GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
GRADE 12

2024

TECHNICAL SCIENCES

(PAPER 2)

TECHNICAL SCIENCES P2

C2102E

TIME: 1½ hour

MARKS: 75

8 pages + 2 data sheets

X05

INSTRUCTIONS AND INFORMATION

1. This question paper consists of FIVE 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 open between two subquestions, e.g. 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 answer to a minimum of TWO decimal places.
8. Give brief motivations, discussions, etc., where required.
9. Write neatly and legibly.

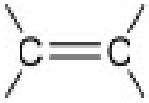
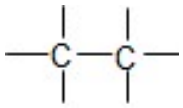
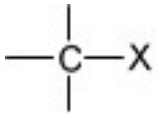
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 to 1.5) in the ANSWER BOOK, e.g. 1.6 D.

1.1 Which of the following represents the third member of an aldehyde?

A CH_3CH_2COOH
B $CH_3CH_2OCH_3$
C CH_3OCH_3
D CH_3CH_2CHO (2)

1.2 Consider the compound with a molecular formula of C_5H_8. The compound's functional group is:

A 
B 
C 
D 

(2)

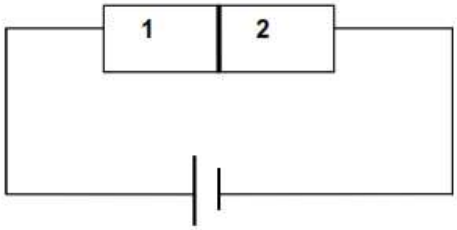
1.3 The vapour pressure of a substance refers to the …

A temperature where the solid and gas phase are at equilibrium.
B change of a liquid to a gas phase.
C temperature where the liquid and solid phase are at equilibrium.
D change of a solid to a liquid phase. (2)

1.4 The number of valence electrons in the outer shell of a germanium atom.

A Three
B Four
C Five
D Two (2)

1.5 Consider the following diagram of a p-n junction diode.



If the diode is FORWARD BIAS, which option below shows the correct labelling of parts **1** and **2**?

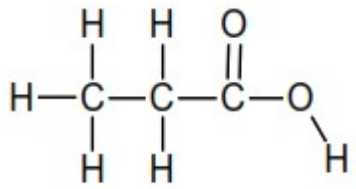
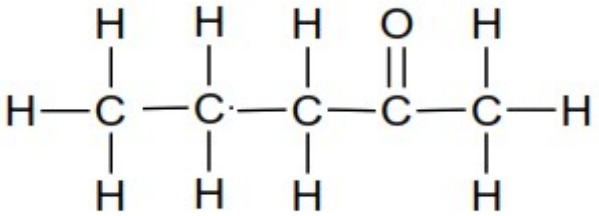
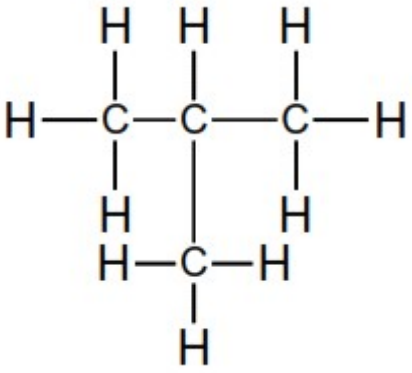
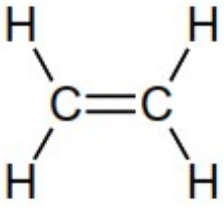
	PART 1	PART 2
A	p-type	p-type
B	n-type	n-type
C	p-type	n-type
D	n-type	p-type

(2)

[10]

QUESTION 2 (Start on a new page.)

Letters **A** to **F** in the table below represent SIX organic molecules.

A		**B**	
C		**D**	Butane
E	Methyl butanoate	**F**	

2.1 Define a *functional group*. (2)

2.2 Identify the homologous series of the following organic molecules:

2.2.1 **A** (1)

2.2.2 **B** (1)

2.2.3 **D** (1)

2.3 Consider compound **E** for the following questions.

2.3.1 Draw the structural formula for compound **E**. (3)

2.3.2 Write down the name of the carboxyl acid that is used to prepare compound **E**. (1)

2.4 Give the IUPAC name for the following compounds.

2.4.1 **B** (2)

2.4.2 **C** (2)

2.5 Define the term *structural isomer*. (2)

2.6 Compounds **C** and **D** are isomers. Name the type of isomers. (1)

2.7 Distinguish between *saturated* and *unsaturated hydrocarbons*. (4)

2.8 Identify an unsaturated hydrocarbon from the table above. Write down ONLY the letter of the correct answer. (1)

2.9 Write down a balanced chemical equation for the combustion of compound **D**. (3)

2.10 Draw the functional group for compound **B**. (2)

2.11 Compound **F** is a monomer than can be used to form a polymer.

2.11.1 Define the term *monomer*. (2)

2.11.2 Draw the structural formula of the polymer that can be formed from monomer **F**. (2)

[30]

QUESTION 3 (Start on a new page.)

The boiling points of THREE organic compounds represented by **A**, **B** and **C**, are shown in the table below.

COMPOUND	BOILING POINT (°C)
A	141,2
B	97
C	−42

3.1 Define the term *boiling point*. (2)

3.2 Which compound (**A** or **C**) has the weaker intermolecular force? Explain your answer. (2)

3.3 The compounds have been identified as propan-1-ol, propane and propanoic acid.

Identify compound:

3.3.1 **A** (1)

3.3.2 **B** (1)

3.3.3 **C** (1)

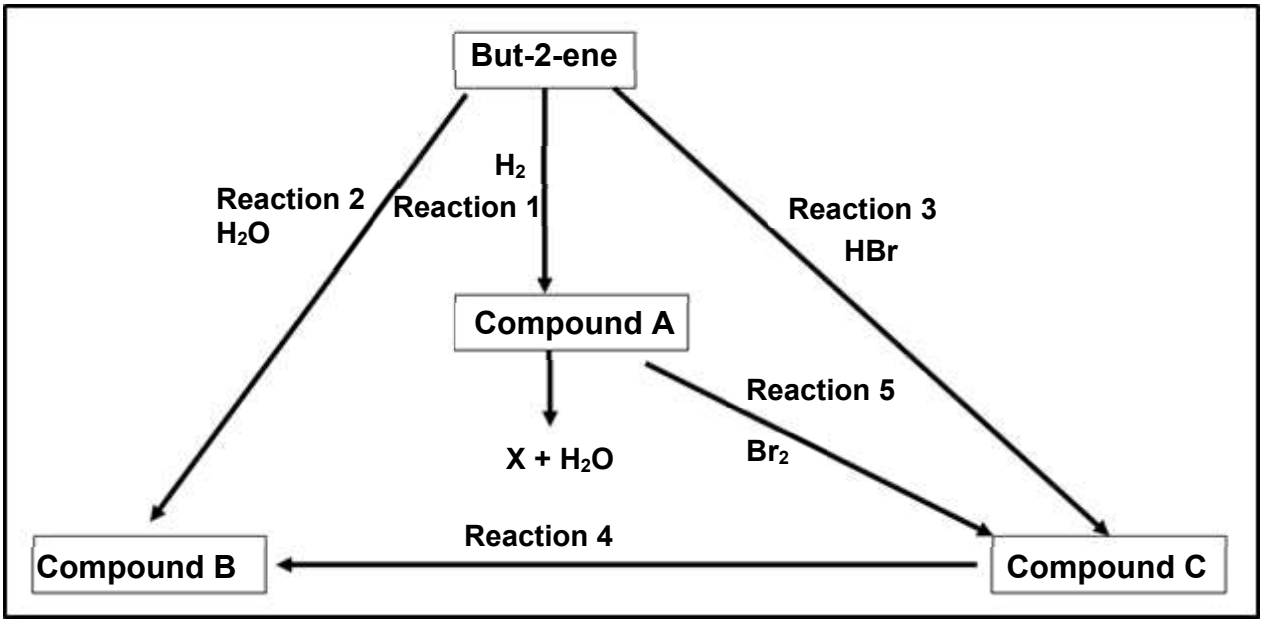
3.4 Identify the type of intermolecular force of compound **B**. (2)

3.5 Which compound (**A** or **B**) has the higher vapour pressure? Explain your answer in full. (4)

[13]

QUESTION 4 (Start on a new page.)

The flow diagram below shows how but-2-ene can be converted into various other organic compounds. Study the reactions below and answer the questions that follow.



4.1 Write down the TYPE of addition reaction for:

4.1.1 Reaction **1** (1)

4.1.2 Reaction **3** (1)

4.2 Study reaction **4**. Write down TWO reaction conditions which are needed for this reaction. (2)

4.3 Write down the NAME of compound:

4.3.1 **A** (2)

4.3.2 **B** (2)

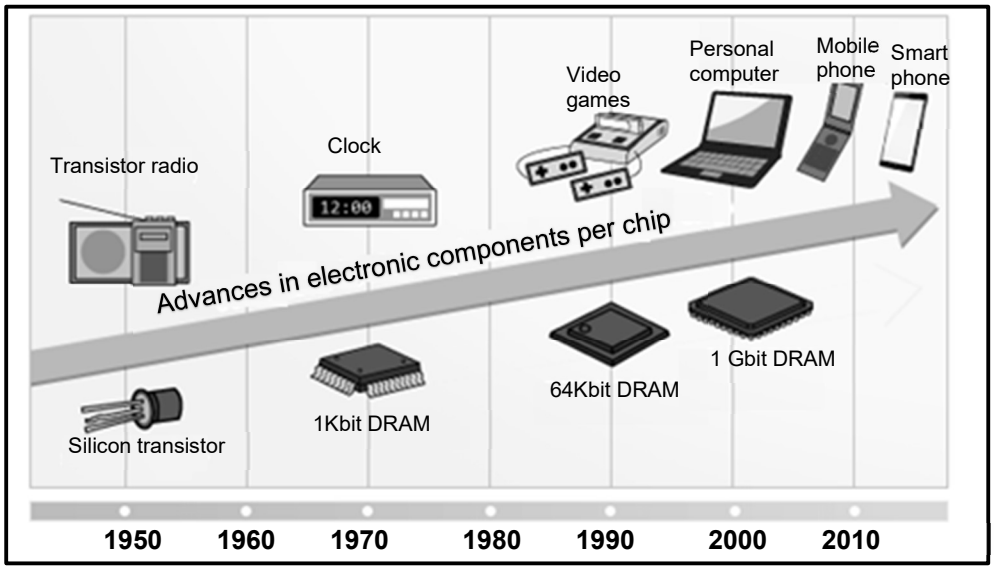
4.4 Write down a balanced equation, using structural formulae, to illustrate the formation of compound **C** for reaction **5**. (3)

4.5 Give the formula of substance **X**. (1)

[12]

QUESTION 5 (Start on a new page.)

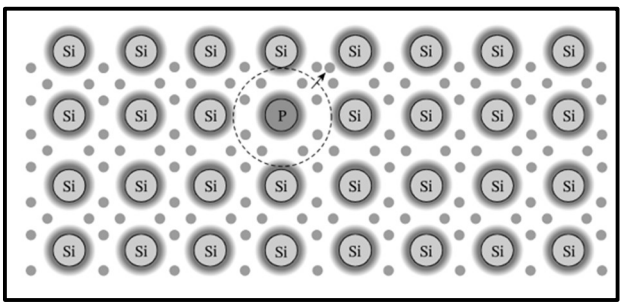
The picture below illustrates the evolution of semiconductor application since 1950.



[Source: *hitachi-hitech.com*]

5.1 What is a *semiconductor*? (2)

5.2 The following diagram shows a lattice of silicon atoms to which an atom of phosphorus is added. A phosphorus atom has five valence electrons and a silicon atom has four valence electrons.



5.2.1 Define the process that is depicted above. (2)

5.2.2 How many free electrons are added to the lattice when the phosphorus atom is added to it? (1)

5.2.3 Name the different types of charge carriers in the P-N junction diode when it is forward biased. (2)

5.2.4 When phosphorus is added to silicon, what type of semiconductors does it form? (1)

5.3 Explain the effect of adding phosphorus to silicon. (2)
[10]

TOTAL: 75

DATA FOR TECHNICAL SCIENCES GRADE 12 / *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12*

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTE*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure/ *Standaarddruk*	p^{θ}	1,01 x 10^5 Pa
Standard temperature/ *Standaardtemperatuur*	T^{θ}	0 °C/273 K

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

ELECTROCHEMISTRY/*ELEKTROCHEMIE*	
Emf/*Emk*	$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

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)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 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	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 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

KEY/*SLEUTEL*

Atomic number/ *Atoomgetal*

Electro negativity/ *Elektronegatiwiteit*

29
1,9 Cu
63,5

Symbol/ *Simbool*

Approximate relative atomic mass/ *Benaderde relatiewe atoommassa*