

KABARAK



UNIVERSITY

SUPPLEMENTARY/SPECIAL EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHEM 424

**COURSE TITLE: COMPARATIVE STUDY OF D AND F BLOCKS
ELEMENTS**

STREAM: SESSION IV

DAY: TUESDAY

TIME: 2.00 – 4.00 P.M.

DATE: 17/03/2009

INSTRUCTIONS TO CANDIDATES:

Answer **ALL** questions

PLEASE TURN OVER

1. (a) Write the electron configuration of the following atoms or ions
 (i) Ti^{3+} (ii) Cr (iii) Cu^{2+} (iv) Gd (v) Yb
 [Atomic numbers: Ti =22, Cr =24, Cu =28, Ce = 58 and Yb = 70] [5 marks]
- (b) Briefly comment on your answer in (ii) and (iv) above [2 marks]
- (c) (i) What are the possible oxidation states of Yb? [1 mark]
 (ii) Defend your answer in c (i) above? [2 marks]
2. (a) Monazite sand is the most important and most widespread mineral that accounts for 78 % of the rare earths mined. Outline the process followed in the extraction of lanthanum from Monazite. [5 marks]
- (b) (i) State two uses of compounds the f block elements [2 marks]
 (ii) What properties of the f-block elements make the suitable for uses in b (i) above? [2 marks]
- (c) Briefly explain using chemical equation how $\text{Ce}(\text{CH}_3)_3$ can be prepared in the laboratory [3 marks]
3. (a) State and explain four similarities and four differences between the *d* and the *f* block elements [4 marks]
- (b) Compare and contrast the lanthanides and actinides
 [Hint: State and explain four differences and four similarities 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) (i) Briefly explain what is meant by “lanthanide contraction” [2 marks]

4. (a) The complex ion $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is paramagnetic with four unpaired electrons. Account for this observation using the following bond theories

(i) Valence bond (ii) Crystal field (iii) molecular orbital

[Atomic number; Fe = 26] [10 marks]

(b) State two advantages of crystal field theory over valence bond theory [2 marks]

(b) Account for the following observations;

(i) Actinide and lanthanide ions give rise to very sharp bands in electronic spectra [2 marks]

(ii) Square planar d^8 paramagnetic complexes are extremely rare [2 marks]

(iii) Co^{2+} is stable in aqueous solution, but in presence of a strong field ligand it is easily oxidized to form Co^{3+}

[Atomic number; Co=27] [2.5 marks]

(iv) High valent transition metal ion readily form complexes with π -donor ligands [2 marks]

5. (a) The following absorption bands are found in the spectrum of $[\text{V}(\text{H}_2\text{O})_6]^{2+}$ ion; 17,200 cm^{-1} , 25,600 cm^{-1} and 36000 cm^{-1} (charge transfer);

[Atomic number; V=23]

(i) Interpret the spectrum of $[\text{V}(\text{H}_2\text{O})_6]^{2+}$ using Tanabe-Sugano diagram

[3 marks]

(b) (i) Write short notes on selection rules in electronic transitions [4.5 marks]

(ii) Explain the mechanism under which **Laporte** rule is relaxed [2 marks]