SH CHE(03)

2018

(2nd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer all questions

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(ORGANIC CHEMISTRY-I)

SECTION – A

1. Answer *all* questions : 2×6

   (*a*) Between acetic acid and formic acid which one is stronger and why ?

   (*b*) Explain homolytic and heterolytic bond-fission.

   (*c*) Discuss preparation of alkane by Wurtz reaction.

(*d*) Write down the various optical isomers of tartaric acid.

(*e*) Discuss ozonolysis of 2-methyl butene-2.

(*f*) Explain aromaticity of furan.

SECTION – B

Answer all questions : 12×4

2. (*a*) Write notes on : 6×2

(*i*) Hyperconjugation and

(*ii*) Electromeric effect.

Or

(*b*) What are carbanions ? Discuss its formation structure and stability. 2+2+4+4

3. (*a*) What are optical isomers ? Discuss conditions for optical activity. Define specific rotation. What are racemic mixture and its resolution ? 2+3+3+4

Or

(*b*) Write notes on : 6×2

(*i*) Geometrical isomerism and

(*ii*) Sequence rules.

4. (*a*) Discuss mechanism of Markownikoff and anti Markownikoff addition with examples. Explain acidic character of acetylene. 5+5+2

Or

(*b*) (*i*) Discuss Bayer-Strain theory.

(*ii*) Explain : Chair conformation of cyclohexane is more stable than boat conformation. 9+3

5. (*a*) (*i*) State and explain Hückel's rule of aromaticity with examples.

(*ii*) What are ortho-para directors and meta directors ? 8+4

Or

(*b*) Write notes on : Friedal-Craft reaction and nitration and sulphonation of benzene. 6+3+3

SH CHE(04)

2018

(2nd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer questions from Section–A and Section–B as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(PHYSICAL CHEMISTRY-II)

SECTION – A

1. Answer *all* questions : 2×6

   (*a*) Define heat capacity of a system.

   (*b*) State 1st law of thermodynamics. Write its mathematical expression.

   (*c*) Explain molecular mass of a substance

determined by elevation of boiling-point is more than its normal value when solute associates in the solution.

(*d*) Discuss the concept of fugacity.

(*e*) Justify : The entropy of universe is increasing.

(*f*) Define enthalpy combustion with one example.

SECTION – B

Answer all questions : 12×4

2. (*a*) (*i*) Derive PV^{γ} = Constant during adiabatic process. 8

(*ii*) Differentiate between open, closed and isolated system. 4

Or

(*b*) Derive Kirchhoff's equation. Discuss two of its application. $8 + 2 \times 2$

3. (*a*) State 2nd law Thermodynamics. Explain it. Discuss the concept of entropy. Derive entropy change for ideal gas in terms of temp. and volume. $2+4+2+4$

Or

(*b*) Derive the relationship : 4×3

$$dG = Vdp - SdT$$
$$dA = -SdT - PdV$$
$$dE = TdS - PdV$$

4. (*a*) Derive Van't Hoff reaction isotherm and isochore. $6+6$

Or

(*b*) State Le-Chatelier's principle. Discuss the effect of temp. and pressure on the reaction

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)} \qquad 2+5+5$$

5. (*a*) Derive a relationship between elevation of boiling-point and molecular mass of solute thermodynamically. Prove that osmotic pressure is a colligative property. $8+4$

Or

(*b*) Derive thermodynamically relation between osmotic pressure and molecular mass of solute. How is determination of molecular mass of solute by colligative property measurement affected when the solute associates or dissociates in solution ? 8 + 4

SG CHE (02)

2018

(2nd Semester)

Time : $2\frac{1}{2}$ hours

Full Marks : 60

Answer **all** questions from any **one** Group as per your specialisation

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

GROUP—I

(CHEMICAL ENERGETICS, EQUILIBRIA AND FUNCTIONAL ORGANIC CHEMISTRY-I)

SECTION—A

1. Answer *all* questions : 2 × 6

(*a*) State Third law of thermodynamics.

(*b*) Calculate the enthalpy change for the reaction

$$H_{2_{(g)}} + Cl_{2_{(g)}} \rightarrow 2HCl_{(g)}$$

Bond enthalpies of H—H, H—Cl and Cl—Cl bonds are 434·02 kJ mole^{-1}, 675 kJ mole^{-1} and 350·03 kJ mole^{-1} respectively.

(*c*) What is Common-Ion effect ?

(*d*) What is Friedal-Craft reaction ? Give one example.

(*e*) Explain : solution of ammonium chloride is acidic.

(*f*) Distinguish between 1°, 2° and 3° alcohol by Lucas test.

SECTION–B

Answer **all** questions : 12 × 4

2. (*a*) State 1st law of thermodynamics. Derive its mathematical expression. State Hess's Law. 4 + 4 + 4

Or

(*b*) Write notes on : 6 + 6

(*i*) Kirchhoff's equation

(*ii*) Le Chatelier's principle.

3. (*a*) What are solubility and solubility product of partially soluble salts ? Derive its mathematical expression. What is the condition for precipitation ? Give reasons for it. 2 + 2 + 6 + 2

Or

(*b*) Write notes on : 6 + 6

(*i*) Buffer solution

(*ii*) Hydrolysis of salt.

4. (*a*) Write notes on : 4 × 3

(*i*) Sandmeyer's reaction

(*ii*) Friedal-Craft reaction

(*iii*) Gattermann reaction.

Or

(*b*) (*i*) Explain S_N1 and S_N2 reactions involving hydrolysis of alkyl halides. 5 + 5

(*ii*) Discuss preparation of benzene by decarboxylation. 2

5. (*a*) (*i*) Discuss preparation of 1°, 2° and 3° alcohols from Grignard's reagent. 3 + 3 + 3

(*ii*) Write notes on pinacol-pinacolone rearrangement. 3

Or

(*b*) Write notes on : 4 + 4 + 4

(*i*) Aldol condensation

(*ii*) Clemensen reduction and Wolf-Kishner reduction

(*iii*) Iodoform test.

GROUP–II

(ORGANOMETALLIC, BIOINORGANIC CHEMISTRY)

SECTION– A

1. Answer *all* questions : 2 × 6

(*a*) Write IUPAC name of $[CO(NH_3)_6]Cl_3$ and $Na_3[CO(NO_2)_6]$.

(*b*) What is EAN rule ? Calculate EAN of Fe in $[Fe(CO)_5]^0$.

(*c*) Discuss two biological role of calcium Ions.

(*d*) What are active-methylene compounds ? Give two examples.

(*e*) Explain : Furan undergoes electrophilic substitution preferably at α-position.

(*f*) Define the terms : Chromophore and Auxochrome giving one example for each.

SECTION–B

Answer **all** questions : 12×4

2. (*a*) Discuss one method of preparation and two important properties of pot. Ferrocyanide and sodium nitroprusside. $6 + 6$

Or

(*b*) What are organometallic compounds ? Discuss its classification. Discuss structures Zeise's salt and Ferrocene. $2 + 2 + 4 + 4$

3. (*a*) Write notes on : Na/K pump and role of Mg^{+2} Ion in energy production. $6 + 6$

Or

(*b*) Discuss biological role of Ca^{+2} Ions. Write harmful effect of excess intake of metals on human body. $8 + 4$

4. (*a*) Discuss electrophilic substitution reactions of furan and pyrrole with mechanism. $6 + 6$

(*Continued*)

Or

(*b*) How is aceto acetic ester prepared ? How are the following compounds prepared from it

(*i*) Succinic acid

(*ii*) Acetyl acetone

(*iii*) Uracil. $3 + 3 + 3 + 3$

5. (*a*) Explain the following with examples : Bathochromic shift and hypsochromic shift. How IR spectra helps in detecting Inter and Intramolecular H-bonding ? $4 + 4 + 4$

Or

(*b*) Discuss Woodward rules for calculating λ max of conjugated dienes. 12

BA–3,500

2017

ORGANIC CHEMISTRY-I

Time : $2\frac{1}{2}$ Hours] [*Full Marks* : 60

Answer **all** questions. The figures in the right-hand margin indicate marks.

SECTION-A

1. Answer the following questions: 2×6

   (*a*) Explain, Phenol is acidic.

   (*b*) A compound $C_4H_{10}O$ shows optical activity. Identify the compound and write the possible stereoisomers.

   (*c*) Discuss the structure of carbene.

   (*d*) What are +I and –I effects? Illustrate with examples.

   (*e*) Differentiate between Enantiomers and Diastereoisomers.

   (*f*) Between *n*-butane and isobutane which one boils at a lower temperature? Justify your answer.

SECTION-B

Answer **all** questions:

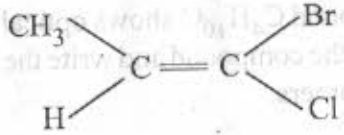
2. (*a*) Discuss mesomeric effect. What are the conditions for resonance? Define resonance energy and explain with one example. 2+6+4

OR

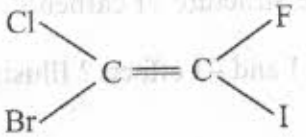
(*b*) What are carbocations? Discuss the formation, structure and stability of carbocations. 1+3+4+4

3. (*a*) What do you understand by *E* and *Z* notations for geometrical isomerism? Explain with examples. Assign *E* and *Z* notations for the following: 2+6+2+2

(*i*)



(*ii*)



OR

(*b*) What are *R* and *S* configurations? State sequence rules with examples. Differentiate between meso and racemic form. 2+6+4

4. (*a*) Discuss the mechanisms for the following reactions: 4×3

(*i*) Addition of HBr to propene

(*ii*) Dehydrohalogenation of alkyl halide

(*iii*) Diels-Alder reaction

OR

(*b*) Discuss the conformation analysis of *n*-butane. 12

5. (*a*) Explain, $-NO_2$ group is meta director while $-OH$ group is ortho and para director when present in the benzene ring. Justify "chlorine is ortho-para director but ring-deactivator". 5+5+2

OR

(*b*) Discuss Friedel-Crafts alkylation and acylation with mechanism. How is benzophenone prepared from benzene? 5+5+2

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2017

PHYSICAL CHEMISTRY-II

Time : $2\frac{1}{2}$ Hours] [*Full Marks* : 60

Answer from **both** the Sections as directed. The figures in the right-hand margin indicate marks.

SECTION-A

1. Answer the following questions: 2×6

   (*a*) What are extensive and intensive property of a system? Give one example of each.

   (*b*) Derive the relationship between K_p and K_c for the reaction

   $$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$$

   (*c*) Find out work done during isothermal reversible expansion of 2 moles of ideal gas from volume 10 litres to 1000 litres at 27°C.

   (*d*) What do you mean by state of a system and state variables?

   (*e*) Explain, 1 molal solution of NaCl boils at a higher temperature than 1 molal solution of sugar.

(*f*) Formation of ammonia is more at high pressure. Explain by Le Chatelier's principle.

SECTION-B

Answer all questions:

2. (*a*) Derive Kirchhoff's equation. Discuss two of its applications. 8+2+2

OR

(*b*) Derive an expression for the work done during isothermal reversible expansion involving an ideal gas. Prove that this work done is maximum. 8+4

3. (*a*) (*i*) Derive Gibbs-Helmholtz equation. 8

(*ii*) Derive an expression for entrophy change for ideal gas considering temperature and pressure variable. 4

OR

(*b*) Derive an expression for free-energy change with temperature and pressure. Calculate the standard entropy change for the reaction $P \rightleftharpoons Q$ if $\Delta H^\circ = 28.40$kJ and equilibrium constant is 1.8×10^{-7} at 298K. 8+4

4. (*a*) Derive Gibbs-Duhem equation. Define chemical potential. 10+2

OR

(*b*) Derive an expression for free-energy change during chemical reaction. Calculate free-energy change during expansion of 1 mole of ideal gas at 27°C from 20 litres to 2000 litres. 10+2

5. (*a*) (*i*) Derive thermodynamically depression in freezing point of solvent on the addition of a non-volatile solute. 9

(*ii*) Calculate osmotic pressure of 2 litres of $\frac{M}{10}$ solution of sugar at 27°C (mol. mass of sugar = 342). 3

OR

(*b*) State Raoult's Law. Derive it thermodynamically. Discuss the limitations of Raoult's Law. 2+8+2

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2017

Time : $2\frac{1}{2}$ Hours] [*Full Marks* : 60

Answer **all** questions from any **one** Group as per your specialization. The figures in the right-hand margin indicate marks.

GROUP-A

Chemical Energetics, Equilibria and Functional Organic Chemistry-i

SECTION-A

1. Answer **all** questions: 2×6

(*a*) Differentiate between bond energy and bond dissociation energy.

(*b*) Define pH of a solution. Calculate the pH of 10^{-4} *M* NaOH solution.

(*c*) What is Buffer Solution? How many types of buffer solutions are there? Give one example for each.

(*d*) What is Sandmeyer's reaction?

(*e*) What happens when toluene undergoes oxidation with alkaline $KMnO_4$ solution?

(*f*) Prepare ethyl alcohol from methyl magnesium bromide.

SECTION-B

Answer **all** questions:

2. (*a*) (*i*) Thermodynamically derive the law of chemical equilibrium. 6

(*ii*) Derive relationship between K_p and K_c for the reaction

$$aA + bB \rightleftharpoons lL + mM$$ 6

OR

(*b*) Derive Kirchhoff's equation. What is residual entropy? 10+2

3. (*a*) Write notes on the following: 6+6

(*i*) Common ion effect

(*ii*) Solubility product

OR

(*b*) Derive mathematical expression for hydrolysis constant and pH involving hydrolysis of a salt of weak acid and strong base. 12

4. (*a*) Discuss any two methods of preparation of benzene. What happens when benzene undergoes (*i*) nitration, (*ii*) sulphonation, and (*iii*) ozonolysis? 3+3+2×3

OR

(*b*) (*i*) Discuss S_N1 and S_N2 with suitable examples. 4+4

(*ii*) Discuss relative reactivities of alkyl halide vs allyl halides and vinyl halides. 4

5. (*a*) Discuss the two methods of preparation of acetone. How does it react with —

(*i*) $NaHSO_3$;

(*ii*) I_2 and KOH? 3+3+3+3

OR

(*b*) Write notes on the following: 6+6

(*i*) Cannizzaro's reaction

(*ii*) Benzoin condensation

GROUP-B

Organometallics, Bioinorganic Chemistry

SECTION-A

1. Answer **all** questions: 2×6

(*a*) Write the IUPAC name of $Fe_4[Fe(CN)_6]_3$ and find out oxidation state of iron in co-ordination sphere.

(*b*) What is Hapticity? Give examples.

(*c*) Write two biological roles of Mg^{+2} ion.

(*d*) Explain aromaticity of pyrrole.

(*e*) What is keto-enol tautomerism?

(*f*) What are the possible electronic transitions? Arrange them in the order of decreasing energy.

SECTION-B

Answer **all** questions:

2. (*a*) Discuss preparation and two important properties of $KMnO_4$ and $K_2Cr_2O_7$. 6+6

OR

(*b*) What are metal carbonyls? Discuss a method of preparation and structure of one (*i*) Mononuclear and (*ii*) Binuclear compounds. 2+5+5

3. (*a*) Write notes on the following: 6+6

(*i*) $Na^{\oplus}$–$K^{\oplus}$ pump

(*ii*) Ca^{+2} pump

OR

(*b*) What is the function of sodium and potassium? Why is it important to have correct percentage of these ions in human body?

4. (*a*) Discuss evidences in support of keto and enol structure of acetoacetic ester. Discuss synthesis of one heterocyclic compound from ethyl acetoacetate. 12 5+5+2

OR

(*b*) Discuss preparation of pyrrole by any two methods. Discuss nitration and Friedel-Crafts reaction of pyrrole. Explain, pyrrole is more reactive than benzene to electrophilic attack. 2×2+2×2+4

5. (*a*) Explain Chromophore, Auxochrome, Red shift and Blue shift with examples. Arrange anthracene, ethylene, naphthalene and butadiene in increasing order of UV absorption maxima and justify your answer. 2×4+4

OR

(*b*) (*i*) Discuss the various factors influencing vibrational frequency.

(*ii*) Two isomers *A* and *B* having molecular formula C_3H_6O exhibit the following peaks in IR— *A*: 1710 cm^{-1}, *B*: 3300 cm^{-1} and 1640 cm^{-1}. Write the structure of *A* and *B* on this basis. 8+4