GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

NOVEMBER 2021

GRADE 10

PHYSICAL SCIENCES (CHEMISTRY)

(PAPER 2)

TIME: 2 hours

MARKS: 100

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

SECTION A

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 1.10) in the ANSWER BOOK.

1.1 The smallest particle to be found in sugar that still has the properties of sugar, is called a …

A granule.
B molecule.
C atom.
D electron. (2)

1.2 The particles of a solid …

A move haphazardly.
B do not move at all.
C move over one another.
D vibrate around fixed positions in the crystal. (2)

1.3 The process that takes place when a calcium atom reacts with an oxygen atom to form calcium oxide, is:

A Four electrons (two from each atom) are shared between the atoms
B Two electrons (one from each atom) are shared between the atoms
C Two electrons from the calcium atom are transferred to the oxygen atom
D Two electrons from the oxygen atom are transferred to the calcium atom (2)

1.4 This valency electron-configuration is possibly that of: (2)

$$s^2p_x^2p_y^1p_z^1$$

A Br
B P
C Si
D S (2)

1.5 Elements T, X, Z and Y are respectively in group IA, IIA, VIA and VIIA of the periodic table of elements.

A formula for the compound formed by two of these elements which is NOT CORRECT is:

A TZ
B XY_2
C T_2Z
D TY (2)

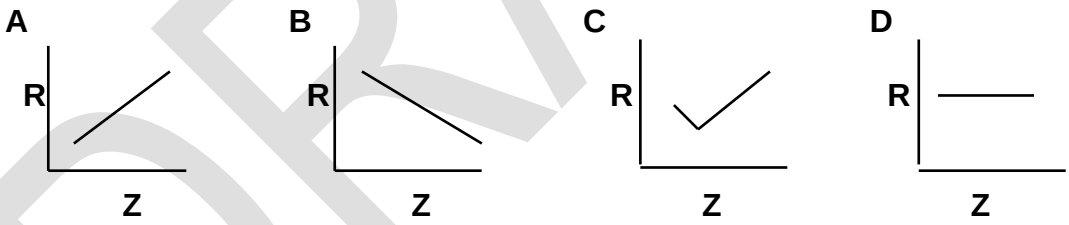
1.6 At STP…

I the molar volume of hydrogen is 22,4 dm^3.
II 22,4 dm^3 of any gas consists of 6,02 x 10^{23} particles.
III 22,4 dm^3 of helium consists of 1 mol of atoms.

Which of these statements are true?

A only I
B I and II only
C II and III only
D I, II and III (2)

1.7 Which graph represents atomic radius, **R**, versus atomic number, **Z**, for the elements of period 2?



(2)

1.8 The energy released when an electron is added to an isolated neutral atom to form a negative ion, is called …

A ionisation energy.
B electronegativity.
C lattice energy.
D electron affinity. (2)

1.9 This balanced chemical equation represents the reaction between methane (CH_4) and steam (H_2O):

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3H_2(g)$$

The volume of methane (in m^3) needed to form 150 m^3 of hydrogen at the same temperature and pressure is …

A 25.
B 50.
C 75.
D 150. (2)

1.10 The formula for Epsom Salt is $MgSO_4 \cdot 7H_2O$.
The mass (in gram) of Epsom Salt needed to prepare 1 dm^3 of solution with concentration 0,1 $mol \cdot dm^{-3}$ is …

A 12.
B 15.
C 19,2.
D 24,6. (2)

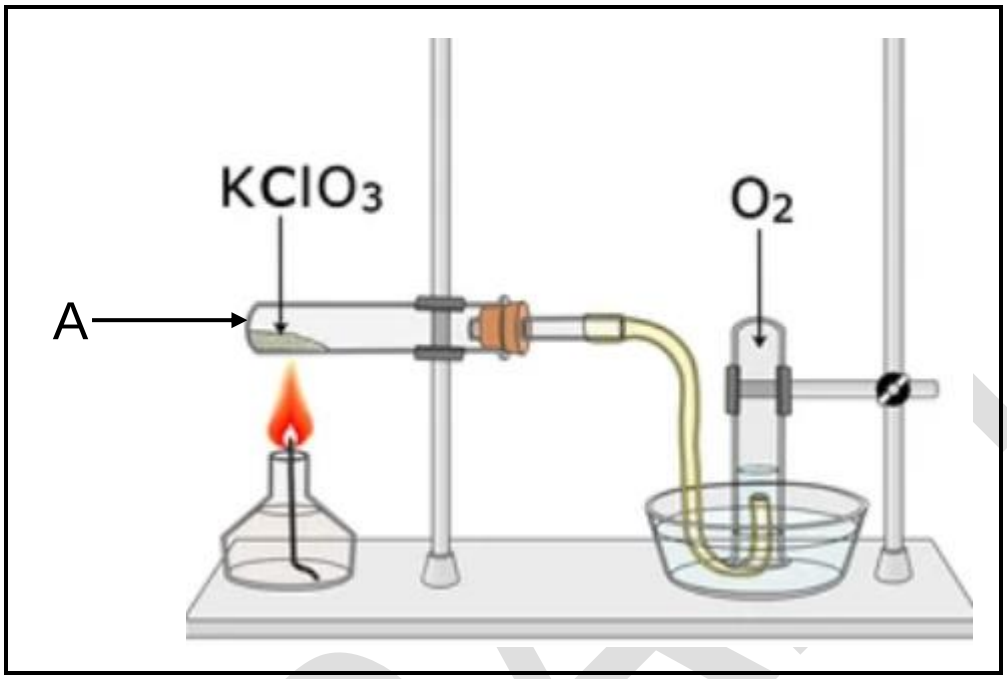
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2 (Start on a new page.)

To prepare oxygen, potassium chlorate can be heated in the presence of a suitable catalyst as shown below.



The equation for the reaction is: $KC\ell O_3(s) \rightarrow KC\ell(s) + O_2(g)$

2.1 Balance the equation. (1)

2.2 Give the empirical formula for potassium chlorate. (1)

2.3 What is the chemical name of the product 'KCℓ'? (1)

2.4 Is potassium chlorate a pure or impure substance? Explain the answer. (2)

2.5 Draw the Aufbau diagram for an oxygen atom. (3)

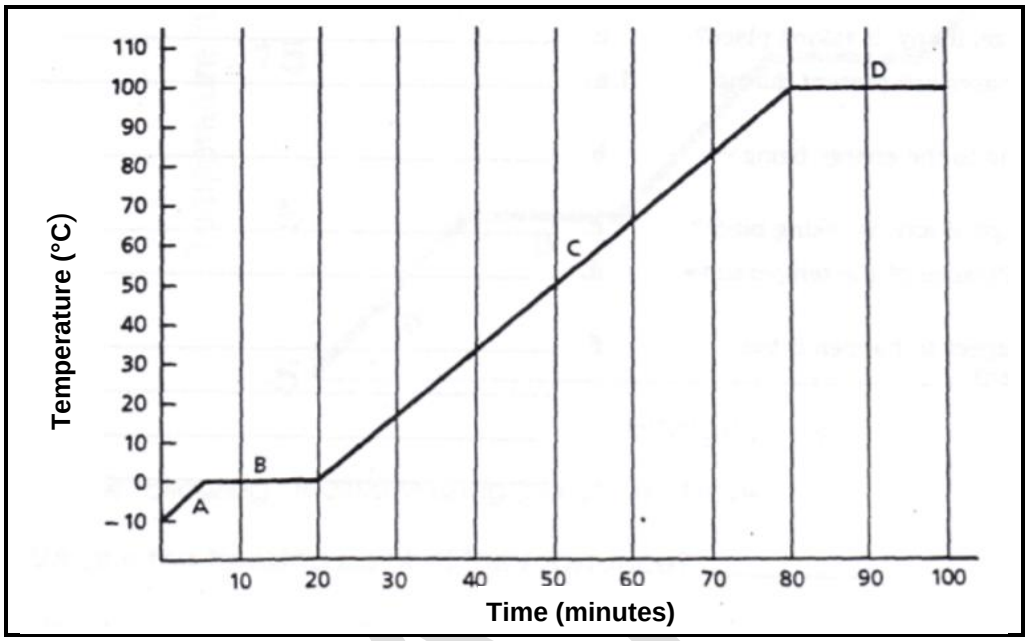
2.6 Draw the Lewis diagram of an oxygen molecule. (2)

2.7 Name the apparatus labelled **A**. (1)

[11]

QUESTION 3 (Start on a new page.)

The heating curve shown in the figure is a plot of temperature vs. time. It represents the heating of what is initially ice, at –10 °C, at a constant rate of heat transfer.



3.1 Write down the chemical formula of *ice*. (1)

3.2 What phase/s are present during interval **A** (0 – 5 min)? (1)

3.3 Define the phase change during interval **B** (5 – 20 min). (2)

3.4 Explain what is happening to the kinetic and potential energy during interval **C** (20 – 80 min). (2)

3.5 What is the significance of the temperature at 80 minutes? (1)

3.6 What would you expect to happen if the heating were continued after 100 minutes? (2)
[9]

QUESTION 4 (Start on a new page.)

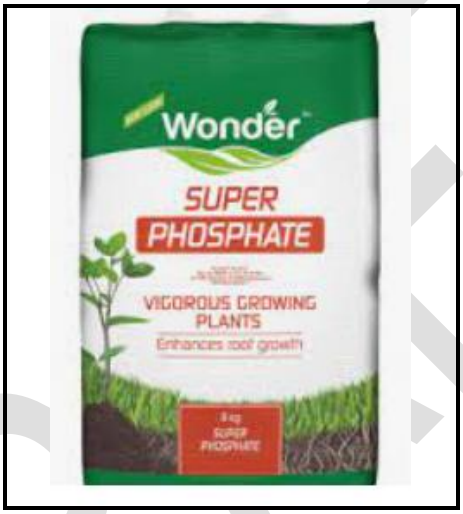
Natural nitrogen ($_7N$) consists of two stable isotopes. The vast majority (99,6%) of naturally occurring nitrogen is nitrogen-14, with the remainder being nitrogen-15.

4.1 Define the term *isotope*. (2)

4.2 Write down the name of the particles that represent the 7 in natural nitrogen ($_7N$) (1)

4.3 Calculate the relative atomic mass of nitrogen. (3)

4.4 Nitrogen is the nutrient that is most essential to plant growth.
One such fertiliser contains ammonium phosphate, ($(NH_4)_3PO_4$).



Calculate the percentage of nitrogen in this fertiliser. (3)

4.5 The manufacturing process of fertilisers uses a compound containing 82,24% nitrogen and 17,76% hydrogen.

Name this compound by using a calculation. (6)
[15]

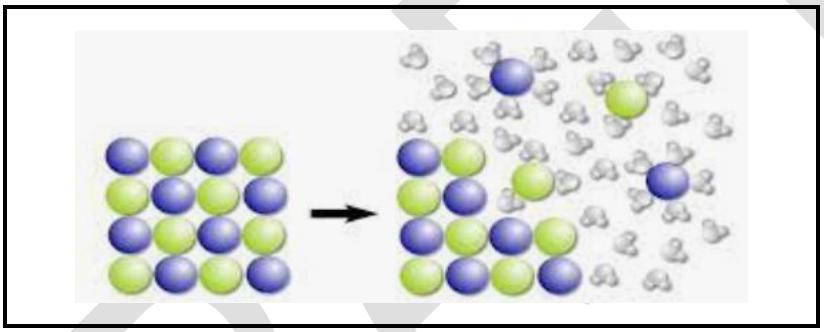
QUESTION 5 (Start on a new page.)

Sodium chloride is prepared by reacting hydrochloric acid with sodium. A colourless, odourless and tasteless gas is produced. (The practical execution however is dangerous and hence not recommended.)

The unbalanced chemical reaction is:

$$Na + HC\ell \rightarrow NaC\ell + H_2 \qquad \ldots \text{ Reaction } \mathbf{A}$$

When sodium chloride dissolves in water, the sodium chloride dissociates into ions.



The equation representing this reaction is:

$$NaC\ell(s) \xrightarrow{H_2O} Na^+(aq) + C\ell^-(aq) \qquad \ldots \text{ Reaction } \mathbf{B}$$

5.1 Give one use of sodium chloride. (1)

5.2 What is a positive test for the gas that is produced? (2)

5.3 Give one reason why this practical execution is dangerous. (1)

5.4 Balance reaction **A.** (1)

5.5 Identify the reaction that represents:

5.5.1 Physical change (1)

5.5.2 Chemical change (1)

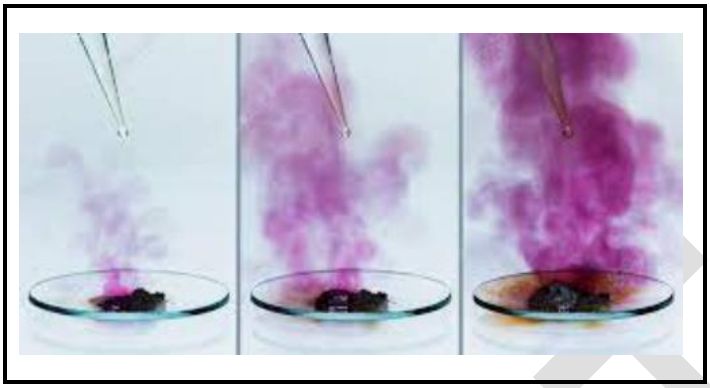
5.6 25 g sodium chloride is dissolved in 250 ml water.

Calculate the concentration of the solution. (4)

[11]

QUESTION 6 (Start on a new page.)

Aluminium reacts with iodine in the presence of a catalyst to produce a metal halide.



The balanced chemical reaction is:

$$2A\ell + 3I_2 \xrightarrow{\text{water}} 2A\ell I_3$$

6.1 Name the type of chemical bonding found in each of the following substances. Choose from covalent, ionic or metallic bonds.

6.1.1 Aluminium (1)

6.1.2 Iodine (1)

6.1.3 Water (1)

6.1.4 Aluminium iodide (1)

6.2 Define the term *mole*. (2)

6.3 317,5 g iodine reacts completely during the reaction.

Calculate the number of:

6.3.1 Moles iodine reacting (3)

6.3.2 Aluminium atoms that are used to produce aluminium iodide (3)

6.4 Calculate the mass of aluminium required to yield 20,4 g of aluminium iodide. (6)

[18]

QUESTION 7 (Start on a new page.)

The periodic table is a tabular display of the chemical elements. The structure of the table shows periodic trends.

7.1 Define the term *atomic number* of an element. (2)

7.2 Where would you find the non-metals on the periodic table? (2)

7.3 Give ONE word for the following sentence:

An atom or molecule with a net electric charge due to the loss or gain of one or more electrons. (1)

7.4 What is the name of Group 2 elements? (1)

7.5 How many valency electrons do elements have in Group 2? (1)

7.6 Write down the name of the element in Group 2 and Period 3. (1)

7.7 7.7.1 Define the term *ionisation energy*. (2)

7.7.2 Compare the first ionisation energy of elements in Group 2. (2)

7.7.3 Explain why the first ionisation energy of sulphur is less than that of phosphorous. (4)

[16]

TOTAL SECTION B: 80

TOTAL: 100

END

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$	$n = \frac{N}{N_A}$

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																	**He** 2 4
1,0 **Li** 3 7	1,5 **Be** 4 9											2,0 **B** 5 11	2,5 **C** 6 12	3,0 **N** 7 14	3,5 **O** 8 16	4,0 **F** 9 19	**Ne** 10 20
0,9 **Na** 11 23	1,2 **Mg** 12 24											1,5 **Aℓ** 13 27	1,8 **Si** 14 28	2,1 **P** 15 31	2,5 **S** 16 32	3,0 **Cℓ** 17 35,5	**Ar** 18 40
0,8 **K** 19 39	1,0 **Ca** 20 40	1,3 **Sc** 21 45	1,5 **Ti** 22 48	1,6 **V** 23 51	1,6 **Cr** 24 52	1,5 **Mn** 25 55	1,8 **Fe** 26 56	1,8 **Co** 27 59	1,8 **Ni** 28 59	1,9 **Cu** 29 63,5	1,6 **Zn** 30 65	1,6 **Ga** 31 70	1,8 **Ge** 32 73	2,0 **As** 33 75	2,4 **Se** 34 79	2,8 **Br** 35 80	**Kr** 36 84
0,8 **Rb** 37 86	1,0 **Sr** 38 88	1,2 **Y** 39 89	1,4 **Zr** 40 91	**Nb** 41 92	1,8 **Mo** 42 96	1,9 **Tc** 43	2,2 **Ru** 44 101	2,2 **Rh** 45 103	2,2 **Pd** 46 106	1,9 **Ag** 47 108	1,7 **Cd** 48 112	1,7 **In** 49 115	1,8 **Sn** 50 119	1,9 **Sb** 51 122	2,1 **Te** 52 128	2,5 **I** 53 127	**Xe** 54 131
0,7 **Cs** 55 133	0,9 **Ba** 56 137	**La** 57 139	1,6 **Hf** 72 179	**Ta** 73 181	**W** 74 184	**Re** 75 186	**Os** 76 190	**Ir** 77 192	**Pt** 78 195	**Au** 79 197	**Hg** 80 201	1,8 **Tℓ** 81 204	1,8 **Pb** 82 207	1,9 **Bi** 83 209	2,0 **Po** 84	2,5 **At** 85	**Rn** 86
0,7 **Fr** 87	0,9 **Ra** 88 226	**Ac** 89															

Ce 58 140	**Pr** 59 141	**Nd** 60 144	**Pm** 61	**Sm** 62 150	**Eu** 63 152	**Gd** 64 157	**Tb** 65 159	**Dy** 66 163	**Ho** 67 165	**Er** 68 167	**Tm** 69 169	**Yb** 70 173	**Lu** 71 175
Th 90 232	**Pa** 91	**U** 92 238	**Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103