

**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 THE *d* AND *f*-  
BLOCK ELEMENTS**

**STREAM: Y4S2**

**DAY: THURSDAY**

**TIME: 2.00 – 4.00 P.M.**

**DATE: 18/03/2010**

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**INSTRUCTIONS:**

- *Attempt all questions*

**PLEASE TURN OVER**

### QUESTION ONE (20MARKS)

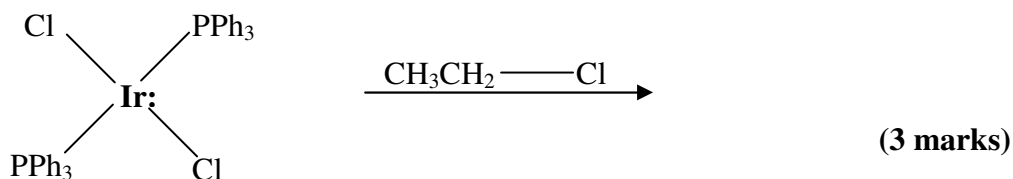
- (a) Discuss two general properties of d-block elements? **(2 marks)**
- (b) Give three differences between d-block and f- block elements. **(6 marks)**
- (c) Explain the following observations.
- (i) The size of lanthanides decreases across the period. **(2 marks)**
  - (ii) The ionic radius of  $\text{Fe}^{3+}$  is 0.64Å while that of  $\text{Fe}^{2+}$  is 0.76Å **(2 marks)**
  - (iii) Transition metals have very high boiling and melting points. **(2 marks)**
  - (iv) d-block elements have a marked ability to form alloy compounds. **(2 marks)**
  - (v) d-block elements have a marked ability to form interstitial compounds. **(2 marks)**
  - (vi) The covalent character of the  $\text{M}^{3+}$  ions of the lanthanides increases across the period. **(2 marks)**

### QUESTION TWO (20MARKS)

- (a) Explain what is meant by transition element? **(2 marks)**
- (b) State two properties of the d-block elements that make them have a marked ability to form complex compounds. **(2 marks)**
- (c) In the oxysalts of transition elements like  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , there are no unpaired electrons at the central atom but they are deep in colour. Explain the origin of this colour. **(2 marks)**
- (d) When a concentrated solution of  $\text{NH}_3$  is added to a solution containing  $\text{Zn}(\text{NO}_3)_2$ , a colorless solution containing the complex ion  $\text{Zn}(\text{NH}_3)_4^{2+}$  results. Explain why this solution is colorless? **(4 marks)**
- (e) Account for the following observations using valence bond theory:  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  is paramagnetic while  $[\text{Co}(\text{NH}_3)_6]^{3+}$  diamagnetic [Atomic numbers; Co =27, and Cu =29]. **(6 marks)**
- (f) Define and give an explanation for Lanthanide contraction. **(4 marks)**

### QUESTION THREE (15MARKS)

- (a) What are metal carbonyls? **(2 marks)**
- (b) Show the hybridization in the formation of  $\text{Ni}(\text{CO})_4$  molecule. **(4 marks)**
- (c) Show the mechanism involved in the following reaction.



- (d) Give the structures of the following complexes.

- (i)  $\eta^5\text{-CpRh}(\eta^2\text{-C}_2\text{H}_4)(\text{P}(\text{CH}_3)_3)$  **(4 marks)**
- (ii)  $[\text{Ni}(\text{dppe})_2]$  **(2 marks)**

### QUESTION FOUR (15 MARKS)

- (a) Give two equations for the formation of organometallic compounds. **(3 marks)**
- (b) What would be the effect on vibrational frequency and bond length of a  $\text{C}=\text{C}$  when it bonds to a metal centre? **(4 marks)**
- (c) With reference to the 18-electron rule, comment on the stability of the following complexes:
- (i)  $\text{Ni}(\text{CO})_4$ ,
- (ii)  $\text{Fe}(\text{CO})_5$
- (iii)  $\text{Mn}(\text{CO})_5$
- (iv)  $\text{Mn}_2(\text{CO})_{10}$  **(8 marks)**