

ALIAH UNIVERSITY

Subject: Inorganic Chemistry -III

Time: 2 Hrs

End-Term Examination (Semester-VI; 2020-21)

Subject Code: CH 302

Full Marks: 40

Group A

1. Answer any five questions 2x5=10
 - a) describe the role of iron and calcium in biological systems
 - b) what are beneficial metal ions in biological systems
 - c) name the metal ions those are present in the following biometals: nitrogenase, azurin, bromoperoxidase and chlorophyll
 - d) depict the structure of 2Fe₂S ferredoxin
 - e) present the active site structure of Rubredoxin
 - f) a human being of 70 kg weight contains how much amount of Fe, Zn, Ca and Cu ?
2. Answer any two questions 5x2= 10
 - i) Depict the active site structure of Carbonic anhydrase and establish its catalytic mechanism of action
 - ii) Present a brief account of 8Fe-8S ferredoxin including its redox activity
 - iii) Pictorially describe the oxygen binding by Hemoglobin mentioning the role of cooperativity in it.

Group B (Answer any FIVE)

1. Draw the approximate MO diagram of ferrocene molecule. 4
2. a) How do oxidative addition and reductive elimination play important roles in catalytic conversion of Monsanto acetic acid synthesis? Explain.
b) Convert $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2$ to $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)(\eta^5\text{-C}_5\text{H}_4\text{COOH})$. 3+1
3. a) Find the value x and y in i) $\text{Co}_2(\text{CO})_x(\text{C}_2\text{H}_2)$ and ii) $\text{Fe}(\eta^5\text{-CP})_4(\eta^1\text{-CP})(\text{CO})_y$.
c) Find the number of Os–Os bonds in $\text{Os}_4(\text{CO})_{15}$ and draw the probable structure. 2+2
4. a) ν_{CO} runs as $\nu_{\text{CO}} \text{ V}(\text{CO})_6^- < \text{Cr}(\text{CO})_6 < \text{Mn}(\text{CO})_6^+$. Explain.
b) Co–N–O linkage is linear in $[\text{Co}(\text{diars})_2(\text{NO})]^{2+}$ but bent in $\text{trans-}[\text{Co}(\text{diars})_2(\text{NCS})(\text{NO})]^+$. Justify. 2+2
5. a) Discuss the mechanistic steps in the catalysed reactions of polymerization of olefin by Z–N catalyst.
b) In $\text{Fe}_3(\text{CO})_{12}$ there are two bridging $\mu_2\text{-CO}$ while in $\text{Ru}_3(\text{CO})_{12}$ or $\text{Os}_3(\text{CO})_{12}$ there is no $\mu_2\text{-CO}$. Explain. 2+2
6. a) Define the term “ring-whizzing”.
c) In $\text{Ru}(\eta^5\text{-CP})(\eta^2\text{-C}_2\text{H}_4)_3$, there are 2 types of protons for ethylene at low temperature. But at room temperature, the PMR signal records a single sharp line. Explain. 1+3

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ALIAH UNIVERSITY
DEPARTMENT OF CHEMISTRY

End-Term Examination
(Semester- VI; Session: 2020-21)

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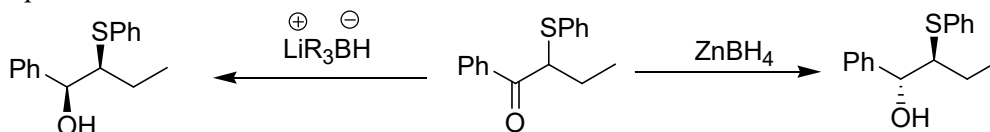
Subject Code: CH 304
Time: 2h

Group A

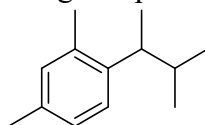
Answer any four questions.

4×5=20

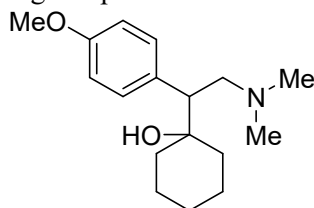
1. (a) How can you convert (*S*)-Serine to (*R*)-Serine? (2)
- (b) Explain the observation. (3)



2. (a) A decapeptide undergoes partial hydrolysis to give peptides whose amino acid compositions are shown. Reaction of the intact decapeptide with Edman's reagent releases PTH-Gly. What is the sequence of the decapeptide?
 A. Ala, Trp B. Val, Pro, Asp C. Pro, Val D. Ala, Glu E. Trp, Ala, Arg
 F. Arg, Gly G. Glu, Ala, Leu H. Met, Pro, Leu, Glu (3)
- (b) Plan a retrosynthesis for the following compound. (2)



3. (a) Give one preparatory method for L-glutamic acid? (2)
- (b) Suggest synthesis of the following compound: (3)



4. (a) Describe a solid phase synthesis of the dipeptide valinyl leucine. (3)
- (b) How can you transform D-glucose to 2,3,4,5,6-penta-O-acetyl-D-Glucose. (2)
5. (a) Narrate Watson and Crick's proposal for the structure of DNA. (3)
- (b) In what order would the following amino acids be eluted with a buffer of pH 3 from a column containing a cation-exchange resin?
 histidine, aspartic acid, valine (2)

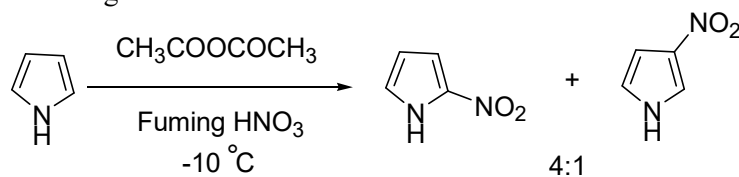
Group B

Answer any four questions.

4×5=20

6. (a) How one can get pyrrole and furan ring by taking ethylacetoacetate as one of the starting material? (2.5)

(b) Explain the following observation:

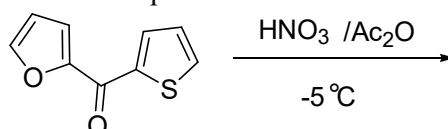


What strategy would you take to get 3-nitropyrrole as the major isomer? (2.5)

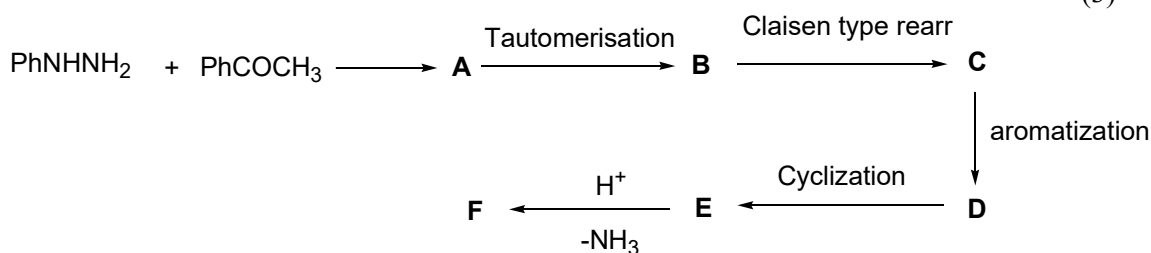
7. (a) Show the steps for the Bischler–Napieralski synthesis of 1-methylisoquinoline starting from an acid chloride. (2)

(b) Pyrrole undergoes electrophilic substitution at 2-position whereas indole undergoes electrophilic substitution at 3-position. Explain. (2)

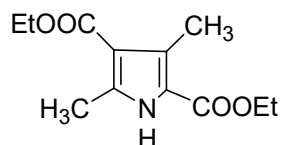
(c) Draw the structure of the mononitro product: (1)



8. (a) Give the structural formula for the intermediate A through E involved in the synthesis of F. (3)



(b) What reactants are needed to make the following compound by Knorr - pyrrole synthesis? (2)



9. (a) How could you convert naphthalene into 2-nitronaphthalene? (2)

(b) Synthesize phenanthrene starting from naphthalene and butyric acid. (2)

(c) Which is more reactive towards electrophilic substitution between naphthalene and benzene? (1)

10. (a) Provide a synthetic route for 2,9-dimethylantracene starting from compounds containing benzene ring. (2.5)

(b) Convert β -naphthol to β -naphthylamine (with mechanism) (2.5)

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ALIAH UNIVERSITY

Subject: Physical Chemistry -III

Time: 2 Hrs

End-Term Examination (Semester-VI; 2020-21)

Subject Code: CH 306

Full Marks: 40

Answer Question 1 and any three from Part A and Part B, taking at least one from each Part

Q1. Mention the following statements as TRUE or FALSE

5x1

- a) The net number of atoms in a simple cubic unit cell is 8.
- b) A simple cubic unit cell is nearly 52% occupied.
- c) The Miller indices of a unit cell with intercepts (2a, 3b, 2c) is (2 3 2).
- d) $S_1 \rightarrow S_0$ and $T_1 \rightarrow S_0$ transitions are fluorescence and phosphorescence respectively.
- e) ϕ (quantum yield) > 1 in a primary step does not violate the Stark-Einstein law.

Part-A

Q2. a) What are essential characteristics of a unit cell?

b) What are the types of crystal system? What do you mean by 'Bravais lattice'?

2+3

Q3. a) An orthorhombic crystal has the following parameters: $a = 8.2 \times 10^{-10}$ m; $b = 9.4 \times 10^{-10}$ m; $c = 7.5 \times 10^{-10}$ m. What is the distance between (123) planes?

b) State Bragg's law explain the terms therein.

3+2

Q4. a) If the separation between the lattice layers in a crystal is 404 pm and the wavelength of X-rays is 154 pm, what would be the angle of incidence at which reflection would occur?

Assume $n = 1$.

b) Differentiate between n-type and p-type semiconductors.

2+3

Part-B

Q5. a) State the Beer-Lambert law. Explain the terms therein.

b) What is molar extinction coefficient? Explain with a suitable plot how one can determine it experimentally.

2+3

Q6. Define quantum efficiency or yield of a photochemical reaction.

In photochemical decomposition of acetone using 313 nm light, 7.57×10^{-6} mol of carbon monoxide is formed in 20 minutes. If the light absorbed corresponds to $2.41 \times 10^{-3} \text{ J s}^{-1}$, calculate the quantum efficiency for the formation of carbon monoxide.

5

Q7. a) Propose a suitable reaction mechanism to explain that quantum efficiency for photochemical

decomposition of hydrogen iodide is 2.

b) Give a graphical sketch to differentiate between fluorescence and phosphorescence. 3+2

Group C

Answer any two questions

8. What are the essential conditions for microwave and IR activity of a molecule? What is the advantage, if any, of rotational Raman spectroscopy over pure rotational spectroscopy? First rotational absorption of ^{12}CO is found to occur at 3.8424 cm^{-1} . Calculate the bond length of ^{12}CO molecule. 3+3+4

9. State and explain Franck Condon principle. For $^1\text{H}^{35}\text{Cl}$ the following data were observed in the IR region; (i) strong absorption at 2886 cm^{-1} , (ii) weak absorption at 5668 cm^{-1} . Calculate anharmonicity constant, hypothetical equilibrium oscillation frequency and the force constant. 5+5

10 What is the essential condition for a molecule to be Raman active? Derive the expression of wave numbers of rotational Raman lines for a homo-nuclear diatomic molecule and also give a representative spectrum. How one can calculate the bond length of the molecule from the spectral data? 2+(3+2+3)

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