DETAILED SYLLABUS FOR THE POST OF SANITARY CHEMIST IN KERALA WATER AUTHORITY - DIRECT RECRUITMENT

(Cat.No. : 127/2023)

Chemistry

1. **Chemistry in everyday life** **(10 marks)**
    - Household materials- soap, detergent, cooking gas, hair dye, cosmetics, moth balls, toothpaste and shampoo
    - Food industry- Additives, Preservatives, Artificial sweeteners- Adulterants
    - Fertilisers- Urea, NPK and super phosphate- Pesticides
    - Paints and pigments- White pigments (white lead, ZnO, Lithopone, TiO2)- Blue, red, yellow and green pigments-Paints and distempers
    - Polymers-Natural and synthetic polymers-Types of plastics-Problems of plastic waste management
2. **Chemistry of Water** **(10 marks)**
    - Water- Chemical structure and bonding- Hydrogen bonding and its consequences-Polarity
    - Properties of water-Pure water, fresh water and sea water-Hardness of water-Water softening-Heavy water
    - Water Pollution- Causes, Treatment of industrial waste water- Reverse osmosis and electrodialysis-Management and control of water pollution
    - Water analysis- pH, temperature, specific conductance, turbidity, salinity, chlorinity, Dissolved Oxygen, Total hardness
    - Water Quality- Definition, Physicochemical and biological parameters of water-Water quality standards-BIS, WHO, USEPA
3. **Qualitative and Quantitative aspects of Chemistry** **(10 marks)**
    - Lab safety awareness- Labels, material safety-Hazard warning symbols-Explosive compounds, Flammable solvents-Emergency procedures in chemical splashes, burns and electric shock
    - Preparation of solutions- Normal, Molar, Molal and percentage solutions
    - Inorganic qualitative analysis-Principle of analysis of cations and anions-Solubility product, common ion effect

- Quantitative analysis- Theory of titrations-Acid-base, redox, precipitation, conductometry, potentiometry
- Theory of indicators-Acid-base, redox, adsorption and metallochromic indicators-Choice of indicator

4. Physical Chemistry (10 marks)

- Acid-base chemistry- Arrhenius, Lowry Bronsted and Lewis concepts-Introduction to SHAB principle
- Solutions-Colligative properties, Osmotic pressure, Calculation of molar mass of solutes
- Ionic equilibria- Strong and weak electrolytes, degree of dissociation, ionic product of water, Dissociation constant of weak acids
- Chemical thermodynamics-Concept of heat, work, internal energy, enthalpy, entropy and free energy
- Chemical kinetics-Order and molecularity of reaction, rate laws-factors affecting rate of reactions-Collision theory

Biochemistry

5. **Foundations of Life (10 marks)**

- Water-Unique properties that support life, Hydrogen bonding, Ionization of water
- Molecules of life- Importance of carbon, Basic idea about the classification and important properties of carbohydrates, proteins, lipids and nucleic acids, Stabilizing interactions in biological macromolecules
- Colloids- Classification and properties, Application of colloids in daily life, Coagulation, Dialysis-Donnan Membrane Equilibrium, Emulsions-types and biological applications, Emulsifying agents
- Biophysical chemistry-Laws of thermodynamics, concept of free energy and spontaneity, Ka, pH and pKa-High energy compounds and coupled reactions-Biological buffers-Henderson Hasselbalch equation
- Cell biology-Basic idea about the structure and functions of cell membrane, mitochondria, Golgi bodies, Endoplasmic reticulum, nucleus and lysosome

6. **Biochemical Techniques (10 marks)**

- Photometry-Electromagnetic Spectrum- Principle of light absorbing molecules-Beer Lambert's law-Principle and working of Colorimeter and Spectrophotometer-Applications of Colorimetry and Spectrophotometry

- Chromatography- Partition, Adsorption- Thin Layer Chromatography, Column Chromatography, Gel filtration, Affinity Chromatography, HPLC, Gas Chromatography-Rf value
- Electrophoresis- Protein and Nucleic acid separation-Agarose, PAGE, SDS-PAGE-Staining and visualisation techniques
- Centrifugation- Principle and factors affecting sedimentation- Types of rotors-Preparative centrifugation(Differential, Sub-cellular, Density gradient)-Analytical centrifugation (ultracentrifugation)
- Radioactivity-Units of radioactivity-Measurement of radioactivity-GM Counter and Scintillation Counter-Autoradiography- Applications of radioisotopes in biological sciences-Radiation hazards-Safe handling of radioactive materials

7. **Enzymology** **(10 marks)**

- Enzymes- Classification, Nomenclature, Active site, Mechanism of action, coenzymes
- Enzyme kinetics-Factors affecting rate of enzyme catalysed reactions, Km, Vmax, Michaelis Menten equation, Lineweaver Burk Plot
- Enzyme inhibition-Competitive, Noncompetitive and Uncompetitive inhibition
- Enzyme regulation-Covalent modification-Allosteric enzymes-kinetics, cooperativity-Multienzyme complex
- Enzyme technology- Industrial, therapeutic and diagnostic applications of enzymes-Immobilized enzymes-Abzymes

Microbiology

8**. Fundamentals of Microbiology** **(10 marks)**

- Microscopy- Principle and types
- Sterilisation- Physical and Chemical methods
- Culture media-Types of media- solid, liquid, semisolid, synthetic, complex, enriched, enrichment, differential, selective
- Culture methods- Pour plate, spread plate, streak plate, Anaerobic culture methods-GasPak jar, McIntosh and Fildesjar
- Staining methods- Simple, Gram staining, Acid fast staining, Negative staining, Spore staining

9. **Microbial testing of Water** **(10 marks)**

- Sampling of water

- Bacteriological examination of water-Presumptive, confirmed and completed coliform tests
- Indicator organisms
- Sewage treatment- primary, secondary and tertiary
- Methods of disinfection for onsite waste water treatment

10. **Environmental Microbiology** **(10 marks)**

- Solid waste management- Composting
- Bioremediation- Pesticides, detergents, Petroleum and Hydrocarbon contamination
- Biofertilisers-Production and application of Rhizobium, Azospiryllum, Azobacter
- Symbiotic Nitrogen Fixation
- Biogeochemical cycles

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.

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