TRIBHUVAN UNIVERSITY

2079

Bachelor Level (4 Yrs.)/Science & Tech./III Year — Full Marks: 100

General Chemistry -I **(CHE/CHEM 301)** — Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.

New Course

Use separate answer-book for each group.

The *Comprehensive Question* of each group is compulsory.
Attempt SIX questions of *Short Answer Questions* of each Group.

GROUP "A" (INORGANIC)

1. *Comprehensive Question*

What is meant by group electronegativity? What parameters are to be considered to estimate it? [2+7]

OR

What are interhalogens? Discuss the structure of AX_1, AX_3 AX_5 and AX_7 type of compound. [1+8]

2. *Short Answer Questions* 6×4=24

2.1. What are the heavier isotopes of hydrogen? Discuss the method of preparation of one of the isotope by the use of exchange reactions.

2.2. How is Borazime prepared? Why it is called as inorganic benzene?

2.3. What are silicates? What are the basis used for classifying the different silicate structures?

2.4. Suggest any two methods of forming Si-c bond. What type of hydrolysis products are obtained when an organosilicon compound is hydrolysed.

2.5. Point out the molecular orbital treatment for the structure of XeF_2. What is bond order for Xe-F bond in XeF_2?

2.6. Why is Ozone layer important for us? What factors contribute to the dipletion of ozone layer and in what way the depletion could be controlled?

2.7. What is meant by chemical Oxygen Demand? What type of information does this value provide as to the quality of water?

2.8. What are synthetic fertilizers? Improper use of synthetic chemical fertilizers could causes soil acidity and eatrophication. Explain.

2.9. How is urea produced? How much nitrogen is taken up by the soil per kg of urea used?

GROUP "B" (ORGANIC)

3. *Comprehensive Question*

What are nonclassical carbocations? What are the evidences in the existence of nonclassical carbocations in organic reactions? Explain this by neighboring group participation of π- and σ-bonds. 1+3+5]

OR

Give the sources of furan. Write its five electrophilic substitution reactions with mechanism. [1.5+7.5]

4 *Short Answer Questions* 6×4=24

4.1. How the isotopic labelling is helpful in designing the mechanism of reaction?

4.2. Give an example of nucleophilic substitution reaction of pyridine.

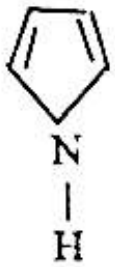
4.3. Wah do you mean by chemical shift? Sketch out the ^1H- and ^{13}C-NMR spectrum of benzaldehyde showing chemical shift and splitting patterns of signals.

4.4. Write down the basic applications of mass spectrometry, IR and UV spectroscopic techniques.

4.5. What is benzyne intermediate and give evidences for its existence with suitable illustrations.

4.6. What do you mean by coupling constant? How one can differentiate between cis-and trans-2 butene by 1H-NMR.

4.7. Complete the following reaction giving mechanism.



$+ CHCl_3 + KOH \longrightarrow ?$

4.8. What is meant by Kinetic and theromodynamic control of reaction? Explain with giving example.

4.9. What are the characteristics of free radical reaction? Explain.

GROUP "C" (PHYSICAL)

5. *Comprehensive Question*

What are the failures of Arhenius theory what in case of strong electrolytes? State and explain Debye- Huckel theory of equivalent conductance calculate the ionic strength of 0.1 MKCl and 0.3M $cacl_2$. (2+4+4)

OR

State and explain third law of Thermodynanics. Mention the applications of third law of tharmodynamics. For a reaction, $H_2(g) + s(g) \rightleftharpoons H_2s(g)$, Kp at 945^0c is 20.2 atm and 9.21 atm at 1065^0c. calculate heat of reaction. [3+3+4]

6. *Short Answer Questions* 6×4=24

6.1. Describe liquid function potential and how it is minimized?

6.2. Mention the applications of emf measurement in brief.

6.3. How molecular spectra and originated? Explain with suitable example.

6.4. Show your acquaintance with the vibrational frequency of different functional groups.

6.5. Describe Frank-conden principle and its application in electronic spectroscopy.

6.6. What are addition and condensation polymerization? How average weight of polymers can be determined?

6.7. Distinguish between polymers and copolymers.

6.8. Describe clausius -clapeyron equation and its importance.

6.9. How does temperature and pleasure affects in chemical equilibrium?

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Old Course

GROUP "A" (INORGANIC)

1. *Comprehensive Question*

What is meant by environmental pollution? Explain briefly the major types of pollutants found in water. How is water pollution controlled? Explain. [1+6+2]

OR

What are borates? How are borazines and boron nitrides prepared? Discuss about the similarities and differences between borazine and benzene. [1+2+6]

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6×4=24

2. *Short Answer Questions*

2.1. Give any one method for the preparation of orthoboric acid and also comment on its structure.

2.2. How are hydrides classified? Give the evidences for existence of ionic hydrides.

2.3. How are deuterium compounds prepared by the use of exchange reactions? Explain.

2.4. Give any one method for the preparation of
a) XeF_6 b) XeO_3 c) $XeOF_4$ d. XeF_2

2.5. What is group electronegativity? Explain the difference between electronegativity and election affinity.

2.6. How is urea manufactured? Give the advantages and disadvantages of urea as a fertilizer.

2.7. What is meant by Ozone layer depletion? How does it affect us?

2.8. Comment on the structure and bonding of diborane.

2.9. What is nitrogenase? Explain its importance in nitrogen fixation.

GROUP "B" (ORGANIC)

3. *Comprehensive Question*

What is the basic principle of NMR spectroscopy? Write important application of NMR spectroscopy. Why do we choose tetramethylsilane $(CH_3)_4$ Si as standard substance for recording NMR spectrum. [3+3+3]

OR

What are singlet and triplet carbene? Give molecular structure of SP^2 and SP hybridized carbene. How do carbenes take part in addition and insertion reactions? Give example in both cases.

4 *Short Answer Questions* 6×4=24

4.1. How does isotope labelling (tracer technique) help in determination of reaction mechanism? Give example.

4.2. What are major application of Infra red spectroscopy?

4.3. Show your acquaintance with initiation, propagation and termination of free radical.

4.4. What are thermodynamic and kinetic requirement for a reaction? Explain with suitable illustrations.

4.5. What information do you get from ultraviolet spectrum of organic compound?

4.6. Explain why Electrophonic substitution takes place preferably at 2-position instead of 3-position in furan?

4.7. Given the mechanism and orientation of electrophilic substitution on pyridine .

4.8. Define the term aromaticity and anti-aromacity. Which of following compounds are aromatic and why?

a. Cyclobutadiene b. Cyclopropenylcation
c. Naplhalene d. cyclopentadienyl

4.9. What are carbanion? How are they generated? Discuss their stability.

GROUP "C" (PHYSICAL)

5. *Comprehensive Question*

What are concentration cells? Give an example of concentration cell without transference and hence derive an expression for emf of such cell.

The standard electrode potential, $E^0Ag^+/Ag = 0.799v$ and $E^0fe^{3+}/fe^{2+} = 0.771v$. Calculate equilibrium constant for a reaction

$Ag(s) + Fe^{3+}(ar) \rightleftharpoons Ag^+(aq) + Fe^{2+}(ar)$ [2+4+4]

OR

Explain the terms used in Gibb's Phase rule with suitable examples. Discuss the nature of phase diagram of water system. What is triple point? [4+4+2]

6. *Short Answer Questions* 6×4=24

6.1. Define ionic strength. Calculate the ionic strength of 0.3 M solution of calcium phosphate.

6.2. Explain the variation of equivalent conductance of strong electrolyte with concentration on the basis of Debye-Huckle theory.

6.3. Explain the terms eutetic point and eutetic misture.

6.4. The spacing between the lines in rotational spectrum of HCl is 20.68 cm^{-1}. Calculate bond length of HCl

6.5. Write short notes on Raman spectra.

6.6. Write an expression for vibrational energy of a diatomic molecules what are the selection rules for vibrational spectra?

6.7. What do you mean by the term adsorption? Point out the difference between physical and chemical adsorption.

6.8. Derive the Langmuir adsorption isotherm equation.

6.9. Define the terms adsorbate and adsorbents. How do you determine surface area of solid adsorbents?

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