3rd Semester Examination, 2021

Time : 3 hours

Full Marks : 60

Answer from all the Parts as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(MODEL CBCS)

(ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY AND ALIPHATIC HYDROCARBONS)

PART – I

1. Answer *all* the questions : 1×8

 (*i*) The maximum number of electrons that can be accomodated in 'N' Shell of an atom is _____.

(2)

(ii) The designation assigned to an orbital having $n = 4$ and $l = 1$ is _____ .

(iii) The solubility of an ionic solid decreases if lattice energy is _____ than solvation energy.

(iv) The bond angel of a molecule having trigonal planar geometry is _____

(v) Which type of resonance effect is exhibited by–NO_2 in nitrobenzene ?

(vi) Which is less stable between eclipsed and staggered conformations of ethane ?

(vii) Can methane be prepared by Wurtz reaction ?

(viii) Name the compound formed by oxidation of C_2H_2 with hot alkaline $KMnO_4$ solution.

PART – II

2. Answer any *eight* of the following questions within *two* or *three* sentences each : $1\frac{1}{2} \times 8$

(a) What is the meaning of quantization of energy ?

(3)

(b) How many number of nodes are present in radial wave functions of $2s$, $2p$ and $3d$ atomic orbitals ?

(c) Write the electronic configuration of Mn atom, Fe^{+2} ion and Cl^- ion.

(d) Write any three important characteristics of ionic compounds.

(e) Predict the bond angles in following molecules. CO_2, H_2O and NH_3

(f) Name three electron displacement effects which are very common in organic compounds.

(g) What is Huckel's rule ? Explain what is aromatic character of a compound.

(h) What happens when C_2H_5Mgcl reacts with water ?

(i) What happens when C_2H_4 reacts with alkaline potassium per manganate solution ?

(j) What happens when C_2H_2 gas is passed through dilute sulphuric acid solution containing . $HgSO_4$ at 333K temperature ?

(4)

PART—III

3. Answer any *eight* of the following within 75 words each : 2 × 8

(a) What are the limitations of Bohr's theory of atoms ?

(b) Explain Hund's rule.

(c) Derive de-Broglie equation.

(d) What are the important postulates of VSEPR theory ?

(e) Write the rules of LCAO.

(f) Which is stronger acid between CH_3—COOH and C_6H_5—COOH and why ?

(g) Which is a weaker base between $C_2H_5 NH_2$ and C_6H_5—NH_2 and why ?

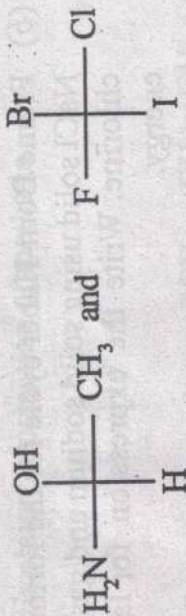(h) Assign E or Z notation to the following.
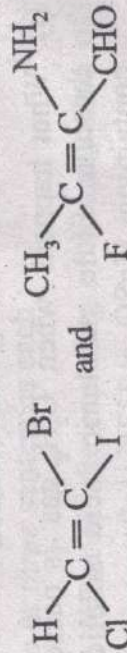
SG CHE – 01 (Continued)

(5)

(i) Assign R or S notation to the following :

(j) State Markownikov's rule and Saytzeff's rule.

PART—IV

Answer all questions : 6 × 4

4. (a) Write a short note on quantum numbers. 6

Or

(b) Write notes on :

(i) Pauli's exclusion principle

(ii) Aufbau's rule. 3 + 3

5. (a) Draw MO diagram for N_2 molecule and predict its bond order and magnetic nature. 4 + 1 + 1
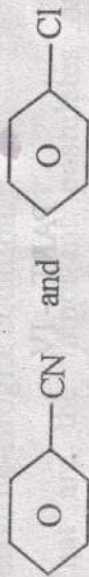
SG CHE – 01 (Turn Over)

(6)

Or

(b) Frame Born-Haber cycle for the formation NaCl solid using solid sodium and gaseous chlorine. Write the expression for lattice energy.

5 + 1

6. (a) What is resonance ? Write the resonating structures of

3

[chemical structure: benzene ring with —CN and benzene ring with O—Cl] —CN and [O]—Cl

(b) What is hyper conjugation ? Show that hyperconjugation of $CH_3 — CH = CH_2$ and $CH_3 — CH_2^+$ belong to two different types.

1 + 2

Or

(c) Explain optical isomerism shown by tartaric acid.

3

(d) Distinguish between enartiomers and diastereomers.

3

(Continued)

(7)

7. (a) Write short note on Wurtz reaction.

2

(b) Explain Chlorination of methane.

4

Or

(c) Explain Ozonolysis of $CH_3 — CH = CH_2$.

3

(d) Explain why acetylenic hydrogens are acidic in nature ?

3

_____

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GROUP—A

(MODEL SYLLABUS)

(INORGANIC CHEMISTRY-II)

SECTION—A

1. Answer *all* of the following questions :   1 × 8

   (*a*) Give one example each for sulphide and oxide ore of metals.

(2)

(*b*) Write the formulae of conjugate base of HCO_3^- and conjugate acid of NH_3.

(*c*) _____ + _____ = slag.

(*d*) In alkaline earth metal group of the periodic table which element has a variety of different properties unlike other elements ?

(*e*) Draw the geometry of XeF_4.

(*f*) Write the general formula of silanes.

(*g*) What is the basicity of H_3PO_3 ?

(*h*) Write formula of one pseudo halogen.

SECTION – B

2. Answer any *eight* questions : $1\frac{1}{2} \times 8$

(*a*) Define zone refining.

(*b*) From amongst Ag^+, Li^+, CN^- identify the hard/soft acids/bases.

(*c*) How can you prepare basic beryllium acetate ?

(*d*) Name the following oxyacids of chlorine.
$HClO$, $HClO_2$, $HClO_3$

(3)

(*e*) Write the formula of following metaphosphoric acid, orthophosphoric acid, pyrophosphoric acid.

(*f*) Write formula of any three interhalogen compounds of iodine.

(*g*) Complete the following reaction and give balanced equation.
$$BN + H_2O \longrightarrow \underline{\quad} + \underline{\quad\quad}$$

(*h*) Write the formulae of lithium oxide, sodium peroxide and potassium superoxide.

(*i*) What are interstitial hydrides ? Give one example.

(*j*) Write three important postulates of VSEPR theory.

SECTION – C

3. Answer any *eight* of the following questions : 2×8

(*a*) Distinguish between ore and minerals giving example.

(4)

(*b*) How is basic beryllium nitrate prepared ?

(*c*) Write two reasons for inertness of noble gases.

(*d*) What are carboranes and graphitic compounds ?

(*e*) What are allotropy and catenation of Carbon atom ?

(*f*) What happens when borax is heated ?

(*g*) Give name and formula of different oxides of phosphorus. Give one method for preparation of P_2O_5.

(*h*) Define Acids and Bases on the basis of Lewis theory. Give examples for each.

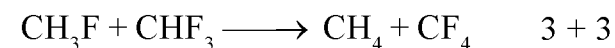(*i*) What are Clathrates ?

(*j*) What is hydrometallurgy ?

SECTION— D

Answer **all** the questions as directed : 6×4

(5)

4. (*a*) (*i*) Explain Van Arkel-De Boer Process.

   (*ii*) What are Ellingham diagrams ? $4 + 2$

   Or

   (*b*) (*i*) Explain Symbiosis.

   (*ii*) Predict the feasibility of the following reaction giving reasons.

   $$CH_3F + CHF_3 \longrightarrow CH_4 + CF_4 \qquad 3 + 3$$

5. (*a*) (*i*) Explain inert pair effect giving example.

   (*ii*) What is diagonal relationship ? $4 + 2$

   Or

   (*b*) Write a brief note on complex formation tendency of S and P block elements.   6

6. (*a*) (*i*) Give one method of preparation of diborane.

   (*ii*) Discuss the structure of B_2H_6 on the basis of multicentre bond concept. $2 + 4$

Or

(*b*) Give one method of preparation for each of the following : $2 + 2 + 2$

(*i*) ICl

(*ii*) BrF_5

(*iii*) IF_7

7. (*a*) Draw the structures of following compounds and explain. $3 + 3$

(*i*) XeF_2

(*ii*) ClF_3

Or

(*b*) What are different types of inorganic polymers on the basis of type of reaction of their formation ? Give examples of each type. $4 + 2$
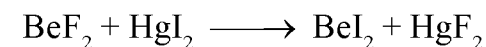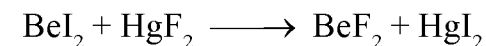
GROUP – B

(**OLD SYLLABUS**)

(**INORGANIC CHEMISTRY-II**)

SECTION – A

1. Answer *all* questions : 2×6

(*a*) By HSAB principle explain which one of the following reaction is spontaneous :

$$BeI_2 + HgF_2 \longrightarrow BeF_2 + HgI_2$$

$$BeF_2 + HgI_2 \longrightarrow BeI_2 + HgF_2$$

(*b*) Explain : $AgI_2^{(-)}$ exists but $AgF_2^{(-)}$ does not.

(*c*) Explain : OF_2 is named as oxygen flouride in stead of Fluorine oxide.

(*d*) Write two differences between Inorganic and organic polymers.

(*e*) What are silicones ? Write its one application.

(*f*) Write two applications of phosphagens.

SECTION — B

Answer **all** questions :   12 × 4

2. Write notes on the following :   4 × 3

    (*i*) Zone-refining

    (*ii*) Electro-refining

    (*iii*) Van Arkel-De Boer process of purifying metal.

Or

What are hard and soft acids ? Discuss their characteristics. Explain HSAB principle by two examples.   3 + 3 + 3 + 3

3. Discuss complex formation of alkali metal ions. 12

Or

Write notes on :   6 + 6

    (*i*) Inert-pair effect

    (*ii*) Diagonal relationship.

4. Name and write formulas of oxyacids of phosphorous. Discuss their structures and relative acid strength.   4 + 6 + 2

Or

Write notes on :   6 + 6

    (*i*) Diborane

    (*ii*) Interhalogen compounds.

5. Discuss structure and bonding of XeF_2 by valence bond treatment and by M.O. treatment.   6 + 6

Or

Write notes on :   6 + 6

    (*i*) Silicones

    (*ii*) Borazines.

_____

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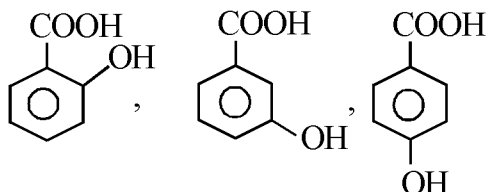
GROUP – A

(MODEL SYLLABUS)

(ORGANIC CHEMISTRY - II)

SECTION – A

1. Answer *all* the questions :   1 × 8

   (*a*) Which alkyl halide (between $1°$ and $3°$) would follow preferentially $S_N 1$ reaction ?

(b) What is the formula of benzyne ?

(c) Which reducing agent is used in Bouveault-Blanc reduction ?

(d) Amongst

which is the weakest acid ?

(e) Between CH_3CHO and $C_6H_5 - CHO$ which gives aldol condensation ?

(f) Which aldoxime does not give Beckmann rearrangement ?

(g) What is the reducing agent used in Wolff-Kishner reduction ?
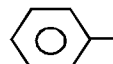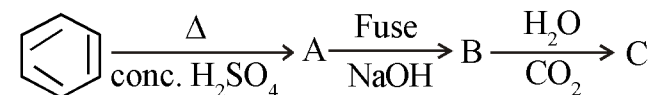
(h) Write the formula of citric acid.

SECTION – B

2. Answer any *eight* of the following questions :

$$1\frac{1}{2} \times 8$$

(a) Write the full form of $S_N i$, E_{ICB} and SNAr reaction mechanisms.

(b) Between —Cl and C_2H_5Cl which is more reactive and why ?

(c) Write formula of propene glycol. Give one method of its preparation.

(d) What are epoxides ? Give one example of it.

(e) Explain Clemmensen's reduction.

(f) What is tautomerism ? Write the formulae of Keto and enol tautomers of ethyl acetoacetate.

(g) What are thiols ? Give the formula and name of one thiol ?

(h) Identify A, B and C in the following reaction :

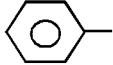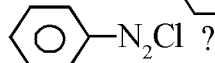(i) What is an active methylene group ? Give two examples of compounds having this group.

(j) Write the formula of crotonic acid, malic acid and maleic acid.

SECTION – C

3. Answer any *eight* of the following :   2 × 8

(a) When 2-bromobutane is treated with alcoholic KOH But-2-ene is the major product. Give reasons for this with equations.

(b) How can ⟨O⟩—Cl be prepared from ⟨O⟩—N_2Cl ?

(c) Why is phenol acidic ?

(d) What is Lucas reagent ? Between 1°, 2° and 3° alcohols which reacts at fastest rate with this reagent ?

(e) What happens when △ reacts with NH_3 ?

(f) Explain MPV reduction with one example.

(g) Explain Baeyer-Villiger oxidation with one example.

(h) Complete the following reaction and name the product (s).

$$\begin{array}{l} CH(OH)-COOH \\ | \\ CH(OH)-COOH \end{array} \xrightarrow[\text{with Hl}]{\text{reduction}}$$
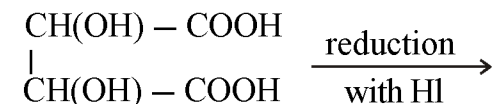
(i) What happens when citric acid is heated ?

(j) What happens when maleic acid reacts with alkaline $KMnO_4$ solution ?

SECTION – D

Answer **all** the following questions as directed :
6 × 4

4. (a) Give Benzyne mechanism for the following reaction and substantiate the suggested mechanism with evidence.   4 + 2

Cl ⟨benzene ring⟩ $\xrightarrow[\text{liq. } NH_3]{NaNH_2}$ NH_2 ⟨benzene ring⟩
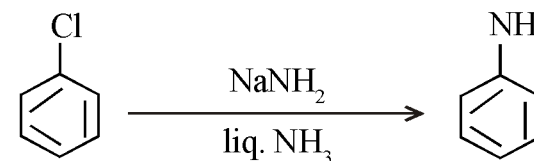
Or

(b) Attempt the following conversions :   3 + 3

(*i*) Preparation of 2° alcohol using Grignard's reagent.

(*ii*) Preparation of monocarboxylic acid by use of organolithium compound.

5. (*a*) (*i*) Give mechanism of Pinacol-Pinacolone rearrangement. 4

(*ii*) What happens when

$$CH_2 - OH$$
$$|$$
$$CH_2 - OH$$
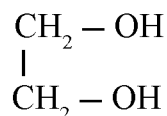
is oxidised with HIO_4 ? 2

Or

(*b*) Give mechanism of the following : 3 + 3

(*i*) Reimer-Tiemann reaction

(*ii*) Fries rearrangement.

6. (*a*) Give mechanism of following : 3 + 3

(*i*) Benzoin condensation

(*ii*) Perkin reaction.

(Continued)

Or

(*b*) (*i*) Explain Claisen condensation for preparation of ethylacetoacetate. 4

(*ii*) How can you synthesise

$$CH_2 - COOH$$
$$|$$
$$CH_2 - COOH$$

by using $CH_2 {\Large \langle} {{COOC_2H_5} \atop {COOC_2H_5}}$? 2

7. (*a*) (*i*) Why is CH_3COCl more reactive than CH_3CONH_2 towards nucleophilic acyl substitution ? 4

(*ii*) What is Curtius rearrangement ? 2

Or

(*b*) (*i*) Give the mechanism of Dieckmann reaction. 4

(*ii*) What happens when a thioether is boiled with alkali solution ? 2

(Turn Over)

GROUP – B

(OLD SYLLABUS)

(ORGANIC CHEMISTRY - II)

SECTION – A

1. Answer *all* questions :

2×6

(a) Arrange the following halides in the decreasing order of $S_N 1$ reactivity :

(i) $CH_2 - CH_2 - CH_2 - Cl$

(ii) $CH_2 = CH - \underset{\underset{Cl}{|}}{CH} - CH_3$

(iii) $CH_3 - CH_2 - \underset{\underset{Cl}{|}}{CH} - CH_3$
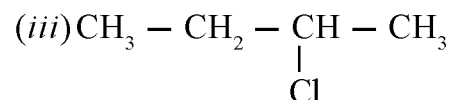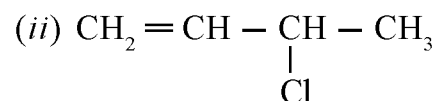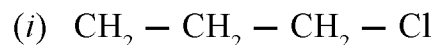
(b) Name the products when methyl prophyl ether is heated with HI.

(c) Complete the reaction :

$$C_6H_5CHO + HCHO \xrightarrow{\text{conc. NaOH}} \ ?$$

(d) Explain why carboxylic acids are stronger acids than phenols.

(e) How ethylene is prepared from ethylene glycol ?

(f) What happens when tartaric acid is oxidised by conc. HNO_3 ?

SECTION – B

Answer **all** questions : 12×4

2. (a) Discuss the mechanism, stereochemical aspects and effects of solvents in $S_N 2$ reaction. $2 + 3 + 4$

(b) How do you prepare chlorobenzene from benzene diazonium chloride ?   3

Or

(a) Give a note on Benzyne mechanism.   4

(b) How acetaldehyde can be prepared using a suitable Grignard's reagent ?   4

(c) Discuss the dehydrohalogenation reaction of 2-Bromopentane with alcoholic KOH. 4

3. (a) Complete the following reaction with mechanism.

$$\xrightarrow{H_2SO_4} \ ?$$ 4
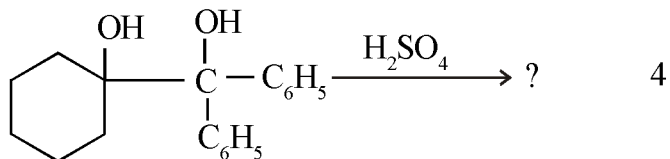
(b) Discuss Williamson's synthesis for preparation of ether. Give mechanism. 4

(c) Write a note on Reimer-Tiemann reaction. 4

Or

(a) Give a short account of the oxidative cleavage of per-iodic acid. 4

(b) An organic compound (A) of molecular formula C_6H_6O when reacts with CO_2 and NaOH at 410 K under pressure gives compound (B). Compound(B) on acidifica-

tion gives compound (C) which reacts with CH_3COCl to give compound (D), an analgesic. Identify the Compound A, B, C and D and reaction involved. 4

(c) How does phenol react with dil. HNO_3 and conc. HNO_3 ? 4

4. (a) Write notes on : 4 + 4

(i) Wittig reaction

(ii) Iodoform reaction.

(b) Give a method of preparation of ethyl acetoacetate. 4

Or

(a) How can you synthesize succinic acid from ethylacetoacetate ? 4

(b) What happens when acetaldehyde is treated with NH_3 ? What is urotropine ? 3 + 1

(c) Write a note on Aldol condensation. 4

(**12**)

5. (*a*) Give reactions when : 3 + 3

    (*i*) Maleic acid is heated with alkaline $KMnO_4$.

    (*ii*) Phthalic acid is heated with sodalime.

  (*b*) Write a note on Curtius rearrangement. 3

  (*c*) Explain why acylhalides are most reactive while amides are least reactive of all the derivatives of carboxylic acids. 3

Or

  (*a*) What happens when ammonium acetate is heated with glacial acetic acid and then the product is treated with Br_2 and KOH solution ? Give reactions. 4

  (*b*) How does ethane thiol react with acetic acid ? 4

  (*c*) Write a note on Dieckmann's condensation reaction. 4

SH CHE—07

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GROUP – A

(MODEL SYLLABUS)

(PHYSICAL CHEMISTRY - III)

SECTION – A

1. Answer *all* the following questions : 1 × 8

    (*a*) The phase rule equation is
    $$F = C - P + \underline{\qquad}.$$

(2)

(b) How many phases are there in Sulphur system ?

(c) Give an example of a three components system.

(d) What is the number of components of following system ?

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$$
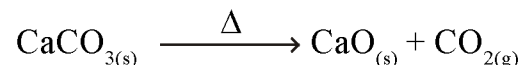
(e) What is the order of following reaction ?

$$H_{2(g)} + Cl_{2(g)} \xrightarrow{hv} 2HCl_{(g)}$$
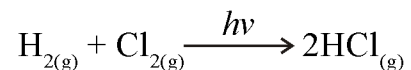
(f) Write the unit of second order reaction rate constant.

(g) The substance which adsorbs is called _____ and the substance which is adsorbed is called _____ .

(h) What is the relation between catalyst and surface area ?

SECTION – B

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

(Continued)

(3)

(a) What is triple point of water ? What are the values of pressure and temperature ?

(b) Define degree of freedom of a system.

(c) What is eutectic point ?

(d) What informations are obtained from the curves and areas of phase diagram ?

(e) What is metastable equilibrium ?

(f) What are azeotropes ?

(g) What are parallel reactions ? Give one example.

(h) What are consecutive reactions ? Give one example.

(i) Write any three important characteristics of a catalyst.

(j) What is autocatalysis ? Give one example.

SECTION – C

3. Answer any *eight* of the following : 2×8

(Turn Over)

(a) Find number of phases for following system :

(i) Water-ethylalcohol

(ii) Water- benzene.

(b) What do you understand by congruent and incongruent melting points ?

(c) Why is Sulphur system considered to be one component system ?

(d) In the phase diagram of water system the fusion curve and sublimation curve of ice have respectively negative and positive slopes. Why ?

(e) What are the phases present in Pb — Ag system ?

(f) What is the half - life period of a first order reaction having rate constant 0.0023 Sec^{-1} ?

(g) Define activation energy and write Arrhenius equation.

(h) Explain Temperature coefficient of a reaction.

(i) Which factors affect extent of adsorption and how ?

(j) What do you understand by chemisorption ? What is the effect of temperature on it ?

SECTION — D

Answer *all* the questions as directed :   6 × 4

4. (a) Draw and explain phase diagram of water system.   6

Or

(b) Derive Clapeyron - Clausius equation for solid vapour equilibrium.   6

5. (a) State and explain Nernst Distribution Law.
                                                                    1 + 5

Or

(b) Derive Gibbs-Duhem-Margules equation.   6

6. (a) Derive the rate expression for a second order reaction of the type 2A $\longrightarrow$ products.   6

(6)

Or

(b) Discuss the salient features of Collision theory of reaction rates. 6

7. (a) Write notes on : 3 + 3

  (i) Acid-Base catalysis

  (ii) Enzyme catalysis.

Or

(b) What is adsorption isotherm ? Explain Freundlich adsorption isotherm. 1 + 5

GROUP – B

(OLD SYLLABUS)

(PHYSICAL CHEMISTRY - III)

SECTION – A

1. Answer *all* questions : 2 × 6

(a) Explain the activity of a catalyst increases on decrease in particle size.

(7)

(b) What are catalytic inhibitors ? Give one specific example.

(c) Write two difference between molecularity and order of reaction.

(d) Differentiate between triple-point of water and melting-point of Ice.

(e) What are congruent and in congruent melting point ?

(f) Define and distinguish between absorption and adsorption.

SECTION – B

Answer **all** questions : 12 × 4

2. Explain with the help of Clausius-Clapeyorn equation : 4 × 3

  (i) Effect of pressure on melting-point of ice.

  (ii) Effect of pressure on melting-point of sulphur.

  (iii) Effect of pressure on the transition-temperature of SR.

Or

Discuss phase-diagram for two component systems the two components form.   6 + 6

(*i*) An eutectic mixture

(*ii*) A stable compound with congruent melting-point.

3. Draw and discuss the phase diagram for a three-component system consisting two solids *A* and *B* and water.   12

Or

Write notes on :   4 × 3

(*i*) Azeotrope mixtures

(*ii*) Cooling curves for a two component systems in which two components are not miscible in solid state and form an eutectic mixture.

(*iii*) Steam distillation.

4. State and explain the term "Temperature coefficient of a reaction." What is energy of

activation ? How is it determined by Arrhenius equation.   12

Or

Write notes on :   8 + 4

(*i*) Lindemann theory of unimolecular reaction

(*ii*) Consequtive reactions.

5. Write notes on :   4 × 3

(*i*) Specificity of a catalyst

(*ii*) Selectivity of a catalyst

(*iii*) Auto catalysis.

Or

Write notes on :   4 × 3

(*i*) Physical adsorption and chemical adsorption

(*ii*) Frendulisch's adsorption isotherm

(*iii*) Nature of adsorbed state.

——————————

SG CHE—01

3rd Semester Examination, 2020

Time : 3 hours

Full Marks : 60

Answer any **one** Group as per your syllabus

Answer from **all** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

GROUP – A

(MODEL SYLLABUS)

(ATOMIC STRUCTURE BONDING, GENERAL ORGANIC CHEMISTRY AND ALIPHATIC HYDROCARBONS)

SECTION – A

1. Answer *all* the following questions : 1 × 8

(*Turn Over*)

(**2**)

(*a*) Write the designation of the orbital having $n = 3, l = 1$.

(*b*) What is the value of Rydberg constant ?

(*c*) When Four atomic orbitals combine, how many molecular orbitals are formed ?

(*d*) If number of elctrons present in bonding and antibonding molecular orbitals are given, what is the formula for calculation of bond order ?

(*e*) How many hyperconjugation structures are present in isopropyl carbocation ?

(*f*) Which conformation of cyclohexane has highest stability ?

(*g*) During Kolbe's electrolysis of sodium salt of mono carboxylic acid, alkane is obtained at which electrode ?

(*h*) The major product of dehydrochlorination of
$$CH_3 - \underset{\underset{Cl}{|}}{CH} - CH_2 - CH_3 \text{ is} \underline{\qquad}.$$

SECTION – B

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

(a) Write the electronic cofiguration of Fe, Fe^{+2} and Fe^{+3}.

(b) Draw the shapes of 1S, 2px and $3d_{x^2-y^2}$ orbitals.

(c) Draw the square planar, trigonal Bi Pyramid and octahedral geometry of molecules.

(d) Explain LCAO principle.

(e) What are the conditions of Aromaticity ?

(f) Name three reactive intermediates.

(g) Draw the structures of *d, l* and meso tartaric acids.

(h) How can you get C_2H_2 using CaC_2 ?

(i) Write the resonating structures of

(j) What is ($n + l$) rule ?

(4)
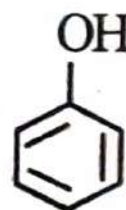
SECTION – C

3. Answer any *eight* of the following :   2 × 8

(*a*) mention the significance of ψ and ψ^2.

(*b*) Why completely filled and half filled orbitals are stable ?

(*c*) Write Schrödinger equation or hydrogen atom.

(*d*) Give one example each for homonuclear and heteronuclear diatonic molecular.

(*e*) Write Born Lande equation and explain the notations used.

(*f*) Draw the geometry of carbonation and carbanion.

(*g*) Assign R/S notations :

(*i*)

$$HO-\overset{\displaystyle CH_3}{\underset{\displaystyle Cl}{|}}-NO_2$$

(*ii*)

$$I-\overset{\displaystyle H}{\underset{\displaystyle Br}{|}}-Cl$$

(h) Assign E/Z notations :

(i)

$$Cl \underset{Br}{\overset{}{\diagup}} C = C \underset{NO_2}{\overset{NH_2}{\diagup}}$$

(ii)

$$H \underset{CH_3}{\overset{}{\diagup}} C = C \underset{Br}{\overset{OH}{\diagup}}$$
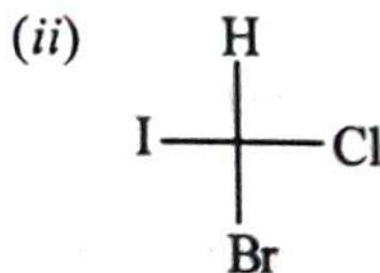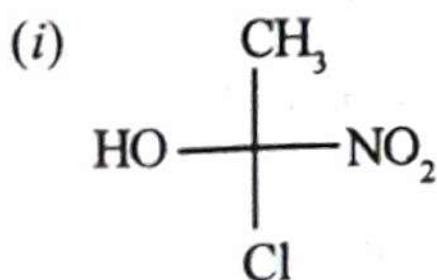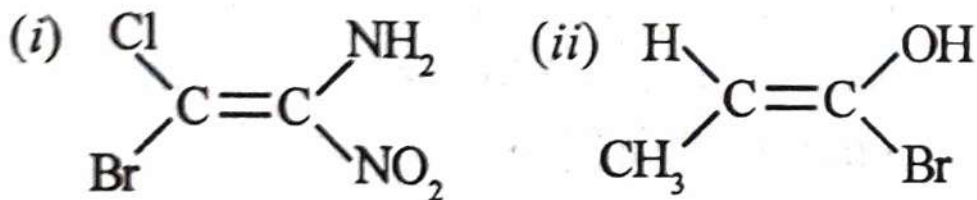
(i) Explain Markonikoff's rule.

(j) Give ozonotysis reaction of C_2H_4.

SECTION – D

Answer **all** questions as directed :   6 × 4

4. (a) (i) Explain the significance all the four quantum numbers.   4

    (ii) Write the limitations of Bohr's theory.   2

Or

(b) Explain the following :   3 + 3

    (i) de-Broglie's relation.

    (ii) Heisenberg uncertainty principle.

5. (a) Frame Born-Haber cycle for the formation of NaCl crystal starting from sodium metal and gaseous chlorine. Calculate lattice energy of NaCl.   5 + 1

Or

(b) (i) Draw MO diagram for O_2 molecule and calculate bond order.   3 + 1

(ii) Predict the shape of NH_3 molecule with the help of VSEPR theory.   2

6. (a) Explain the following :   2 + 2 + 2

(i) $C_6H_5 - COOH$ is stronger acid than CH_3COOH

(ii) $C_6H_5 - NH_2$ is weaker base than $CH_3 - NH_2$

(iii) $(CH_3)_3C^-$ is less stable than $(CH_3)_2CH^-$.

Or

(b) (i) Discuss optical isomerism of Lactic acid.   4

(*ii*) Draw Newmann formula structures for staggered and fully eclipsed conformations of *n*-butane. $\qquad$ 1 + 1

7. (*a*) (*i*) Explain chlorination of mathane in presence of sullight giving mechanism. 4

(*ii*) What happens when ethylene reacts with alkaline $KMnO_4$? $\qquad$ 2

Or

(*b*) Complete the following reactions : 2 + 2 + 2

(*i*) $CH \equiv CH \xrightarrow[\text{liq. NH}_3]{\text{Na}}$

(*ii*) $CH_3 - CH = CH_2 \xrightarrow[\text{Peroxido}]{\text{HBr}}$

(*iii*) $CH_3 - C \equiv C - CH_3 \xrightarrow[\text{liq. NH}_3]{\text{Na}}$
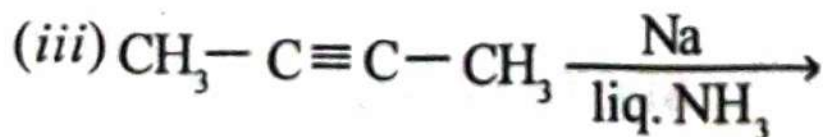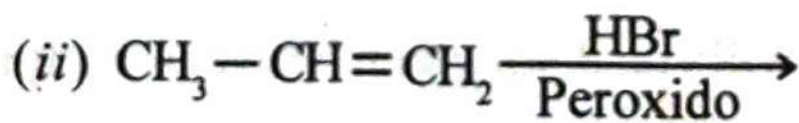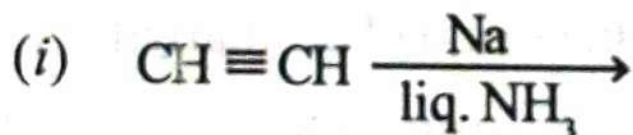
GROUP – B

(OLD SYLLABUS)

(ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY AND ALIPHATIC HYDROCARBONS)

SECTION – A

1. Answer the following : 2×6

   (a) What is Heisenberg's uncertainity principle.

   (b) PCl_5 exists, whereas NCl_5 does not, explain.

   (c) Write down the bond angle order in H_2O, H_2S and H_2Se, explain the reason.

   (d) Explain Hückel's rule of aromaticity.

   (e) Acetylene is more acidic than ethane, explain.

   (f) How will you distinguish between acetylene and ethylene ?

SECTION – B

Answer **all** questions : 12×4

2. (a) Explain Bohr's theory. Write down its limitations. $6 + 2$

(Continued)

(b) Write notes on the following :   2 × 2

   (i) Exchange Energy

   (ii) Aufbau principle.

Or

(c) Briefly discuss the origin of hydrogen spectrum from Bohr's theory.   6

(d) Write down the Schrödinger equation for hydrogen atom.   6

3. (a) Write down the postulates of VSEPR theory. Apply this theory to explain the shape of some inorganic molecules.   6

   (b) Draw the molecular orbital diagram for CO and NO molecules.   3 + 3

Or

(c) What is Born-Haber cycle ? Write down the application.   6

(d) Write the essential rules for resonance. Discuss the resonating structures of CO_3^{2-}, SO_4^{2-} ions. 4

(e) Discuss the geometry of the following molecules : PCl_5, XeO_3. 2

4. (a) Discuss on the stabilities of different possible conformations of cyclohexane. 6

(b) Write notes on the following : 6

   (i) Hyperconjugation

   (ii) Optical Isomerism.

Or

(c) Discuss Newmann, Sawhorse and Fisher representations by taking suitable examples. 6

(d) Write notes on the following : 6

   (i) Inductive effect

   (ii) Enantiomers.

5. (a) Write down two methods of preparation of alkane. Explain the free radical substitution reaction in case of methane. 6

(b) How will you synthesize : 6

    (i) Benzene from acetylene

    (ii) Ethane from acetic acid.

Or

(c) Discuss Markownikoff's and anti-Markownikoff's addition reaction in case of propene. 6

(d) Discuss the following reactions with their mechanism : 6

    (i) Birch Reduction

    (ii) Ozonolysis of alkenes.

GROUP – C

(OLD SYLLABUS)

(CHEMISTRY OF S- AND P-BLOCK
ELEMENTS, STATES OF MATTER
AND CHEMICAL KINETICS)

SECTION – A

1. Answer the following :

2×6

(a) Explain the Monds process.

(b) Why bond angle in H_2O is more than that in H_2S ?

(c) Explain why NH_3 has higher boiling point than PH_3.

(d) Derive a relationship between Cp and Cv for an ideal gas.

(e) What are the different symmetry elements ?

(f) Explain the order and molecularity of a reaction by taking suitable examples.

SECTION – B

Answer **all** questions :

12×4

2. (a) Describe Ellingham diagram. Discuss briefly the application of this diagram.   8

(b) Explain the diagonal relation among elements in the periodic table.   2

(c) The dipole moment of $(CH_3)_3 PO$ is less than that of $(CH_3)_3 NO$, explain.   2

Or

(d) Write short notes on :   4 + 4

    (i) Ionization energy

    (ii) Electronegativity.

(e) The oxidizing character decreases and reducing character increases as we move down a group, comment on this.   2

(f) What is inert pair effect ?   2

3. (a) Write down the preparation, properties and structures of Caro's acid and Marshall's acid.   6

(b) Write down the preparation of hydrides of nitrogen.   2

(c) Explain the geomerty of PCl_3 and PCl_5.   2

(d) Arrange the following acids in increasing order of their strength. Justify the reason.   2

$HClO_4$, $HClO_3$, $HClO_2$, $HClO$

Or

(e) What are hydrides ? Discuss briefly the ionic, covalent and interstitial hydrides.   6

(f) Explain the multicentre bonding in diborane.   4

(g) Explain the basicity of primary, secondary and tertiary amines.   2

4. (a) Define surface tension. Explain the determination of surface tension of a liquid using stalganometer.   6

(b) What is Boyle's temperature ? Give its significance.   2

(c) Write short note on critical constants and their experimental determination.　　2

(d) Calculate the root mean square velocity of methane molecule at 370 K. ($R = 8.314$ JK^{-1} mol^{-1}. $M = 16 \times 10^{-3}$ Kg).　　2

Or

(e) Define viscosity and coefficient of viscosity. Describe one method of determining the coefficient of viscosity.　　6

(f) What is the difference between most probable and root mean square velocities ?　2

(g) How is the surface tension of a liquid affected by temperature ?　　2

(h) Calculate the average Kinetic energy in Joules of the molecules in 8.0 g of methane at 27 °C.　　2

5. (a) Derive Bragg's equation for diffraction of X-rays by crystal lattice.　　4

(b) Explain Graphical method of determination of order of a reaction.   4

(c) What is half life period ? Write down the applications.   4

Or

(d) Derive an expression for rate constant of a bimolecular gaseous reaction on the basis of Collision theory.   4

(e) Write notes on different types of defects found in crystals.   4

(f) Write down the laws of crystallography.   2

(g) Rate of the particular reaction becomes three times when temperature is increases from 298 K to 308 K. Calculate activation energy of the reaction.   2

Or

Write notes on :

6 + 6

(*i*) Phosphagenes

(*ii*) Borazines.

———————

SH CHE— 05

2019

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(INORGANIC CHEMISTRY - II)

SECTION — A

1. Answer *all* questions :   2 × 6

(*a*) What is zone-refining ?

(*b*) Write down conjugate-Base of HNO_2, $HCO_3^{\ominus}$, H_2S and C_6H_5OH

(*c*) What is Inert-Pair effect ?

(d) Explain diagonal relationship.

(e) What are pseudohalogens ? Give two examples.

(f) What are clathrates ? Give one of its uses.

SECTION – B

Answer all questions : 12 × 4

2. Write notes on : 4 × 3

(i) Electrolytic reduction

(ii) Hydrometallurgy

(iii) Parting process.

Or

(i) Discuss important points of Lowry-Brownsted concept of acid and base. 6

(ii) Discuss briefly Lewis concept of acid and base. 6

3. What are hydrides ? How many types of

hydrides are there ? Discuss each class of hydrides. 2 + 3 + 7

Or

Write notes on : 6 + 6

(i) Allotropy

(ii) Catenation.

4. Name and write the formulas of various oxyacids of chlorine. Discuss structures of any two oxyacids of chlorine. Discuss relative acidic strength of these oxyacids of chlorine. 2 + 6 + 4

Or

Write notes on : 6 + 6

(i) Oxides of Nitrogen

(ii) Pseudohalogens and polyhalide ions.

5. Discuss two methods of preparation of XeF_6. Discuss its structure. Write down two properties of XeF_6. 2 + 2 + 4 + 2 + 2

SH CHE—06

2019

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from both the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(ORGANIC CHEMISTRY - II)

SECTION—A

1. Answer *all* questions : 2 × 6

   (*a*) Vinyl Chloride is inert towards nucleophilic substitution reaction. Explain.

   (*b*) How does phenol react with benzoyl chloride in presence of NaOH ?

(6)

(*b*) How ethane thiol is prepared from ethyl bromide ? Write reaction with mechanism. 4

(2)

(c) Which alkene on ozonolysis produces acetone as the only product?

(d) Complete the following reaction :

$$C_2H_5 - S - C_2H_5 \xrightarrow{H_2O_2} ?$$

(e) Write a chemical property that distinguishes thiol from alcohol.

(f) Diethyl ether does not react with sodium metal. Explain.

SECTION—B

Answer all questions : 12 × 4

2. (a) Discuss the mechanism and stereochemical aspects of S_N1 and S_N2 reactions. 2 + 4

(b) How fluorobenzene is prepared from benzene diazonium salt ? 3

(c) How can you prepare t-Butyl alcohol using a suitable Grignard's reagent. 3

(3)

Or

(a) Discuss the mechanism of nucleophilic substitution reaction in chlorobenzene. Nucleophilic substitution reaction is faster in p-Nitrochlorobenzene than chlorobenzene. Explain. 4 + 2

(b) An organic compound (A) on heating with AgCN forms a compound (B), which on acidic hydrolysis produces compound (C) and HCOOH. Identify the compounds A, B and C and also write the chemical equations involved. 6

3. (a) Write a note on Bouvealt-Blanc reduction. 4

(b) Discuss the mechanism of dehydration of primary, secondary and tertiary alcohol which alcohol dehydrates easily. 3 + 1

(c) Discuss the oxidation of glycol with lead tetraacetate. 4

(5)

(b) An organic compound of molecular formula C_8H_8O gives a yellow precipitate of compound (B) with 2, 4-Dinitrophenyl hydrazine in acidic medium. Compound (A) does not respond to Tollen's reagent or Fehling solution, but forms an yellow precipitate of compound (C) when it is treated with I_2 and NaOH and compound (D). Identify A, B, C and D and write the chemical reactions involved. 4

5. (a) Give reaction of phthalic acid when it is heated with NH_3. 3

(b) Write the reaction when tartaric acid is treated with Fehling's solution. 3

(c) Write the mechanisms of acid and base catalysed hydrolysis of ester. 3 + 3

Or

(a) Write notes on : 4 + 4

(i) Hoffmann's bromamide reaction

(ii) Reformatsky reaction.

(4)

Or

(a) How do you convert phenol to salicylic acid? Give mechanism. 4

(b) Write a note on diazonium coupling. 4

(c) Give the reaction of epoxide with methyl amine. 4

4. (a) Explain Keto-enol tautomerism in ethyl acetoacetate. 3

(b) How can the following compounds be synthesized from ethyl acetoacetate ? 3 × 3

(i) Ethyl methyl ketone

(ii) n-Butyric acid

(iii) Crotonic acid.

Or

(a) Write short notes on : 4 × 2

(i) Cannizzaro's Reaction

(ii) Perkin's Reaction.

2019

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

*Candidates are required to answer in their own words
as far as practicable*

(PHYSICAL CHEMISTRY - II)

SECTION – A

1. Answer *all* questions :　　　　　　　　2×6

(*a*) Is it possible to have a quadruple-point in the phase-diagram of one-component system ? Justify your answer.

(*b*) Calculate the number of phases, components and degrees of freedom in

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$

(Turn Over)

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(4)

Or

Derive Michaleis-Menten's equation for enzyme catalysed reaction. Discuss it at

(*i*) High concentration of substrate

(*ii*) Low concentration of substrate.　　　12

(c) Define critical solution temperature. Give one example each (i) system with upper CST (ii) system with lower CST.

(d) Is it possible to find the distribution-coefficient of Iodine in water and ethanol? Justify your answer.

(e) Explain the terms : rate law and rate-constant.

(f) Half-life period of a 1st order reaction is 90 sec. Find out its rate-constant.

SECTION – B

Answer all questions : 12 × 4

2. State phase-rule. Derive it. Explain true equilibrium and meta-stable equilibrium. 3 + 6 + 3

Or

Discuss phase-diagram of KI and H_2O system and $FeCl_3$ and H_2O system. 6 + 6

3. (a) Derive Gibb's-Duhem Margules equation for a binary system. 6

(b) What is CST ? Discuss a system with upper CST with one suitable example. 6

Or

(a) State distribution law. Derive it thermodynamically. 1 + 5

(b) Discuss a system having both upper and lower CST with a suitable example. 6

4. (a) Derive mathematically expression for the rate-constant of 2nd-order reaction of the type $2A \rightarrow$ product. 8

(b) Define and distinguish between molecularity and order of reaction. 4

Or

Write notes on :

(i) Opposing reaction

(ii) Activation energy and arrhenius equation. 12

5. Discuss and derive Gibb's adsorption isotherm. 12

2019

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY AND ALPHATIC HYDROCARBON)

SECTION – A

1. Answer all questions : 2 × 6

    (*i*) Write de-Broglie's equation and its significance.

---

(6)

(*e*) Write a note of Kolbe's electrolytic process for preparation of alkane. 4

(*f*) Discuss about dehydro halogenation of alkyl halides on the basis of Saytzeff's Rule. 4

———

(ii) State Hund's rule of maximum multiplicity. Why it is so called ?

(iii) Write the orbital denoted by $n = 3$, $l = 2$, $m = 0$ and $s = \pm \frac{1}{2}$ and find the maximum number of electrons which can be filled in it.

(iv) Explain why CO_2 has linear shape where as SO_2 has bent shape.

(v) State Huckel's rule of aromaticity and explain why furan is aromatic.

(vi) How can you distinguish ethyne and ethene ? Give one reaction.

SECTION – B

Answer **all** questions : 12 × 4

2. (a) Discuss briefly about Hydrogen spectrum. 4

(b) Write Schrödinger wave equation. Explain the significance of ψ and ψ^2. 4

(c) What is exchange energy ? How does it explains the stability of an electronic configuration ? 4

Or

(d) What do you mean by quantisation of energy ? Explain. 4

(e) Discuss briefly about the quantum numbers along with their significance. 4

(f) Write a note on radial and angular wave functions. 4

3. (a) Explain how lattice energy and solvation energy influence the solubility of an ionic solid. 4

(b) Derive Born equation for the potential energy due to attractive and repulsive inter-ractions. 4

(c) Explain the shape of XeF_4 on the basis of VSEPR theory and hybridisation. 4

(4)

Or

(d) Explain Born-Haber Cycle for the determination of lattice energy of an ionic lattice like NaCl. 4

(e) What is resonance ? Discuss about the resonating structures of CO_2 and NO_3^- ion. 4

(f) Discuss about M.O diagram of O_2 molecule and find its magnetic character. 4

4. (a) What is inductive effect ? How does it influence the basic characters of amines ? 4

(b) Discuss about the structure and relative stabilities of carbocations. 4

(c) Assign E/Z notations for the following : 4

(i) $\overset{H_3C}{\underset{H}{}}C=C\overset{NH_2}{\underset{Br}{}}$ and (ii) $\overset{C_6H_5}{\underset{H}{}}C=N{\diagdown}OH$
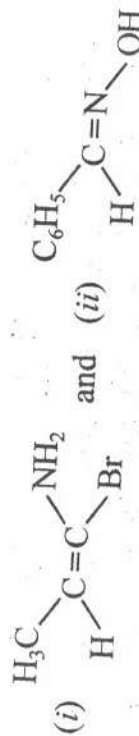
(5)

Or

(d) What is hyperconjugation ? Explain why But-2-ene is more stable than propene. 4

(e) Discuss about the conformations of butane alongwith Newmann's projection formula. 4

(f) What are enantiomers and diastereo isomers ? Explain with example. 4

5. (a) Write a note on Wurtz reaction. 4

(b) Explain Markownikoff's rule. 4

(c) What is ozonolysis reaction ? How this reaction can be used to detect the position of double bond in an alkene ? 4

Or

(d) What happens when ethye is reacted with

(i) Cu_2Cl_2 in the presence of base and

(ii) dilute H_2SO_4 in the presence of $HgSO_4$? 4

2018

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(INORGANIC CHEMISTRY-II)

SECTION – A

1. Answer *all* the following questions :　　　2×6

   (a) How is nickel refined by Mond's process ?

   (b) Every Bronsted base is also a Lewis base but every Bronsted acid is not a Lewis acid. Explain, giving examples.

(2)

(c) Explain why CO_2 is a gas, where as SiO_2 is a solid.

(d) Explain why HF is the weakest reductant whereas HI is the strongest reductant among the hydrogen halides.

(e) Give one method of preparation of peroxo-mono sulphuric acid. What happens when it is reacted with KI ?

(f) What are silicates ? What are the various types of silicates ?

SECTION – B

Answer all questions : 12×4

2. (a) Discuss about the electrochemical principles involved in the extraction of metals. Discuss about Ellingham diagram for the selection of appropriate reducing agent for the reduction of a metal oxide.

Or

(b) Explain Pearson's HSAB principle. Discuss about its limitations.

SH CHE–05   (Continued)

(3)

3. (a) Describe the preparation of Beryllium nitrate and Beryllium acetate. Discuss about the structure of Beryllium nitrate.

Or

(b) What do you understand by the term catenation ? How the tendency of catenation varies in a group ? Why the group 15 elements have less tendency to show catenation than the elements of group 14 ?

4. (a) Describe the preparation, properties and structure of orthoboric acid.

Or

(b) What are interhalogen compounds ? Give one example of each type of interhalogen compound with method of preparation. Why most of the interhalogen compounds contain fluorine ?

5. (a) Describe any two methods of preparation of XeF_4. Describe its structure. What happens when XeF_4 is hydrolysed by water ?

SH CHE–05   (Turn Over)

(4)

(b) What is borazine ? Describe atleast two methods of preparation of borazine. Describe its structure.

———

2018

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(ORGANIC CHEMISTRY - II)

SECTION – A

1. Answer *all* questions of the following :   2 × 6

   (*a*) How can you prepare allylchloride from propene ?

   (*b*) How can you prepare 1-phenyl ethanol from benzene ?

(2)

(c) Complete the reaction :

OH
$\underset{\text{CHO}}{\bigcirc} + CH_3(CH_2)_4COOH \xrightarrow{ZnCl_2} [A] \xrightarrow{Zn - Hg/HCl} [B]$

(d) Explain the order of reactivity of acid derivatives.

(e) Carbonyl compounds undergo nucleophilic substitution addition reaction but acylchloride prefer substitution reaction. Explain.

(f) How can you prepare sulphanilic acid from benzene ?

SECTION – B

Answer all questions : 12×4

2. (a) What is Wurtz-Fittig's reaction ? Discuss its

(i) Mechanism

(ii) Explain the relative reactivity of vinyl and aryl halides.
$8 + 4$

(3)

Or

(b) Explain the following : $3 + 3 + 6$

(i) Chlorine in chlorobenzene is inert.

(ii) Saytzev's rule

(iii) An unsaturated hydrocarbon 'A' upon hydration gave an alcohol 'B' which on oxidation gave a ketonic compound 'C'. 'C' when reacts with I_2 and NaOH gave propanoic acid. Identify the compounds A, B and 'C' and explain the various reaction involved.

3. (a) Discuss the general methods of preparation of phenol. How does phenol reacts with :   12

(i) CHCl$_3$/KOH

(ii) CO$_2$/HCl

(iii) Phthalic anhydride,

Or

(b) Explain the following name reactions : 4×3

(i) Pinacol-Pinacolone rearrangement.

(ii) Claisen's rearrangement

(iii) Fries rearrangement.

4. (a) State and explain the following with mechanism (any two) : 12

(i) Michael addition reaction

(ii) Knoevenagel condensation reaction

(iii) Backmann's rearrangement.

Or

(b) How can you prepare malonic ester ? Starting from malonic ester how can you synthesised the following compounds (i) Succinic Acid (ii) Cinnamic Acid (iii) Acetoacetic ester. 12

5. (a) An organic compound 'A'(C_5H_8) when

(i) Treated with sodium and liquid NH_3 followed by reaction with n-propyl iodide yields 'B' (C_8H_{14}). 'A' gives a ketone 'C' ($C_5H_{10}O$) when treated with

(*Continued*)

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dil H_2SO_4 and HgSO4. 'B' on oxidation with alkaline $KMnO_4$ gives two isomeric acids 'D' and 'E'. Identify the compounds 'A' to 'E' with proper reasoning. 8

(ii) Explain why acetyl chloride is hydrolysed at a faster rate than benzoyl chloride by aqueous NaOH ? 4

Or

(b) How Latic acid is prepared from Acetaldehyde ? What happens when Latic acid is : 12

(i) Heated in presence of Fenton's reagent ?

(ii) Heated with conc. H_2SO_4

(iii) Heated alone.

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SH CHE–07

2018

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from both the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words
as far as practicable

(PHYSICAL CHEMISTRY-III)

SECTION – A

1. Answer all questions :   2 × 6

   (a) Define the terms :

      (i) Eutectic

      (ii) Triple point.

   (b) What is meant by a condensed system and predict the reduced phase rule equation.

   (c) What is CST ?

(Turn Over)

(d) Show that the time taken for 99% completion of a first order reaction is double the time taken for 90% completion of the reaction.

(e) Define the terms physical and chemical adsorption.

(f) Why a rough surface piece of platinum metal acts as a good catalyst in comparison to a metal piece having a smooth surface ?

SECTION – B

Answer all questions : 12×4

2. (a) Explain the phase diagram of sulphur system. 12

Or

(b) Justify or criticise the following statements :

4×3

(i) Three phases cannot co-exist in a one component system.

(ii) The fusion curve in the phase diagram of water system has a negative slope.

(iii) The solid-vapour line is more steep than liquid-vapour line at the triple point of water system.

(Continued)

(iv) Phase diagram of water is used to explain ice skating.

3. (a) Apply phase rule to a three components water-chloroform-acetic acid system.   12

Or

(b) What is azeotrope ? Discuss the type of azeotropes in case of binary mixture. Why azeotrope cannot be separated into its constituents by simple distillation.   12

4. (a) (i) Discuss the methods for determination of order of reaction with reference to

(I) Fractional change

(II) Vant Hoff differential methods.   8

(ii) In the reaction

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

at 336 mm Hg initial pressure, was half changed in 108 sec and when the initial pressure was 288 mm Hg, it was half changed in 147 sec. Determine the order of reaction.   4

(Turn Over)

(4)

Or

(b) (i) Most of the reactions do not occur at
room temperature. Explain.   3

(ii) Define activation energy. Derive
Arrhenius equation to calculate the
activation energy of a reaction at different
temperatures.   6

(iii) Calculate the activation energy of a first
order reaction whose temperature
coefficient is 2 obtained by studying the
reaction at 25 °C and 35 °C.   3

5. (a) Explain Langmuir adsorption isotherm.
Derive the adsorption isotherm equation on
the basis of Langmuir postulates.   12

Or

(b) What is acid-base catalysis ? Explain the
kinetics of acid-base catalysis.   12

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SG CHE–01

2018

(3rd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY AND ALPHATIC HYDROCARBON)

SECTION – A

1. Answer *all* questions : 2×6

   (*i*) What are the different series of spectral lines of hydrogen spectra ?

   (*ii*) Write down the Schrödinger wave equation and write down the significance of ψ.

(2)

(iii) Explain the relationship between lattice energy and solvation energy.

(iv) Assign (R, S) notation to the following :

$$H_3C - \underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}} - Cl \quad \text{and} \quad H - \underset{\underset{OH}{|}}{\overset{\overset{CHO}{|}}{C}} - CH_3$$

(v) Predict the product and state the reason.

$$CH_3 - CH = CH_2 + HI \rightarrow$$

(vi) Explain why monochloroacetic acid is more acidic than acetic acid.

SECTION – B

Answer all questions : 12×4

2. (a) What is Heisenberg's uncertainity principle? What is its significance ? 4

(b) Write down the shapes of p and d orbitals. 4

(c) Find out the values of the four quantum numbers for the electron revolving in $2p$ and $3d$ orbital. 4

(3)

(d) What is aufbau principle, explain with suitable example. 4

(e) Explain Hund's rule of maximum multiplicity with example. 4

(f) Write down the electronic configuration of Cr and Cu. 4

3. (a) How can you calculate lattice energy using Born-Haber cycle. 4

(b) What are Fajan's rules ? 4

(c) What is M.O. theory ? Draw the M.O. diagram of CO. 4

Or

(d) What is VSEPR theory? Write down the rules of this theory. 4

(e) Predict the shapes of SnCl$_2$ and SF$_6$ molecules on the light of VSEPR theory. 4

(4)

(f) What is dipole moment? How can you calculate the percentage ionic character of HCl molecule?   4

4. (a) Define Resonance. Why p-nitrophenol is more acidic than phenol?   4

(b) Write down a method of formation of carbocation and discuss the stability of $1°$, $2°$ and $3°$ carbocations.   4

(c) What are the important conditions for a compound to become aromatic? Explain.   4

Or

(d) Write down different conformers of n-butane and show their energy diagramatically.   4

(e) Assign E/Z notations for the following: 4

(i)
$$H_3C \quad Cl$$
$$C=C$$
$$H \quad OH$$

and (ii)
$$I \quad Cl$$
$$C=C$$
$$H \quad Br$$

(f) Explain how D and L notations are assigned to glucose molecule.   4

(*Continued*)

(5)

5. (a) How can you prepare ethene from the following: 6

(i) Ethanol

(ii) Ethylbromide and

(iii) Ethyne.

(b) What is Saytzef rule? Explain with a suitable example.   4

(c) What is Anti-Markownikoff's rule?   2

Or

(d) What happens when: 3×4

(i) Methane is treated with Cl_2 in presence of Sunlight.

(ii) Calcium carbide is sprinkled with water?

(iii) Ethylene is reacted with alkaline $KMnO_4$?

(iv) Acetylene is reacted with Cu_2Cl_2?

_____

2017

(Semester-III)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

The figures in the right-hand margin indicate marks.

Answer from both the Sections as per direction.

(Inorganic Chemistry-II)

SECTION—A

Answer **all** questions :

1. Answer *all* of the following :

2×6

   (a) What is zone refining ? Explain.

   (b) Explain how liquid NH_3 behaves as a levelling solvent for different acids.

   (c) Explain why NF_3 has very low dipole moment and it does not act as a Lewis base.

   (d) How is boron nitride prepared from BCl_3 ? What happens when it is hydrolysed by H_2O ?

(*Turn Over*)

(e) Define inert pair effect. Give example.

(f) Explain why noble gases form compounds with F_2 and O_2 only.

SECTION—B

Answer all questions : 12 × 4

2. (a) Use Ellingham diagram to explain the use of carbon and carbon monoxide for the reduction of metal oxides.

Or

(b) What are Lewis acids and Lewis bases ? Explain the effect of substituents on the strength of Lewis acids and bases.

3. (a) What are Hydrides ? Describe the various types of hydrides with one method of preparation for each type.

Or

(b) What is allotropy ? Discuss about the various allotropic forms of Group-16 elements.

4. (a) Give the preparation, properties and structure of diborane.

Or

(b) Name the different oxyacids of chlorine. Give one method of preparation and discuss about the structure of chloric acid. Discuss about the relative strengths of oxyacids of chlorine.

5. (a) What are clathrate compounds ? What are the conditions for clathrate formation ? Explain the various types of clathrates.

Or

(b) What are silicones ? What are the various types of silicones ? Discuss the preparation of linear and cross linked silicones.

_____

2017

(Semester-III)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

The figures in the right-hand margin indicate marks.

Answer from both the Sections as per direction.

(Organic Chemistry-II)

SECTION—A

Answer all questions :

1. Answer *all* of the following : 2 × 6

    (a) How can you distinguish between benzyl chloride and chlorobenzene ?

    (b) Phenol is acidic but did not give effervescence with $NaHCO_3$. Explain.

    (c) Account for the fact that ether is soluble in H_2SO_4.

    (d) How can you distinguish between HCOOH and CH_3COOH ?

(Turn Over)

(e) Complete the reaction :

$\xrightarrow{\text{peroxybenzoic acid}}$

(f) Acetone is less reactive towards addition nucleophilic (Ad_N) reaction compare to acetaldehyde. Explain.

SECTION—B

Answer all questions : 12×4

2. (a) Explain S_N1 and S_N2 reactions with special reference to stereochemistry taking suitable examples. 12

Or

(b) Discuss benzyne mechanism. Give one evidence in support of this mechanism.

3. (a) Explain the following : 3×4

(i) Ethyl alcohol responds to iodoform test.

(ii) Phenol is more reactive towards nitration reaction than benzene.

(iii) The reactivity of halo acids with ether follows the order $HI > HBr > HCl$.

(iv) Acid catalysed dehydration of tert-butyl alcohol is faster than that of n-butanol.

Or

(b) Discuss the methods of preparation of ethylene glycol. How does ethylene glycol reacts with : $6 + 6$

(i) Phosgene (ii) HIO_4

4. (a) State and explain the following with mechanism (any two) : 6×2

(i) Perkin's reaction

(ii) Michael addition reaction

(iii) Backmann's rearrangement.

Or

(b) Discuss the preparation of AAE. Starting from AAE how can you prepare the following compounds : 12

(i) 2-methyl propanoic acid

(ii) Crotonic acid

(iii) r-ketovaleric acid

5. (*a*) What happens when : 4×3

    (*i*) Propanoic acid is heated with bromine in presence of red phosphorous ?

    (*ii*) How can you convert acetic acid to ethyl amine ?

    (*iii*) How phthalic acid reacts with phenol ?

    (*iv*) What happens when citric acid is heated with fumming H_2SO_4 ?

Or

(*b*) Explain the following : 4×3

    (*i*) Acid anhydrides are less reactive than acid chlorides.

    (*ii*) Trans-esterification reaction

    (*iii*) Dieckmann's reaction

    (*iv*) Curtius rearrangement reaction.

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2017

(Semester-III)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

The figures in the right-hand margin indicate marks.

Answer from both the Sections as per direction.

(**Physical Chemistry-III**)

SECTION—A

Answer **all** questions :　　　　　2×6

1. (a) What are the limitations of phase rule ?

   (b) Define the term true and metastable equilibrium.

   (c) Calculate the number of phases, components, and degree of freedom for
   $$Fe(s) + H_2O(g) \rightleftharpoons FeO(s) + H_2(g)$$

   (d) Show that the half-life period of a first order reaction is independent of initial concentration of reactant.
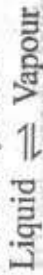
(e) What is azeotrope ? Give one example of minimum boiling azeotrope.

(f) Distinguish between catalyst and photo-sentizer.

SECTION—B

Answer all questions : 12 × 4

2. (a) Derive Clausius-Clapeyron equation for the equilibrium system :

   Liquid ⇌ Vapour

   How will you obtain the heat of vapourisation using this equation ? 12

   Or

   (b) State phase rule. Derive the phase rule thermodynamically.

3. (a) State and explain Nernst distribution law with special reference to association of solute in one of the solvent. 12

   Or

   (b) Derive Gibbs-Duhem-Margules equation for a binary solution. Explain why it is applicable to both ideal and non-ideal liquid mixtures ?

4. (a) What do you understand by complex reactions ? Explain consecutive and reverse reactions. 12

   Or

   (b) Derive the expression for the rate :

   (i) Constant of a second order reaction of the type $A + B \rightarrow$ Product. 8

   (ii) Explain the characteristics of second order reaction. 4

5. (a) Define catalyst. Discuss the general characteristics of catalyst. 12

   Or

   (b) Derive the Michaelis-Menten equation in enzyme catalysis and show the result graphically indicating the change in order of kinetics involved.

SGCHE 01

2017

(Semester-III)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

The figures in the right-hand margin indicate marks

Answer from **both** the Sections as per direction

(Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons)

SECTION — A

1. Answer *all* questions :

2 × 6

(a) Describe briefly the limitations of Bohr's theory.

(b) PCl_5 exists, whereas NCl_5 does not, explain.

(c) What is the relation between dipole moment and percent ionic character ?

(d) How will you distinguish enantiomers from diastereomers ?

(e) Acetylene is more acidic than ethane, explain.

(f) How will you distinguish between acetylene and ethylene ?

SECTION—B

Answer any four questions : 12 × 4

2. (a) Derive Schrödinger wave equation. 4

(b) Describe the de Broglie equation. 4

(c) Discuss the Exchange energy with suitable examples. 4

Or

(d) What is radial and angular wave function ? 4

(e) Draw the radial probability distribution curves for 2s, 2p, 3s and 3p orbitals. 4

(f) Briefly discuss the origin of hydrogen spectrum from Bohr's theory. 4

3. (a) Draw the molecular orbital diagram of N_2 and NO molecules. 6

(3)

(b) Discuss the geometry of the following molecules : 6

$$SO_3, XeF_4, NO_3^-$$

Or

(c) How can you calculate the lattice energy of an ionic solid by Born-Lande equation ? 4

(d) Write the essential rules for resonance. Discuss the resonating structures of CO_3^{2-} ion. 4

(e) Discuss the geometry of the following molecules : 4

$$ClF_3, SO_4^{2-}$$

4. (a) Discuss on the stabilities of different possible conformations of cyclohexane. 6

(b) Write notes on the following : 6

  (i) Inductive effect

  (ii) Hyperconjugation.

Or

(c) Discuss on the optical isomerism in lactic acid and tartaric acid. 6

(4)

(d) Give an account of mode of formation of carbocations and carbanions. Discuss on their stabilities. 6

6

5. (a) Write notes on the following :

 (i) Ozonolysis reaction

 (ii) Wurtz reaction.

 (b) How will you synthesize : 6

 (i) Benzene from acetylene

 (ii) Ethane from acetic acid.

Or

(c) Discuss Markownikoff's and Anti-Markownikoff's addition reaction in case of propene. 6

(d) Discuss the following reactions with their mechanism : 6

 (i) Hydration of alkenes

 (ii) Chlorination of methane.