

NATIONAL OPEN UNIVERSITY OF NIGERIA  
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA  
FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY  
NOVEMBER 2021 EXAMINATION

COURSE CODE: CHM 423

CREDIT UNIT: 3

COURSE TITLE: COORDINATION CHEMISTRY

TIME: 2 ½ HRS

INSTRUCTION: Answer Question ONE (1) and any other Three (3) Questions

### QUESTION ONE

- 1.a(i) Write suitable equations to compare the dissociation of simple salt (NaCl), double salt (KAl(SO<sub>4</sub>)<sub>3</sub>) and complex salts? (6 marks)
- (ii) What are the conditions required for a molecule to function as a Lewis base, hence give three examples of neutral molecules and three examples of anions that can function as Lewis bases? (4 marks)
- (iii) What do you expect when a Lewis acid and Lewis base interact chemically. Hence give general name for the product formed during such interaction? (2 marks)
- (iv) Complete the information in the Table below:

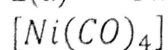
Complex	Central atom	Anion/ molecule	Number coordinated	Valency of the metal ion	
$[Fe(CN)_6]^{3+}$	Fe				(1.5 marks)
$[Ni(CO)_4]$	Ni				(1.5 marks)
$[Ag(NH_3)_2]^+$	Ag				(1.5 marks)
$[Co(NH_3)_4Cl_2]^+$	Co				(1.5 marks)

b. In four sentences, outline the Wermer's postulates (6 marks)

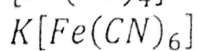
c. State the kinetic methods you can use to monitor slow reaction and a reaction that occurs with a change in colour (1 mark)

### QUESTION TWO

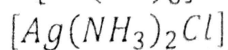
2(a) State the primary and secondary valencies of the following complexes



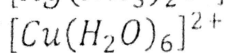
(1 mark)



(1 mark)



(1 mark)



(1 mark)

- b.(i) Explain how Werner used a chloride containing complex to deduced the existence of electrolyte and non electrolyte complexes. hence what is the current instrumental approach of achieving this results (4 marks)
- (ii) What is a ligands? Give examples of different forms of neutral and organic molecules that can act as ligands (4 marks)
- (iii) What are mono and bidentate ligands (3 marks)

### QUESTION THREE

- 3a.(i) What is the importance of the trans effect with respect to the coordination of ligands to Pt? (3 marks)
- (ii) Outline the five steps required for the formation of coordination compounds, based on the valence bond theory (9 marks)
- (iii) What are the expected geometries for compounds formed through  $sp$ ,  $sp^2$ ,  $sp^3$  and  $dsp^2$  hybridizations (3 marks)

### QUESTION FOUR

- 4.a(i) State two limitation of the valence bond theory (2 marks)
- (ii) Briefly describe how a crystal field is formed between d- orbital and anion (3 marks)
- (iii) Briefly described how the crystal field theory predicts the properties of complexes, existing repulsion and splitting (8 marks)
- (iv) State the major factor that affects the magnetic properties of compounds (2 mark)

### QUESTION FIVE

- 5.a(i) In terms of the spin strength, differentiate between tetrahedral and square planner complexes (2 marks)
- (ii) What is spectrochemical series (based on absorption band) (4 marks)
- (iii) What is metal ion series (2 marks)
- b(i) State the principle of Jahn Teller theory of geometric distortion (3 marks)
- (ii) State the reason why  $Cu^{2+}$  ( $d^9$ ) and  $Cr^{2+}$  ( $d^4$ ) have distorted octahedral shape (2 mark)
- (iii) Consider two orbitals having one and two electrons respectively. Which of them will have greater repulsion? (2 mark)

### QUESTION SIX

- 6.a(i) State the information that can be derived from the following analytical investigation of coordination compounds
- (i) Elemental analysis (4 marks)
- (ii) Thermal analysis (3 marks)
- (iii) Conductivity measurement (2 marks)
- (iv) Magnetic properties (2 marks)
- b. Explain how the half filled d-orbital of the transition metal affects their appearance and possibilities using IR, visible and UV spectroscopy to study their complexes (4 marks)