



GAUTENG PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL EXAMINATION

JUNE 2023

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY

PAPER 2

TIME: 1 hour

MARKS: 50

6 pages + 1 data sheet



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, 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, 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 number (1.1 to 1.4) in the ANSWER BOOK, for example 1.5 A.

- 1.1 The tendency of an atom to attract a bonding pair of electrons is referred to as ...
- A electron affinity.
B electronegativity.
C polarity.
D valency. (2)
- 1.2 Which of the following compounds contains ionic bonds?
- A CH_4
B CO_2
C MgCl_2
D O_2 (2)
- 1.3 The type of intermolecular forces that exist in a water molecule are called ...
- A London forces.
B ion-ion forces.
C ion-dipole forces.
D hydrogen bonds. (2)
- 1.4 What type of IMF are present in all substances, regardless of polarity?
- A Dipole-dipole forces
B Dispersion/London forces
C Ion-dipole forces
D Hydrogen bonding (2)

[8]

QUESTION 2: (Start on a new page.)

2.1 Hydrogen cyanide (HCN) is a very poisonous compound used in the mining of gold and the manufacturing of plastic and poison.

2.1.1 Define a *chemical bond*. (2)

2.1.2 Draw the Lewis structure for HCN. (2)

2.1.3 What is the shape of the HCN molecule? (2)

2.1.4 What is the polarity of the HCN molecule? Write only POLAR or NON-POLAR. (1)

2.2 The table below indicates the values of the bond length and bond energy of the different bonds in HCN.

Bond	Bond length (nm)	Bond energy (kJ.mol ⁻¹)
CH	0,109	413
CN	0,116	890

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

2.2.2 Explain why the bond energy of the CN bond is more than the bond energy of the CH bond. (2)

2.2.3 Explain the difference between *the bond length of the CH bond and the bond length of the CN bond*. (2)

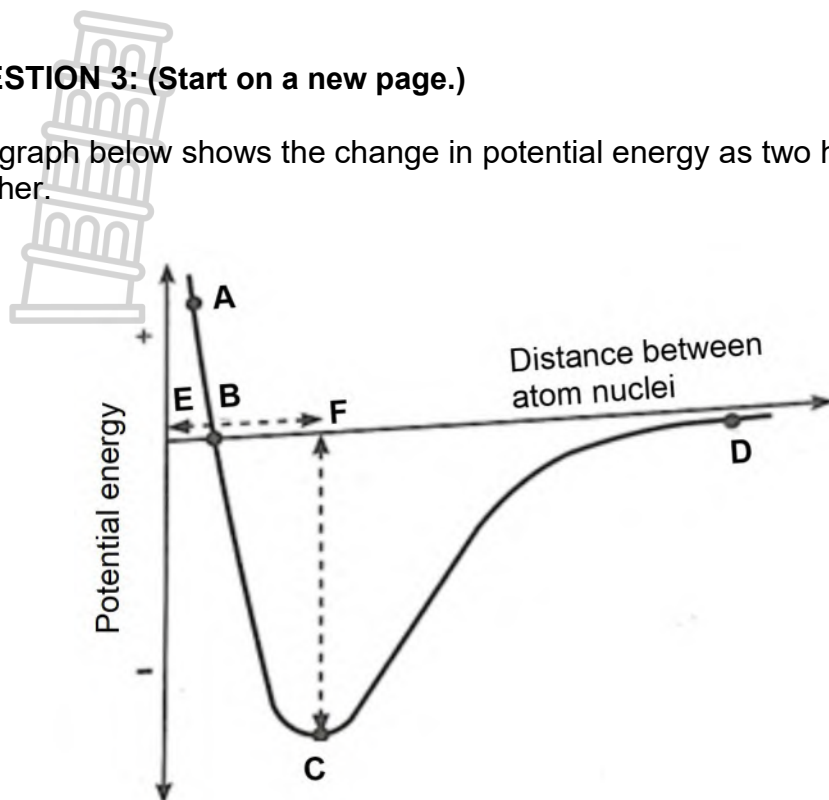
2.2.4 Will HCN be soluble in water? Write only YES or NO. (1)

2.2.5 Explain the answer to QUESTION 2.2.4 by referring to the polarity and intermolecular forces of the compounds. (3)

[17]

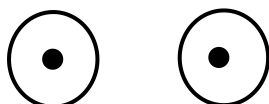
QUESTION 3: (Start on a new page.)

The graph below shows the change in potential energy as two hydrogen atoms approach one another.



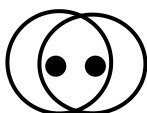
3.1 Match the diagram 3.1.1 – 3.1.3 below to point **A**, **B**, **C** or **D** that illustrates the distance between the hydrogen nuclei to the points on the energy diagram.

3.1.1



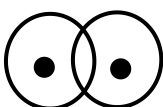
(1)

3.1.2



(1)

3.1.3



(1)

3.2 What is represented by **EF** and **FC** respectively?

(2)

3.3 Which point on the graph represents the position of greatest stability?

(1)

3.4 Which ONE of the letters **A**, **C** or **D**, represents the formation of the H_2 molecule. Give a reason for your answer.

(2)

3.5 Which factor will cause the potential energy to decrease as the two atoms approach one another?

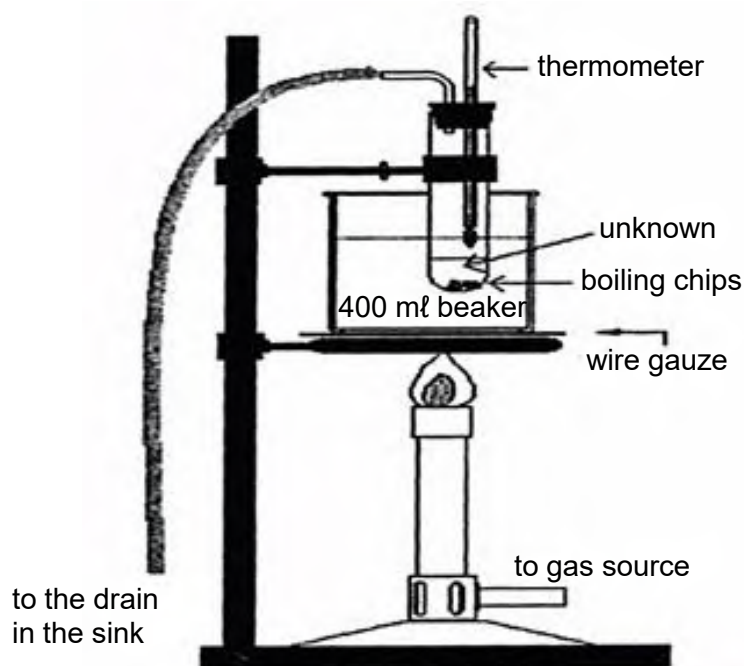
(2)

[10]

P.T.O.

QUESTION 4: (Start on a new page.)

The grade 11 learners perform an experiment to determine the effect of intermolecular forces on the boiling point. Learners heated equal amounts of different liquids (acetone, distilled water, ethanol, and methylated spirits) in a water bath over a bunsen burner. It was found that the distilled water took longer to boil.



- 4.1 Give an investigative question for this investigation. (2)
- 4.2 For this investigation give the:
- 4.2.1 Independent variable (1)
- 4.2.2 Controlled variable (1)
- 4.3 Why are the liquids heated in a water bath? (1)
- 4.4 Which liquid has the lowest vapour pressure? Explain your answer. (2)
- 4.5 State your conclusion for this investigation. (2)
- 4.6 Define the term *boiling point*. (2)
- 4.7 Explain the difference in boiling points of acetone and distilled water in terms of intermolecular forces and energy. (4)

[15]

TOTAL: 50

END

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 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	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	85 At	86 Rn																												
87 Fr	88 Ra 226	89 Ac	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>58 Ce 140</td> <td>59 Pr 141</td> <td>60 Nd 144</td> <td>61 Pm</td> <td>62 Sm 150</td> <td>63 Eu 152</td> <td>64 Gd 157</td> <td>65 Tb 159</td> <td>66 Dy 163</td> <td>67 Ho 165</td> <td>68 Er 167</td> <td>69 Tm 169</td> <td>70 Yb 173</td> <td>71 Lu 175</td> </tr> <tr> <td>90 Th 232</td> <td>91 Pa</td> <td>92 U 238</td> <td>93 Np</td> <td>94 Pu</td> <td>95 Am</td> <td>96 Cm</td> <td>97 Bk</td> <td>98 Cf</td> <td>99 Es</td> <td>100 Fm</td> <td>101 Md</td> <td>102 No</td> <td>103 Lr</td> </tr> </table>															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
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

1,9
29
Cu
63,5

Symbol/
Simbool

Approximate relative atomic mass/
Benaderde relatiewe atoommassa



**PROVINCIAL EXAMINATION/
PROVINSIALE EKSAMEN**

JUNE/JUNIE 2023

GRADE/GRAAD 11

MARKING GUIDELINES/NASIENRIGLYNE

**PHYSICAL SCIENCES: CHEMISTRY/
FISIESE WETENSKAPPE: CHEMIE**

PAPER/VRAESTEL 2

5 pages/bladsye



QUESTION/VRAAG 1

- 1.1 B ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 B ✓✓ (2)

[8]

QUESTION/VRAAG 2

- 2.1 2.1.1 The chemical bond is a mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons. ✓✓ / *Chemiese binding is die gemeenskaplike aantrekkingskrag tussen twee atome as gevolg van die gelyktydige aantrekkingskrag tussen hul kerne en buite elektrone.* ✓✓ (2)
- 2.1.2 $\text{H}:\text{C}::\text{N}:$ ✓✓ (2)
- 2.1.3 Linear/Linieêr ✓✓ (2)
- 2.1.4 Polar/Polêr ✓ (1)
- 2.2 2.2.1 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 van die molekules in aparte atome op te breek.* ✓✓ (2)
- 2.2.2 CN has a higher order bond/triple bond with more orbitals overlapping ✓ than CH, which is a single bond. ✓ Thus the CN bond needs more energy to break. / *CN het 'n hoër orde binding/trippelbinding met meer orbitale wat oorvleuel ✓ as in CH, wat 'n enkelbinding is. ✓ Dus neem die CN meer energie om die binding te breek.* (2)
- 2.2.3 CN has a longer bond length than CH ✓ because the H atom is smaller than the N atom. ✓ / *CN het 'n langer bindingslengte as CH ✓ omdat die H atom kleiner is as die N atoom.* ✓ (2)
- 2.2.4 Yes/Ja ✓ (1)

- 2.2.5
- Both molecules are polar. ✓/Beide molekules is polêr. ✓
 - HCN has dipole-dipole forces and H₂O has (dipole-dipole forces) hydrogen bonds. ✓/HCN het dipool-dipool kragte en H₂O het (dipool-dipool) waterstofbindings. ✓
 - Like dissolves like. ✓/Soort los soort op. ✓

OR/OF

- HCN has polar molecules with dipole-dipole forces ✓./HCN het polêre molekules met dipool-dipool kragte. ✓
- H₂O has polar molecules with hydrogen bonds (dipole-dipole forces). ✓/H₂O het polêre molekules met waterstof bindings (dipool-dipool kragte) ✓
- If the forces are of the same order/comparable, the substances will dissolve. ✓/Indien kragte van dieselfde orde/vergelykbaar is, dan sal die stowwe oplos. ✓

(3)
[17]

QUESTION/VRAAG 3

- 3.1 3.1.1 D ✓ (1)
- 3.1.2 A ✓ (1)
- 3.1.3 C ✓ (1)
- 3.2 EF: bond length ✓/bindingslengte ✓
FC: bond energy ✓/bindingsenergie ✓ (2)
- 3.3 C ✓ (1)
- 3.4 C ✓ – lowest potential energy./laagste potensiële energie ✓ (2)
- 3.5 Attractive forces between the subatomic particles of the atoms./Aantrekkingskrag tussen die subatomiese deeltjies van die atome. ✓✓ (2)

[10]

QUESTION/VRAAG 4

4.1	Criteria for investigative question:/ <i>Kriteria vir ondersoekende vraag:</i>	
	The dependent and independent variables are stated correctly./ <i>Die afhanklike en onafhanklike veranderlikes is korrek gestel.</i>	✓
	Asks a question about the relationship between dependent and independent variables./ <i>Vra 'n vraag oor die verband tussen die afhanklike en onafhanklike veranderlikes.</i>	✓

What is the relationship between the boiling point and the strength of the intermolecular forces?/*Wat is die verband tussen die kookpunt en die sterkte van die intermolekulêre kragte?* (2)

4.2 4.2.1 Liquid ✓/*Vloeistof* ✓ (1)

4.2.2 The volume of liquid, atmospheric pressure. (Any one) ✓/*Die volume van die vloeistof, atmosferiese druk (Enige een)* ✓ (1)

4.3 (Some) liquids are flammable. ✓/*(Sommige) vloeistowwe is vlambaar.* ✓ (1)

4.4 Water or/of H₂O. ✓ Water has a higher boiling point. ✓/*Water het 'n hoër kookpunt.* ✓ (2)

4.5 The stronger the intermolecular force, the higher the boiling point. ✓✓/*Hoe sterker die intermolekulêre kragte, hoe hoër die kookpunt.* ✓✓ (2)

4.6 The **temperature** at which the **vapour pressure** of a substance **equals atmospheric pressure**. ✓✓/*Die temperatuur* waarby die **dampdruk** van 'n **verbinding gelyk is aan die atmosferiese druk**. ✓✓ (2)

- 4.7
- Acetone has dipole-dipole forces ✓, and water has hydrogen bonds. ✓/*Asetoon het dipool-dipool kragte* ✓, en water het waterstofbindings. ✓
 - The intermolecular forces in water are stronger than in acetone (The hydrogen bond is stronger than dipole-dipole). ✓/*Die intermolekulêre kragte in water is sterker as in asetoon (Die waterstof binding is sterker as dipool-dipool.)* ✓
 - More energy is needed to overcome intermolecular forces in water/hydrogen bonding than in acetone/dipole-dipole. ✓/*Meer energie is nodig om die intermolekulêre kragte in water/waterstofbinding te oorkom as in asetoon/dipool-dipool.* ✓

OR/OF

- The intermolecular forces in acetone are weaker than in water (dipole-dipole are weaker than hydrogen bonding). ✓/*Die intermolekulêre krag in asetoon is swakker as in water (dipool-dipool is swakker as waterstofbinding).* ✓
- Less energy is needed to overcome intermolecular forces in acetone/dipole-dipole than in water/hydrogen bonding. ✓/*Minder energie is nodig om die intermolekulêre in asetoon/dipool-dipool te oorkom as in water/waterstofbinding.* ✓ (4)

[15]

TOTAL/TOTAAL: 50

Taxonomy/taksonomie: Weighting of Topics/gewig van onderwerpe

QUESTION VRAAG	Atomic combinations <i>Atoomkombinasies</i>	Intermolecular forces <i>Intermolekulêre kragte</i>	Question Total <i>Vraagtotal</i>
1	4	4	8
2	17		17
3	10		10
4		15	15
Total Mark/Totale punt	31	19	50
Actual/Werklik Target/Teiken			50
			50

Cognitive Levels/Kognitiewe vlakke

Question no: Vraagnommer	Knowing Science <i>Wetenskap kennis</i>	Understanding Science <i>Om Wetenskap te verstaan</i>	Applying scientific knowledge <i>Die toepassing van wetenskaplike kennis</i>	Evaluating, analysing, synthesising <i>Evaluering/analiseringsintetisering</i>
1.1	2 ✓			
1.2		2 ✓		
1.3		2 ✓		
1.4		2 ✓		
2.1.1	2 ✓			
2.1.2		2 ✓		
2.1.3		2 ✓		
2.1.4		1 ✓		
2.2.1	2 ✓			
2.2.2			2 ✓	
2.2.3			2 ✓	
2.2.4		1 ✓		
2.2.5			3 ✓	
3.1.1		1 ✓		
3.1.2		1 ✓		
3.1.3		1 ✓		
3.2		2 ✓		
3.3		1 ✓		
3.4		2 ✓		
3.5		2 ✓		
4.1		2 ✓		
4.2.1		1 ✓		
4.2.2		1 ✓		
4.3		1 ✓		
4.4			2 ✓	
4.5	2 ✓			
4.6	2 ✓			
4.7			4 ✓	
Total Mark// Totale punt	10	27	13	