Province of the
EASTERN CAPE
EDUCATION

OR TAMBO INLAND DISTRICT

GRADE 10

PHYSICAL SCIENCES P2

JUNE 2023

MARKS: 75

TIME: 1 HOUR 30 MINUTES

THIS QUESTION PAPER CONSISTS OF EIGHT PAGES INCLUDING THE COVER PAGE.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 6 questions. Answer ALL questions in the ANSWER booklet.
2. Start each question on a new page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave one line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached data sheets.
8. Show all formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to TWO decimal places unless stated otherwise by the question.
10. Give brief motivations, discussions et cetera where required.
11. Write neatly and legibly.

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.5) in the ANSWER BOOK, for example 1.11 E.

1.1 Substance consisting of one type of atom.

A. Element
B. Compound
C. Boiling point
D. Pure Substance

(2)

1.2 Which one of the following describes the ability of an atom to form a positive ion?

A. Ionisation energy
B. Electronegativity
C. Electron affinity
D. Bond energy (2)

1.3 The chemical name for NO_3^- is …

A. Nitrite ion
B. Nitride ion
C. Nitrate ion
D. Nitrogen tetraoxide. (2)

1.4 Which ONE of the following molecules will contain ionic bonds when chemical bonding occurs between the atoms?

A. HCl
B. O_2
C. Al_2O_3
D. CO_2

(2)

1.5 In a chemical change:

(i) The number of atoms is conserved.
(ii) The total mass is conserved.
(iii) No new substances are formed.
(iv) The number of molecules is conserved.

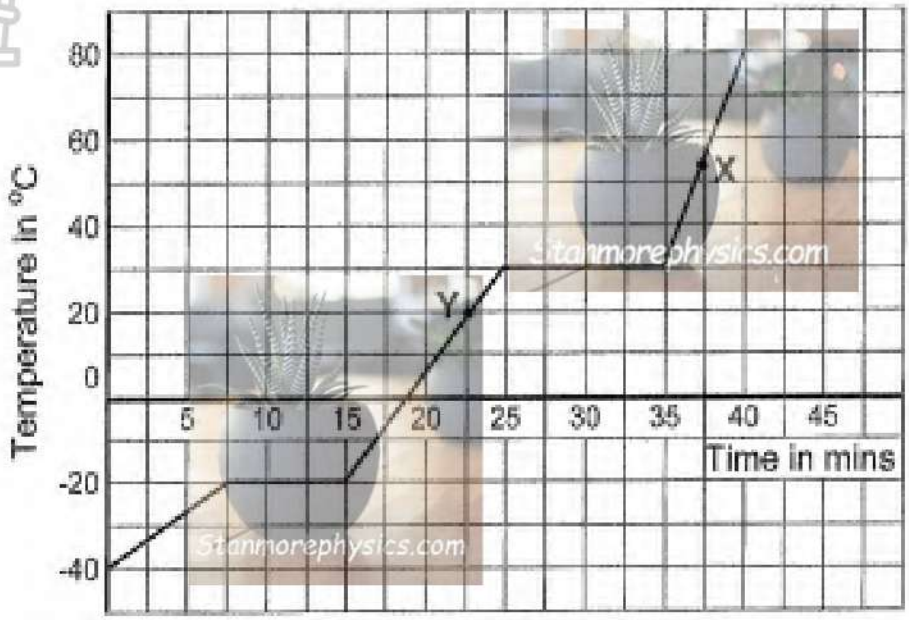
Which of the statements above that describe a chemical change is true?

A. (i); (ii) and (iii).
B. (i); (ii) and (iv).
C. (i) and (ii) only.
D. (iv) only. (2)

[10]

QUESTION 2

2.1 The graph below represents the heating curve of a pure substance at sea level.



2.1.1 Define melting point. (2)

2.1.2 What is the temperature at which the vapour pressure of the substance is equal to the atmospheric pressure? (2)

2.1.3 At which point, X or Y, are the molecules of this substance having the highest potential energy?
Explain your answer. (3)

2.1.4 Between which time interval(s) on the graph does the average kinetic energy of this substance remain constant? (2)

2.1.5 At $-20\ ℃$, there is no temperature change although heat is being added to the substance. Give an explanation for this observation. (3)

[12]

QUESTION 3

3.1 Copper atoms exist naturally as $^{63}_{29}Cu$ and $^{65}_{29}Cu$.

3.1.1 What are such atoms called? (1)

3.1.2 Besides their masses, how else do these atoms differ? (1)

3.1.3 The relative atomic mass of copper is 63,5. Determine the percentage abundance of each of the copper atoms. (5)

3.2 Complete the table below. Write only the answer next to the question number (3.2.1 – 3.2.5).

ELEMENT	MASS NUMBER	ATOMIC NUMBER	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
Aluminium ion	3.2.1	13	3.2.2	3.2.3
3.2.4	30	3.2.5	16	15

(5)

3.3 Write down:

3.3.1 the name of the compound: $KMnO_4$ (2)

3.3.2 the chemical formula for iron (III) chloride. (2)

[16]

QUESTION 4

Consider the following substances: $MgBr_2$; NH_3; Mn

4.1 Define a chemical bond. (2)

4.2 Write down a substance from the list above which has:

4.2.1 a covalent bond. (1)

4.2.2 An ionic bond (1)

4.3 Magnesium reacts with bromine to form magnesium bromide.

4.3.1 Using Lewis dot diagrams, show how magnesium reacts with bromine to form magnesium bromide. (3)

4.3.2 Draw the Aufbau (orbital box) diagram for the **magnesium ion**. (3)

[10]

QUESTION 5

The periodicity of elements on the periodic table is affected by some factors such as atomic radius, ionization energy, electron affinity and electronegativity.

5.1 Define atomic radius. (2)

5.2 What is the general trend in atomic radii as you move from left to right across the period? Write down INCREASES, DECREASES OR REMAINS THE SAME.
Give a reason for your answer. (3)

5.3 The table below represents the first ionisation energies of the first 10 elements on the periodic table.

Element	Ionisation energy ($kJ.mol^{-1}$)	Element	Ionisation energy ($kJ.mol^{-1}$)
H	1312	C	1086.5
He	2372	N	1402.3
Li	520.2	O	1313.9
Be	899.5	F	1681
B	800.6	Ne	2080.7

5.3.1 Define ionisation energy. (2)

5.3.2 Write down the group names to which the following elements belong in the periodic table. (4)
(I)H and Li
(II) Be
(III) He
(IV)Give the general name that is given to the following elements:(B,Si and Ge)

5.3.3 Copy and complete the following reaction:
$Li + 520.2\ kJ.mol^{-1} \longrightarrow$ ____ + ____ (2)

5.3.4 Ionisation energy generally increases across the period and decreases down the group. However, the first ionisation energy of Boron is smaller than that of Beryllium. Explain why this happens(**Hint** :use the electron configuration of the two atoms). (3)

[16]

QUESTION 6

6.1 In the Haber process, **hydrogen reacts with nitrogen to produce ammonia.**

6.1.1 Define a chemical change. (2)

6.1.2 Write a balanced equation for the reaction that takes place during the Haber process. (3)

6.1.3 Use this reaction to prove the law of conservation of mass. (3)

6.1.4 Is this reaction a synthesis or a decomposition? (1)

6.2 Balance the following reaction: $C_2H_6 + O_2 \longrightarrow CO_2 + H_2O$ (2)

[11]

TOTAL [75]

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*: 29
Electronegativity / *Elektronegatiwiteit*: 1,9
Symbol / *Simbool*: Cu
Approximate relative atomic mass / *Benaderde relatiewe atoommassa*: 63,5

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

PHYSICAL SCIENCES PAPER 2 MARKING GUIDELINES GRADE 10

MARKS: 75

QUESTION 1

1.1	A	✓✓	(2)
1.2	A	✓✓	(2)
1.3	C	✓✓	(2)
1.4	C	✓✓	(2)
1.5	C	✓✓	(2)

[10]

QUESTION 2

2.1.1 The temperature at which a solid, given sufficient heat, becomes a liquid. ✓✓ (2)

2.1.2 30°C✓✓ (2)

2.1.3 X✓ (3)
They are gas particles at X and the (intermolecular) forces of attraction are very little or not existing. ✓
Therefore the particles have very big spaces between them. ✓

2.1.4 7,5 and 15 minutes ✓ (2)
25 and 35 minutes ✓

2.1.5 The heat is used to overcome the (intermolecular) forces of attraction between the molecules. ✓ (3)
The molecules now slip past each other. ✓
They are now converted from a solid to a liquid. ✓

[12]

QUESTION 3

3.1.1 Isotopes ✓ (1)

3.1.2 Number of neutrons✓ (1)

3.1.3

$$63{,}5\checkmark = \frac{(x\times 63)\ \checkmark + [(100-x)\times 65]\ \checkmark}{100}$$

$x = 75$

Percentage abundance of Cu – 63 is 75%✓

Percentage abundance of Cu – 65 is 25%✓ (5)

3.2.1 27 ✓ (1)

3.2.2 14 ✓ (1)

3.2.3 10 ✓ (1)

3.2.4 P (Phosphorus) (1)

3.2.5 14 ✓ (1)

3.3.1 Potassium permanganate ✓✓ (2)

3.3.2 $FeCl_3$ ✓✓ (2)

[16]

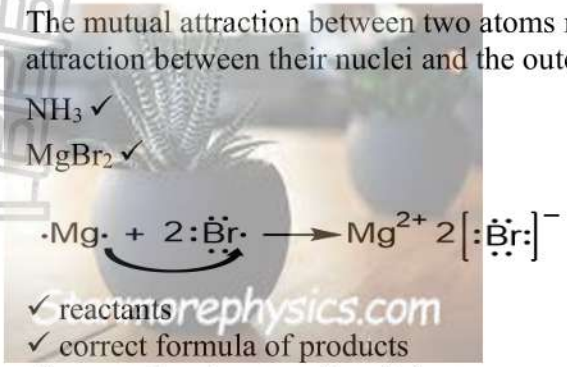
QUESTION 4

4.1. The mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons. ✓✓ (2)

4.2.1 NH_3 ✓ (1)

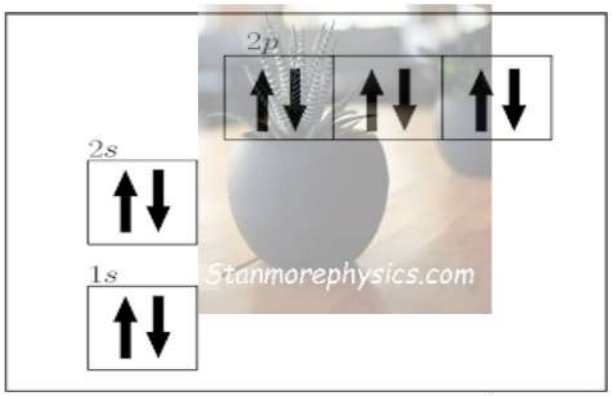
4.2.2 $MgBr_2$ ✓ (1)

4.3.1



✓ reactants
✓ correct formula of products
✓ arrow showing transfer of electrons. (3)

4.3.2



✓ 1s orbital
✓ 2s orbital
✓ 2p orbital (3)

[10]

QUESTION 5

5.1 The average distance from the nucleus to the border of the outer orbital. ✓✓ (2)

5.2 Decreases. ✓
The strength with which the nucleus (protons) attracts the electrons increase ✓ (3)
(from left to right across the periodic table).
This strength is much greater than the repulsion between the electrons.
The electron cloud moves closer to the nucleus✓ causing a decrease in the atomic radius.

5.3.1 The energy needed per mole to remove an electron from an atom in the gaseous phase. ✓✓ (2)

5.3.2 (I) Alkali metals ✓
(II) Alkaline earth metals ✓
(III) Noble gases ✓
(IV) Metalliods ✓ (4)

5.3.3 Li^+ ✓+ e^- ✓ (2)

5.3.4 An electron has to be removed from the s–orbital in Beryllium compared to removing an electron from the p-orbital in Boron.✓
An s-orbital is closer to the nucleus with much less electron repulsion than the p-orbital. ✓
Hence the removal of an electron in the s-orbital is more difficult and will require more energy than that in the p-orbital. ✓
This increases the Ionisation energy slightly.
OR
The electron configuration of Beryllium is $1s^2 2s^2$ compared to $1s^2 2s^2 2p^1$ of Boron. ✓
The electron configuration of Beryllium is more stable than that of Boron. ✓
Therefore, more energy is needed to remove an electron from Beryllium than in Boron. ✓ (3)

[16]

QUESTION 6

6.1.1 A change in which new chemical substances are formed. ✓✓ (2)

6.1.2 $3H_2 + N_2 \longrightarrow 2NH_3$ (3)

✓ N_2 and H_2
✓ NH_3
✓ Balancing

6.1.3

Reactants	Products
3(2) + 2(14) ✓	2[14 + 3(1)] ✓
= 34	=34 ✓

(3)

6.1.4 Synthesis ✓ (1)

6.2 **2** C_2H_6 + **7** $O_2 \longrightarrow$ **4** CO_2 + **6** H_2O

✓ balancing reactants
✓ balancing products (2)

[11]