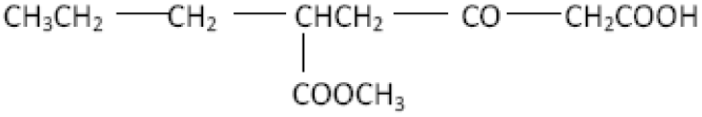
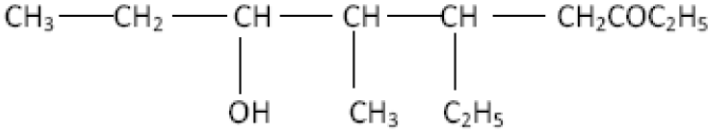
12.	

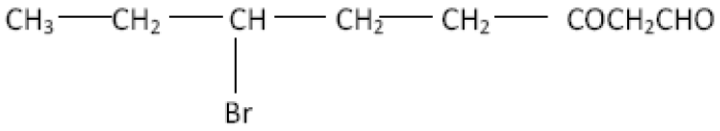
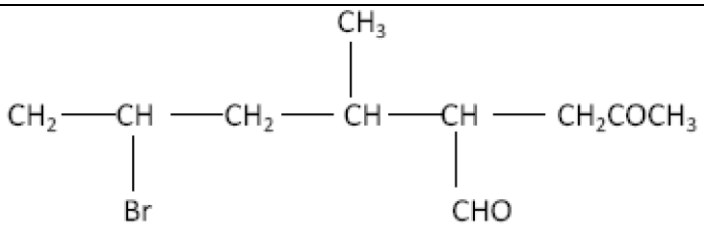
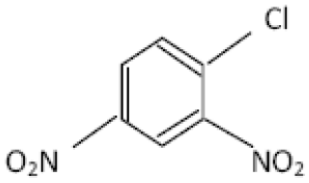
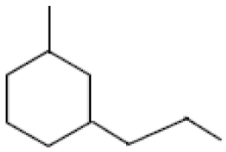
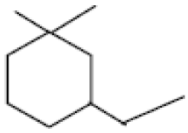
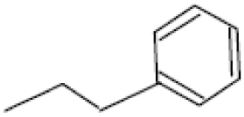
13.	$C_6H_5OCH_3$
14.	$C_6H_5OC_7H_{15}$
15.	$C_6H_5OC_6H_{13}$
16.	$CH_3CH=CHCH_2\underset{\displaystyle Br}{\underset{\vert}{C}}HCHO$
17.	$CH_3\underset{\displaystyle CONH_2}{\underset{\vert}{C}}H\,CH_2C{\equiv}C\text{-}CHO$
18.	$OHC\text{--}\,CH_2CH_2CHO$
19.	$OHC\text{--}\,CH_2\underset{\displaystyle CHO}{\underset{\vert}{C}}HCH_2CHO$
20.	$HOOC\text{--}\,CH_2CH_2COOH$
21.	$HOOC\text{--}\,CH_2\underset{\displaystyle COOH}{\underset{\vert}{C}}HCH_2COOH$
22.	$CH_2{=}CH-CH{=}CH_2$
23.	$CH{\equiv}C-CH_2CH_2-C{\equiv}CH$
24.	$CH{\equiv}C-CH{=}CH-CH{=}CH_2$
25.	$CH_3CH{=}CH-C{\equiv}CH$
26.	$CH_3\underset{\displaystyle OH}{\underset{\vert}{C}}H-\underset{\displaystyle OH}{\underset{\vert}{C}}HCH_3$
27.	$\underset{\displaystyle CN}{\underset{\vert}{CH_2}}\!\!-\!\!\underset{\displaystyle OCH_3}{\underset{\vert}{CH}}\text{--}\,CH_2\!\!-\!\!COO\,CH_3$
28.	$CH_3-O-\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle CH_3}{\overset{\vert}{C}}}}-CH_3$
29.	$C_6H_5\,CH_2\text{--}\underset{\displaystyle OH}{\underset{\vert}{C}}HCH_2CH_3$
30.	$C_6H_5CH_2\underset{\displaystyle Br}{\underset{\vert}{C}}H\underset{\displaystyle Br}{\underset{\vert}{C}}HCH_2CH_3$
31.	$C_6H_5CH_3$, $C_6H_5OCH_3$, $C_6H_5NH_2$, $C_6H_5NO_2$, C_6H_5Br

32.	
33.	
34.	
35.	
36.	
37.	
38	
39	

MORE PRACTICE ON NOMENCLATURE

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

23	
24	
25	
26	
27	
28	
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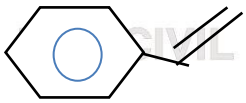
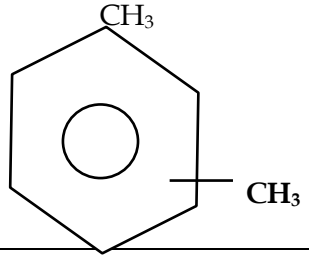
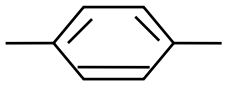
30	$C_6H_5COCH_3$, $C_6H_5CO\,C_6H_5$, C_6H_5OH,
31	
32	

33	H_3C  CH_3

ASSIGNMENT No.: 11

Organic Chemistry: Some basic Principles and Techniques

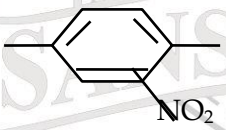
Q1. In which of the following, functional group isomerism is not possible?
(i) Alcohols (ii) Aldehydes (iii) Alkyl halides (iv) Cyanides

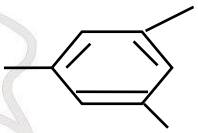
Q2. Electronegativity of carbon atoms depends upon their state of hybridisation. In which of the following compounds, the carbon marked with asterisk is most electronegative?
(i) $CH_3 - CH_2 - {}^*CH_2 - CH_3$
(ii) $CH_3 - {}^*CH = CH - CH_3$
(iii) $CH_3 - CH_2 - C \equiv {}^*CH$
(iv) $CH_3 - CH_2 - CH = {}^*CH_2$

Q3. Assertion (A) : Energy of resonance hybrid is equal to the average of energies of all canonical forms. Reason (R) : Resonance hybrid cannot be presented by a single structure.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.

Q4. Assertion (A) : Pent- 1- ene and pent- 2- ene are position isomers.
Reason (R) : Position isomers differ in the position of functional group or a substituent.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.

Q5. Write the IUPAC names of the following organic compounds:
(a) $CH_3CH(CHO)CH_2CH(CH_3)CH(CH_3)COBr$
(b) $CH_3CH(NO_2)CH_2\ CH_2CH(Cl)COOCH_2CH_2\ CH_3$
(c) $CH_3CH_2CH(C_2H_5)CH_2COCH_2COCH_2CH_3$
(d) $CH_3CH(COOC_2H_5)CH_2CH(CH_3)COOH$

(e) H_3C  OH
NO_2

(f) HOOC  OH
CH_3

Q6. Identify the following as electrophiles or nucleophiles:
CH_3^+, OH^-, Cl^+, NH_3, BH_3, H_2O

Q7. Expand each of the following condensed formulae into their complete structural formulae and indicate the hybridization state of each carbon atom:
(a) $(CH_3)_3CCH_2CH_2COCH_2NO_2$
(b) $CH \equiv CCH_2(CH_2)_2COOH$
(c) $CH_3CH= C(NH_2)CONH_2$

Q8. Write bond line formulae for the following:
(a) Sec-butyl alcohol (b) Neo-pentylbromide (c) Isoprpyl chloride
(d) 2,3-Dimethyl butanal

Q9. Arrange the following carbocations in increasing order of stability:

$(CH_3)_2CH^+$, $(CH_3)_3C^+$, CH_3^+, $CH_3CH_2^+$. Explain the reason also.

Q10. Explain the relationship between the members of following pairs of structures? Are they structural or geometrical isomers or resonance contributors?

(i) $CH_3CH_2COCH_2CH_3$, $CH_3COCH_2CH_2CH_3$

(ii) 

(iii) $CH_3CH_2CH{=}CH_2$ (OH) , $CH_3CH_2C{=}O$ (CH_3)

(iii) $CH_3CH_2CH_2CH_2CH_3$, $CH_3CH(CH_3)CH_2CH_3$

Q11. For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or hetrolysis, Identify reactive intermediate produced as free-radical, carbocation and carbonion:

(a) $C_2H_5O\text{-}OCH_3 \rightarrow C_2H_5O\cdot + \cdot OCH_3$

(b) $(CH_3)_3C\text{-}Br \rightarrow (CH_3)_3C^+ + Br^-$

(c) $CH_3CH_2\text{-}Cu \rightarrow C_2H_5^- + Cu^+$

Q12. Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct order of acidity of the carboxylic acids?

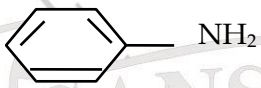
(a) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$

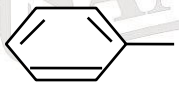
(b) $CH_3CH_2COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

Q13. Draw resonating structures of the following:

(a) $CH_2{=}CHCHO$

(b) CH_3COO^-

(c) 

(d) 

Q14. Write the structures of : (a) 5-Bromoheptanoic acid (b) 2-Ethylanisole 3-Bromo-5-ethylbenzaldehyde (d) Cyclohex-2-en-1-ol (e) 4-nitroaniline

ASSIGNMENT No.: 12

HYDROCARBONS

Q1. In an electrophilic substitution reaction of nitrobenzene, the presence of nitro group _____.
(i) deactivates the ring by inductive effect.
(ii) activates the ring by inductive effect.
(iii) decreases the charge density at ortho and para position of the ring relative to meta position by resonance.
(iv) increases the charge density at meta position relative to the ortho and para positions of the ring by resonance.

Q2. Arrange the following in decreasing order of their boiling points. (A) n–butane (B) 2–methylbutane (C) n-pentane (D) 2,2–dimethylpropane
(i) A > B > C > D
(ii) B > C > D > A
(iii) D > C > B > A
(iv) C > B > D > A

Q3. Assertion (A) : Toluene on Friedal Crafts methylation gives o– and p–xylene.
Reason (R) : CH_3-group bonded to benzene ring increases electron density at o– and p–position.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.

Q4. Assertion (A) : Nitration of benzene with nitric acid requires the use of concentrated sulphuric acid.
Reason (R) : The mixture of concentrated sulphuric acid and concentrated nitric acid produces the electrophile, NO_2^+ .
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.

Q5. Draw geometrical isomers of But-2-ene.Which of these have high boiling point and why?

Q6. Draw Sawhorse projection and eclipsed conformation of ethane? Which of the two is more stable and why?

Q7. Give the mechanism of
(i) Addition of HBr to propylene in the presence of peroxide.
(ii) Halogenation of Benzene
(iii) Addition of HBr to propylene in the presence of peroxide

Q8. Branched chain alkanes have lesser boiling points than straight chain alkanes. Explain.

Q9. What happens when :
(i) Ethylene dibromide is heated with zinc dust.

(ii) Isopropyl bromide is heated with ethanolic solution of potassium hydroxide.

Q10. An alkene on ozonolysis gives a mixture of ethanol and pentan-3-one. Write the structure and IUPAC name of 'A'.

Q11. Complete the following reaction:

(i) $HC{\equiv}CH + NaNH_2 \longrightarrow$

(ii) $HC{\equiv}CH + H_2O \xrightarrow[\text{dil. } H_2SO_4]{Hg2+}$

(iii) $HC{\equiv}CH \xrightarrow{?} HC{\equiv}C{-}CH_3$

(iv) $? + 2Zn \xrightarrow{heat} HC{\equiv}CH + 2ZnBr_2$

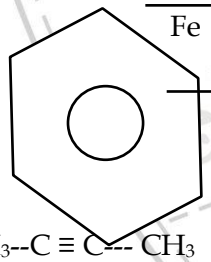
(v) $nCH_2=CHCl \xrightarrow[\text{Polymerization}]{\text{Benzoyl Peroxide}}$

(vi) $(CH_3)(C_2H_5)C=CH(C_2H_5) \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3}$

(vii) $RCH_2CH_2X \xrightarrow{?} RCH=CH_2 + HX$

(viii) $3\,CH{\equiv}CH \xrightarrow[\text{Fe tube}]{\text{Red hot}}$

(ix)



$+ Zn \longrightarrow ?$

(x) $CH_3{-}C{\equiv}C{-}CH_3 \xrightarrow{?} CH_3{-}CH=CH{-}CH_3$

Q12. How does benzene react with:
(i) methyl chloride in the presence of $AlCl_3$
(ii) nitric acid in the presence of sulphuric acid.
(iii) Halogen in the presence of lewis acid.

Q13. Explain the following reaction with example:
(i) Wurtz reaction
(ii) Friedel craft's Acylation.
(iii) Kolbe's electrolysis

Q14. Why does benzene show electrophilic substitution reaction easily and nucleophilic substitution substitution with difficulty?

Q15. Carry out the following conversions:

(i) Propene to 2- bromopropane
(ii) Propene to 1-bromopropane
(iii) Ethyl alcohol to ethane
(iv) Isopropyl alcohol to n- propyl alcohol
(v) Isopropyl bromide to n-propyl bromide
(vi) n-Propyl bromide to isopropyl bromide
(vii) Isopropyl alcohol to n-propyl bromide
(viii) n-propyl alcohol to isopropyl alcohol
(ix) propane to Propene
(x) propene to propyne
(xi) 2-Butene to Butane
(xii) 1-chloropropane to propan-1-ol
(xiii) Propanoic acid to butane
(xiv) Isopropyl bromide to 2,3 dimethyl butane
(xv) Propanoic acid to ethane
(xvi) Benzene to Toluene
(xvii) Ethyne to Acetophenone
(xviii) 2-Butyne to trans 2- butene
(xix) 2-butyne to cis 2- butane

Q16. An alkyl halide $C_5H_{11}Br$ (A) reacts with ethanolic KOH to give an alkene 'B', which reacts with Br_2 to give a compound 'C', which on dehydrobromination gives an alkyne 'D'. On treatment with sodium metal in liquid ammonia one mole of 'D' gives one mole of the sodium salt of 'D' and half a mole of hydrogen gas. Complete hydrogenation of 'D' yields a straight chain alkane. Identify A,B, C and D. Give the reactions involved.

ASSIGNMENT No. 13

ENVIORNMENTAL CHEMISTRY

1. Which of the following gases is not a green house gas?
   (a) CO (b) O_3 (C) CH_4 (d) H_2O vapour
2. Biochemical oxygen demand (BOD) is a measure of organic material present in water. BOD value less than 5 pp, indicates a water sample to be ……
   (a) rich in dissolved oxygen
   (b) poor in dissolved oxygen.
   (c) highly polluted.
   (d) not suitable for aquatic life.
3. Which of the following statements is wrong?
   (a) Ozone is not responsible for green house effect.
   (b) Ozone can oxidise sulphur dioxide present in the atmosphere to sulphur trioxide.
   (c) Ozone hole is thinning of ozone layer present in stratosphere.
   (d) Ozone is produced in upper stratosphere by the action of UV rays on oxygen.
4. Which of the following practices will not come under green chemistry?
   (a) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.
   (b) Using H_2O_2 for bleaching purpose instead of using chlorine based bleaching gents.
   (c) Using bicycle for travelling small distances instead of using petrol/ diesel based vehicles.
   (d) Using plastic cans for neatly storing substances.
5. What do you understand by ozone hole? Why does it occur mainly over Antarctica?

6. (a)What do you understand by Green house effect? What are the major green house gases?
   (b)What would have happened if the greenhouse gases were totally missing in earth's atmosphere?
7. What is the cause of acid rain? How is it harmful to the environment?

8. Name the factors which cause soil pollution.

9. How does detergent cause water pollution?

10. What is green chemistry? Give two importance of green chemistry in day to day life.

11. Drycleaners in your area frequently use tetrachloroethane for the purpose of drycleaning. They were advised to use liquefied carbon dioxide with suitable detergent as an alternative solvent. Answer the following questions:
    (i) What type of harm to the environment can be prevented by avoiding the use of tetrachloroethane?
    (ii) Will the use of liquefied carbon dioxide and detergent be completely safe from the point of view of pollution? Comment.

12. An ozone-layer is present at a height of 25-30 km from earth-surface which protects us from U.V. radiation.A hole in the ozone-layer is created due to human activity.
    Now answer the following questions:
    (i) Which activity has been causing ozone-hole?
    (ii) Give harmful effects of ozone depletion on plant or animal life.
    (iii) What has been done to protect ozone layer?
    (iv) How does excess CO_2 gas pollute the atmosphere ?

REVISION PAPER-1 (First Term- 2019-2020)
SECTION : A

Q1. What is absolute zero temperature? (1)

Q2. Why are vegetables cooked with difficulty at a hill station? (1)

Q3. What type of intermolecular force exists between NH_3 molecules? (1)

Q4. Why Mg^{2+} ion is more hydrated than Na^+ ion? (1)

Q5. If the value of Vander Waal's constant 'a' is zero, what does this signify? (1)

Fill in the blanks: (Q6 to Q 10)

Q6. A given _____ always contains exactly the same proportion of elements by weight. (1)

Q7. The stability of exactly half- filled and completely filled configuration is due to _____ and _____. (1)

Q8. According to Heisenberg's uncertainty principle, the product of uncertainty in position and uncertainty in momentum should be ≥ _____. (1)

Q9. The IUPAC name of the element with atomic number 108 is _____. (1)

Q10. Number of atoms in 52g of He are _____.(Atomic mass of He=4u) (1)

Choose the correct option from the following Multiple Choice Questions:
(Q11 to Q15)

Q11. Principal, azimuthal and magnetic quantum numbers are respectively related to: (1)
(a) size, orientation and shape.
(b) size, shape and orientation.
(c) shape, size and orientation.
(d) None of these.

Q12. Mass of 2.5gram atoms of Magnesium is equal to (given atomic mass of Mg=24u) (1)
(a) 30g (b) 60g (c) 90g (d) 120g

Q13. Which of the following statements indicate that the law of multiple proportion is being followed? (1)
(a) Sample of carbon dioxide taken from any source will always have carbon and oxygen in the ratio of 1:2.

(b) Carbon forms two oxides namely CO and CO_2, where masses of oxygen which combine with the fixed mass of carbon are in the ratio of 2:1.
(c) When magnesium burns in oxygen, the amount of magnesium taken for the reaction is equal to the amount of magnesium in magnesium oxide formed.
(d) At constant temperature and pressure, 200ml of Hydrogen will combine with 100ml oxygen to produce 200ml water vapours.

Q14. Consider the elements B, Al, Mg and K, the correct order of their metallic character is, (1)
(a) B>Al>Mg>K
(b) Al>Mg>B>K
(c) Mg>Al>K>B
(d) K>Mg>Al>B

Q15. 4.9g of H_2SO_4 contain (given Molecular mass of H_2SO_4=98u) (1)
(a) 0.05 moles (b) 20 moles (c) 0.02 moles (d) 0.5 moles

Write True / False for the following questions: (Q16 to Q20)

Q16. The element with electronic configuration $[Ar]^{18}3d^54s^1$ belong to s-block. (1)

Q17. Two flasks of equal volumes contain N_2 and O_2 gases at same temperature and pressure. N_2 will have greater number of molecules. (1)

Q18. The correct order of amount of energy released in electron gain (electron gain enthalpy) is F>Cl>Br>I. (1)

Q19. Both Mg and Ca do not impart colour to the Bunsen flame. (1)

Q20. Ne and Na^+ are iso-electronic thus they have same ionization enthalpies. (1)

SECTION : B

Q21. 2g of H_2 react with 25g of O_2 to form H_2O. (2)
(a) Which is the limiting reagent?
(b) Calculate the maximum amount of H_2O that can be formed.
(Given Atomic mass of H=1u and that of O=16u)

Q22. An element belongs to third period of p-block. It has four valence electrons. Predict its group. How many unpaired electrons does it have? (2)

Q23. (a) Draw the graph of PV vs P at constant temperature for an ideal gas. (2)
(b) If the compressibility factor (Z) is greater than 1, will the gas be more compressible or less compressible than an ideal gas?

Q24. Why the first ionization enthalpy of; (2)
(a) N is higher than that of O.
(b) B is lower than that of Be.

Q25. First ionization energy of Mg is higher than that of Na while its second ionization enthalpy is lower than that of Na. Explain. (2)

Q26. Explain why cation has smaller and anion has larger radius as compared to the parent atom. (2)

Q27. Draw Lewis dot structures of the following compounds: (2)
(a) SO_2
(b) HNO_3

SECTION : C

Q28. Calculate the concentration of nitric acid (HNO_3) in moles per litre in a sample which has a density 1.41 g/cc and the mass percent of nitric acid in it being 69%. (Given molar mass of HNO_3= 63g/mol) (3)

Q29. (a) What do you understand by Green chemistry? (3)
(b) Why is the temperature of the earth gradually increasing?
(c) How does rain water get contaminated with acidic impurities?

Q30. Give reasons for the following: (3)
(a) Li^+ has least mobility amongst alkali metal ions.
(b) Alkaline earth metals are harder and denser than alkali metals.
(c) Alkali metals are strong reducing agents.

Q31. (a) Specify the values of n_1 and n_2 when an electron does longest wavelength transition in Paschen series. (3)
(b) Calculate the energy required to ionize a Hydrogen atom if an electron occupies n=4 orbit.

Q32. Two elements A and B have atomic numbers 16 and 19 respectively. (3)
(a) Write down the electronic configuration of A and B.
(b) Which block do they belong to?
(c) Write the formula of the compound formed between A and B.

Q33. (a) Give reasons for the following: (3)
(i) Real gases behave ideally at low pressure and high temperature.
(ii) A gas cannot be liquefied above its critical temperature.
(b) Write Vander Waals' equation for 1 mole of a gas.

Q34. (a) Dual behavior of matter proposed by de Broglie led to the discovery of electron microscope often used for the highly magnified images of biological molecules and other type of materials. If the velocity of an electron in this microscope is $1.6x10^6$m/s. Calculate de Broglie's wavelength associated with this electron. (Given h=$6.6x10^{-34}$ Js, mass of electron= $9.1x10^{-31}$ kg) (3)
(b) State Pauli's exclusion principle.

SECTION : D

Q35. (a) A mixture of hydrogen gas and oxygen gas at one bar pressure contain 20% by weight of hydrogen gas. Calculate partial pressure of hydrogen gas. (5)

(b) Calculate the temperature of 4 mol of a gas occupying 0.005ml at 3.32 bar. (Given R= 0.083 bar *l*/K/mol)

(c) Give any two postulates of Kinetic molecular theory of gases.

Q36. (a) A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38g carbon dioxide, 0.69g of water and no other products. A volume of 10 *l* of this welding gas is found to weigh 11.5g at STP. Calculate: (5)

(i) empirical formula of the gas.

(ii) molar mass of the gas.

(iii) molecular formula of the gas.

(b) What will be the final molarity of 0.5M NaCl solution when diluted from 100ml to 500ml.

Q37. (a) Write the electronic configuration of: (5)

(i) Tc (Atomic number = 43u)

(ii) Co^{3+}(Atomic number of Co= 27u)

(b) The unpaired electrons in Si and P are present in 3p orbitals. Which electrons will experience more effective nuclear charge from the nucleus and why? (Given Atomic number of Si=14 and of P=15 respectively)

(c) Designate the atomic orbital with quantum numbers as n=5, l=2

(d) Draw the shape of d_{x2-y2} orbital.

QUESTION BANK (FOR TERM 1)

1 Explain: 3d, 4d and 5d series elements have 10 elements each.

2 Write the IUPAC name and give symbol of the element with atomic number 112.

3 The lithium salts are commonly hydrated and those of other alkali metal ions are usually anhydrous.

4 Mention two causes of water pollution.

5 A liquid is transferred from a smaller vessel to a bigger vessel at the same temperature. What will be the effect on the vapour pressure?

6 (i) Calculate the amount of water (g) produced by combustion of 16g of methane.
(ii) In the reaction, $NH_3 + O_2$ □ $NO + H_2O$, when 3.25g of NH_3 react with 3.50g moles of O_2, then identify the limiting reactant.
(Atomic mass of N=14u, H=1u, O=16u)

7 Write electronic configuration of elements with atomic number 45 and mention the group, period and block in which the element is present.

8 (i) How many sub-shells are associated with n=4?
(ii) How many electrons will be present in the subshells having m_s value of -1/2 for n=4?

9 A flask contains 0.5 mole of oxygen gas. Another flask contains 0.4 mole of ozone gas. Which of the two flask contains greater number of oxygen atoms?

10 A 100watt bulb emits a monochromatic light of wavelength 400 nm. Calculate the number of photons emitted per second by the bulb. (1W = 1J/s)

11 (i) Why is the electronic energy negative?
(ii) Write two limitations of Bohr's model of atom.
(iii) What is common in the structures between d_{xy} and d_{x2-y2} orbitals? What is the difference between them?

12 Arrange the following in the order of the property indicated:
(iv) Br, I, Cl, F (decreasing order of electron gain enthalpy)
(v) Mg, Al, Si, Na (increasing order of first ionization enthalpy)
(vi) B, Al, Mg, Ca (increasing order of metallic character)

13 Give reason:
(i) The radius of Na^+ atom is less than that of Na atom.
(ii) Sulphur has more ore negative electron gain enthalpy than oxygen.
(iii) K^+ is smaller than Cl^-, although both have the same electronic configuration.

14 Answer the following:
(i) What is the significance of ψ^2?
(ii) Find The ion of an element has configuration $[Ar]3d^4$ in +3 oxidation state. What will be the electronic configuration of its atom the number of unpaired electrons in Cr^{3+}ion? (At. Mass of Cr=24u, Cu=29u)

(iii) Write all the possible quantum numbers for the 19th electron of Cr (Z=24).

15 Calculate the energy required for the process $He^+(g) \rightarrow He^{2+}(g) + e^-$ ion? The ionization energy of H atom in the ground state is $2.18X10^{-18}$ J $atom^{-1}$. Also calculate the radius of the first orbit of He^+ion ?

16 0.6g of a compound contains 227cm^3 at STP. It contains 6.67% H and 40%C and rest is oxygen. Calculate (i) Molecular mass of the compound (ii) Empirical formula (iii)Molecular formula of the compound.
(At. Mass of C=12u, H=1u, O=16u)

17 4.0g of NaOH is contained in one deciliter solution. Calculate the following in this aqueous solution.
(i) Mole fraction of NaOH (ii) Molarity of NaOH.
(At. Mass of Na=23u, O=16u, Density of NaOH solution is 1.038g/ml , 1decilitre=0.1*l*)

18 (i) Out of the following alkali metals which is having least melting point: Na, K, Rb, Cs . Why?
(ii) Why do Alkaline earth metals have lattice enthalpy than the corresponding alkali metals.
(iii) Caesium is used in photoelectric cells.

19 At 0^0C, the density of a gaseous oxide at 2 bar is same as that of nitrogen at 5 bar. What is the molecular mass of its oxide? (Atomic mass of N=14u)

20 Calculate the kinetic energy of the electron ejected when yellow light of frequency $5.2X10^{14}$ sec^{-1} falls on the surface of potassium metal. Threshold frequency of potassium is $5X10^{14}$ sec^{-1}.

21 Give reasons:
(i) Gallium has higher ionization enthalpy than Aluminium.
(ii) Li as good a reducing agent as Cs in aqueous solution.
(iii) Out of the following alkali metals which is having least melting point: Na, K, Rb, Cs

22 Give reason for the following:
(i) Carbon forms only tetrahalides while Si can form $[SiF_6]^{2-}$
(ii) TlOH is more stable than $Tl(OH)_3$.
(iii) Boron trifluoride behaves as a lewis acid.

23 Drycleaners in your area frequently use tetrachloroethane for the purpose of drycleaning. They were advised to use liquefied carbon dioxide with suitable detergent as an alternative solvent. Answer the following questions:
(i) How does the use of tetrachloroethane cause harm to the environment?
(ii) What is green chemistry?
(iii) Give the harmful effects of ozone depletion on plant or animal life. What has been done to protect ozone layer?
(iv) What is acid rain? Mention one harmful effect of acid rain.

24 (i) Among the elements – Cl, Br, F, O, Al, C, Li, Cs and Xe, identify

a) The element with lowest ionization enthalpy
b) The element with smallest radii.
c) The element whose atoms have 8 electrons in their outermost shell.

(ii) The first ionization enthalpy of Carbon atom is greater than that of Boron atom whereas reverse is true for the second ionization enthalpy. Explain.

(iii) What is the basic difference in approach between Mendeleev's periodic law and Modern periodic law?

25 (i) Calculate the wavelength of the radiation emitted when an electron in hydrogen atom undergoes a transition from 4^{th} energy level to 2^{nd} energy level. In which series of the emission spectrum of hydrogen atom and which part of the electromagnetic spectrum is this line present?

(ii) What will be the wavelength of a ball of mass 0.1Kg moving with a velocity of 10m/s? Calculate the wavelength of an electron moving with 1% the speed of light? (Mass of electron=$9.1X10^{-31}$ Kg)

26 (i) Mention any two postulates of kinetic theory of gases.
(ii) How do we explain Boyle's law theoretically using Kinetic theory of gases.
(iii) What are the two faulty assumptions in kinetic theory of gases?
(iv) Define critical temperature.
(v) Under what conditions a real gas can behave as ideal gas.

1 What is the charge in coulombs on a nucleus of an atom of carbon? (Atomic no. of C = 6 u)

2 Why are Bohr's orbit called stationary orbits? When is the energy of electron taken as negative?

3 Molecular weight of Butyric acid (C_3H_7COOH) is 88u. What is its empirical weight.

4 What would be the IUPAC name and symbol for the element with atomic number 115?

5 Under what conditions do gases deviate maximum from ideal gas behavior?

6 What is global warming. What are its ill effects?

7 How many moles of oxygen are contained in one litre of air, if its volume is 21% STP?

8 State Heisenberg principle. Show that the uncertainty is of little significance for an object of mass 10^{-3} g. ($h/4\pi = 0.527 \times 10^{-34}$ kg m^2 s^{-1})

9 Classify each of the following solids as ionic, metallic, molecular, network.
a) KCl b) diamond c) Rb d) solid CO_2

10 Which cubic lattice structure has minimum efficiency. How many effective no. of atoms are present in one such unit cell.

11 a) Which alkali metal can be used for photoelectric effect and why?
b) In aqueous solution, Li^+ ion has the lowest mobility. Why?

12 a) Why majority of s- block elements impart colour to the flame.

b) Which group of the s- block has higher lattice energy and why?

13 a) What is the difference between heterogeneous and homogenous mixture .
b) The relative abundance of various isotopes of Silicon is 28Si = 92.23%, 29Si = 4.67% and 30Si = 3.1%. What is the average atomic mass of Silicon.

14 a) Define molarity. Give its SI units.
b) A sample of NaNO3 weighing 0.38 g is added to 50 ml volumetric flask. The flask is then filled with water upto the mark on the neck. What is the molarity of the solution?

15 What is green chemistry? Give two examples how it can be used.

16 What is the maximum capacity of $4p_x$ orbitals . Write the quantum numbers for each electron present. What principle does this depict. Give its statement.

17 The electron energy of the ground state of hydrogen atom works out to be -1.312×10^6 J mol^{-1}. What change will occur in the position of the electron in this atom if an energy of 9.84×10^5 J mol^{-1} is added to the hydrogen atom?

18 a) Explain the term screening effect.
b) Distinguish between covalent radii and metallic radii.
c) Define the term Electronegativity.

19 Arrange the elements as indicated:
a) B, C, N, F and Si (increasing order of their non-metallic character).
b) F, Cl, O and N (increasing order of their chemical reactivity).
c) Li^+, Na^+, Be^{2+}, Mg^{2+} (increasing order of their sizes)

20 a) Assign the position of the element having outer electronic configuration as: $(n-1)d^2ns^2$ for n = 4
b) Would you expect the first ionization enthalpies for two isotopes of the same element to be the same or different? Justify your answer.
c) Explain why Oxygen has lower first ionization enthalpy than Nitrogen.

21 The first (Δ_iH_1) and the second (Δ_iH_2) ionization enthalpies (in kJ mol^{-1}) and the ($\Delta_{eg}H$) electron gain enthalpy (in kJ mol^{-1}) of a few elements are given below:

Elements	ΔH_1	ΔH_2	$\Delta_{eg}H$
I	520	7300	-60
II	419	3051	-48
III	1681	3374	-328
IV	1008	1846	-295
V	2372	5251	+48
VI	738	1451	-40

Which of the above elements is likely to be:
a) The least reactive element
b) The most reactive metal
c) The most reactive non-metal
d) The least reactive non-metal
e) The metal which can form a stable binary halide of the formula MX_2 (X= halogen).

f) The metal which can form a predominantly stable covalent halide of the formula MX (X= halogen)?

22 The drain cleaner, Drainex contains small bits of aluminium which react with caustic soda to produce dihydrogen as per the following equation: $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$. What volume of dihydrogen at 20^0C and one bar will be released when 0.15 g of aluminium reacts?

23 Give reason:
a) Why is it difficult to cook food at higher altitudes.
b) Acetone and ether are kept in cool places.
c) During summers, the tyres of automobiles are inflated to lesser pressure.

24 a) What is critical temperature? If a gas has very low critical temperature , what can be predicted about its intermolecular forces.
b) What kind of forces exist between Na+ ion and water molecules.
c) What do you understand by the term 'absolute zero temperature'? What is its significance?

25 a) Calculate the number of moles of methanol in 5L of its 2 m solution, if the density of the solution is 0.981 kg/L (Molar mass of methanol = 32 g/mol)
b) In the commercial manufacture of nitric acid, how many moles of NO_2 produce 7.33 mol of HNO_3 in the reaction.
$3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq.) + NO(g)$
c) What volume of conc. HCl (12.4 M) is required to make 1L of 0.1 M HCl?

26 a) How many orbitals are present in third shell?
b) Explain Hund's rule of maximum multiplicity taking an example of oxygen atom?
c) Write the electronic configuration of Cu(atomic no.29) . State the reason for high stability of this configuration.
d) Draw the shape of $3d_{z2}$ and $3d_{yz}$.
e) What is the number of unpaired electron present in Fe^{2+} ? (At. No. of Fe= 26)

27 a) Distinguish between hexagonal close packing and cubic close packing.
b) What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy $2/3^{rd}$ of Octahedral voids?
c) Copper crystallizes into an fcc lattice with edge length of 3.61×10^{-8} cm. Calculate the density of copper.

REVISION PAPER-3 (For Second Term)
SECTION : A

Read the given passage and answer the questions Q1 and Q2.

Equilibrium constant Kc is independent of initial concentrations. But if a system at equilibrium is subjected to change in concentration of one or more of the reacting substances, then the system is no longer at equilibrium and the net reaction takes place in some direction until the system returns to equilibrium once again. Similarly a change in temperature or pressure of the system may alter the equilibrium. In order to decide what course the reaction adopts and make a qualitative prediction about the effect of a change in conditions on equilibrium, we use Le Chateliar's principle. It states that a change in any of the factors that determine the equilibrium conditions of a system will cause the system to change in such a manner so as to reduce or to counteract the effect of the change. This is applicable to all physical and chemical equilibrium.

Q1. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per the endothermic reaction: (1)
$H_2O(g) + CH_4(g) \rightleftharpoons 3H_2(g) + CO(g)$; What will be the effect on equilibrium when (i) pressure is increased (ii) temperature is increased.

Q2. For a reaction: (1)
$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$, ; $K_p = 0.265$ at 1050K .
Write expression for K_c and calculate its value. (R= 0.0831 bar *l* /K/mol)

Write very short answers for the questions from Q3- Q10.

Q3. Why HCl is added before adding H_2S solution in qualitative cation analysis for group 2? (1)

Q4. The concentration of hydrogen in a sample of soft drink is 3.2×10^{-6}. Calculate the pH of the sample. (log3.2= 0.5051) (1)

Q5. What will be the conjugate base of H_2SO_4? (1)

Q6. Identify the oxidizing agent and reducing agent for the reaction: (1)
$HCHO(l) + 2Cu^{2+}(aq) + 5OH^-(aq) \rightarrow Cu_2O(s) + HCOO^-(aq) + 3H_2O(l)$

Q7. How do you explain higher stability of BCl_3 as compared to $TlCl_3$. (1)

Q8. Draw the Newman projection of staggered conformation of ethane. (1)

Q9. Draw the structural formula of 4-Oxopentanoic acid. (1)

Q10. Write short notes on Wurtz reaction. (1)

Choose the correct option in the questions from Q 11- Q15.

Q11. The empirical formula and molecular mass of a compound are CH_2O and 180g respectively . What will be the molecular formula (1)

(i) $C_9H_{18}O_9$ (ii) CH_2O
(iii) $C_6H_{12}O_6$ (iv) $C_2H_4O_2$

Q12. In the reaction $2H_2O_2\ (aq) \rightarrow 2\ H_2O(l)\ +\ O_2\ (g)$, the oxidation states of oxygen from left to right, are (1)

(i) 0, -1, -2 (ii) -1, -2, 0
(iii) -2, 0, -1 (iv) -2, -1, 0

Q13. For H_3PO_3 and H_3PO_4 , the correct choice is (1)

(i) H_3PO_3 is monobasic (ii) H_3PO_4 is dibasic
(iii) H_3PO_4 is tribasic (iv) H_3PO_3 is tribasic

Q14. The electronic configurations of A and B are as under : (1)
A: $1s^22s^22p^63s^2$ B: $1s^22s^22p^5$. The formula of the compound AB is

(i) AB (ii) A_2B
(iii) AB_2 (iv) AB_3

Q15. Which of the following will show the maximum covalent character? (1)

(i) $FeCl_2$ (ii) $SnCl_2$
(iii) $AlCl_3$ (iv) $MgCl_2$

In each of the Questions 16-20, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements mark the correct answer as
(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is wrong statement.
(d)Assertion is wrong, but reason is correct statement.

Q16. **Assertion:** The mathematical relationship between pressure and temperature was given by Gay- Lussac. (1)
Reason: Equal volume of all gases under the same conditions of pressure and temperature contain equal number of molecules.

Q17. **Assertion:** All perfectly crystalline substances, possess zero entropy at absolute zero temperature. (1)
Reason: If $\Delta G_{system} > 0$, the reaction is spontaneous.

Q18. **Assertion:** Na^+ and Al^{3+} are isoelectronic but magnitude of the ionic radius of Al^{3+} is less than that of Na^+. (1)
Reason: The magnitude of effective nuclear charge on the outer shell electrons in Al^{3+} is greater than in Na^+.

Q19. **Assertion:** Spontaneous process is an irreversible process and may be reversed by some external agency. (1)
Reason: Decrease in enthalpy is a contributory factor for spontaniety.

Q20. **Assertion:** Boiling point of cis- isomer of ethene is higher than that of trans-isomer. (1)
Reason: Dipole moment of cis-isomer is higher than that of trans-isomer.

SECTION : B

Q21. Balance the Redox reaction in basic medium: (2)
$P_4(s) + OH^-(aq) \rightarrow PH_3(g) + HPO_2^-(aq)$.

Q22. The reaction $2C + O_2 \rightarrow 2CO$ is carried out by taking 24g of C and 96g of O_2. Find: (2)
(i) Which reactant is left in excess?
(ii) How many grams of the other reactant should be taken so that nothing is left at the end of the reaction?
(Given: Atomic mass of C=12u, O=16u)

Q23. Explain the following: (2)
(i) Gallium has higher ionization enthalpy than aluminum.
(ii) Aluminum forms $[AlF_6]^{3-}$ ion but boron does not form $[BF_6]^{3-}$ ion.

Q24. 29.5% (w/w) HCl solution has a density of $1.25 gmL^{-1}$. The molecular mass of HCl is $36.5 gmol^{-1}$. Calculate the molarity of this solution. (2)

OR

Chlorophyll the green colouring matter of plants responsible for photosynthesis, contains 2.68% of magnesium by mass. Calculate the number of magnesium atoms in 2.00g of chlorophyll. (Atomic mass of Mg=24u)

Q25. (i) An electron orbiting in first energy level of hydrogen atom is associated with $-2.18 \times 10^{-18} J$/atom energy. What is the energy associated with the first orbit of He^+. (2)
(ii) Write the expression for calculating the wavelength of a photon emitted during a transition from n=5 state to n=2 state in hydrogen atom.

Q26. Calculate the total pressure of a mixture of 8g O_2 and 4g H_2 confined in a vessel of volume $1 dm^3$ at 25^0C. ($R=0.083$ bar $dm^3K^{-1}mol^{-1}$, atomic mass of H=1u, O=16u) (2)

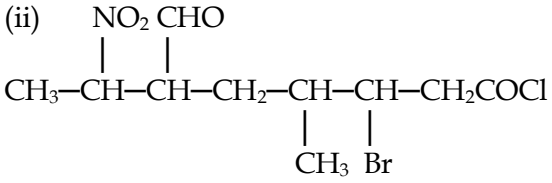
Q27. Write the mechanism of Chlorination of benzene. (2)

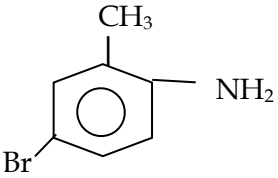
SECTION : C

Q28. late the pH of 0.08M solution of hypochlorous acid, HOCl. The ionization constant of the acid is $2.5X10^{-5}$. Determine the percentage dissociation of the acid. Also calculate the concentration of H_3O^+ in the solution at equilibrium. (3)
$OCl + H_2O \rightleftharpoons H_3O^+ + ClO^-$ (log 1.36= 0.1335)

Q29. Write the IUPAC names of the following organic compounds: (3)
(i) $CH_3CH(C_2H_5)COCH_2CH(CH_3)COOH$

(ii)





Q30. An atom of an element has 29 electrons and 35 neutrons. Deduce (3)
(i) electronic configuration of the element
(ii) the number of unpaired electrons of its ion in oxidation +2 state.
(iii) all the quantum numbers (n, *l*, m) for the 19th electron of it.

Q31. (i) The first ionization enthalpy of carbon atom is greater than that of Boron whereas the reverse is not true for the second ionization enthalpy. Give reason (3)
(ii) Which of the following will have the most negative electron gain enthalpy and which is the least electronegative? P, S, Cl , F
(iii) First ionization enthalpy of Nitrogen is more than that of Oxygen.

OR

The elements Na, Mg, Al, Si, P, S, Cl and Ar are arranged in the increasing order of their atomic numbers.
(i) Which element is most electropositive?
(ii) Which element is least reactive?
(iii) Which element exists as a gas at room temperature?

Q32. Account for the following: (3)
(i) Beryllium and Magnesium do not give colour to flame of the burner whereas other alkaline earth metals do so.
(ii) Alkaline earth metals have lattice enthalpy higher than the corresponding alkali metals.
(iii) Arrange the following in decreasing order of mobility in aqueous : Li^+, Na^+, K^+, Rb^+, Cs^+. Give reason for your answer.

Q33. (i) Draw the structural formula of the alkene formed if 2-Butyne is treated with Lindlar's catalyst. (3)
(ii) Why neo-pentane has lower boiling point as compared to n- pentane?
(iii) Give one chemical test to distinguish between ethene and ethyne.

Q34. (i) Which of the two : $O_2NCH_2CH_2O^-$ or $CH_3CH_2\ CH_2O^-$ is expected to be more stable and why? (3)
(ii) Why tertiary butyl carbocation is more stable than isopropyl carbocation?
(iii) Draw the resonating structures of $C_6H_5NH_2$.

SECTION : D

Q35. (i) Arrange the following in decreasing order of their bond angle: (5)
H_2O, CH_4, NH_3 .

(ii) Draw resonating structures of CO_3^{2-} .

(iii) Draw the structure and name the shape XeF_4 .

(iv) Assign hybridization to Boron in the species: BH_3 and BH_4^-.

(v) He_2 does not exist. Explain on the basis of MO Theory.

OR

(i) Define hybridization. With box diagram, explain hybridization in NH_3 molecule. Also draw the labelled orbital overlap diagram.

(ii) Write MO configuration for F_2 molecule. Indicate its magnetic property. (paramagnetic or diamagnetic)

(iii) Why is water a liquid and hydrogen sulphide a gas though both O and S belong to the same group?

Q36. (i) When $\Delta H > 0$ and $\Delta S < 0$, reaction is never spontaneous. Explain (5)

(ii) Two litres of an ideal gas at a pressure of 10atm expands isothermally into vacumm until a total volume of 10 litre capacity. Calculate the amount of heat absorbed and how much work is done in the expansion.

(iii) Calculate the lattice enthalpy of LiF; given that the enthalpy of

(a) Sublimation of lithium is 155.2 KJ/mol.

(b) Dissociation of 1 mole of F_2 at 75.3 KJ/mole.

(c) Ionization of lithium is 520 KJ/mole.

(d) Electron gain enthalpy of 1 mole of F(g) is -333 KJ.

(e) $\Delta_f H^o$ is -594.1 KJ/mole

OR

(i) Calculate the Enthalpy of formation of ammonia from the following data:

$N_2 + 3H_2 \rightarrow 2NH_3$

[$\Delta_b H$ (N-H) bond=389kJ/mol; $\Delta_b H$ (H-H) bond= 435kJ/mol; $\Delta_b H$ (N≡N) bond = 945.36kJ/mol]

(ii) A swimmer coming out of a pool is covered with a film of water weighing about 18g. Calculate the internal energy of vaporization at 100^0C. ($\Delta_{vap} H$ for water at 373K = 40.66kJ/mol, R=8.314J/K/mol)

(iii) What is an extensive property? Give example.

Q37. (i) How will you convert (a) Ethyne to Acetophenone (b) iso-propyl bromide to n-propyl bromide. (5)

ɔmplete the following reaction :

CH_3CH_2COONa (aq) $\xrightarrow{\text{Electricity}}$

(iii) Ethanal and pentan-3-one are the products of reductive ozonolysis of an alkene. Write the structural formula of the alkene .

(iv) Why does Benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty?

OR

(i) An alkylhalide C_3H_7Br [A]reacts with ethanolic KOH to give alkene [B], which reacts with Br_2 to give a compound[C] which on dehydrobromination twice gives an alkyne [D]. [D] on hydration in the presence of dil.H_2SO_4 and $HgSO_4$ forms a ketone[E]. Identify the compounds [A] to [E] and write equation for the formation of ketone [E] from [D].

ı Complete the following reactions.

(a) $C_6H_5COONa \xrightarrow{(NaOH + CaO)}$

) $CH_3\text{-}CH = CH_2 \xrightarrow[HBr]{\text{Benzoyl peroxide}}$

Systematic analysis of anions

EXPERIMENT	OBSERVATION	INFERENCE
ANIONS		
CO_3^{2-}		
PRELIMNARY TEST-		
To the salt sample add a few drops of dil.h2so4	A brisk effervescence is seen due to evolutin of odourless colourless gas.	May be CO_3^{2-}
Confirmatory test-		
Collect the gas evolved in a dry test tube and add lime water to it and shake	Lime water turns milky	CO_3^{2-} confirmed
S^{2-}		
PRELIMINARY TEST		
To the salt sample add dil H2SO4	Colourless gas with smell of rotten eggs is evolved	Maybe S^{2-}
Confirmatory test		
Bring a filter paper dipped in lead acetate solution	The paper turns black	S^{2-}confirmed
SO_3^{2-}		
PRELIMINARY TEST		
To the salt sample add a few drops of dil H_2SO_4	Colourless pungent gas with smell of burning sulphur	Maybe SO_3^{2-}
CONFIRMATORY TEST		
Bring a filter paper dipped in potassium dichromate near the mouth of the test tube	It turns green	SO_3^{2-} confirmed
NO_2^-		
PRELIMINARY TEST		
To the salt sample add a few drops of dil H_2SO_4	Adark reddish brown coloured gas is evolved	Maybe NO_2-

	with effervescence	
CONFIRMATORY TEST		
To the salt solution add a few drops of acetic acid followed by some $FeSO_4$	A dark brown solution is obtained	NO_2-
CH_3COO^-		
PRELIMINARY TEST		
To the salt add a few drops of dil H_2SO_4	Smell of vinegar is obtained	Maybe CH_3COO^-
CONFIRMATORY TEST		
To a solution of salt in water add a few drops of neutral $FeCl_3$	A reddish brown ppt	CH_3COO^- confirmed
TEST WITH Conc H_2SO_4		
Cl^-		
PRELIMINARY TEST		
To the salt add a few drops of conc H_2SO_4 and heat	Colourless pungent smelling gas is evolved	May be Cl^-
CONFIRMATORY TEST		
Bring a glass rod dipped in NH_4OH near the mouth of the test tube	Dense white fumes are evolved	
To the salt soltion adda few drops of dil HNO_3 followed by $AgNO_3$	White ppt is formed which is completely soluble in NH_4OH	Cl^- confirmed
Chromyl chloride test Take salt and potassium dichromate in the ratio of 1: 3 in a clean and dry test tube and add conc H_2SO_4 to it and	Orange brown fumes are evolved.	Cl- confirmed

heat 2 pass these fumes *through* sodium hydroxide solution	Thesolution turns yellow	Cl^- confirmed
To this yellow solution add a few drops of acetic acid and lead acetate	A yellow ppt is obtained	Cl^- confirmed
Br^- PRELIMINARY TEST To the salt add a few drops of conc H_2SO_4	Orange fumes are evolved and the solution turns orange	May be Br^-
CONFIRMATORY TEST To the salt solution add a few drops of dil $HNO_3 + AgNO_3$	A pale yellow ppt which is partially soluble in NH_4OH	Br^- confirmed
Organic layer test To the salt solution add some CS_2 followed by chlorine water and shake it vigorously	The organic layer becomes brown in colour	Br^- confirmed
I^- Preliminary test To the salt add some conc H_2SO_4 and heat	Violet fumes are evolved and the walls of the test tube become violet in colour	Maybe I^-
CONFIRMATORY TEST To the salt solution add dil HNO_3+AgNO_3	Deep yellow ppt is obtained which is insoluble in NH_4OH	I^- Confirmed
Organic layer test To the salt solution add some CS_2 followed by chlorine water and shake vigorously	Organic layer becomes violet in colour	I^- confirmed
NO_3^- PRELIMINARY TEST To the salt add some conc H_2SO_4 and heat	Light brown fumes which become dark brown on heating with copper chips and the	May be NO_3^-

	solution in the test tube becomes blue	
CONFIRMATORY TEST Brown ring test To the salt solution add double the amount of ferrous sulphate and add conc H_2SO_4 to the tube along the walls of the test tube gradually and carefully	A brown ring is formed at the junction of two solutions NOTE if a white ppt is formed on the addition of ferrous sulphate filter the ppt and again add ferrous sulphate followed by sulphuric acid	NO_3^- Confirmed
SO_4^{2-} To the salt solution add some dil HCl+ $BaCl_2$	Curdy white ppt is obtained which is insoluble in conc . HCl or conc. HNO_3	SO_4^{2-} Confirmed
PO_4^{3-} To the salt solution add conc HNO_3 + Ammonium molybdate and heat	A canary yellow ppt is obtained	PO_4^{3-} confirmed

SYSTEMATIC ANALYSIS OF CATIONS [BASIC RADICALS]

0 group (NH_4^+)		
Preliminary test- To the salt add some sodium hydroxide and heat the test tube.	Smell of ammonia	Maybe ammonium ions NH_4^+
Confirmatory test-		
1. bring a glass rod dipped in conc HCl near the mouth of the test tube .	Dense white fumes are seen	NH_4^+ confirmed
2 Collect the gas obtained in the preliminary test in a test tube and add Nesslars reagent to it.	A brown ppt is obtained	NH_4^+ confirmed
Preparation of original solution ***The salt is dissolved in the following solutions in the given order*** 1. ***cold water*** 2. ***hot water*** 3. ***cold dil HCl*** 4. ***hot dil HCl*** 5. ***cold concHCl*** 6. ***hot conc HCl***		
Group 1-		
Pb^{2+}		
Preliminary test- To the original salt solution add dil HCl	1. white ppt	Maybe Pb^{2+}
Confirmatory test -		
Dissolve the white ppt in hot water and divide it into two parts 1. To the first part add KI solution 2. To the second part add K_2CrO_4	1. A yellow ppt is obtained 2. A yellow ppt is obtained	Pb^{2+} confirmed Pb^{2+} confirmed

Group 2 To the first group solution pass H_2S gas	Black ppt Yellow ppt	Cu^{2+} As^{3+}
CU^{2+} dissolve the black ppt in conc HNO_3	Agreenish solution is obtained which becomes deep blue on addition of NH_4OH . to this solution add a few drops of acetic acid and then add potassium ferrocyanide(K_4FeCN_6) Choclate brown ppt is obtained .	Cu^{2+} confirmed
As^{3+} Boil the yellow ppt with yellow ammonium silphide	Ppt dissolves	
To the above solution addconc HCl	A yellow ppt	As^{3+} confirmed
Dissolve the yellow ppt in conc HNO_3 and add ammonium molybdate and boil	A yellow ppt	As^{3+} confirmed
Group 3 boil off H_2Sgas from the second group solution , boil(if the salt is coloured) with concHNO_3 .Add NH_4Cl solid,dissolve and then add NH_4OH	1 Rust brown ppt 2 gelatinous ppt	1 Fe^{3+} 2Al^{3+}
Confirmatory test of Fe^{3+} dissolve the brown ppt in dilHCl and divide the solution into two parts 1. to the first part add K_4FeCN_6 2 to the second part add KCNS	1Prussian blue colouration is obtained 2 blood red colouration is obtained	Fe^{3+} confirmed
Confirmatory test for Al^{3+} Blue lake test –Dissolve the gelatinous ppt in dil HCl and add litmus solution and add NH_4OH	Blue lake is obtained	Al^{3+} confirmed

Group 4- $Co^{2+}Ni^{2+}Mn^{2+}Zn^{2+}$ To the third group solution pass H_2S gas	1 black ppt 2buff ppt 3dirty white ppt	1Co^{2+},Ni^{2+} 2Mn^{2+} 3Zn^{2+}
Confirmatory test for Co^{2+} dissolve the black ppt in aqua regia (conc HCl:concHNO_3 3:1 in a china dish and heat to dryness	1 a blue residue 2 a yellow residue	1Co^{2+} 2Ni^{2+}
Dissolve the residue in water,add someammonium hydroxide and some solid KNO_2 followed by some acetic acid	Yellow ppt	Co^{2+} confirmed
Confirmatory test for Ni^{2+} dissolve the yellow residue in water and add ammonium hydroxide followed by DMG	Rose red ppt is seen	Ni^{2+}confirmed
Confirmatory test for Mn^{2+} dissolve the buff ppt in dil HCl and add NaOH.	Light brown ppt which changes to dark brown on standing	Mn^{2+}confirmed
Confirmatory test for Zn^{2+} dissolve the dirty ppt in dil HCl and add potassium ferrocyanide .	A greenish blue ppt is seen	Zn^{2+}
Group 5($Ba^{2+}Sr^{2+}$,Ca^{2+}) boil off H_2S gas from the fourth group solution and add ammonium carbonate and some ammonium hydroxide **2 dissolve the white ppt in acetic acid and divide this solution into 3 parts**	White pptC	Group 5 present
Confirmatory test for Ba^{2+} to the first part add K_2CrO_4	Yellow ppt	Ba^{2+} confirmed
Confirmatory test for Sr^{2+} to the second part add ammonium sulphate	White ppt	Sr^{2+} confirmed
Confirmatory test for Ca^{2+} to the third part add ammonium oxalate	White ppt	Ca^{2+} confirmed
Flame test make a paste of salt and conc HCl on a watch glass nd perform the flame test	1. *1.apple green flame* 2. *crimson red flame* 3. *brick red flame*	*1.Ba^{2+}* *2.Sr^{2+}* *3Ca^{2+}*
Group 6 (Mg^{2+}) To group 5 solution add ammonium hydroxide and sodium dihydrogen phosphate	White ppt	Mg^{2+} confirmed

SYSTEMATIC QUALITATIVE ANALYSIS

ANION ANALYSIS

Test for Carbonate ion [CO_3^{2-}]

Indicatory - $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$ (effervescence)

Confirmatory test -

1. Lime water test - $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$
   $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
   (lime water turns milky)
2. Magnesium sulphate test - $Na_2CO_3 + MgSO_4 \longrightarrow Na_2SO_4 + MgCO_3\downarrow$
   (white precipitate)

Test for Sulphide ion [S^{2-}]

Indicatory- $Na_2S + H_2SO_4 \longrightarrow Na_2SO_4 + H_2S$(rotten egg smell)

Confirmatory test -

1. Lead acetate test - $(CH_3COO)_2Pb + H_2S \longrightarrow PbS + 2CH_3COOH$
   Lead sulphide
   Black precipitate
2. Sodium nitroprusside test - $Na_2S + Na_2[Fe(CN)_5NO] \longrightarrow Na_4[Fe(CN)_5NO.S]$
   Purple colour

Test for Sulphite ion [SO_3^{2-}]

Indicatory - $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$ (Pungent smell)

Confirmatory test -

1. Potassium dichromate test- $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$
   Chromium sulphate (green)
2. Barium chloride test- $Na_2SO_3 + BaCl_2 \longrightarrow 2NaCl + BaSO_3\downarrow$
   (precipitate in dilute HCl, dissolves)

Test for Nitrite ion [NO_2^-]

Indicatory - $2NaNO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + 2HNO_2$

$3HNO_2 \longrightarrow HNO_3 + 2NO + H_2O$

$2NO + O_2 \longrightarrow 2NO_2$ (Brown gas)

Confirmatory test -

1. Potassium iodide test- $NaNO_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + NO$
   $2NO + O_2 \longrightarrow 2NO_2$
   $2NO_2 + 2KI \longrightarrow 2KNO_2 + I_2$
   I_2 + Starch $\longrightarrow$ Blue complex
2. Ferrous sulphate test- $NaNO_2 + CH_3COOH \longrightarrow CH_3COONa + HNO_2$
   $4HNO_2 \longrightarrow 2HNO_3 + H_2O + 2NO$
   $FeSO_4 + NO \longrightarrow [Fe(NO)]SO_4$ or $FesO_4.NO$
   Nitroso ferrous sulphate (Brown)

Test for Acetate ion [CH_3COO^-]

Indicatory - $2CH_3COONa + H_2SO_4 \longrightarrow Na_2SO_4 + 2CH_3COOH$

Confirmatory test -

1. Ferric chloride test- $3CH_3COONa + FeCl_3 \longrightarrow (CH_3COO)_3Fe + 3NaCl$
   (reddish brown ppt)
2. Oxalic acid test-
   $(COOH)_2$ or HOOC-COOH $+ 3CH_3COONa \longrightarrow$ NaOOC-COONa $+ 2CH_3COOH$
   (vinegar smell)

Test for Chloride ion [Cl^-]

Indicatory - $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$

Colourless gas

$HCl + NH_3 \longrightarrow NH_4Cl$

White fumes

Confirmatory test -

1. Silver nitrate test- $NaCl + AgNO_3 \longrightarrow NaNO_3 + AgCl$

   (White precipitate)
2. Chromyl chloride -$4NaCl + K_2Cr_2O_7 + 6H_2SO_4 \longrightarrow 2KHSO_4 + 2CrO_2Cl_2 + 4NaHSO_4 + 3H_2O$

   (Chromyl chloride)

   $CrO_2Cl_2 + 4NaOH \longrightarrow Na_2CrO_4 + 2NaCl + 2H_2O$

   $(CH_3COO)_2Pb + Na_2CrO_4 \longrightarrow PbCrO_4 + 2CH_3COONa$

   (Yellow precipitate)

Test for Bromide ion (Br^-)

Indicatory - $2NaBr + 2H_2SO_4 \longrightarrow Br_2 + SO_2 + Na_2SO_4 + 2H_2O + Br_2$ (brown gas with pungent smell)

Confirmatory test -

1. Silver nitrate test- $NaBr + AgNO_3 \longrightarrow NaNO_3 + AgBr$

   Pale yellow precipitate
2. Layer test- $Br^- \xrightarrow[CCl_4]{\text{Conc. } HNO_3} Br_2$

Test for Iodide ion (I^-)

Indicatory - $2NaI + 2H_2SO_4 \longrightarrow Na_2SO_4 + SO_2 + 2H_2O + I_2$

deep violet vapours with a pungent smell

Confirmatory test -

1. Silver nitrate test- $NaI + AgNO_3 \longrightarrow NaNO_3 + AgI$

   (Yellow precipitate)
2. Layer test- $I^- \xrightarrow[CCl_4]{\text{Conc. } HNO_3} I_2$

Test for Nitrate ion [NO_3^-]

Indicatory - $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$

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

light brown fumes

Confirmatory test -

1. Copper chips test- $NaNO_3 + 4H_2SO_4 + 3Cu \longrightarrow 3CuSO_4 + Na_2SO_4 + 4H_2O + 2NO$

   $2NO + O_2 \longrightarrow 2NO_2$ (Brown gas)
1. Brown Ring test- $NaNO3 + H2SO4 \longrightarrow NaHSO4 + HNO3$

   $6FeSO_4 + 3H_2SO_4 + 2HNO_3 \longrightarrow 3Fe_2(SO_4)_3 + 4H_2O + 2NO$

   $FeSO_4 + NO + H_2O \longrightarrow [Fe(H_2O)_5(NO)]SO_4$

   nitrosonium complex (Brown ring)

Test of Sulphate ions [SO_4^{2-}]

Confirmatory test -

1. $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$

   (White precipitate)
2. $Na_2SO_4 + (CH_3COO)_2Pb \longrightarrow PbSO_4 + 2CH_3COONa$

   (White precipitate)

Test for Phosphate ion [PO_4^{3-}]

Confirmatory test -

$(NH_4)_3PO_4 + 12(NH_4)_2MoO_4 + 24HNO_3 \longrightarrow (NH_4)_3PO_4.12MoO_3 + 24NH_4NO_3 + 6H_2O$

Canary yellow precipitate

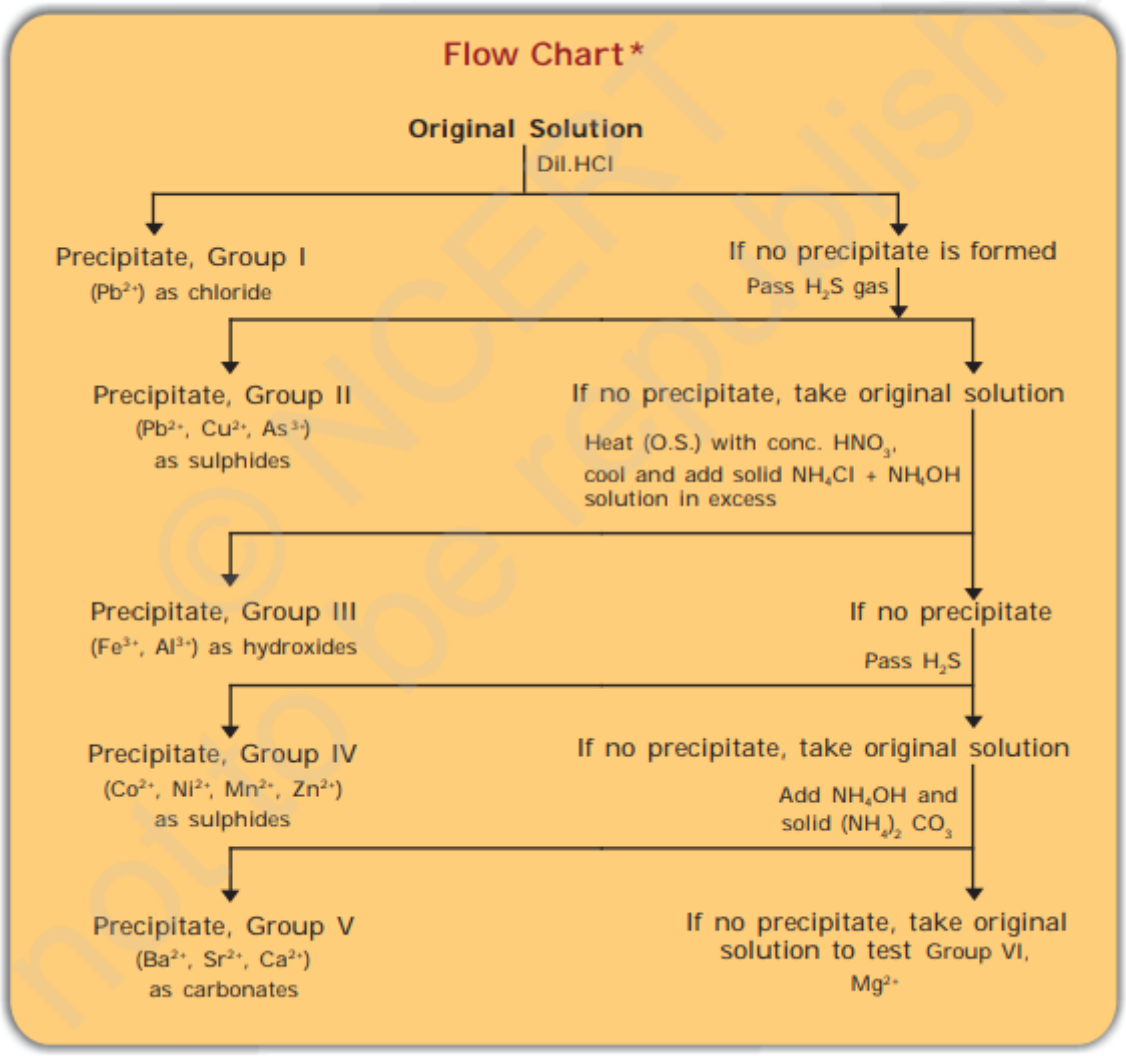
CATION ANALYSIS

Analysis of Zero group cation (NH_4^+ ion)

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

Confirmatory test-

1. Dil. HCl test - $NH_3 + HCl \rightarrow NH_4Cl$
2. Nessler's reagent test - $2K_2HgI_4 + NH_3 + 3KOH \longrightarrow HgO.Hg(NH_2)I + 7KI + 2H_2O$
   Basic mercury (II) amido-iodine
   (Brown precipitate)



Analysis of Group-I cations

Confirmatory Tests of Pb^{2+} ions-

$Pb^{2+} + 2HCl \longrightarrow PbCl_2$ (white precipitate)

Confirmatory test-

1. KI test - $PbCl_2 + 2KI \longrightarrow PbI_2 + 2KCl$
   yellow precipitate
2. Lead chromate test - $PbCl_2 + K_2CrO_4 \longrightarrow PbCrO_4 + 2KCl$
   (Yellow precipitate)

Analysis of Group–II cation:

Group test -

$Cu^{2+} + H_2S \longrightarrow CuS$ (black precipitate) $+ 2H^+$

$As^{3+} + H_2S \longrightarrow As_2S_3$ (yellow precipitate) $+ 2H^+$

Test for Copper ion (Cu^{2+})

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

Confirmatory test-

1. Ammonium hydroxide test- $Cu(NO_3)_2 + 2NH_4OH \longrightarrow Cu(OH)_2 + 2NH_4NO_3$

   Bluish white ppt

   $Cu(OH)_2 + NH_4OH + 2NH_4NO3 \longrightarrow 2[Cu(NH_3)_4](NO_3)_2 + 2H_2O$

   Tetraamminecopper (II) sulphate

   (Deep blue)

2. Potassium ferrocyanide test- $2Cu(NO_3)_2 + K_4[Fe(CN)_6] \longrightarrow Cu_2[Fe(CN)_6] + 4KNO_3$

   Potassium Copper hexacyanoferrate (II)

   (Chocolate brown precipitate)

Test for arsenic ion (As^{3+})

$As_2S_3 + 3(NH_4)_2S \longrightarrow 2(NH_4)_3AsS_4 + S$

Confirmatory test-

1. Ammonium molybdate test - $2(NH_4)_3AsS_4 + 6HCl \longrightarrow As_2S_5 + 3H_2S + 6NH_4Cl$

   $3As_2S_5 + 10HNO_3 + 4H_2O \longrightarrow 6H_3AsO_4 + 10NO + 15S$

   Arsenic acid

   $H_3AsO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 \longrightarrow (NH_4)_3AsO_4.12MoO_4 + 21NH_4NO_3 + 12H_2O$

   (yellow precipitate)

Analysis of Group–III cations

Group test- $Al^{3+} + 3NH_4OH \longrightarrow Al(OH)_3 + 3NH_4^+$

White gelatinous

$Fe^{3+} + 3NH_4OH \longrightarrow Fe(OH)_3 + 3NH_4^+$

Reddish brown precipitate

Test for Aluminium ion (Al^{3+})

$Al(OH)_3 + HCl \longrightarrow AlCl_3 + 3H_2O$

Confirmatory test-

1. NaOH test- $AlCl_3 + 3NaOH \longrightarrow Al(OH)_3 + 3NaCl$

   $Al(OH)_3 + NaOH \longrightarrow NaAlO_2 + 2H_2O$

   Soluble complex

2. Blue lake test- $AlCl_3 + 3NH_4OH \longrightarrow Al(OH)_3$ (ppt) $+ 3NH_4Cl$

   The ppt adsorbs blue colour of the solution

Test for Ferric ion (Fe^{3+})

$Fe(OH)_3 + 3HCl \longrightarrow FeCl_3 + 3H_2O$

Confirmatory test-

1. Potassium ferrocyanide test - $4FeCl_3 + 3K_4[Fe(CN)_6] \longrightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$

   Prussian blue precipitate

2. Potassium thiocyanate test - $FeCl_3 + KSCN \longrightarrow K_3[Fe(SCN)_6]$

   Iron (III) Thiocyanate(Blood red colour)

Analysis of group-IV cations

Group test-

$Ni^{2+} + H_2S \longrightarrow NiS$ (black precipitate) $+ 2H^+$

$Co^{2+} + H_2S \longrightarrow CoS$ (black precipitate) $+ 2H^+$

$Zn^{2+} + H_2S \longrightarrow ZnS$ (dirty white precipitate) $+ 2H^+$

$Mn^{2+} + H_2S \longrightarrow MnS$ (Buff coloured precipitate) $+ 2H^+$

Test for Zinc ion (Zn^{2+})

Dissolution in dil.HCl- $ZnS + 2HCl \longrightarrow ZnCl_2 + H_2S$

Confirmatory test-

1. Sodium hydroxide test - $ZnCl_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaCl$

   (white precipitate of zinc hydroxide)

$Zn(OH)_2 + 2NaOH \longrightarrow Na_2 ZnO_2 + 2H_2O$
(white precipitate is soluble in excess of NaOH)

2. Potassium ferrocyanide test - $2\ ZnCl_2 + K_4 [Fe(CN)_6] \longrightarrow Zn_2 [Fe(CN)_6] + 4\ KCl$
Zinc ferrocyanide(bluish white)

Test for Manganese ion (Mn^{2+})

$MnS + 2HCl \longrightarrow Mn\ Cl2 + H_2S$

Confirmatory test-

1. Sodium hydroxide test - $MnCl_2 + 2NaOH \longrightarrow Mn(OH)_2 + 2NaCl$
(White precipitate)

$Mn(OH)_2 + [O] \rightarrow MnO(OH)_2$
Hydrated manganese dioxide (Brown colour)

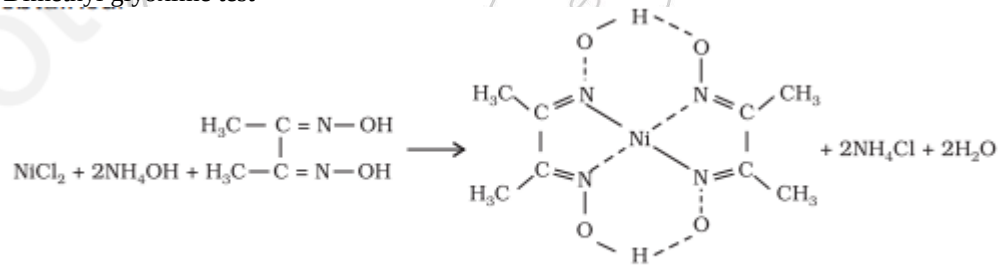
2. Lead dioxide test - $2Mn^{2+} + 5PbO_2 + 4H^+ \longrightarrow 2MnO_4^- + 2H_2O + 5Pb^{2+}$
(Pink colour)

Test for Nickel ion (Ni^{2+})

$3NiS + 2HNO_3 + 6HCl \longrightarrow 3NiCl_2 + 2NO + 3S + 4H_2O$
(aqua regia) green solution

Confirmatory test-

1. Dimethyl glyoxime test -



Complex of red colour
(Stable form of complex)
brilliant red precipitate

2. $NiCl_2 + NaOH \longrightarrow Ni(OH)_2 + 2NaCl$
White ppt

Test for Cobalt ion (Co^{2+})

$CoS + HNO_3 + 3HCl \longrightarrow CoCl_2 + NOCl + S + 2H_2O$
(aqua regia) (pink colour)

1. Potassium nitrite test- $CoCl_2 + 7KNO_2 + 2CH_3COOH \longrightarrow K_3 [Co(NO_2)_6] + 2KCl + 2CH_3\ COOK + NO + H_2O$
Potassium hexanitritocobaltate(III)
(Yellow precipitate)

2. Ammonium thiocyanate test- $Co^{2+} + NH_4CNS \longrightarrow (NH_4)_2[Co(CNS)_4] + 2\ NH_4^+$
(blue colour)

Analysis of Group–V cations

Group test-

$Ba^{2+} + (NH_4)_2CO_3 \longrightarrow BaCO_3$ (white precipitate) + NH_4^+

$Sr^{2+} + (NH_4)_2CO_3 \longrightarrow SrCO_3$ (white precipitate) + NH_4^+

$Ca^{2+} + (NH_4)_2CO_3 \longrightarrow CaCO_3$ (white precipitate) + NH_4^+

Test for Barium ion (Ba^{2+})

1. Potassium chromate test (K_2CrO_4) test-

$BaCO_3 + 2CH_3COOH \longrightarrow (CH_3COO)_2\ Ba + H_2O + CO_2$

$(CH_3COO)_2\ Ba + K_2\ CrO_4 \longrightarrow BaCrO_4 + 2CH_3COOK$

Barium chromate
(yellow precipitate)

2. Flame test : Ba^{2+} + Conc. HCl $\longrightarrow$ A grassy green colour of the flame confirms the presence of Ba^{2+} ions.

Test for Strontium ion (Sr^{2+})

1. Ammonium sulphate, $(NH_4)_2SO_4$ test- .

$$SrCO_3 + 2CH_3COOH \longrightarrow (CH_3COO)_2Sr + H_2O + CO_2$$

$$(CH_3COO)_2Sr + (NH_4)_2SO_4 \longrightarrow \underset{\text{Strontium sulphate (White precipitate)}}{SrSO_4} + 2CH_3COONH_4$$

2. Flame test : Sr^{2+} + Conc. HCl $\longrightarrow$ A crimson red colour of the flame confirms the presence of Sr^{2+} ions.

Test for Barium ion (Ca^{2+})

1. Ammonium oxalate test ($(NH_4)_2C_2O_4$) test-

$$CaCO_3 + 2CH_3COOH \longrightarrow (CH_3COO)_2Ba + H_2O + CO_2$$

$$(CH_3COO)_2Ca + (NH_4)_2C_2O_4 \longrightarrow (COO)_2Ca \text{ or } \underset{\text{Calcium oxalate (White precipitate)}}{CaC_2O_4} + 2CH_3COONH_4$$

2. Flame test : Ca^{2+} + Conc. HCl $\longrightarrow$ A brick red colourof the flame confirms the presence of Ca^{2+} ions.

<u>Analysis of Group–VI cations</u>

Test for Magnesium ion (Mg^{2+})

1. $$Mg^{2+} + Na_2HPO_4 + NH_4^+ \longrightarrow \underset{\text{Magnesium ammonium phosphate (White precipitate)}}{Mg(NH_4)PO_4} + NH_4OH + 2Na^+ + H_2O$$

COMMON LOGARITHMIC TABLES $\log_{10} x$

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
10	0.0000	0043	0086	0128	0170	0212					42	4	8	13	17	21	25	29	34	38
							0253	0294	0334	0374	40	4	8	12	16	20	24	28	32	36
11	0.0414	0453	0492	0531	0569	0607					39	4	8	12	16	20	23	27	31	35
							0645	0682	0719	0755	37	4	7	11	15	19	22	26	30	33
12	0.0792	0828	0864	0899	0934	0969					35	4	7	11	14	18	21	25	28	32
							1004	1038	1072	1106	34	3	7	10	14	17	20	24	27	31
13	0.1139	1173	1206	1239	1271	1303					33	3	7	10	13	17	20	23	26	30
							1335	1367	1399	1430	32	3	6	10	13	16	19	22	26	29
14	0.1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	30	3	6	9	12	15	18	21	24	27
15	0.1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	28	3	6	8	11	14	17	20	22	25
16	0.2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	26	3	5	8	10	13	16	18	21	23
17	0.2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	25	3	5	8	10	13	15	18	20	23
18	0.2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	24	2	5	7	10	12	14	17	19	22
19	0.2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	22	2	4	7	9	11	13	15	18	20
20	0.3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	21	2	4	6	8	11	13	15	17	19
21	0.3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	20	2	4	6	8	10	12	14	16	18
22	0.3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	19	2	4	6	8	10	11	13	15	17
23	0.3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	18	2	4	5	7	9	11	13	14	16
24	0.3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	18	2	4	5	7	9	11	13	14	16
25	0.3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	17	2	3	5	7	9	10	12	14	15
26	0.4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	16	2	3	5	6	8	10	11	13	14
27	0.4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	16	2	3	5	6	8	10	11	13	14
28	0.4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	15	2	3	5	6	8	9	11	12	14
29	0.4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	15	2	3	5	6	8	9	11	12	14
30	0.4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	14	1	3	4	6	7	8	10	11	13
31	0.4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	14	1	3	4	6	7	8	10	11	13
32	0.5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	13	1	3	4	5	7	8	9	10	12
33	0.5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	13	1	3	4	5	7	8	9	10	12
34	0.5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	13	1	3	4	5	7	8	9	10	12
35	0.5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	12	1	2	4	5	6	7	8	10	11
36	0.5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	12	1	2	4	5	6	7	8	10	11
37	0.5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	12	1	2	4	5	6	7	8	10	11
38	0.5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	11	1	2	3	4	6	7	8	9	10
39	0.5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	11	1	2	3	4	6	7	8	9	10
40	0.6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	11	1	2	3	4	6	7	8	9	10
41	0.6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	10	1	2	3	4	5	6	7	8	9
42	0.6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	10	1	2	3	4	5	6	7	8	9
43	0.6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	10	1	2	3	4	5	6	7	8	9
44	0.6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	10	1	2	3	4	5	6	7	8	9
45	0.6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	10	1	2	3	4	5	6	7	8	9
46	0.6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	9	1	2	3	4	5	5	6	7	8
47	0.6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	9	1	2	3	4	5	5	6	7	8
48	0.6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	9	1	2	3	4	5	5	6	7	8
49	0.6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	9	1	2	3	4	5	5	6	7	8
50	0.6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	9	1	2	3	4	5	5	6	7	8
51	0.7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	8	1	2	2	3	4	5	6	6	7
52	0.7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	8	1	2	2	3	4	5	6	6	7

COMMON LOGARITHMIC TABLES $\log_{10} x$

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
53	0.7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	8	1	2	2	3	4	5	6	6	7
54	0.7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	8	1	2	2	3	4	5	6	6	7
55	0.7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	8	1	2	2	3	4	5	6	6	7
56	0.7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	8	1	2	2	3	4	5	6	6	7
57	0.7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	8	1	2	2	3	4	5	6	6	7
58	0.7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	8	1	2	2	3	4	5	6	6	7
59	0.7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	7	1	1	2	3	4	4	5	6	6
60	0.7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	7	1	1	2	3	4	4	5	6	6
61	0.7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	7	1	1	2	3	4	4	5	6	6
62	0.7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	7	1	1	2	3	4	4	5	6	6
63	0.7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	7	1	1	2	3	4	4	5	6	6
64	0.8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	7	1	1	2	3	4	4	5	6	6
65	0.8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	7	1	1	2	3	4	4	5	6	6
66	0.8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	7	1	1	2	3	4	4	5	6	6
67	0.8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	6	1	1	2	2	3	4	4	5	5
68	0.8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	6	1	1	2	2	3	4	4	5	5
69	0.8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	6	1	1	2	2	3	4	4	5	5
70	0.8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	6	1	1	2	2	3	4	4	5	5
71	0.8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	6	1	1	2	2	3	4	4	5	5
72	0.8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	6	1	1	2	2	3	4	4	5	5
73	0.8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	6	1	1	2	2	3	4	4	5	5
74	0.8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	6	1	1	2	2	3	4	4	5	5
75	0.8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	6	1	1	2	2	3	4	4	5	5
76	0.8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	6	1	1	2	2	3	4	4	5	5
77	0.8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	6	1	1	2	2	3	4	4	5	5
78	0.8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	6	1	1	2	2	3	4	4	5	5
79	0.8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	6	1	1	2	2	3	4	4	5	5
80	0.9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	5	1	1	2	2	3	3	4	4	5
81	0.9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	5	1	1	2	2	3	3	4	4	5
82	0.9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	5	1	1	2	2	3	3	4	4	5
83	0.9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	5	1	1	2	2	3	3	4	4	5
84	0.9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	5	1	1	2	2	3	3	4	4	5
85	0.9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	5	1	1	2	2	3	3	4	4	5
86	0.9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	5	1	1	2	2	3	3	4	4	5
87	0.9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	5	1	1	2	2	3	3	4	4	5
88	0.9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	5	1	1	2	2	3	3	4	4	5
89	0.9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	5	1	1	2	2	3	3	4	4	5
90	0.9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	5	1	1	2	2	3	3	4	4	5
91	0.9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	5	1	1	2	2	3	3	4	4	5
92	0.9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	5	1	1	2	2	3	3	4	4	5
93	0.9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	5	1	1	2	2	3	3	4	4	5
94	0.9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	5	1	1	2	2	3	3	4	4	5
95	0.9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	5	1	1	2	2	3	3	4	4	5
96	0.9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	4	0	1	1	2	2	2	3	3	4
97	0.9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	4	0	1	1	2	2	2	3	3	4
98	0.9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	4	0	1	1	2	2	2	3	3	4
99	0.9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	4	0	1	1	2	2	2	3	3	4

ANTILOGARITHMS 10^x

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
0.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	2	0	0	1	1	1	1	1	2	2
0.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	2	0	0	1	1	1	1	1	2	2
0.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	2	0	0	1	1	1	1	1	2	2
0.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	2	0	0	1	1	1	1	1	2	2
0.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	3	0	1	1	1	2	2	2	2	3
0.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	3	0	1	1	1	2	2	2	2	3
0.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	3	0	1	1	1	2	2	2	2	3
0.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	3	0	1	1	1	2	2	2	2	3
0.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	3	0	1	1	1	2	2	2	2	3
0.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	3	0	1	1	1	2	2	2	2	3
0.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	3	0	1	1	1	2	2	2	2	3
0.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	3	0	1	1	1	2	2	2	2	3
0.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	3	0	1	1	1	2	2	2	2	3
0.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	3	0	1	1	1	2	2	2	2	3
0.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	3	0	1	1	1	2	2	2	2	3
0.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	3	0	1	1	1	2	2	2	2	3
0.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	3	0	1	1	1	2	2	2	2	3
0.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	4	0	1	1	2	2	2	3	3	4
0.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	4	0	1	1	2	2	2	3	3	4
0.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	4	0	1	1	2	2	2	3	3	4
0.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	4	0	1	1	2	2	2	3	3	4
0.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	4	0	1	1	2	2	2	3	3	4
0.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	4	0	1	1	2	2	2	3	3	4
0.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	4	0	1	1	2	2	2	3	3	4
0.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	4	0	1	1	2	2	2	3	3	4
0.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	4	0	1	1	2	2	2	3	3	4
0.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	4	0	1	1	2	2	2	3	3	4
0.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	4	0	1	1	2	2	2	3	3	4
0.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	4	0	1	1	2	2	2	3	3	4
0.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	4	0	1	1	2	2	2	3	3	4
0.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	5	1	1	2	2	3	3	4	4	5
0.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	5	1	1	2	2	3	3	4	4	5
0.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	5	1	1	2	2	3	3	4	4	5
0.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	5	1	1	2	2	3	3	4	4	5
0.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	5	1	1	2	2	3	3	4	4	5
0.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	5	1	1	2	2	3	3	4	4	5
0.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	5	1	1	2	2	3	3	4	4	5
0.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	6	1	1	2	2	3	4	4	5	5
0.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	6	1	1	2	2	3	4	4	5	5
0.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	6	1	1	2	2	3	4	4	5	5
0.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	6	1	1	2	2	3	4	4	5	5
0.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	6	1	1	2	2	3	4	4	5	5
0.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	6	1	1	2	2	3	4	4	5	5
0.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	6	1	1	2	2	3	4	4	5	5
0.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	6	1	1	2	2	3	4	4	5	5
0.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	7	1	1	2	3	4	4	5	6	6
0.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	7	1	1	2	3	4	4	5	6	6
0.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	7	1	1	2	3	4	4	5	6	6
0.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	7	1	1	2	3	4	4	5	6	6
0.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	7	1	1	2	3	4	4	5	6	6

ANTILOGARITHMS 10^x

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
0.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	7	1	1	2	3	4	4	5	6	6
0.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	8	1	2	2	3	4	5	6	6	7
0.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	8	1	2	2	3	4	5	6	6	7
0.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	8	1	2	2	3	4	5	6	6	7
0.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	8	1	2	2	3	4	5	6	6	7
0.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	8	1	2	2	3	4	5	6	6	7
0.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	8	1	2	2	3	4	5	6	6	7
0.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	9	1	2	3	4	5	5	6	7	8
0.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	9	1	2	3	4	5	5	6	7	8
0.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	9	1	2	3	4	5	5	6	7	8
0.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	9	1	2	3	4	5	5	6	7	8
0.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	10	1	2	3	4	5	6	7	8	9
0.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	10	1	2	3	4	5	6	7	8	9
0.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	10	1	2	3	4	5	6	7	8	9
0.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	10	1	2	3	4	5	6	7	8	9
0.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	10	1	2	3	4	5	6	7	8	9
0.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	11	1	2	3	4	6	7	8	9	10
0.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	11	1	2	3	4	6	7	8	9	10
0.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	11	1	2	3	4	6	7	8	9	10
0.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	11	1	2	3	4	6	7	8	9	10
0.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	12	1	2	4	5	6	7	8	10	11
0.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	12	1	2	4	5	6	7	8	10	11
0.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	12	1	2	4	5	6	7	8	10	11
0.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	12	1	2	4	5	6	7	8	10	11
0.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	13	1	3	4	5	7	8	9	10	12
0.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	13	1	3	4	5	7	8	9	10	12
0.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	13	1	3	4	5	7	8	9	10	12
0.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	14	1	3	4	6	7	8	10	11	13
0.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	14	1	3	4	6	7	8	10	11	13
0.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	14	1	3	4	6	7	8	10	11	13
0.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	15	2	3	5	6	8	9	11	12	14
0.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	15	2	3	5	6	8	9	11	12	14
0.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	15	2	3	5	6	8	9	11	12	14
0.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	16	2	3	5	6	8	10	11	13	14
0.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	16	2	3	5	6	8	10	11	13	14
0.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	16	2	3	5	6	8	10	11	13	14
0.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	17	2	3	5	7	9	10	12	14	15
0.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	17	2	3	5	7	9	10	12	14	15
0.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	18	2	4	5	7	9	11	13	14	16
0.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	18	2	4	5	7	9	11	13	14	16
0.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	18	2	4	5	7	9	11	13	14	16
0.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	19	2	4	6	8	10	11	13	15	17
0.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	19	2	4	6	8	10	11	13	15	17
0.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	20	2	4	6	8	10	12	14	16	18
0.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	20	2	4	6	8	10	12	14	16	18
0.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	21	2	4	6	8	11	13	15	17	19
0.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	21	2	4	6	8	11	13	15	17	19
0.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	22	2	4	7	9	11	13	15	18	20
0.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	22	2	4	7	9	11	13	15	18	20
0.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	23	2	5	7	9	12	14	16	18	21