KABARAK UNIVERSITY

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 BLOCKS ELEMENTS

STREAM: Y4S2

DAY: TUESDAY

TIME: 9.00 – 11.00 A.M.

DATE: 11/08/2009

INSTRUCTIONS TO CANDIDATES:
Answer **ALL** questions

PLEASE TURN OVER

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

   (b) Write the electron configuration of the following atoms or ions

   (i) Ce (ii) Eu (iii) Gd (vi) Yb (v) Ac

   [Atomic numbers: Ce = 58, Eu = 63, Gd = 64, Yb = 70 and Ac = 89]

   [5 marks]

   (c) Briefly comment on your answer in (iii) and (iv) above [2 marks]

   (d) What is the possible oxidation state of Yb? Briefly explain your answer

   [2 marks]

   (e) Account for the following observations;

   (i) *d* and *f* block elements form complexes [2 marks]

   (ii) Hg is a metallic element but a liquid at room temperature [2marks]

   (f) The table below shows the variation of atomic radii and ionization energies of some group IIIB transition elements. Study it and answer the questions that follow;

Element	**Sc**	**Yb**	**La**
Atomic radii (pm)	**162**	**180**	**187**
First ionization energy (kJ/mol	**633**	**600**	**538**

   Briefly comment on the trend in variation of;

   (i) Atomic radii

   (ii) Ionization energy [4 marks]

2. (a) Explain why *d* block elements form co-ordination compounds easily compared to the *f* block elements. [2 marks]

   (b) Give ***four*** similarities and ***four*** differences between the lanthanides and actinides. [2 marks]

   (c) Briefly discuss the three bonding theories in transition metal compounds

   [3 marks

   (d) ***State*** and ***explain*** two uses of compounds of the f block elements. [2 marks]

   (e) Briefly explain what is meant by "Actinide contraction'' and explain its consequence. [3 marks]

3. (a) Describe the preparation, properties ,uses and the structure of nitrosonium pentaquo iron (I) sulphate. [7 marks]

(b) Account for the following observations;

(i) Lanthanide and actinide metal ions show sharp almost line like bands in their electronic spectra

(ii) Ce^{3+} shows exceptionally strong absorptions in the UV region

(iii) Transition metals readily form alloys with each other

(iv) Low valent transition metal ions readily form complexes with π-acid ligands

(iv) ν_{CO} in carbonyl complexes is different from that of CO molecule

(v) Lanthanides and actinides generally have high boiling points compared to the main block elements

(vi) Co-ordination number less than 7 is rare in complexes of d-block elements [12 marks]

4. (a) Using molecular orbital theory show that CO is π-acid ligand. [4 marks]

(b) Illustrating with an example each, give three methods of preparing a metal carbonyl [6 marks]

(c) (i) $Ni(CO)_4$ is tetrahedral and diamagnetic. 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]

(d) Infrared and x-ray studies of $Co_2(CO)_8$, shows that the compound does not have a bridging carbonyl and the metal ions are in an octahedral environment. Describe the bonding in the compound using valence bond theory.
[Atomic number; Co =27] [4 marks]

(e) Differentiate between organometallic compound and coordination compound [1 mark]