



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF EDUCATION (SCIENCE)

SCH 400: TRANSITION METALS CHEMISTRY

DATE: 14/12/2017

TIME: 11.00-1.00 PM

INSTRUCTIONS:

Answer Question One [Compulsory] And Any Other Two Questions.

QUESTION ONE (30 MARKS)

- a) List the five stages involved in extractive metallurgy (2.5 marks)
- b) List the uses of group 3 transition elements (1.5 marks)
- c) Using your knowledge of transition elements explain why Sc Y and La are not classified as typical transition elements. (2 marks)
- d) Why is it not possible to obtain anhydrous halides of group three elements from aqueous solutions? (2 marks)
- e) Give a possible explanation why the tetrahalides of titanium show a gradation in colour and other physical properties as follows TiF_4 (white solid, MP = 284°C), TiCl_4 (clear liquid, MP = -36°C), TiBr_4 (orange brown solid, MP = 38°C) and TiI_4 (dark brown solid, MP = 155°C). (2 marks)
- f) Describe ONE method used to prepare V_2O_5 (2 marks)
- g) There are no VX_5 (X = Cl, Br, I) for V but it only forms VF_5 . 3 Marks
- h) Given a supply of potassium dichromate and any other reagent you may require, how would you prepare crystals of Cr_2O_3 (2 marks)
- i) Show that the dichromate and chromate equilibrium is pH dependent. (2 marks)
- j) State the main ores of manganese and describe one extraction method (3 marks)
- k) State one application of each of the following; CoCl_2 , CoO and metallic Co. (3 marks)

- l) Draw the chain structure of α -PdCl₂ (2 marks)
- m) When KCN solution is added to a silver(I) salt, a white precipitate of the AgCN is produced. The solid has a chain structure. Write down the equation for this reaction (2 marks)

QUESTION TWO (20 MARKS)

- a) Give reasons for the following (8 marks)
- Most of the compounds formed by transition elements are coloured.
 - Zn and Cd are normally not considered as transition elements
 - K₂[PtCl₆] is a well-known compound whereas the corresponding nickel compound is not known.
 - The atomic radii of the 2nd and 3rd transition series elements are almost equal.
- b) Briefly describe the following processes involved in the metallurgy of transition elements
- Pyrometallurgy
 - Hydrometallurgy
 - Electrometallurgy (12 marks)

QUESTION THREE (20 MARKS)

- a) Discuss the applications of Cr and Cr compounds (10 marks)
- b) Describe preparatory routes of molybdenum chlorides and chloro complexes (10 marks)

QUESTION FOUR (20 MARKS)

- a) Discuss d-block elements with reference to the following: (8 marks)
- Electronic configuration
 - Magnetic properties
 - Complex compound formation
 - Catalytic properties
- b) Briefly describe the mechanism involved in the polymerization of an alkene over the Ziegler-Natta catalyst TiCl₄/AlEt₃. Would you expect a regular or an irregular polymer? Explain your answer. (Describe only the main stages involved). (12 marks)

QUESTION FIVE (20 MARKS)

- a) Outline the key steps used in the Kroll process through which Zirconium is produced commercially (6 marks)
- b) Discuss the complexes of Fe²⁺ in the context of their usefulness in qualitative analysis (8 marks)
- c) Discuss rusting of iron as an electrochemical reaction and prevention methods (8 marks)