GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL EXAMINATION
JUNE 2024

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY

PAPER 2

TIME: 1 hour

MARKS: 50

6 pages + 2 data sheets

INSTRUCTIONS AND INFORMATION:

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of FOUR questions. Answer ALL 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 subquestions, e.g. 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 SHEETS.
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, et cetera where required.
12. 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. Write only the letter (A – D) next to the question numbers (1.1 – 1.4) in the ANSWER BOOK, e.g. 1.5 A.

1.1 A dative covalent bond forms when…

A water decomposes.
B ionic compounds dissociate in water.
C hydronium ions are produced.
D hydroxide ions are produced. (2)

1.2 The factor that does NOT affect bond length between two atoms is:

A The size of the atoms.
B The difference in electronegativity between the atoms.
C The number of bonds between the atoms.
D The valences of the atoms. (2)

1.3 Identify the intermolecular force that must be overcome to convert the following substance from a liquid to a gas: CH_3OH

A London Forces
B Dipole-dipole forces
C Hydrogen bonds
D Ionic bonds (2)

1.4 Which of the following groups of substances have the same intermolecular forces present?

A NH_3, $CH_3C\ell$
B CH_4, CO_2
C H_2O, CO
D $HC\ell$, H_2O (2)

[8]

QUESTION 2 (Start on a new page.)

2.1 Ammonia (NH_3) is a colourless, poisonous gas. It is synthesized by the Haber-Bosch process, in which nitrogen gas and hydrogen gas are reacted at high temperature and pressure. Ammonia has a lone pair.

2.1.1 Define the term *lone pair*. (2)

2.1.2 Name and explain the type of chemical bond between nitrogen and hydrogen. (3)

2.1.3 Draw the Lewis structure for the ammonia molecule. (2)

2.1.4 Name the shape of the ammonia molecule. (2)

2.2 Ammonia reacts with a hydrogen ion to form NH_4^+.

2.2.1 How many electrons surround the central atom in NH_4^+? (2)

2.2.2 Name the type of bond between ammonia and hydrogen ions in NH_4^+. (2)

2.3 Phosphine (PH_3) and Ammonia (NH_3) are molecules that have the same shape. Explain why the boiling point of PH_3 is less than that of NH_3. (3)

[16]

QUESTION 3 (Start on a new page.)

The diagram below represents the bonding that takes place in a molecule.

The electronegativity difference between element **X** and oxygen is 1,0.

3.1 Define the term *electronegativity*. (2)

3.2 To which group in the periodic table does element **X** belong? Give a reason for your answer. (2)

3.3 Identify element **X**. (1)

3.4 Is the molecule **X**O_2 polar or non-polar? Explain your answer fully.
Use the table below to answer the questions that follow.

BOND	BOND ENERGY (k.J.mol-1)	BOND LENGTH
O – H	463	96
N – H	389	100,8
C – C	348	154

(2)

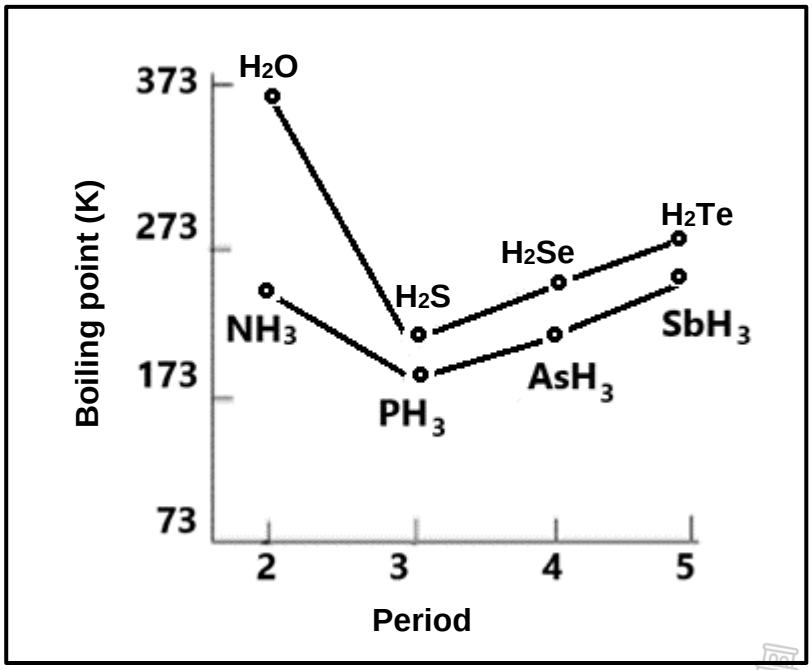
3.5 Define the term *bond energy*. (2)

3.6 From the data provided, what is the relationship between bond length and bond energy? (2)

[11]

QUESTION 4 (Start on a new page.)

The graph below shows the boiling points of different substances from groups 15 and 16 on the periodic table.



4.1 Define the term *boiling point* in words. (2)

4.2 Explain, in terms of the strengths of intermolecular forces, why the boiling points of H_2O and NH_3 are much higher than those of the rest of group 15 and 16. (3)

4.3 The boiling points increase from H_2S to H_2Te.

4.3.1 Identify the strongest type of intermolecular forces present. (1)

4.3.2 Explain the trend that can be seen in their boiling points. (2)

4.3.3 Give the formula of one of the above mentioned compounds that will be a liquid at 0 °C? (1)

4.4 In the laboratory you are provided with the following chemicals:

$C\ell_2$, SO_2 and NaBr

4.4.1 Identify the intermolecular forces in each of the above compounds. (3)

4.4.2 Which ONE of the above chemicals will have the highest vapour pressure? Explain the answer. (3)

[15]

TOTAL: 50

END

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 se 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)
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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

29
1,9
Cu
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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PROVINCIAL EXAMINATION/ *PROVINSIALE EKSAMEN*

JUNE/*JUNIE* 2024

GRADE/*GRAAD* 11

MARKING GUIDELINES/ *NASIENRIGLYNE*

PHYSICAL SCIENCES: (CHEMISTRY) PAPER 2
FISIESE WETENSKAPPE: (CHEMIE) VRAESTEL 2

6 pages/*bladsye*

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 D ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

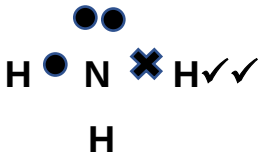
[8]

QUESTION 2/*VRAAG 2*

2.1 2.1.1 A lone pair is a pair of electrons in the valence shell of an atom that is not shared with another atom. ✓✓/
Alleenpaar is 'n paar elektrone in die valensievlak van 'n atoom wat nie met 'n ander atoom gedeel word nie. ✓✓ (2)

2.1.2 A covalent bond✓ is a sharing of electrons between two atoms to form a molecule. ✓✓/
'n Kovalente binding✓ is wanneer atome elektrone deel om 'n molekule te vorm. ✓✓ (3)

2.1.3



(2)

2.1.4 Trigonal pyramid ✓✓/*Trigonaal piramidaal* ✓✓ (2)

2.2 2.2.1 8 ✓✓ (2)

2.2.2 Covalent bond ✓✓/*Kovalente binding* ✓✓ (2)

2.3 Phosphine (PH_3) has dipole-dipole forces ✓ while Ammonia (NH_3) has hydrogen bonds. ✓
Dipole-dipole is weaker than hydrogen bonds. ✓/
Fosforhidried (PH_3) het dipool-dipool kragte ✓terwyl Ammoniak (NH_3) waterstofbindings het. ✓✓
Dipool-dipool kragte is swakker as waterstofbindings ✓

OR/*OF*

Ammonia (NH_3) has hydrogen bonds ✓ while Phosphine (PH_3) has dipole-dipole forces.✓ Hydrogen bonds are stronger than dipole-dipole forces. ✓/
Ammoniak (NH_3) het waterstofbindings ✓terwyl Fosforhidried (PH_3) dipool-dipool kragte het. ✓Waterstofbindings is sterker as dipool-dipool kragte. ✓ (3)

[16]

QUESTION 3/*VRAAG 3*

3.1 Electronegativity is a measure of the tendency of an atom in a molecule to attract bonding electrons. ✓
Elektronegatiwiteit is 'n maatstaaf van die neiging van 'n atoom in 'n molekule om bindingselektrone aan te trek. ✓✓ (2)

3.2 Group IV, ✓ can form 4 bonding pairs ✓ with no lone pair or has a valency of four./
Groep IV, ✓*kan 4 bindingspare vorm* ✓*met geen alleenpare of dit het 'n valensie van vier.* (2)

3.3 C/carbon atom ✓/
C/koolstofatoom (1)

3.4 Non-polar,✓ the bonds between C and O atoms are polar, ✓ but the molecule is symmetrically shaped/ even distribution of electrons around the molecule.
Nie-polêr, ✓*die bindings tussen C en O atome is polêr,* ✓ *maar die molekule is simmetries in vorm/ eweredige verspreiding van elektrone rondom die molekule.* (2)

3.5 Bond energy is the energy needed to break one mole of its molecules into separate atoms. ✓✓/
Bindingsenergie is die energie wat nodig is om een mol molekules op te breek in aparte atome. ✓✓ (2)

3.6 As the bond length increases, the bond energy decreases. ✓✓/
Soos die bindingslengte toeneem, sal die bindingsenergie afneem. ✓✓

OR/*OF*

As the bond length decreases, the bond energy increases. ✓✓
Soos die bindingslengte afneem, sal die bindingsenergie toeneem. ✓✓ (2)
[11]

QUESTION 4/*VRAAG 4*

4.1 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 atmosferiese druk. ✓✓ (2)

4.2
- NH_3 and H_2O has Hydrogen bonds, while the rest has dipole-dipole forces ✓
- Hydrogen bonds are much stronger than dipole dipole forces ✓
- Thus more energy will be needed to overcome the hydrogen bonds than the dipole-dipole forces. ✓/
- *NH_3 en H_2O het Waterstofbindings, terwyl die res dipool-dipool kragte het* ✓
- *Waterstofbindings is sterker as dipool-dipool kragte* ✓
- *Dus word meer energie benodig om die waterstofbindings te oorkom as om dipool-dipoolkragte te oorkom.* ✓ (3)

4.3 4.3.1 Dipole-dipole forces ✓/
Dipool-dipool kragte ✓ (1)

4.3.2
- All had dipole-dipole forces./
- The molecular mass increases as you go down in the groups. ✓
- As the molecular mass increases the strength of the dipole-dipole forces increases. ✓/
- *Almal het dipool-dipool kragte.* ✓
- *Die molekulêre massa neem toe soos wat daar afbeweeg word in die groep.* ✓
- *Indien die molekulêre massa toeneem sal die sterkte van die dipool-dipool kragte toeneem.* ✓ (2)

4.3.3 H_2Te ✓ (1)

4.4 4.4.1 $C\ell_2$, – London forces ✓/*London kragte*✓
SO_2 – Dipole-dipole forces ✓/*Dipool-dipool kragte*✓
NaBr – Ionic bonds/Electrostatic forces ✓/*Ioniese binding/ Elektrostatiese kragte*✓ (3)

4.4.2 $C\ell_2$ ✓
– the substance with the weakest intermolecular forces ✓will have the lowest boiling point and therefore the highest vapour pressure. ✓/
– die stof met die swakste intermolekulêre kragte ✓*sal die laagste kookpunt hê en daarom die hoogste dampdruk.* ✓ (3)
[15]

TOTAL/*TOTAAL*: 50

Taxonomy

Weighting of Topics

Question	Atomic combinations	Intermolecular forces			Question Total
1	4	4			**8**
2	13	3			**16**
3	11				**11**
4		17			**15**
5					
6					
7					
8					
Total Mark	28	24			**50**
Actual					**100%**
Target					**100%**

	Cognitive Levels			
Question no:	**Knowing science**	**Understanding science**	**Applying scientific knowledge**	**Evaluating, analysing, synthesising**
1.1		2		
1.2		2		
1.3		2		
1.4			2	
2.1.1	2			
2.1.2		3		
2.1.3		2		
2.1.4		2		
2.2.1		2		
2.2.2		2		
2.3		3		
3.1	2			
3.2		2		
3.3			1	
3.4				2
3.5	2			
3.6			2	
4.1	2			
4.2		3		
4.3.1		1		
4.3.2			2	
4.3.3		1		
4.4.1		3		
4.4.2			3	
Total Mark	08	30	10	02
REQUIRED	15 %	35 %	40 %	10 %