GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

2019

GRADE 11

PHYSICAL SCIENCES
PAPER 2

CHEMISTRY

NAME OF LEARNER: _____

GRADE: _____

MARKS: 150

TIME: 3 hours

15 pages

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PHYSICAL SCIENCES
Paper 2 (CHEMISTRY)

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INSTRUCTIONS AND INFORMATION:

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SEVEN 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 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 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 given 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 – 1.10) in the ANSWER BOOK.

1.1 Which of these is **NOT** an intermolecular force?

A Covalent bonding
B Hydrogen bonding
C London / dispersion forces
D Dipole – dipole forces (2)

1.2 London forces are found between …

A two polar molecules.
B two non-polar molecules.
C a polar molecule and a non-polar molecule.
D a polar molecule and an ionic substance. (2)

1.3 Which of the following compounds have a shape that can be described as trigonal bipyramidal?

A CH_4
B $PC\ell_5$
C SF_6
D BF_3 (2)

1.4 Which of the following have the same molecular geometry?

CO_2, H_2O, $BeCl_2$ and N_2O

A CO_2, $BeCl_2$ and N_2O
B H_2O and N_2O only
C H_2O, $BeCl_2$ and CO_2
D CO_2 and N_2O only (2)

1.5 Under which of the following conditions of temperature and pressure will hydrogen's behaviour be similar to an ideal gas?

	TEMPERATURE	PRESSURE
A	273 K	1×10^5 Pa
B	10 K	1×10^2 Pa
C	273 K	1×10^2 Pa
D	10 K	1×10^5 Pa

(2)

1.6 The volume of an enclosed gas is 200 cm^3. The pressure is tripled and the temperature is doubled, the new volume is…

A 1200,33 cm^3.
B 800,33 cm^3.
C 300,33 cm^3.
D 133,33 cm^3. (2)

1.7 Charles' Law can be represented mathematically as follows …

A $V \propto T$.

B $V \propto \frac{1}{T}$.

C $pV \propto T$.

D $VT = k$. (2)

1.8 Consider equal masses of each of the four different gases given below. The gases are of the same temperature and pressure. The gas that will occupy the **biggest** volume is …

A Helium.
B Chlorine.
C Hydrogen.
D Sulphur dioxide. (2)

1.9 18,25 g of HCl is dissolved in 250 cm^3 distilled water. The concentration of the solution is …

A 0,073 $mol.dm^{-3}$.
B 73 $mol.dm^{-3}$.
C 0,002 $mol.dm^{-3}$.
D 2 $mol.dm^{-3}$. (2)

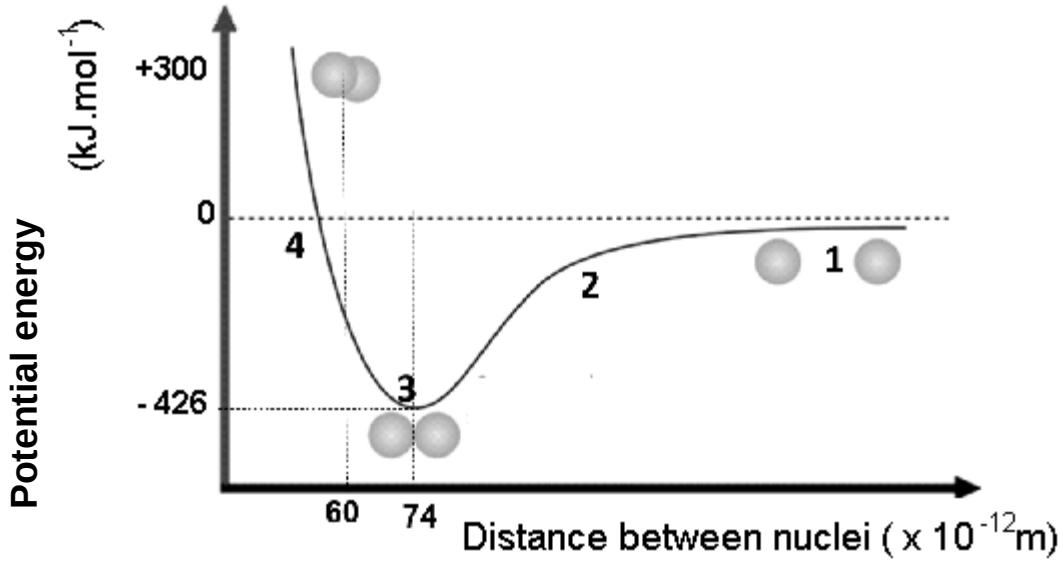
1.10 How many molecules are there in 1,5 moles of hydrogen sulphide?

A $1,51 \times 10^{24}$ molecules
B $9,03 \times 10^{23}$ molecules
C $3,01 \times 10^{23}$ molecules
D $4,21 \times 10^{23}$ molecules (2)

[20]

QUESTION 2: (START ON A NEW PAGE.)

The graph below shows how the potential energy of two hydrogen atoms change as the distance between them changes.



It is possible to find the magnitude of the bond energy for hydrogen and the bond length of the hydrogen molecule.

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

2.2 From the graph, state the bond energy for hydrogen. (1)

2.3 Define the term *bond length*. (2)

2.4 From the graph state the bond length for the hydrogen molecule. (1)

2.5 Explain in your own words why the molecule is more stable at point 3 than at point 4, as shown on the graph. (4)
[10]

QUESTION 3: (START ON A NEW PAGE)

A chemical bond is defined as a mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons. Answer the following questions in terms of chemical bonding.

3.1 Define the term *electronegativity*. (2)

3.2 Use electronegativities to explain which of the following atoms would most likely be the negative ion: Al or S. (2)

3.3 Show by means of electronegativity what type of bond will be formed between the elements in each of the following examples.

3.3.1 MgO (2)
3.3.2 $HC\ell$ (2)
3.3.3 PH_3 (2)

3.4 The valence shell electron repulsion theory (VSEPR) is used to predict the geometrical shape of molecules.

Define the term *Valence electrons*. (2)

3.5 Draw Lewis structures for the following:

3.5.1 The oxygen atom (2)
3.5.2 P (2)
3.5.3 $C\ell^{-1}$ (2)
3.5.4 $HOC\ell$ (2)

3.6 How many bonding electron pairs are there in a trigonal planar molecule? (2)

3.7 Indicate the VSEPR-shape of each of the following molecules.

3.7.1 $CC\ell_4$ (2)
3.7.2 BF_3 (2)
3.7.3 SO_2 (2)

3.8 The hydronium ion (H_3O^+) is formed when an acid ionises in water.

3.8.1 What type of bond forms between a H^+ ion and a water molecule? (2)

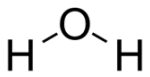
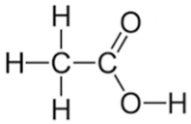
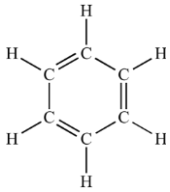
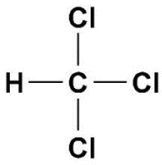
3.8.2 Use Lewis diagrams to show the formation of the hydronium ion. (3)

[33]

QUESTION 4: (START ON A NEW PAGE)

4.1 A group of Grade 11 learners investigate how intermolecular forces affect the boiling and melting points of different substances.

They record the following results:

Name	Formula	Diagram	Melting point (^oC)	Boiling point (^oC)
Water	H_2O		0,0	100,0
Acetic Acid	CH_3COOH		17,0	118,1
Benzene	C_6H_6		5,5	80,2
Chloroform	$CHCl_3$		-63,5	61.2

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

4.1.2 Explain why water has a higher boiling point than chloroform. (3)

4.1.3 Using the diagrams of the molecules in the table above as a guide, explain why chloroform has a lower boiling point than benzene. (2)

4.2 Study the following substances:

HCℓ, $C\ell_2$, H_2O, CO_2, HF, $MgC\ell_2$

Which of the above will have ...?

4.2.1 the highest boiling point (1)

4.2.2 london forces (2)

4.2.3 hydrogen bonds (2)

4.2.4 dipole – dipole forces (1)

4.2.5 ionic bonds (1)

4.3 For the following compounds state whether the molecule is polar or non-polar.

4.3.1 O_2 (2)
4.3.2 NH_3 (2)
4.3.3 CO_2 (2)

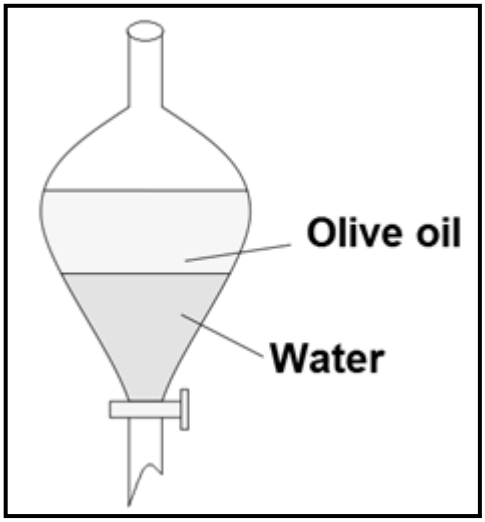
4.4 The molecules of NH_3 and PH_3 have a similar shape, yet PH_3 has a much higher vapour pressure at STP than NH_3.

4.4.1 Define the term *vapour pressure*. (2)

4.4.2 Explain the difference in vapour pressure between above mentioned molecules, by referring to the type and strength of intermolecular forces in each one. (4)
[26]

QUESTION 5: (START ON A NEW PAGE)

The following diagram shows a separating funnel containing water and olive oil.



5.1 Give TWO reasons why the olive oil and water don't mix. (2)

5.2 Define *density* in words. (2)

5.3 Potassium permanganate ($KMnO_4$) and iodine crystals (I_2) are dropped into the funnel.

5.3.1 What type of forces exist between the iodine crystals? (2)

5.3.2 What type of forces exist between the $KMnO_4$ crystals? (2)

5.3.3 Which layer will turn purple? (2)

5.3.4 Explain your answer to 5.3.3. by referring to the type of intermolecular forces in both the solute and the solvent. (4)
[14]

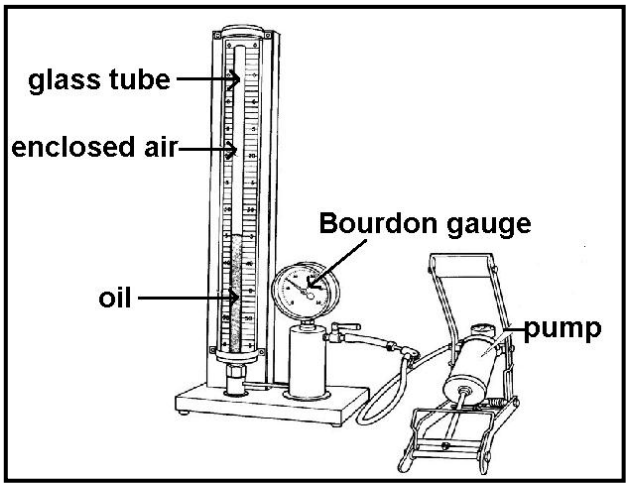
QUESTION 6: (START ON A NEW PAGE)

6.1 Hydrogen and helium are very close to ideal gases.

6.1.1 Give THREE properties of an ideal gas. (3)

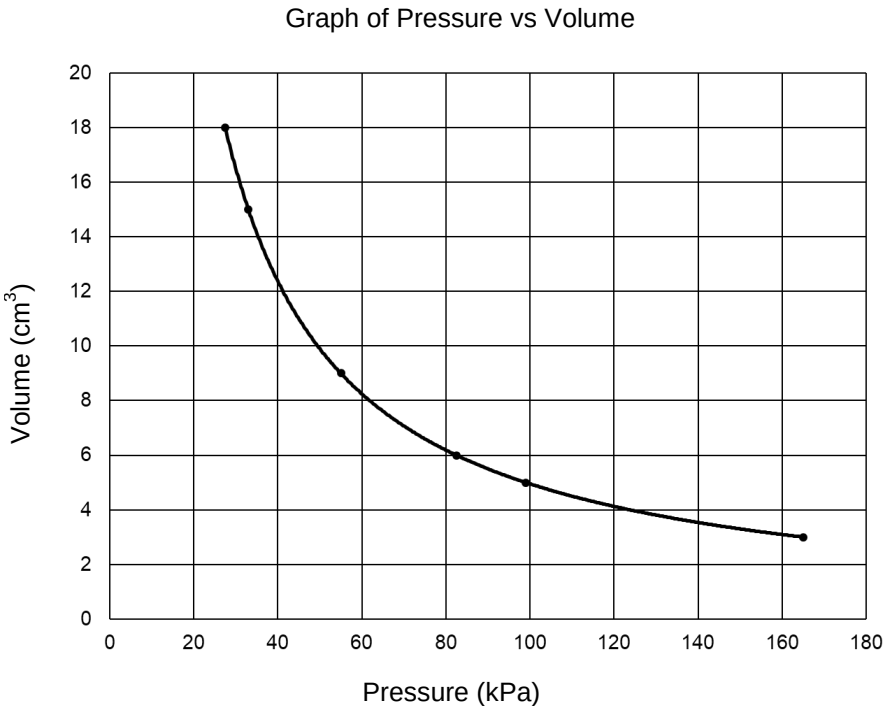
6.1.2 Under what conditions of temperature and pressure do real gases behave most as ideal gases? (2)

6.2. During an investigation of the relationship between pressure and volume of a given mass of gas, a group of learners set up the following apparatus.



6.2.1 Name the apparatus shown above. (1)

The learners use the pump to change the pressure on the gas. From their results they obtained the following graph.



6.2.2 State Boyle's law in words. (2)

6.2.3 Identify the following variables:

6.2.3.1 Independent variable (1)

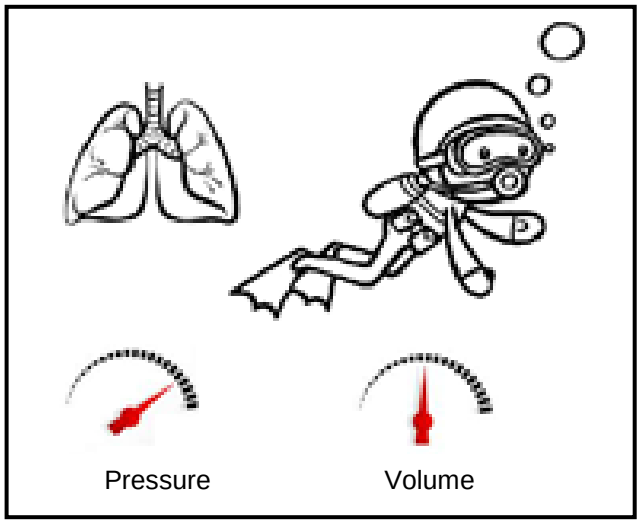
6.2.3.2 Dependent variable (1)

6.2.3.3 Controlled variables (2)

6.2.4 From the graph state the pressure of the gas when the volume of the gas is 4 cm^3. (2)

6.2.5 Describe how the shape of the graph would change if the experiment is performed at a higher temperature. (2)

6.3. Safety during diving is of extreme importance. Ignoring the gas laws might be fatal.



A scuba diver's lungs contain 6 ℓ volume of gas, at a pressure of one atmosphere and a temperature of 295 K.

6.3.1. Find the volume of the gas at a pressure of 120 kPa and temperature of 282 K. (5)

6.3.2. Convert 282 K to ^{o}C. (2)

6.3.3. Explain what will happen to the diver's lungs if he surfaces too quickly and why it would happen. (3)
[26]

QUESTION 7: (START ON A NEW PAGE)

7.1 Aluminium hydroxide is widely used as an antacid as well as in deodorant. Whereas hydrogen sulphide is used to produce elemental sulphur that is then used in the production of sulphuric acid. Both these substances are produced in the following reaction.

$$H_2O + A\ell_2S_3 \rightarrow H_2S + A\ell(OH)_3$$

7.1.1 Re-write and balance the reaction. (3)

7.1.2 If 10 g of aluminium hydroxide was produced, calculate the mass of aluminium sulphide that was added to the excess water to produce this. (4)

7.1.3 Calculate the percentage of oxygen in $A\ell(OH)_3$. (3)

7.2 When hydrochloric acid reacts with calcium carbonate it produces calcium chloride and carbonic acid, according to the following balanced equation:

$$2HC\ell(aq) + CaCO_3(s) \rightarrow CaC\ell_2(aq) + H_2CO_3(aq)$$

400 cm^3 hydrochloric acid of concentration 0,2 $mol.dm^{-3}$ is used with 20 g calcium carbonate.

7.2.1 Determine which reactant is in excess. (6)

7.2.2 Determine the mass of $CaC\ell_2$ produced. (3)

7.2.3 If only 4 g of $CaC\ell_2$ is produced, calculate the percentage yield for this reaction. (2)

[21]

TOTAL: 150

END

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

TABLE / *TABEL* 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·K^{-1}·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·mol^{-1}
Standard temperature *Standaardtemperatuur*	T^θ	273 K

TABLE / *TABEL* 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