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FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCE
APRIL/MAY, 2019 EXAMINATIONS

COURSE CODE: CHM 303
COURSE TITLE: INORGANIC CHEMISTRY III
COURSE UNIT: 3
TIME: 2½ HOURS
INSTRUCTION: Answer question one and any other four questions.

QUESTION ONE

1 (a) With the aid of molecular orbital energy level diagram describe the three-centered four-electron bond nature in XeF_2 . 4 Marks

1b) Boron practically prefers to form borate than forming a B^{3+} ion, explain? 2½ Marks

1 (c) If the number of unpaired electrons in $[\text{V}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ are x and y respectively, what will be the value of $2x + y$. 3 Marks

1 (d) Write down the chemical equations for the reactions of lanthanum (Ln) with:
(i) water and (ii) oxygen 4 Marks

1 (e) List three methods of beneficiation of ore. Hence, which of the methods will be most appropriate for beneficiation of haematite (Fe_2O_3). 2½ Marks

1 (f) In the crystal field theory, itemize any two consideration that should be given to the electronic configuration of the metal ion in the complexes. 3 Marks

1(g) With equation only, explain alpha decay of Uranium-238 i.e. ($^{238}_{92}\text{U}$). 3 Marks

QUESTION TWO

2. (a) What are clathrates? Hence, explain how the clathrate of the composition G.3 Quinol can be formed. 3 Marks
2. (b) The decrease in atomic radius from sodium to chlorine is greater than that from scandium to copper, explain. 3 Marks
2. (c) The simple equation for the preparation of boron is $B_2O_3 + Mg \rightarrow 2B + 3MgO$. What is the change in oxidation state of B and what is the role of Mg. 3 Marks
2. (d) Write the electronic configuration of the transition metal ions and mention the number of unpaired electrons in each case: (i) Mn^{4+} (ii) Cr^{2+} . 3 Marks

QUESTION THREE

- 3a) The noble gases are chemically unreactive but chemical reactivity of the noble gases increase as we go down the group from helium to radon. Explain. 4 Marks
- 3b). Outline any four general properties of transition elements. 4 Marks
- 3c) Complete the following chemical equations:
- (i) $2K(s) + O_2(g) \longrightarrow$
- (ii) $2Na(s) + 2H_2O(l) \longrightarrow$
- (iii) $? \longrightarrow NaHCO_3(aq) + NaOH(aq)$
- 4 Marks

QUESTION FOUR

- 4(a) Discuss the effect of increase in pH in the following half-cell reaction:
 $FeO_4^{2-} + 8H^+ + 4e^- \rightarrow Fe^{2+} + 4H_2O$ 3 Marks
- 4(b) Study the equation below carefully and provide condition A and B
- $$Xe + F_2 \xrightarrow[700\text{ K, B}]{A} XeF_2$$
- 2 Marks

4(c) The most stable oxidation state for Mn, Co, Ni is +2. Explain briefly why FeCl_3 is more stable than FeCl_2 . 4 Marks

4(d) Explain briefly the preparation of borazine and boron nitride 3 Marks

QUESTION FIVE

5(a) Explain why group IIIB elements, unlike group I and II are essentially covalent or contain an appreciable amount of covalent character. 4 Marks

5(b) What kind of oxides are formed when oxygen reacts with;

i. Group I and II metals

ii. Sulphur and Phosphorus 2 Marks

5(c) How do elements of group IVA make more than four covalent bonds (carbon excluded). 2½ Marks

5(d) Vanadium can exist as V^{2+} and V^{3+} . Which of the two conditions: $\text{V}_{(\text{s})}/\text{V}^{3+}_{(\text{aq})}$ and $\text{V}^{2+}_{(\text{aq})}/\text{V}^{3+}_{(\text{aq})}$ has the electrode potential closer to positive and why? 3½ Marks

QUESTION SIX

6a. Using Valence Shell Electron Pair Repulsion Theory (VSEPR), justify the shape of XeF_2 compounds. 6 marks

6b. Comment on colour of transition metal compounds. 6 marks