

Five Year Integrated M.Sc. Examination, 2019

Semester - II
Course: CH-1-2-1
(Chemistry)

Time: Three Hours

Full Marks: 60

Questions are of value as indicated in the margin.

Group-A

Answer **any two** questions.

1. a) What are interhalogens? Using VSEPR theory predict the structures of any two type of interhalogens of your choice. 1+2
b) What are the products formed when B_2H_6 is allowed to react with NH_3 at high temperature in 1:1 and 1:2 ratios? Hence write the structure of the compounds. 2+2
c) Draw the molecular orbital energy level diagram of B_2 molecule. Comment on its magnetic property based on the diagram. 2+1
2. a) Draw the molecular orbital energy level diagram of LiH molecule. 2
b) Bond angle of $PH_3 < PF_3$ whereas bond angle of $NH_3 > NF_3$. Justify. 2
c) What are extrinsic semiconductors? What are the different types of extrinsic semiconductors? Give examples. 3
d) Write down the names, symbols and electronic configurations of noble gases. 3
3. a) Write down a method for the synthesis of S_4N_4 . Discuss about its structure and bonding. State one interesting property of the compound. 1+2+1
b) Magnesium oxide has a higher melting point than sodium fluoride.- Explain. 2
c) What do you understand by stoichiometric defect? Explain the different types of such defects with examples. Comment on the conductivity property of such compounds. 1+2+1

Group-B

Answer **any two** questions.

4. a) Explain the increasing stability order in the following: 2

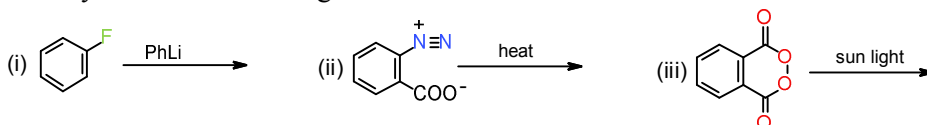
$\oplus$
 CH_3
I

$\oplus$
 H_3C-CH_2
II

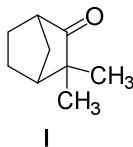
$\oplus$
 $H_3C-\underset{\substack{| \\ CH_3}}{CH}$
III

$\oplus$
 $H_3C-\underset{\substack{| \\ CH_3}}{C}-CH_3$
IV

b) What is the structure and hybridization of CF_3 radical? 1
c) For phenol there is no evidence of keto form, explain. 2
d) Write a short note on Ring-Chain Tautomerism. 2
e) Identify the structures and give mechanisms of formation 3



5. a) Give examples of intra and inter molecular condensation reactions. 2
b) What is deuterium isotope labeling in KIE experiment? 2
c) Compound (I) exist totally in keto form, explain. 2



P.T.O.

- d) Complete the following: 1
- $$\text{CHCl}_3 \xrightarrow{\text{KOH}}$$
- e) Explain HBr addition in 1,3-butadiene in terms of KCP and TCP. 3
6. a) What kind of tautomerism do you expect in cyclooctatetraene? 2
- b) Write the products and mention the stereospecific and non-stereospecific reaction: 2
- (i) $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3 + \ddot{\text{C}}\text{Br}_2 \text{ (singlet)} \xrightarrow{\text{KOH}}$
- (ii) $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3 + \ddot{\text{C}}\text{Br}_2 \text{ (triplet)} \xrightarrow{\text{KOH}}$
- c) Which species in each of the following pairs is more stable and why? 3
- (i) Phenyl cation and cyclohexyl cation
- (ii) Phenyl anion and cyclohexyl anion
- d) What is cross over experiment? Explain with examples. 3

Group-C

Answer **any two** questions.

7. a) What are reversible and irreversible processes? Derive the thermodynamic relation for the expansion work by an ideal gas, expanding from its initial volume (V_i) to final volume (V_f) reversibly and isothermally. 2+3
- b) Calculate the final pressure of 2.4 g CO_2 gas that expands adiabatically and reversibly from its initial temperature 5°C and volume 1.0 L to final volume 2.0 L. Given the ratio of heat capacity (γ) of CO_2 is 1.4. 3
- c) Using the relation $H = U + PV$, establish the Maxwell relation, $\left(\frac{dT}{dP}\right)_S = \left(\frac{dV}{dS}\right)_P$. 2
8. a) State with suitable example the “Hess’s law of constant heat summation”. 2
- b) The heat of oxidation of magnesium and iron to produce MgO and Fe_2O_3 are $-14.57 \text{ kcal mol}^{-1}$ and $-193.50 \text{ kcal mol}^{-1}$, respectively. Calculate the heat produced in the following reaction: $3\text{Mg} + \text{Fe}_2\text{O}_3 = 3\text{MgO} + 2\text{Fe}$. 2
- c) Define the term “Heat of combustion”. Discuss a method by which the heat of combustion of a substrate can be measured experimentally. 1+3
- d) Show that the heat of neutralization of an acid by a base is nothing but the heat of formation of one mole of water from one gm ion of H^+ and one gm ion of OH^- only. 2
9. a) Define ‘isolated’, ‘open’ and ‘closed’ systems. 3
- b) State the law of thermal equilibrium. Show that the Joule-Thomson process is a constant enthalpy process. 1+2
- c) Using thermodynamic relations, show that $C_p - C_v = \frac{TV\alpha^2}{K}$ for a real gas, where symbols have their usual meaning. 4