

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER
SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST
OF SENIOR SCIENTIFIC OFFICER
DOCUMENT DIVISION (M.Sc. PHYSICS)
STATE FORENSIC SCIENCE LABORATORY (HOME
DEPARTMENT)

Unit-I

Newton's law of Motion, Frame of reference, inertial and non-inertial frames, Rotating frame of reference, Coriolis force Conservation Laws. Collisions, impact parameter, centre of mass frame, rotational motion of rigid bodies, moment of inertia, products of inertia, conservation of angular momentum. Gravitation & Central forces of motion. Special Theory of Relativity, Michelson-Morely experiment, Lorentz Transformations-addition of velocities, Time dilation and length contraction, variation of mass with velocity, mass-energy equivalence. Kepler's laws, Basic idea of Global Positioning System (GPS).

Unit-II

Oscillations, simple harmonic motion, damped harmonic motion, forced oscillation and resonance. Wave equation, harmonic solutions, plane and spherical waves, superposition of waves, beats, stationary waves Doppler's Effect, phase and group velocities. Conditions of interference, Newton's rings and Michelson's interferometer. Diffraction-Fresnel and Fraunhofer, diffraction by plain transmission grating, Rayleigh criterion, resolving power of grating and telescope.

Unit-III

Electric field and potential, Gauss's law. Poisson's and Laplace equations, dielectrics and polarization, Electromagnetic induction, transformer. Transient behaviour of R-C, and R-L, circuits, time constant. Dielectric property of matter.

Maxwell's equations and their application to plane electromagnetic wave. Polarization, Dipole moment. Vector and scalar potentials; Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics; Fresnel's relations; Total internal reflection; Normal and anomalous dispersion; Lasers, He-Ne and Ruby lasers, spatial and temporal coherence.

Unit-IV

De Broglie waves. Photo-electric effect, Compton effect, wave-particle duality, Uncertainty principle and its applications (like - size of H-atom, zero point energy, wave packet, finite width of energy levels). Schrodinger wave equation with applications for free particle potential step or particle in a one dimensional box, extension of results to three dimensional case, Hydrogen spectrum, electron spin, Stern-Gerlach experiment, Zeeman effect space-quantization, characteristic and continuous x-rays, Bohr Magneton.

Unit-V

Band theory of solids - conductors, insulators and semiconductors; Bloch Theorem, effective mass, Electric conduction in metals, Sommerfeld theory of electrical conductivity, specific heat of solids - Einstein and Debye theories. Electronic specific heat, Wiedemann Franz law, Hall effect. Magnetic properties of materials: para, diaferro, anti-ferro and ferrimagnetism. Elements of superconductivity, Meissner effect, Elementary ideas about high temperature superconductivity.

Unit-VI

Kirchhoff's law, Faraday's law, Lenz's law, Thevenin, Norton and maximum power-transfer theorems. p-n junction diode, ideal diode equation, use of diode for rectification, zener diode and its use in voltage regulation. Transistor, its biasing, common emitter amplifier. Digital electronics-Boolean identities, De Morgan's laws, logic gates and truth tables; Simple logic circuits. Ballistics Galvanometer-current & charge sensitivity.

Unit-VII

Forensic Document Examination:- Legal aspects of forensic document examination, Classification of documents; Disputed/ Specimen/ Admitted ; Care, handling, preservation of documents; Preliminary examination of case documents, Procurement of samples, Contemporaneous writing. Principle of handwriting examination; Importance of natural variations, Holographic documents. Physiology of handwriting, various writing features– terminology and definitions, class characteristics of handwriting, individual characteristics of handwriting. Nature and types of forgeries, characteristics of genuine and forged signatures, their detection, identification of line quality, artificial and natural tremor. Natural variations in hand writing, Disguised & normal writings.

Unit-VIII

Classification of Erasures: - Chemical & Physical erasures and techniques involved for their detection and decipherment, Sequence of strokes, working principle & features and applications of Video Spectral Comparators, principle and working of Electrostatic Detection apparatus and its applications. Ink examination, chemical composition of different types of inks, destructive and non-destructive techniques involved in differentiation of ink. Secret writings & their decipherment. Writing instruments, working of fountain pen, ball pen, gel pen, writing inks, Printing inks and printing toners. Viscosity, Surface tension, Capillary rise.

Unit-IX

Paper examination: - Physical comparison parameters, chemical composition, sizing & loading materials, tensile strength, comparison techniques: destructive & non-destructive. Examination of seal impressions. Facsimile document/ signature examination. Photocopy and scanned documents: process of scanning, identifying features. Charred documents: preservation and examination techniques involved.

Unit-X

Printed document examination, type-script, classification of printers: identification of printed matter. Examination of computer printouts, Concept of digital signature. Examination of security documents: Currency notes, Passport, Visa, Various identity cards, Stamp papers, travel documents. OVI ink, thermal ink, Examination of credit, debit and other plastic cards.

Unit-XI

Forensic Photography of Documents: Close-up, UV, IR, oblique, side and transmitted light photography. Portable document detector. Working principle of Raman spectrophotometer, TLC, HPTLC, Docucenter Nirvis, Cedar fox and their application, principle & working of the simple microscope, stereo-zoom microscope, comparison microscope.

Unit-XII

Computer Organization and Architecture (COA): Definition, history, types of computers, block-diagram, processor and its types; I/O devices: input devices, output devices, storage media and its types; Operating System, File Systems: definition, File Allocation Table (FAT), MS Word, MS Excel and Power Point Presentation, Basic Knowledge of Internet, Cyber security, Artificial Intelligence

DOCUMENT DIVISION (M.Sc. CHEMISTRY)

Unit I

Bohr's Theory, Atomic Structure, Wave Mechanics, de Broglie's equations, Heisenberg's uncertainty Principle, Quantum Numbers, Pauli's exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle.

Analytical Chemistry: Classification of analytical methods – Classical and Instrumental, volumetric, titrimetric and gravimetric techniques, selection of proper analytical techniques: types and range of determination, accuracy, precision and errors, sample preparation, handling of reagents with safety, density and viscosity measurements.

Unit II

Periodicity of elements s, p, d, f block elements and their nature & anomaly, ionic bond, covalent bond, H-bonds, Vander wall forces, Entropy, Enthalpy, electro negativity, Born- Haber cycle, Valence Bond Theory, Hybridization & Resonance. Noble Gases.

Analysis of unknown samples: -

Organic: Physical examination, element detection (N, S, Cl, Br, I, F), Functional Group analysis (-OH, -COOH, -NO₂, -NH₂, -CONH₂, -CO-, -CHO, Hydrocarbons)

Inorganic: Qualitative analysis of cations and anions with special reference to cations i.e. As, Sb, Pb, Ba, Cu, Hg, Zn and Tl and anions i.e. NO₂⁻, NO₃⁻, S²⁻, SO₄²⁻, SO₃²⁻, halides and cyanides.

Analysis of poisonous gases: CO, H₂S, PH₃, CH₄ and NH₃.

Unit III

Spectroscopic and other techniques: -

Unifying principles: Electromagnetic radiation, interaction of electromagnetic radiation with matter- absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.

Basic principles, instrumentation and applications: UV- Visible, FTIR, AAS, Mass, Spectroscopy, Fluorescence and Phosphorescence spectrophotometry, ESR Spectroscopy, ED-XRF.

Fundamentals of Acids, Bases and Buffers, pH, pK_a, and pK_b values, principles, instrumentation and applications of pH metry, Potentiometry, Conductometry and colorimetry. Microscopic analysis in forensic Science.

Unit IV

Chromatography and Electrophoresis: -General Principles and types of chromatographic techniques: Paper chromatography, column chromatography, Thin layer chromatography, adsorption chromatography, partition chromatography, Gas chromatography, Gas-liquid chromatography, Ion exchange chromatography,

Exclusion (permeation) chromatography, affinity chromatography, HPLC, HPTLC, Capillary Chromatography, GC-MS and Electrophoresis.

Unit V

Chemical Thermodynamics, Laws of Thermodynamics, Thermochemistry, Electrochemistry, Gibbs & Helmholtz energy, free energy, chemical equilibrium, degree of freedom, solution & colligative properties, dilute solutions, Raoult's & Henry's Laws. Coordination chemistry. Werner's theory. IUPAC. Ligand field.

Basic Organic Chemistry: Important preparations and properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, carboxylic acids, aldehydes, ketones, amines and nitro compounds.

Unit VI

Amino acids, Peptides, Proteins: Classification, Structure and Properties, Molecular weight determination, ATPs. Isoelectric point, coagulation and denaturation. Carbohydrates: Classification, Structure and Reactions. Fats and Lipids: Classification, Structure and Reactions.

Alkaloids: Classification, Isolation and Identification.

Terpenes, Bio-inorganic chemistry: - metal-ion present in biological system, Na/K pump, Toxicity of metal-ions. Chelating agents.

Unit-VII

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks: 150
3. Number of Questions: 150
4. Duration of Paper: 2.30 Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate has to choose either Physics or Chemistry