

**NORTH MAHARASHTRA UNIVERSITY,**

**JALGAON**

**SYLLABUS**

**FOR**

**T.Y.B.Sc. CHEMISTRY**

**WITH EFFECT FROM JUNE, 2004**

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*25.5.04*

॥ अंतर्नी वेद्यं ज्ञानममृतं ॥  
NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus for  
T. Y. B. Sc. CHEMISTRY  
W.E. From June, 2004

**COURSE STRUCTURE**

1. There will be six compulsory theory papers & three compulsory practical courses of 100 marks each
2. The sixth theory course will have one optional course which will have two sections each.

The Title of the courses will be as follows.

**THEORY COURSES:**

- Paper I : Physical Chemistry  
Paper II : Inorganic Chemistry.  
Paper III : Organic Chemistry  
Paper IV : Analytical Chemistry.  
Paper V : Industrial Chemistry.  
Paper VI : Biochemistry and Polymer Chemistry  
OR  
Paper VI : Agriculture, Dairy and Environmental Chemistry

**PRACTICAL COURSES:**

- Paper VII : Physical Chemistry Practicals.  
Paper VIII : Inorganic Chemistry Practicals.  
Paper IX : Organic Chemistry Practicals.

3. Each theory course will be covered in four periods per week.
4. Each practical course will be covered in four periods per week per batch.
5. Number of students in a batch for practical courses should not be more than twelve.
6. A visit to chemical industry is compulsory. The students will have to prepare a report of the industrial visit and will have to submit it at the time of University practical examination.
7. Each theory course will be of maximum 150 marks with internal options.
8. Two tutorials (one per term) and one seminar should be conducted for each course excluding the regular schedule.

## Paper - 1 : PHYSICAL CHEMISTRY

### 1. The Solid State:

Introduction, Crystallization and fusion, Crystallography, Laws of crystallography, The Crystal systems, Properties of crystals, Polymorphism, The structure of crystal, x-rays Bragg's method of crystal analysis, The x-ray analysis of sodium chloride, Position of  $\text{Na}^+$  and  $\text{Cl}^-$  atoms in lattice, Calculation of  $d$  and wave length of x-rays, Powder method, Indexing and determination of unit cell constant, Number of molecules in unit lattice.

(P16, M16)

Related numerical problems.

Ref. 1. Pages 67 to 76, 77 to 87

Ref. 2. Pages 77 to 79

Ref. 3. Relevant pages

### 2. Colligative Properties of Solution:

Introduction, Lowering of vapor pressure of solvent, Boiling point elevation of solution, Calculation of molecular weight from boiling point elevation of solution, Freezing point lowering of solution, Osmosis and osmotic pressure, Relation of osmotic pressure to vapour pressure, Vant'-Hoff equation for osmotic pressure, Landberger's method for the determination of elevation of boiling point, Beckman's method for determination of freezing point. Berkeley and Hartley's method of measurement of osmotic pressure, Solution of electrolyte, Colligative properties of electrolyte. Related numerical problems.

(P16, M16)

Ref. 1 : Pages 312 to 332

### 3. Chemical Kinetics :

Introduction, Measurement of reaction rate, Order and molecularity of reactions, First order reactions, Example of first order reaction, Thermal decomposition of azoisopropane, Second order reactions, Example of second order reaction, Thermal decomposition of acetaldehyde. Third order reactions with equal initial concentration of reactants, Pseudomolecular reactions, Hydrolysis of methyl acetate, Inversion of cane sugar, Effect of temperature on reaction velocity, Energy of activation, Determination of the order of the reaction. Related numerical problems.

(P16, M14)

Ref. 1. Pages 548 to 555, 557 to 565, 571 to 574

Ref. 3. Pages 616 to 618

#### 4. Electrochemical Cells:

Classification of electrochemical cells, Chemical cell with and without transference, Concentration cells, Electrode concentration cells with transference, Electrolyte concentration cells with and without transference, Liquid junction potential, Application of emf measurement, Determination of solubility product, Measurement of pH using hydrogen electrode and quinhydrone electrode, Potentiometric titration. (P14, M14)

Related numerical problems

Ref. 1. Pages 497 to 519

Ref. 2. Pages 549 to 550

#### 5. Investigation of molecular structure:

Molar refraction, electrical polarization of molecules, Permanent dipole moment, Determination of dipole moment, Molecular structure and dipole moment. Molecular spectroscopy:- Introduction, Electromagnetic radiation, Types of spectra, Electronic, Vibrational and Rotational energy levels, regions of spectra, Fluctuation in dipole moments due to rotation, vibration and electronic excitation, Rotational spectrum of a rigid diatomic molecule. (P12, M12)

Related numerical problems.

Ref. 1. Pages 691 to 702

Ref. 4. Pages 5 to 9, 34 to 37

#### 6. Photochemistry :

Introduction, Grotthus-Draper law, Einstein's law of photochemical equivalence, Quantum yield, Primary and secondary process, Consequences of light absorption by atoms, Experimental Study of photochemical reaction, Photochemical reaction such as photolysis of ammonia, decomposition of HI,  $H_2-Cl_2$  reaction, Photosensitised reactions, Fluorescence and Phosphorescence, Chemiluminescence. (P12, M12)

Related numerical problems.

Ref.1: 775 to 780, 784 to 789, 796 to 797

Ref.3 : 658 to 662, 664 to 667, 672 to 677.

#### 7. Nuclear Chemistry :

Classification of nuclides, Radioactivity, Radioactive elements, General characteristics of radioactive decay, Decay kinetics, Half life period and mean life, Units of radioactivity, Alpha decay, Range and ionizing power of alpha particles, Beta decay, Types of beta decay, Measurement of

radioactivity by using Gieger-Muller counter, Variation of pulse size with voltage, Types of G.M. counter, Resolution time, Quenching of counter potential, Applications of radioactivity: Radiochemical principles in the use of tracer, Chemical investigation; Reaction mechanism, Structure determination, Dating by C-14 . (P10, M10)  
Related numerical problems.

Ref.5.: 5 to 6, 117 to 125, 139 to 141, 148 to 150, 299 to 306, 371 to 378,  
402 to 404

### 8. Equilibrium in Electrolytes:

Ionic strength, Activity and activity coefficient of strong electrolytes, Determination of activity coefficient, Debye-Huckel theory of activity coefficient, Related numerical problems: (P8, M6)

Ref.1. Pages: 484, 521 to 529

### REFERENCES

1. Fundamentals of Physical Chemistry.  
S. Maron and C.F. Prutton., IV<sup>th</sup> edition, Oxford and IBH publishing Co. Pvt. Ltd.
  2. Fundamental of Physical chemistry.  
S.H. Maron and J.B. Lando, Collier MacMillan International.
  3. Elements of Physical Chemistry.  
S. Glasstone and D. Lewis., McMillan and Co. Ltd., London.
  4. Fundamentals of Molecular Spectroscopy.  
Banwell and McCash, 4<sup>th</sup> Edition, Tata McGraw Hill Publishing Co. Ltd.
  5. Essentials of Nuclear Chemistry.  
H.J. Arnikar, 4<sup>th</sup> Edition, New Age International Publishers Ltd.
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### Paper - II : INORGANIC CHEMISTRY.

#### 1. Nomenclature of inorganic compounds :

Introduction, Greek numerical prefixes, Structure abbreviations, Arabic numbers, Square brackets, Symbol of an element in Italics, Representation of valence states of elements, Nomenclature of the cations, Nomenclatures of anions, Nomenclatures of isopolyanions, Nomenclatures of heteropolyanions, Nomenclatures of neutral and cationic radicals, Nomenclature of compound in general, Nomenclature of binary compounds, Nomenclature of oxyacids. (P6, M6)

Ref. 1 : Pages 728 to 735

## 2. Coordination Chemistry :

Double Salts and coordination compounds, Nomenclature of coordination compounds, Werners work, More recent methods of studying complexes, Effective atomic numbers, Shapes of d-orbitals, Isomerism, Geometrical isomerism, Stereoisomerism. (P18, M18)

Ref. 3 : Pages 230 to 236 and 194 to 201

## 3. Bonding in transition metal complexes:

Valence bond theory , Crystal field theory, Octahedral complexes, Effect of crystal field splitting , Tetragonal distortion of octahedral complexes (Jahn-Teller distortion), Square planer arrangements, Tetrahedral complexes, Chelates, Magnetism, Molecular orbital theory,  $\pi$  acceptors,  $\pi$ -donors. (P22, M22)

Ref. 3 Pages 202 to 229

## 4. d-block elements:

Elements of first, second, and third transition series, General characteristics of d-block elements, Metallic character, Atomic volume and densities, Atomic radii, Ionic radii, Melting points, Boiling points, Ionization energies, Reactivity, Oxidation states, Standard electrode potential, Reducing properties, Colour, Magnetic properties, Catalytic properties and tendency to form complexes. (P12, M12)

Ref. 2 Pages 762 to 775

## 5. f-block elements:

Lanthanide series, Properties of lanthanides, Electronic configuration, Oxidation states, Atomic and ionic radii, Lanthanide contraction, Colour, Magnetic properties, Oxidation potentials, Basic characters, Solubility of compounds, Double salts, Chemical reactivity, Extraction of lanthanides, Separation of lanthanides, Lanthanum Compounds, Actinide series, Transuranic elements, Properties of actinides, Oxidation states, Ionic radii, Colour of ions, Formation of complexes, Comparison with lanthanides, Thorium extraction, Properties and compounds of thorium, Uranium extraction, Compounds of Uranium, Plutonium production and properties. (P28, M24)

Ref. 2 Pages 885 to 919

## 6. Passivity and corrosion :

Introduction to passivity, alternative definition of passivity. Theories of passivity, Theories of electronic configuration, Applications of passivity, Electrochemical passivity, Mechanical passivity.

Introduction to corrosion, Economical aspects of corrosion, Types of corrosion, Dry or chemical corrosion, Wet or electrochemical corrosion or immersed corrosion, Corrosion by gases environments, Theory of corrosion by gaseous environment. Theory of immersed corrosion, Electrochemical theory, Microbiological corrosion, Prevention of corrosion. (P18, M18)  
Ref. 4 Pages 872 to 892

## REFERENCES :

1. Advance Inorganic Chemistry (volume 1) : Satya Prakash, G.D. Tuli, S. K. Basu, and R. D. Madan, S. Chand and Co. Ltd., New Delhi.
2. Principles of inorganic Chemistry: B. R. Puri, L. R. Sharma and K. C. Kalia, Vallabh Publications, Delhi.
3. Concise Inorganic Chemistry (5<sup>th</sup> Edition) : J.D. Lee
4. Advance Inorganic Chemistry (Volume 1): Gurdeep Raj, Goel Publication House, Meerut.

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## PAPER- III : ORGANIC CHEMISTRY

### 1. Structural Effects and Reactivity

- a) Conditions Necessary for Delocalisation
- b) Breaking and Formation of bonds
- c) Factors affecting Electron availability
  - i) Inductive Effect
  - ii) Resonance Effect
  - iii) Hyperconjugation
  - iv) Steric Effect
  - v) Tautomerism

Ref. 1 Pages 18 to 28

(P10, M10)

### 2. Strength of Acids and Bases

- a) Theories of Acids and Bases
- b) Acid and  $pK_a$  values, bases and their  $pK_b$  values
- c) Origin of Acidity in Organic Compounds
- d) Factors affecting Strength of Acids and Bases

- e) Simple Aliphatic Acids
- f) Substituted Aliphatic Acids
- g) Phenols and Aromatic Carboxylic Acids
- h) Dicarboxylic Acids
- i) Aliphatic and Aromatic Bases
- j) Heterocyclic Bases (Pyrrole and Pyridine)

(P8, M8)

Ref.1. Pages 53 to 74

### 3. Nucleophilic Substitution at Saturated Carbon

- a. Relation between Kinetics  $SN^1$ , &  $SN^2$  Mechanism.
- b. Stereochemical Implication of Mechanism.
  - i.  $SN^2$  Mechanism - Inversion of Mechanism
  - ii. Determination of Relative Configuration
  - iii.  $SN^1$  Mechanism - Racemisation
  - iv.  $SN^1$  Mechanism
- c. Factors affecting the rate of  $SN^1$  and  $SN^2$  reactions.
  - i. Effect of Structure
  - ii. Effect of Solvent
  - iii. Effect of entering Group
  - iv. Effect of Leaving Group

(P12, M10)

Ref.1. Pages 77 to 92, 96 to 99

### 4. Aromatic Electrophilic Substitution Reactions

- a. Friedle Craft's Alkylation and Acylation, Diazo-coupling Reactions
- b. Orientation in Mono-substituted Benzene
- c. IPSO - Substitution
- d. Electrophilic Substitution in other Aromatic Compounds-  
Naphthalene, Pyridine, Pyrrole.

(P12, M10)

Ref.1. Pages 141 to 150, 152 to 156, 161 to 163

### 5. Elimination Reactions

- a) Elimination Reactions
- b)  $E_1$ ,  $E_2$ , and  $E_{1cb}$  Mechanism
- c) Stereochemistry of Elimination  $E_2$
- d) Orientation in  $E_1$  and  $E_2$ , Saytzeff and Hofman
- e) Elimination Vs Substitution

(P10, M10)

Ref.1. Pages 246 to 262



## 6. Electrophilic Addition to $>C=C<$ Double Bond

- a) Addition to Halogen
- b) Effect of Substitution on Rate of Addition
- c) Orientation of Addition (Add<sup>E2</sup> Mechanism)
- d) Other Addition Reactions
  - i) Hydration
  - ii) Hydroboration
  - iii) Hydroxylation
  - iv) Hydrogenation
  - v) Ozonolysis

Ref.1. Pages 178 to 197

(P8, M8)

## 7. Nucleophilic Addition to $>C=O$ Double Bond

- a) Introduction
- b) Structure and Reactivity
- c) Simple Addition Reactions- Hydration, Alcohols, Thiols, HCN, Bisulphite, Complex Metal Hydride ions, derivatives of ammonia
- d) Cannizzaro Reaction
- e) Carbon Nucleophilic Addition
  - i) Carbanion formation stability
  - ii) Aldol condensation
  - iii) Claisen condensation
  - iv) Perkin's reaction
  - v) Wittig reaction

Ref.1. Pages 203 to 230

(P12, M12)

## 8. Organometallic Compounds

- a) Organomagnesium Compounds: The Grignard reagent - Formation, structure and chemical reactions.
- b) Organozinc compounds: formation and chemical reactions.
- c) Organolithium compounds: formation and chemical reactions.

Ref.2. Pages 239 to 247

(P8, M8)

## 9. Spectroscopy Methods

### A. Introduction

- i) Meaning of Spectroscopy, Nature of electromagnetic radiations, Wave length, frequency, energy, amplitude, wave number and their relationship

Different units of measurement of wavelength, frequency. Different regions of electromagnetic radiations.

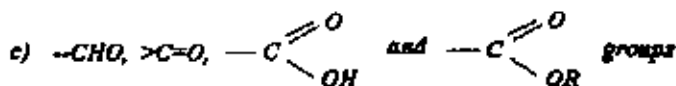
- ii) Interaction of radiations with matter, excitation of molecules to different energy levels such as rotational, vibrational and electronic waves.

### B. Ultraviolet Spectroscopy

- i) Various electronic transitions, effect of solvent on electronic transitions.  
ii) Ultraviolet bands for Carbonyl compounds, conjugated unsaturated carbonyl compounds, dienes, conjugated polyenes  
iii) Fieser-Woodward rules for conjugated dienes and conjugated carbonyl Compounds.  
iv) Ultraviolet spectra of aromatic compounds.

### C. Infrared Spectroscopy

- i) Introduction, Principle of IR Spectroscopy, Fundamental modes of Vibrations.  
ii) Characteristic of IR, Absorption of following groups  
a) Alkane, Alkene, Alkyne  
b) Alcohol, Ester



- d) Amine and Amide  
e) Aromatic Compounds and their Substitution pattern  
iii) Effect of the following factors on IR spectroscopy, Inductive effect, Resonance effect, Hydrogen bonding  
iv) Applications of IR Spectroscopy  
a) Determination of structure, Identification of Functional groups  
b) Study of chemical reactions  
c) Hydrogen Bonding

### D. NMR Spectroscopy

- a) Introduction, Principle of NMR Spectroscopy, Magnetic & Nonmagnetic Nuclei.

- b) Nuclear resonance, chemical shift, molecular structure, shielding and deshielding measurement of chemical shift, TMS reference and its advantages.
- c) Peak area, spin-spin coupling, coupling constant,  $J$  value (only first order coupling to be discussed)
- d) Applications of NMR Spectroscopy
- e) Spectral Problem based on UV, IR an NMR data. (P24, M24)

Ref. 2, 3, 4 and 5 Relevant Pages

#### REFERENCES:

1. A Guide Book to Reaction Mechanism, Peter and Sykes, VI<sup>th</sup> Edition
2. Organic Chemistry, H. Pine, V<sup>th</sup> Edition
3. Organic Chemistry, Morrison and Boyd, VI<sup>th</sup> Edition
4. Spectroscopy Methods in Organic Chemistry, Williams Fleming, IV<sup>th</sup> Edition
5. Spectroscopy of organic compounds, P. S. Kalsi, Wisly Eastern Publ.

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#### PAPER-IV : ANALYTICAL CHEMISTRY

##### 1. Solvent Extraction:

The distribution coefficient, distribution ratio, percent extracted, solvent extraction of metals.

a) Ion association complexes

b) Metal chelates.

The extraction process, the separation process, the separation efficiency of metal chelates, analytical separation, multiple batch extraction, counter current distribution, simple numerical problems on percent extracted and the multiple extractions.

(P14, M12)

Ref. 1. Pages-484-498.

##### 2. Chromatographic Methods :

Technique of column chromatography, column efficiency in chromatography, size exclusion chromatography, ion exchange chromatography, cation exchange resins, anion exchange resins, cross linkage, effect of pH, separation of amino acids, effect of complexing agents, some applications of

ion exchange chromatography, purification, concentration, analytical separations, Gas chromatography-principles, gas chromatography columns, gas chromatography detector-thermal conductivity detector. (P18, M18)

Ref.1. Pages-508-525.

### 3.Potentiometry and Potentiometric Titrations:

The potentiometer and pH meter, cell for potential measurements, the glass pH electrode, principle, combination electrodes, theory of glass membrane potential, alkaline error, acid error, standard buffers, accuracy of pH measurements, measurements with pH meter, ion selective electrodes, glass membrane electrodes, precipitate electrode solid state electrodes, liquid-liquid electrodes, plastic membrane/ionophore electrode, coated wire electrode, enzyme electrode potentiometric titrations, (Indirect Potentiometry), pH titrations, precipitation titrations, Redox titrations. (P26, M24)

Ref.1. Pages 312,313,316 to 325,327 to 333.

Ref.2. Relevant pages

### 4. Gravimetric Analysis

Unit operations in gravimetric analysis steps of gravimetric analysis, preparation of solutions, conditions of analytical precipitations, digestion of precipitate, impurities in precipitates, washing and filtering of precipitates, Drying and ignition of precipitate, precipitation from homogeneous solution, gravimetric calculations. (P12, M12)

Ref.1. Pages 145-158.

### 5.Spectrometry.

Interaction of electromagnetic radiation with matter, Electromagnet spectrum, the absorption of radiation, the concept of absorption, absorption by inorganic compounds, solvents for spectrometry, quantitative calculations, Beer's law, mixtures, principles of instrumentation, sources, monochromators, prisms, diffraction gratings, optical filters, cells, detectors, slit width, type of instruments, - single beam spectrophotometers, double beam spectrophotometers, spectrometric errors, deviations from Beer's law, chemical deviation, Instrumental deviation. (P16, M16)

Ref.1.Pages 398-401,410,413-420,422-427,429,435, 439-443.

Ref.2.Relevant pages.

## 6. Flame Emission Spectroscopy:

Introduction, distribution between ground and excited state, Instrumentation, burners, flames, Interference: spectral, Ionisation, Refractory compound, formation, Physical, use of organic solvents, sample preparations.  
(P10, M10)

Ref.1. Pages 464-475.

## 7. Nephelometry and Turbidimetry:

Introduction, turbidimetry, colorimetry, nephelometry and fluorimetry, choice between nephelometry and turbidimetry theory, Instrumentation and applications of nephelometry and turbidimetry.  
(P8, M8)

Ref. 3. Pages 380-390.

### REFERENCES:

1. 'Analytical Chemistry' : G.D.Christian 5<sup>th</sup> edition.
2. 'Analytical Chemistry An Introduction : Skoog West & Holler 6<sup>th</sup> edition.
3. Instrumental methods of chemical analysis : Chatwal & Anand, 7<sup>th</sup> edition.

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## PAPER-V : INDUSTRIAL CHEMISTRY

### 1. Glass:

Physical properties, Chemical properties, classification of glass, effect of different constituents in glass, principal raw material used in manufacture of glass, chemical reactions, manufacture of glass, special glasses.  
(P10, M10)

Ref.1. Pages 296-302, 308-313.

### 2. Fertilizers:

Introduction, classification of fertilizers;

- a) Nitrogenous fertilizers - Manufacture process of ammonium sulphate and urea with flow sheet.

b) Phosphatic fertilizers-Triple superphosphate (manufacturing process)  
Ref.1. Pages 315-320, 324,326,328, 331,336,337. (P10, M10)

### 3. Soap and Detergents:

Soaps : raw materials used to prepare soap, manufacture of soaps-continuous process only, cleaning action of soaps, classification of soaps.

Detergents: principal groups of synthetic detergents, detergent builders and additives, comparison between soap and detergents. (P12, M10)

Ref.1. Pages 641-644,646,649-654,669-675.

### 4. Cement :

Portland cement, Types of Portland cement, chemical specifications of Portland cement, Raw materials, manufacture of cement . Dry and Wet process, clinker compounds and reactions during formation clinker, setting and hardening of cement. (P10, M10)

Ref.2. Pages 170-180.

### 5. Sugar Industry:

Introduction, manufacture of cane sugar, Grades, Baggasse, preparation of celotex. (P10, M10)

Ref.1. Pages 676-687.

### 6. Dyes :

a) Colour: Colour and chemical constitution, chromophores, auxochromes, Bathochromic and Hypsochromic groups.

b) Dyes: Nomenclature, classification according to their constitution and Mode of application.

c) Synthesis and uses of following dyes - Methyl orange, congo red, crystal violet, phenolphthalein, Eriochrome Black T indicator, Indigotin. (P12, M10)

Ref.1. Relevant pages

### 7. Drugs & Pharmaceuticals :

a) Introduction to chemotherapy, Qualities of good drugs, classification, functional and Chemotherapeutic drugs, meaning of following terms

with one example each - Analgesic, antacid, antibiotic, antihistamine, antiaribitic,antiinflammatory, anti-obesity, cardio-vascular agents, cough and cold preparations, diuretics,laxatives,phycophoroceticals, sedetives, hypnotics, sulpha drugs.

- b) Synthesis and uses of Benadryl, antipyrine, paracetamol, sulphadiazine Benzocane. (P10, M10)

Ref. 2,3,4,5. Relevant pages.

#### 8. Fermentation Industry :

introduction, alcohol fermentation, uses of alcohol, theory underlying process of making alcohol beverages, Manufacture of Beer, Manufacture of spirit, alcohol from cane sugar molasses, theory of fractional distillation, coffey's still, rectified spirit, absolute alcohol, fusel oil, proof spirit, denatured alcohol, mechanism of alcohol formation. (P10, M10)

Ref. 2 pages 578-596 (related topics).

#### 9. Petroleum Industry :

- Discovery of petroleum origin.
- Exploration methods.
- Nature of petroleum, composition of crude oil.
- Refining of crude petroleum, desalting and distillation.
- Cracking process, Reforming.
- Improving gasoline by additions & reactions, antiknock compounds. (P10, M10)

Ref. 2,4,6 (Relevant pages).

#### 10. Explosives & Toxic chemical weapons:

- Explosives - Introduction, classification, characteristics of explosives, RDX or Cyclonite, TNT, Picric acid.
- Toxic chemical weapons :Introduction, toxic chemicals mustard, phosgene Nerve gases, chloroacethophenone, Chloropicrin. (P10, M10)

Ref. 8 pages 919-933.(Relevant pages).

#### REFERENCES :

- Industrial Chemistry - M.G. Arora, M singh (Anmol publication, New Delhi).
- Shreve's Chemical Process Industries - Vth Edn.

3. Organic Chemistry - I.L. Finar (Vol. II)
4. Reagent Handbook of Industrial Chemistry - S.A. Kent (1974).
5. Organic Chemistry ,I.L.Finar(Vol. I)
6. Synthetic Organic Chemistry - G.R.Chatwaj.
7. Industrial Chemistry - R.K. Das 11nd Edn 1976
8. Industrial Chemistry - B.K. Sharma (10<sup>th</sup> Edn.)

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## Paper-VI : BIOCHEMISTRY and POLYMER CHEMISTRY

### SECTION - I : BIOCHEMISTRY

#### 1. Introduction:

Meaning, objectives and scope of Biochemistry. (P1,M0)

Ref.1. Pages 4 & 5

#### 2. Carbohydrates :

Definition, classification, structure of monosaccharides, and reactions of monosaccharides – oxidation, reduction, mutarotation, ester formation, glycoside formation, polysaccharides-starch and cellulose. (P3,MB)

Ref 1,.2. and 3: Relevant Pages.

#### 3. Amino Acids, Proteins and Enzymes :

Definition and classification of amino acids, characteristic chemical reactions viz ninhydrin, FDNB, Dansyl chloride, phenyl isothiocyanate.

Proteins : Classification based on shape, function. Structure of proteins- primary, secondary, tertiary and quaternary, Fibrous proteins & keratins.

Enzymes : Definition, classification factors affecting enzyme activity, Michaelis Menten equation (derivation not expected) (P15,M14)

Ref. 1 pages 57-62, 71-76,84-85,125-130

Ref. 2 pages 71-72,79-80,89-90,92-94.



#### 4. Lipids :

Classification of lipids, Nomenclature of fatty acids, triacyl glycerols, waxes, phospholipids, sphingolipids. (P4, M4)

Ref.1, 2: .Relevant Pages.

Ref.3 : Pages 194-200.

#### 5. Nucleic Acids:

Components of nucleic acids-bases, nucleosides, nucleotides, Watson and crick model of DNA, structure and functions of RNA-tRNA, RNA, MRNA. (P9, M9)

Ref.1 Pages 309 to 322

Ref.2 Pages 103 to 110

#### 6. Metabolism and Nutrition :

Definition, Glycolysis, energetics of glycolysis, trans amination, deamination, decarboxylation,  $\beta$ -oxidation and its energetics. Nutritional requirements in humans, composition of food, food energy. (P15, M15)

Ref. 1 Pages 543-552,562-566,570-574.

Ref. 2 Pages 214,216-217,249-250,282-285,289-290,370-371.

Ref. 3 Pages 661-668.

#### REFERENCES:

1. Principles of Biochemistry By A. L. Lehninger 1977 revised.
2. Outlines of Biochemistry By E.C.Conn and P.K.Stumpf.
3. Harpers Review of Biochemistry. By D.W. Martin, P. A. Mayes, V. W. Rodwell, D. K. Granner. 20<sup>th</sup> Ed<sup>n</sup>, (Asian)

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#### SECTION -II :POLYMER CHEMISTRY

##### 1. Introduction :

Basic concept and Polymer nomenclature :

Brief history, definition, concept of functionality and reactivity, degree of polymerisation, homopolymers, copolymers, branched polymers, cross linked or three dimensional polymers block and graft co-polymers.

Classification of polymers with examples: natural and synthetic, organic and inorganic, thermoplastic and thermosetting polymers, plastics, elastomers, and fibers, nomenclature of polymers. (P8,M6)

Ref.1 Pages 1-9,142-144.

Ref.2. Relevant Pages.

#### 4. Chemistry of Polymerisation :

Introduction, chain polymerisation, free-radical polymerisation, ionic polymerisation, co-ordination polymerisation, step polymerisation, ring opening polymerisation and Zeigler-Natta catalyst. (P14,M14)

Ref. 1. Pages 15-64.

#### 5. Polymerisation techniques and their salient features :

bulk polymerisation, solution polymerisation, suspension, polymerisation, emulsion polymerization, interfacial condensation polymerisation. (P10, M10)

Ref. 1 Pages 71-79, 82-84.

#### 6. Preparation, Properties and uses of some important polymers:

polypropylene, Polymethylmethacrylate, Phenolformaldehyde resin, Urea-formaldehyde resin, Polyesters, Nylon-66, Polyacrylonitrile. (P6, M6)

Ref.1 Chapter-9 Relevant pages.

#### 7. General Properties of Polymers :

Glass transition temperature, factors affecting glass transition temperature, Importance of glass transition temperature, concept of molecular weights (number average wt. average, viscosity average, molecular wt. of polymers), tensile strength, young modulus, Hardness, elongation, melt flow index of polymers. (P14, M14)

Ref.1, 2, 4 & 5 : Relevant Pages.

#### REFERENCES:

- Polymer Science by V. R. Gowarikar.
- Text Book of Polymer Science by F. W. Billmeyer, Jr.
- Polymer Chemistry by M. G. Arora & M. Sing.
- Physical Chemistry of Polymers by A Tager, MIR Publications.
- Polymer Chemistry: The Basic Concepts by Paul C. Hiemenz, Marcel-Dekker publisher.

[ OR ]

**PAPER - VI : AGRICULTURE, DAIRY AND ENVIRONMENTAL CHEMISTRY**

**SECTION-I AGRICULTURE & DAIRY CHEMISTRY**

**1. SOIL TESTING AND SOIL AMENDMENT:**

Soil Testing : Importance of soil testing, collection of representative soil samples, interpretation of soil test results for fertilizer recommendation.

Soil Amendment: Types of soil amendments, soil pH, acidic soil, effect of liming on soil, liming materials, saline and alkaline soils, use of gypsum, soil conditioners.

(P4, M4)

Ref. 1 Pages: 239,240,242,247-250,256-260,265,311-315.

**2. QUALITY OF IRRIGATION WATER:**

Sources and collection of representative sample of irrigation water, various terms and units used to express data obtained from chemical analysis of water (ppm, me/l, epm), dissolved constituents and their functions. Major constituents - calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphate, chloride and nitrate. Minor constituents - boron, silica, nitrite, sulphide, fluorine, water quality standards - TSS, SAR, ESP, RSC, %Na salinity classes for irrigation water, sodium classification.

(P3, M3)

Ref.2 Pages: 262-272.

**3. BULKY ORGANIC MANURES:**

**A) Farm-Yard manures (F.Y.M.):**

Composition, factors affecting the composition of F.Y.M., methods of handling F.Y.M., losses during handling and storage of F.Y.M., trench method for preparation of good quality F.Y.M., construction, working and uses of bio-gas plant.

**B) Green Manuring:**

Definition, types of green manuring, advantages and disadvantages of green manuring, methods of growing green manure crops in situ, plants suitable for green manuring in situ.

(P5, M5)

Ref.1 Pages: 29-31,34-35,64-68.

#### 4. BIOFERTILIZERS:

- A) Introduction, Definition, Classification of Biofertilizers, Importance and Contribution of Biofertilizers in Agriculture.  
Ref.4: Pages: 1,6,7.
- B) Isolation of Rhizobium for Nodules, Rhizobium in soil.  
Ref.5: Pages: 16,36.
- C) Isolation of Azotobacter, Azobacter in Soil  
Ref.5: Pages: 70,72,73.
- D) Isolation of Blue Green Algae, Preparation of blue green algae in open air shallow culture, multiplication of blue-green algae in the field.  
Ref.5: Pages: 104,107,108.
- E) Phosphate solubilizing microorganism-solubilization of Phosphate by micro-organisms, isolation of phosphate solubilizing micro-organisms.  
Ref.4: Pages: 129-131.
- F) Biofertilizers-Demand and production.  
Ref.4: Pages: 19-20. (P8, M7)

#### 5. PESTICIDES: Definition & Classification.

##### Insecticides:

Definition, classification based on chemical nature. Elemental composition of mode of action of plant originated and synthetic insecticides. e.g. Nicotine, carbaryl.

##### Fungicides:

Definition, classification properties, elemental composition and mode of action of sulphur, copper and mercuric, fungicides, e.g. lime sulphur, thiram, Bordeaux-mixture, mercuric chloride.

##### Herbicides:

Definition classification chemical properties and mode of Selective, non-selective herbicides. e.g. 2-4 D and 2,4,5-T. Ref.3: Relevant pages.

(P6, M6)

#### DAIRY CHEMISTRY

#### 6. MARKET MILK

Introduction, importance of dairy chemistry, definition of milk, composition-milk constituents, chemical composition of milk of different species such as cow, buffalo, goat, and sheep. Chemical composition of milk of some Indian and foreign breeds, factors affecting composition of milk of some Indian and foreign breeds, factors affecting composition of milk food and nutritive value of milk physico chemical properties of milk, uses of milk. (P5, M5)

Ref.6: Pages 1 to 23.

Ref.10: Pages 1 to 24.

## **7. METHODS OF MANUFACTURE, PACKING AND STORAGE OF SPECIAL MILK:**

Pasteurized milk-flow diagram, receiving milk, preheating, filtration, classification, cooling and storage of raw milk, standardization, pasteurization, homogenisation, bottling packing and storage, sterilized milk, homogenized milk, flavoured milk, standardized milk and toned milk.

(P5, M5)

Ref.6: Pages, 90-116, Topics: 2.2.1, 2.2.2, 2.41, 2.81, 2.82, 2.83, 2.111, 2.113, 2.114, 1.17.

## **8. PRESERVATIVES AND ADULTERANTS:**

### **A) Preservation of milk :**

Common method of preservation of milk-action of heat and uses of chemical preservation. Preservatives-Definition, importance, some important preservatives and their detection such as boric acid, borax, formalin, salicylic acid, benzoic acid, and hydrogen peroxide.

### **B) Adulteration in milk:**

Modes of adulteration and their detection such as skimming, addition of separated milk or skim milk. Addition of water, starch, and cane sugar.

(P3, M3)

Ref.7: Pages 78-87.

Ref.9: Pages 114-118.

## **9. MILK PROTEINS, VITAMINS AND ENZYMES:-**

### **A) Milk-proteins:**

Importance, classification composition, separation of milk proteins. Casein : preparation, properties, uses whey proteins-preparations, separations-lacto albumin, lactoglobuline and protenes-peptones.

### **B) Vitamins in Milk:**

Importance, properties, vitamin A, vitamin B-complex, vitamin-B1(thiamine), vitamin B2 (Riboflavin), vitamin B6(Pyridoxine), vitamin B12, vitamin C & D.

### **C) Enzymes in Milk:**

Importance, definition, important enzymes-Amylase, catalase, lipase, proteose phosphatase, peroxidase, lactase.

(P5, M4)

Ref.8: Pages 12-15, 19-22, 27-32.

## **10. MILK PRODUCTS:**

### **A) Cream:**

Definition, classification, composition, food and nutritive value, method of preparation/manufacture, uses of cream.

Ref.6: Topics 3.1- 3.5, 3.7, 3.16.

**B) Butter:**

Definition, Classification, composition, food and nutritive value, manufacturing of butter- selection of milk/cream, pasteurization of cream, ripening of cream, churning, salting of butter, washing of butter, packing and storage, uses of butter.

Ref.6: Topics 4.1-4.7, 1.17.

**C) Cheese:**

Definition, classification, composition, food and nutritive value, manufacture of cheddar cheese, receiving of milk, filtration and classification, pasteurization, homogenization, addition of salt, ripening with starter, renneting, cutting of curd and drainage of whey, milling and salting, hopping dressing pressing and drying, uses of cheese.

Ref.6: Topics 7.1, 7.2,7.8.7.20.

**D) Ice-cream:**

Definition, classification, composition, food and nutritive value, method of manufacturing-selection of the ingredient, figuring mix; making mix, pasteurizing the mix, homogenizing the mix. Cooling and ageing of mix, freezing of mix, overrun in ice-cream, packaging, hardening and storage of ice-cream, use of ice-cream.

Ref.6: Topics 6.1, 6.2,6.4-6.7,6.9,6.14.

(PS, M8)

**REFERENCES**

1. Manures And fertilizers. (VIIIth edition) By K. S. Yawalkar, J. P. Agrawal, S. Bokade. Agriculture Horticulture Publishing House, Nagpur.
2. Irrigation and Drainage. By D.Lenka, Kalyani Publishers, New Delhi.
3. Chemistry of Insecticides and Fungicides. By U.S.Sree Ramulu
4. Biofertilizers-Technology, Marketing and Usage. By Dr.M.R Motasara, Dr.P.Bhattacharyya and Dr. Beena Srivastava. (Fertilizer Development and Consultation Organization )
5. Biofertilizers in Agriculture and Forestry. By N.S.Subba Rao (IIIrd Ed.), Oxford and IBH Publishing Co-Pvt. Ltd.
6. Outline of Dairy Chemistry (3<sup>rd</sup> Ed.) By Sukumar De (Oxford University Press.)
7. Dairy Chemistry and Animal Nutrition.By M.M.Rai (Kalyani Publishers)
8. Chemistry and testing of Dairy Products (4<sup>th</sup> Ed.) By Henry V.Atherton; J.A. Newlander (CBS Publishers and Distributors).
9. Dairy Chemistry. By Dr. Nanak Singh. (Aman Publishing House, Meerut)
10. Fundamental of Dairy Chemistry By Webb. Johnson, Alford.

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## SECTION-II: ENVIRONMENTAL CHEMISTRY

### 1. Introduction to Environmental Chemistry

Concept and scope of Environmental Chemistry, Nomenclature, Environmental Segments.

(P4, M4)

Ref.1: Pages 1 to 5.

### 2. Atmosphere and Air Pollution

Atmosphere- Composition, Atmospheric structure, Evolution of atmosphere, Earth radiation balance.

Air Pollution – Air pollutants, primary pollutants, carbon monoxide – Sources and sinks of co-pollution.

Nitrogen Oxides- Sources and sinks of Nox Pollution, Concentration profile of NO<sub>x</sub>, Control of NO<sub>x</sub> pollution.

Hydrocarbons and Photochemical Smog.

Sulphur dioxide – Sources, Control of Sox Pollution.

Particulates – Sources, effect on humans, effect on materials, particulate and climate, control of particulate emissions.

(P18, M18)

Ref.1: Pages 6-12,93-114,117-124.

### 3. Water Pollution

Hydraulic Cycle. Complexion in natural and waste water, eutrophication. Sewage treatment, industrial waste water treatment, drinking water treatment, aquatic environment, water pollutants, organic pollutants, inorganic pollutants, sediments.

(P20, M18)

Ref.1: Pages 33-34,44-46,50-58,164-190.

### 4. Chemical Toxicology :

Toxic chemicals in environment, toxic chemicals in air, toxic elements in water.

Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, lead, mercury, Biochemical effects of carbon monoxide, nitrogen oxides, sulphurdioxide, Ozone and PAN, Cyanide, Pesticides.

(P10, M10)

Ref.1: Pages 66-71,73,89.

## REFERENCES

1. Environmental Chemistry – By A.K.DE,(Second Edition)

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## PAPER-VII : PHYSICAL CHEMISTRY PRACTICALS

Each student has to perform minimum 18 experiments with at least one experiment from each technique.

### 1. Potentiometry :

- I. Determination of Escal and pH of buffer solutions using quinhydrone electrode.
- II. Estimation of amount of KCl/ NaCl by titration with silver nitrate.
- III. Determination of strength of HCl by titration with NaOH.
- IV. Determination of formal redox potential of  $Fe^{2+} / Fe^{3+}$  system.

### 2. Conductometry :

- I. Conductometric titration of oxalic acid with NaOH solution.
- II. Determination of relative strength of monochloroacetic acid and acetic acid.
- III. To determine concentration of  $Fe^{2+}$  ion by titrating it with  $K_2Cr_2O_7$  solution conductometrically.

### 3. Refractometry :

- I. Determine the molar refractivities of give liquids A, B, C & D.
- II. Determine the specific refractivities of given liquids A & B and their mixtures and hence determine the composition of unknown mixture.
- III. Determination of refractive indices of series of solutions of KCl, and hence the composition of given solution of KCl.

### 4. pH - metry :

- I. Determine  $pK_a$  and  $K_a$  values of a given weak acid by pH metric titration with strong base.
- II. Determine the hydrolysis constant of aniline hydrochloride.
- III. Determination of  $pK_{a1}$  and  $pK_{a2}$  values of malonic acid / oxalic acid.
- IV. Determination of pH values of various mixtures of sodium acetate and acetic acid in aqueous solution and hence find out  $K_a$  of the acid.



**5. Radioactivity :**

- I. Determination of plateau voltage and resolving time of G. M. counter.
- II. Determination of  $E_{max}$  of  $\beta$ -particles

**6. Colorimetry :**

- I. Verification of Beer's law and determination of conc of given solution of  $Cu^{2+}$  ions.
- II. Determine  $\lambda_{max}$  and concentration of given solution of  $K_2Cr_2O_7$  in 0.01N NaOH.

**7. Polarimetry :**

- I. Determine the conc of a given solution of optically active substance (cane sugar) by polarimetric measurements.
- II. To study the inversion of Cane-sugar by polarimeter.

**8. Chemical Kinetics :**

- I. Investigation of the kinetics of decomposition of  $H_2O_2$  by volume measurement of  $O_2$  (2sets).
- II. Determine the energy of activation of the reaction between  $K_2S_2O_8$  and KI (equal initial conc.)
- III. Investigation of kinetics of the hydrolysis of methyl acetate catalyzed by HCl.
- IV. Investigation of the reaction between  $H_2O_2$  and KI.
- V. Study the kinetics of iodination of acetone.

**9. Non-instrumental :**

- I. Determination of molecular weight of polystyrene / polyvinyl alcohol by viscosity measurement
- II. Determination of radius of glycerol / sucrose molecule by viscosity measurement.
- III. Determination of molecular weight of an organic liquid by steam distillation.
- IV. Determine the vapour pressure of chlorobenzene by steam distillation.
- V. To determine the molecular weight of non-volatile solute by Landsberger's method.
- VI. To determine the mol wt of a given non volatile solute by depression in freezing point.

## REFERENCES

1. **Advanced Practical Physical Chemistry** J.B.Yadav (Goel publishing House Meerut)
2. **Systematic experimental Physical Chemistry** Rajboj & Chondekar (Anjali publication).
3. **Practical Chemistry** Dr.C.M. Bhavsar (Nirali Prakashan)
4. **Experimental Physical Chemistry** R.C. Das & B. Behra (Tata Mc Graw Hill)
5. **Experiments in Physical Chemistry** Wilson, New Combe, Denaro Pergamon Press Rickett.
6. **Findlay's Practical Physical Chemistry**. Revised by J A.Kitchener and B.P.Lavit.

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## SCHEME FOR PRACTICAL EXAMINATION:

Q.1 Experiment I:	40 marks
Q.2 Experiment II :	40 marks
Q.3 Oral:	10 marks
Q.4 Journal:	10 marks

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100 marks

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## PAPER-VIII: INORGANIC CHEMISTRY PRACTICALS

### 1. Inorganic Qualitative Analysis:

Separation of binary mixture containing two basic and two acidic radicals ( excluding phosphate and borate ). At least six mixtures.

### 2. Gravimetric Estimations (Any two ).

- I. Iron as  $\text{Fe}_2\text{O}_3$ .
- II. Lead as  $\text{PbCrO}_4$ .
- III. Zinc as  $\text{Zn}_2\text{P}_2\text{O}_7$ .
- IV. Sn as  $\text{SnO}_2$  by using cuferron.

### 3. Volumetric Estimations : (Any two )

- I. Chloride by Volhard's method.
- II. Manganese by Volhard's method
- III. Carbonate and Hydroxide from the mixture.
- IV. Determination of boric acid and borax.

### 4. Alloy / Ore Analysis( Any two)

- I. Copper volumetrically from brass.
- II. Antimony volumetrically from type metal.
- III. Lead volumetrically from solder alloy
- IV. Aluminium gravimetrically from bauxite.

### 5. Colorimetric Analysis( Any two)

- I. Titanium by using  $\text{H}_2\text{O}_2$
- II. Fe (III) in solution by photometric titration with EDTA .
- III. Cobalt using R-nitroso salt .
- IV. Nickel as Ni-DMG complex .

### 6. Preparation and its purity determination (Any two)

- I. Ferric ammonium sulphate .
- II. Sodium trioxalato ferrate (III)
- III. Chloropentamine Co (III ) chloride

### 7. Paper chromatography (Any two mixtures)

Separation and identification of binary mixture of cations.  
(  $\text{Fe}^{3+}$  ,  $\text{Co}^{2+}$  ,  $\text{Ni}^{2+}$  ,  $\text{Cu}^{2+}$  )

## REFERENCES:

1. Quantitative Inorganic Analysis, A. I. Vogel, 4<sup>th</sup> edition
2. Advanced Practical Inorganic chemistry Gurdeep Raj, Goel Publishing House, Meerut.

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## SCHEME OF MARKING FOR PRACTICAL EXAMINATION

Q.1	Inorganic Qualitative OR Gravimetric Analysis OR Ore Analysis	..... 35 Marks
Q.2	Volumetric Analysis OR Alloy Analysis OR Preparation and its purity.	..... 25 Marks.
Q.3	Colorimetric Analysis OR Paper Chromatography	..... 20 Marks.
Q.4	Oral	..... 10 Marks
Q.5	Journal	..... 10 Marks
		----- 100 marks

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## PAPER- IX: ORGANIC CHEMISTRY PRACTICALS

### A. Qualitative Analysis of binary mixtures (Minimum 8 mixtures)

- i) Solid – Solid mixtures (04)
- ii) Solid – Liquid mixtures (02)
- iii) Liquid – Liquid mixture (02)
- iv) At least one mixture from each of the following:

Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral-Neutral.

(Name and structure of the compound is not expected)

No ether separation. Solid-Solid mixture should not be included for Neutral-Neutral type. Nitro phenols should not be given in the mixture.

### B. Estimations of ( any two )

- i) Amide by hydrolysis
- ii) Ester by hydrolysis
- iii) Sugar by alkaline Cu reagent

### C. Determination of ( any two )

- i) Saponification value of an oil
- ii) Molecular weight of mono basic/dibasic acid by volumetric method
- iii) Iodine value of an oil.

### D. Single stage preparation (any four)

- i) Acetanilide to p-nitro acetanilide
- ii) Acetanilide to p-bromo acetanilide
- iii) Aniline to sudan-I
- iv) Hydroquinone to quinone
- v) m-dinitrobenzenes to m-Nitro aniline.
- vi) Salicylic acid to Aspirin

### E. Isolation of ( any two )

- i) Caffeine from tea leaves
- ii) Casein from milk
- iii) Starch from potatoes

## REFERENCES :

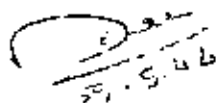
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2. Laboratory Manual of organic chemistry, second edition R.K.Bansal
3. Laboratory manual of biochemistry J.Jayaraman, Wiley Eastern
4. Introduction to practical Biochemistry David Plummer
5. Hand book of food analysis Mahendra 1987, Meerut

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## SCHEME OF MARKING FOR PRACTICAL EXAMINATION

Q.1 Separation of binary mixture	: 30 marks
Q.2 Estimation of amide/ester/cane sugar OR	
Q.2 Determination of sap value/molecular weight of acid/Iodine value	: 20 marks
Q.3 Single stage preparation OR	
Q.3. Isolation of caffeine / casein starch	: 20 marks
Q.4. Oral	: 10 marks
Q.5. Journal (compulsory):	: 10 marks
Q 6. Industrial visit report:	: 10 marks
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Total	100 marks

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