

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN

EDUCATION SCIENCE

COURSE CODE: CHEM 421

**COURSE TITLE: COMPARATIVE STUDY OF *d* AND *f*
BLOCKS ELEMENTS**

STREAM: SESSION VII, VIII & IX

DAY: MONDAY

TIME: 9.00 – 11.00 A.M.

DATE: 30/11/2009

INSTRUCTIONS:

Answer **ALL** questions

PLEASE TURN OVER

1. (a) Differentiate between a transition and an inner transition element?
[1 mark]
- (b) Give the electron configurations of the following atoms
(i) Cr(ii) Nb(iii) Eu (iv) Gd (vi) Yb
[Atomic numbers: Cr = 24, Nb = 41, Eu = 63, Gd = 64, and Yb = 70]
[5 marks]
- (c) Briefly comment on your answer in (ii) and (iv) of (b) above [2 marks]
- (d) What are the possible oxidation states of Eu?
Defend your answer. [3 marks]
- (e) Account for the following observations;
(i) Transition metals show variable oxidation states [2 marks]
(ii) Chromium is the hardest element among the first row transition elements [2 marks]
- (f) Study the table below showing the atomic radii and reduction potentials of group IIIB elements and answer the questions that follow;

Element	Sc	Yb	La
Atomic radii (pm)	162	180	187
Reduction potentials (volts) $M^{3+} + 3e^- \leftrightarrow M$	-2.1	-2.37	-2.52

Briefly comment on the trend in variation of;

- (i) Atomic radii
(ii) Reduction potentials [4 marks]
2. (a) Contrast the complexation chemistry of the *d* and *f* block elements
[3 marks]
- (b) Give *two* similarities and *two* differences between the lanthanides and actinides [2 marks]
- (c) Write short notes on the following subjects as used in inorganic chemistry;
(i) Crystal field stabilization energy

- (ii) Selection rules of electronic transitions
- (iii) Valence bond theory [6 marks]
- (d) Explain briefly what is meant by “Lanthanide contraction” and comment on its consequence. [3 marks]
3. (a) Describe three methods of preparing metal carbonyls. Give an example in each case. [4.5 marks]
- (b) State three physical properties of metal carbonyls [3 marks]
- (c) Explain using chemical equations three chemical properties of metal carbonyls [4.5 marks]
- (d) Account for the following observations;
- (i) Ni^{2+} compounds are thermodynamically more stable than Pt^{2+} compounds while Pt^{4+} compounds are relatively more stable than Ni^{4+} compounds
- (ii) Ce^{3+} shows exceptionally strong absorptions in the UV visible region.
- (iii) Transition metals readily form alloys with each other
- (iv) High valency transition metal ions readily form complexes with π -donor ligands. [8 marks]
4. (a) Using molecular orbital theory show that CO is a π -acid ligand. [3 marks]
- (b) Describe the bonding in bridging CO using valence bond theory. [3 marks]
- (c) (i) $\text{V}(\text{CO})_6$ is octahedral and paramagnetic. Describe the bonding in this complex using valence bond theory [Atomic number V=23] [4 marks]
- (ii) Calculate the effective atomic number of V in the complex and comment briefly on your answer [1 mark]

(d) Explain briefly how a bridging carbonyl ligand can be distinguished from a terminal one [2 marks]

(e) Infrared and x-ray studies of $\text{Mn}_2(\text{CO})_{10}$, show that the compound does not have a bridging carbonyl and the metal ions are in an octahedral environment. Describe the bonding using valence bond theory.

[Atomic number; Mn =25]

[4 marks]