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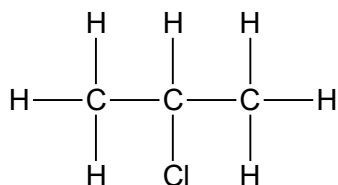
INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You are advised to use the attached DATA SHEETS.
7. Round off your FINAL numerical answers to a minimum of TWO decimal places.
8. Give brief motivations, discussions etc. where required.
9. Write neatly and legibly.

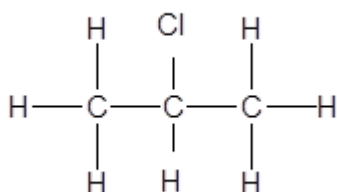
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

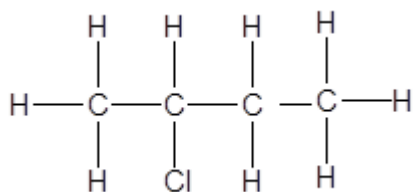
1.1 The positional isomer of the molecule below is ...



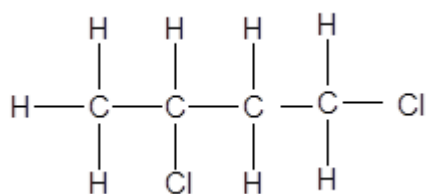
A



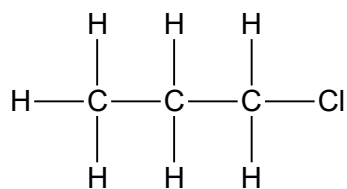
B



C

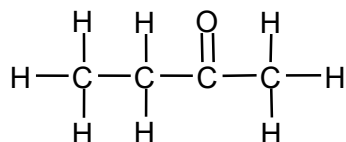


D



(2)

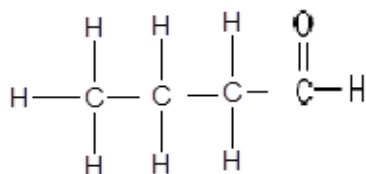
1.2



The IUPAC name for the compound above is ...

- A butanal.
- B butanol.
- C butanone.
- D butanoic acid. (2)

1.3



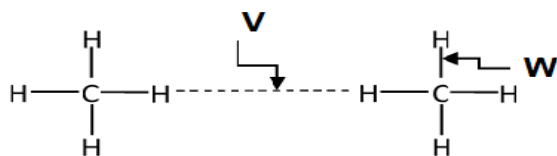
The structure above represents a/an ...

- A ketone.
- B aldehyde.
- C ester.
- D carboxylic acid. (2)

1.4 Which of the following groups of elements can be used for doping?

- A Group 3 and Group 5 elements
- B Alkali metals (Group 1) and alkali earth metals (Group 2)
- C All transition metals since they can conduct electricity
- D Halogens (Group 7) and inert gases (Group 8) (2)

1.5



The correct labels for **V** and **W** are respectively:

	V	W
A	Intramolecular forces	Intermolecular forces
B	Intermolecular forces	Intramolecular forces
C	Inter atomic forces	Chemical bonds
D	Chemical bonds	Inter-atomic forces

(2)
[10]

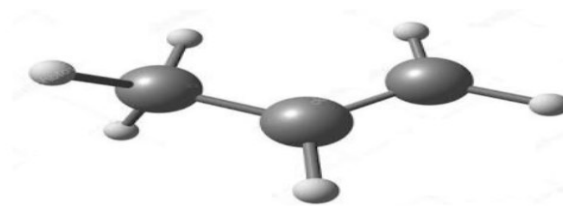
QUESTION 2 (Start on a new page.)

Give ONE word for each of the following statements.

- 2.1 When a hydrocarbon burns in oxygen. (1)
- 2.2 Organic molecules with the same molecular formula, but different structural formulae. (1)
- 2.3 A large molecule composed of smaller monomer units covalently bonded to each other in a repeating pattern. (1)
- 2.4 A semiconductor doped with phosphorus (P), arsenic (As) or antimony (Sb) as an impurity. (1)
- [4]**

QUESTION 3 (Start on a new page.)

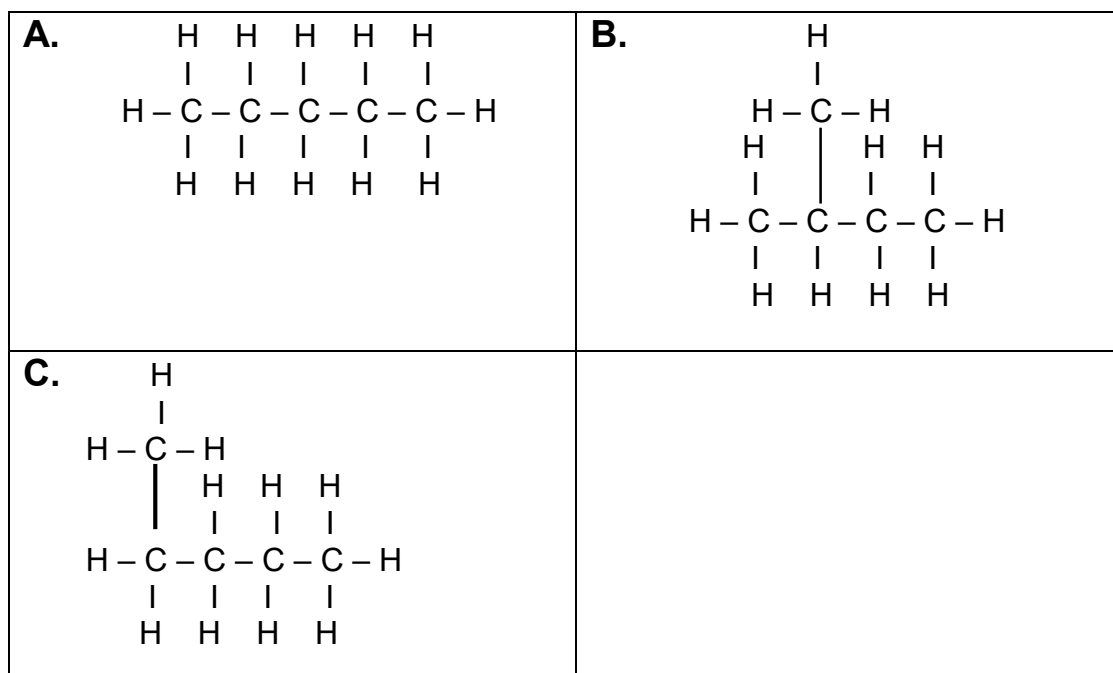
The diagram below represents the model of propene.



Propene is one of the most important organic compounds that is used in the industry to manufacture various products such as **propanol** and **esters**.

- 3.1 3.1.1 Define the term *organic compound*. (2)
- 3.1.2 Write down the general formula for alkenes. (1)
- 3.1.3 To which homologous series does propanol belong? (1)
- 3.1.4 What is the NAME of the functional group which propanol belongs to? (1)
- 3.1.5 Draw the structural formula of propan-2-ol. (2)
- 3.2 Propyl methanoate is the ESTER that is a product of an industrial process mentioned in the statement above. Use this information and answer the following questions.
- 3.2.1 Name the type of intermolecular forces found between esters and between alcohols. (2)
- 3.2.2 Write down the NAME of the carboxylic acid used to form the propyl methanoate. (1)
- 3.2.3 Draw the structural formula of the functional isomer of propyl methanoate. (2)
- 3.2.4 Draw the structural formula for the FUNCTIONAL GROUP of the isomer mentioned in QUESTION 3.2.3 above. (1)

- 3.3 Consider the organic compounds given below and answer the questions that follow.



Write down:

- 3.3.1 ONE similarity between compounds **A**, **B** and **C** (1)
- 3.3.2 ONE observable difference between **A** and **B** (1)
- 3.3.3 The homologous series to which these compounds belong (1)
- 3.4 Write down the IUPAC names of the compounds represented by the following letters:
- 3.4.1 **A** (1)
- 3.4.2 **B** (2)
- 3.4.3 **C** (1)
- 3.4.4 Which of these compounds has the smallest surface area? Write only **A**, **B** or **C**. (1)
- 3.4.5 Explain your answer to QUESTION 3.4.4 above. (2)

- 3.5 3.5.1 Define the term *plastic* in words. (2)
- 3.5.2 Choose TWO industrial uses of polyethene from the list given in the table below.

	USES
A	Electroplating
B	Food packaging plastics
C	Squeezable bottles
D	Electrorefining
E	Flexible water pipes
F	Aluminium extraction

(2 x 1) (2)
[27]

QUESTION 4 (Start on a new page.)

In the table below FIVE substances, as well as their molecular formula and viscosity, are given. Use the table to answer the questions which follow.

	SUBSTANCE	MOLECULAR FORMULA	VISCOSITY (mPa.s)
A	Pentane	C ₅ H ₁₂	X
B	Chlorohexane	C ₆ H ₁₁ Cl	0,695
C	Pent-2-ene	C ₅ H ₁₀	0,210
D	Ethanol	C ₂ H ₆ O	1,074
E	Propan-1-ol	C ₃ H ₈ O	1,945

4.1 Define the term *vapour pressure*. (2)

4.2 Identify the TYPE of intermolecular force in:

4.2.1 Chlorohexane (1)

4.2.2 Pent-2-ene (1)

4.3 Use the table above to answer these questions.

How does the viscosity of chloro-hexane compare with the viscosity of pentane? Write only HIGHER or LOWER.

Explain your answer. (2)

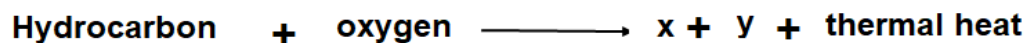
4.4 Explain, by referring to **intermolecular forces** and **energy**, which of the organic compounds from the table above will have the highest vapour pressure. (3)

4.5 Which intermolecular forces are common between pent-2-ene and ethanol? (2)

[11]

QUESTION 5 (Start on a new page.)

Hydrocarbons are famous for being the primary constituents of fossil fuels. Energy is obtained from fossil fuels through combustion of the fuel. Hydrocarbon combustion is the primary process in the burning of fossil fuels. Regardless of the type of hydrocarbon, the combustion produces the same products and large amounts of thermal heat are released.



5.1 Define the term *hydrocarbon*. (1)

5.2 Write down:

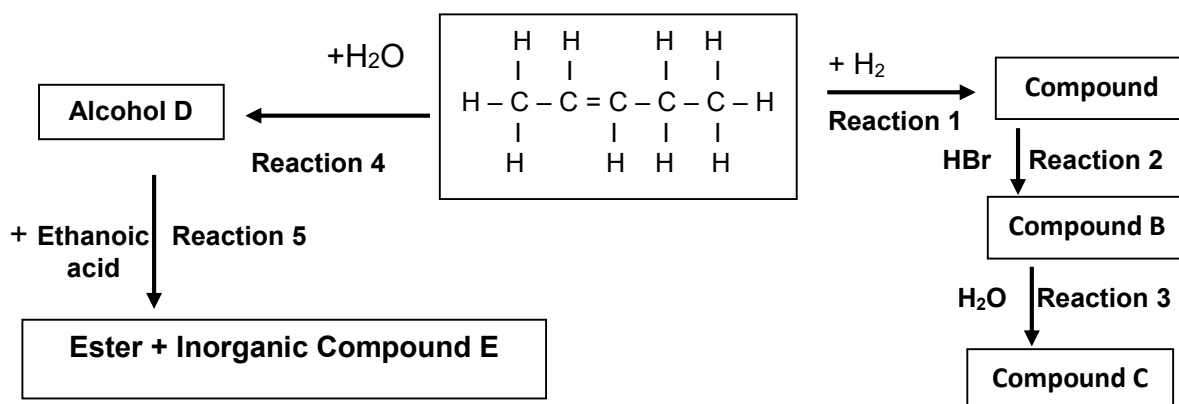
5.2.1 A balanced chemical reaction for the complete combustion of methane using a molecular formula (3)

5.2.2 The reaction conditions for the complete combustion of methane (1)

[5]

QUESTION 6 (Start on a new page.)

6.1 Consider the flow diagram below and answer the questions that follow.



Write down the NAME/TYPE of the following:

6.1.1 **Reaction 3** (1)

6.1.2 **Reaction 4** (1)

6.1.3 **Reaction 5** (1)

6.2 Write down the IUPAC name for the following compounds:

6.2.1 Secondary alcohol **D** (1)

6.2.2 Minor product compound **B** (1)

6.2.3 Inorganic compound **E** (1)

6.3 Write down the reaction conditions for the following reactions:

6.3.1 **Reaction 1** (1)

6.3.2 **Reaction 2** (1)

6.4 Draw the structural formula of compound **C**. (2)

6.5 Write down:

6.5.1 A balanced chemical reaction for **Reaction 5** using structural formulae (4)

6.5.2 The NAME of the ester formed in **Reaction 5** (1)

6.5.3 A balanced chemical reaction for **Reaction 1** using structural formulae (3)

[18]

TOTAL: 75

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DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2

TABLE/TABEL 1: PHYSICAL CONSTANTS / FISIIESE KONSTANTES

NAAM/NAME	SIMBOOL/SYMBOL	WAARDE/VALUE
Standard pressure / <i>Standaarddruk</i>	p^{θ}	$1,01 \times 10^5 \text{ Pa}$
Standard temperature / <i>Standaardtemperatuur</i>	T^{θ}	273 K
Speed of light in a vacuum/ <i>Speed van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant / <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: 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)
KEY/ SLEUTEL																	
Atomic number																	
Elektronegatiwiteit Electronegativity																	
Simbool Symbol																	
Benaderde relatiewe atoommassa Approximate relative atomic mass																	
1 H 1																	2 He 4
3 Li 7	4 Be 9											5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20
11 Na 23	12 Mg 24											13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35,5	18 Ar 40
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 63,5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc 98	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po 209	85 At 210	86 Rn 222
87 Fr 223	88 Ra 226	89 Ac															
			58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175	
			90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	