

UNIVERSITY OF FORT HARE

PAC 121

DEGREE EXAMINATION

NOVEMBER 2018

Time: 3 HOURS

Subject: Descriptive Chemistry

Marks: 100

This paper consists of 5 pages including cover page

Internal Examiner

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External Examiner

Instructions: There are two sections in this examination, section A and B

Answer 4 questions, two questions from each section

SECTION A

Question 1

- a) What is meant by nuclear shielding? [4]
- b) What effect does nuclear shielding have on trends in atomic radii? [4]
- c) State and explain briefly the trend in electronegativity across Period 3 from sodium to chlorine [6]
- d) i) what are the two allotropes of Phosphorus? [1]
ii) What type of crystal structure would you expect for the two allotropes? [1]
iii) Which of the two allotropes will have higher melting point? [1]
- e) Andile Jali a young undergraduate student of chemistry is asked to carry out flame test on the following elements: lithium, sodium, potassium, rubidium, magnesium, calcium, strontium and beryllium.
- i) Briefly explain to Andile the principle of a flame test. [2]
- ii) What colour should Andile expect for each of the elements? [4]
- iii) Which elements does not colour a flame and why? [2]

[25 marks]

Question 2

- a) i) Write the name and symbol of the element with the highest melting point temperature in period 3 of the periodic table. [2]
ii) What is the melting point temperature of this element? [2]
iii) Explain why this element has the highest melting point temperature [4]
iv) State 2 industrial uses of this element [2]
v) Write the full electronic configuration of this element [1]
- b) i) What is an Oxo-acid? [2]
- ii) List any 3 Oxo-acids that formed from three elements in Period 3 [3]
- iii) When you add one of the oxo-acid listed above to sucrose
- a) What is the resultant product? [2]
b) Name this oxo- acid [1]
c) What is the nature of this oxoacid? Support your answer with a balanced chemical equation.[2]

- c)) Discuss the reaction of halogens in water,(Support your answers with balanced chemical equations) [4]

[25 marks]

Question 3

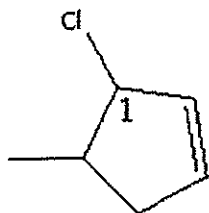
- a) i) What is ionization energy of an atom? [1]
ii) Briefly discuss the ionization energy of group 1 elements? [2]
iii) Outline the factors that affect the size of ionization energy [2½]
- b) i) What is the relationship between Lithium and Magnesium? [1]
ii) Give reasons for this relationship [3]
iii) Which other elements have such relationship? [2]
- c) When an element A in Period 3 react with limited and excess amount of oxygen it gives compounds B and C respectively.
- i) What is A,B and C (give their names and formula) [5]
ii) Write a single balance equation to show this reaction. [2½]
iii) Show by calculation the oxidation numbers of A in B and C. [4]
iv) From the calculation above what is the group number of A in the periodic table? [1]
v) Write the full electronic configuration of A. [1]

[25 marks]

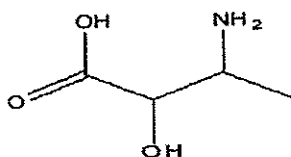
SECTION B

QUESTION 1 (25 marks)

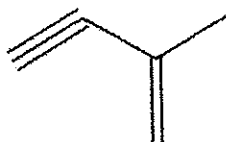
1.1 Identify the hybridization state of the **carbon atom** labelled 1 in the structure below and using the IUPAC rules, name the compound below.



1.2 List functional groups present in the following molecule?



1.3 How many **sigma** and **pi** bonds are there in the following compound?



1.4 **Draw** the structural formulae for each of the following substances and state whether each is a primary, secondary or tertiary alcohol:

(a) Butan-2-ol

(b) 2-Methylbutan-2-ol

(c) Cyclohexanol

(6)

1.5 Using the IUPAC rules, name the molecule below:



(2)

1.6 Explain why compounds of d-block elements are often colored. (3)

1.7 Which property of the transition metals makes their compounds particularly useful as catalysts? (2)

1.8 Write the electronic configuration for V and V²⁺ (5)

Question 2 (25 marks)

2.1 Name **TWO** metal catalyst used for the hydrogenation of an alkene (2)

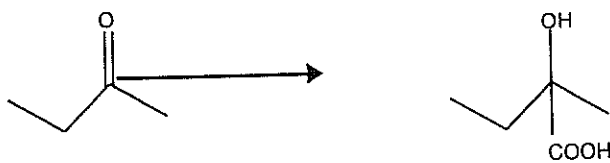
2.2 Draw and Name the **TWO** major products that will result from the ozonolysis of the alkene compound below:



(8)

2.3 Draw the **LINE** structure for the compound 3-Methyl-2-buten-1-ol. (3)

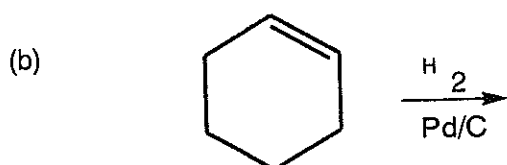
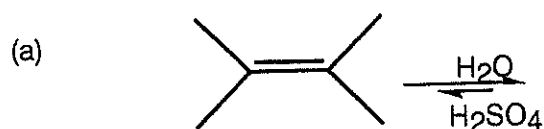
2.4 What reagents do you require for the following conversion?



(2)

2.5 Explain why Fe^{2+} ion to be less stable than the Fe^{3+} ion. (3)

2.6 Complete the following reactions by filling in the missing products. Draw only the major products. (4)



2.7 Give three changes which can result in a change of color during the reaction of transition metal ion. (3)

Question 3 (25 marks)

3.1 Draw the structure of 2,3-dinitrophenol (3)

3.2 Predict the **TWO starting materials** (REACTANTS) for production of ethyl ethanoate (4)

3.3 Draw the line structure for hexanamide (2)

3.4 Draw the structure(s) for the following compounds: (6)

(a) 5-methyl-4-hexenoic acid

(b) 2,2-dichlorocyclohexanone.

3.5 Define the term "hybridization", and show how the sp^3 and sp^2 hybridization is formed. (4)

3.6 List three chemical characteristics of the transition elements. (3)

3.7 Draw the electronic configuration of Cr and Cr^{2+} ion. (3)

THE END!

