# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS
## 2021/2022 ACADEMIC YEAR

### FOURTH YEAR FIRST SEMESTER
### MAIN EXAMINATIONS

**FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE**

**COURSE CODE: SCH 418**

**COURSE TITLE: COMPARATIVE STUDY OF D BLOCK ELEMENTS**

**DURATION: 2 HOURS**

**DATE:** 19/05/2022 **TIME: 2:00PM-4:00PM**

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**INSTRUCTIONS TO CANDIDATES**

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

## QUESTION ONE [30 MARKS]

a) Write the electronic configurations of the elements with the atomic numbers 21, 29, 89 and 47. **[4mks]**

b) Predict which of the following will be coloured in aqueous solution; **[3mks]**

$Ti^{3+}$, $V^{3+}$, $Cu^{+}$, $Sc^{3+}$, $Mn^{2+}$, $Fe^{3+}$, $Co^{2+}$.

c) Compare and explain *the ionisation enthalpies* and *atomic sizes* of the first series of the transition metals with those of the second and third series metals in the respective vertical columns. **[4mks]**

d) i. Determine the oxidation state of the metal and the total valence electron count of $[V(CO)_7]^+$ **[3mks]**

ii. State three Limitations of 18 Electron Rule. **[3mks]**

e) i. Calculate the 'spin only' magnetic moment of $M^{2+}_{(aq)}$ ion (Z = 27). **[3mks]**

ii. Describe the trends in the Magnetic behaviour of dipositive gaseous ions ($M^{2+}$) of the first series of the transition elements **[3mks]**

f) i. Giving examples, distinguish between alloys and Interstitial compounds **[4mks]**

ii. State three properties of Interstitial compounds **[3mks]**

## QUESTION TWO [20 MARKS]

a) Why do most transition elements act as good catalysts? **[4mks]**

b) The Monsanto process is used for industrial production of acetic acid using a rhodium carbonyl iodide, $[RhI_2(CO)_2]^-$ , catalyst.

i. Write a balanced equation for the overall reaction **[1mk]**

ii. Draw the catalytic cycle for the process **[10mks]**

iii. Name the elementary steps of the reaction **[3mks]**

iv. State the Limitations/Drawbacks of the Monsanto process **[2mks]**

## QUESTION THREE [20 MARKS]

a) Distinguish between the following

i. Complex compounds and Organometallic compounds **[2mks]**

ii. Monodentate ligands and bidentate ligands **[2mks]**

b) Determine the oxidation state of the Central metal ion for each of the complexes. **[6mks]**

i. $[Fe(CO)2(CN)4]^{2-}$

ii. $[Ir(PPh_3)2\ (CO)Cl]$

iii. $[Pt(H_2NCH_2CH_2NH_2)_2Cl_2]Cl_2$

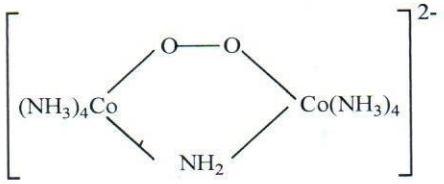
c) Give the IUPAC names of the following coordination complexes **[4mks]**

i. $[Co(NH_3)_5CO_3]Cl$

ii. $[Cr(H_2O)_4Cl_2]Cl$

iii. $[Mn(CO)_5Cl]^+$

iv.




**d)** List THREE factors which affect the stability of coordination complexes **[3mks]**

e) State three applications of 18 electron rule in coordination compounds. **[3mks]**

## QUESTION FOUR [20 MARKS]

a) Account for the following; **[10mks]**

(i) Transition metals and many of their compounds show paramagnetic behavior.

(ii) The enthalpies of atomisation of the transition metals are high.

(iii) $Ti(H_2O)_6]^{3+}$ is coloured whereas $[Sc(H_2O)_6]^{3+}$ is colourless, though it is a transition metal complex.

(iv) The $E^o$ $(M^{2+}/M)$ value for copper is positive (0.34v).

(v) There is irregular variation of ionisation enthalpies in the first series of the transition elements.

b) The IUPAC name of Wilkinson catalyst is chlorotris(triphenylphosphine)rhodium(I)

i. Give two physical properties of Wilkinson Catalyst **[2mks]**

ii. Describe the steps involved in the Wilkinson catalytic hydrogenation reaction mechanism of the unsaturated organic compound. **[8mks]**

## QUESTION FIVE [20 MARKS]

a) Cyclic, conjugated systems make good ligands for transition metals. In each of the following cases,

a)


b)

c) 


d) 


i. describe the hapticity of each. **[4mks]**

ii. indicate the number of electrons donated to the metal. **[4mks]**

iii. indicate the charge on the ligand. **[4mks]**

b) By stating the chief ore, method of extraction and uses, discuss the extraction chromium metal **[8mks]**