

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: SESSION VII & VIII

DAY: FRIDAY

TIME: 9.00 – 11.00 A.M.

DATE: 14/08/2009

INSTRUCTIONS TO CANDIDATES:

Answer **ALL** questions

PLEASE TURN OVER

1. (a) What is an actinide? [1 mark]
- (b) Write the electron configuration of the following atoms or ions:
 (i) Ce (ii) Eu (iii) Gd (vi) Yb
 [Atomic numbers: Ce = 58, Eu = 63, Gd = 64, and Yb = 70] [5 marks]
- (c) Briefly comment on your answer in (iii) and (iv) above [2 marks]
- (d) (i) What are the possible oxidation states of Eu? [1 mark]
 (ii) Defend your answer in d (i) above? [2 marks]
- (e) Account for the following observations;
 (i) *d* and *f* block elements form interstitial compounds [2 marks]
 (ii) Hg is a metallic but a liquid at room temperature [2 marks]
- (f) The table below shows the variation of atomic radii and ionization energies of the first row transition elements. Study it and answer the questions that follow;

Element	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Atomic radii (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 variation of;
 (i) Atomic radii
 (ii) Ionization energy [4 marks]
2. (a) Give *two* similarities and *two* differences between the *d* and the *f* block elements [4 marks]
- (b) Contrast the lanthanides and actinides
 [Hint: State and explain four differences between the elements in the two series] [4 marks]
- (c) Briefly discuss three methods used in separation of the *f*-block elements [3 marks]
- (d) State two uses of compounds of the *f* block elements [4 marks]
- (e) Briefly explain what is meant by “lanthanide contraction” [2 marks]

3. (a) Explain the following terms;
- (i) Back bonding
 - (ii) Effective atomic number rule
 - (iii) Spin pairing promotion energy
 - (iv) π acid ligand
 - (v) Organometallic compound
- [5.5 marks]

- (b) Account for the following observations;
- (i) Position of the absorption bands in electronic spectrum of lanthanides and actinides is independent of the ligands
 - (ii) Yb^{4+} shows exceptionally strong absorptions in the UV region
 - (iii) Transition metals readily form alloys with each other
 - (iv) High valent transition metal ions readily form complexes with π -donor ligands
 - (iv) Carbonyl ligand binds to the metal ion via carbon and not oxygen
 - (v) Lanthanides and actinides are metals
- [10 marks]

4. (a) Using valence bond theory, describe the structure of CO as a;
- (i) Terminal ligand (ii) bridging ligand
- [5 marks]
- (b) Briefly explain how the bonding mode of CO can be confirmed using infra red spectroscopy
- [1 mark]
- (c) Illustrating with an example each, give three methods of preparing a metal carbonyl
- [4.5 marks]
- (d) (i) $\text{V}(\text{CO})_6$ is tetrahedral and paramagnetic with one unpaired electron. Describe the bonding in this complex using valence bond theory
- [Atomic number $\text{V}=23$]
- [4 marks]
- (ii) Calculate the effective atomic number of vanadium in the complex [1 mark]
- (e) Infrared and x-ray studies of $\text{Mn}_2(\text{CO})_9$, show that the compound does not have a bridging carbonyl and the metal ions are in an octahedral environment. Describe the bonding in compound using valence bond theory.
- [Atomic number; $\text{Mn}=25$]
- [4 marks]