

21/11/22 o/c

Deccan Education Society's
Fergusson College (Autonomous) Pune-4
F.Y.B.Sc. Semester II

CHEMISTRY-I
PHYSICAL AND INORGANIC CHEMISTRY (CHE1201)
(2016 Pattern)

Time: 2Hours

Marks:50

INSTRUCTION TO THE CANDIDATES:

- 1) All Questions are compulsory.
- 2) Figures to the right indicate full mark.
- 3) Draw figures/ diagrams wherever necessary.

Q.1. Answer any FIVE of the following.

(10 Marks)

- 1) Define buffer and its types.
- 2) Define degree of ionisation and mention the factors affecting it.
- 3) Mention the limitations of Arrhenius concept of acid and base.
- 4) Determine the Miller Indices for a plane when the intercept along the axes are 2a, 1b, 2c.
- 5) Calculate the pH of 0.02 M $\text{Ba}(\text{OH})_2$ solution.
- 6) Explain vacancy defect with suitable diagram.
- 7) Draw lewis dot structure of O_2 molecule and mention the number of bonding and non-bonding electrons.
- 8) What is the pH range and color change of phenolphthalein indicator.

Q.2.(A) Answer any THREE of the following.

(9 Marks)

- 1) Derive the equation for ionic product of water.
- 2) Explain the mechanism of acidic buffer with suitable example.
- 3) Write the conditions for formation of Ionic bond?
- 4) Explain the structure of Sulphur Dioxide on the basis of VSEPR Theory?
- 5) Explain the Valence Bond Theory with an example.

Q.2.(B) Answer any TWO of the following.

(6 Marks)

- 1) Find the interplanar distance in a crystal in which a series of plane produce first order reflection from X-ray tube ($\lambda=1.345\text{\AA}$) at an angle of 23.2° .
- 2) At 20° the solubility of silver chloride in water is 1.435×10^{-3} g/litre. Find the solubility product of silver chloride? (M. W. of silver chloride= 143.5)
- 3) Calculate the concentration of sodium formate that must be present in 0.20 M solution of formic acid to produce a pH of 4.00. Given K_a of formic acid = 1.8×10^{-4} .

Q.3.(A) Answer any THREE of the following.

(15 Marks)

- 1) Define acid-base indicator. Discuss the choice of suitable indicator for the titration of strong base with strong acid using pH – curve.
- 2) On the basis of VSEPR Theory explain the hybridisation and shape of following molecules
 - a) I_3^-
 - b) XeF_5^-
- 3) Ne_2 molecule does not exist in nature. Explain on the basis of Molecular Orbital Theory.
- 4) Write short notes on –
 - a) Isotropy & Anisotropy.
 - b) Symmetry elements with suitable diagrams.
- 5) a) Derive the relation between degree of dissociation, concentration and dissociation constant of weak acid.
b) Explain the decreasing order of dissociation constants K_{a1} , K_{a2} , K_{a3} for H_3PO_4 with reasons.

Q.3.(B) Answer any TWO of the following.

(10Marks)

- 1) NaCl crystal has FCC structure. Its density is $2.163 \times 10^3 \text{ Kg m}^{-3}$. Calculate the edge of the unit cell cube.
[$M_{\text{NaCl}} = 58.45 \times 10^{-3} \text{ Kg/mole}$, $N_0 = 6.023 \times 10^{23}$ per mole]
- 2) Calculate the pH of 0.1M CH_3COOH . The dissociation constant of acetic acid is 1.8×10^{-5}
- 3) Calculate the pH before and after the addition of 0.2 moles/litre of HCl solution to a buffer containing 0.5 moles/litre of formic acid and 0.5 moles/litre of sodium formate. Given K_a of formic acid = 1.8×10^{-4}

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Deccan Education Society's
Fergusson College (Autonomous), Pune-4

F.Y.B.Sc. (Semester-II)
Subject: -Stereochemistry, Hydrocarbons & Mole Concept
(CHE1202)(2019 pattern)

Time:

Max. Marks: 50

Instruction to candidates:

- All questions are compulsory
- Figures to the right indicate full marks
- Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

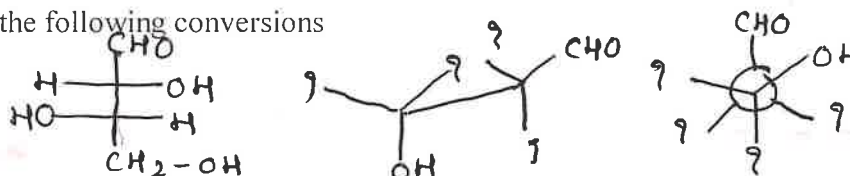
[2 x 5 = 10]

- Define geometrical isomers with suitable examples.
- Why eclipsed conformation is more unstable than staggered conformation? Explain.
- Meso Compound is Optically inactive. Explain.
- Why cyclopentadienyl anion is aromatic?
- Explain pyridine is more basic than pyrrole.
- Explain oxidation number with suitable example.
- Define : Molality

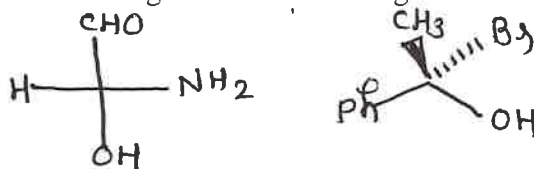
Q.2 Attempt any five questions:

[3 x 5 = 15]

- Do the following conversions



- Find out R and S configuration of following



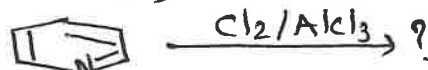
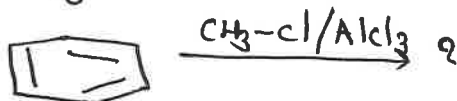
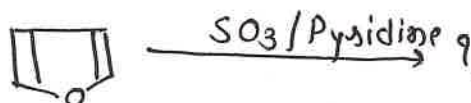
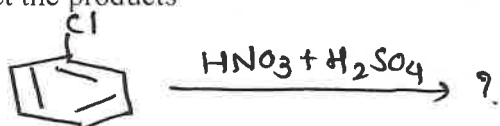
- What are the criteria for aromaticity? Explain with respect to naphthalene.
- Furan acts as diene and shows Diels Alder reaction. Explain
- Comment on aromaticity of the following compounds
 - Cyclopropenyl Cation
 - Cycloheptatrienyl cation
 - cyclobutadiene

- f) Find oxidation number of Mn in KMnO_4 and MnO_2 .
- g) State rules to assign oxidation number.

Q.3 Attempt any five questions:

[5 x 5 = 25]

- a) Explain conformations of n-butane with energy profile diagram.
- b) Define with suitable examples.
- Enantiomer
 - Diastereoisomer
- c) Explain Friedel Craft Alkylation and its drawbacks.
- d) Predict the products



- e) What are aromatic heterocyclic compounds? Give their classification with one example each.
- f) Balance the following reactions by ion electron method



- g) Define with suitable examples.
- Equivalent weight
 - Normality

22/11/2022

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Deccan Education Society's
Fergusson College (Autonomous) Pune-4
F. Y. B. Sc Semester II
Chemistry
Organic & Inorganic Chemistry (CHE1202)
(Paper -II) (2016 Pattern)

Time: 2 Hours

Max Marks: 50

*Instructions: a) All questions are compulsory.**b) Figures to right indicate full marks.**c) Draw neat labelled diagrams whenever necessary.***Q.1 Define Any Five of the following questions:**

(2x5=10)

a. Predict the products (A) and (B)



b. What are oxidizing and reducing agents?

c. Why does He₂ molecule not exist?

d. Match the following

Be₂

Diradical

B₂

Paramagnetic

O₂⁺

Diamagnetic

N₂

Unknow species

e. Classify the following compounds into aromatic and anti-aromatic



f. What is the oxidation state for elements represented in bold?

i) **Sb**₂S₃ ii) H₃**P**O₄

g. Write major and minor product obtained from following reaction.

**Q.2 Answer Any Five of the following questions:**

(3x5=15)

a. What are alkenes? How is propene prepared from – a) propyl bromide b) iso-propanol?

b. Write note on dehydrohalogenation.

c. What is Friedel-Craft acylation? How it is carried out by using a) acyl halide b) carboxylic acid?

d. Write the principle involved in estimation of iron from the given solution of Fe²⁺ using 0.05N KMnO₄ solution.

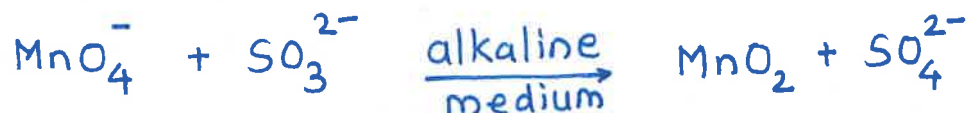
e. Discuss Hückel's rule of aromaticity with suitable example.

- f. What is standard electrode potential? What are its applications in inorganic reactions?
 g. Explain formation of H_2 molecule with the help of molecular orbital diagram.

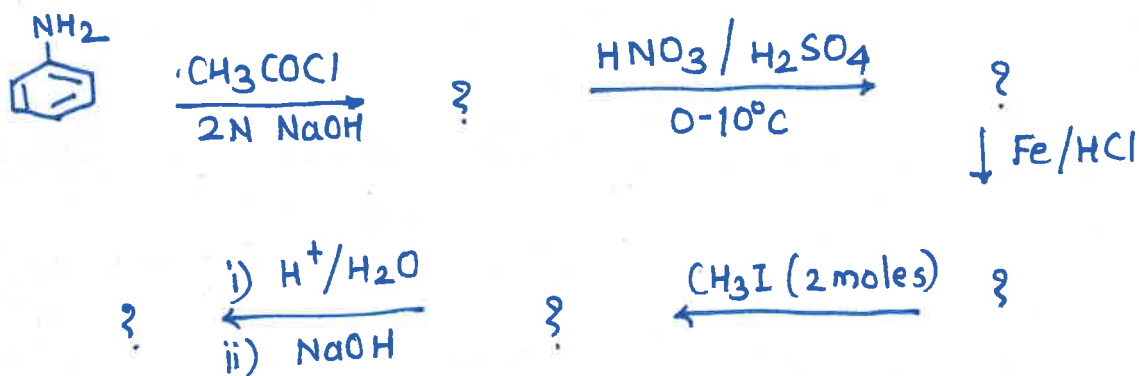
Q.3 Answer Any Five of the following questions:

(5x5=25)

- a. Balance the following reaction using ion-electron method.



- b. Complete the following sequence



- c. Explain formation of O_2 molecule with following details.
 i) MO diagram
 ii) MO electronic configuration
 iii) Stabilizing energy
 iv) Bond order
 v) Paramagnetic/diamagnetic in nature
- d. Elaborate on E1 and E2 mechanism.
- e. Write a note on oxymercuration and deoxymercuration.
- f. Comment on the following observation

Reactant	→	Product	Relative rates
CH_3CH_2Br	→	$CH_2=CH_2$	1.0
$CH_3CH_2CH_2Br$	→	$CH_3-CH=CH_2$	3.3
$CH_3-CHBr-CH_3$	→	$CH_3-CH=CH_2$	9.4
$(CH_3)_3C-Br$	→	$(CH_3)_2C=CH_2$	120.0

- g. Write mechanism of ozonolysis with suitable example.

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10:30

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**Deccan Education Society's
Fergusson College (Autonomous), Pune-411004
S.Y.B.Sc. (Semester III)
Subject: Chemistry
(CHE 2301) Chemical Kinetics and Quantitative Analysis of
Organic Compounds (2016 pattern)**

Time: 2hr 30min

Max. Marks: 50

Instructions to candidates:

- i) *All questions are compulsory*
- ii) *Figures to the right indicate full marks*
- iii) *Use of logarithmic tables and scientific calculators is allowed.*

Q.1 Attempt any five questions:

[2 x 5 =10]

- a) Write the unit for the zero-order reaction.
- b) In first-order reaction, it takes the reactant 40.5min to be 20% decomposed. Calculate the rate constant of the reaction.
- c) Explain with an example of heterogeneous catalysis.
- d) Write any two applications of Nernst distribution law.
- e) Give examples of two acidic and two basic radicals.
- f) What is a Confirmatory test for carboxylic acid with the reaction?
- g) Calculate the correct number of significant figures for the final solution:
 $76.4 + 180.4 = ?$

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) Write the condition validity of Nernst distribution law?
- b) In the fermentation of sugar in an enzymation solution that is initially 0.12M. The concentration of sugar is reduced to 0.06M in 10 hrs and 0.03M in 20 hrs. What is the order of reaction? What is the rate constant of reaction?
- c) Write characteristics of catalytic reactions

- d) What are the group reagents used from Gr I to Gr V in Inorganic Qualitative Analysis?
- e) Find out the absolute and relative errors, where the actual and measured values are 252.14 mm and 249.02 mm.
- f) Write short note : Lassigne's Test
- g) The solubility of BaSO_4 is $1.0 \times 10^{-3} \text{ mol lit}^{-1}$ at 20°C . Calculate solubility product of BaSO_4 assuming salt is completely ionized.

Q.3 Attempt any five questions:

- a) Discuss the kinetics of acid base catalyzed reaction.
- b) Integrate the rate equation for second order reaction, when both the reactants are the same.
- c) Experiments in study of distribution of phenol between water and chloroform gave the following result

concentration in aqueous solution (C1)	0.094	0.163	0.254	0.436
concentration in chloroform solution (C2)	0.254	0.761	1.85	5.430

What conclusion can be drawn from these results about the molecular condition of phenol in chloroform solution?

- d) Explain with suitable diagram : Method for Quantitative estimation of Nitrogen from organic compound.
- e) i) Explain Common ion effect with example
ii) Write note on : Interfering radicals in Inorganic Qualitative Analysis
- f) Quantitative analysis of an organic compound gave the following results.
% of carbon = 92.3 and % of hydrogen = 7.7
If the molecular weight of the compound is 78. Calculate its molecular formula. (Atomic wt C= 12 Atomic wt H =1)
- g) Write note on : Applications of Chemical analysis.

8/12/2022
10:30 am

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
S.Y.B.Sc. (Semester III)
Subject: Chemistry
(CHE 2302) Organic Chemistry (2019 pattern)

Time: 2 Hours 30 minutes

Max. Marks: 50

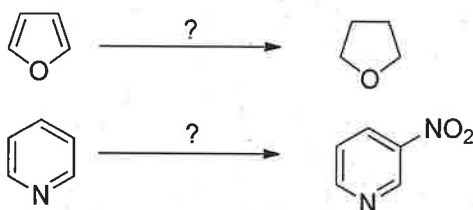
Instruction to candidates:

- i) All questions are compulsory.
- ii) Figures to the right indicate full marks.
- iii) Use of statistical tables and scientific calculators is allowed.

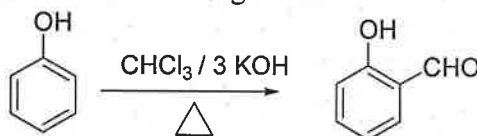
Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Match the following.
 - 1) Birch reduction A) $\text{CrO}_3/\text{H}_2\text{SO}_4$
 - 2) OsO_4 B) alkane
 - 3) Sn/HCl C) *cis*-hydroxylation
 - 4) Jones reagent D) substituted 1,4-cyclohexadiene
- b) Draw the structure of lactose.
- c) Write the reaction involving nitrene intermediate.
- d) Comment on the aromaticity of pyridine.
- e) Complete the following conversions reaction sequence by choosing the correct reagent/s and reaction conditions.



- f) Identify the name of the following reaction.



- g) Draw the stable most conformation of *t*-butylcyclohexane.

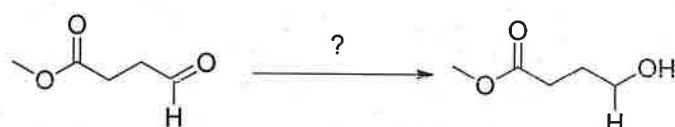
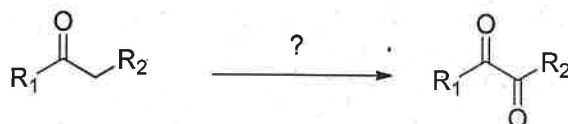
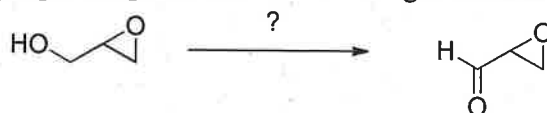
Q.2 Attempt any five questions:

[3 x 5 = 15]

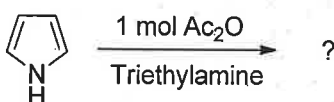
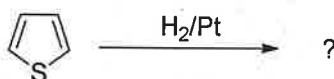
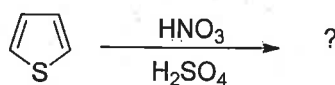
- a) Summarize the factors affecting the stability of cyclohexane conformation.
- b) Elaborate on E2 elimination and list the factors affecting the rate of E2 reaction.
- c) Why is there a need for Wittig-Horner modification over the Wittig reaction?

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- d) Plan synthesis of D-glyceraldehyde from D-erythrose via Ruff degradation.
 e) Choose the proper reagent/s for the following reactions.



- f) Predict the Product/s.



- g) Enlist *three* tests of identification of amino acid.

Q.3

Attempt any five questions:

[5 x 5 = 25]

- Elaborate on the mechanism of Prevost oxidation.
- Make use of Killani-Fischer synthesis in preparation of aldopentose from aldotetrose.
- Write the reasonable mechanism for pinacol-pinacolone rearrangement.
- Illustrate on Paal-Knorr synthesis of pyrrole.
- Explain Beckmann rearrangement and Hoffmann bromide degradation with a suitable example.
- Distinguish between S_N1 and S_N2 reactions.
- Draw and explain the energy profile diagram for cyclohexane conformations.

22-11-2022

O/C

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**S.Y.B.Sc. (Semester IV)
Subject: Inorganic Chemistry
(CHE 2401) (2019 pattern)**

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

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory.
- ii) Figures to the right indicate full marks.
- iii) Use of scientific calculators are allowed.

[Given, Atomic No. V-23, Cr-24, Mn-25, Fe-26, Co-27, Ni-28, Cu-29, Zn-30]

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Find the primary and secondary valency in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$ complex.
- b) Find out the oxidation state of Fe in the complex $\text{K}_4[\text{Fe}(\text{CN})_6]$ and give the IUPAC name of this complex.
- c) What are interhalogens? Give two examples.
- d) Oxidation state of Boron is +III but Thallium is +I – Why?
- e) Identify Lux-Flood acid and Lux-Flood base in the given equation.
 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
- f) Define Lewis bases. Give two examples.
- g) Draw the structure of borazine.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) What is the Effective Atomic Number (EAN) rule? Predict the stability of $[\text{Ni}(\text{CO})_4]$ complex by EAN rule.
- b) Predict hybridization and geometry of paramagnetic complexes –
 - (i) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ (n=2)
 - (ii) $[\text{MnBr}_4]^{2-}$ (n=5)
- c) Calculate spin only magnetic moments for (i) V^{3+} (ii) Fe^{3+} (iii) Co^{2+} .

- d) Give an account for the allotropes of sulphur.
- e) Draw the structures of
- (i) BF_3
- (ii) PCl_5 .
- f) Give two merits of Bronsted-Lowry theory. Write down the conjugate acids of the following -
- i. HPO_4^{2-} ii. SO_4^{2-}
- iii. NH_2^- iv. CN^- .
- g) What are oxyacids? What will be the order of the increasing acid strength in HOI , HOCl , HOBr ?

Q.3

Attempt any five questions:

[5 x 5 =25]

- What are outer and inner orbital complexes. Predict the hybridization and geometry of paramagnetic complex ion $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$.
- What is isomerism? Explain stereoisomerism with suitable example. Draw the isomers possible for the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$.
- What are boranes? Discuss different types of boranes with examples.
- What is the general electronic configuration of Group VI elements? Give an account of oxoacids of sulphur.
- Explain the anomalous behavior of Carbon from rest of the Group IV elements. Discuss the classification of silicates.
- With the help of structure and bonding explain the order of acidity of the following acids: HClO_4 , HClO_3 and HClO_2 .
- Write the names of the noble gas elements and their electronic configuration. Explain the bonding, hybridization, and structure of XeF_6 molecule.

22-11-2022

O/c

**Deccan Education Society's
Fergusson College (Autonomous), Pune-411004
S.Y.B.Sc. (Semester IV)
Subject: Chemistry
(CHE 2401) Thermodynamics and Volumetric Analysis (2016 pattern)**

Time: 2 Hrs

Max. Marks: 50

Instructions to candidates:

- i) *All questions are compulsory*
- ii) *Figures to the right indicate full marks*
- iii) *Use of logarithmic tables and scientific calculators is allowed.*

Q.1 Attempt any five questions:

[2 x 5 =10]

- a) Give any two statements of Second law of thermodynamics.
- b) Distinguish between isothermal and adiabatic process.
- c) State and explain Raoult's law.
- d) State and explain Henry's law.
- e) Give each two examples of a primary and secondary standard substance.
- f) What is Normal and Molar solution.
- g) Give any two examples of acid base indicators with its pH transition range.

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) 16 gm of O₂ is expanded isothermally and reversibly from 5 dm³ to 15 dm³ at 25°C. Calculate the maximum work done in the process
- b) Distinguish between ideal and non-ideal solutions,
- c) Heat supplied to Carnot engine is 1897.8 kJ. How much useful work can be done by engine which works between 0°C and 100°C?
- d) Write Clausius Clapeyron equation. Explain different terms involved in it.
- e) Calculate pH of the solution when 30ml 0.1 N HCl added to 25 ml 0.1N NaOH.
- f) Draw structure of Mg EDTA complex.
- g) Calculate amount of in grams required to prepare 100 ml 0.025N oxalic acid solution (Given eq. wt. of Oxalic acid = 63)

Q.3 Attempt any five questions:

- a) Derive an Gibbs Helmholtz equation.
- b) Explain the distillation of non-ideal solution with a positive deviation using temperature composition diagram
- c) Write note on Carnot cycle.
- d) Distinguish between iodometry and iodimetry
- e) Explain using titration curve of Strong Acid Strong Base titration
- f) Write a note on the Standardisation of Sodium Thiosulphate.
- g) Write a short note on Theory of indicators.

23/11/2022
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Deccan Education Society's
Fergusson College (Autonomous), Pune-411004

S.Y.B.Sc. (Semester IV)
Subject: Analytical Chemistry
(CHE 2402) (2019 pattern)

Time: 2 Hrs 30 minutes
Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of logarithmic tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Define the terms: i) Accuracy ii) Precision
- b) How is Nitrogen detected from organic compounds?
- c) What are the functional groups of following organic compounds?
i) Acetic acid ii) p nitro aniline iii) Acetone iv) β naphthol.
- d) What is the pH of the resultant solution after adding 6.0 ml, 0.1 N NaOH to 10 ml 0.1 N HCl?
- e) Give classification of determinate errors.
- f) Calculate absolute and relative errors if the theoretical value is 12.5 ml and the measured value is 11.9 ml.
- g) Write the group reagents for Gr IV & Gr V in Inorganic Qualitative Analysis.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) An organic compound on elemental analysis was found to contain C = 77.42%, H = 7.53%, N = 15.05%. Calculate its molecular formula if the molecular weight is 93.
- b) What is a test for phenolic OH and write down the reaction of the same.
- c) Calculate the proper number of significant figures each of the following:
i) 443.01 ii) 5.9071 iii) 1.539×10^{-3} iv) 2.0035
- d) What is the difference between iodometry and iodimetry?

- e) How are the following reagents prepared?
i) Nessler's reagent ii) Tollen's Reagent iii) Hypoiodite reagent
- f) Calculate the normality and strength of the resultant solution when 25 ml HNO_3 solution reacts with 20 ml of 0.125 N NaOH solution (Eq. Wt. of HNO_3 = 63)
- g) What is the common ion effect and write its application in qualitative analysis.

Q.3 Attempt any five questions:

[5 x 5 =25]

- a) Explain the quantitative analysis of Mg solution by complexometric titration.
- b) Write short notes:
i) Applications of chemical analysis
ii) Factors affecting choice of method in chemical analysis
- c) What are interfering anions? Why are they removed from the solution? Explain removal of Phosphate by FeCl_3 method?
- d) i) Calculate solubility of AgCl in water at 25 °C.
(K_{sp} for AgCl = 2.8×10^{-10})
ii) Four different samples were analyzed for Fe and were found to contain 3.00, 3.10, 3.15 & 3.19 g of Fe. Calculate the mean deviation, standard deviation & relative standard deviation.
- e) Explain with suitable diagram: Kjeldahl's method of estimating nitrogen in an organic compound.
- f) What are primary and secondary standards? Give two examples of each. What are the characteristics of a standard solution?
- g) What is a titration curve? Explain the titration curve of strong acid and strong base. Explain which indicator you will choose for this titration?

29/11/2022

O/C
2:30pm

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester V)
Subject: Inorganic Chemistry I
(CHE 3502) (2019 pattern)**

Time: 2.5 Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of scientific calculators is allowed.

[Given, Atomic No. Ti-22, V-23, Cr-24, Mn-25, Fe-26, Co-27, Ni-28, Cu-29, Zn-30]

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) What do you understand by LCAO principle?
- b) Write MO electronic configuration of boron (B_2) and helium (He_2) molecule.
- c) Draw and name the d-orbitals having their lobes along the coordinate axes.
- d) Find the CFSE (in terms of Δ_o and P) of d^6 system in weak octahedral field?
- e) Why octahedral complexes are more stable than tetrahedral complexes?
- f) Define plane of symmetry. Give an example of a molecule possesses plane of symmetry.
- g) What do you mean by hapticity? Give example.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) What is the change in bond order during the ionization of O_2 to O_2^- ion? Show with the help of MO electronic configuration.

- b) What are the conditions for obtaining molecular orbitals (MO) from atomic orbitals (AO)? (Mention atleast three factors)
- c) Explain the terms strong field and weak field ligands with examples.
- d) State and explain which complex out of the following pair has a larger value of Δ_o
- i) $[\text{Co}(\text{CN})_6]^{3-}$ and ii) $[\text{Co}(\text{NH}_3)_6]^{3+}$.
- e) Which factors favors the formation of Tetrahedral complexes? (Mention atleast three factors)
- f) Sketch and label all the symmetry elements present in BF_3 molecule.
- g) Calculate the total electrons in the following compounds and predict whether they obey the 18-electron rule or not:
i) $\text{Cr}(\text{CO})_6$ ii) $[\text{Mn}(\text{CO})_5]^-$

Q.3

Attempt any five questions:

[5 x 5 =25]

- a) Construct the MO energy level diagram and discuss the bonding in CO molecule according to MO theory. Comment on the bond order and magnetic properties.
- b) Why NO^+ has stronger bond than NO? – explain with MO energy level diagram.
- c) What is CFSE? Show the octahedral splitting of d-orbitals with electronic arrangements and calculate μ_s in BM for the following complexes: i) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ and ii) $[\text{FeF}_6]^{3-}$.
- d) State Jahn Teller theorem. Explain tetragonal compression of octahedral complex with a suitable example.
- e) For an octahedral Mn^{3+} complex $\Delta_o = 21,150 \text{ cm}^{-1}$. Pairing energy is $P \sim 27,750 \text{ cm}^{-1}$. Will this be a high spin or low spin complex? Show the crystal field splitting diagram and electron distribution in t_{2g} and e_g orbitals. Find CFSE (in cm^{-1}) and calculate the number of unpaired electrons.
- f) Define improper axis of symmetry. Give one example. Prove that $S_n^{2n} = E$ when $n=3$.
- g) Discuss the synthesis, structure and bonding of ferrocene molecule.

30/11/2022
olc
2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE 3503-Organic Chemistry I) (2019 pattern)

Time: 2 hours 30 minutes

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks

Q.1 Attempt any five questions:

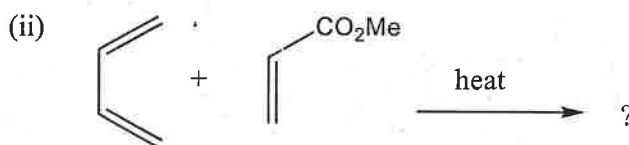
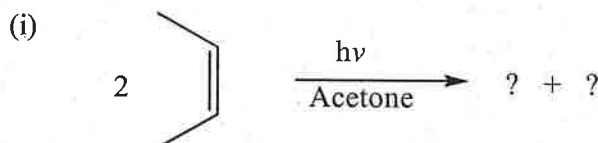
[2 x 5 = 10]

- a) What is Michael addition?
- b) Define regioselectivity with a suitable example.
- c) How benzoyl peroxide acts as a radical initiator.
- d) Define ylid. Give a suitable example
- e) Give two uses organocopper reagents.
- f) How do ionic liquids assist in chemical reactions?
- g) Write uses of tributyltin hydride.

Q.2 Attempt any five questions:

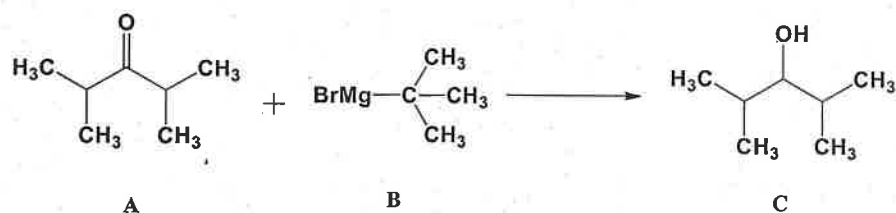
[3 x 5 = 15]

- a) Predict the product(s)

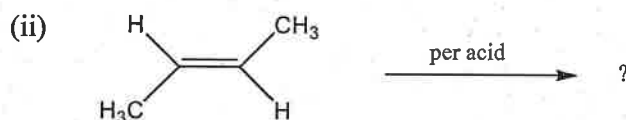
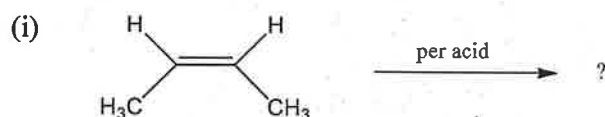


- b) What is microwave radiation and its applications in green chemistry.
- c) Define organolithium reagent and give two methods of its synthesis.
- d) In allylic bromination, NBS is used as brominating agents instead of bromine. Why?

- e) Grignard reaction between hindered substrates (A and B) often leads to reduction (C). Explain.



- f) Explain neighbouring group participation with suitable examples.
- g) What is peracid? Complete the following conversions.

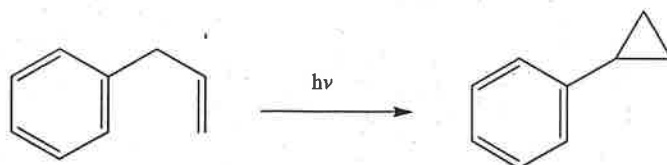


Q.3

Attempt any five questions:

[5 x 5 =25]

- Discuss acid catalyzed hydrolysis mechanism of esters.
- Explain principles of Green Chemistry.
- Discuss amide hydrolysis mechanism in basic medium.
- Explain Reformatsky Reaction and its mechanism.
- What is Norrish type-I cleavage? Explain Norrish type-I cleavage of cyclohexanone.
- What are Pericyclic reactions and its types.
- What is Di- π methane rearrangement. Suggest mechanism for the following reaction.



14/11/2022 o/c

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester V)
GLY 3601 ECONOMIC GEOLOGY (2019 pattern)**

Time: 2.30 Hrs

Max Mark: 50

Instruction to Candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks.
- iii) Draw neat diagrams where necessary.

Q.1) Attempt any five questions:

[2X5=10]

- a) What are syngenetic and epigenetic deposits?
- b) What is saddle reef?
- c) State the ore minerals of Gold.
- d) What is transported limonite?
- e) What are placer deposits?
- f) Give the uses of copper minerals.
- g) Give the different varieties of coal.

Q.2) Attempt any five questions:

[3X5=15]

- a) Explain early magmatic deposits.
- b) Give the classification and types of hydrothermal deposits.
- c) Give any three evidences of gossans as guides to the hidden ore deposits.
- d) Explain origin of coal.
- e) Give mineralogy and properties of Uranium minerals.
- f) Explain mode of occurrence and uses of 'Mn' mineral deposits.
- g) Give properties and uses of fertilizer minerals.

Q.3) Attempt any five questions:

[5X5=25]

- a) Explain the mode of occurrence, mineralogy and properties of Silver mineral deposits.
- b) Explain mineralogy uses geological and geographical distribution of Iron mineral deposits.
- c) Explain mode of occurrence, properties and uses of salt and Brines
- d) Explain the process of supergene sulphide enrichment
- e) Explain stockworks, Ladder vein and solution cavity filling deposits.
- f) Explain the process of Residual concentration in mineral formation.
- g) Explain the various criteria of metasomatic replacement.

15/11/2022 o/c

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester VI)
Subject: Inorganic Chemistry II
(CHE 3602) (2019 pattern)**

Time: 2.5 Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of scientific calculators is allowed.

[Given, Atomic No. Ti-22, V-23, Cr-24, Mn-25, Fe-26, Co-27, Ni-28, Cu-29, Zn-30]

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Define unit cell and crystal lattice.
- b) Write the symbol and IUPAC name for elements having Atomic No. 133 and 150.
- c) Draw the structure of body centered cubic unit cells.
- d) What is the composition of Misch metal?
- e) Univalent radius of a metal ion M^{2+} is 0.082 Å. Calculate its crystal radius. Given Born exponent (n) = 7.
- f) Calculate the total number of microstates possible for the following configurations-
(i) p^3 (ii) d^1
- g) Mention the functions of hemoglobin.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) Explain with example lanthanide contraction.
- b) Calculate the radius ratio for a crystal with coordination number 4.

- c) Give the differences between Schottky and Frenkel defects.
- d) Give an account on tetravalent states of Actinides.
- e) Find out the L and S values for the following terms –
(i) 5D (ii) 3P
- f) $[Zn(H_2O)_6]^{2+}$ is colorless but color of $KMnO_4$ is purple – Explain.
- g) Calculate the total degeneracy of the following states/terms –
(i) 6S (ii) $t_{2g}^3 e_g^1$

Q.3

Attempt any five questions:

[5 x 5 =25]

- a) Write a note on nuclear fission fuels.
- b) Give atomic number, symbol, name, electronic configuration and discuss the important points about electronic configuration of Lanthanides.
- c) Explain a suitable method used for the separation of lanthanides.
- d) What are trans-uranic elements? Describe different methods used to synthesize transuranic elements.
- e) Explain formation of NaCl molecule by using Born Haber cycle.
- f) State the rules to find out ground state (GS) term. Find the ground state term for the following ions –
(i) Ti^{3+} (ii) Ni^{2+}
- g) Discuss the structure and functions of iron-sulphur proteins Fe_2S_2 and Fe_4S_4 .

16/11/2022
2.30 pm

O/C

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
T.Y.B.Sc. (Semester VI)
Subject: Chemistry
(CHE 3603) Organic Chemistry II (2019 pattern)

Time: 2 Hours 30 minutes

Max. Marks: 50

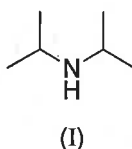
Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Calculate the fundamental mode of vibrations for benzene.
- b) What are alkaloids?
- c) How many sets of protons are present in compound (I)?

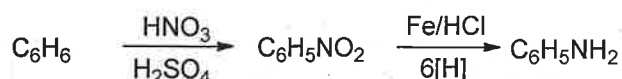


- d) Define chemical shift.
- e) State 'special isoprene rule'.
- f) Define the term disconnection with one example.
- g) What is the extinction coefficient?

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) Calculate the relative intensity for underlined protons.
 $\text{CH}_3\text{-CH}_2\text{-Ph}$
- b) Draw the structure of the citral and calculate the λ_{max} for it.
- c) Comment on anisotropic effect in ^1H -NMR spectroscopy.
- d) N,N-dimethylaniline shows blue shift in an acidic medium. Explain.
- e) Write an explicit retrosynthesis for benzyl benzoate.
- f) How will you prove the presence of $>\text{N-CH}_3$ group in ephedrine?
- g) How will you monitor the following reaction by IR spectroscopy?



Q.3

Attempt any five questions:

[5 x 5 =25]

- a) Deduce a structure for the organic compound from the following spectroscopy data. Justify your answer.

Molecular Formula: C_3H_6BrI

NMR: i) quintet, 2.27 δ , (2H)

ii) triplet, 3.55 δ , (2H)

iii) triplet, 3.70 δ , (2H)

- b) In the 1H -NMR spectrum, a triplet appears as a quartet at 3.4 δ (ppm), $J = 7$ Hz on a 300 MHz instrument. Indicate the line position in Hz of different lines. Give relative intensities of these lines.
- c) A compound having molecular formula $C_{10}H_{14}$ shows the following spectral values. Deduce its structure and assign the spectral values.

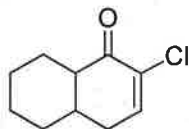
IR: 3100, 2910, 700, 750 cm^{-1}

NMR: i) 1.38 δ (singlet, 9H)

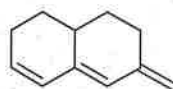
ii) 7.28 δ (singlet, 5H)

- d) An organic compound having molecular formula C_3H_6O shows bands at 1720 and 2720 cm^{-1} in its IR spectra. Find out the structure of the compound.

- e) Calculate λ_{max} for the following compounds.



(I)



(II)

- f) Write a note on the role of Grignard reagent in C-C bond formation.
- g) Write synthesis of citral from methyl heptanone.

Table –1
Characteristics Infrared Absorptions of Functional Groups

Frequency Range ν cm^{-1}	Bond	Functional Group
2853-2962 1380-1385 and 1365-1370 1385-1395 and 1365	C-H (stretching) -CH(CH ₃) ₂ -C(CH ₃) ₃	Alkyl Isopropyl Tert-Butyl
3010-3095 1620-1680 985-1000 and 905-920 880-900 675-730 960-975	C-H (stretching) C=C(stretching) R-CH=CH ₂ R ₂ C=CH ₂ (out of plane) <i>cis</i> RCH=CHR (C-H Bending) <i>trans</i> RCH=CHR	Alkenyl
3300 2100-2260	α C-H (stretching) C α C (stretching)	Alkynyl
740-1850 1770-1815 1730-1750 1730-1740	R-CO-O-CO-R R-CO-X R-CO-OR R-CO-H	Anhydrides Acyl halides Esters Aldehydes
1705-1720 1700-1725 1680-1700 1620-1680 1590-1690 1500-1600 1370-1540 2200-2260 3300-3500	R-CO-R R-CO-OH R-CO-N- -C=C- -C=N- -C=C- (aromatic) -NO ₂ -C α N -N-H	Ketone Acid Amide Alkene, olefine Imine, oxime Aromatic Nitro Nitrile/Cyanide Amines
Single Bond Region 1000-1300 1100-1120 500-750 3200-3550 2500-3000	-C-O- -C-C- -C-X O-H O-H	Alcohol, phenol, ester, ether alkane Halo alkane Alcohols, phenols, hydrogen-bonded Carboxylic acid hydrogen-bonded
C-H Bending Vibrations 3030 690—710 and 730-770 735-770 680-725 and 750-810 790-850	Ar-H (stretching) =C-H =C-H (o) =C-H (m) =C-H (p)	Aromatic region Mono substituted benzene Ortho substituted benzene Meta substituted benzene Para substituted benzene
1400-1000 785-540 <667	C-F C-Cl C-Br	Halides

PTO

Table 2
Approximate Proton Chemical Shift in NMR

Type of Proton	Chemical Shift, Delta, ppm, (τ)
1° Alkyl, RCH ₃	0.8-1.0
2° Alkyl, RCH ₂ R'	1.2-1.4
3° Alkyl, R ₃ CH	1.4-1.7
Allylic, R ₂ C=CRCH ₃	1.6-1.9
Ester RCOOCH ₂ R	4.0-4.5
Benzylic, ArCH ₃	2.2-2.5
Alkyl chloride, RCH ₂ Cl	3.6-3.8
Alkyl bromide, RCH ₂ Br	3.4-3.6
Alkyl iodide, RCH ₂ I	3.1-3.3
Ether, ROCH ₂ R	3.3-3.9
Alcohol, HOCH ₂ R	3.3-4.0
Ketone RCOCH ₃	2.1-2.6
RCOCH ₂ -	2.4
RCOCH<	2.5
Aldehyde, RCHO	9.5-9.6
Vinyl, R ₂ C=CH ₂	4.6-5.0
R ₂ C=CH-R	5.2-5.7
Aromatic, ArH	6.0-9.5
Acetylene, RC≡CH	2.5-3.1
Alcohol hydroxyl ROH	0.5-6.0 ^a
Carboxylic acid, RCOOH	10.0-13.0 ^a
Phenolic, ArOH	4.5-7.7 ^a
Amino, R-NH ₂	1.0-5.0
^a The chemical shifts of these groups vary in different solvents and with temperature and concentration	

Table -3
U. V. Absorption rules for diene chromophores

Parent	215 nm
Each extra conjugation	30 nm
Homoannular	39 nm
Exocyclic double bond	05 nm
Each alkyl (R) substituent is directly attached to a double-bonded carbon	05 nm
-Halogen	05 nm
-SR	30 nm
-NR ₂	60 nm
-OH, -OR	05 nm
-OCOR	00 nm
U. V. Absorption rules for enone chromophores	
Parent	215 nm
Parent for aldehyde	207 nm
Parent for five-membered ring	202 nm
Each extra conjugation	30 nm
Homoannular	39 nm
Substituents	
a) alkyl group at α	10 nm
b) alkyl group at β	12 nm
c) alkyl group at γ , δ and higher	18 nm
Exocyclic double bond	05 nm
-Cl at α	15 nm
-Cl at β	12 nm
-Br at α	25 nm
-Br at β	30 nm
-SR at α	35 nm
-NR ₂ at α	30 nm
-NR ₂ at β	95 nm
-OH, -OR at α	35 nm
-OH, -OR at β	30 nm

18/11/22 qc

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester VI)
Subject: Chemistry
(CHE3605) Industrial Chemistry II (2019 pattern)**

Time: 2 Hrs. 30 minutes

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Draw neat labeled diagram wherever necessary.

Q.1 Attempt any Five questions:

[2 x 5 =10]

- a) What is the role of PbO and B₂O₃ in glass?
- b) What are the advantages of Organic manures?
- c) Why p-nitrophenol shows red shift in alkaline medium?
- d) Define – i) Cullet ii) Calorific value
- e) How will you remove stains of i) Hair dye ii) Grease?
- f) Why is urea a most popular nitrogenous fertilizer?
- g) Define – i) Dye ii) Auxochrome

Q.2 Attempt any Five questions:

[3 x 5 =15]

- a) Explain the term – Octane number.
- b) Write a note on – Coloured glass.
- c) Describe the manufacture of Wax candles.
- d) Write a note on – Vermi-compost.
- e) Explain the synthesis and uses of Alizarin dye.
- f) What is LPG? Describe its manufacture.
- g) Explain the chemical properties of glass.

Q.3

Attempt any Five questions:

[5 x 5 =25]

- a) Describe the manufacture of glass by Tank furnace method.
- b) Describe the manufacture of Single superphosphate from rock phosphate and draw flow sheet diagram.
- c) What is Cracking of petroleum? Discuss the Fluid catalytic cracking process.
- d) Discuss the classification of dyes on the basis of their method of applications.
- e) What is Lubricating oil? Explain its formulation, properties and applications.
- f)
 - i) Describe the manufacture of Plaster of paris.
 - ii) What is the importance of annealing process of glass?
- g) What are mixed fertilizers? Discuss the manufacture of mixed fertilizer and draw flow-sheet diagram.

18/11/22

OK

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4
T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE 3606) Biochemistry II (2019 pattern)**

Time: 2 Hrs 30 minutes
Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

**[2 x 5
=10]**

- a) Define the terms anabolism and catabolism with examples
- b) What are restriction enzymes? Give example
- c) List out the rate limiting enzymes of TCA cycle
- d) What are antibiotics? Give example
- e) What is Initiation codon and termination codon
- f) Draw the structure of ATP
- g) Give examples of Inhibitors and uncouplers of ETC and oxidative phosphorylation process in mitochondria

Q.2 Attempt any five questions:

**[3 x 5
=15]**

- a) Write note on features genetic code
- b) Show the three fates of Pyruvate based on the availability of oxygen
- c) What are ketone bodies? How are they formed in liver?
- d) Differentiate between transamination and deamination reactions
- e) What is the principle of electrophoresis?
- f) Give the significance of HMP shunt
- g) Differentiate between Nucleoside and Nucleotide with example

Q.3 Attempt any five questions:

**[5 x 5
=25]**

- a) Explain glycolysis with its energetics
- b) Discuss the process of DNA replication with suitable diagram
- c) Describe the steps involved in converting ammonia to urea
- d) Explain the synthesis of triacylglycerol in human body
- e) Discuss the procedure and interpretation of experiments that proved DNA is the genetic material
- f) Explain the steps involved in gene cloning
- g) Describe the process of electron transport chain in mitochondria.

21/11/22 o/k

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

T.Y.B.Sc. (Semester VI)
Subject: Polymer Chemistry
(CHE-3611) Polymers (2019 pattern)

Time: 2 Hrs. 30 minutes
Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 =10]

- a) What are synthetic polymers? Give the examples of synthetic polymers.
- b) Draw the structures of following monomers-
i) Vinyl Acetate ii) Acrylonitrile
- c) Write the name of polymers of following abbreviations.
i) LCP ii) LLDPE
- d) Define the terms: Atactic, Isotactic and Syndiotactic Polymers.
- e) How hydrolysis of polymer is carried out? Write the reaction.
- f) Give the names and structure of any two radical initiators used in polymerization.
- g) Explain the cross linking of polythene.

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) Describe the method of preparation, properties and uses of Bakelite.
- b) Explain the terms: Thermosetting & thermoplastic with suitable examples.
- c) Give a detailed account of conducting polymers.
- d) Distinguish between chain growth and step growth Polymerization.
- e) Write note on Average Molecular Weight.
- f) Distinguish between Elastomers and Fibers.
- g) Explain in brief a degree of crystallinity in polymers.

Q.3 Attempt any five questions:

[5 x 5 =25]

- a) Discuss Molecular weight determination of polymer by Viscosity method.
- b) Explain the anionic mechanism of chain polymerization with suitable examples.
- c) Write the steps and mechanism involved in step growth polymerization and discuss carbonyl addition and nucleophilic addition.
- d) Give a full account on melt polymerization.
- e) Discuss the Molecular weight determination by End Group Analysis method.
- f) Describe the method of preparation, properties and uses of –
 - a) Phenol-formaldehyde resin
 - b) Polypropylene.
- g) Explain any two reactions involved in crosslinking of polymers with suitable examples.

22/11/2022 EV

OK

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE 3612) Analytical Methods (2019 pattern)**

Time: 2.5 Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

- Q.1 Attempt any five questions:** [2 x 5 = 10]
- a) Define accuracy and precision.
 - b) Explain chemical oxygen demand (COD).
 - c) Define chemical oxygen demand (BOD).
 - d) Define relative and absolute error.
 - e) What is standard deviation along with its equation.
 - f) Define permanent wilting point.
 - g) Describe general composition of food components.
- Q.2 Attempt any five questions:** [3 x 5 = 15]
- a) Describe in details parameters of water quality assessment.
 - b) Name and explain any two chromatographic techniques carried out in food analysis.
 - c) Explain key factors associated with water analysis.
 - d) Give general schematic diagram for GC-instrumentation.
 - e) Explain How to determine pH of water samples?
 - f) Explain applications of Gas Chromatography.
 - g) Name and explain any two types of detectors used in Gas chromatography technique.
- Q.3 Attempt any five questions:** [5 x 5 = 25]
- a) What is the significance of analytical chemistry in daily life.
 - b) Describe Kjeldals method to determine total nitrogen.
 - c) What are the possible adverse effects of impurity of water?
 - d) Write a note on ion exchange chromatography.
 - e) Write a note on need for food analysis?
 - f) White a note on biological oxygen demand (BOD) .
 - g) Describe method to determine particle size distribution.

02/12/2021
2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE3505) Industrial Chemistry I (2019 pattern)

Time: 2 Hrs. 30 minutes

Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Draw neat labeled diagram wherever necessary.

Q.1 Attempt any Five questions:

- a) List the important uses of Sulphuric acid.
- b) What do you mean by Power alcohol?
- c) Define – i) Water gas ii) Surfactant.
- d) What do you mean by Inversion of sugar?
- e) Define – i) Copy right ii) Selectivity in chemical reaction.
- f) Explain the term – Process control
- g) Explain the term – Medicated soap with example.

[2 x 5 = 10]

Q.2 Attempt any Five questions:

- a) Explain the methods of Concentration of dilute HNO_3
- b) Explain Lime defecation process of cane juice and reactions involved in it.
- c) What is the basic requirement for Chemical Industry?
- d) Write a note on – Cleansing action of detergent.
- e) Discuss the optimization of pressure and temperature in manufacture of Ammonia.
- f) Discuss in brief the factors favoring Fermentation.
- g) Describes the Centrifugation process in manufacture of cane sugar.

[3 x 5 = 15]

Q.3

Attempt any Five questions:

[5 x 5 =25]

- a) What are Detergent Builders? Discuss the important functions of different builders used in detergents.
- b) What is MSDS? Describe MSDS for Phenol with reference to
 - i) Accidental releases measures
 - ii) Handling and storage
 - iii) First Aids measures
 - iv) Toxicological Information.
- c) What is Compound Imbibition process? Describe the Compound Imbibition process involved in extraction of cane juice.
- d) Draw the flow sheet diagram for the manufacture of Sulphuric acid and describe the working operations involved in Burner and Purifying units.
- e) What is rectified spirit? Discuss in details the construction and working of Coffey Still used in manufacture of alcohol.
- f) Describe the manufacture of neat soap from oils and fats and draw the flow sheet diagram.
- g) i) Discuss any one chemical method for Testing and Estimation of raw sugar.
ii) Write the reactions involved in manufacture of Nitric acid by Ostwald process

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0/c

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

F.Y.B.Sc. (Semester-I)
Subject: -Basics of Organic Chemistry and Periodicity of Elements
(CHE1102) (2019 pattern)

Time:

Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

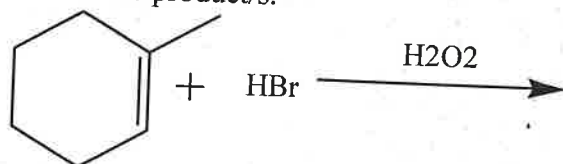
Q.1 Attempt any five questions:

[2 x 5 =10]

a) Cyclohexyl amine is more basic than aniline. Justify.

b) Draw the structures of
Benzophenone
Picric Acid

c) Predict the product/s.



d) Why trifluoroacetic acid is stronger than monochloroacetic acid?

e) Define Nucleophile and Electrophile. Give Examples.

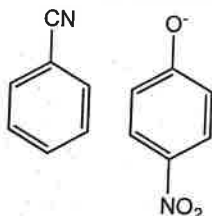
f) Why zero group elements are inert?

g) Give the electronic configuration of Li and Si.

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) Explain screening effect with respect to it's trend in VIth group.
- b) Comment on reactivity of S block elements.
- c) Compare Basicity and Nucleophilicity with suitable examples.
- d) Explain mechanism of E1 reaction with suitable example.
- e) Draw the resonating structures of

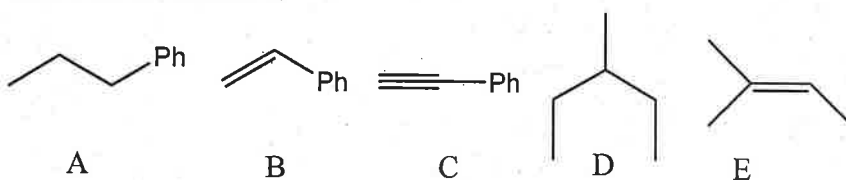


- f) Write a note on oxymercuration, demercuration.
- g) Phenols are acidic in nature while alcohols are neutrals. Explain

Q.3 Attempt any five questions:

[5 x 5 =25]

- a) Write note on S_N^2 Reaction.
- b) Define the following terms
 - a) Electronegativity
 - b) Nuclear Charge
 - c) Ionization Potential
 - d) Ionization Energy
 - e) Atomic radii
- c) Draw the schematic diagram of periodic table. Show the position of s,p,d & f block elements in it. Draw the general electronic configuration of each block.
- d) Explain with mechanism
 - a) Hydroboration-oxidation in alkene
 - b) Ozonolysis in alkene
- e) Give IUPAC names to



- f) Discuss the Wurtz and Wurtz Fittig reaction for preparation alkanes. What are the drawbacks of Wurtz Reactions?
- g) What is sp^2 hybridization? Explain in detail the formation of ethene molecule.

03/12/2022
2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE 3506) Biochemistry I (2019 pattern)

Time: 2 Hrs 30 minutes

Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5
=10]

- a) Write the structure of a saturated and unsaturated fatty acid.
- b) What are transport protein and structural protein? Give example.
- c) Give examples of storage and structural polysaccharides.
- d) Show the formation of peptide bond between amino acids : G-A.
- e) Name the disaccharide is present in sugarcane juice and its monomers.
- f) Why is it necessary to eat diet rich in essential amino acids? Justify.
- g) List out the types of derived sugars.

Q.2 Attempt any five questions:

[3 x 5
=15]

- a) Compare the features of any three disaccharides.
- b) What is Isoelectric pH? Show the protonated, deprotonated and zwitter ion forms of glycine.
- c) Write the structure of lecithin and triacylglycerol.
- d) Write note on blood group substances.
- e) What are anomers? Give the structure of anomeric forms of glucose.
- f) Write note on the principle of affinity chromatography.
- g) Write MM equation, draw MM graph and give significance of K_m

Q.3 Attempt any five questions:

[5 x 5
=25]

- a) Discuss the difference between six classes of enzymes with examples
- b) Classify Amino acids based on their R side chain with examples
- c) Draw diagram of an eukaryotic cell and functions of each organelle
- d) Explain the composition, types and significance of lipoproteins
- e) Tabulate the name of endocrine glands and their hormones.
- f) Explain the reactions of amino acid with Sanger's, Dansyl chloride and Dabsyl chloride and Edmann's reagents with significance.
- g) Classify lipids with examples.

3:30 PM
03/15/2025

03/12/2022
O/C
2:30 pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

T.Y. B.Sc. (Semester V)
Subject: BTH3506- Principles of Enzymology (2019 pattern)

Time: 2.5Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 =10]

- a) How does aspirin work?
- b) Define coenzymes.
- c) What are radioisotopes?
- d) Draw Eadie Hofstee plot.
- e) Define homotropic modulators.
- f) Mention the assumption of Lock and Key Hypothesis.
- g) What are reversible inhibitors of enzymes?

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) Differentiate between allosteric and non-allosteric enzymes.
- b) Using Hill's plot, explain positive and negative cooperativity.
- c) What is the specific activity of an enzyme?
- d) Draw the Lineweaver-Burk plot and mention its drawbacks.
- e) How to determine the spontaneity of a reaction?
- f) Write a note on proteolytic activation of enzymes.
- g) Calculate the initial velocity of a reaction at substrate concentration of 0.001M. Given, the $V_{max} = 48 \mu\text{M}/\text{min}$; $[S]$ at $24 \mu\text{M}/\text{min} = 5.4 \times 10^{-4}$.

Q.3 Attempt any five questions:

[5 x 5 =25]

- a) Write a note on competitive inhibition.
- b) Describe the allosteric regulation of Aspartate Transcarbamoylase.
- c) Calculate ΔG for hydrolysis of ATP at pH 7 and 25°C under steady-state conditions in which the concentrations of ATP, ADP and P_i are maintained at 10^{-3}M , 10^{-4}M , and 10^{-2}M , respectively. $G^\circ = -31\text{KJ/mol}$. $R = 8.314 \text{ J/K-mol}$.

- d) Write a note on the effect of enzymes on activation energy of a reaction (E_a)
- e) Write a note describing enzyme-substrate interactions at the active site.
- f) Describe some spectroscopic approaches to study enzyme assays.
- g) Derive MM equation using a suitable kinetic approach.

05/12/2022
O/e
2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
End Semester Examination (ESE)
F. Y. B. Sc. (Chemistry) Semester I (2016 Pattern)
CHE 1101: Physical & Inorganic Chemistry
OR
Chemical Mathematics & Atomic Structure

Time: 2 Hrs

Max. Marks: 50

- Instructions:** a) All questions are compulsory.
b) Figures to right indicate full marks.
c) Draw neat labelled diagrams whenever necessary.
d) Use of logarithmic table/scientific calculator is allowed.

Q.1 Answer Any Five of the following questions:

(5x2=10)

- State and explain Avogadro's Law.
- Elucidate the unit of molar gas constant 'R' in $\text{lit atm mole}^{-1} \text{K}^{-1}$.
- Explain with example: London dispersion forces.
- Define and elucidate the unit of Specific refraction.
- Write two important assumptions of Bohr's theory.
- Write Schrödinger wave equation and explain the terms involved in it.
- Calculate the pH of monobasic acid having concentration 0.25 M.

Q.2(A) Attempt Any Three of the following questions:

(3x3=9)

- Define free-path and mean free -path. Explain the effect of temperature on mean free path.
- Explain the effect of temperature on vapor pressure of liquid.
- Write a note on 'Photoelectric effect'.
- Explain Hund's rule of maximum multiplicity and Pauli's exclusion principle with example.

Q.2(B) Attempt Any Two of the following questions:

(3x2=6)

- Calculate the most probable velocity of nitrogen molecule (N_2), at 15°C .
[Given: $R=8.314 \times 10^7 \text{ ergs K}^{-1} \text{mol}^{-1}$]
- In an experiment with Ostwald's viscometer, the flow time for water and ethanol are 75 sec. and 175 sec. at 20°C while the densities of water and ethanol are 0.998 g cm^{-3} and 0.800 g cm^{-3} respectively. If the viscosity of water at 20°C is 0.01008 poise, calculate the viscosity of ethanol.
- Find out the slope and intercept of line : $3x - 2y - 11 = 0$

Q.3(A) Attempt Any Three of the following questions:

(5x3=15)

- Define- Compressibility factor. Explain the effect of variation of pressure on compressibility factor.
- Derive the Kinetic gas equation and explain the terms involved in it.
- Define Surface tension and give it's unit. How it is experimentally determined using Stalagmometer.
- Write a short note on-
 - Heisenberg's uncertainty principle
 - de Broglie's hypothesis.

Q.3(B) Attempt Any Two of the following questions:

(5x2=10)

- a. Calculate the pressure exerted by 1 mole of hydrogen gas enclosed in 250 ml container at 25 °C using van der Waal's equation.
[Given: $a=1.390 \text{ atm. lit}^2.\text{mol}^{-2}$; $b=0.0391 \text{ lit.mol}^{-1}$; $R=0.0821 \text{ lit.atm. mole}^{-1}.\text{K}^{-1}$]
- b. Calculate the wavelength of first line in Balmer series of hydrogen spectrum.
[Given: $R=109677 \text{ cm}^{-1}$]
- c. (a) Find $\frac{dy}{dx}$ if $y = \frac{(x^2-1)}{(x^2+1)}$
(b) Find $\int (4x^3 + 2x^2 + x). dx$

05/12/2022
6/12
2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune – 4

T.Y.B.Sc (Semester V)

Subject Chemistry

CHE 3511 Chemical Lab safety and waste Management

Time: 2 Hrs

Max.Marks:50

Instructions to candidates

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed

Q. 1 Answer the following (Any five) 10

- i) Define Green Chemistry.
- ii) What is MSDS?
- iii) What is toxicology?
- iv) What do you mean by Hazchem code?
- v) Mention Laboratory Safety Equipment's?
- vi) What is exposure pathway? Mention the name of exposure pathways.
- vii) What is CPR? When should it be administered.

Q. 2 Answer the following (Any five) 15

- i) Why do we need twelve principles of Green Chemistry?
- ii) What is the importance of designing safer chemicals ?
- iii) Elaborate on three degrees of thermal burns?
- iv) Name four Phenol based products we use in daily life?
- v) How to handle and store mercury? Explain.
- vi) What are the types of toxic substances?
- vii) Write a short note on radiation carcinogenesis?

Q. 3 Answer the following. (Any five) 25

- i) Define chemical hazard. Give classification of chemical hazard. Explain how to handle chemical hazard.
- ii) Mention and explain the types of extinguishers used for various class of fires?
- iii) Which safety measures do we need to follow while performing experiments in Laboratory?
- iv) How many pictograms are used for hazard recognition. Explain any three in short? .
- v) Explain the use of Biological Safety cabinets? What are the different types of safety cabinets in chemical laboratory?
- vi) Write a short note on three principles of Green Chemistry.
- vii) Elucidate the fourth principle of RAMP.

05/12/2022

2:30pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-411004

F.Y.B.Sc. (Semester I)
Subject: Chemistry
(CHE 1101) Chemical Mathematics and Atomic Structure (2019 pattern)

Time: 2 Hrs 30 min

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) State and explain Charle's Law using graphical presentation.
- b) Define Surface tension with unit.
- c) Give any two values of R with any two units.
- d) Explain Intermolecular hydrogen bonding with example.
- e) Define frequency and wavelength with units.
- f) State Aufbau Principle.
- g) Calculate the pH of 0.05M HCl.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) Deduce Boyle's Law from kinetic gas equation.
- b) Explain the effect of temperature on Viscosity.
- c) Why is pressure correction necessary for a real gas?
What is the unit of 'a'?
- d) Explain Schrödinger's wave equation and its significance.
- e) Calculate slope and intercept of equation:
 $x-3y=1$ and $3x-y=2$

Q.3

Attempt any five questions:

[5 x 5 = 25]

- f) In the determination of surface tension of a liquid by the drop-number method, it gives 55 drops while water gave 25 drops for the same volume. The densities of the liquid and water are 0.996 and 0.800 g/cm³ respectively. Find the surface tension of the liquid if that of water is 72.0 dynes/cm.
- g) Calculate RMS velocity of methane molecule at 370 K
($R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$)

- a) Define Critical constants. Explain Andrews Isotherm of CO₂ gas with the help of graph.
- b) Write a short note on Quantum numbers and its significance.
- c) What is relative viscosity. Explain Ostwald's method for the determination of Viscosity.
- d) What is compressibility factor and explain its effect on pressure?

- e) Calculate the pressure exerted by 2.00 mole of a gas in a 250 mL container at 300 K using van der Waals equation. What pressure will be predicted by ideal gas equation?
Given: $a = 2.253 \text{ L}^2 \text{ atm mol}^{-2}$, $b = 0.0428 \text{ L mol}^{-1}$,
 $R = 0.0821 \text{ lit atm mol}^{-1} \text{ K}$.

- f) Calculate the wavelength of the first line in Lyman series of hydrogen spectrum.
($R = 109677 \text{ cm}^{-1}$)

- g) i) Find $\frac{dy}{dx}$ if $y = \frac{2x+2}{4x-3}$

ii) $\int_2^5 (3x^2 + 4x + 6) \cdot dx$

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Special Exam -
2011/2022

Evening

**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**S.Y.B.Sc. (Semester IV)
Subject: Inorganic Chemistry
(CHE 2401) (2019 pattern)**

Time: 2.5 Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of scientific calculators is allowed.

[Given, Atomic No. Cr-24, Mn-25, Fe-26, Co-27, Ni-28, Cu-29, Zn-30]

Q.1 Attempt any five questions:

[2 x 5 =10]

- a) What is the IUPAC name of the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$?
- b) What is ambidentate ligand? Give examples.
- c) What do you mean by intercalation compounds?
- d) Explain inert pair effect with example.
- e) What are pseudo halogens?
- f) What are oxyacids? Give two examples of oxyacids.
- g) Define Lewis acid. Give two demerits of Lewis theory.

Q.2 Attempt any five questions:

[3 x 5 =15]

- a) What is the Effective Atomic Number (EAN) rule? Does $[\text{Mn}(\text{CN})_4]^{2-}$ complex ion obey EAN rule?
- b) Predict hybridization and geometry of diamagnetic complexes –
(i) $[\text{ZnCl}_4]^{2-}$ (ii) $[\text{Ni}(\text{CN})_4]^{2-}$.
- c) Explain variable oxidation state in d-block element.
- d) Give an account on allotropes of carbon.
- e) Draw the structure of (i) P_4O_9 (ii) P_4O_{10} .

- f) Complete the given equation and explain the role of CaO with the help of correct acid-base theory.



- g) Define Bronsted-Lowry acid. Write down the conjugate acid of the following Bronsted-Lowry base.



Q.3 Attempt any five questions:

[5 x 5 =25]

- Write the assumptions of Valence Bond Theory and its limitations.
- What are silicones? Explain the structure and uses of silicones.
- Why Group-1 elements are (i) monovalent (ii) ionic (iii) strong reducing agents (iv) poor complexing agent (v) having low ionization energy in the periodic table.
- Explain electronic spectra of d-block elements. Calculate the magnetic moments for following ions (i) Cr^{2+} (ii) Co^{2+} (iii) Cu^{2+}
- Discuss the main postulates of Werner's theory of coordination complexes. Explain the structure of $\text{CoCl}_3 \cdot 6\text{NH}_3$ on the basis of this theory.
- Draw the structure of the following molecules and explain the order of acidity in H_3PO_4 , H_3PO_2 and H_3PO_3 .
- Write the names and electronic configuration of noble gas elements. Explain the bonding, hybridization and structure of XeOF_4 molecule.

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**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T. Y. B. Sc. (Semester V)
Subject: Chemistry
(CHE3504) Analytical chemistry (2019 pattern)**

Time: 2Hrs. 30 min.

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory.
- ii) Figures to the right indicate full marks.
- iii) Use of log tables and scientific calculators is allowed.
- iv) Neat labeled diagrams must be drawn wherever necessary.

Q.1 Attempt any FIVE questions:

[2 × 5 = 10]

- a. Define common ion effect and explain it with example.
- b. Draw an idealised DTA curve and explain significance of sharp endothermic peak.
- c. What is bathochromic shift? Explain with example.
- d. State Ilkovic equation and identify the solute parameters in it with units.
- e. What do you mean by spectral interference in AAS?
- f. Give any two criteria used for selecting ideal wash liquid.
- g. Write any two applications of FES.

Q.2 (A) Attempt any THREE questions:

[3 × 3 = 9]

- a. Explain the concept of homogeneous precipitation with one example.
- b. Write the three stages for decomposition of hydrated calcium oxalate $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.
- c. Write a note on Job's continuous variation method.
- d. Give advantages and disadvantages of DME.
- e. Draw a neat labelled optical diagram for AAS.

(B) Attempt any TWO numerical:

[3 × 2 = 6]

- a. Calculate the molar absorptivity of 1.5×10^{-5} M solution having 0.29 absorbance, when placed in a cell of 1.5 cm path length.
- b. Calculate the solubility of Ag_2CrO_4 in water in terms of g/lit. at 25°C. [Given $K_{sp} = 9 \times 10^{-12}$, (Ag = 108, Cr = 52, O = 16)].
- c. 132.50 mg. sample containing a mixture of Ca-oxalate-monohydrate (M. Wt. 146) and a thermally stable salt, showed a mass loss of 8.9 mg. at an onset temperature of about 140°C, corresponding to vapourisation of water during a thermogravimetric analysis. Determine the percentage (W/W) of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ in the sample.

Q.3 Attempt any FIVE questions:

[5 × 5 =25]

- a. Write conditions for good precipitation.
- b. Calculate percentage of magnesium carbonate MgCO_3 and calcium carbonate CaCO_3 in 95 milligrams of a limestone sample that exhibits thermograph showing a weight of 78 milligram at 500 °C and 63 milligrams at 900 °C.
[Given: Ca =40, Mg =24, C =12, O =16]
- c. Explain construction and working of photomultiplier tube with diagram.
- d. Draw a neat labeled polarogram. Explain the factors affecting the polarographic wave.
- e. Give the construction and working of HC lamp with a neat labelled diagram.
- f. Write a note on colourimetric titrations and also explain four different types of curves possible in colourimetric titrations.
- g. Explain the principle and instrumentation of TGA with diagram.

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Deccan Education Society's
Fergusson College (Autonomous) Pune-4
F.Y.B. Sc. Semester I
Chemistry
Organic and Inorganic Chemistry-I (CHE1102)
(Paper II - 2016 Pattern)

Time: 2 Hours

Max Marks: 50

Instructions: a) All questions are compulsory and carry equal marks.

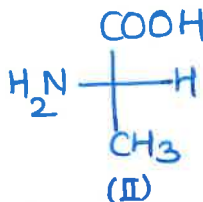
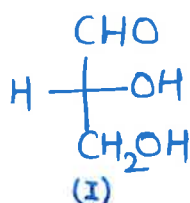
b) Neat and labelled diagrams must be drawn wherever necessary.

c) Figures to the right indicate full marks.

Q.1 Answer Any Five of the following questions:

(2x5=10)

- Write electronic configuration of i) Na (At. No. 11) ii) F (At. No. 9)
- Define atomic radii and covalent radii
- Why pyridine is stronger base than aniline?
- What is mean by geometric isomerism?
- What are the effects of hybridization on bond properties?
- Assign R or S configuration to the following compounds.

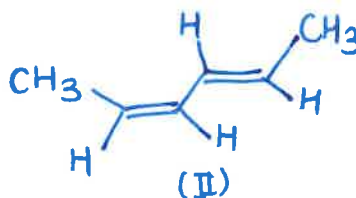
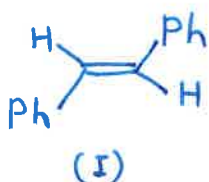


- Define i) dextrorotatory ii) chiral carbon

Q.2 Answer Any Five of the following questions:

(3x5=15)

- Assign E or Z configuration to the following compound.

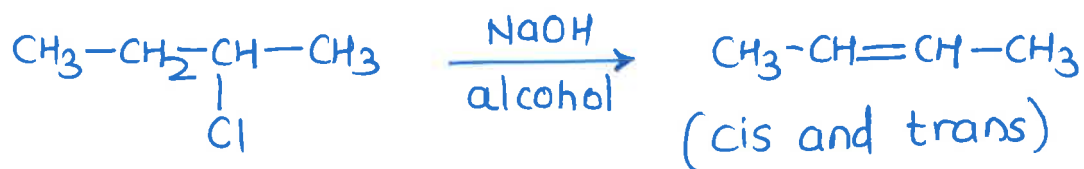


- Discuss racemic mixture and resolution
- Write a note on peroxide effect.
- Justify CH_3COOH $\text{Cl-CH}_2\text{COOH}$ $\text{F-CH}_2\text{-COOH}$
 pK_a 4.76 pK_a 2.87 pK_a 2.58
- Define electro negativity. Explain the trend of it across the periods and within block
- Define:
 - Shielding effect
 - Ionization energy
 - Slater rule
- What is absolute configuration? Explain with suitable example.

Q.3 Answer Any Five of the following questions:

(5x5=25)

- a. Write a note on S_N^1 reaction
- b. Draw the skeleton of long form of a periodic table, show the position of the following.
 - i) Lithium
 - ii) Magnesium
 - iii) Boron
 - iv) s-block
 - v) p-block
- c. Write the chemical test for detection of following groups.
Acid, phenol, amine, aldehyde, ester
- d. Explain the following reaction



- e. Write a note on alkali and alkaline earth metals.
 - f. What are distereomers and enantiomers?
 - g. Write a note on C. I. P. rules.
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06 DEC 2022

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Deccan Education Society's
Fergusson College (Autonomous), Pune-4

T.Y.B.Sc. (Semester V)
Subject: Chemistry
(CHE 3512) Pharmacology (2019 pattern)

Time: 2 Hrs

Instruction to candidates:

Max. Marks: 50

- i) All questions are compulsory
- ii) Figures to the right indicate full marks
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

- a) Explain Tachyphylaxis.
- b) Write clinical uses of scopolamine.
- c) Give clinical uses of Atenolol.
- d) Give two Examples for Cognition enhancers.
- e) What are the examples of psychoactive drugs.
- f) Write Any two clinical uses of salbutamol.
- g) Give clinical uses of Simvastatin.

[2 x 5 = 10]

Q.2 Attempt any five questions:

- a) Define a) Pharmacokinetics b) Pharmacodynamics.
- b) Explain the renal route of drug excretion.
- c) What is drug dependency and efficacy?
- d) How does age and gender affect drug action?
- e) Highly lipophilic drug cross the blood-brain barrier justify.
- f) Define a) apparent volume of distribution b) bioequivalence.
- g) How do physiological factors affect drug action?

[3 x 5 = 15]

Q.3 Attempt any five questions:

- a) Write note on pharmacokinetics drug interactions.
- b) Explain the factors affecting metabolism of drug.
- c) Define subacute toxicity with example.
- d) Write a note on atropine.
- e) Explain the pharmacology of fibrates.
- f) Write a note on calcium channel blockers.
- g) Classify anxiolytics. Explain about phenobarbitone.

[5 x 5 = 25]

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**Deccan Education Society's
Fergusson College (Autonomous), Pune-4**

**T.Y.B.Sc. (Semester VI)
Subject: Chemistry
(CHE3604) Analytical chemistry (2019 pattern)**

**Time: 2Hrs. 30 min.
Instruction to candidates:**

Max. Marks: 50

- i) All questions are compulsory.
- ii) Figures to the right indicate full marks.
- iii) Use of log tables and scientific calculators is allowed.
- iv) Neat labeled diagrams must be drawn wherever necessary.

Q.1 Attempt any FIVE questions:

[2 × 5 =10]

- a. Give various types of support media used in zone electrophoresis.
- b. Draw neat and labeled schematic diagram of a nephelometer.
- c. Write functional exchanger groups present in strong and weak acid resins.
- d. Define retention time and give its significance.
- e. Name any two gases, with their critical constants, that can be used as mobile phase in SFC.
- f. Write the expression correlating percent extracted (%E) and distribution ratio (D). Also give meaning of every term in that expression.
- g. What are masking agents? Give one example.

Q.2 Attempt any FIVE questions:

[3 × 5 =10]

- a. 3 g of solute is dissolved in 50 mL aqueous solution. Calculate amount of solute remained unextracted in aqueous phase after i) single extraction of 40 mL ether ii) a single extraction of 100 mL and iii) five successive extractions with 25mL ether. (Given: D = 10)
- b. Classify different types of chromatography describing stationary and mobile phases used.
- c. How peak area is calculated? Explain significance of peak area.
- d. Write a short note on McLafferty rearrangement.
- e. Explain how HPLC technique is superior to GC.
- f. Explain with example the use of chelate formation during solvent extraction.
- g. Calculate the turbidity coefficient of chloride ion at 415 nm if a solution having concentration of 5.2×10^{-5} mole/lit placed in 1 cm cell gave a transmittance of 0.6215.

Q.3 Attempt any FIVE questions:

[5 × 5 =25]

- a. Give construction and working of ECD.
- b. Explain 'match box model' in details.
- c. Explain paper chromatography with special reference to
 - i) stationary and mobile phase

- ii) development of chromatography
- iii) detection of spots.
- d. Describe 'Disc Electrophoresis' in details with diagram.
- e. Write in details 'continuous extraction' process.
- f. Write a note on applications of turbidimetry.
- g. Explain SFC in detail and give applications of SFC.

14/11/2022 O/C

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
T.Y. B. Sc. (Semester VI)
Subject: Chemistry
(CHE3601) Physical Chemistry II (2019 pattern)

Time: 2 hrs 30 min.

Instruction to candidates:

Max. Marks: 50

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of scientific calculators is allowed.

Q.1 Attempt any five questions.

[2 x 5 = 10]

- a) Calculate the energy released in the destruction of 1 amu mass.
- b) Complete the following nuclear reaction (identify the X)
 - (i) ${}_{78}^{170}\text{Pt} \rightarrow {}_{59}^{135}\text{Pr} + X$
 - (ii) ${}_{94}^{239}\text{Pu} + X \rightarrow {}_{96}^{242}\text{Cm} + {}_0^1\text{n}$
- c) Write the equation of Freundlich adsorption isotherm. Explain the different terms involved in it?
- d) Explain the term (i) Transport number (ii) Hittorf rule
- e) Using the phase rule calculate the number of degrees of freedom at the triple point of water. Comment on the answer
- f) A reaction $A + B \rightarrow C$ obeys the following rate law $\text{Rate} = K[A]^2$ (i) if [B] is doubled how will the rate change? (b) What is the unit of the rate constant.
- g) State the Kohlrausch law with the suitable example.

Q.2 Attempt any five questions.

[3 x 5 = 15]

- a) If we start with 1.000 g of strontium-90, 0.953 g will remain after 2.00 yr.
 - (a) What is the half-life of strontium-90? (b) How much strontium-90 will remain after 5.00 yr?
- b) (i) Calculate the binding energy and mean binding energy of ${}_{92}^{238}\text{U}$.
Given; Mass of proton = 1.007825 amu, mass of neutron = 1.008665 amu and mass of ${}_{92}^{238}\text{U}$ = 238.00031 amu

- (ii) Plot the graph of mean binding per nucleon as function of atomic mass number.
- c) Derive the Phase rule.
- d) (i) Define the specific conductance with unit. How the specific conductance is related to the equivalent conductance.
 (ii) Calculate the specific conductance and molar conductance of 0.0075 M aqueous solution of KCl (Given: Conductance of KCl solution is 1.49×10^{-3} S and the cell constant is 1.05 cm^{-1}).
- e) Illustrate how the ionic product of water can be determined with the help of conductance measurements.
- f) Rate constants for the decomposition of gaseous dinitrogen pentoxide are $3.7 \times 10^{-5} \text{ s}^{-1}$ at 25°C and $1.7 \times 10^{-3} \text{ s}^{-1}$ at 55°C .
 (a) What is the activation energy for this reaction in kJ/mol?
 (b) What is the rate constant at 35°C ?
- g) Explain why the adsorption occurs? How does the chemical adsorption is differed from physical adsorption.

Q.3 Attempt any five questions.

[5 x 5 =25]

- a) Explain-Debye-Huckel theory of strong electrolyte.
- b) Explain the isotope dilution analysis and inverse isotope dilution analysis with suitable example.
- c) State and explain Kohlrausch's law. Illustrate how this law is used for calculation of molar conductance at infinite dilution of weak electrolyte?
- d) Explain the nuclear stability on the basis of neutron-proton (N/Z) ratio and even-odd nature of number of neutrons.
- e) Draw and discuss the phase diagram of sulphur system.
- f) Derive an Eyring equation of transition state theory.
- g) Derive an expression for Langmuir adsorption isotherm.

28/11/2022
O/C
2:30 pm

Deccan Education Society's
Fergusson College (Autonomous), Pune-4
T.Y. B. Sc. (Semester VI)
Subject: Chemistry
(CHE3501) Physical Chemistry I (2019 pattern)

Time: 2 hrs 30 min.

Max. Marks: 50

Instruction to candidates:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of scientific calculators is allowed.

Physicochemical Constant:

1. Planck constant $= h = 6.626 \times 10^{-34} \text{ J.s}$,
2. Velocity of light $= c = 3 \times 10^8 \text{ m.s}^{-1}$
3. Avogadro's Number $= N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$
4. Mass of electron $= 9.1 \times 10^{-31} \text{ kg}$
5. Molar gas constant $= R = 8.314 \text{ J.K}^{-1} \text{ mol}^{-1}$
6. $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$
- 7.

Q.1 Attempt any five questions.

[2 x 5 = 10]

- a) Explain-Tetrahedral and octahedral molecules are microwave inactive.
- b) Explain-Rayleigh, anti-stokes and stokes line in Raman spectra.
- c) Explain with example-Redox electrode.
- d) Define-Liquid-liquid junction Potential. How can it be eliminated?
- e) Calculate the energy of one quantum of light that has a wavelength is 540 nm.
- f) Find out whether the function $\cos ax$ is an eigen function of $\frac{d^2}{dx^2}$
- g) Calculate the de-Broglie's wavelength of an electron moving with the one fifth of the speed of light. Neglect relativistic effects.

Q.2 Attempt any five questions.

[3 x 5 = 15]

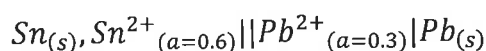
- a) Draw and explain important components of spectrophotometer.
- b) Explain the terms and significance of equation $\bar{\nu}_{scatt} = \bar{\nu}_{inci} \pm \Delta\bar{\nu}$
- c) How will you find the amount of halide present by potentiometric titration.
- d) Explain-Basic difference of primary, secondary and fuel cell.
- e) Calculate the force constant of the $^{12}\text{C}^{16}\text{O}$ molecule if its fundamental vibration frequency is 2140 cm^{-1} .

- f) What is the work function of a metal if the threshold wavelength for it is 580 nm?
- g) If, $(E_{oxi}^0)_{Ni/Ni^{2+}} = 0.257 V$ and $(E_{red}^0)_{Cu/Cu^{2+}} = 0.342 V$. Write reaction occurring at both the electrodes, represent the cell and find E_{cell}^0 at 25 °C.

Q.3 Attempt any five questions.

[5 x 5 =25]

- a) Draw-Rotational-Vibrational spectra of rigid diatomic molecule. Label line, branch, selection rule, rotational constant and band centre.
- b) Give the classification of electrochemical cell with examples.
- c) Derive-Schrodinger wave equation for one dimensional box.
- d) Show that the equilibrium vibrational frequencies of fundamental, first and second overtones are in proportion of 1:2:3.
- e) Calculate the free energy change and equilibrium constant of the cell at 25 °C, If $E_{cell}^0 = 0.014 V$.



- f) Explain-Uncertainty principle and calculate uncertainty in position. If, the uncertainty in momentum of particle is $3.31 \times 10^{-2} kg.m.sec^{-1}$.
- g) Calculate the value of moment of inertia and internuclear distance of $^{12}C^{16}O$ If spacing between rotational lines is $1.92118 cm^{-1}$.

23/11/2022
01C

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

S.Y.B.Sc. (Semester IV)
Subject: Chemistry (CHE 2402)

Introduction of Biomolecules and Coordination Chemistry (2016 pattern)

Time: 2.5 Hrs

Max. Marks: 50

Instruction to candidates:

- i) All questions are compulsory
- ii) Figures to the right indicate full marks

[Given: Atomic Numbers of Cr (24), Mn(25), Fe (26), Co(27), Ni (28), Cu (29)]

Q.1 Attempt any five questions:

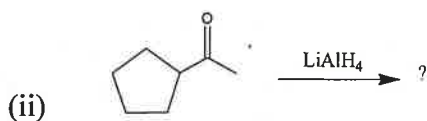
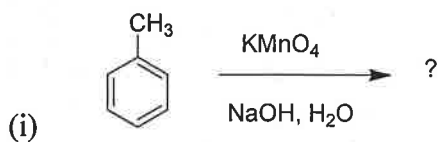
[2 x 5 = 10]

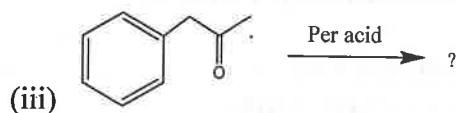
- a) Define reducing agent and give a suitable example.
- b) What is PCC? Draw its structure.
- c) What is isoelectric point?
- d) Give the electronic configuration of Helium (At no. 2) and Argon (At no. 18).
- e) Draw the possible stereoisomers for the complex $[\text{Co}^{\text{II}}(\text{NH}_3)_4\text{Cl}_2]$?
- f) Write the correct formula for potassiumtrioxalatochromate(III) and find its secondary valency.
- g) What is the oxidation state of Fe in $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{Fe}(\text{CO})_5]$ complexes?

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) Differentiate between homogenous and heterogeneous catalyst.
- b) What is Ruff degradation of carbohydrates?
- c) Electrophilic substitution on furan occurs at carbon atom adjacent to oxygen atom. Why?
- d) Predict the product(s)





- Write the correct IUPAC name of the complexes $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})(\text{I})]\text{SO}_4$ and $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$.
- Define ligand. Give two examples of neutral monodentate ligand.
- Calculate EAN for $[\text{Ni}(\text{CO})_4]$ and state whether it obeys Sidgwick EAN rule or not?

Q.3 Attempt any five questions:

[5 x 5 =25]

- What is Birch reduction? Explain its mechanism with suitable example.
- Define α -amino acid? Give two methods of its preparation.
- What is an aldose? Predict the product(s) formed on reaction of glucose with the following reagents (i) $\text{Br}_2/\text{H}_2\text{O}$ (ii) HNO_3 (iii) Tollen's Reagent (iv) H_2/Pd .
- Predict the product(s) formed on reaction of pyridine with following reagents- (i) CH_3I (ii) H_2O_2 (iii) H_2SO_4 (iv) $\text{C}_2\text{H}_5\text{Cl}/\text{AlCl}_3$ (v) $\text{HNO}_3/\text{H}_2\text{SO}_4$
- Explain bonding and structure of XeF_4 molecule.
- $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ has sp^3d^2 hybridisation - explain its bonding and geometry with box diagram. Calculate the spin only magnetic moment of this complex.
- Discuss the biochemical effects of lead (Pb).

7/12/22
10.30

O/C

Deccan Education Society's
Fergusson College (Autonomous), Pune-4

S.Y.B.Sc. (Semester III)
Subject: Physical Chemistry
(CHE 2301) (2019 pattern)

Time: 2 hrs 30min

Max. Marks: 50

Instruction to candidates:

- All questions are compulsory.
- Figures to the right indicate full marks.
- Use of scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 = 10]

- Write the rate expression for the following reaction in terms of the disappearance of the reactant and the appearance of the product.
$$\text{BrO}_3^-(\text{aq}) + 5 \text{Br}^-(\text{aq}) + 6 \text{H}^+(\text{aq}) \rightarrow 3 \text{Br}_2(\text{aq}) + 3 \text{H}_2\text{O}(\text{l})$$
- Draw vapour -pressure composition curve for a non-ideal solution with negative deviation.
- State any two statements of the first law of thermodynamics. Give its mathematical expression. Explain the different terms involved in it.
- Calculate the mole fraction of each component of a solution prepared by dissolving 2.25 g of nicotine ($\text{C}_{10}\text{H}_{14}\text{N}_2$) in 80.0 g of dichloromethane CH_2Cl_2 .
- Write any two applications of Nernst distribution law.
- What is the relationship between the standard free energy change (ΔG°) for reaction and equilibrium constant K? What is the sign of ΔG° (a) $K=1$ (b) $K>1$
- A reaction $A + B \rightarrow C$ obeys the following rate law $\text{Rate} = K[B]^2$ (i) if $[A]$ is doubled how will the rate change? (b) What is the unit of the rate constant?

Q.2 Attempt any five questions:

[3 x 5 = 15]

- Six moles of ideal gas expand isothermally and reversibly from a volume of 25 lit to a volume of 50 lit at 27 °C. Calculate the work done during this process.
- Explain the $\Delta H_{\text{mixing}} \neq 0$ for a non-ideal solution.
- For the given reaction, $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightleftharpoons 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g})$ using the following data (a) Calculate the standard free-energy change for this reaction at 25 °C (b) Is the reaction spontaneous under standard-state conditions at 25 °C?

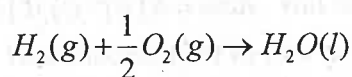
	$\text{Fe}_2\text{O}_3(\text{s})$	$\text{CO}(\text{g})$	$\text{Fe}(\text{s})$	3CO_2
$\Delta H_f^\circ(\text{kJ/mol})$	-824.2	-110.5	0	-393.5
$S^\circ(\text{J/K/mol})$	87.4	197.6	27.3	213.6

- d) For certain reaction, frequency factor (A) is $8.7 \times 10^{12} \text{ s}^{-1}$ and the activation energy is 63 kJ/mol. What is the rate constant for the reaction at 75 °C .
- e) Calculate the amount of acid extracted from 1 litre of an aqueous solution containing 60 g of acid on extracting with 100 ml of ether every time in 4 lots. The partition coefficient of acid in water and ether is 4.6
- f) What is the vapor pressure in mm Hg of the following solutions, each of which contains a non-volatile solute? The vapor pressure of water at 45 °C is 71.93 mm Hg.
- (i) A solution containing 10 g of urea ($\text{CH}_4\text{N}_2\text{O}$), in 150.0 g of water at 45°C
- (ii) A solution of 10.0 g of LiCl in 150.0 g of water at 45 °C
- g) What is the half-life period? Consider the first-order decomposition of H_2O_2 with a rate constant of $1.8 \times 10^{-5} \text{ s}^{-1}$ at 20 °C.
- (i) What is the half-life (in hours) of the reaction at 20 °C?
- (ii) How many hours will it take for the concentration to drop to 25% of its initial value?

Q.3 Attempt any five questions

[5 x 5 =25]

- a) (i) How molecular weight of the organic liquid is determined by steam distillation?
- (ii) A mixture of nitrobenzene and water distills at 98.2 °C at a pressure of 731.9 mm Hg and the weight ratio of nitrobenzene and water in the distillate is 0.188. The vapour pressures of water and nitrobenzene at this temperature are 712.4 mm and 19.5 mm Hg respectively. Calculate the molecular weight of nitrobenzene.
- b) Derive an Eyring equation of transition state theory.
- c) Discuss entropy as a predictor of the spontaneity of chemical change using the following reaction.



$$S_{298}^0(\text{H}_2\text{O}(\text{l})) = 69.9 \text{ JK}^{-1} \text{ mol}^{-1}, S_{298}^0(\text{H}_2(\text{g})) = 130.7 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$S_{298}^0(\text{O}_2(\text{g})) = 205 \text{ JK}^{-1} \text{ mol}^{-1}, \Delta H_r^0 = -285.8 \text{ kJ}$$

- d) Derive Clausius Clapeyron equation.
- e) Discuss the distillation of a non-ideal solution with negative deviation with the help of a temperature-composition diagram (with a suitable example).
- f) Derive an expression of van't Hoff reaction isotherm.
- g) (i) Derive an integrated rate of the equation for a second-order reaction with equal concentration.
- (ii) The second-order reaction with a rate constant is $0.030 \text{ M}^{-1} \text{ s}^{-1}$. What are the half-lives of the reaction with initial concentrations of 0.075 M and 0.035M?

21/11/22 o/c

Deccan Education Society's
Fergusson College (Autonomous), Pune-411004

F.Y.B.Sc. (Semester II)
Subject: Chemistry
(CHE -1201) Ionic Equilibrium & Chemical Bonding (2019 pattern)

Time: 2 Hrs 30 min

Instructions to candidates:

Max. Marks: 50

- i) All questions are compulsory.
- ii) Figures to the right indicate full marks.
- iii) Use of statistical tables and scientific calculators is allowed.

Q.1 Attempt any five questions:

[2 x 5 = 10]

- a) Explain with suitable diagram i) Axis of symmetry ii) Plane of symmetry
- b) Define and explain with a diagram, Body-centered cubic cell.
- c) Define Colligative properties and give example.
- d) Define Common ion effect
- e) The solubility of CuBr is found to be 2.0×10^{-4} mol/L at 25°C. Calculate K_{sp} value for CuBr.
- f) Differentiate between sigma bond and pi bond
- g) Mention the hybridization and geometry of methane.

Q.2 Attempt any five questions:

[3 x 5 = 15]

- a) Describe the theory of Bragg's method of crystal analysis.
- b) Phenol (C₆H₅OH) associates in water to give a dimer. When 0.6677 g of phenol is dissolved in 35.5 g of water; it depresses the freezing point by 0.215°C. Calculate the van't Hoff factor and the degree of association of phenol.
[Given : Molal depression constant of water = 1.85°C mole⁻¹.]
- c) Explain Raoult's Law with example.
- d) Define Ostwald's dilution law and derive the expression for it.

- e) What type of bonds do you expect in the following cases? Give reasons:
 (i) between a very small cation and a large anion.
 (ii) between atoms having a very large difference in electro negativities,
 (iii) between atoms of the same element.
- f) Find the interplanar distance in a crystal in which a series of planes produce a first order reflection from a copper X-ray tube having wavelength of $1.639 \text{ \AA}$ at an angle of 27.5° .
- g) Explain the shape of ammonia molecule on the basis of VSEPR theory.

Q.3

Attempt any five questions:

[5 x 5 =25]

- a) i) Explain the classification of crystals on the basis of molecular bonds.
 ii) Explain different types of crystal defects.
- b) How is the molecular mass of a solute determined from elevation of boiling point?
- c) Define the terms 'Solubility' and 'Solubility product'. Explain the use of solubility products in qualitative analysis.
- d) i) Classify the bonds in the following as ionic, polar covalent or covalent:
 (a) HCl (b) NaCl and (c) NCl_3 .
 ii) Discuss the geometry and shape of PF_5 molecule.
- e) i) Define Lattice energy. Discuss the factors on which it depends.
 Why melting and boiling points of ionic compounds are usually higher than covalent compounds?
- f) i) 18.2 g of substance is dissolved in 100 g of water at 50°C . The lowering of vapor pressure produced is 5 mm Hg. Calculate the molecular mass of the substance. The vapor pressure of water at 50°C is 92 mm Hg.
 ii) The solubility of BaSO_4 at 18°C is 0.00233 g per liter. Calculate the solubility product of BaSO_4 .
 (Molecular weight of BaSO_4 is 233)
- g) By X-ray diffraction, it is found that nickel crystals are face-centered cubic. The edge of the unit cell is $3.52 \text{ \AA}$. The atomic mass of nickel is 58.7 and its density is 8.94 g/cm^3 . Calculate Avogadro's number from the data.