B. Sc. CHEMISTRY EXAMINATION, 2024

(3rd Semester)

CHEMISTRY (CORE)

PAPER : CORE/CHEM/TH/05

Time : *Two Hours*   *Full Marks* : 40

(*20 marks for each Unit*)

Use separate answer scripts for each Unit.

UNIT—3051 – I

1. Answer *any five* questions :   2×5

(a) State with explanation and equation whether acidity/basicity will increase or decrease in the following cases :

  (i) Formaldehyde is added to ammonium chloride solution

  (ii) Potassium iodide is added to aqueous suspension of mercuric oxide

(b) Arrange the following in their increasing order of acidity and discuss the entropy factor to support your answer :

  $CH_3COOH, ClCH_2COOH, Cl_2CHCOOH$ and Cl_3CCOOH

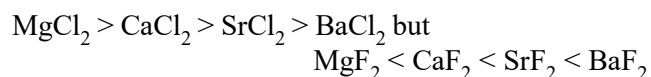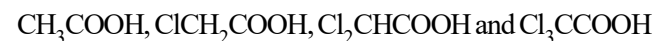CHEM-**10**   [*Turn Over*]

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(4)

(e) Comment on the geometry of HF_2^- using M.O. theory. 2

(f) Arrange water, methanol and di-methyl ether in increasing order of their boiling point and viscosity. Give reason. 1

4. (a) Explain the observed solubility trends of the following salts in water : 2

  $MgCl_2 > CaCl_2 > SrCl_2 > BaCl_2$ but
  $$MgF_2 < CaF_2 < SrF_2 < BaF_2$$

(b) The stability of complexes with the cations, 18-Crown-6- follows the order : $Ca^{2+} < Sr^{2+} < Ba^{2+}$ – explain. 1

(c) How would you prepare (i) diberyllocene and (ii) a complex with Zn-Be bond? 2

(d) BeX_2 (X = Cl, Br and I) forms complexes $[(PMe_2Ph)_2BeX_2]$, $[(PMePh_2)_2BeX_2]$ and $[(PPh_3)BeX_2]_2$ (X = Cl, Br, I). Explain the structural differences of these complexes. 1

(e) The complexes $[Be(CAAC)_2Cl_2]$ (CAAC = cyclic-alkyl-amino-carbene) contain very short Be-C bonds and linear Be-C coordination geometry. How would you explain such observations? 1

(f) Briefly describe the anomalous behaviour of Li in contrast to other group members. 2

(g) What is phase transfer catalysis? Give one example of the use of K-Crown ether complex in phase transfer catalysis. 1

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(c) Explain Lux-Flood acid-base concept. How can the enthalpy change of a reaction between Lux-Flood acid and base be calculated?

(d) How can you identify a hard acid and a soft acid? Discuss in detail with examples.

(e) Derive the expression to calculate pH of a solution containing acetic acid and sodium hydroxide. Calculate pH of the solution of a 50 mL of 0.1 M acetic acid when 50 mL of 0.1 M NaOH is added to it?
(Given : K_a of acetic acid is 1.75×10^{-5})

(f) How do you select an indicator in acid-base titration? Discuss in detail.

(g) Can Fe^{3+} and Mg^{2+} be separated quantitatively as hydroxide from solution that is 0.10 M in each cation? Consider a precipitation to be quantitative when all but 1 part in 100000 of the ion has been removed from solution.

K_{sp} of $Fe(OH)_3 = 2.0 \times 10^{-39}$ and
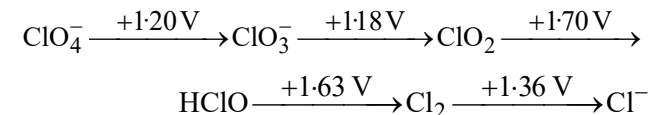
$$Mg(OH)_2 = 7.1 \times 10^{-12}$$

2. (a) Define a redox indicator. Give example of a redox indicator and describe its redox potential, structures in the oxidized and reduced forms and color change.
1+2

(b) What is SCE? Describe the reaction(s) in it and explain the role of KCl.
1+2

(c) $PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$ $E_1^0 = 1.68$ V

$Pb^{2+} + 2e^- \rightleftharpoons Pb^0$ $E_2^0 = -0.36$ V
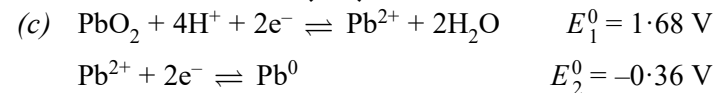
Based on the above two half-cell reactions, write down the net redox reaction and comment on its type and spontaneity.   2

(d) The Latimer diagram for chlorine is given below :

$ClO_4^- \xrightarrow{+1.20\,V} ClO_3^- \xrightarrow{+1.18\,V} ClO_2 \xrightarrow{+1.70\,V}$

$HClO \xrightarrow{+1.63\,V} Cl_2 \xrightarrow{+1.36\,V} Cl^-$

(i) Calculate the potential for going from HClO to Cl^-.

(ii) Identify the species which will undergo disproportionation in solution. Indicate why?
1+1

UNIT—3052 – I

3. Answer each question :

(a) Draw the possible M.Os when two p_x orbitals interact with each other. Mention the symmetry operations present in the M.Os.   2

(b) Discuss bonding pattern present in $[Tc_2Cl_8]^{2-}$.   2

(c) Using M.O. diagram, show that B_2 is paramagnetic in nature.   1

(d) Ionization of NO to NO^+ is an easy process. Explain it using M.O. theory.   2