MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

WEBUYE CAMPUS (SCHOOL BASED)

UNIVERSITY EXAMINATIONS 2021/2022

EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF EDUCATION SCIENCE

COURSE CODE: SCH 410

COURSE TITLE: COORDINATION AND ORGANOMETALLIC COMPOUDS

DATE: 19th APRIL 2022 **TIME: 2.00 PM**

INSTRUCTION TO CANDIDATES: Answer all questions in this paper

TIME: 2 HOURS

MMUST observes zero tolerance to Examination cheating

QUESTION ONE (18MKS)

a)

i) In the third period, Na to Ar atoms radii rapidly decreases from left to the right. This trend is hardly observed among the transition metals in the period from scandium to copper. Explain. (2mks)

ii) Give the consequence of the observation made in a(i) (1mk)

b)

i) Most transition metals like chromium are inert towards acids or react slowly despite a rather negative standard reduction potential. Explain. (2mks)

ii) Write the electronic configuration of elements Ti(22), Cr(24), Cu(29) and Fe^{2+}(24) (2mks)

c)

i) Lewis acids and bases are classified by designating them as hard or soft. What criteria would be ideal in classifying the given elements. (3mks)

ii) With reasons classify each of the following as soft acids or bases I^-, Cd^{2+}, Cu^+, S^{2-} (2mks)

iii) H^+ is a hard acid while H^- of the same element is a soft base. Explain (1mk)

d)

i) When amino acids like cysteine and methionine get in contact with Hg(I) and Hg(II) poisoning occurs. In light of the amino acid structures explain how the poisoning takes place. (3mks)

ii) Propose formulae for the plausible mineral ores that would naturally contain each of the following (2mks)

I. Zirconium (IV)
II. Cadmium (II)
III. Zinc (II)
IV. Copper (I)

QUESTION TWO (16MKS)

a) With examples differentiate between coordination compounds and double salt. (2mks)

b) Define the terms

i) Denticity (2mks)

ii) Coordination sphere (2mks)

c)

i) State the effective atomic number rule (1mk)

ii) Determine whether the following complexes obey the rule in(i)

I. $[Cr(NH_3)_6]^{3+}$ (Cr = 24) (2mks)

II. $[CO(NH_3)_5\,Cl_2]^{2+}$ (CO = 27) (2mks)

d) Write the structural formulae of the following coordination compounds.
   i) Dichlorobis(ethanediamine) platinum (IV) nitrate (1mk)
   ii) Sodium hexanitrocobaltate (III) (1mk)

e) Explain why $[Mn(H_2O)_6]^{2+}$ reacts with CN^- to form $[Mn(CN)_6]^{4-}$ which has one unpaired electron but with I to give $[MnI_4]^{2-}$ which has five unpaired electrons. (3mks)

QUESTION THREE (16MKS)

a) How relevant are Werner's postulates to the present day understanding of coordination chemistry. (2mks)

b)
   i) Outline the limitation of valence bond theory easily overcome when one uses the molecular orbital theory. (4mks)
   ii) Give three key features brought out by the crystal field theory. (3mks)
   iii) On the basis of crystal field theory draw a diagram to illustrate energy level splitting in octahedral complexes. (4mks)

c) How does molecular orbital theory differ from other theories of bonding in coordination compounds? (3mks)

QUESTION FOUR (20MKS)

a) Discuss the three broad groups of organometallic compounds (3mks)

b) Unstable or labile species with σ- bonds to carbon are of great importance particularly in catalytic reactions of alkenes and alkynes induced by transition metals or metal complexes.
   i) Explain why transition metals are ideal compared to main periodic table elements. (2mks)
   ii) Using diagram where necessary explain how ethylene binds to a transition metals. (4mks)

c) Ferrocene represented systematically as $\eta^5 - (C_5H_5)_2Fe$ can be prepared in several ways using equations show how you would do this given C_5H_6, TiOH, THF and water. (2mks)

d)
   i) Define oxidative addition reactions (1mk)
   ii) State the condition's necessary for oxidative addition reactions to take place. (2mks)
   iii) Suggest a mechanism pathway for the oxidation addition reactions. (2mks)

e) In the Zieglar- Natta polymerization of alkenes triethylaluminium is a key requirement

i) State two functions of triethylaluminium in this process. (2mks)

ii) Briefly explain the mechanism for the Zieglar – Natta polymerization of ethene. (2mks)