TEACHERS' RECRUITMENT BOARD, TRIPURA (TRBT)
EDUCATION (SCHOOL) DEPARTMENT, GOVT. OF TRIPURA
SYLLABUS: CHEMISTRY (MCQs OF 150 MARKS)
SELECTION TEST FOR POST GRADUATE TEACHER(STPGT) : 2016

1. Basic Concepts of Chemistry

- States of matter, properties of matter and its measurement, S. I system of units, Uncertainty in measurements, Dimensional analysis, Laws of Chemical Combination. Concept of elements, atoms and molecules. Atomic and Molecular masses, Mole concept, Empirical and Molecular formula Determination from percentage composition, Equivalent weight, Concept of limiting reagent, and Calculations based on Stoichiometry and Eudiometry.

2. States of Matter (Gaseous & Liquid States)

- Gaseous State: Gas laws, Ideal behaviour, Ideal gas equation, Derivation from ideal behaviour, Van der Waals equation, Significance of Van der waals constants, Liquification of Gases, Critical temperature, Postulates of kinetic theory of gases, Average kinetic energy of molecules, Molecular speeds (elementary ideal) and distribution of molecular speed. Mean free path, Heat capacity of gases, Atomicity of Molecule, Viscosity of gases and its Dependency on Temperature and Pressure.
- Liquid State: Vapour pressure, Viscosity and Surface tension (Qualitative idea only, No mathematical derivations) and Dependency on Temperature and Pressure. Liquid Crystal.

3. Solid State

- Classification of Solids based on Different Bindings Forces : Molecular, Ionic, Covalent and Metallic solids, Amorphous and Crystalline Solids (elementary idea), Laws of Crystallography. Unit cell in two dimensional and three dimensional Lattices, Different crystal system, Braggs equation, Number of atoms per unit cell in different types of Cubic unit cell, Packing efficiency, Calculation of Density of unit cell, Voids, Different types of Point Defects, Electrical and Magnetic properties of Solids. Band theory of Metals Conductors, Semiconductors, Insulators, n & p type semiconductors and Superconductors.

4. Thermodynamics

- Concepts of System, Types of systems, Surroundings, Work, heat, energy, Different types of Process, Extensive and Intensive properties, State functions. First law of Thermodynamics and its Mathematical form in different condition. Expression of Work done in Reversible and Irreversible Process during Isothermal and Adiabatic change. Thermodynamic relation of Heat capacities of gases. Joule Thompson cooling experiment.
- Internal energy change (ΔU) and enthalpy change (ΔH), Hess's law of constant heat Summation, Enthalpy of bond dissociation, Combustion, Formation, Atomization, Sublimation, Phase transformation, Neutralization, Ionization, and Solution.
- Limitations of first law of Thermodynamics, Second laws of Thermodynamics. Introduction of entropy as a state function, Gibbs-Helmholtz equation, Gibbs energy change for spontaneous and nonspontaneous processes, criteria for equilibrium and Spontaneity. Calculations related to change in Entropy, change in Gibbs free energy Third laws of Thermodynamics. Application of Thermodynamics.

5. Equilibrium

- Chemical Equilibrium-Equilibrium in physical and chemical processes, dynamic nature of equilibrium, Law of mass action, Different forms of equilibrium constant and their interrelat ionship. Factors affecting equilibrium and equilibrium constant. Le Chatelier's principle and its applications. Vant Hoff's equation.
- Ionic equilibrium - Ionization of acids and bases, Strong and Weak electrolytes, degree of ionization, Ostwald dilution Law, Ionization of polybasic acids, acid strength, concept of pH, Henderson Equation, Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples).Calculation of pH of different types of solution. Concepts of acid base indicator, Choice of Indicators.

6. Electrochemistry

- Conductance in electrolytic solutions- Electrolysis and laws of electrolysis (elementary idea), Transport number, Ionic mobility, Conductivity, Specific and Molar Conductance, variations of conductivity with concentration, Debye-Huckel Limitting law, Ionic Strength, Kohlrausch's Law, Application of Conductance measurement. Electrochemical cell – Electrolytic cells and Galvanic cells; EMF of a cell, Standard electrode potential, standard Electrodes, Nernst equation and its application to chemical cells, Thermodynamics of electrochemical cells, Application of emf measurement to calculate pH, change in Gibbs free energy, enthalpy change, reaction quotient. Fuel cells, Different types of storage cell (Constitution and Charging/Discharging reaction), Corrosion.

7. Chemical kinetics

- Rate of reaction (average and instantaneous), Factors affecting rates of reaction; Order and Molecularity of a reaction; Rate law and specific rate constant, integrated rate equations, Calculation of Rate constant and Half-life period for Zero order, First order and Second order reactions. Calculation of Order of reaction by different methods, concept of Collision theory (elementary idea, no mathematical treatment), Activation energy, Arrhenius equation, and its application.

8. Solution

- Type of solution, Ideal and non ideal solution, Henry's law for solubility of a gas in liquid, mode of expressing strength of solution- Molarity, Normality, Molality, Mole Fraction and Percentage strength, Type of properties- extensive, intensive, additive, constitutive and colligative. Rault's law related to colligative properties – Relative Lowering of Vapour pressure, Elevation of Boiling point, Depression of freezing point. Laws of Osmotic pressure, Determination of molecular masses using colligative properties. Abnormal molecular mass, van't Hoff factor and relationship with degree of dissociation / association. Analogy between ideal gas and dilute solution.

9. Surface Chemistry and Catalysis

- Adsorption: Adsorption; types adsorption-Physical & Chemical Adsorption; Freundlich and Langmuir isotherms , . Application of Adsorption phenomenon in nature and industry.
- Colloids: Types of Colloids, Preparation and purification of colloids, Lyophilic & Lyophobic Colloids, Properties of colloids – physical, mechanical (Brownian

motion),optical (Tyndal effect), electrical & Sedimentation, stability of colloids,(Zeta potential); Hurdy – Schulze rule, Electro kinetic Phenomena, Micelles, Emulsion and Gel.

- Catalysis: Criteria of Catalyst, Classification of Catalyst promoters, catalyst poison, theories of catalysis, applications of catalysts in the manufacture ammonia, nitric acid and sulphuric acid, acid -base catalysis and enzyme catalysis.

10. Polymers

- Definition, types of Macromolecules, Degree of Polymerization, Number-average and Weight-average molar mass, Classification of Polymers, Methods of polymerization (addition and condensation), copolymerization. Some important Polymers - natural and synthetic like polythene, nylon, polyesters, bakelite, Synthetic and natural rubber and vulcanization, Poly dispersity index (PDI). Bio-degradable polymers like PHBV.

11. Structure of Atom

- Discovery of electron, proton and neutron. Black body radiation, Photo electric effect, Planck`s quantum theory, Rutherford's model and its limitations. Bohr's atomic model, its application and limitations, Introduction to Sommerfeld Theory, Dual nature of matter and light. De Broglie's relationship., Wave-particle duality, Heisenberg Uncertainty principle, Schrodinger wave equation, Wave mechanical interpretation of orbital, Probability distribution curves, Shapes of s, p, d and f orbitals (qualitative)concept of orbitals, quantum numbers, shapes of s, p, and d orbital's, rules for filling Electrons in Orbital's - Aufbau principle, Pauli exclusion principle and Hund's rule, Electronic configuration of atoms/ions and determination of Magnetic property, stability of half filled and completely filled orbitals.

12. Classification of Elements and Periodicity in Properties

- Significance of Classification, Brief History of the Development of periodic table. Modern Periodic law and the Modern form of periodic table, Periodic trends in properties of elements-Atomic radii, Ionic radii. Atomic size and volume, Ionization enthalpy, Electron gain enthalpy, Electro negativity, Valence, Oxidizing reducing property. Long form of Periodic Table, Nomenclature of elements with atomic number greater than 100.

13. Chemical Bonding and Molecular Structure

- Valence electrons, Ionic bond, Lattice energy, Bond parameters, Covalent bond: Born Haber Cycle. Lewis structure, Polar character of covalent bond, Covalent character of ionic-bond, Valence bond theory, Resonance, Geometry of covalent molecules, VSEPR theory, Concept of Hybridization involving s, p, and d orbitals, Shapes of some simple molecules, Dipole moment, Molecular Orbital Theory of Homonuclear diatomic molecules and Hydrogen bond.

14. Oxidation & Reduction

- Concept of Oxidation and Reduction, Redox reactions, oxidation number, Balancing Redox reactions in terms of loss and gain of electrons and change in Oxidation number. Redox potential and its application.

15. Hydroge

- Position of Hydrogen in Periodic Table, Occurrence, Isotopes, Preparation of hydrogen, On small and Commercial scale, Hydrides, Water, Hard and Soft water, Heavy water, Hydrogen Peroxide, Hydrogen economy, Hydrogen as a fuel.

16. General principles and processes of isolation of elements

- Principles and Methods of extraction, oxidation and reduction as applied to the Extraction procedures of Na, Ca, Al, Cu, Zn and Fe.

17. s – Block Elements

- General introduction – Electronic configuration, Occurrence, Anomalous properties of the first element of each group, diagonal relationship, Trends in variation of the properties, reaction of alkali and alkaline earth metals. Preparation and Properties and uses of some important compounds: - Sodium Carbonate, Sodium Bicarbonate, Sodium Chloride, Sodium Hydroxide, Calcium Hydroxide and Calcium Carbonate, Industrial Uses of Lime and Lime Stone, Biological importance of Sodium, Potassium, Magnesium and Calcium.

18. p – Block Elements

- Electronic configuration, Variation in physical and chemical properties of groups 13 to 18, Preparation, Properties and Uses of Borax, Boric acid, Boron hydride, Silicones, Preparation, Properties and Uses of Nitrogen, Ammonia, Nitric acid and Oxides of nitrogen, Phosphorus – Allotropic forms, Preparation and Properties of Phosphine, Phosphorus Pentachloride and Phosphorus Trichloride, Preparation, Properties and uses of Oxygen and Ozone, Allotropic Forms of Sulphurtheir Preparation, Preparation, Properties and Uses of Sulphur dioxide, Industrial Preparation of Oxo-Acids of Sulphur, Preparation and Properties of Halogen and Halogen acids, Inter Halogen Compounds, Pseudohalide ions. Oxo-Acids of Halogens, Their Structure and Nature, Preparation, Properties and uses of Xenon Fluorides, Oxides of Xenon And Xenon oxo fluorides.

19. The d – and f- Block Elements

- General Introduction, Electronic configuration and General trend in the Properties of Transition metals like Metallic character, Ionization enthalpy, Oxidation states, Ionic radii, Origin of colour in their compounds, Catalytic properties, Magnetic properties, complex compound formation . Preparation, properties and structures of KMnO4 and K2Cr2 O7,Lanthanoids and Actinoids- General introduction, electronic configuration and oxidation states. Uses of f-block elements.

20. Co-ordination Compounds and Organometallics

- Meaning of Co-ordination compounds, Werner's theory, ligands – their types, IUPAC Nomenclature of Co- ordination Compounds, Isomerism, Bonding in co-ordination compounds, Valence bond theory, Crystal field theory, Origin of colour, Magnetic properties and, Stabilities of Co-ordination compounds. Chemical and biological importance of co-ordination compounds, Metal complexes of π-acids ligands: Carbonyls, Nitrosyls and Cyanides, metal (mono) olefins-Zeise's salt; Metallocenes; Ferrocene.

21. Basic concepts in Organic chemistry

- General introduction, methods of qualitative and quantitative analysis, Hybridization of organic compounds, Bond lengths , Bond angles , Bond energy , Bond polarity, Bond Polarizability, Formation of σ and π bonds, Localized and delocalized chemical bonds, Van der Waals interaction, Resonance, Tautomerism, Steric inhibitio n of resonance, Hyperconjugation, Inductive effect , H-bonding, Dipole moment- bond moment and group moment , physical properties(mp, bp, solubility) related to molecular structures. Strength of organic acids and bases. Elementary idea of the applications of UV, IR and H-NMR spectroscopy for simple Organic molecules.

22. General Organic Reaction Mechanism with Important Reagents

- Homolytic and Heterolyt ic fission of a covalent bond: Free radicals, Carbocations, Carbanions; Electrophiles and Nucleophiles, types of Organic reactions. Nucleophilic substitution reactions - S_N^1, S_N^2, S_N^1; and for aromatic system (S_E^2) Elimination reactions - α and β –eliminations, *syn* - and anti-elimination, E_1, E_2 and E_{1cb}– mechanism. Activation energy, Transition state, Reaction intermediates, Energy profile diagrams involving two transition states. Idea of a reversibility of a reaction, kinetically and thermodynamically controlled products.

Important Reagents

- General methods of Preparation, Properties, Reactions, Structure and Synthetic used of Grignard reagents; preparation of uses of Li and Zn alkyls. Uses of Lindlars catalyst, NBS, OsO_4, SeO_2, H_5IO_6, $LiAlH_4$. $NaBH_4$, $(CH_3COO)_4Pb$, C_6H_5COOOH, Fenton`s Reagent, and Raney Nickel.

23. Stereochemistry

- Types of Stereoisomers - Configurational and Conformational isomerism, Enantiomers and Diastereomers, Geometrical and Pi-diastereomers and their Nomenclatures, difference in chemical and physical properties of pi-diastereomers,elements of symmetry, Optical isomers, chirality, asymmetry, dissymmetry, R/S and D/L notations of Optical isomers, Raceimic mixture and Resolution of Racemic modifications. Substituted allens. Walden inversion, Mutarotation, Asymmetric synthesis, Epimerisation; Elementary idea of sterospecific and stereosclective reactions.
- Conformation, Conformational nomenclature ; eclipsed , staggered , gauche and anti ; dihedral angle, energy barrier of rotation , relative stability of conformers on the basis of steric effects, conformational analysis of ethane, n-butane, cyclohexane andmonosubstituted cyclohexanes; chair and boat forms of cyclohexane, stability of cycloalkanes-strains in rings, angle strain and torsional strain , Baeyer strain theory and its limitations.

24. Hydrocarbon

- Alkane–Nomenclature, Preparation, Isomerism, Physical properties, Chemical reactions including halogenation, Free radical mechanism, Combustion and P yrolysis.
- Alkenes- Nomemclature, Physical properties, Methods of preparation; Chemical reactions : Addition of hydrogen, Halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), Ozonolysis, Hydroboration oxidation, Oxymercuration-Demercuration, Oxidation, mechanism of electrophilic addition.

- Alkadienes-Classification of dienes, Preparation of Conjugated Dienes, Chemical Properties (1,2 and 1,4- addition to conjugated dienes).
- Alkynes – Nomenclature, structure of triple bond (Ethyne), physical propert ies. Methods of preparation, Chemical reactions, Acidic character of alkynes, Addition reaction of-hydrogen, Halogens hydrogen halides and water.
- Aromatic hydrocarbons: Introduction, IUPAC nomenclature, Resonance, Aromaticity, Preparation of Benzene , Toluene & chemical properties: mechanism of Electrophilic substitution- Nitration Sulphonation, Halogenation, Friedel Craft's alkylation and acylation, Gatterman –koch synthesis ,Gatterman aldehyde synthesis, carcinogenicity and toxicity.

25. Haloalkanes and Haloarenes

- Haloalknes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions. Hunsdicker synthesis, Haloform Reaction.Haloarenes : Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only. Ullmann Reacton. Use and environmental effects of- Dichloromethane, Trichloromethane, Tetrachloromethane, Iodoform, Freons, DDT.

26. Oxygen containing Organic compounds

- Alcohols : Nomenclature, Methods of preparation, Physical and Chemical properties (primary alcohols only) , Identification of primary, secondary and tertiary alcohols; Mechanism of dehydration, Uses of methanol and ethanol.
- Phenol : Nomenclature, Methods of preparation, Physical and chemical properties, Acidic nature of Phenols, Elctrophillic substitution reaction, Reimer Tiemann reaction Kolbe Schmidt reaction, Fries rearrangement, Uses of Phenols.
- Ether : Nomenclature, Methods of preparation, physical and chemical properties, Williamson synthesis, Claisen Rearrengement, uses.
- Aldehydes and Ketones (aliphatic and aromatic): Nomenclature, nature of Carbonyl group, Methods of preparation, Physical and Chemical properties and mechanism of nucleophilic addition, Reactivity of alpha hydrogen in aldehydes & ketones special reference to Aldol condensation; Cannizero Reaction, MPV reduction, Rosenmund Reduction, Stephen Reduction, Clemmensen Reduction, Wolf Kishner reduction, Reformatsky reaction, Perkin Reaction, Knoevenagel Reaction, Tischenko Reaction, Baeyer-villiger Oxidation; Pinacol-Pinacolone rearrangement, uses.
- Carboxylic Acids (aliphatic and aromatic): Nomenclature, acidic nature, methods of preparation, physical and chemical properties; Arndt Eistert Recation. HVZ Reaction, Schmidt Reaction, uses.

27. Organic compounds containing Nitrogen

- Nitro Compounds: General methods of preparation and Chemical reactions. Amines : Nomenclature, Classification, Structure, methods of preparation, physical and chemical properties, Gabriel Phthalimide Synthesis,Lossen Rearrengement, Curtius Reaction,Diazo Reaction, uses, identification of primary, secondary and tertiary amines.
- Cyanides and Isocyanides: Preparation, Properties and Distinction. Diazonium salts: Preparation, Chemical reactions and importance in synthetic organic chemistry.

28. Biomolecules

- Carbohydrates: Classification of carbohydrates ,Structural determination of glucose and fructose on the basis of their chemical properties, Open chain (Fischer) structure, cyclic structure(Haworth form), α and β forms of glucose, Mutarotation, anomers and epimers, Chemical reactions of glucose, Reducing and non-reducing sugars, Configuration of glucose and fructose. Disaccharides Sucrose, Haworth representation of disaccharides, Polysaccharides, Starch, Cellulose, and Amylopectin structures, Functions of Carbohydrates in living organisms.
- Proteins: Amino acids, Zwitter ion, Iso -electric point, Peptides and peptide bond, Fibrous proteins, Globular proteins and their functions, Primary, Secondary(Helix and pleated sheet structures) and tertiary structure of proteins, Denaturation and Renaturation, Enzymes, specificity and mechanism of enzyme activity , coenzymes, applications of enzymes.
- Nucleic acids : Nucleosides, Nucleotides, Structure of ATP, Primary and Secondary structure of DNA(Double Helix structure) , Biological functions of nucleic acids, Vitamins, Classification, Diseases caused by the deficiency of vitamins, Hormones (steroid hormones and non-steroid hormones) and their functions.

29. Chemistry in Everyday life

- Drug, Classification of drugs, Enzymes as drug targets, Action of drug through drug receptor interaction, Types of drugs: Antipyretics, Analgesics, Antiseptics, Disinfectants, Tranquilizers, Antimicrobials, Antibiotics(Narrow spectrum and broad spectrum antibiotics), Antifertility drugs, Antihistmmines, Antacids. Chemicals in food, Food preservatives, artificia l sweetening agents, Soaps and Detergents, Preparation soaps(Saponification) and detergents, Cleansing action of soaps, Advantages of detergents over soaps, Deodorants, Edible colours, Antioxidants.

30. Environmental Chemistry

- Environmental pollution, Atmospheric pollution, Tropospheric pollution(Air pollution), Major air pollutants, Control of air pollution, Smog(Chemical and Photochemical smog), Stratospheric pollution: Ozone layer and its depletion, Acid rain, Green House Effect and Global warming, Water pollution, Soil pollution and Industrial waste.

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