DEPARTMENT OF CHEMISTRY
NAMBOL L. SANOI COLLEGE, NAMBOL

QUESTION BANK FOR CHEMISTRY (ELECTIVE)
PREVIOUS 6 YEARS (2016-2021)

SEMESTER - III
PAPER-III / CHM : SE 3O3

(SECTION-A) INORGANIC CHEMISTRY

UNIT-1: Metallurgy

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) What is liquation process in metallurgy? **(2017)**
(b) What is smelting? **(2018)**
(c) How are impurities like CaO removed in metallurgy? **(2019)**
(d) What is leaching ? **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) Write a note on electrolytic refining. **(2017)**
(b) What is a flux in metallurgy? Give an example of acid flux with chemical reaction. **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) Write the chemical reactions involved in the extraction of chromium from its ore. **(2017)**

(5 MARKS QUESTIONS)

1. Give reasons of the following :
    The atomic radii from chromium to copper are very close to one another. **(2017)**
2. (a) Explain the following processes of dressing of ore : 2 marks **(2018)**
    (i) Wilfley table method
    (ii) Leaching or chemical method

    (b) Explain electrolytic refining of lithium from its ore. 3 marks **(2018)**
3. Explain elaborately the extraction of pure Cr from its ore. **(2019)**

UNIT-2: Chemistry of p-block elements

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) Why is HF liquid while other hydrogen halides are gas at ordinary condition? **(2017)**
(b) Write the general formula of inter-halogen compounds and express the meaning of the symbols. **(2018)**
(c) PbI_4 is unstable while SnI_4 is stable. Why? **(2018)**
(d) Why does $PbBr_4$ not exist but $PbBr_2$ does? **(2019)**
(e) Why are interhalogen compounds more reactive than halogens? **(2021)**
(f) KHF_2 is a well-known compound whereas $KHCl_2$ does not exist. Why? **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) Why is BF_3 a weaker Lewis acid than BCl_3 and BBr_3? **(2017)**

(b) Why does fluorine exhibit only -1 oxidation state while other halogens exhibit higher positive oxidation state also? **(2018)**

(c) Compare the acidic strength of hydrides formed by p-block elements. **(2019)**

(d) Explain why the acidity of oxoacids of chlorine increases in the order given below:
$HClO < HClO_2 < HClO_3 < HClO_4$ **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) What is diagonal relationship? Write the reaction for hydrolysis of halides and nitrides of boron and silicon. **(2017)**

(b) Give three important similarities between boron and aluminium. **(2018)**

(c) Write a note on interhalogen compounds. **(2019)**

UNIT-3: General properties of d-block elements

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) Calculate the effective magnetic moment of Mn^{2+} in BM. **(2017)**

(b) Why is Cu^{2+} more stable than Cu^+ ? **(2019)**

(c) Why docs copper not replace hydrogen from acid? **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) For transition metals, 4s subshell is filled prior to *3d* but on ionization, 4s electrons are removed first. Justify. **(2018)**

(b) "Transition metals are less reactive than alkali and alkaline earth metals." Justify. **(2019)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) Explain why for first row transition metal ~ eff is only ~ spin . **(2018)**

(b) Discuss the optical isomerism for the following coordination compounds
$[Co(en)_2 Cl_2]^+$ and $[Co (en) (NH_3) Cl_2]^+$ **(2019)**

(c) Why do transition elements-
(i) show variable oxidation states;
(ii) form coloured compounds? **(2021)**

(5 MARKS QUESTIONS)

1. Give reasons of the following :

(a) In filling up of atomic orbitals; the electrons enter the 4s orbital before the 3d orbital but during their ionization the electrons from 4s leave first. **(2017)**

(b) Most of the transition metals have high melting point and are paramagnetic. **(2017)**

(c) Transition elements are much less reactive than alkali or alkaline earth metals although they have same number of outermost electrons. **(2017)**

(d) Though Cu, Ag and Au have completely filled sets of *d* orbitals yet they are considered as transition metals. **(2017)**

UNIT-4: Coordination Chemistry

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What is a complex ion ?   **(2017)**

(b)   Write the IUPAC name of

[(NH$_3$)Co-NH$_2$ -Co(NH$_3$)4 (H$_2$O)]Cl$_5$ **(2017)**

(c)   What is coordination isomerism ?   **(2018)**

(d)   Write down the structure of tetra-bis (ethylenediamine) - ~ -amido- ~ - hydroxo-
       dicobalt(III) sulphate.   **(2018)**

(e)   What is ionization isomerism ?   **(2019)**

(f)   Write down the structure of 'tetrabis(ethylenediamine)- ~ -diamido- dichromium(III)
       sulphate'.   **(2019)**

(g)   What are chelates?   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Give the classification of ligands based on the donor-acceptor properties.   **(2017)**

(b)   Draw the possible optical isomers of dichlorido(ethylenediamine)cobalt(III) ion.

                                                                                                         (2018)

(c)   Write the classification of ligands based on donor-acceptor theory.   **(2019)**

(d)   Write the formula of the following complexes;
       (i) Dichloridobis (ethane-1,2-diamine) cobalt (IV) sulphate
       (ii) Potassium hexacyanoferrate *(III)*   **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Draw the possible isomers of the octahedral *[M(a$_2$b$_2$c$_2$)]* complex. Which of these would be
       optically active?   **(2017)**

(b)   Give evidence to support Werner's theory of coordination with suitable examples.   **(2018)**

(c)   Why do transition metals form large number of coordination complexes and exhibit good catalytic
       properties?   **(2019)**

(d)   Write the structure of the optical isomers of the complex ion [CoCl$_2$(en)$_2$]$^+$. Which isomer is
       optically active?   **(2021)**

(SECTION-B) ORGANIC CHEMISTRY

UNIT-1: Phenols

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What happens when phenol is treated with benzene diazonium chloride?   **(2017)**

(b)   Why is phenol acidic in nature?   **(2018)**

(c)   What happens when phenol is distilled with zinc dust?   **(2019)**

(d)   Draw a resonance structure of phenoxide ion.   **(2021)**

(e)   What happens when phenol is treated with excess of bromine water?   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Write the scope of Gattermann synthesis.   **(2017)**

(b)   Write the mechanism of Fries rearrangement.   **(2018)**

(c)   Write the mechanism of either Hauben-Hoesch reaction or c1aissen rearrangement.   **(2019)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Give the product and write the relevant mechanisms of the following :
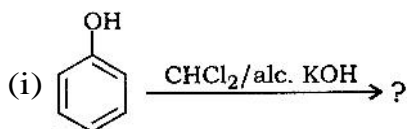
(i) $\xrightarrow{CHCl_2/alc.\ KOH}$?   **(2019)**

UNIT-2: Ethers and epoxides

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What are epoxides?   **(2017)**
(b)   Why are ethers more volatile than the isomeric alcohols?   **(2018)**
(c)   Give the compounds that will be used in Williamson synthesis of anisole.   **(2019)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   How is methoxybenzene prepared by Williamson synthesis?   **(2017)**
(b)   What are the epoxides? Give an example.   **(2018)**
(c)   Give the product and write the mechanism involved when 2-methoxy- 2-
       methylpropane is heated with concentrated HI.   **(2019)**
(d)   Write the mechanism of an acid catalyzed hydrolysis of epoxide.   **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Write the mechanism of the following:
       Acid catalyzed hydrolysis of 2,2- dimethyloxirane   **(2017)**
(b)   Give the products and write the relevant mechanisms of the following:
       Williamson's synthetic reaction of sodium t-butoxide with bromomethane   **(2018)**

UNIT-3: Aldehydes and ketones

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Give the product formed when acetaldehyde is subjected to Wolff-Kishner reduction.
                                                                                  (2017)
(b)   Addition of HBr to acrolein, $CH_2 =CH - CHO$ does not obey Markownikoffs rule.
       Give reason.   **(2018)**
(c)   Write the enol-form of ethanal.   **(2019)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Write the mechanism of the following:
       Wittig reaction   **(2017)**
(b)   Give the products and write the relevant mechanisms of the following:
       Aldol condensation of ethanal   **(2018)**
(c)   Give the product and write the relevant mechanisms of the following :
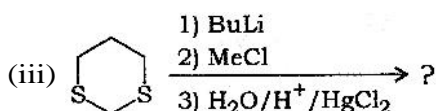
(iii) $\xrightarrow[\text{3) } H_2O/H^+/HgCl_2]{\substack{\text{1) BuLi}\\ \text{2) MeCl}}}$?   **(2019)**

(c)   Give the products and write the relevant mechanisms of the following :

(ii) [benzaldehyde structure with CHO] + CH_3CHO $\xrightarrow{OH^-}$?   **(2021)**

(5 MARKS QUESTIONS)

1.   Write notes on any *two* of the following :   **(2017)**
(a) Baeyer- Villiger oxidation
(b) Synthesis of aldehydes and ketones by using 1 ,3-dithianes
(c) Reduction of г , ѕ -unsaturated aldehydes by $NaBH_4$

2.   Write notes on any *two* of the following :   **(2018)**
(a) Benzoin condensation .
(b) Cannizzaro reaction

3.   Write notes on any *two* of the following :   **(2019)**
(a) Wolff-Kishner reduction
(b) Perkin condensation
(c) Baeyer- Villiger oxidation

UNIT-4: Organic compounds of nitrogen

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Why is methylamine more basic than ammonia?   **(2017)**
(b)   Write one method for the synthesis of nitroalkanes.   **(2017)**

(c)   Write the tautomeric forms of nitro-methane.   **(2018)**
(d)   What happens when nitrobenzene is reduced with zinc dust and aqueous ammonium chloride?
                                                                                         (2018)
(e)   Why is methanamine more basic than aniline?   **(2019)**
(f)   Write the IUPAC name of trimethylamine.   **(2019)**
(g)   What are epoxides?   **(2021)**
(h)   Write the structure of N,N-dimethyl-amine.   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   How will you convert nitrobenzene to aniline?   **(2017)**
(b)   How are primary, secondary and tertiary amines separated by Hinsberg method?   **(2018)**
(c)   How can primary, secondary and tertiary nitroalkanes be distinguished?   **(2019)**
(d)   How can primary, secondary and tertiary aliphatic amines be distinguished?   **(2021)**
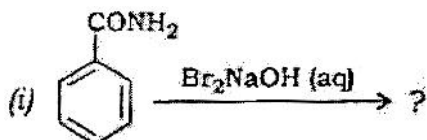
SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Write the mechanism of the following:
Hofmann bromamide reaction   **(2017)**
(b)   How will you convert acetaldehyde to propan-2-ol? What happens when glycerol is added slowly
                                                                                         (2018)
(c)   Give the products and write the relevant mechanisms of the following:
Gabriel phthalimide reaction with bromoethane   **(2018)**
(d)   Give the product and write the relevant mechanisms of the following :

(ii) [benzene ring structure]$-CONH_2$ $\xrightarrow{Br_2/KOH (aq)}$?   **(2019)**

(c) Give the products and write the relevant mechanisms of the following :

(i)
$$\text{C}_6\text{H}_5\text{—CONH}_2 \xrightarrow{\text{Br}_2\text{NaOH (aq)}} \text{?}$$

(2021)

(5 MARKS QUESTIONS)

1. Write notes on any *two* of the following : **(2018)**
   (c) Synthesis of ketones from nitriles

(SECTION-C) PHYSICAL CHEMISTRY

UNIT-1: Thermochemistry
Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) Define enthalpy of combustion. **(2017)**
(b) Define enthalpy of formation of a compound. **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) Derive Kirchhoff's law. **(2017)**
(b) State Hess's law of constant heat summation. Give an application of the law. **(2018)**
(c) Calculate the heat of formation of CH_3OH if its heat of combustion at 25°C is –726.1 kJ mol⁻¹. **(2019)**
(d) The combustion of 1 mole of benzene takes place at 298 K and 1 atm. After combustion, $CO_2(g)$ and $H_2O(l)$ are produced and 3267.0 kJ of heat is liberated. Calculate the standard enthalpy of formation, $\Delta_f H^0$ of benzene. Standard enthalpies of formation of $CO_2(g)$ and $H_2O(l)$ are –393.5 kJ mol⁻¹ and –285.83 kJ mol⁻¹ respectively. **(2021)**
(e) How does the enthalpy of combustion differ from the enthalpy of formation ? Explain. **(2021)**
(f) State and explain Hess' law of constant heat summation. **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) From the reaction data
$$2H_2\,(g) + O_2\,(g) = 2H_2O\,(l) + 571 \cdot 83\ \text{kJ}$$
calculate the enthalpy of combustion (ΔH) of hydrogen. **(2017)**
(b) Calculate the entropy change when 2 moles of helium gas is heated from 100 K to 300 K at constant pressure.
[Given C_p for helium = 5.0 cal deg⁻¹ mol⁻¹] **(2018)**
(c) Calculate the heat of the reaction, $H_2(g) + \frac{1}{2}O_2 \rightarrow H_2O(g)$. [Given, bond energy of O–H bond, H–H bond and O=O bond are 111 kcal mol⁻¹, 104 kcal mol⁻¹ and 118 kcal mol⁻¹ respectively.] **(2018)**
(d) The standard molar enthalpy of formation of cyclohexane and benzene at 25°C are -156 kJ mol⁻¹ and 49 kJ mol⁻¹ respectively. The standard enthalpy of hydrogenation of cyclohexene at 25°C is -119 kJ mol⁻¹. Using these data, estimate the resonance energy of benzene. **(2019)**

UNIT-2: Thermodynamics-II

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   State the second law of thermodynamics.   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Explain the term 'thermodynamic efficiency' of a Carnot engine.   **(2018)**

(b)   Define thermodynamic temperature scale. At what temperature of the scale an engine becomes perfectly efficient?   **(2019)**

(c)   What is meant by efficiency of an engine ? Calculate the maximum efficiency of an engine operating between 110^0C and 25^0C.   **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Calculate the coefficient of performance of a reversible refrigerator operating between an interior temperature of 4 °C and an exterior temperature of 22°C.   **(2017)**

(b)   Show that

$$-(\Delta G)_{P,T} = W_{net}$$ **(2019)**

(c)   Derive the relation :

$$\Delta G = \Delta H + T[\mathsf{u}(\Delta G)/\mathsf{u}T]_p$$

Or

Derive the relation, $\Delta A = -W_{rev}$.   **(2021)**

(5 MARKS QUESTIONS)

(a)   Derive the following relationships :
For reversible isothermal expansion of an ideal gas

$$\Delta S = -nR\ln\frac{p_2}{p_1}$$ **(2017)**

(b)   Derive the relationships of the following :

(i) $-\Delta A = w_{rev}$

(ii) $\Delta G = \Delta H + Td(\Delta G/dT)_p$ **(2018)**

UNIT-3: Chemical equilibrium

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What is fugacity of a gas?   **(2017)**

(b)   State Le Chatelier's principle.   **(2017)**

(c)   What is the unit of K_c for the reaction,
$N_2O_4(g) \rightleftharpoons 2NO_2(g)$?   **(2018)**

(d)   What will be the effect of temperature on the equilibrium of the following reaction?
$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) - X$ cal   **(2018)**

(e)   Give the relationship between k_p and k_c for the reaction

$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ **(2019)**

(f)   What will be the effect of pressure on the equilibrium of the following reaction?

$2\,HI\,(g) \rightleftharpoons H_2(g) + I_2(g)$ **(2019)**

(g)   What does the equilibrium constant $K < 1$ indicate ?   **(2021)**

(h)   What is meant by fugacity of a gas ?   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Show that for one mole of an ideal gas

$C_p - C_v = R$ **(2017)**

(b)   Derive the relation between K_P and K_C for a gaseous reaction.   **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Find the value of ΔG when 2 mol of an ideal gas is isothermally pressurized from 1 atm to 3 atm at 298 K.   **(2017)**

(b)   Calculate K_p of the reaction, $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ at 25°C. [Given that partial pressures $p_{NOCl} = 1.2$ atm, $p_{NO} = 5.0 \times 10^{-2}$ atm and $p_{Cl_2} = 3.0 \times 10^{-1}$ atm]   **(2018)**

(c)   Derive Clausius-Clapeyron equation.   **(2019)**

(d)   State Le Chatelier principle. Also write the conditions of temperature and pressure that favour better yield of ammonia which is prepared by the reaction

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);\ \Delta H = -92.4\ kJ$ **(2021)**

(5 MARKS QUESTIONS)

(a)   Derive the following relationships :

$C_p = -T\left(\dfrac{d^2G}{dT^2}\right)$ **(2017)**

UNIT-4: Chemical Kinetics-I
Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Write the equation which expresses the effect of temperature on the rate of reactions.   **(2017)**

(b)   What is half-life period of a reaction?   **(2017)**

(c)   What is order of a reaction?   **(2018)**

(d)   What is an elementary reaction?   **(2018)**

(e)   The unit of rate constant for a reaction is

$\sqrt{mol}\,\sqrt{L^{-1}}\ S^{-1}$. What will be its order?   **(2019)**

(f)   What is half-life period of a reaction?   **(2019)**

(g)   Define molecularity of a reaction.   **(2019)**

(h)   Write the unit of rate constant for first-order reaction.   **(2021)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   A reaction between A and B is 3/2 order in A and -1 order in B. Give the rate expression and find the unit of the rate constant k: **(2017)**

(b)   A first-order reaction is completed in 10 minutes. Calculate the rate constant k.   **(2018)**

(c)   A first-order reaction is one-fifth complete in 20 minutes. Calculate the rate constant k.   **(2019)**

(d)   Show that in case of a first-order reaction, the time taken for 99.9% completion of reaction is about ten times that of 50% completion. [Given that, log2 = 0.3010]   **(2021)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Derive the integration rate expression of second-order reaction.

      Or

Derive the relation,

$$\ln\frac{K_2}{K_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$ **(2021)**

(5 MARKS QUESTIONS)

(a)   Derive an equation to show that the rate of chemical reaction increases exponentially with rise in temperature.   **(2019)**