# UNIVERSITY OF FORT HARE

PAC 121

## SUPPLEMENTARY EXAMINATION

## JANUARY 2019

.....

**Time:** 3 HOURS

**Subject:** Descriptive Chemistry

**Marks:** 100

**This paper consists of 5 pages including cover page**


**Internal Examiner**

**Prof O Oyedeji**

**Dr. Z. Tywabi-Ngeva**

**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) Define the term electronegativity [2]

b) Explain electronegativity trend across Period 3 from Sodium to Chlorine. [6]

c) Explain why there is a different bond formation type as you move from Sodium to Sulphur. [10]

d) i) What are the two allotropes of Phosphorus? [3]
ii) What type of crystal structure would you expect for the two allotropes? [3]
iii) Which of the two allotropes will have higher melting point? [1]

**[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? [1]
iii) Explain why this element has the highest melting point temperature [3]
iv) State 2 industrial uses of this element [3]
v) Write the full electronic configuration of this element [1]

b) Discuss the reactions of Halogens with water [Support your answer with balance chemical equations] [4]

c) Calculate the oxidation number (ON) of the elements you studied in PAC 121 in the compounds below, state their formula [7]

i) Sodium oxide
ii) Magnesium oxide
iii) Aluminium oxide
iv) Silicon oxide
v) Phosphorus pentoxide
vi) Sulphur trioxide
vii) Dichlorine hepta oxide

e) Explain the trend in sulphate solubility in water of s-block element (Group I and II) [4]

**[25 marks]**

**Question 3**

a) i) What is ionization energy of an atom? [3]

ii) Briefly discuss the ionization energy of group 1 elements? [4]

b) Which two of the following elements would you expect to be most similar? State your reasons.
Lithium, Aluminium, Iodine, Oxygen and Potassium [4]

c) Vuyo has three salt samples labelled A, B and C (which are supposedly chlorine, Iodine and Bromine salts). Briefly explain in a table form the test (chemicals to be used), the observation, inference and confirmatory test to distinguish the salt samples. [9]

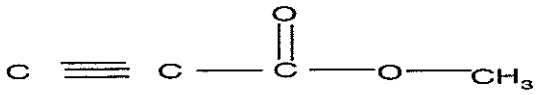
d) Arrange the following halides in order of increasing solubility; $MgI_2$, $MgCl_2$, $MgBr_2$, $MgF_2$ and give one reason to support your arrangement [5]

**[25 marks]**

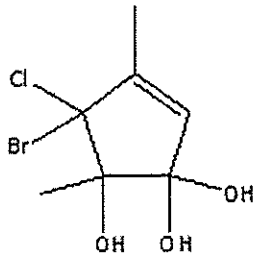
## SECTION B

**QUESTION 1 (25 marks)**

1.1 How many sigma and pi bonds are there in the following compound? (2)



1.2 Using the IUPAC system, Name the compound below:




(4)

1.3 Draw the structure of a tertiary 3° alcohols. (2)

1.4 **Draw** and **Name** the two constitutional isomers of $C_2H_6O$. (6)

1.5 Draw structures corresponding to the following names:

a) Butyl pentanoate (3)
b) 3,3,6-trimethyl-5-heptenoic acid (3)

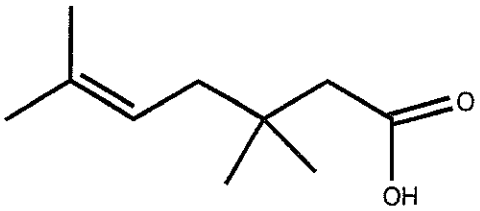
1.7 State three common characteristics of transition metals (3)

1.8 Give the common oxidation states for manganese and chromium. (2)

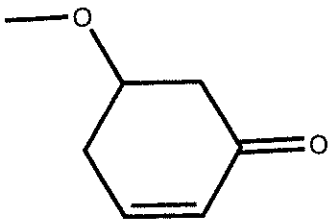
**Question 2 (25 marks)**

2.1 Name the following molecules (6)

a)




b)




2.2 Draw Newman projections for the **staggered** and **eclipsed** conformers of: 1,2- dibromoethane on ration about **C1** and **C2** bond. (6)

2.3 Explain the term addition reaction (2)

2.5 Explain what is meant by the term "stereoisomerism. (2)

2.6 Draw the structural formula for 2,2-dimethyl-pentanoic acid. (4)

2.7 Explain why Sc and Zn are not classified as transition metals. (2)

2.8 Give the electronic configuration of the $Co^{2+}$. (3)

**Question 3 (25 marks)**

3.1 Predict a reaction where Bromine reacts with but-2-ene in an addition reaction. Draw the structure of the product formed and name the product formed. (6)

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

3.3 Draw the line structure (*Z*)-3-methylhept-3-ene (3)

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

3.5 Explain how the colour of solutions containing transition metals can be used to determine their concentration.
( (2)

3.6 Give the electronic configuration of the following atoms:

a) V
b) $Cr^{3+}$
d) $Cu^{+}$

(6)

**THE END!**

# IUPAC Periodic Table of the Elements

| 1 | | | | | | | | | | | | | | | | | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H hydrogen [1.007; 1.009] | 2 | | Key: atomic number / Symbol / name / standard atomic weight | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 2 He helium 4.003 |
| 3 Li lithium [6.938; 6.997] | 4 Be beryllium 9.012 | | | | | | | | | | | 5 B boron [10.80; 10.83] | 6 C carbon [12.00; 12.02] | 7 N nitrogen [14.00; 14.01] | 8 O oxygen [15.99; 16.00] | 9 F fluorine 19.00 | 10 Ne neon 20.18 |
| 11 Na sodium 22.99 | 12 Mg magnesium 24.31 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 Al aluminium 26.98 | 14 Si silicon [28.08; 28.09] | 15 P phosphorus 30.97 | 16 S sulfur [32.05; 32.08] | 17 Cl chlorine [35.44; 35.46] | 18 Ar argon 39.95 |
| 19 K potassium 39.10 | 20 Ca calcium 40.08 | 21 Sc scandium 44.96 | 22 Ti titanium 47.87 | 23 V vanadium 50.94 | 24 Cr chromium 52.00 | 25 Mn manganese 54.94 | 26 Fe iron 55.85 | 27 Co cobalt 58.93 | 28 Ni nickel 58.69 | 29 Cu copper 63.55 | 30 Zn zinc 65.38(2) | 31 Ga gallium 69.72 | 32 Ge germanium 72.63 | 33 As arsenic 74.92 | 34 Se selenium 78.96(3) | 35 Br bromine 79.90 | 36 Kr krypton 83.80 |
| 37 Rb rubidium 85.47 | 38 Sr strontium 87.62 | 39 Y yttrium 88.91 | 40 Zr zirconium 91.22 | 41 Nb niobium 92.91 | 42 Mo molybdenum 95.96(2) | 43 Tc technetium | 44 Ru ruthenium 101.1 | 45 Rh rhodium 102.9 | 46 Pd palladium 106.4 | 47 Ag silver 107.9 | 48 Cd cadmium 112.4 | 49 In indium 114.8 | 50 Sn tin 118.7 | 51 Sb antimony 121.8 | 52 Te tellurium 127.6 | 53 I iodine 126.9 | 54 Xe xenon 131.3 |
| 55 Cs caesium 132.9 | 56 Ba barium 137.3 | 57–71 lanthanoids | 72 Hf hafnium 178.5 | 73 Ta tantalum 180.9 | 74 W tungsten 183.8 | 75 Re rhenium 186.2 | 76 Os osmium 190.2 | 77 Ir iridium 192.2 | 78 Pt platinum 195.1 | 79 Au gold 197.0 | 80 Hg mercury 200.6 | 81 Tl thallium [204.3; 204.4] | 82 Pb lead 207.2 | 83 Bi bismuth 209.0 | 84 Po polonium | 85 At astatine | 86 Rn radon |
| 87 Fr francium | 88 Ra radium | 89–103 actinoids | 104 Rf rutherfordium | 105 Db dubnium | 106 Sg seaborgium | 107 Bh bohrium | 108 Hs hassium | 109 Mt meitnerium | 110 Ds darmstadtium | 111 Rg roentgenium | 112 Cn copernicium | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 La lanthanum 138.9 | 58 Ce cerium 140.1 | 59 Pr praseodymium 140.9 | 60 Nd neodymium 144.2 | 61 Pm promethium | 62 Sm samarium 150.4 | 63 Eu europium 152.0 | 64 Gd gadolinium 157.3 | 65 Tb terbium 158.9 | 66 Dy dysprosium 162.5 | 67 Ho holmium 164.9 | 68 Er erbium 167.3 | 69 Tm thulium 168.9 | 70 Yb ytterbium 173.0 | 71 Lu lutetium 175.0 |
| 89 Ac actinium | 90 Th thorium 232.0 | 91 Pa protactinium 231.0 | 92 U uranium 238.0 | 93 Np neptunium | 94 Pu plutonium | 95 Am americium | 96 Cm curium | 97 Bk berkelium | 98 Cf californium | 99 Es einsteinium | 100 Fm fermium | 101 Md mendelevium | 102 No nobelium | 103 Lr lawrencium |

**Notes**

- IUPAC 2009 Standard atomic weights abridged to four significant digits (Table 4 published in *Pure Appl. Chem.* 83, 359-396 (2011); doi:10.1351/PAC-REP-10-09-14). The uncertainty in the last digit of the standard atomic weight value is listed in parentheses following the value. In the absence of parentheses, the uncertainty is one in that last digit. An interval in square brackets provides the lower and upper bounds of the standard atomic weight for that element. No values are listed for elements with no stable isotopes. See PAC for more details.
- "Aluminum" and "cesium" are commonly used alternative spellings for "aluminium" and "caesium."

For updates to this table, see iupac.org/reports/periodic_table/. This version is dated 21 January 2011.



International Year of CHEMISTRY 2011