KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHEM 421**

COURSE TITLE: COMPARATIVE STUDY OF D AND F BLOCK ELEMENTS

STREAM: **SESSION VI & VIII**

DAY: **TUESDAY**

TIME: **9.00 – 11.00 A.M.**

DATE: **07/04/2009**

INSTRUCTIONS:
Answer ALL questions

PLEASE TURN OVER

1. (a) What is a lanthanide? [1mark]

(b) Give the electron configurations of the following elements;

(i) La (ii) Eu (iii) Yb (iv) Am

[Atomic numbers; La = 57, Eu = 63, Yb = 70, and Am = 95]

[4 marks]

(c) Predict the possible oxidation states of Eu giving reasons for your answer.

[2 marks]

(d) Account for the following observations;

(i) Atoms of the transition elements are smaller than those of the group 1 or 2 elements in the same horizontal period.

(ii) Elements in group IIB have lower melting points than other transition elements. [4 marks]

(e) The table below shows the variation of atomic radii and ionization energies of the first row transition elements.

Element	**Sc**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**
Atomic radius (pm)	**162**	**147**	**134**	**127**	**126**	**126**	**125**	**124**	**128**	**138**
First ionization Energy (kJ/mol)	**631**	**658**	**650**	**653**	**717**	**759**	**758**	**736**	**746**	**906**

Briefly comment on the trend in the variation of;

(i)Atomic radii

(ii) First ionization energies [6 marks]

2. (a) What is Lanthanide contraction? [2 marks]

(b) State and explain two consequences of lanthanide contraction [2 marks]

(c) Compare and contrast the chemistry of the d and f block elements

[Hint: Give four similarities and differences of the elements in the two blocks]

[8 marks]

(d) Distinguish between π acid and π donor ligands. [2 marks]

3. (a) Contrast the complexation chemistry of the lanthanides and the actinides;
[Hint: Give three differences] [3 marks]

(b) Write short notes on the following terms;
(i) spin pairing promotion energy (ii) Organometallic compounds
(iii) Interstitial compounds (iv) Back bonding (v) fluxional compound
[5 marks]

(c) Account for the following observations;
(i) Position of the absorption bands in lanthanides is independent of the ligands
(ii) +3 oxidation state is common among the lanthinides
(iii) Ce^{3+} show exceptionally strong absoptions in the Uv region
(iv) Transition metals readily form alloys
(v) Formation of metal-carbon double bonds is favoured in metal carbonyls
[10 marks]

4. (a) Using valence bond theory, describe the structure of CO as a;
(i) terminal ligand (ii) bridging ligand [5 marks]

(b) Discuss three methods that can be used to prepare metal carbonyls and give an example in each case [3 marks]

(c) List two physical properties of metal carbonyls [2 marks]

(d) $[Ni(CO)_4]$ is tetrahedral and diamagnetic:
(i) Describe the bonding in this complex using valence bond theory.
[Atomic number Ni =28] [4 marks]
(ii) Calculate the effective atomic number of Ni in the complex and comment briefly on your answer. [2 marks]

(e) Infra red absorption and X-ray studies have shown that the structure of $Fe_2(CO)_9$ consists of three bridging carbonyl groups, six terminal carbonyl groups and one single bond (δ) between the two atoms in a octahedral environment. Describe the bonding in this compound using valence bond theory and draw its structure.
[Atomic number: Fe =26] [5marks]