



**NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE,
NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2023_1 POP EXAMINATION**

COURSE CODE: CHM 303

COURSE TITLE: INORGANIC CHEMISTRY III

COURSE UNIT: 3

INSTRUCTION: Answer question one (1) and any other three questions

Time: 3 hours

QUESTION 1

1. Give reasons for the following observations
 - (i) The decrease in atomic radius from sodium to chlorine is greater than that from scandium to copper **(3 marks)**
 - (ii) No known noble gas hydrates of helium and neon have been prepared **(3 marks)**
 - (iii) Lanthanide and actinide elements do not occur naturally in their free state. **(3 marks)**
 - (iv) Zinc has only one oxidation number whereas manganese has six. **(3 marks)**
 - (v) There is reduced tendency of higher oxidation states towards the end of the first row transition metal series **(3 marks)**
 - (vi) Chromium can form complexes but Potassium does not despite the fact they belong to the same period of the periodic table **(4 marks)**
 - (vii) Copper exhibits +1 oxidation state very frequently **(3 marks)**
 - (viii) Sulphur unlike oxygen can make up to six covalent bonds despite that they both belong to this same group. **(3 marks)**

QUESTION 2

2. (a) Define the following terms **(i)** Monodentate Ligands **(ii)** coordination number **(iii)** interstitial compounds **(9 marks)**
(b) Give the oxidation state of the central metal atom and coordination number of **(i)** $K_3[Co(C_2O_4)_2(CN)_2]$ **(ii)** $Na_4[Mn(CN)_6]$ **(6 marks)**

QUESTION 3

3. (a) Illustrate using chemical equation the reaction of chlorine with
 - (i) water
 - (ii) cold dilute alkali
 - (iii) hot concentrated alkali **(9 marks)**
- (b) Using equations only, describe the roasting of cuprous sulphide to produce pure copper metal **(6 marks)**

QUESTION 4

4. (a) Which is the last element in the series of the actinides? Write the electronic configuration of this element and hence comment on its possible oxidation state. **(6 marks)**
- (b) Why is $\text{Ti}(\text{H}_2\text{O})_6^{3+}$ is coloured whereas $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless, **(5 marks)**
- (c) Write a balance chemical equation for the reaction of Silica with sodium carbonate **(4 marks)**

QUESTION 5

5. (a) Explain the process that can be used to separate Cerium from a mixture of lanthanides **(5 marks)**
- (b) Arrange the ions of each group in the order of increasing size
- (i) Cl^- , I^- , Te^{2-} , Ar^+ **(5 marks)**
- (ii) Rb , Li , K , Na , **(5 marks)**

QUESTION 6

6. (a) Highlight any four (4) differences between the valence bond and molecular orbital theories **(12 marks)**
- (b) Outline any two (2) factors that paramagnetism exhibited by lanthanide and actinide ions depends on **(3 marks)**