

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHEM 321

COURSE TITLE: COORDINATION CHEMISTRY

STREAM: SESSION VII

DAY: SATURDAY

TIME: 2.00 – 4.00 P.M.

DATE: 14/08/2010

INSTRUCTIONS:

- 1. Attempt ALL questions*
- 2. A periodic table will e provided to you.*

PLEASE TURNOVER

QUESTION ONE (17.5marks)

- a) Define the following terms:
- i. Coordination complex (2marks)
 - ii. Ligand (2marks)
 - iii. Chelate (2marks)
- b) Differentiate between;
- i. A monodentate and a polydentate ligand (2marks)
 - ii. A transition element and a d-block element. (2marks)
- c) Explain the following observations.
- i. The ionic radius of Fe^{3+} is 0.64Å while that of Fe^{2+} is 0.76Å (2.5marks)
 - ii. Transition metals have very high boiling and melting points. (1mark)
 - iii. d-block elements have a marked ability to form complex compounds. (2marks)
 - iv. d-block elements have a marked ability to form interstitial compounds. (2marks)

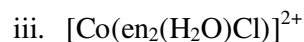
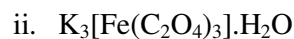
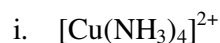
QUESTION TWO (17.5marks)

- a) Identify the donor atoms from the following ligands and classify each ligand as monodentate, bidentate or polydentate: Ethylenediamine ($\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$), Oxalate ion (O^-COCOO^-) and EDTA ($(\text{CH}_2\text{COOH})_2\text{NCH}_2\text{CH}_2\text{N}(\text{CH}_2\text{COOH})_2$). (6marks)
- b) When a concentrated solution of NH_3 is added to a solution containing $\text{Zn}(\text{NO}_3)_2$, a colorless solution containing the complex ion $\text{Zn}(\text{NH}_3)_4^{2+}$ results. Explain why this solution is colorless? (2marks)
- c) Show the hybridization in the formation of $\text{Ni}(\text{CO})_4$ molecule. (Ni=28) (4marks)
- d) Illustrate with a relevant example, the existence of Jahn-Teller distortions in some coordination compounds. (5.5marks)

QUESTION THREE (17.5marks)

- a) Give the structure for each of the following coordination compounds.
- i. Chlorotris(phenanthroline)cobalt(II)
 - ii. Diamminedichloroplatinate(II)
 - iii. Potassiumtetrachlorocobaltate(II)
 - iv. Hexaaminenickelate(II) (4marks)

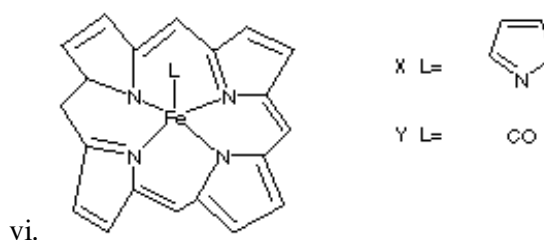
b) Assign IUPAC names to the following coordination compounds:



c) Indicate the number of unpaired electrons in each of the following compounds;



d) Below are structural formulas for two iron porphyrins. The pyridine complex, X, is paramagnetic whereas the carbonyl derivative is diamagnetic. The pyridine complex strongly binds a second pyridine forming a diamagnetic bis-pyridine complex; however, the carbonyl complex, Y, only weakly binds a second carbonyl.



i. Offer two reasons for this difference. (2.5marks)

ii. How many unpaired electrons are in the mono pyridine complex? (2marks)

QUESTION FOUR (17.5marks)

a) State four factors that affect the field splitting according to crystal field theory. (4marks)

b) Illustrate the octahedral field splitting of the d- orbitals according to the crystal field (CF) theory. (6marks)

c) Consider two complexes A and B. One is $\text{Ni}(\text{NH}_3)_2\text{Br}_2$; while the other is $\text{Pd}(\text{OH}_2)_2\text{Br}_2$ respectively. A is paramagnetic and B is diamagnetic.

i. What is the oxidation state of each of the metals? (2marks)

ii. How many d electrons does each metal have? (2marks)

iii. What is the coordination number of each complex? (2marks)

iv. What is the geometry of complex A? (1.5marks)