higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T360**(E)**(A9)T

NATIONAL CERTIFICATE

CHEMISTRY N5

(15040015)

9 April 2019 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and 1 periodic table.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
CHEMISTRY N5
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

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QUESTION 1: INTRODUCTION TO ORGANIC CHEMISTRY AND ALKANES

1.1 Reaction 1:

$$C\ell{:}C\ell \xrightarrow[\text{light}]{} C\ell^{\cdot} + {}^{\cdot}C\ell$$

Reaction 2:

$$CH_3O - H + H_2O \rightarrow \overset{\cdot\cdot}{CH_3O}{:}^{-} + H_3O{:}^{+}$$

1.1.1 Which reaction involves a homolytic bond cleavage? (1)

1.1.2 Name the species formed in reaction 1. (1)

1.1.3 Reaction 2 involves the formation of an electrophile and a nucleophile.

Which product is the nucleophile? (1)

1.1.4 Briefly define the term *electrophile.* (2)

1.1.5 Write a reaction equation for the chlorination of methane. (4)

1.1.6 Classify the reaction mentioned in QUESTION 1.1.5 as a substitution or addition reaction. Justify the answer. (2)

1.1.7 Briefly describe heterolytic bond cleavage. (2)

1.2 $CH_3CH_2CHCH_2$

1.2.1 Name the type of hybridisation that occurs at C1 and C4. (2)

1.2.2 Is the compound a saturated or unsaturated hydrocarbon? Justify the answer. (2)

1.3 Give ONE example of each of the following:

1.3.1 Aliphatic compound

1.3.2 Aromatic compound

1.3.3 Heterocyclic compound

(3 × 1) (3)

[20]

QUESTION 2: ALKENES, ALKYNES AND AROMATIC COMPOUNDS

2.1

Compound number	Structural formula	Condensed structural formula	Molecular formula
1	$CH_3 - CH_3$		C_2H_6
2		$CH_3(CH_2)_3CH_3$	
3			C_7H_{16}

2.1.1 Write the general formula of compound 3. (1)

2.1.2 Draw the condensed structure of compound 1. (1)

2.1.3 Which ONE of the compounds is classified as an unsaturated compound? (1)

2.1.4 Briefly discuss the polarity of the THREE compounds. (2)

2.1.5 Write the IUPAC name of compound 2. (2)

2.1.6 Write the molecular formula of compound 2. (1)

2.1.7 Draw the structures of TWO branched isomers of compound 3. (2 × 2) (4)

2.2 Electrophilic addition of hydrogen bromide to 1-methylcyclohexene produced a mixture of two products according to Markovnikov's rule.

2.2.1 State Markovnikov's rule. (2)

2.2.2 Use Markovnikov's rule to predict the major and minor products formed when 1-methylcyclohexane reacts with hydrogen bromide. (2 + 2) (4)

2.3 Alkynes are easily converted to alkanes by addition of hydrogen over a metal catalyst like a Lindlar catalyst.

2.3.1 Briefly describe a Lindlar catalyst. (3)

2.3.2 Draw and name the alkane product that is produced when 2-pentyne is reduced in the presence of a Lindlar catalyst. (2)

2.4 Write a balanced reaction equation for the combustion of 2-butene. (4)

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2.5 Draw the structures of each of the following compounds:

2.5.1 Aminobenzene

2.5.2 Benzoic acid

2.5.3 *p*-bromotoluene

(3 × 1) (3)
[30]

QUESTION 3: ALCOHOLS, ALDEHYDES AND KETONES

3.1 Alcohols are organic derivatives of water with the same geometry as water and a bond with an approximate tetrahedral value of 109°.

3.1.1 Alcohols, like water, are weak proton donors.

Write a reaction equation for the dissociation of methanol in water. (3)

3.1.2 Write the equilibrium expression (K_a) for the reaction. (2)

3.1.3 Will the K_a value be big or small? (1)

3.1.4 Briefly account for the high boiling points of alcohols. (3)

3.1.5 Which reagent is used to convert compound alcohols to alkenes? (2)

3.1.6 Give TWO uses of methanol. (2)

3.2 Chlorine is added to ethene in the presence of water to yield a halohydrin.

3.2.1 Write a reaction equation for the formation of the halohydrin. (4)

3.2.2 Name the product formed in QUESTION 3.2.1. (2)

3.3

$$\text{Alcohol} \xrightarrow{\text{oxidation}} CH_3 - CH_2 - \underset{\displaystyle O}{\overset{\displaystyle \|}{C}} - H \xrightarrow{\text{oxidation}} \text{carboxylic acid}$$

3.3.1 Name the alcohol used for the reaction. (1)

3.3.2 Classify the alcohol as primary, secondary or primary alcohol. Justify the answer. (2)

3.3.3 Write the formula of the reagent used during the reaction. (1)

3.3.4 Write the general formula of carboxylic acids. (1)

3.3.5 Draw the structure of a carboxylic acid. (2)

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3.3.6 What is the IUPAC name of the aldehyde produced during the reaction? (1)

3.3.7 Briefly explain how to distinguish aldehydes from ketones. (3)
[30]

QUESTION 4: CARBOXYLIC ACIDS, ESTERS AND AMINES

4.1 Give ONE term for each of the following descriptions. Write only the term next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

4.1.1 Common name of a carboxylic acid with two carbon atoms

4.1.2 Amine with two carbon atoms

4.1.3 Common name of methanamide

4.1.4 Major animal waste product found in urine

4.1.5 IUPAC name of a simple aromatic amine

(5 × 2) (10)

4.2 Alcohol + carboxylic acid $\xrightarrow{\text{acid}}$ methylbutanoate

4.2.1 Draw and name the structure of the carboxylic acid used to prepare the product. (4)

4.2.2 Name the alcohol used in the reaction. (2)

4.2.3 Carboxylic acids are weak proton donors.

Write a reaction equation for the dissociation of acetic acid in water. (4)
[20]

TOTAL: 100

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THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 **H** 1																	**He** 4
1,0 **Li** 7	1,5 **Be** 9											2,0 **B** 11	2,5 **C** 12	3,0 **N** 14	3,5 **O** 16	4,0 **F** 19	**Ne** 20
0,9 **Na** 23	1,2 **Mg** 24											1,5 **Aℓ** 27	1,8 **Si** 28	2,1 **P** 31	2,5 **S** 32	3,0 **Cℓ** 35,5	**Ar** 40
0,8 **K** 39	1,0 **Ca** 40	1,3 **Sc** 45	1,5 **Ti** 48	1,6 **V** 51	1,6 **Cr** 52	1,5 **Mn** 55	1,8 **Fe** 56	1,8 **Co** 59	1,8 **Ni** 59	1,9 **Cu** 63,5	1,6 **Zn** 65	1,6 **Ga** 70	1,8 **Ge** 73	2,0 **As** 75	2,4 **Se** 79	2,8 **Br** 80	**Kr** 84
0,8 **Rb** 86	1,0 **Sr** 88	1,2 **Y** 89	1,4 **Zr** 91	**Nb** 92	1,8 **Mo** 96	1,9 **Tc**	2,2 **Ru** 101	2,2 **Rh** 103	2,2 **Pd** 106	1,9 **Ag** 108	1,7 **Cd** 112	1,7 **In** 115	1,8 **Sn** 119	1,9 **Sb** 122	2,1 **Te** 128	2,5 **I** 127	**Xe** 131
0,7 **Cs** 133	0,9 **Ba** 137	**La** 139	1,6 **Hf** 179	**Ta** 181	**W** 184	**Re** 186	**Os** 190	**Ir** 192	**Pt** 195	**Au** 197	**Hg** 201	1,8 **Tℓ** 204	1,8 **Pb** 207	1,9 **Bi** 209	2,0 **Po**	2,5 **At**	**Rn**
0,7 **Fr**	0,9 **Ra** 226	**Ac**															

Ce 140	**Pr** 141	**Nd** 144	**Pm**	**Sm** 150	**Eu** 152	**Gd** 157	**Tb** 159	**Dy** 163	**Ho** 165	**Er** 167	**Tm** 169	**Yb** 173	**Lu** 175
Th 232	**Pa**	**U** 238	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**

