



UNIVERSITY OF EMBU

2017/2018 ACADEMIC YEAR

SECOND SEMESTER EXAMINATIONS

FOURTH YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF
EDUCATION, BACHELOR OF SCIENCE, BACHELOR OF SCIENCE IN
ANALYTICAL CHEMISTRY AND BACHELOR OF SCIENCE IN INDUSTRIAL
CHEMISTRY

SCH 401 CHEMISTRY OF TRANSITION ELEMENTS FIRST DRAFT

DATE: APRIL 6, 2018

TIME: 8:30-10:30AM

INSTRUCTIONS:

Answer Question ONE and any other TWO

QUESTION ONE (30 MARKS)

- a) Using the electronic configurations explain why ^{47}Ag and ^{79}Au are classified as transition metals. (3 marks)
- b) Suggest with reasons the electronic configurations of ^{24}Cr and ^{29}Cu . (3 marks)
- c) Explain why Cr^{2+} is a powerful reducing agent while Mn^{2+} is not. (3 marks)
- d) Low oxidation states in transition metals are unstable. Explain how they can be stabilized. (3 marks)
- e) VCl_2 is ionic while VCl_5 is covalent. Account for this observation. (3 marks)
- f) Explain why transition metals form good catalysts. (2 marks)
- g) Transition metals form most numbers of co-ordination complexes. Suggest

reasons for this. (2 marks)

h) The transition elements in second and third series have similar atomic and ionic radii. Explain why this is the case. (3 marks)

i) Explain why the transition metal complex containing metal ion in higher oxidation state complex is more stable than the one in the lower oxidation state. (3 marks)

j) State and explain the general variation trend in the density down the group of transition metals in the periodic table. (3 marks)

k) Explain why blast furnace is not a good method for the extraction of Ruthenium and Osmium. (2marks)

QUESTION TWO (20 MARKS)

a) Briefly describe the processes involved in the metallurgy of transition elements. (12 marks)

b) Explain why Sc, Y and La may not be classified as transition metal elements and why it is not possible to obtain anhydrous salts of these three elements from aqueous solutions. (4 marks)

c) Explain why CrO_4^{2-} is a strong oxidizing agent while MoO_4^{2-} is not yet Cr and Mo are both in group 6 of the periodic table. (4 marks)

QUESTION THREE (20 MARKS)

a) One of the main uses of Titanium is the production of Ziegler –Natta catalyst. Explain how it is used in the polymerization of ethene draw the possible structure of the polymer. (8 marks)

b) Account for the following observation in the properties of transition metal elements.

i) The highest oxidation state for the early transition metal elements, Sc, Ti, V, Cr, and Mn is the group number. On the other hand the highest

oxidation state for the later elements of the same period (Fe, Co, Ni and Cu) is less than the group number. (3 marks)

ii) The physical and chemical properties of Zr are similar to those of Hf but differ slightly to those of Ti. (4 marks)

c) Explain why vanadium forms the pentafluoride VF_5 , and yet, no similar compound is known for Nickel. (5 marks)

QUESTION FOUR (20 MARKS)

a) Discuss the rusting of iron as an electrochemical reaction, as a chemical reaction and its prevention. (10 marks)

b) Explain why transition metals form coloured compounds. (4 marks)

c) Outline the method for the extraction of manganese from any of the ore of your choice and give all the equations of the reactions involved. (6 marks)

QUESTION FIVE (20 MARKS)

a) Describe the sulphate process for the manufacture of the pigment grade TiO_2 . Explain why TiO_2 has replaced the white lead as a pigment base. (10 marks)

b) Whereas both aluminum and chromium form stable compounds with chlorine namely AlCl_3 and CrCl_3 only chromium forms a stable compound with carbon monoxide namely chromium hexacarbonyl $\text{Cr}(\text{CO})_6$. (4 marks).

c) Iron is one of the most abundance and useful transition elements. Briefly discuss why it is important in human body. (6 marks).

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