BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF CHEMISTRY

MAIN EXAMINATION PAPER

COURSE: **INORGANIC CHEMISTRY II**

COURSE CODE: **CH 202**

DURATION: **2 HOURS**

INSTRUCTIONS TO CANDIDATES

1. Answer **QUESTION 1** and **Two** questions in **SECTION A** and **Two** from **SECTION B.**
2. Each question should start on a fresh page and marks will be allocated as indicated.
3. Each question carries 20 marks

QUESTION 1

(a) List four limitations of the valence bond theory. **[4 marks]**

(b) Explain why potassium and cesium, rather than lithium are used in photoelectric cells?

(c) Explain why the Lewis acidity of Boron halides follow the order $BF_3 < BCl_3 < BBr_3 < BI_3$ **[3 marks]**

(d) Give the systematic name for each of the following coordination compounds;

(i) $[Mn(NH_3)_5Cl]Cl_2$ **[1 mark]**

(ii) $Na_3Fe(CN)_6$ **[1 marks]**

(e) Explain why lanthanides occur in pairs in nature. **[3 marks]**

(f) Explain the macrocyclic effect. **[5 marks]**

SECTION A: ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION 2

(a) Summarise and comment on the following major trends observed for group 15 elements (N, P, As, Sb, Bi). **[20 marks]**

Trend	Summary and Comments
Oxide basicity	**[3 marks]**
Hydrolysis of Flourides:	**[3 marks]**
Stabilization of the +3 oxidation state relative to +5 oxidation state	**[3 marks]**
Catenation	**[2 marks]**
Coordination number	**[3 marks]**
Multiple bond formation	**[3 marks]**
Thermal stabilities of hydrides and alkys compounds	**[3 marks]**

QUESTION 3

(a) When an alkali metal dissolves in liquid ammonia the solution can acquire different colours. Explain the reasons for this type of colour change and magnetic properties.

[5 marks]

(b) Explain why beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so. **[3 marks]**

(c) Explain why hydroxides and carbonates of sodium and potassium are easily soluble in water while the corresponding salts of magnesium and calcium are sparingly soluble in water.

[3 marks]

(d) Comment on each of the following observations:

(i) The mobilities of the alkali metal ions in aqueous solution are $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$. **[2 marks]**

(ii) Lithium is the only alkali metal to form a nitride directly. **[3 marks]**

(e) Explain four significance functions of sodium, potassium, magnesium and calcium in biological system. **[4 marks]**

QUESTION 4

(a) Explain the structure and bonding in diborane. **[10 marks]**

(b) Explain why the catenation ability for Group 4 elements follow the order C>>Si ≈Ge> Sn≈Pb. **[2 marks]**

(c) List any three carbon nanomaterials. **[3 marks]**

(d) Explain why the compound trimethylamine $(CH_3)_3N$ and trisilylamine $(SiH_3)_3N$ have similar formulae but have totally different structures. **[5 marks]**

SECTION B: ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION 5

(a) Explain the inner and outer sphere reaction mechanisms. Include the relevant equations in your answer. **[15 marks]**

(b) Explain circumstances that lead to Metal Ligand Charge transfer (MLCT) bands in metal complexes. **[5 marks]**

QUESTION 6

(a) Determine the configuration, the number of unpaired electrons, and the ligand field stabilization energy as a multiple of Δ_o or Δ_T.

(i) $[W(CO)_6]$ **[5 marks]**

(ii) $[Co(NH_3)_6]^{3+}$ **[5 marks]**

(b) Construct molecular orbital energy level diagrams for Fe^{III} ion in a high spin octahedral crystal field. Clearly show the relative positions of the metal, ligand and complex orbitals. Do placement of electrons in each case. **[10 marks]**

QUESTION 7

(a) Explain why the f-block elements are placed outside the body of the periodic table separately. **[5 marks]**

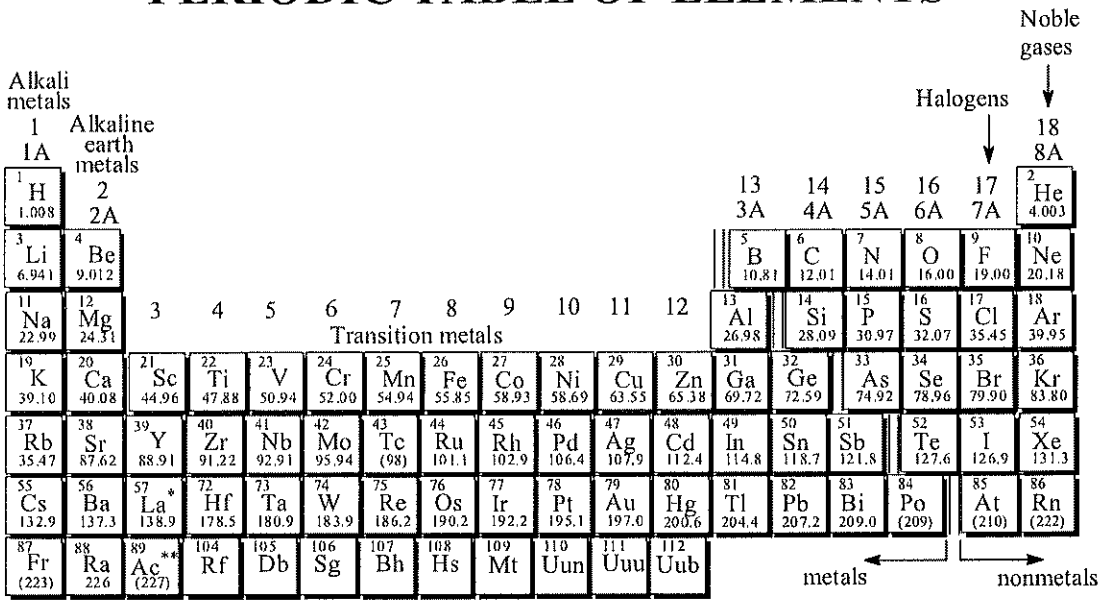
(b) Outline four uses of Lanthanoids. **[4 marks]**

(c) Explain the cause and two consequences of lanthanoid contraction. **[2 marks]**

(d) Briefly explain three methods that are used for lathanoid separation. **[9 marks]**

END OF EXAMINATION

PERIODIC TABLE OF ELEMENTS



* Lanthanides

** Actinides

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)