KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY (P2)

JUNE EXAMINATION

2025

MARKS: 75

TIME: 1 ½ hours

This question paper consists of 8 pages and 2 data sheets.

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 between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

1.1 The hydrogen bond is a type of...

A ionic bond.

B metallic bond.

C covalent bond.

D intermolecular force. (2)

1.2 Which ONE of the following substances has dative covalent bonds?

A H_2O

B NH_3

C OH^-

D NH_4^+ (2)

1.3 Which ONE of the following liquids will have the greatest vapour pressure when equal amounts are placed in a sealed container at the same temperature?

A HF

B HCℓ

C HBr

D HI (2)

1.4 Which ONE of the following statements is correct about intermolecular forces?

A They hold atoms together in a molecule

B They are much stronger than intramolecular forces

C They determine the physical state of the compound

D They are chemical bonds (2)

1.5 Which ONE of the following molecules is non-polar, but has polar bonds?

A H_2O

B $HC\ell$

C CO_2

D H_2

(2)
[10]

QUESTION 2

2.1 Write down the number of valence electrons in an atom of:

2.1.1 Flourine (1)

2.1.2 Hydrogen (1)

2.2 Define the term *covalent bond.* (2)

2.3 Write down the name given to the type of bond between the particles in:

2.3.1 NaF (1)

2.3.2 CH_4 (1)

2.4 Write down the Lewis structure for:

2.4.1 F_2 (2)

2.4.2 HCN (2)

2.4.3 MgF_2 (3)

2.5 State whether the following molecules are POLAR or NON-POLAR and write down the name of its molecular shape.

2.5.1 H_2O (2)

2.5.2 CH_4 (2)

2.5.3 NH_3 (2)

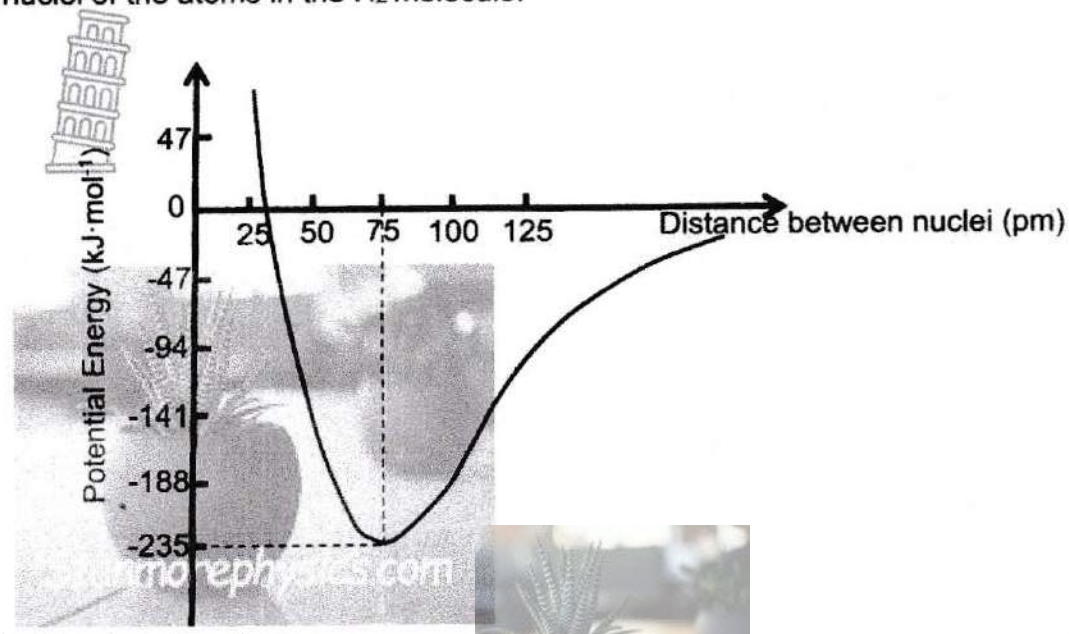
2.6 Both BF_3 and NH_3 are molecules that are made up of 4 atoms. Explain the difference in shapes between these molecules. (3)

2.7 Use Lewis Diagrams to show how a dative covalent bond forms between H_2O and the H^+ ion. (3)

[25]

QUESTION 3

The graph below shows the relationship between the potential energy and the distance between the nuclei of the atoms in the H_2 molecule.



3.1 Define the term *bond energy*. (2)

3.2 Give a reason why two hydrogen atoms:

3.2.1 Attract each other (1)

3.2.2 Repel each other (1)

3.3 Write down the:

3.3.1 Bond energy of H_2 (1)

3.3.2 Bond length of H_2 (1)

3.4 The BOND LENGTH of H_2 is less than that of N_2.
Give a reason for this statement. (2)

3.5 The BOND ENERGY of H_2 is less than that of N_2
Give a reason for this statement. (2)

3.6 Explain the shape of the graph between 0 and 75 pm. (3)
[13]

QUESTION 4

4.1 In an experiment to investigate the relationship between the hydrides of group IV and their boiling points, the following results were obtained:

Hydride	Relative molecular mass ($g \cdot mol^{-1}$)	Boiling point (°C)
CH_4	16	-164
SiH_4	32	-112
GeH_4	77	-89
SnH_4	123	-52

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

4.1.2 Identify the independent variable in this experiment. (1)

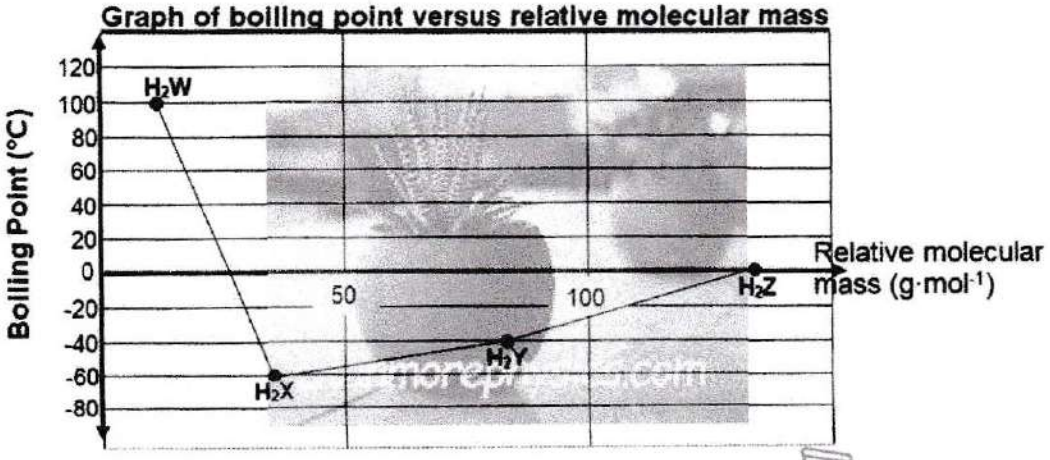
4.1.3 Use a relevant calculation to determine whether the bond between silicon (Si) and hydrogen is POLAR or NON-POLAR. (3)

4.1.4 Which one of the above hydrides will be a liquid at -60°C? (1)

4.1.5 Which one of the above hydrides will have the greatest vapour pressure at -180°C? (1)

4.1.6 Fully explain why SiH_4 has a higher boiling point than CH_4. (3)

4.2 The graph below shows the relationship between the boiling points of the hydrides of a certain group of the periodic table, and their relative molecular masses. W, X, Y and Z are elements in this group. Boiling points were measured at atmospheric pressure of one atmosphere.



4.2.1 State the relationship between boiling point and molecular mass for H_2X, H_2Y and H_2Z. (2)

4.2.2 Explain the relationship referred to in QUESTION 4.2.1. (3)

4.2.3 Identify element W. Give a reason for the answer. (2)

4.2.4 Explain why H_2W has a much higher boiling point than expected. (2)

[20]

QUESTION 5

5.1 Define *solubility*. (2)

5.2 Will iodine crystals, $I_2(s)$, dissolve in water, $H_2O(\ell)$?

Explain fully by referring to the polarity of the molecules and the types and strength of the intermolecular forces. (5)
[7]

TOTAL MARKS: [75]

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

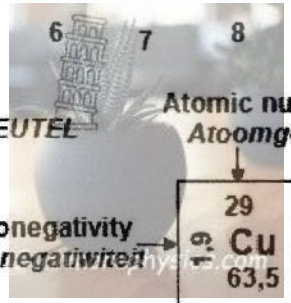
TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}\ mol^{-1}$
Molar gas constant *Molêre gaskonstante*	R	$8,31\ J{\cdot}K^{-1}{\cdot}mol^{-1}$
Standard pressure Standaarddruk	p^θ	$1,013 \times 10^5\ Pa$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4\ dm^3{\cdot}mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^θ	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$

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 H 1																	2 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															

							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

Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

GRADE/*GRAAD* 11

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

JUNE 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 75

These marking guidelines consist of 6 pages.
Hierdie nasienriglyne bestaan uit 5 bladsye.

QUESTION 1/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 D ✓✓ (2)

1.3 B✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

[2 x 5 = 10]

QUESTION 2/*VRAAG 2*

2.1.1 7/seven/*sewe* ✓ (1)

2.1.2 1/one/*een* ✓ (1)

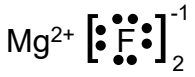
2.2 A covalent bond is the sharing of electrons between two atoms to form a molecule. ✓✓
'n Kovalente binding is die deel van elektrone tussen twee atome om 'n molekuul te vorm. ✓✓ (2)

2.3.1 Ionic/Electrostatic ✓
Ionies/Elektrostaties ✓ (1)

2.3.2 Covalent/*Kovalent* ✓ (1)

2.4.1  ✓✓ (2)

2.4.2  ✓✓ (2)

2.4.3  (3)

(The 2 can be in front of the F)

Marking criteria/*Nasienkriteria*
- Magnesium with no electrons. /*Magnesium met geen elektrone.* ✓
- Flourine with brackets, surrounded by eight electrons./Fluoor met blok hakkies, omring deur agt elektrone. ✓
- Both charges and number of fluorine ions correct./*Albei ladings en aantal fluoor ione korrek.* ✓

2.5.1 POLAR ✓,Angular✓/*POLĘR* ✓,*Hoekig* ✓ (2)

2.5.2 NON-POLAR ✓Tetrahedral✓/ *NIE-POLĘR*✓ *Tetraëdriese*✓ (2)

2.5.3 POLAR ✓ Trigonal-pyramidal✓/ *POLĘR* ✓*Trigonaal-piramidaal*✓ (2)

2.6 Boron/central atom has no lone pair of electrons✓ while nitrogen/central atom has one lone pair of electrons. ✓
Therefore flourine atoms are arranged symmetrically around the boron atom.✓
OR
The lone pair of electrons in nitrogen push the hydrogen atoms down.

Boor/sentrale atoom het geen alleenpaar elektrone nie✓ terwyl stikstof/sentrale atoom een alleenpaar elektrone het. ✓
Daarom is fluoor atome simmetries rondom die boor atoom gerangskik. ✓
OF
Die alleenpaar elektrone in stikstof druk die waterstofatome af. ✓ (3)

2.7

Marking criteria/*Nasienkriteria*

- Lewis Diagram of water correct./*Lewis Diagram van water korrek.* ✓
- Hydrogen ion with no electrons and correct charge./*Waterstof ioon met geen elektrone en korrekte lading.* ✓
- Dative covalent bond illustrated correctly./*Datief-kovalente binding korrek.* ✓
- Brackets with correct charge outside the brackets./*Block hakkies met korrekte lading buite hakkies* ✓

(4)
[25]

QUESTION 3/*VRAAG 3*

3.1 The energy needed to break one mole of its molecules into separate atoms./*Die energie benodig om een mol van sy molekules in aparte atome op te breek.* ✓✓ (2)

3.2.1 Attractive forces between the protons of one atom and the electrons of the other / the unlike charges of each atom./*Aantrekkingskrag tussen die protone van een atom, en die eleckrone van die ander / twee atome se teenoorgestelde ladings.* ✓ (1)

3.2.2 Repulsive forces between the protons of both atoms and the electrons of both atoms / two atoms like charges./*Afstotingskrag tussen die protone van beide atome en die elektrone van beide atome / twee atome se soortgelyke ladings.* ✓ (1)

3.3.1 <u>235 kJ·mol^{-1}</u> ✓ (No mark is awarded for negative answer./*Geen punt word toegeken vir negatiewe antwoord.)* (1)

3.3.2 <u>75 pm/75 x 10^{-12}m</u> ✓ (1)

3.4. Nitrogen atoms are larger than hydrogen atoms./Hydrogen atoms are smaller than nitrogen atoms ✓✓
Stikstof atome is groter as waterstof atome./Waterstof atome is kleiner as stikstof atome ✓✓. (2)

3.5 <u>N_2 has a triple bond between the two nitrogen atoms</u> while H_2 has a single bond between the two hydrogen atoms. ✓✓ OR
N2 has a higher bond order than H.
GROOTER AS ✓
<u>*N_2 het 'n trippel binding tussen die twee stiksto atome*</u>, *terwyl H_2 'n enkel binding tussen die twee waterstof atome het.* ✓ (2)

3.6 When the nuclei of the atoms get too close to eachother✓, the atoms start to repel. ✓ Potential energy starts to increase. ✓
Wanneer die kerne van die twee atome te naby aan mekaar kom ✓*stoot die atome mekaar af.* ✓ Potensiële energie neem toe. ✓ (3)
[13]

QUESTION 4/*VRAAG 4*

4.1.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓
Die temperatuur waarteen die dampdruk van 'n stof aan die atmosferiese druk gelyk is. ✓✓ (2)

4.1.2 Type of hydride or Relative molecular mass/*Tipe hydride of Relatiewe atoommassa* ✓ (1)

4.1.3 $\Delta EN = 2,1 - 1,8$✓
$= 0,3$ ✓
∴ polar covalent/*polêr kovalent* ✓ (3)

4.1.4 SnH_4 ✓ (1)

4.1.5 CH_4 ✓ (1)

4.1.6
- SiH_4 and CH_4 both have London forces/Induced dipole - induced dipole/Dispersion forces ✓
- SiH_4 has stronger intermolecular forces because it has a larger relative molecular mass./CH_4 has weaker intermolcular forces because it has a smaller relative molecular mass. ✓
- More energy will be needed to break the intermolecular forces between SiH_4 molecules./Less energy will be needed to break the intermolecular forces between CH_4 molecules.✓
- *SiH_4 en CH_4 het albei London kragte/Geïnduseerde dipool - geïnduseerde dipool/Dispersiekragte.* ✓
- *SiH_4 het sterker intermolekulê kragte aangesien dit 'n grooter realtiewe molekulêre massa het./CH_4 het swakker intermolekulêre kragte aangesien dit 'n kleiner relatiewe molekulêre massa het.* ✓
- *Meer energie word benodig om die intermolekulêre kragte tussen SiH_4 molekules te breek./Minder energie word benodig om die intermolekulêre kragte tussen CH_4 molekules te breek.* ✓

(3)

4.2.1 There is an increase in boiling point as the relative molecular mass increases./ *Daar is 'n toename in kookpunt soos die relatiewe molekulêre massa toeneem.* ✓✓ (2)

4.2.2
- All the molecules have dipole-dipole/Van die Waals forces ✓
- Van der Waals forces increase with an increase in relative molecular mass. ✓
- More energy will be needed to break the intermolecular forces between molecules with a larger relative molecular mass.✓
- *Al die molekules het dipool-dipool kragte/Van der Waals kragte.* ✓
- *Die sterkte van Van der Waals kragte neem toe met 'n toename in relatiewe molekulêre massa* ✓
- *Meer energie word benodig om die intermolekulêre kragte te breek tussen molekules met 'n groter molekulêre massa.*✓

(3)

4.2.3 W is oxygen/O. ✓
It has a boiling point of 100°C **OR** It has a molecular mass of 18 g·mol^{-1}. ✓

W is Suurstof/O. ✓
Dit het 'n kookpunt van 100°C ***OF*** *Dit het 'n relatiewe molekulêre massa van 18 g·mol^{-1}.* ✓

(2)

4.2.4 H_2W has strong hydrogen bonds, while the other molcules have dipole-dipole forces. ✓

Hydrogen bonds are stronger than dipole-dipole bonds. ✓
OR
Dipole-dipole bonds are weaker than hydrogen bonds. ✓

H_2W het sterk waterstofbindings, terwyl die ander molekules dipool-dipool kragte besit. ✓

Waterstof bindings is sterker as dipool-dipool kragte. ✓
OF
Dipool-dipool bindings is swakker as waterstof bindings. ✓ (2)

[20]

QUESTION 5/*VRAAG 5*

5.1 Solubility is the ability of a solid, liquid, or gaseous chemical to dissolve in solvent and form a solution. ✓✓
Oplosbaarheid is die vermoë van 'n vastestof, vloeibare of gasvormige chemikalie om in oplosmiddel op te los en 'n oplossing te vorm. (2)

5.2 No.✓
Iodine chrystals are non-polar ✓and have weak London forces/Induced dipole - induced dipole/Dispersion forces. ✓
Water molecules are polar ✓and form strong hydrogen bonds. ✓

Nee✓
Jodium kristalle is nie-poler, ✓*en het swak London kragte/Geïnduseerde dipool - geïnduseerde dipool/Dispersiekragte.* ✓
Water molekules is polêr✓ *en besit sterk waterstofbindings.* ✓ (5)
[7]

TOTAL/*TOTAAL*: 75