V/CHEM (v)

2015

(5th Semester)

CHEMISTRY

FIFTH PAPER (CHEM–351)

(Organic Chemistry—II)

Full Marks : 55

Time : 2½ hours

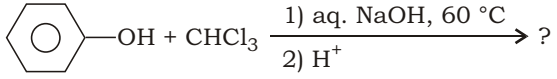
(PART : B—DESCRIPTIVE)

(*Marks* : 35)

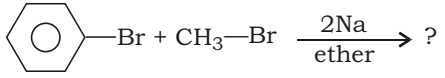
The figures in the margin indicate full marks for the questions

1. *(a)* Draw the MO picture of non-benzoid compound. 2

(b) Complete the following reactions : 2½+2½=5

(i) 

(Reimer-Tiemann reaction)

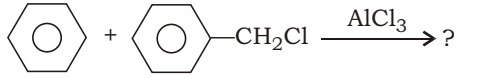
(ii) 

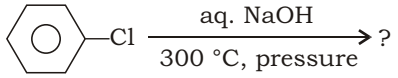
(Wurtz-Fittig reaction)

OR

2. *(a)* Discuss the acidic character of phenol. 3

(b) Complete the following reactions : 2+2=4

(i) 

(ii) 

3. *(a)* What is benzoin condensation? Discuss with mechanism. 3

(b) Complete the following reactions : 2+2=4

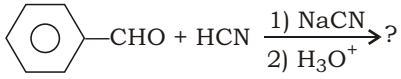
(i) CH_3—CHO + NH_2—NH_2 ⟶ ?

(ii) C_6H_5COOH $\xrightarrow[2)]{1)\ NH_3}$?

OR

4. *(a)* Discuss in brief giving suitable example the effect of substituents on the acidity of carboxylic acid groups. 2

(b) Complete the following reactions : 2½+2½=5

(i) 

(ii) $CH_3—\overset{\overset{O}{\|}}{C}—CH_3$ $\xrightarrow[2)\ HCl]{1)\ Zn/Hg}$?

5. *(a)* Write the basic differences between tautomerism and resonance. 2

(b) Complete the following reactions : 2½+2½=5

(i) $CH_3—NH_2 + CS_2 \longrightarrow ?$

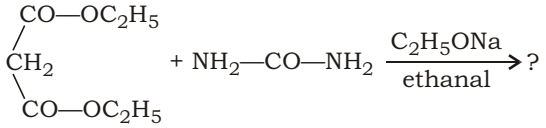
(ii) $CH_3—CO—\underset{\underset{R}{|}}{CH}—CO—C_2H_5 \xrightarrow[2)\ H_3O^+]{1)\ \text{dil. KOH/}} ?$

OR

6. *(a)* Discuss Hinsberg test for distinguishing 1°, 2° and 3° amines. 3

(b) Complete the following reactions : 2+2=4

(i)  $\longrightarrow ?$

(ii)  $\xrightarrow[\text{ethanal}]{C_2H_5ONa} ?$

7. *(a)* Write short notes on the following : 2½+2½=5

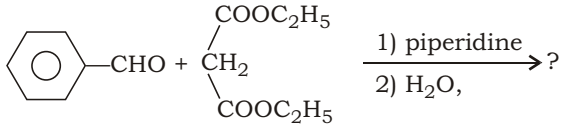
(i) Reformatsky reaction

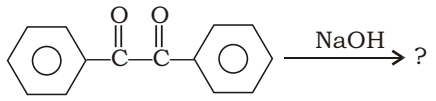
(ii) Wagner-Meerwein reaction

(b) What are acetals and ketals? Give one example of each. 2

OR

8. *(a)* Complete the following reactions with mechanisms : 2½+2½=5

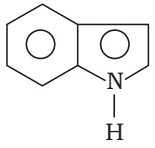
(i) 

(ii) 

(b) What are esters and amides? Give one example of each. 2

9. *(a)* Draw the resonance molecular orbital picture of thiophene. 2

(b) Complete the following reactions with mechanism : 2½+2½=5

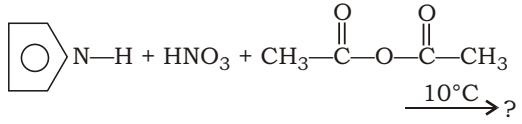
(i)  $+ HCHO + (CH_3)_2NH \longrightarrow ?$

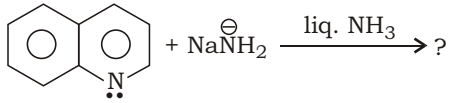
(ii)  $+ CH_3OH + HCl \longrightarrow ?$

OR

10. *(a)* Discuss the structure of pyridine. 2

(b) Complete the following reactions with mechanism : 2½+2½=5

(i) 

(ii) 

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Subject Code : V/ CHEM (v)

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2015

(5th Semester)

CHEMISTRY

FIFTH PAPER (Chem–351)

(Organic Chemistry—II)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. When phenol is substituted by electron withdrawing groups at para-position, the acidity

(a) will be increased ( )

(b) will be decreased ( )

(c) will remain same ( )

(d) None of the above ( )

2. Aldol condensation reaction can take place only in aldehydes and ketones having

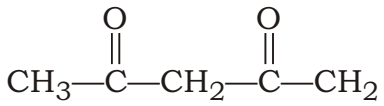
(a) -hydrogen ( )

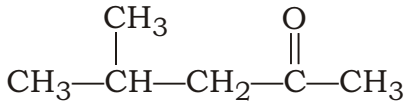
(b) -hydrogen ( )

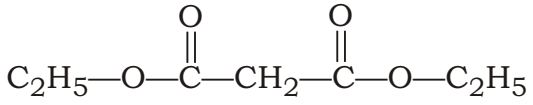
(c) -hydrogen ( )

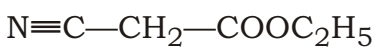
(d) None of the above ( )

3. Which of the following molecules does not consist of active methylene group?

(a)  ( )

(b)  ( )

(c)  ( )

(d)  ( )

4. Pinacol-pinacolone rearrangement is a rearrangement reaction of

(a) diols to monoketone ( )

(b) diols to diketone ( )

(c) monoalcohol to monoketone ( )

(d) monoalcohol to diketon ( )

5. In Skraup synthesis of quinoline, the reagents are

(a) aniline and glycerol ( )

(b) phenyl hydrazine and pyruvic acid ( )

(c) cinnamaldehyde and hydroxylamine ( )

(d) None of the above ( )

SECTION—II

(*Marks* : 15)

Answer the following questions in not more than *6* sentences each : 3×5=15

1. Write a short note on Hückel rule.

2. What is Perkin reaction? Write with mechanism.

3. Discuss with example, the effect of substituent on basicity of aromatic amines.

4. Discuss Friedel-Craft acylation reaction with suitable example along with mechanism.

5. Discuss the comparative basicity of pyrrole/pyridine, pyrrole/pyrrolidine and pyridine/piperidine.

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V/CHEM (vi)

2015

(5th Semester)

CHEMISTRY

SIXTH PAPER (CHEM–352)

(Inorganic Chemistry—II)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Mention the important characteristics of ionic crystals. 3

(b) The ionic radii of K^+ and Cl^- ions are 1·33 Å and 1·81 Å respectively. Predict the coordination number of K^+ ion and the site occupied by K^+ ion in the KCl crystal. 2

(c) How is a tetrahedral site formed in a closed-packed structure? 2

OR

2. *(a)* Discuss briefly the characteristic features of Schottky defect in crystals. 3

(b) Define non-stoichiometric defects. Explain briefly metal deficiency defects. 1+2=3

(c) What is the effect of temperature on *n*-type semiconductor? 1

3. *(a)* What are the essential conditions required for the formation of atomic orbitals to form molecular orbitals? 3

(b) Give pictorial representation of the molecular orbitals formed by the combination of *s* and p_x atomic orbitals (assuming *x*-axis as the molecular axis). 1

(c) Draw the molecular orbital (MO) energy level diagram of O_2 molecule and explain its magnetic behaviour. 2+1=3

OR

4. *(a)* Compare the electrical conductance of conductors and insulators in terms of band model. 3

(b) What do you mean by dipole-induced dipole interactions? 2

(c) Give reasons why the boiling point of noble gases increases from He to Xe. 2

5. *(a)* What is meant by inert pair effect? Explain the stability of different oxidation states shown by group 13 elements. 1+2=3

(b) How will you prepare B_2H_6? Briefly explain its structure. 1+2=3

(c) Write the structure of dinitrogen tetroxide and Caro's acid. ½+½=1

OR

6. *(a)* What do you mean by pseudohalogens? Provide suitable examples. 3

(b) Explain the bonding and structure of XeF_4. 3

(c) What are clathrates? 1

7. *(a)* What do you mean by conjugate acid-base pair? Give example. 2

(b) On the basis of HSAB principle, give reason why AgI_2^- is stable while AgF_2^- does not exist. 1

(c) Explain by giving suitable example the following reactions in liquid ammonia : 2+2=4

(i) Neutralization reaction

(ii) Redox reaction in which alkali metals in liquid ammonia act as reducing agents

OR

8. *(a)* What is meant by amphiprotic solvent? 1

(b) Explain the following terms : 1+1=2

(i) Axis of symmetry

(ii) Order of a group

(c) Write the symmetry elements and symmetry point group of the following molecules : 2+2=4

(i) BF_3

(ii) NH_3

9. *(a)* Mention two points of differences of the first transition series as compared to the second series. 1

(b) Discuss the tendency of transition metals to form complex compounds. 3

(c) Using crystal field stabilization energy, explain that $[Fe(CN)_6]^{3-}$ is more stable than $[Fe(H_2O)_6]^{3+}$. 3

OR

10. *(a)* Account for the smaller magnitude of crystal field splitting in tetrahedral than in octahedral complexes. 2

(b) Illustrate the factors that affect the magnitude of crystal field splitting. 3

(c) Calculate CFSE of the following complexes : 1+1=2

(i) $[Fe(H_2O)_6]^{3+}$

(ii) $[CoCl_4]^{2-}$

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Subject Code : V/CHEM (vi)

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2015

(5th Semester)

CHEMISTRY

SIXTH PAPER (CHEM–352)

(Inorganic Chemistry—II)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The coordination number of each sphere in hexagonal closed-packed structure is

(a) 6 ( )

(b) 8 ( )

(c) 10 ( )

(d) 12 ( )

2. Dipole-dipole interactions are also called

(a) London forces ( )

(b) Debye forces ( )

(c) Keesom forces ( )

(d) Ion-dipole interactions ( )

3. The hardest abrasive substance ever made artificially is

(a) boron carbide ( )

(b) carborundum ( )

(c) aluminium carbide ( )

(d) beryllium carbide ( )

4. Pyrophosphorus acid ($H_4P_2O_5$) is a

(a) monobasic acid ( )

(b) dibasic acid ( )

(c) tribasic acid ( )

(d) tetrabasic acid ( )

5. Square planar complexes are usually

(a) low spin ( )

(b) high spin ( )

(c) Both *(a)* and *(b)* ( )

(d) None of the above ( )

SECTION—II

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What are the consequences of Frenkel defects in crystals?

2. Differentiate between bonding and anti-bonding molecular orbitals.

3. Why does nitrogen show catenation properties less than phosphorus?

4. Explain how BF_3 acts as a Lewis acid.

5. Give reasons why transition elements exhibit variable oxidation states.

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V/CHEM (vii)

2015

(5th Semester)

CHEMISTRY

SEVENTH PAPER (CHEM–353)

(Physical Chemistry—II)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Discuss in detail Maxwell's distribution law of molecular velocities. Illustrate the effect of temperature on this distribution. 3

(b) Explain the term mean free path. 1

(c) Calculate the root-mean-square velocity of nitrogen at 27 °C temperature and 70 cm pressure. 3

OR

2. *(a)* Explain the principle of equipartition of energy. 2

(b) Calculate the mean free path for oxygen gas at 25 °C and 1 atmospheric pressure. The collision diameter of oxygen molecule = 361 pm. 2

(c) Define molar heat capacity at constant volume. Show that heat capacity of any gas at constant volume should be equal to 12·5 J. 1+2=3

3. *(a)* Define chemical potential. Derive Gibbs-Duhem equation of variation of chemical potential. 1+2=3

(b) Write the statement of third law of thermodynamics. 1

(c) Explain how the absolute entropy of substance is determined with the help of third law of thermodynamics. 3

OR

4. *(a)* Derive Gibbs-Helmholtz equation for the calculation of ΔH at constant pressure. 3

(b) What is Debye's T^3 law? Show that entropy of any substance at very low temperature when Debye's relation for heat capacities of crystals is valid, is one-third of the molar heat capacity. 1+3=4

5. *(a)* What are liquid crystals? Mention their characteristics. 2

(b) Derive an expression for the determination of surface tension by capillary rise method. 3

(c) Discuss in detail the collision theory of bimolecular reactions. 2

OR

6. *(a)* Differentiate clearly between smectic and nematic liquid crystals. 2

(b) Explain the terms additive property and consecutive property. Give examples. 3

(c) Differentiate between homogeneous and heterogeneous catalyses. Give examples to illustrate your answer. 2

7. *(a)* What is turnover number? 1

(b) Derive Bragg's equation for X-ray crystallography. 2

(c) Explain the terms—

(i) elements of symmetry;

(ii) plane of symmetry;

(iii) centre of symmetry;

with examples in each case. 4

OR

8. *(a)* What are different kinds of Bravais lattices in a cubic unit cell? Calculate the number of atoms per unit cell in each of them. 6

(b) What are Miller indices? 1

9. *(a)* Explain the term ionic mobility. 1

(b) The H^+ ion, because of its heavy hydration and consequent large size and shape, should have a low mobility but its mobility is very high. How would you account for it? 3

(c) What is meant by transport number of an ion? How would you measure it using Hittorf's method? 1+2=3

OR

10. *(a)* State and explain Kohlrausch law. 1½

(b) For the strong electrolytes NaOH, NaCl and $BaCl_2$, the molar conductivities at infinite dilution are $248 \cdot 1 \times 10^{-4}$, $126 \cdot 5 \times 10^{-4}$ and 280×10^{-4} S m^2 mol^{-1} respectively. Calculate the Λ_m° for $Ba(OH)_2$. 2½

(c) Write Debye-Hückel-Onsager equation for strong electrolyte. 1

(d) Write a note on asymmetry effect. 2

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Subject Code : V/ CHEM (vii)

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2015

(5th Semester)

CHEMISTRY

SEVENTH PAPER (CHEM–353)

(Physical Chemistry—II)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The numbers of translational, rotational and vibrational degrees of freedom, respectively, for H_2O molecules are

(a) 3, 3, 3 ( )

(b) 3, 2, 1 ( )

(c) 1, 2, 3 ( )

(d) 2, 2, 2 ( )

2. Nernst heat theorem is applicable to

(a) pure solids only ( )

(b) solids and liquids ( )

(c) solids, liquids and gases ( )

(d) pure gases only ( )

3. An essential condition for mesomorphism to occur is that the molecule must be

(a) isotropic ( )

(b) anisotropic ( )

(c) both *(a)* and *(b)* ( )

(d) None of the above ( )

4. How many Na and Cl ions are present in the unit cell of NaCl?

(a) Na 1, Cl 1 ( )

(b) Na 2, Cl 2 ( )

(c) Na 3, Cl 3 ( )

(d) Na 4, Cl 4 ( )

5. The SI unit of specific conductance is

(a) ohm^2 cm^{-1} ( )

(b) ohm cm ( )

(c) $S\ m^{-1}$ ( )

(d) S m ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. Calculate the standard entropy change of the reaction

$$N_2\ (g) \quad O_2\ (g) \quad 2NO\ (g)$$

Given standard entropies for

N_2 (g) 191 62 JK ^{1} mol ^{1}

O_2 (g) 205 01 JK ^{1} mol ^{1}

NO (g) 210 45 JK ^{1} mol ^{1}

2. Derive a relationship between molar conductance and specific conductance and hence the unit of molar conductance.

3. Write a note on interfacial angles.

4. Explain with examples the enzyme catalysis.

5. Define the following :

(a) Collision diameter

(b) Collision frequency

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V/CHEM (viii) (B)

2015

(5th Semester)

CHEMISTRY

EIGHTH (B) PAPER [Chem-354 (B)]

(Industrial Chemistry)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* What is syngas? Mention two uses of syngas. 3

(b) Write three points of difference between soaps and detergents. 3

(c) What are micronutrients? What are their main functions? 4

OR

2. *(a)* What are the basic raw materials for making ceramics? 2

(b) What is PCE? How is it useful in measuring the refractiveness of raw ceramic materials? 2

(c) What are fireclays? Mention their general compositions. 2

(d) Define glazing. Give three important purposes of glazing in manufacturing process of ceramics. 4

3. *(a)* What are the factors that influence the synthesis of heterologous proteins by a microbial cell? 2

(b) Why is process optimization necessary in a fermentation process? 2

(c) Discuss the significance of transformation process in fermentation technology. 3

(d) What are microbial enzymes? Comment in brief the commercial application of amylase. 1+2=3

OR

4. *(a)* Distinguish between free water and bound water. 2

(b) What are the main functions of carbohydrates in the body? 2

(c) Write a short note on food safety assurance. 3

(d) What is denaturation of protein? Why is it necessary in food technology? 3

5. *(a)* Write the structure of PETN. 2

(b) How is $[Pb(N_3)_2]$ prepared? 3

(c) How is tanning achieved in leather industry? Discuss the two types of tanning process. 1+4=5

OR

6. *(a)* What are primary explosives? How are they related to PETN? 3

(b) Describe any one process by which softening of water could be achieved. 3

(c) Write a short note on the process of treatment of tannery effluents. 4

7. *(a)* Discuss the process of production of coke from coal. 3

(b) What is cracking? Discuss the advantage of catalytic cracking method over ordinary cracking method. 3

(c) How is water gas produced? Write two uses of water gas. 2+2=4

OR

8. *(a)* Why is the process of reforming necessary for engine fuels? 1½

(b) Differentiate between allothermal and autothermal processes of coal gasification. 1½

(c) Write a short note on the environmental impact of coal. 3

(d) What is producer gas? Mention its properties and uses. 1+3=4

9. *(a)* What are polysilanes? How do they degrade to silicon carbides? 2

(b) Write the structures and monomers for getting PMMA. 2

(c) What is the role of jobber in textile industry? 2

(d) Discuss the importance of timing in textile manufacture. 4

OR

10. *(a)* Describe how texture of the paper could affect designing in textile industry. 3

(b) What are polyurethanes? Illustrate with equation the two principal methods of forming polyurethanes. 3

(c) How are low-density and high-density polyethylenes manufactured? How do they differ in their densities? 3+1=4

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V/ CHEM (viii) (B)

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1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within 1 (one) Hour of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

To be filled in by the Candidate

DEGREE 5th Semester
(Arts / Science / Commerce / .....) Exam., **2015**

Roll No. .....
Regn. No. .....

Subject .....
Paper .....

Descriptive Type
Booklet No. B .....

Signature of Scrutiniser(s)

Signature of Examiner(s)

Signature of Invigilator(s)

2015

(5th Semester)

CHEMISTRY

EIGHTH (B) PAPER [Chem-354 (B)]

(Industrial Chemistry)

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×10=10

1. Fuel gas that is formed by decomposition of organic matters in absence of O_2 is

(a) water gas ( )

(b) producer gas ( )

(c) biogas ( )

(d) syngas ( )

2. A compound used to impart smell to LPG is

(a) tetraethyl lead ( )

(b) ethyl mercaptan ( )

(c) triethyl thiol ( )

(d) phthalic acid ( )

3. Synthesis of enzymes of animal origin by microorganisms is possible by the use of

(a) gene mutation ( )

(b) RNA recombination ( )

(c) cell culture ( )

(d) DNA recombination ( )

4. Which of the following is not a primary component of food?

(a) Glycoside ( )

(b) Carbohydrate ( )

(c) Lipid ( )

(d) Protein ( )

5. Cordite is prepared by mixing a paste of

(a) nitrocellulose + nitroglycerine ( )

(b) nitrocellulose + picric acid ( )

(c) nitroglycerine + picric acid ( )

(d) None of the above ( )

6. The process of excessive nutrient enrichment of water is called

(a) saponification ( )

(b) eutrophication ( )

(c) phosphorylation ( )

(d) nitrification ( )

7. The highest rank coal is

(a) bituminous coal ( )

(b) anthracite ( )

(c) peat ( )

(d) lignite ( )

8. Coal gasification is the process of producing

(a) producer gas ( )

(b) water gas ( )

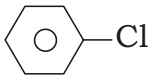
(c) gobar gas ( )

(d) syngas ( )

9. Bakelite is obtained from phenol by reacting it with

(a) HCOOH ( )

(b) HCHO ( )

(c)  ( )

(d) CH_3CHO ( )

10. In textile industry, fabric that has been woven but has not been wet or dry processed is called

(a) greige ( )

(b) yarn ( )

(c) foulard ( )

(d) None of the above ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What are NPK fertilizers? Give a brief account of their manufacture.

2. What do you understand by lag phase in a microbial culture? Elaborate.

3. Describe the process of curing of leather.

4. What is octane number? Write a brief account by which octane number could be increased.

5. Illustrate with equation, how Nylon-6 is obtained from caprolactam.

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