

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
BLOCKS ELEMENTS**

STREAM: Y4S2

DAY: MONDAY

TIME: 11.00 -1.00 P.M.

DATE: 08/12/2008

INSTRUCTIONS:

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) Eu (v) Yb
 [Atomic numbers: Ti = 22, Cr = 24, Cu = 29, Eu = 63 and Yb = 70] [5 mks]
- (b) Briefly comment on your answer in (iv) and (v) above [2 mks]
- (c) (i) What are the possible oxidation states of Yb? [2 mks]
 (ii) Defend your answer in c (i) above. [2 mks]
- (d) Write short notes on the following terms;
 (i) Jahn-Teller distortion (ii) nephelauxetic effect. [6 mks]
2. (a) Monazite sand is the most important and the most wide spread mineral that accounts for 78 % of the rare earths mined. Outline the process followed in the extraction of lanthanum from Monazite. [5 mks]
- (b) State two uses of the f block elements and their compounds. [2 mks]
- (c) Briefly explain using chemical equation how $Ce(CH_3)_3$ can be prepared in the laboratory. [2 mks]
- (d) The following absorption bands are found in the spectrum of $[V(H_2O)_6]^{3+}$ ion; $17,200\text{ cm}^{-1}$, $25,600\text{ cm}^{-1}$ and 36000 cm^{-1} (charge transfer). Interpret the spectrum of $[V(H_2O)_6]^{3+}$ using Tanabe-Sugano diagram.
 [Atomic number; V = 23] [3 mks]
- (e) Explain the mechanism under which **Laporte** rule is relaxed. [2 mks]
3. (a) State and explain **two** similarities and **two** differences between *d* and the *f* block elements. [4 mks]
- (b) Compare and contrast the lanthanides and actinides.
 [Hint: State and explain two differences and two similarities between the elements in the two series].
- (c) Briefly discuss three methods used in separation of the *f* block elements. [6 mks]
- (d) Account for the following observations;
 (i) 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] [3 mks]

- (ii) High valent transition metal ion readily forms complexes with π -donor ligands. [2.5 mks]
4. (a) The complex $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is paramagnetic with four unpaired electrons. Account for the bonding in this complex using the following bond theory; [Atomic number; Fe = 26]
- (i) Valence bond theory (ii) Crystal field theory
- (iii) Molecular orbital theory. [10.5 mks]
- (b) State **two** advantages and **two** disadvantages of crystal field theory over molecular orbital theory. [4 mks]
- (c) Account for the following observations;
- (i) Lanthanides are used to calibrate electronic spectrometers. [2.5 mks]
- (ii) Strength hydroxides of lanthanides decrease across the period. [2.5 mks]