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CHE 529/CHE 530/CHE 531

M.Sc. IVth SEMESTER EXAMINATION, 2023-24

(CBCS MODE)

CHEMISTRY

महाराणा प्रताप महाविद्यालय
24-4-24
ग्रन्थालय
जंगल धूसर, गोरखपुर

Time : Three Hours] [Maximum Marks : 75

CHE 529

(Statistical Mechanics)

Note: There are **three** sections, (**A, B** and **C**) and Candidate has to attempt questions from all sections. Marks are indicated against each section.

Section–A

1. Answer all questions. 3×5=15

(a) What are the important features of micro canonical ensemble ?

(b) What is Phase Space ?

(c) Discuss the concept of partition function.

(d) What are the differences among Bose Einstein, Maxwell-Boltzmann and Fermi-Dirac statistics ?

(e) Derive an expression for equilibrium constant in terms of partition function.

Section–B

Note : Answer all questions of the following. 5×4=20

2. (a) Give a statistical interpretation of K_p in case of dissociation reaction :

$$Na_2(g) \rightleftharpoons 2Na(g)$$

Or

(b) Derive the equilibrium constant in terms of partition function in case of the following reaction :

$$H(g) \rightleftharpoons H^+(g) + e$$

3. (a) Describe the density of distribution in phase space.

Or

(b) Describe the two basic postulates of statiscal mechanics which are useful for evaluation of average properties of an ensemble.

4. (a) Discuss the limits of applicability of various distribution laws.

Or

(b) How do you determine the constant β of distribution laws ?

5. (a) Derive relation for rotational partition function for a linear molecule with fixed separation of the atoms in the molecule.

Or

(b) Which statistics will give the highest number of particles per energy level and which will give the lowest ? Explain.

Section-C

Note : Answer any <u>two</u> questions of the following. 20×2=40

6. Derive relation between entropy S and partition function of an ideal gaseous system.

7. What are important features on which Bose-Einstein statistics is based. Derive expression for the distribution of particles among energy levels according to this statistics.

8. Derive expression relating partition function and internal energy, enthalpy and Helmholtz free energy.

9. Derive expression for distribution of identical indistinguishable particles of an ensemble into energy levels by fermi-Dirac statistics.

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CHE 530

(Organotransition Metal Chemistry)

Note: There are **three** sections, (**A, B** and **C**) and Candidate has to attempt questions from all sections. Marks are indicated against each section.

Section–A

1. Answer all questions of the following. 3×5=15

(a) What is the basic concept of Ziegler-Natta polymerization. Is Ziegler Natta system homogenous or heterogeneous ?

(b) Give the structure of any one :

(i) Triple Decker Sandwich compound.

(ii) Slipped Sandwich Compound.

(c) What are different types of σ-hydrocarbonyls formed by transition metals ?

(d) What is oxidative addition reaction ? Give an example.

(e) Which technique is used to demonstrate fluxional character of organometallic molecules ?

Section–B

Note : Answer all question of the following. 5×4=20

2. (a) Enumerate the difference between Fischer type and Schrock type carbyne complex.

Or

(b) Explain, how cyclooctatetraene acts as η^2, η^4 - bridging, η^6 or η^8 ligand.

3. (a) Discuss the mode of bonding η^3-allyl complexes.

Or

(b) Predict the products of following reactions :

(i) $(\eta^6 - C_6H_6)_2Cr \xrightarrow[(ii)\ CO_2|H_2O]{(i)\ LiBu} A$

(ii) $[(\eta^7 - C_7H_7)\ M_0(CO)_3]^+ + O^-CH_3 \longrightarrow B$

4. (a) Discuss the mechanism of Fischer Tropsch process.

Or

(b) Explain in brief the bonding mechanism of metal carbine complexes.

5. (a) How will you distinguish between η^1-allyl and η^3-allyl. Complexes with the help of IR and NMR spectroscopy ?

Or

(b) Discuss the catalytic cycle of hydrogenation of alkenes using Wilkinson's catalyst.

Section-C

Note : Answer any <u>two</u> questions of the following. 20×2=40

6. Discuss bonding for bis-(benzene) chromium. Complex. Draw the qualitative molecular energy level diagram for same complex and describe its special properties.

7. Discuss the polymerization of alkene by using Ziegler-Natta Catalyst in detail.

8. Discus bonding synthesis and properties of η^4-butadiene complexes.

9. Give method of preparation and structure of the following.

   (i) $Ru_3(CO)_{12}$

   (ii) $Rh_4(CO)_{12}$

   (iii) $Ir_4(CO)_9$

   Discuss the M-C and C-O bond in metal carbonyls.

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CHE 531

(Select Topics in Organic Chemistry)

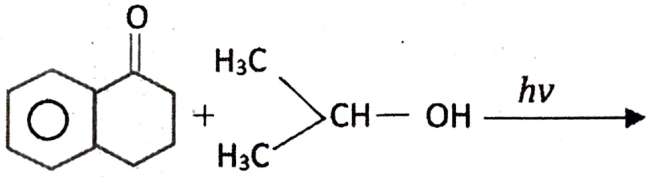
Note: There are **three** sections, (**A, B** and **C**) and Candidate has to attempt questions from all sections. Marks are indicated against each section.

Section–A

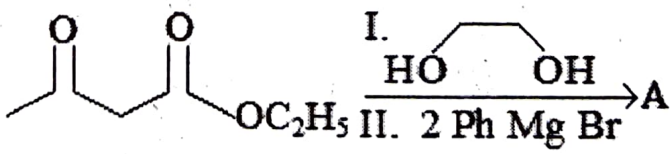
1. Answer all questions of the following. 3×5=15

(a) Explain with reason whether the following compound is aromatic or non-aromatic :

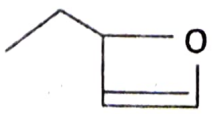
(b) Complete the following reactions with mechanism.

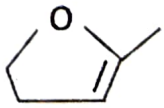


(c) Justify the following reactions for product A

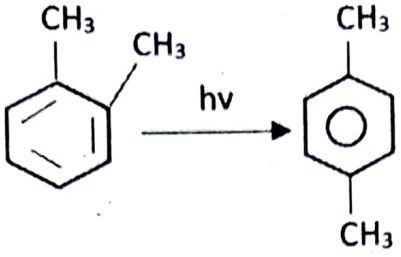


(d) Give the names of following compounds :

(i) 

(ii) 

(e) Rationalize the following transformations :



Section–B

Note : Answer all question of the following. 5×4=20

2. Discuss the aromaticity of tropolone and ferrocene with suitable examples.

Or

Write short notes on the following

(a) Homoaromatility

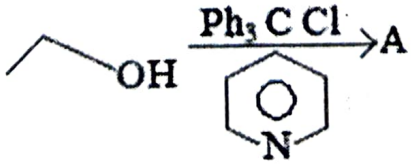
(b) Fullerene

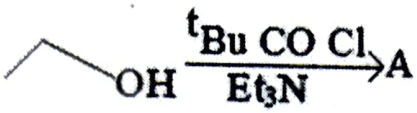
3. What do you mean by protecting groups ? Brief with suitable examples.

Or

Complete the following reaction and write the product :-

(i) $ROH \xrightarrow[THF,\ 0°C]{NaH} A \xrightarrow{CH_3I} B \xrightarrow[TMSI]{CH_2Cl_2} C$

(ii) 

(iii) 

(iv) $$R-OH \xrightarrow[II.\ Ph\,CH_2\,Br]{I.\ NaH,\ THF} A \xrightarrow[EtOH]{Pd/CH_2} B + C$$

(v) $$R-OH \xrightarrow[H_2SO_4(Conc.)]{^tBu\,OH} A \xrightarrow{4N\,H\,Cl} B$$

4. Give any two methods of preparation of pyrazole.

Or

Give any two methods of preparation of pyrimidine.

5. Draw the Jabloskii diagram and define the following terms by use of Jabloskii diagram.

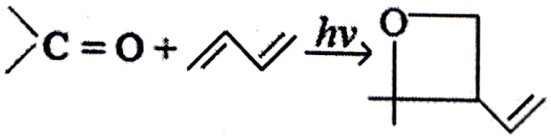
(a) Energy cascade

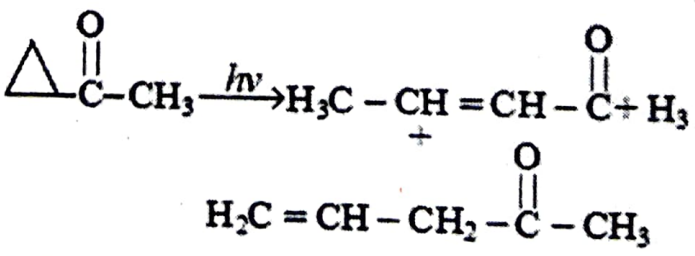
(b) Intersystem crossing

(c) Fluorescence and Phosphorescence

Or

Rationalize the following transformation with mechanism.

(a) 

(b) 

Section-C

Note : Answer any <u>two</u> questions of the following. 20×2=40

6. (a) Describe any two method for preparation of azulene and explain its aromatic character.

   (b) Explain photo-Fries rearrangement with suitable examples.

7. What is di-pi methane (DPM) rearrangement ? Describe it in light of its :

   (a) Mechanism

   (b) Stereochemistry

   (c) Structural features

8. Compare pyrazole and imidazole in light of their :

   (a) Stability

   (b) Electrophilic substitution

   (c) Aromaticity and basicity

9. What is the principle of protection of alcohols ? Explain the acid catalysed benzylatron of 1° alcohols with mechanism.

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