1 (Sem–5/FYUGP) CHE 45 MN/(A)

2025

CHEMISTRY

(Minor)

Paper : CHE0500504

(Inorganic Chemistry—II)

(Set—A)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Fill in the blanks of the following : 1×5=5

(a) Oxygen and ozone are ____.

(b) The increasing order of oxidation states of P in H_3PO_2, H_3PO_3, $H_4P_2O_6$ and $H_4P_2O_7$ is ____.

(c) Effective number of electrons in $Mn_2(CO)_{10}$ is ____.

(d) Geometry of I_3^- is ____.

(e) The ground term of a d^5 configuration of a free metal ion is ____.

2. Answer the following questions (any *five*) : 2×5=10

(a) Define allotropy. Name the main allotropic forms of phosphorus.

(b) H_3PO_2 is a good reducing agent. Why?

(c) Give one example each of pyrosilicate and chain silicate.

(d) C_5H_5 group can act as pentahapto as well as monohapto ligand. Explain.

(e) Why is it difficult to store XeF_6 in glass or quartz vessel?

(f) Calculate magnetic moment (spin only) for Cr^{2+}.

(g) Alkali metals have low ionization energies. Why?

(h) HF is polymeric. Give reason.

(i) What is π acid ligand? Give one example.

(j) Why is borazine known as inorganic benzene? Draw and discuss its structure.

(k) How does B_2H_6 react with ammonia at low and high temperatures?

3. Answer the following questions (any *four*) : 5×4=20

(a) Discuss the structures of $Ni(CO)_4$ and $Mn_2(CO)_{10}$.

(b) H_2SO_3 acts as oxidizing as well as reducing agent while H_2SO_4 acts as oxidizing agent only. Explain.

(c) Diamond is a non-conductor while graphite is a good conductor of electricity. Explain.

(d) Define EAN rule with example. Give one example of metal carbonyl which obeys EAN rule.

(e) Why are the elements of Group I called the alkali metals? Give their electronic configurations. Why are they so reactive?

(f) Derive term symbols for p^6 and d^{10} configuration.

(g) Why do tetrahedral complexes of an element give more intense *d-d* spectra than in octahedral complexes?

(h) Iodine is more soluble in KI solution than in water. Explain.

4. Answer the following questions (any *one*) : 10

(a) What is meant by diagonal relationship? How would you account for this relationship amongst the metallic and non-metallic elements of *s*- and *p*-block elements?

(b) What is Zeise's salt? Give one method of its preparation. Draw its structure and discuss the salient features of the structure.

(c) Give an account of the discovery of noble gases. How can they be separated from one another? How does He occur in nature? How is He obtained in large scale?

(d) Describe in detail the preparation, properties and uses of the interhalogens belonging to XY, XY_3, XY_5 and XY_7 types.

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2025

CHEMISTRY

(Minor)

Paper : CHE0500504

(Inorganic Chemistry—II)

(Set—B)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Fill in the blanks of the following : 1×5=5

(a) Geometry of I_3^- ion is _____.

(b) Number of 3c-2e bonds present in diborane is _____.

(c) Effective number of electrons in $Fe(CO)_5$ is _____.

(d) Geometry of XeF_2 is _____.

(e) The ground state term among ^1S, ^3P, ^1D, ^3F, ^1G is _____.

2. Answer the following questions (any *five*) : 2×5=10

(a) Define allotropy with example.

(b) H_3PO_3 is dibasic acid. Why?

(c) How can $(NPF_2)_3$ be prepared?

(d) What is the action of moisture on XeF_6?

(e) Define *L-S* coupling.

(f) Calculate magnetic moment (spin only) for Co^{2+}.

(g) Why is $[Ti(H_2O)_6]^{3+}$ ion violet?

(h) KO_2 is used in space shuttle. Why?

(i) Name two peroxoacids of sulfur. Give their structures.

(j) Define hapticity with example.

3. Answer the following questions (any *four*) : 5×4=20

(a) What do you mean by interhalogen compounds? Discuss any one of them.

(b) Compare the acidic character of oxoacids of chlorine.

(c) Describe the use of Zeolites as water softeners.

(d) Why does Li have dissimilarities with other alkali metals? What is the reason for the Li having a greater tendency to form covalent compounds than the other elements of the group?

(e) Determine the ground state terms for low-spin and high-spin d^2 octahedral configuration.

(f) Derive the term symbols for d^1, d^4, d^6 and d^9 complexes.

(g) Beryllium shows covalency whereas other members of the family show electrovalency. Explain.

(h) Write notes on *ortho-* and *para-*hydrogen.

4. Answer the following questions (any *one*) : 10

(a) What is meant by diagonal relationship in periodic classification? Discuss the diagonal relationship of boron and silicon.

(b) What is meant by hapticity of a ligand? How is it designated? Classify ligands on the basis of hapticity and give examples. Show clearly that the hapticity of a ligand varies from one organometallic compound to another.

(c) Discuss the utility of Orgel diagrams. What are their limitations? Draw the Orgel diagrams for high-spin d^5 configuration in octahedral field.

(d) Write notes on the following :

(i) Charge transfer spectra

(ii) Spectrochemical series

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Total number of printed pages–11

1 (Sem–5/FYUGP) CHE46MN/(A)

2025

CHEMISTRY

(Minor)

Paper : CHE5000604

(SET–A)

(Organic Chemistry–II)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×5=5

তলৰ প্ৰশ্নবোৰৰ উত্তৰ দিয়া ঃ

(i) State Saytzeff rule with an example.

এটা উদাহৰণসহ চেইট্জেফ নীতিটো উল্লেখ কৰা।

(ii) Define active methylene compounds with suitable examples.

উপযুক্ত উদাহৰণসহ সক্ৰিয় মিথাইলিন যৌগৰ সংজ্ঞা দিয়া।

(iii) What is ylide ? Give example of a phosphorous ylide.

ইলাইদবোৰ কি? ফচফ্‌ৰাছ ইলাইদৰ এটা উদাহৰণ দিয়া।

(iv) Between benzaldehyde and acetaldehyde, which one will be more reactive towards nucleophilic addition reaction ?

বেনজালডিহাইড আৰু এছিটেলডিহাইডৰ ভিতৰত কোনটো নিউক্লিয়'ফিলিক যোজন বিক্ৰিয়াৰ প্ৰতি অধিক সক্ৰিয় হ'ব?

(v) Give example of a disaccharide mentioning the monosaccharides present in it.

এটা দ্বিশৰ্কৰাৰ উদাহৰণ দিয়া আৰু তাত থকা একশৰ্কৰাবোৰ উল্লেখ কৰা।

2. Answer ***any five*** of the following questions : 2×5=10

তলৰ *যিকোনো পাঁচটাৰ* উত্তৰ দিয়া ঃ

(i) Define stereoselective and stereospecific reactions with examples.

উদাহৰণসহ ষ্টেৰিয়'চিলেকটিভ আৰু ষ্টেৰিয়'স্পেচিফিক বিক্ৰিয়াৰ সংজ্ঞা দিয়া।

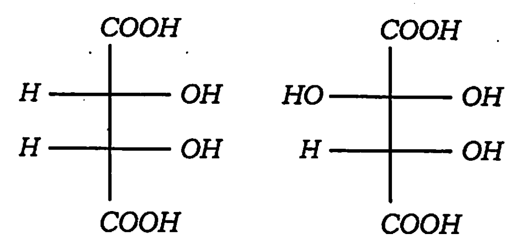
(ii) Ethylacetoaccetate is insoluble in water but soluble in alkali. Explain.

ইথাইলএচিট'এচিটেট পানীত অদ্ৰৱণীয় কিন্তু ক্ষাৰকত দ্ৰৱণীয়। ব্যাখ্যা কৰা।

(iii) What are enolates ? Explain how these are stabilized by resonance with an example.

ইন'লেটবোৰ কি? ইহঁতক সংস্পন্দনে কিদৰে সুস্থিৰ কৰে, উদাহৰণসহ ব্যাখ্যা কৰা।

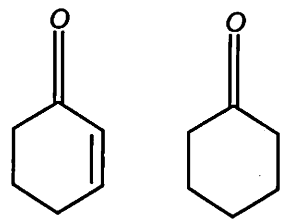
(iv) Define epimers. Mention whether the following two compounds are epimers *or* anomers.



ইপিমাৰৰ সংজ্ঞা দিয়া। তলৰ যৌগদুটা ইপিমাৰ *নে* এন'মাৰ উল্লেখ কৰা।

(v) Which one of the following ketones has one prochiral carbon atom ? Justify your answer.

তলৰ কোনটো কিট'নত এটা প্ৰ'কাইৰেল কাৰ্বন পৰমাণু আছে? তোমাৰ উত্তৰটোৰ যুক্তিযুক্ততা প্ৰতিপন্ন কৰা।



(vi) What are polysaccharides ? Give *two* examples of polysaccharides.

বহুশৰ্কৰাবোৰ কি? দুটা বহুশৰ্কৰাৰ উদাহৰণ দিয়া।

(vii) Draw the structure of citral. What is the natural source of citral ?

চাইট্ৰেলৰ গঠন আঁকা। চাইট্ৰেলৰ প্ৰাকৃতিক উৎস কি?

(viii) What is mCPBA ? Mention *one* of its uses in organic synthesis with suitable reaction.

mCPBA কি? উপযুক্ত উদাহৰণসহ জৈৱ সংশ্লেষণত ইয়াৰ এটা ব্যৱহাৰ উল্লেখ কৰা।

(ix) What are reducing and non-reducing sugars ? Explain with examples.

বিজাৰণকাৰী আৰু অ-বিজাৰণকাৰী শৰ্কৰা বুলিলে কি বুজা? উদাহৰণসহ ব্যাখ্যা কৰা।

(x) With a suitable example show how active methylene compounds can be used in Knoevenagel condensation.

সক্ৰিয় মিথাইলিন যৌগবোৰ ন'ভেনজেল ঘনীভৱনত কিদৰে ব্যৱহাৰ কৰিব পাৰি এটা উদাহৰণসহ ব্যাখ্যা কৰা।

3. Answer ***any four*** questions from the following : 5×4=20

তলৰ *যিকোনো চাৰিটা* প্ৰশ্নৰ উত্তৰ দিয়া ঃ

(i) Carry out the following conversions :

তলৰ পৰিৱৰ্তনবোৰ সম্পন্ন কৰা ঃ

(a) EAA $\rightarrow$ Acetonyl acetone

EAA $\rightarrow$ এচিট'নাইল এচিট'ন

(b) DEM $\rightarrow$ Barbitol

DEM $\rightarrow$ বাৰবিটল

(ii) What is Claisen-Schmidt reaction ? Write its mechanism.

ক্লেইজেন-স্মিদ্‌ট বিক্ৰিয়া কি? এই বিক্ৰিয়াৰ ক্ৰিয়াবিধি লিখা।

(iii) What is a rearrangement reaction ? Write the mechanism of Beckmann rearrangement.

পুনৰবিন্যাস বিক্ৰিয়া কি? বেকমেন পুনৰবিন্যাস বিক্ৰিয়াৰ ক্ৰিয়াবিধি লিখা।

(iv) What is anomeric effect ? Explain why α-D(+)-glucophyranose is less stable than β-D(+)-glucophyranose, whereas methyl-α-D(+)-glucophyranoside is more stable than its β-anomer.

এন'মাৰিৰ প্ৰভাৱ কি? α-D(+)-গ্লুক'পাইৰেন'জ β-D(+)-গ্লুক'পাইৰেন'জতকৈ কম সুস্থিৰ, কিন্তু মিথাইল-α-D(+)-গ্লুক'পাইৰেন'চাইড ইয়াৰ β–সমযোগীতকৈ বেছি সুস্থিৰ। ব্যাখ্যা কৰা।

(v) How many epimeric pairs are possible for a ketose with molecular formula $C_5H_{10}O_5$? Draw the structures in Fischer projections. Mention whether these pairs are either enantiomers or diastereomers.

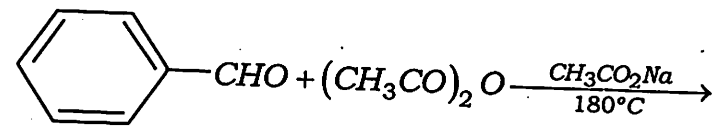
$C_5H_{10}O_5$ আণবিক সংকেতবিশিষ্ট কিট'জ এটাৰ বাবে কিমানবোৰ ইপিমাৰ সম্ভৱ হ'ব? ফিচাৰ প্ৰক্ষেপণত এই গঠনবোৰ আঁকা। এই বোৰকেইটা এনানচিঅ'মাৰ নে ডায়াষ্টেৰিয়'মাৰ?

(vi) State the special isoprene rule. Classify terpenoids on the basis of the number of isoprene units present in their structures with examples.

বিশেষ আইচ'প্ৰিন নিয়মটো লিখা। টাৰপিনয়দত থকা আইচ'প্ৰিন এককৰ সংখ্যাৰ ভিত্তিত উদাহৰণসহ টাৰপিনয়দবোৰ শ্ৰেণী বিভক্ত কৰা।

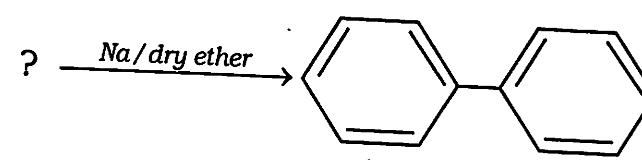
(vii) Complete the following reactions : ***(any five)***

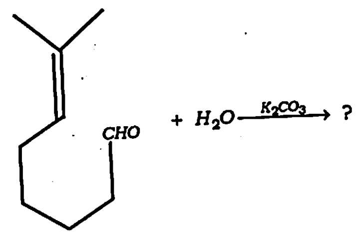
তলৰ বিক্ৰিয়াবোৰ সম্পূৰ্ণ কৰা ঃ *(যিকোনো পাঁচটা)*

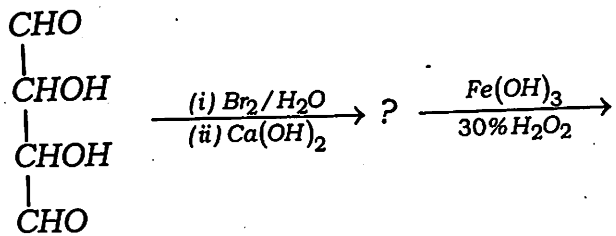
(a) 

(b) $2\,CH_3-CHO \underset{}{\overset{\text{dil. NaOH}}{\rightleftharpoons}} \; ? \xrightarrow[-H_2O]{\Delta} \; ?$

(c) $$\begin{array}{l} CHO \\ | \\ CHOH \\ | \\ CHOH \xrightarrow{\text{Conc. } HNO_3} \; ? \\ | \\ CHOH \\ | \\ CHOH \\ | \\ CH_2OH \end{array}$$

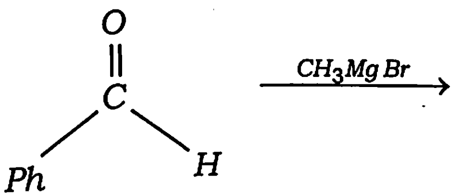
(d) 

(e) 

(f) 

(viii) Using Cram's Rule identify the major product in the following reaction with suitable explanation.

ক্ৰেমৰ নিয়ম ব্যৱহাৰ কৰি উপযুক্ত ব্যাখ্যাসহ তলৰ বিক্ৰিয়াটোৰ বাবে মুখ্য উৎপাদিত দ্ৰব্যটো চিনাক্ত কৰা।



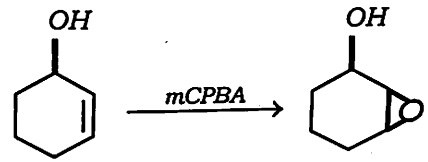
Major Product
(মুখ্য উৎপাদিত দ্ৰব্য)

4. Answer ***any one*** question : 10×1=10

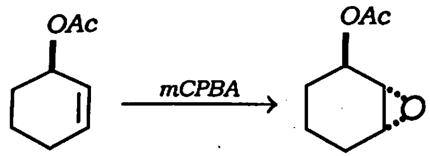
যিকোনো এটা প্ৰশ্নৰ উত্তৰ দিয়া ঃ

(i) Consider the mCPBA epoxidations shown below. Explain the observed diastereoselectivities.

তলৰ mCPBA ইপক্সিডেছনটো লক্ষ্য কৰা। পৰ্যবেক্ষিত ডায়াষ্টেৰিয়-চিলেক্টিভিটিবোৰ ব্যাখ্যা কৰা।



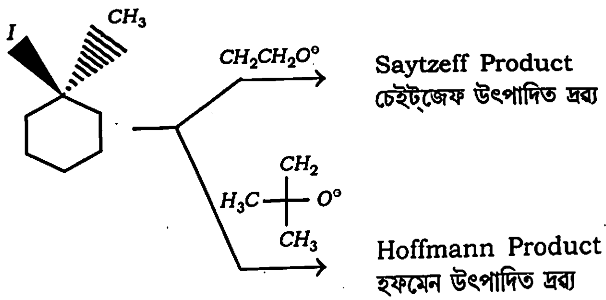
diastereoselectivity >10:1



diastereoselectivity – 2:1

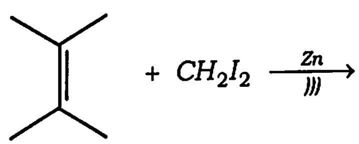
(ii) What are Saytzeff and Hoffmann elimination reactions ? When 1-iodo-1-methylcyclohexane is treated with $NaOCH_2CH_3$ as the base, the more highly substituted alkene product predominates. When $KOC(CH_3)_3$ is used as the base, the less highly substituted alkene predominates. Give the structures of the two products and offer an explanation.

চেইটজেফ আৰু হফমেন অপসাৰণ বিক্ৰিয়া কি? যেতিয়া, 1-আয়'দ'-1-মিথাইলচাইক্ল'হেক্সেনক $NaOCH_2CH_3$ ক্ষাৰৰ সৈতে বিক্ৰিয়া কৰা হয়, অধিক প্ৰতিস্থাপিত এলকিন মূখ্য উৎপাদিত দ্ৰব্য হিচাপে উৎপন্ন হয়। যেতিয়া $KOC(CH_3)_3$ ক ক্ষাৰ হিচাপে ব্যৱহাৰ কৰা হয়, তেতিয়া কম প্ৰতিস্থাপিত এলকিন মূখ্য উৎপাদিত দ্ৰব্য হিচাপে উৎপাদিত হয়। দুয়োটা উৎপাদিত যৌগৰ গঠন আৰু উপযুক্ত ব্যাখ্যা আগবঢ়োৱা।



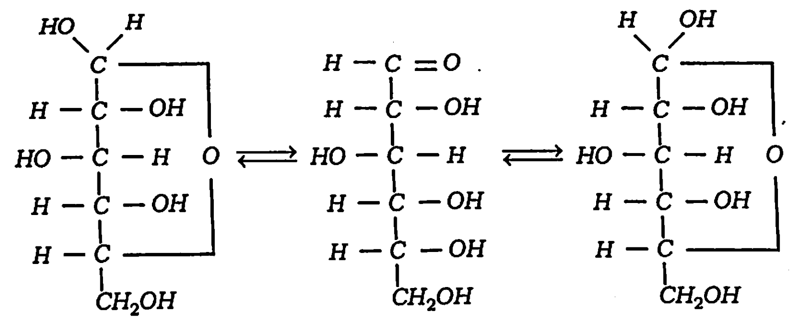
(iii) What is organic cheleotropic reaction? What is the major product of the following reaction? Write a plausible mechanism for the reaction. What is the name of the reaction?

জৈব কিলিঅ'ট্ৰ'পিক বিক্ৰিয়া কি? তলৰ বিক্ৰিয়াটোৰ মূখ্য উৎপাদিত দ্ৰব্য কি হ'ব? বিক্ৰিয়াটোৰ বাবে এটা সম্ভাব্য ক্ৰিয়াবিধি লিখা। বিক্ৰিয়াটোৰ নামটো কি?



(iv) (a) In aqueous solution glucose exhibits the following equilibrium. What is the phenomenon responsible for this equilibrium? Explain the phenomenon with a suitable mechanism. How does it support the cyclic structure of glucose?

জলীয় দ্ৰৱত গ্লুক'জে তলৰ সাম্যটো দেখুৱায়। এই সাম্যটোৰ লগত জড়িত পৰিঘটনাটো কি? উপযুক্ত ক্ৰিয়াবিধিসহ পৰিঘটনাটো ব্যাখ্যা কৰা। ই গ্লুক'জৰ চক্ৰীয় গঠন কিদৰে সমৰ্থন কৰে?



(b) Mention the structural differences between starch and cellulose.

স্টাৰ্চ আৰু চেলুল'জৰ মাজত গঠনগত পাৰ্থক্যবোৰ লিখা।