

B.Sc. (Honours) Examination, 2017

Semester - II

Chemistry (Allied)

Paper: BACH-21

Time: Four Hours

Full Marks: 60

Questions are of value as indicated in the margin.

Group - A

Answer *any two* questions.

- Arrange O_2 , O_2^+ , O_2^- , O_2^{2-} according to bond order and stability and provide explanation in the light of MOT. 2+2
 - Show the stablest structure of ClF_3 according to VSEPR theory with proper explanation. 2
 - Show the stablest structure of PCl_3F_2 according to Bent's rule and explain. 2
 - What will be the hybridized state of central atoms of the following molecules:
(i) SF_4 , (ii) BrF_3 , (iii) BF_3 and (iv) C_2H_4 . 2
- "The dipole moment of CO is too small to be expected" – Justify the statement. 3
 - What is the dipole moment of water? 1
 - Arrange the following according to polar and non-polar character:
(i) C_6H_6 , (ii) NF_3 , (iii) CCl_4 and (iv) BCl_3 . 2
 - Between F_2 and Cl_2 , which one is of lower bond energy and why? 0.5+1.5
 - ' H_2O is liquid but H_2S is gas' – Justify. 2
- What is lattice energy? Show the involved Born-Haber cycle to relate lattice energy and other energy parameters for NaCl. 1+3
 - Between KHF_2 and $KHCl_2$, which one is more stable and why? 2
 - Comment on the boiling point and stability of O-nitro and P-nitro-Phenol. 4

Group - B

Answer *any two* questions.

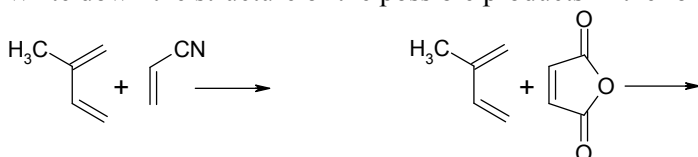
- What type of mechanism, do you expect, for the following reaction:

$$CH_3 - Cl \xrightarrow{aq. NaOH} CH_3 - OH.$$

State the rate law and draw the energy profile of the reaction. Do you expect any intermediate, generated in this reaction? What type of change in stereochemical configuration, do you expect, while taking a chiral substrate for the reaction? 2+4+1+3
- What do you mean by E_1 , E_2 and E_{1CB} reactions? 6
 - What is the difference between syn elimination reaction and anti elimination reaction? Offer an example of the syn elimination reaction. 4
- What is the difference between nucleophilic addition reaction and electrophilic addition reaction? 2
 - Predict the products and show the mechanisms of the following reactions: 5

$$CH_3 - CO - CH_3 + HCN \rightarrow$$

$$CH_3 - CHO + CH_3MgBr \rightarrow$$
 - Write down the structure of the possible products in the following reactions: 3



Group - CAnswer *any two* questions.

1. a) Show that for any aqueous solution $\text{pH} + \text{pOH} = \text{pK}_w$. 2
 - b) Write down the expression for the equilibrium constant of a weak electrolyte AB in terms of its degree of dissociation α and concentration C. 2
 - c) Explain why a solution of Na_2CO_3 is alkaline? 2
 - d) When a small quantity of acid is added to an aqueous solution of ammonium acetate, the pH of the solution remains almost unchanged, whereas when the same acid is added to an aqueous solution of sodium chloride, the pH of the solution changes enormously. Explain why it is so. 2
 - e) Calculate the pH of (i) 0.004 M HCl and (ii) 2.0×10^{-7} M HCl. 2
 2. a) Define the term solubility product as applicable to a sparingly soluble salt. 2
 - b) Explain why there is steep rise of pH values near the equivalence point. 2
 - c) In a saturated solution of calcium phosphate, the concentration of PO_4^{3-} ion is 3.3×10^{-7} M. Calculate the K_{sp}^0 of $\text{Ca}_3(\text{PO}_4)_2$. 2
 - d) Why vapour pressure of solution is lower than of its pure solvent. 2
 - e) What is molal depression constant? 2
 3. a) Show that the Freezing point of depression is directly proportional to the mole fraction of solute. 4
 - b) The boiling point of ether is 36°C . A solution of 1.6 gm naphthalene ($M=128$) in 20 gm ether boils at 36.31°C . Calculate K_b and latent heat of vaporisation of ether. 3
 - c) State the Van't Hoff's law of osmotic pressure. 1
 - d) Equimolar amounts of different substances dissolved in the same amount of a given solvent increase the boiling point to the same extent – Explain the statement. 2
-