लोक सेवा आयोग

नेपाल विविध सेवा, राजपत्राङ्कित तृतीय श्रेणी, रसायन विद पदको खुला र आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

पाठ्यक्रमको रुपरेखा :– यस पाठ्यक्रमको आधारमा निम्नानुसार दुई चरणमा परीक्षा लिइने छ :

प्रथम चरण :– लिखित परीक्षा — पूर्णाङ्क :– २००

द्वितीय चरण :– सामूहिक परीक्षण र अन्तर्वार्ता — पूर्णाङ्क :– ४०

प्रथम चरण – लिखित परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या X अङ्कभार	समय
प्रथम	केमिष्ट्री	१००	४०	वस्तुगत बहुवैकल्पिक (MCQs)	१०० X १ = १००	१ घण्टा १५ मिनेट
द्वितीय		१००	४०	विषयगत (Subjective)	१० X १० = १००	३ घण्टा

द्वितीय चरण

विषय	**पूर्णाङ्क**	**परीक्षा प्रणाली**	**समय**
सामूहिक परीक्षण (Group Test)	१०	सामूहिक छलफल (Group Discussion)	३० मिनेट
व्यक्तिगत अन्तर्वार्ता	३०	मौखिक	-

१. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुन सक्नेछ ।

२. पाठ्यक्रमको प्रथम र द्वितीय पत्रको विषयवस्तु एउटै हुनेछ ।

३. प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।

४. प्रथम तथा द्वितीय पत्रका एकाईहरुको प्रश्नसंख्या निम्नानुसार हुनेछ :

प्रथम पत्रका एकाई	1	2	3	4	5
प्रश्न संख्या	20	10	20	20	30
द्वितीय पत्रका खण्ड	**A**	**B**		**C**	**D**
द्वितीय पत्रका एकाइ	1	2	3	4	5
प्रश्न संख्या	2	1	2	2	3

५. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।

६. बहुवैकल्पिक प्रश्नहरु हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।

७. विषयगत प्रश्नका लागि तोकिएका १० अङ्कका प्रश्नहरुको हकमा १० अङ्कको एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरु (Short notes) सोध्न सकिने छ ।

८. द्वितीय पत्रमा प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरु हुनेछन् । परिक्षार्थीले प्रत्येक खण्डका प्रश्नहरुको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नुपर्नेछ ।

९. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरु परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्क्रममा परेको सम्झनु पर्दछ ।

१०. यस भन्दा अगाडि लागू भएको माथि उल्लिखित समूहको पाठ्यक्रम खारेज गरिएको छ ।

११ पाठ्यक्रम लागू मिति :– २०६८/०९/१४ **(२०७२/०७/२४ को निर्णय अनुसार सामूहिक परीक्षण समावेश)**

लोक सेवा आयोग
नेपाल विविध सेवा, राजपत्राङ्कित तृतीय श्रेणी, रसायन विद पदको खुला र आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

प्रथम र द्वितीय पत्र :– केमिष्ट्री

Section A- 20 Marks

1. Physical Chemistry

1.1 **Ionic Equilibrium and Electrochemistry**: Ostwald's dilution law, pH, Buffer solution, buffer capacity and buffer range, pH change in acid base titration, theory of acid base indicator, hydrolysis of salt, Debye Huckel limiting law, activity and activity coefficient, Ionic strength, Elementary idea on electrical double layer, Emf of a cell, Nernst equation, quinhydrone electrode, ion selective electrodes and their applications, photo-electrochemical and fuel cells

1.2 **Chemical Kinetics:** Qualitative concepts of parallel, opposing and consecutive reactions, Effect of temperature and catalyst on reaction rate, concept of activation energy, collision theory and transition state theory of reaction rates, chain reaction, photochemical reaction, laws of photochemical equivalence, quantum yield, phosphorescence, fluorescence, chemiluminescence and thermoluminescence, Fast reaction, techniques to study fast reaction, Enzyme catalyzed reaction.

1.3 **Thermodynamics:** First and second law of thermodynamics, Hess's law of constant heat summation, enthalpy change from bond energy, variation of heat of reaction with temperature (Kirchoff's equation), calorific value of fuel, calorific value of food. Molar heat capacities, adiabatic expansion of an ideal gas for reversible and irreversible expansion, Carnot cycle, thermodynamic efficiency, entropy and its mathematical derivation, entropy changes, irreversible process, relation between enthalpy and entropy changes, Gibbs-Helmhotz equation, free energy and work function and their significance, criteria of spontaneity.

1.4 **Solid state chemistry:** Seven crystal system and fourteen Bravais lattice, Bragg's law, Crystal structure of sodium chloride, Lattice energy of ionic solid, success and limitation of classical free electron theory of metal, point defects: Frenkel and Schottky defects.

1.5 **Surface and Colloid Chemistry:** Physical adsorption and chemical adsorption, adsorption isotherms, Freundlich isotherms, derivation of Langmuir adsorption isotherms, cleansing action of soap and detergents, emulsion and gels, solution of macromolecules, colloidal state of matter, preparation and purification of colloids, brief discussion of kinetic, optical and electrical properties of colloids.

Section B- 30 Marks

2. Inorganic chemistry 10%

2.1 **General concept of the followings:** Electro negativity, choice of electro negativity system, group electronegativity, electron affinity, anomalous electron affinity, ionization energy, Intrinsic and mean bond energy. Metallic bonding, Buck minister fullerene, Noble gas compounds, Non aqueous solvents, Protic and non-protic solvents, NH_3 and SO_2 as non-aqueous solvent.

2.2 Molecular orbital theory: concept of molecular orbital, LCAO approximation, MOT vs VBT

2.3 **Bonding and applications of coordinate compounds**: Valence bond theory, crystal field, characterization of coordinate compounds, Isomerism in coordination compounds, ligand substitution reactions and trans effect, spectrochmical series, chelation, application of complexes in analytical and biological fields.

2.4 Organometallic compounds: General survey of types, synthetic methods, metallocenes

2.5 Radioactivity and nuclear reactions, C^{14} dating, tracer technique, radiochemical analysis

3. Analytical chemistry 20%

3.1 **General concept of statistical methods in chemical analysis**: Accuracy, precision, minimization of error, significant figures, mean and standard deviation, reliability of results, rejection of results, regression analysis, t-test, chi-test.

3.2 **Principle and applications of**: Atomic absorption spectroscopy, flame photometry, uv-vis spectrophotometry, NMR, IR, mass spectroscopy.

3.3 **Chromatography:** ion exchange chromatography, gas chromatography, HPLC, exclusion chromatography (gel permeation chromatography), affinity; chromatography, partition, column, paper chromatography and solvent extraction,

3.4 **Principle and applications of**: potentiometry, ion selective electrodes, pH measurement, polarography, and conductometry.

3.5 **Gravimetric and volumetric analysis**: principles of volumetric and gravimetric analysis, uses of adsorption indicators, use of Redox indicator, metal ion indicator, use of common organic reagents in gravimetric analysis.

Section C- 20 Marks

4. Organic Chemistry

4.1 **General idea on mechanism and scope of the following types of reactions**: Nucleophilic reaction, Elimination reaction, Addition reaction and Free radical reaction

4.2 **Study and application of the following types of organic reactions**: Oxidation and reduction, Halogenations, Acetylation, Alkylation, Acylation and condensation.

4.3 **Organic photochemistry**: basic concepts on photochemistry of carbonyl compounds, photochemical aromatic substitution, photo- isomerization and photoreduction.

4.4 **Structure and reactivity of the following heterocyclic compounds**: Thiazole, Furan and Pyridine

4.5 **Stereochemistry:** Symmetry and symmetry elements, Enantiomers, Diastereomers, Meso-isomers, Racemic mixture, Enantio-selective reaction, Diastereo-selective reaction, Regio-selective reaction.

Section D- 30 Marks

5. Conservation technologies

5.1 Terminologies: Conservation, restoration, preservation, renovation, preventive conservation, consolidation, water repellents, reproduction.

5.2 Introduction to Archaeological objects: Classification, nature of deterioration, co-operative approach to conservation.

5.3 Introduction to Archival materials: Nature, causes of deterioration, preventive care, repair and restoration, recovery of faded ink.

5.4 Agents of deterioration of Museum objects: Direct physical forces,thieves, vandals' displacers, fire, water, pests, contaminants, radiation, temperature, relative humidity, pollution and flood

5.5 Stone conservation: Classification of stones, types of deterioration, causes of deterioration, photographic documentation, clearing methods and conservation treatments

5.6 Pigments: Red, green, blue, yellow, blade, gold and silver, white.

5.7 Metal conservation: Corrosion, classification of metals on the basis of corrosion behaviour, deterioration of metal objects, cleaning, consolidation and preventive measures.

5.8 Ceramics: Different types of ceramics, causes of deterioration, salt removal (soluble and insoluble), stain removal, repair and cleaning

5.9 Wooden artifacts: Physical, chemical and biological causes of deterioration and control measures.

5.10 Uses of traditional techniques for conservation: Techniques involving uses of Neem, Camphor, Turmeric and Sandalwood

5.11 Termite controls in the museums and the historic buildings: classification, detection and prevention

5.12 Eradication of plants in the monuments: Physical and chemical methods.

---The end---

First Paper: - Sample Questions

1) A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, keeping all other parameters unchanged, the rate of reaction will
   a) Remain unchanged
   b) Increase by a factor of 3
   c) Increase by a factor of 4 *
   d) Doubled.

2) Which of the following conditions is necessary for a reaction to be spontaneous?
   a) $\Delta S_{system} > 0$
   b) $\Delta S_{surrounding} > 0$
   c) $\Delta S_{system} + \Delta S_{surrounding} > 0$
   d) $\Delta S_{surrounding} > \Delta S_{system}$

3) Use the Debye-Hückel limiting law to calculate the mean activity coefficient for the ions in an aqueous solution of potassium sulfate, $K2SO_4$, of molality 0.010 mol kg^{-1} at 25°C.
   a) 0.932
   b) 1.074
   c) 1.023
   d) 0.943

4) Which of the following is not a correct assumption of Langmuir?
   a. Adsorption is limited to monolayer
   b. Adsorption is uniform all over the adsorbent
   c. There is intermolecular interaction among adjacent adsorbed molecule/s
   d. There will be a dynamic equilibrium between adsorption and desorption.

5) How many EDTA molecules are required to make an octahedral complex with a Ca^{2+} ion?
   a) Six
   b) Three
   c) One
   d) Two

6) For which of the following ligands the ligand-field splitting parameter is highest?
   a) SCN^-
   b) pyridine
   c) NCS^-
   d) $C_2O_4^{2-}$

7) Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl because HCl
   a) Gets oxidized by oxalic acid to chlorine
   b) Furnishes H^+ ions in addition to those from oxalic acid
   c) Reduces permanganate to Mn^{2+} *
   d) Oxidizes oxalic acid to carbon dioxide and water.

8) The current responsible for charging electrical double layer is called
   a) Capacitive current
   b) diffusion current
   c) Limiting current
   d) polarizing current

9) 2-nitrofuran is prepared by nitration nitration of furan with
   a) Conc. Nitric acid
   b) a mixture of nitric acid and sulphuric acid
   c) Acetyl nitrate
   d) nitrobenzene

10) o-nitrotoluene when heated with ethanolic sodium hydroxide yields
   a) o- toluidine
   b) sodium salt of o-aminobenzoic acid
   c) sodium-nitromethane
   d) sodium nitrosotoluine

11) α-D-(+)-glucose and β-D-(+)-glucose are
   a) Conformers
   b) Epimers
   c) Anomers *
   d) Enantiomers

12) Tertiary alkyl halides are practically inert to substitution by SN2 mechanism because of
   a) Insolubility
   b) Instability
   c) Inductive effect
   d) Steric hindrance *

13) Alkyl halides react with dialkyl copper reagents to give
   a) Alkenes
   b) Alkyl copper halides
   c) Alkanes *
   d) Alkenyl halides

14) HBr reacts with CH_2=CH-OCH_3 under anhydrous conditions at room temperature to give
   a) CH_3CHO and CH_3Br
   b) $BrCH_2CHO$ and CH_3OH
   c) $BrCH_2$-CH_2-OCH_3
   d) H_3C-CHBr-OCH_3*

15) Wooden artifacts are distroped by:-
   a) Termite
   b) Silverfish
   c) Cockroach
   d) Spider

16) For a paper conservator what are the examination tools?
   a) Pen
   b) Working table
   c) Distilled water
   d) Temperature

17) Stone conservation needs:
   a) Preservation
   b) Consolidation
   c) Water repellants
   d) Fumigation

18) Which of the following reagents are used to remove tea and coffee stain from paper documents:
   a) Potassium perborate
   b) Sodium hydroxide
   c) Carbon tetrachloride
   d) Ethyl alcohol

19) Iron gall ink is temporarily recovered by use of:
   a) Ammonium sulphide vapour
   b) Sulphuric Acid
   c) Ethanol
   d) Methanol

Second Paper: - Sample Questions

1) What is Ostwald's dilution law? Derive a relation between dissociation constant and degree of dilution. Explain its limitations. 10

2) Explain briefly the factors that affect the rate of chemical reaction. What is the difference between catalytic reactions and enzymatic reaction? 10

3) Explain Hess's law. What is the relation between enthalpy, entropy and free energy? 10

4) What is electronegativity? Explain briefly the different approaches in calculation of elctronegativity. 10

5) What do you understand by accuracy and precision? What factors affect the precision of chemical measurement? 10

6) Illustrate the difference between rate of reaction in SN1 and SN2 reactions? Discuss the effects of solvents in SN2 reaction. 10

7) Discuss the photochemistry of carbonyl compounds with suitable examples. 10

8) How can we recover chemically the faded ink on the surface of the archival material? With suitable example. 10

9) a) What is the important agent for the deterioration of museum objects? 5

b) What are main causes of deterioration of archival material? Discuss in brief. 5

10) Write short notes on(any two): 5x2

a. Archaeological Preservation

b. Archaeological Restoration

c. Archaeological Renovation

11) Discuss the chemistry of any two of the following pigments with one example of each. 5x2

a. Red

b. green,

c. blue.

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नेपाल आर्थिक योजना तथा तथ्याङ्क, इन्जिनियरिङ्ग, कृषि, वन, विविध र शिक्षा सेवाका सबै समूह/उपसमूह, राजपत्रांकित तृतीय श्रेणी र एवं स्वास्थ्य सेवाको सातौं र आठौं तहका पदहरुमा प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र लिइने **सामूहिक परीक्षण (Group Test)** को लागि

सामूहिक छलफल (Group Discussion)

यस प्रयोजनको लागि गरिने परीक्षण १० पूर्णाङ्क र ३० मिनेट अवधिको हुनेछ जुन नेताविहिन सामूहिक छलफल (Leaderless Group Discussion) को रुपमा अवलम्वन गरिने छ । दिइएको प्रश्न वा Topic का विषयमा पालैपालोसँग निर्दिष्ट समयभित्र समूहवीच छलफल गर्दै प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ । यस परीक्षणमा मूल्याङ्कनको लागि देहाय अनुसारको ३ जना भन्दा बढीको समिति रहनेछ ।

आयोगका सदस्य	-	अध्यक्ष
आयोगका सदस्य	-	सदस्य
मनोविज्ञ	-	सदस्य
दक्ष/विज्ञ (१ जना)	-	सदस्य

सामूहिक छलफलमा दिइने नमुना प्रश्न वा Topic

उदाहरणको लागि - उर्जा संकट, गरीबी निवारण, स्वास्थ्य बीमा, खाद्य सुरक्षा, प्रतिभा पलायन जस्ता Topics मध्ये कुनै एक Topic मात्र दिइनेछ ।