

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF JUNIOR CHEMIST FOR GROUND WATER DEPARTMENT

1. Chemical Bonding – Valence Bond Theory and its limitations; various types of hybridization; Bent Rule and energies of hybridization, and shapes of simple inorganic molecules and ions; VSEPR theory of NH_3 , H_3O^+ , SF_4 , H_2O , SnCl_2 , ClF_3 , XeO_4 , ICl_2^- ; Molecular Orbital Theory of homonuclear and heteronuclear diatomic molecules; Multicentered bonding in electron deficient compounds; Hydrogen Bonding and van der Waals forces.
2. Werner's Theory; Valence Bond Theory and Crystal Field Theory to explain bonding in transition metal complexes, magnetism, geometry, spectral behaviour and colour of coordination complexes; Limitations of CFT, Molecular Orbital Theory (tetrahedral, octahedral and square planar complexes and π -bonding complexes); Charge transfer spectra; Spin free and spin paired complexes; Stereochemistry of different coordination numbers.
3. Special characteristics & Types of inorganic polymers; Application of silicones, silicates, zeolites, ceramics and ceramic glasses. Diborane and higher boranes, borazines, carboranes, fluorocarbons; Metal clusters: metalloboranes and metallocarboranes.
Nanomaterials: Introduction, preparations and characteristic properties; Quantum dots (QDs), Carbon Nanotubes (CNTs), Graphene, Fullerenes.
4. Definition, classification, preparations, properties, structure and applications of organometallic compounds of Lithium, Magnesium, Mercury, Iron, Rhodium and Tin; Preparation, properties and nature of bond in Metal Carbonyls and Nitrosyls.
5. Arrhenius, Bronsted-Lowary and Lewis Concepts of acids and bases, Theory of Hard and Soft Acids and Bases and its applications.
Physical properties of solvent, types of solvents and their general characteristic; Reactions in non-aqueous solvents with reference to liquid NH_3 , HF and liquid SO_2 .
6. Radiochemical analysis: Introduction of nuclides, isotopes, isobars, isotone, natural and artificial radioactivity, half-life, average life, artificial transmutation, nuclear reactions, nuclear fission and fusion. Applications of radioisotopes; Neutron Activation Analysis (NAA), Radio Immune Assay (RIA).
7. Electrochemical cell and Ion Selective Electrodes; Voltammetric cell and Cyclic Voltammetry; Chemical sensors and biosensors; Modern theories of corrosion, Thermodynamics and stability of metals; Types of corrosion and prevention; Green Inhibitors.

8. Chemical Statistics: Mean, Median, Accuracy, Precision, Standard Deviation, Relative Standard Deviation; Errors, Types of Errors: Determinate and Indeterminate; Statistical evaluation of data: Calibration Curve, Standard Addition Method, Correlation Coefficient, Linear Regression Analysis (LRA), Analysis of Variance (ANOVA).
9. Principle and process of solvent extraction, Distribution Law, Partition Coefficient, Batch Extraction, Continuous Extraction and Counter Current Extraction.
Applications of solvent extraction for determination of ion using organic reagents: Oxine for Iron, Acetylacetone for Beryllium, Diethyldithiocarbamate for Copper, Dithizone for Lead.
10. Principle, Instrumentation and Applications of-
 - (i) Thin layer chromatography (TLC); (ii) Paper chromatography; (iii) Ion Exchange Chromatography; (iv) Gas Chromatography (GC) and GC-MS; (v) High Performance Liquid Chromatography (HPLC); (vi) Ion Chromatography (IC).
11. Water pollutants: classification, their effects and control; Sampling of water; Sources of water pollution, water quality parameters hardness, alkalinity, turbidity, DO, BOD, COD, TDS, metals, content of chloride, sulphate, nitrate, silicates and Microorganisms; water quality standards and their analysis; Nanotechnology for water purification.
Heavy metal pollution; Instrumental technique of analysis of heavy metals in aqueous systems, pesticides as water pollutants; Purification and treatment of water; Water pollution laws and standards.
12. Sources, detrimental effects and control of soil and air pollutions; Fertility management of soils; Soil sediment analysis- physical and chemical analysis of soil pollution. Green House effect, acid rain, ozone hole phenomenon and thermal inversion.
13. Analysis of major and minor components of food, common adulterants in food, microscopic examination of foods for adulteration, pesticides analysis in food products.
Analysis of Water for Pesticides, Volatile Organic Compounds (VOCs) and Endocrine Disrupters (ECDs).
14. Basic principles, Instrumentation and applications in identification of compounds by: UV-visible spectroscopy; IR spectroscopy; NMR spectroscopy; Mass spectroscopy; Differential Scanning Calorimetry (DSC); Particle Size Analysis by Dynamic Light Scattering (DLS).
15. Principle, instrumentation and applications of:
 - (i) Atomic Absorption Spectroscopy (AAS); (ii) X-ray Diffraction Technique; (iii) Thermal Techniques: Thermogravimetric Analysis (TGA); and Differential thermal Analysis (DTA).

16. Basic knowledge of computer systems (CPU and other peripheral devices – input/output/auxiliary storage devices); software, opening system and programming language e.g. Machine language, assembly language and higher-level languages. Data processing, principles and programming, flow-charts.

17. Introduction of photochemical reactions, types of excitations; fate of excited molecules, quantum yield, transfer of excitation energy.

Green and sustainable chemistry: Principles of green chemistry with their explanations and examples; Green technology and applications to reduce environmental pollution.

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Scheme of examination and syllabus for the post of Junior Chemist				
S. No.	Subject	No. of Questions	Total Marks	Examination Duration
1.	Concerned Subject* (as prescribed in qualification)	150	150	2.30 hours
	Total	150	150	

1. The competitive examination shall carry 150 marks and 150 questions of Multiple Choice Type questions.

2. There shall be one paper. Duration of Paper will be Two hours and Thirty Minutes.

3. Negative marking shall be applicable in the evaluation of answers. For every wrong answer one-third of the marks prescribed for that particular question shall be deducted.

Explanation: - Wrong answer shall mean an incorrect answer or multiple answers.

उक्त पद हेतु आयोजित की जाने वाली परीक्षा के लिए ओ.एम.आर. उत्तरपत्रक में प्रश्नों के विकल्प भरने के संबंध में विशेष निर्देश:-

1. Each question has five options marked as 1, 2, 3, 4, 5. You have to darken only one circle (bubble) indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.

2. It is mandatory to fill one option for each question.

3. If you are not attempting a question then you have to darken the circle '5'. If none of the five circles is darkened, one third (1/3) part of the marks of question shall be deducted.

4. After solving question paper, candidate must ascertain that he/she has darkened one of the circles (bubbles) for each of the questions. Extra time of 10 minutes beyond scheduled time, is provided for this.

A candidate who has not darkened any of the five circles in more than 10% questions shall be disqualified.