education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

FURTHER EDUCATION AND TRAINING

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY

PAPER 2

JUNE 2025

MARKS: 50

TIME: 1 hour

This question paper consists of 7 pages and 1 data sheet

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of FIVE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH Question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc, where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE CHIOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1 to 1.3) in the ANSWER BOOK, eg. 1.4E

1.1 Which ONE of the following compounds has the highest ionic character?

A $NaC\ell$

B $RbC\ell$

C $MgC\ell_2$

D $BaC\ell_2$ (2)

1.2 Three chemical bonds are given as; H—N, Cl—Cl and H—F.

Consider the following statements in regard to these bonds:

(i) All of three bonds are polar covalent

(ii) H— N is the most polar bond.

(iii) H—F is the most polar bond.

Which of the above statements are/ is TRUE?

A i and ii only

B i and iii only

C ii only

D iii only (2)

1.3 In which ONE of the following will hydrogen bonding NOT occur between molecules?

A HF(s)

B $NH_3(s)$

C HBr(s)

D $H_2O(s)$ (2)

[6]

QUESTION 2

Two fluorine atoms, F(g), combine by a chemical bond to form a fluorine molecule, $F_2(g)$, as shown in the equation below.

$$F(g) + F(g) \rightarrow F_2(g)$$

2.1 Define the term *chemical bond*. (2)

2.2 How does the stability of the combined atoms, $F_2(g)$ compare to that of individual atoms, F(g)? Choose from LOWER, HIGHER or EQUAL TO. Write down a reason for the answer. (2)

2.3 Consider $F_2(g)$ molecule.

2.3.1 Draw a Lewis dot diagram of F_2. (2)

2.3.2 Write down the number of lone pairs of electrons in the molecule. (1)

2.4 Ammonium ion, $NH_4^+(aq)$, is formed by the reaction of ammonia, $NH_3(g)$, with hydrogen ion, $H^+(aq)$, according to the following equation:

$$NH_3(g) + H^+(aq) \rightarrow NH_4^+(aq)$$

2.4.1 Draw the Lewis dot diagrams to show how NH_4^+ is formed. (4)

2.4.2 Write down the name of the molecular shape of NH_3. (1)

[12]

QUESTION 3

The bond lengths and bond energies of the chemical bonds are given in the table below.

CHEMICAL BOND	BOND LENGTH (nm)	BONG ENERGY ($Kj.mol^{-1}$)
H—H	74	432
H—C	109	413
C—O	143	358
C—C	154	347

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

3.2 Write down the:

3.2.1 Relationship between bond length and bond energy of the bonds. (1)

3.2.2 Explanation for the answer in QUESTION 3.2.1 (2)

3.3 Carbon dioxide molecule, CO_2, has polar covalent bonds, C=O, but the molecule is non polar.

Write down a reason why the:

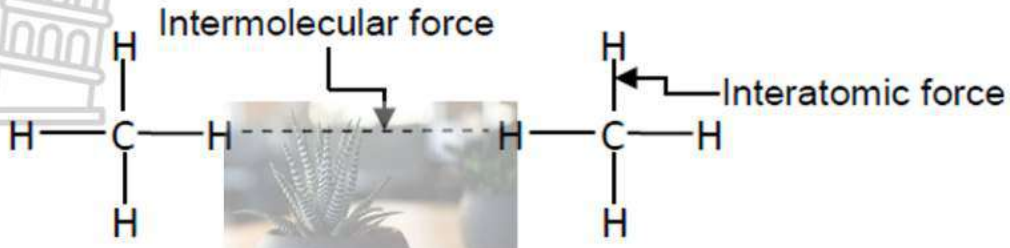
3.3.1 Bond energy of C=O bond is higher than that of C—O bond. (2)

3.3.2 C=O bonds are polar but CO_2 molecule is non polar. (3)

[10]

QUESTION 4

4.1 In the diagram below, two methane molecules, CH_4, are linked together by intermolecular force.



Refer to the diagram and write down the:

4.1.1 Type of intermolecular force between the two methane molecules. (1)

4.1.2 Type of interatomic force between carbon and hydrogen atoms. (1)

4.1.3 Which forces require more energy to separate, intermolecular forces or interatomic forces? (1)

4.2 Letters **A** to **F** represent six compounds used by grade 11 learners to investigate the relationship between molecular mass and boiling point. The results obtained are shown in the table below.

EXPERIMENT	COMPOUND		MOLECULAR MASS ($g.mol^{-1}$)	BOILING POINT (°C)
I	A	CH_4	16	-164
	B	C_2H_6	30	-89
	C	C_3H_8	44	-42
	D	C_4H_{10}	58	-23
II	E	H_2O	18	100
	F	H_2S	34	-64

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

Consider experiment **I,** Write down the:

4.2.2 Independent variable. (1)

4.2.3 Conclusion that is drawn from the results obtained. (1)

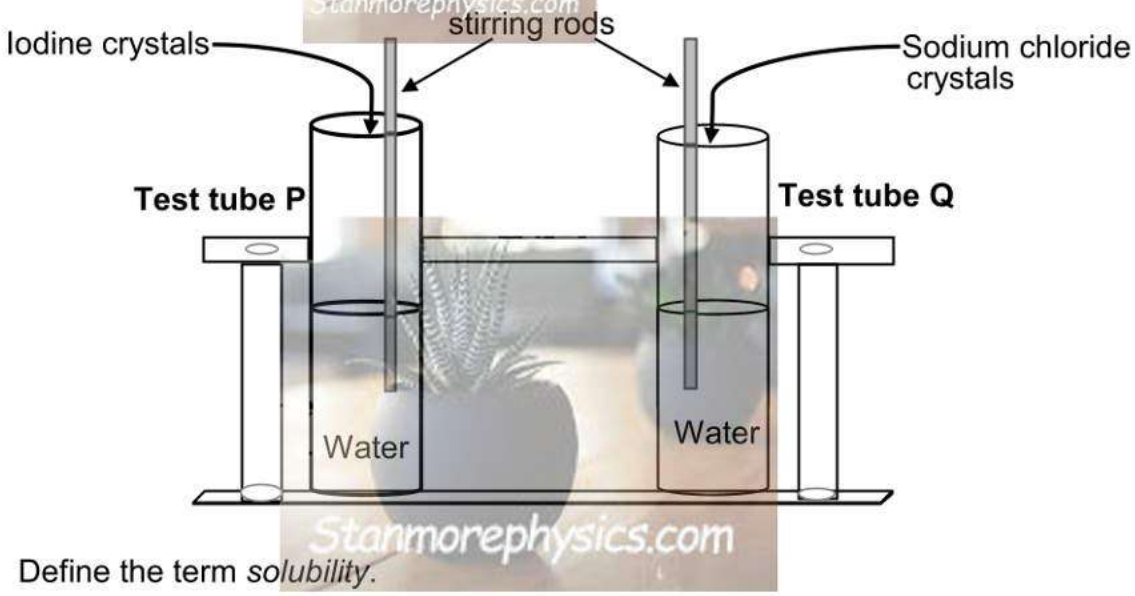
4.2.4 Explain the answer to QUESTION 4.2.3. (2)

A learner makes a conclusion based on the results obtained in experiment **II:**
The vapour pressure of compound **E** is lower than that of **F**.

4.2.5 Is the learner CORRECT or WRONG? Explain the answer. (4)
[13]

QUESTION 5

The effect of intermolecular forces on solubility of solutes is investigated using iodine, I_2, and sodium chloride crystals, NaCl. Equal amounts of each solute are placed in equal volumes of water at the same temperature of 22°C, as shown in the diagram below.
The mixture in each test tube is stirred with a stirring rod.



5.1 Define the term *solubility*. (2)

5.2 Write down the observation made in each test tube.
Choose from CRYSTALS ARE SOLUBLE or CRYSTALS ARE NOT SOLUBLE.

5.2.1 Test tube **P**. (1)

5.2.2 Test tube **Q.** Explain the answer. (4)

5.3 Write down the:

5.3.1 Type of intermolecular forces between iodine crystals. (1)

5.3.2 Conclusion made from observation in test tube **P**. (1)
[9]

TOTAL: 50

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY

Atomic number

Electronegativity → 29 / 1,9 / Cu / 63,5 ← Symbol

Relative atomic mass (approximately)

I	II	III	IV	V	VI	VII	0
1 2,1 H 1							2 He 4
3 1,0 Li 7	4 1,5 Be 9	5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24	13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 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 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 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

education

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FURTHER EDUCATION AND TRAINING
VERDERE ONDERWYS EN OPLEIDING

GRADE/GRAAD 11

PHYSICAL SCIENCES P2/FISIESE WETENSKAPPE V2

JUNE/JUNIE 2025

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE 50

These marking guidelines consist of 10 pages.

Hierdie nasienriglyne betstaan uit 10 bladsye.

Please turn over/Blaai asseblief om

QUESTION / VRAAG 1

1.1 B✓✓ (2)

1.2 D✓✓ (2)

1.3 C✓✓ (2)

[6]

QUESTION / VRAAG 2

2.1 A mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons.✓✓

'n Wedersydse aantrekking tussen twee atome as gevolg van die gelyktydige aantrekking tussen hul kerne en die buite / valenselektrone.

[If any of the underlined key words/phrases in the correct context are omitted; deduct 1 mark. / Indien enige van die onderstreepte woorde / frases in die korrekte konteks uitgelaat is, trek 1 punt af.] (2)

2.2 HIGHER / HOëR ✓

The (potential) energy of F_2/combined atoms is lower than that of individual (F) atoms.✓

Die (potensiële) energie van F_2/gekombineerde atome is ler as die individuele (F) atome. (2)

2.3.1  ✓✓

Marking criteria / Nasienriglyn	
Symbols of both F atoms with two electrons shown as dots/crosses between them. Simbole van beide F atome met twee elektrone as kolletjies / kruisies tussen hulle.	✓
Six lone pairs placed around F atoms. Ses alleenpare rondom die F atome.	✓

(2)

2.3.2 6 ✓ (1)

2.4.1 

Marking criteria / Nasienriglyn	
Correct shape of / Korrekte vorm van NH_3	✓
Correct formula of / Korrekte formule van H^+	✓
Correct shape of / Korrekte vorm van NH_4^+	✓✓

(4)

2.4.2 Trigonal pyramidal / Trigonaal piramidaal ✓ (1)

[12]

QUESTION / VRAAG 3

3.1 The energy needed to break one mole of the compound's molecules into separate atoms. / Die energie benodig om 1 mol van 'n verbinding se molekules op te breek in atome. ✓✓
[2 or 0 marks / 2 of 0 punte] (2)

3.2.1 As the bond length increases, the bond energy decreases.✓
OR: As the bond length decreases, the bond energy increases.
Soos die bindingslengte toeneem, sal die bindingsenergie afneem.
OF: Indien die bindingslengte afneem, sal die bindingsenergie toeneem. (1)

3.2.2 Bonds with longer bond lengths have lesser forces of attraction,✓and require lesser energy to break.✓
OR: Bonds with shorter bond lengths have greater forces of attraction,✓and require more energy to break.✓

Bindings met langer bindingslengtes het swakker aantrekkingskragte, en benodig minder energie om te breek.
OF: Bindings met korter bindingslengtes het sterker aantrekkingskragte, en benodig meer energie om te breek. (2)

3.3.1 In C=O there is a double bond / atoms are closer / bond length is shorter. ✓
Therefore, the bond strength is higher.✓

In C=O is daar 'n dubbelband / atome is nader aan mekaar / bindingslengte is korter. Daarom is die binding sterker. (2)

3.3.2 The electronegativity difference in C=O (3,5 –2,5) is 1,0 (which makes the bonds polar).✓
The charge (electron density) distribution in a molecule is even/ the charge distribution is symmetrical.✓
There is no net dipole moment/ net dipole moment is zero.✓

Die verskil in elektronegatiwiteit in C=O (3,5 –2,5) is 1,0 (daarom is die bindings polêr.)
Die ladingsverspreiding (elektrondigtheid) is simmetries.
Daar is geen netto dipoolmoment nie / die netto dipoolmoment is zero. (3)

[10]

QUESTION / VRAAG 4

4.1.1 Induced dipole forces / London forces ✓
Geïnduseerde dipoolkragte / London kragte (1)

4.1.2 Covalent bonding / Kovalente binding ✓ (1)

4.1.3 Interatomic forces / Interatomiese kragte ✓ (1)

4.2.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure.✓✓
Die temperatuur waarby die dampdruk van 'n stof gelyk is aan die omringende atmosferiese druk.
[If any of the underlined key words / phrases in the correct context are omitted; deduct 1 mark / Indien enige van die onderstreepte woorde / frases in die korrekte konteks uitgelaat is, trek 1 punt af.] (2)

4.2.2 Molecular mass / Molekulêre massa ✓ (1)

4.2.3 **OPTION / OPSIE 1**
Boiling point increases with an increase in molecular mass. ✓
Kookpunt neem toe met 'n toename in molekulêre massa.

OPTION / OPSIE 2
Boiling point decreases with a decrease in molecular mass. ✓
Kookpunt neem af met 'n afname in molekulêre massa. (1)

4.2.4 **OPTION / OPSIE 1**

- As the molecular mass increases, the strength of intermolecular forces / van der Waals forces / induced dipole forces / London forces increases. ✓
- The energy needed to separate the molecules / to overcome the intermolecular forces / van der Waals forces / induced dipole forces / London forces increases. ✓
- As die molekulêre massa toeneem, sal die sterkte van die intermolekulêre kragte / van der Waals kragte / geïnduseerde dipoolkragte / London kragte toeneem.
- Die energie wat die molekules benodig om die intermolekulêre kragte / van der Waals kragte / geïnduseerde dipoolkragte / London kragte te oorkom neem toe.

OPTION / OPSIE 2

- As the molecular mass decreases, the strength of intermolecular forces / van der Waals forces / induced dipole forces / London forces decreases. ✓
- As die molekulêre massa afneem, sal die sterkte van die intermolekulêre kragte / van der Waals kragte / geïnduseerde dipoolkragte / London kragte afneem.
- The energy needed to separate the molecules / to overcome the intermolecular forces / van der Waals forces / induced dipole forces / London forces decreases. ✓
- Die energie wat die molekules benodig om die intermolekulêre kragte / van der Waals kragte / geïnduseerde dipoolkragte / London kragte te oorkom neem af.

(2)

4.2.5 **OPTION / OPSIE 1**

CORRECT / REG ✓

- Between molecules of E / H_2O there are hydrogen bonding, and between molecules of F / H_2S there are dipole-dipole forces. ✓
- Dipole-dipole forces are weaker than hydrogen bonding. ✓

- Tussen die molekules van E / H_2O is daar waterstofbinding, en tussen die molekules van F/ H_2S is daar dipool-dipool kragte.
- Dipool-dipool kragte is swakker as waterstofbinding.

OR / OF: Intermolecular forces in F / H_2S are weaker than between E / H_2O.
Intermolekulêre kragte tussen F / H_2S is swakker as tussen E / H_2O.

- Less energy is needed to overcome dipole-dipole forces (than hydrogen bonding) ✓

- Minder energie word benodig om dipool-dipoolkrgate te oorkom (as waterstofbinding)

OR / OF: Less energy is needed to overcome Intermolecular forces in F / H_2S than in E / H_2O.
Minder energie word benodig om die intermolekulêre in F / H_2S te oorkom as in E/ H_2O.

OR / OF: Less energy is needed to separate the molecules of F / H_2S (than the molecules of E / H_2O.)
Minder energie word benodig om molekules van F / H_2S te skei, as die molekules van E / H_2O.

OPTION / OPSIE 2

CORRECT/REG ✓

- Between molecules of E/ H_2O there are hydrogen bonding, and between molecules of F/ H_2S there are dipole-dipole forces✓
- Hydrogen bonding are stronger than dipole-dipole forces✓
- Tussen die molekules van E / H_2O is daar waterstofbinding, en tussen die molekules van F/ H_2S is daar dipool-dipool kragte.
- Waterstofbinding is sterker as dipool-dipoolkragte.

OR/OF: Intermolecular forces in E / H_2O are stronger than in F/ H_2S.
Intermolekulêre kragte tussen E / H_2O is sterker as tussen F / H_2S.

- More energy is needed to overcome hydrogen bonding (than dipole-dipole forces)✓
- Meer energie word benodig om waterstofbinding te oorkom (as dipool-dipoolkragte)

O /OF: More energy is needed to overcome Intermolecular forces in E / H_2O (than Intermolecular forces in F/ H_2S)
Meer energie is nodig om Intermolekulêre kragte in E / H_2O te oorkom (as Intermolekulêre kragte in F / H_2S)

OR/ OF: More energy is needed to separate the molecules of E/ H_2O (than the molecules of F / H_2S.) (4)
Meer energie word benodig om die molekules van E / H_2O te skei (as die molekules van F / H_2S.)

[13]

QUESTION /VRAAG 5

5.1 The property of a solid, liquid or gaseous chemical substance (solute) to dissolve in a solid, liquid or gaseous solvent to form a homogenous solution.✓✓

Die eienskap van 'n vaste stof, vloeistof of gas (opgeloste stof) om op te los in 'n vaste stof, vloeistof of gas (oplosmiddel) om 'n homogene oplossing te vorm.

[If any of the underlined key words/phrases in the correct context are omitted; deduct 1 mark / Indien enige van die onderstreepte woorde / frases in die korrekte konteks uitgelaat is, trek 1 punt af.] (2)

5.2.1 CRYSTALS ARE NOT SOLUBLE / KRISTALLE LOS NIE OP NIE ✓ (1)

5.2.2 CRYSTALS ARE SOLUBLE / KRISTALLE LOS OP ✓

•Water molecules are held together by strong hydrogen bonding. ✓
Watermolekules word deur sterk waterstofbinding bymekaar gehou.

•The ions in sodium chloride are held together by strong ion-dipole forces. ✓
Die ione in natriumchloried word deur ioon-dipoolkragte bymekaar gehou.

• Sodium chloride is soluble in water because the forces are in the same order of strength/ are of comparable strength. ✓
Natriumchloried is oplosbaar in water want die kragte is van dieselfde grootte orde / vergelykbare sterkte. (4)

5.3.1 Induced dipole forces / London forces. ✓
Geïnduseerde dipool kragte / London kragte. (1)

5.3.2 Intermolecular forces / van der Waals forces between iodine and water molecules are not of comparable strenghths.✓
Intermolekulêre kragte / van der Waals kragte tussen jodium en watermolekules is NIE van vergelykbare sterkte NIE.

OR/ OF: Induced dipole forces / London forces between iodine and hydrogen bonding in water are not of comparable strenghth.
Geïnduseerde dipool kragte / London kragte tussen jodium en waterstof binding in water is NIE van vergelykbare sterkte NIE.

OR/ OF: Substances dissolve in each other only if their Intermolecular forces / van der Waals forces are of comparable strenghths.
Stowwe sal oplos indien hul intermolekulêre kragte / van der Waals kragte van vergelykbare grootte is. (1)

[9]

GRAND TOTAL 50
GROOTTOTAAL 50