TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY:

BTAC/SEP2014/J-FT Y2S2; BTAC/SEP 2015/S-PT Y2S2

ACH4209: COMPARATIVE STUDY OF DTRANSITION ELEMENTS

Paper 2

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

a) Compounds $[Co(NH_3)_5Br]^{2+}$ SO_4^{2-} and $[Co(NH_3)_5SO_4]^{+}$ Br^{-} are isomers.

i) Determine the coordination number and oxidation state of Co, respectively.

ii) State the type of Isomerism exhibited by the compounds. (3 marks)

(b) i) Name TWO important minerals of titanium from which the element can be extracted. (2 marks)

ii) Draw the chemical structures of the following ion and molecule.

I. $[Fe(H_2O)_6]^{2+}$ II. $ReCl_3$ (4 marks)

(c) i) State the general variation trend of atomic/ionic radii across the first transition series of the Periodic Table. (2 marks)

ii) Explain why Eu exhibit only +2 and +3 oxidation state but Uranium (U) forms compounds in which the metal exhibit +3 to +6 oxidation states. (2 marks)

(d) i) Write down electronic configuration of:
I) Sc^{3+} ($_{21}Sc$) II) Lu^{2+} ($_{73}Lu$) (2 marks)

ii) $[Ti(H_2O)_6]^{3+}$ has max absorption at 498 nm ,calculate the Crystal field splitting energy (CFSE) in kJ/mol?
[1nm = 10^{-9}m h = 6.626 x 10^{-34} js c = 3 x 10^{8} ms^{-1}].
(3 marks)

(e) Give reasons why transition metals and their many compounds act as good catalysts. (3 marks)

(f) i) A solution of $Na_2Cr_2O_7$ turns from orange to yellow on addition of an alkali to it. Write a balanced net ionic equation for the reaction that takes place.

(3 marks)

ii) A test tube containing the equilibrium system shown below was placed in a beaker of ice and the color of the solution changed from blue to pink.

$$[Co(H_2O)_6]^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons [CoCl_4]^{2-}(aq) + 6H_2O$$

On heating, the solution turned blue. Using these observations, state whether the forward reaction is exothermic or endothermic. Explain your answer. (3 marks)

Question TWO

(a) In contrast to the representative elements, transition elements form many coordination complexes. Give reasons to account for this tendency.
(5 marks)

(b) Giving examples, suggest reasons why a transition metal exhibits highest oxidation state in oxides and fluorides. (5 marks)

(c) Use reaction equations to describe the major steps involved in the preparation of potassium dichromate from iron chromite ore. (10 marks)

Question THREE

(a) i) Explain what is meant by the term alloys. Give an example. (3 marks)

ii) Name an important alloy which contains some of the lanthanoid metals and give any TWO of its uses. (3 marks)

(b) In aqueous solutions most transition metal ions are exist as hydrated complexes with water molecules however, $[Cr(H_2O)_6]^{6+}$ and $[Mn(H_2O)_6]^{7+}$ do not. Explain. (4 marks)

(c) Use reaction equations to show the major steps in preparation of $KMnO_4$ from pyrolusite ore.
(10 marks)

Question FOUR

a) Draw the structure of each of the following ions and molecules:-
i) The complexes, $[Pt(NH_3)_2Cl_2]$
ii) The complexes, $[Pt(Cl)_6]^{2-}$
iii) The complexes, $[MnCl_4]^{2-}$
iv) The anionic species in KVO_3
v) CrF_5 (15marks)

(b) List any THREE properties of Interstitial compounds. (3 marks)

(c) Give reason(s) why TiO_2 has replaced lead oxide in paints industry. (2 marks)

Question FIVE

(a) i) Determine the oxidation state of Mn in MnO_4^{2-}. (1 marks)

ii) A solution of ammonia was slowly added to an aqueous solution containing copper (II) ions until the ammonia was in excess. Initially a pale blue precipitate formed, followed by the formation of a deep blue solution.

I. Identify the pale blue precipitate and write an equation for its formation. (3 marks)

II. Write the formula of the complex ion in the deep blue solution. (2 marks)

III. Name the geometries of the following THREE complexes (i) $[AlCl_4]^-$ (ii) $[Ag(NH_3)_2]^+$, and (iii) HgI_3^- (3 marks)

(b) Explain why transition metals and many of their compounds show paramagnetic behaviour . (3 marks)

(c) Describe the Sulphate Process for the manufacture of TiO_2. (8 marks)

END