education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY(P2)

JUNE 2023

Stanmorephysics

MARKS: 100

TIME: 2 HOURS

This question paper consists of 12 pages and TWO data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 10 A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 8 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 et cetera where required.
12. Write neatly and legibly.

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QUESTION 1: MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question numbers (1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

1.1 Only two electrons that spin in the opposite direction can exist in an orbital.

A Pauli's exclusion principle.

B Hund's rule.

C Heiselberg's principle.

D None of the above. (2)

1.2 In a physical change, which one of the following statements is true?

A The number of molecules remains constant during the reaction.

B The mass is not conserved but the number of molecules is conserved.

C The mass is conserved but not the number of atoms.

D The atoms are rearranged but remains conserved. (2)

1.3 Which one of the following is the correct formula for lithium carbonate?

A Li_2CO_3

B Li_3CO_2

C $Li_2(CO_3)_3$

D $LiCO_3$ (2)

1.4 The formula mass of $C_2O_4H_2.2H_2O$ is:

A 110

B 126

C 90

D 108 (2)

1.5 Four gases and their corresponding temperatures are given below.

Which ONE of the four will have the greatest **KINETIC ENERGY**?

	Gas	**Temperature (˚C)**
A	Y_2	53
B	X_2	12
C	Q_2	68
D	R_2	6

(2)

[10]

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QUESTION 2

ELEMENTS OF A SMART WATCH

Screen
Aℓ Si O K

The glass used on most smart watches is an aluminosilicate glass composed of a mixture of alumina ($Aℓ_2O_3$) and silica (SiO_2). The glass also contains potassium ions, which help strengthen it.

Electronics
Cu Ag Au Si Sn Pb

Copper is used for wiring in the watch whilst copper, gold and silver are the major metals from which micro electrical components are fashioned. Pure silicon is used to manufacture the chip in the watch. Tin and lead are used to solder electronics in the watch. Newer lead-free solders use a mix of tin, copper and silver.



Most watches use lithium-ion batteries which are composed of lithium cobalt oxide as a positive electrode and graphite as the negative electrode. The battery's casing is made of aluminum.

Battery
Li Co O C Aℓ

Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.

Casing
Br Ni C

2.1 Define the term *compound*. (2)

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

2.3 Name the group of the periodic table to which the elements potassium and lithium belong to. (1)

2.4 Name one ferromagnetic substance referred to in the extract. (1)

2.5 Name a substance from the extract that would be classified as an electrical conductor. (1)

2.6 Give the symbol of the element from the extract with the greatest electron negativity. (1)

2.7 In one of the substances named in the extract, the conductivity increases with an increase in temperature. Give the NAME of this substance. (1)

2.8 Complete the following table for the bromine ion by ONLY writing down the question number (2.8.1 – 2.8.3) and the CORRECT answer.

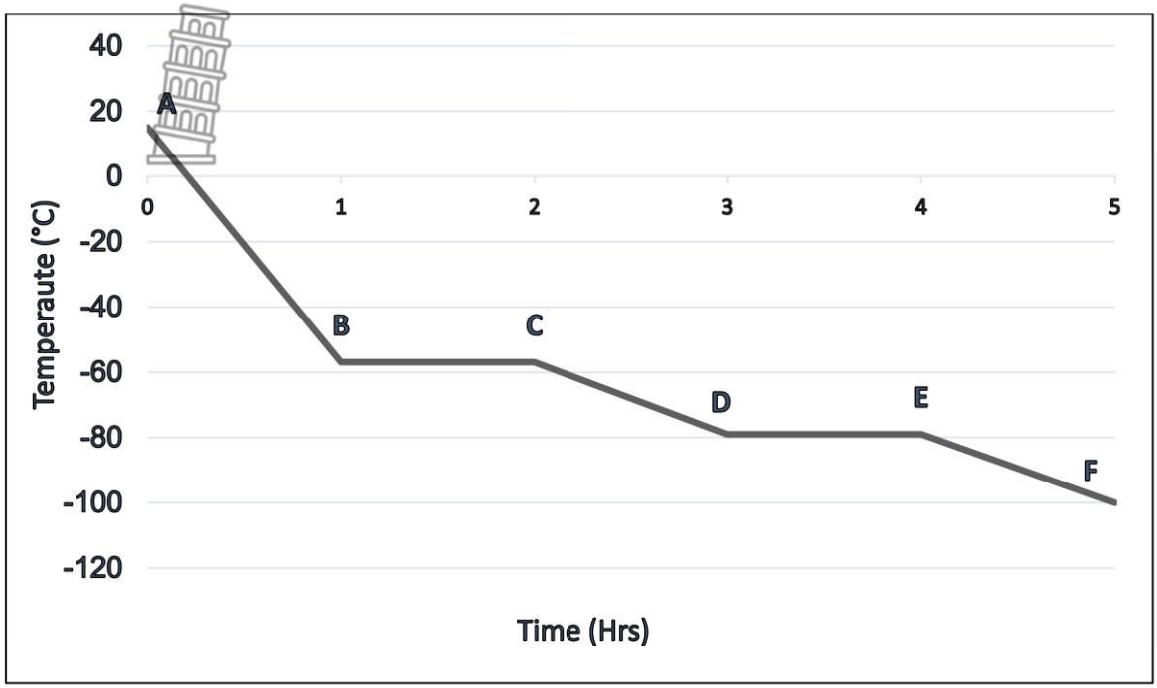
Symbol of ion	**Atomic number**	**Mass number**	**Protons**	**Neutrons**	**Electrons**
2.8.1	35	80	35	**2.8.2**	**2.8.3**

(3)

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QUESTION 3

The diagram below shows the cooling curve of carbon dioxide gas.



3.1 In which phase is carbon dioxide at -40°C? (1)

3.2 At which temperature will carbon dioxide freeze? (1)

3.3 At which point on the graph does the substance have a definite shape and the molecules are close to one another in an orderly pattern? (1)

3.4 At which point on the graph does the substance undergo condensation? (1)

3.5 Refer to line BC to answer the following questions.

3.5.1 Name the phase change that takes place at BC. (1)

3.5.2 Name the change of state that takes place at BC. (1)

3.5.3 Explain the change in phase that takes place at BC by referring to the intermolecular forces and energy of the substance. (3)

[09]

QUESTION 4

Element X has three isotopes in nature , the table below shows the percentage abundance of each isotope.

Isotope	Percentage abundance
^{24}X	78.99
^{25}X	10.00
^{26}X	11.01

4.1 Define the term *isotope*. (2)

4.2 Calculate the relative atomic mass of element X and name the element. (4)

4.3 Calcium reacts with iodine.

4.3.1 Write down the symbol of the calcium ion. (1)

4.3.2 Write the sp-notation of the calcium ion. (2)

4.3.3 Draw the Aufbau diagram for the calcium ion. (3)

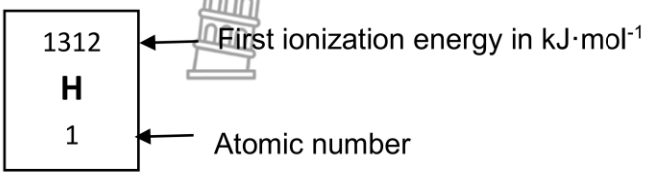
4.3.4 Name the type of bond formed when calcium reacts with iodine. (1)

4.3.5 Indicate the formation of the bond by making use of Lewis diagrams to show the chemical equation. (4)

[17]

QUESTION 5

The first ionization energy and atomic number of each of the first 18 elements of the periodic table is given below.



1312 **H** 1							2372 **He** 2
520 **Li** 3	900 **Be** 4	801 **B** 5	1086 **C** 6	1402 **N** 7	1314 **O** 8	1681 **F** 9	2081 **Ne** 10
496 **Na** 11	738 **Mg** 12	578 **Aℓ** 13	786 **Si** 14	1012 **P** 15	1000 **S** 16	1251 **Cℓ** 17	1520 **Ar** 18

5.1 Define the term *first ionization energy*. (2)

5.2 Why does helium, neon and argon have such high ionization energies? (2)

5.3 Explain why fluorine has higher ionization energy than oxygen. (2)

5.4 Which atom between beryllium and magnesium has the biggest atomic radius? (1)

5.5 Explain the answer to QUESTION 5.4. (2)

5.6 How does electronegativity change down a group? Only write down INCREASE, DECREASE or REMAIN THE SAME. (1)

[10]

QUESTION 6

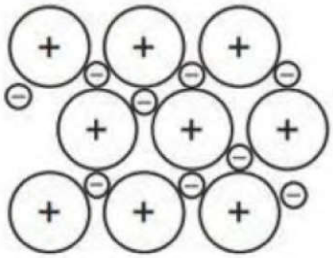
6.1 HCℓ occurs as a colorless, nonflammable aqueous solution or gas. It is used in several industries around the world.

6.1.1 Give the chemical name of HCℓ. (1)

6.1.2 Name and define the type of chemical bonding that exist between the molecules of HCℓ. (3)

6.1.3 Which atom in the HCℓ molecule has the highest electron affinity? (1)

6.2 Study the diagram below.



6.2.1 Which type of chemical bonding is represented by the diagram above. (1)

6.2.2 Name the particles between which the above mentioned chemical bond is formed. (2)

[08]

QUESTION 7

7.1 When sulphur dioxide gas dissolves in rainwater, acid rain is formed. This is a form of air pollution that causes widespread damage to the environment.



$$H_2O(\ell) + SO_2(g) \rightarrow H_2SO_3(aq)$$

7.1.1 Is this a physical or a chemical change? (1)

7.1.2 Explain the answer in QUESTION 7.1.1. (2)

7.1.3 State the *Law of conservation of mass* in words. (2)

7.1.4 Is the mass conserved in the reaction? Make use of relative atomic masses to explain your answer by doing a calculation. (4)

7.2 Classify the following chemical reactions as synthesis, decomposition or ion-exchange reactions.

7.2.1 $Zn\,(s) + 2HC\ell\,(aq) \rightarrow ZnC\ell_2\,(aq) + H_2(g)$ (2)

7.2.2 $CuCO_3\,(s) \rightarrow CuO\,(s) + CO_2(g)$ (2)

7.3 Balance the following equations:

7.3.1 $BaCO_3(s) + HC\ell\,(aq) \rightarrow BaC\ell_2(aq) + H_2CO_3\,(aq)$ (3)

7.3.2 $Cu\,(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + NO_2(g) + H_2O(\ell)$ (3)

[19]



QUESTION 8

There are several steps in the production of fertilizers. In the third step, nitrogen dioxide is absorbed by water to produce nitric acid. Nitric acid and ammonia can react together in an acid-base process to form the salt, ammonium nitrate, which is soluble in water.



$$3NO_2\,(g) + H_2O(\ell) \rightarrow 2HNO_3(aq) + NO(g)$$

$$NH_3\,(\ell) + HNO_3\,(\ell) \rightarrow NH_4NO_3\,(s)$$

8.1 Give the scientific name of nitric acid. (1)

8.2 Calculate the relative molecular mass of ammonium nitrate. (2)

8.3 Calculate the number of moles of ammonium nitrate if 15 g of it was formed. (3)

8.4 Calculate the volume of 12 g of nitrogen oxide at STP. (5)

8.5 Calculate the number of nitrogen atoms present in 2 moles of ammonium nitrate. (4)

[15]

GRAND TOTAL 100



DATA FOR PHYSICAL SCIENCES GRADE 10

CHEMISTRY

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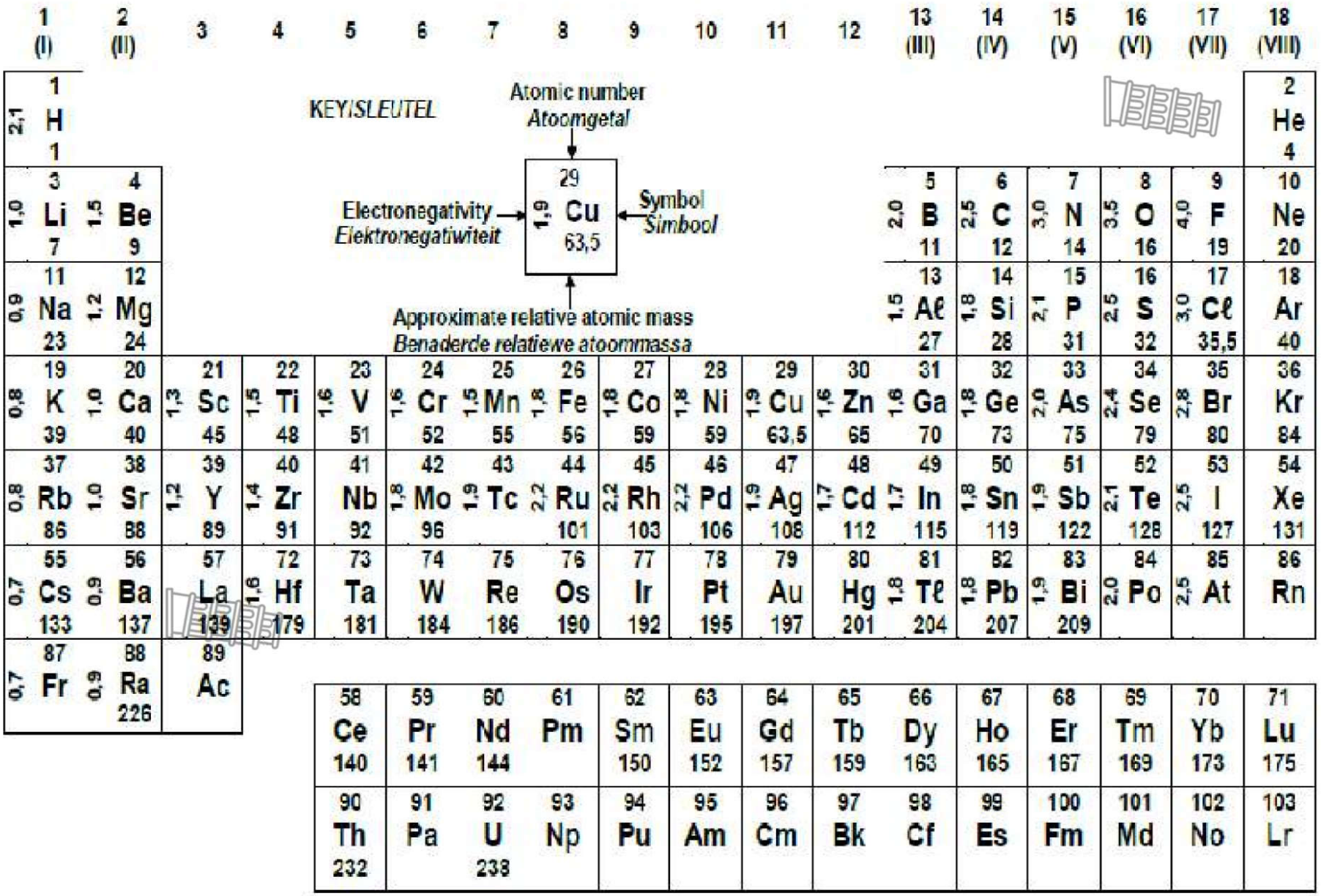
TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
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



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