Hoërskool Johan Jurgens

Physical Science Gr. 10

November 2025

End year exam – Paper 2

Marks: 100

Time: 2 hours

Examiner: S Stoltz

Moderator: N Gertenbach

INSTRUCTIONS AND INFORMATION

1. The question paper consists of SEVEN questions. Answer ALL the questions.
2. Start EACH question on a NEW page.
3. Number your answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, e.g., between QUESTION 2.1 and QUESTION 2.2.
5. A non-programmable calculator may be used.
6. Appropriate mathematical instruments may be used.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. You are advised to use the attached data sheets.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.5), for example 1.10 E.

1.1 The atomic mass of chlorine is the weighted average of the atomic masses of the:

A Radioactive isotopes of chlorine.

B Naturally occurring isotopes of chlorine.

C Artificially produced isotopes of chlorine.

D Radioactive and artificial isotopes of chlorine. (2)

1.2 Which term identifies the type of matter that is composed of two or more different elements chemically combined in a fixed ratio?

A Solution

B Compound

C Homogeneous mixture

D Heterogeneous mixture (2)

1.3 At STP, 2,0 liters of $N_2(g)$ and 2,0 liters of $O_2(g)$ have the same:

A Density

B Boiling point

C Melting point

D Number of molecules (2)

1.4 Element ***X*** reacts with chlorine to form the compound ***X***Cl_3. In which group on the Periodic Table of the Elements is element ***X*** located?

A Group 1

B Group 2

C Group 13

D Group 18 (2)

1.5 Sulfuric acid, $H_2SO_4(aq)$, can neutralize an aqueous solution of calcium hydroxide, $Ca(OH)_2(aq)$. What is the formula for the salt produced by this neutralization reaction?

A Ca_2SO_4

B $Ca(SO_2)_2$

C $CaSO_3$

D $CaSO_4$ (2)

[10]

QUESTION 2

Mixtures are a combination of two or more substance.

2.1 Name the TWO types of mixtures that can be formed. (2)

2.2 Explain the difference between the two types of mixtures. (2)

2.3 State the method by which each of the following mixtures can be separated.

2.3.1 Alcohol (1)

2.3.2 Oil and water (1)

2.4 Classify each of the following as either a pure substance or a mixture:

2.4.1 Distilled water (1)

2.4.2 Sea water (1)

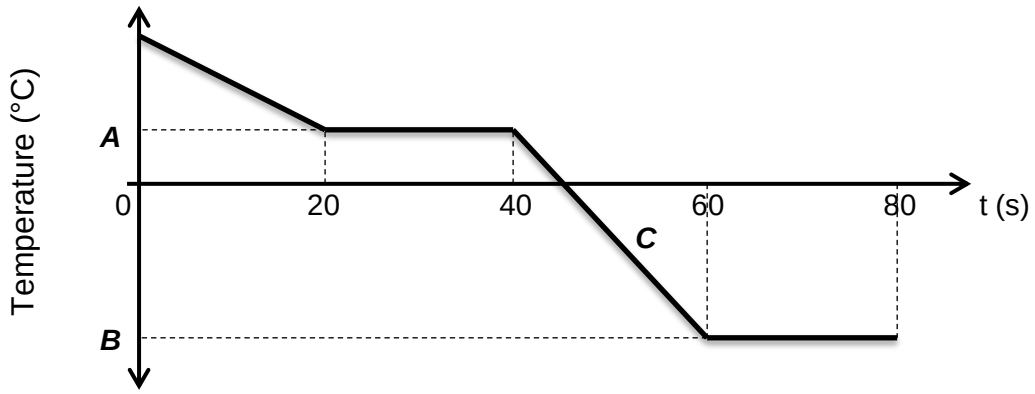
2.4.3 Oxygen gas (1)

2.4.4 Brass (1)

[10]

QUESTION 3

Study the temperature versus time graph for a ketone (an organic compound).
The boiling point of this compound is 56,08°C and its melting point is –94,9°C.



3.1 Define *melting point*. (2)

3.2 Is the above curve a HEATING CURVE or a COOLING CURVE?
Give a reason for your answer. (2)

3.3 Write the value of the temperature at ***A.*** (1)

3.4 In what phase are the particles at ***C***? (1)

3.5 Describe the phase change that takes place during the time intervals
60 s – 80 s. (1)

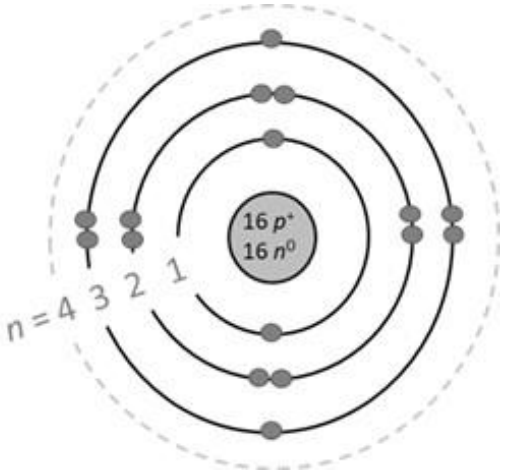
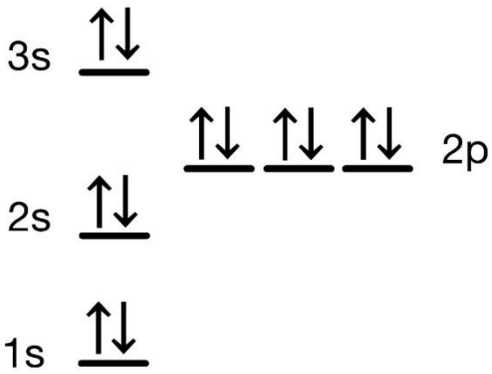
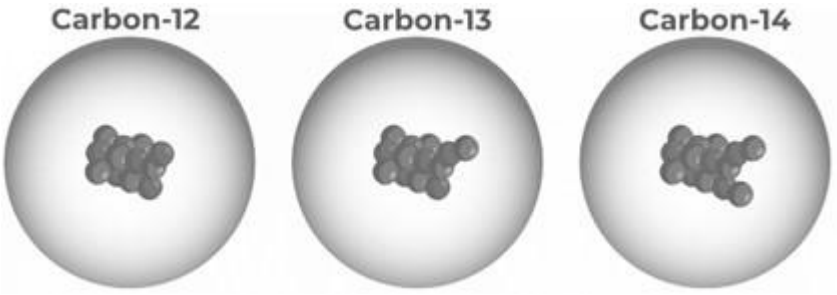
3.6 How is the kinetic energy of this compound's molecules affected from
20 s to 40 s? Choose from INCREASE; DECREASE; or REMAIN THE SAME. (1)

3.7 Give a reason for your answer in QUESTION 3.6. (1)

[9]

QUESTION 4

Consider the information in the table.

A		**B**	
C	Li^+	**D**	$^{12}_{24}Mg$
E			

4.1 Write down the letter(s) of the information from the table that/which:

4.1.1 Represents the Aufbau diagram of magnesium. (1)

4.1.2 Is fully represented by the spectroscopic notation: $1s^2$. (1)

4.1.3 Represents an atom with six valence electrons. (1)

4.1.4 Represents isotopes of the same element. (1)

4.1.5 Visually demonstrate Pauli's exclusion principle. (1)

4.2 How many core electrons does the atom in **A** possess? (1)

4.3 Is the radius of **C** GREATER THAN, SMALLER THAN or EQUAL TO the radius of a lithium atom? Explain your answer. (3)

4.4 Write a fully balanced chemical reaction equation, using LEWIS STRUCTURES, for the reaction between **A** and **D**. (4)

4.5 Name the type of bonding that occurs in QUESTION 4.4 during the formation of the product. (1)

4.6 What is the:

4.6.1 Mass number of carbon-12? (1)

4.6.2 Atomic number of carbon-13? (1)

4.6.3 Number of neutrons in carbon-14? (1)

4.7 Lithium and sodium are in group 1 on the periodic table.

ELEMENT	FIRST IONISATION ENERGY ($kJ.mol^{-1}$)
Lithium	520
Natrium	494

4.7.1 Define first *ionization energy.* (2)

4.7.2 Which element, lithium or sodium, is more reactive? Explain. (3)

4.7.3 What is the name given to the elements in GROUP 1 on the periodic table? (1)

[23]

QUESTION 5

5.1 A certain element, **X**, has two isotopes in nature. One isotope has an atomic mass of 106,9 amu. The percentage appearance of this isotope is 50%. The atomic mass of the other isotope is 109,1 amu.

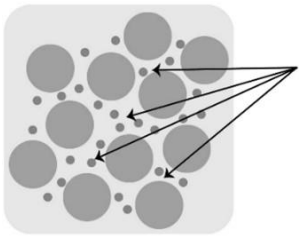
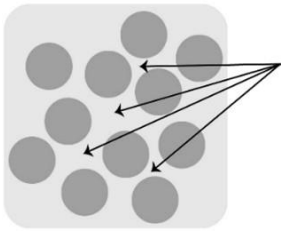
5.1.1 Define the term *isotope*. (2)

5.1.2 Calculate the relative atomic mass of element **X**. (5)

5.1.3 Identify element **X** in QUESTION 5.1.2. (2)

5.2 14,2 g of a sample of hydrated sodium carbonate, $Na_2CO_3 \cdot \mathbf{n}H_2O$, was strongly heated until no further change in mass was recorded. On heating, all the water of crystallisation evaporated as follows:

$$Na_2CO_3 \cdot \mathbf{n}H_2O \rightarrow Na_2CO_3 + \mathbf{n}H_2O$$

Before heating	***After strong heating***
 Crystal Water 14,2 g $Na_2CO_3 \cdot \mathbf{n}H_2O$	 Gaps (openings / spaces) 5,3 g

5.2.1 Calculate the number of moles of water of crystallisation in the sodium carbonate sample. (5)

5.3 The empirical formula for a certain compound is to be determined. On analysis a sample of the compound was found to contain 48,7% C, 8,1 % H and 43,2% O.

Determine the molecular formula of the compound if it has a molar mass of 72 $g.mol^{-1}$. Show ALL calculations. (6)

[20]

QUESTION 6

Potassium oxide crystals, K_2O, is dissolved in 250 cm^3 of water to produce a potassium hydroxide (KOH) solution of concentration 0,25 $mol.dm^{-3}$.

6.1 Identify the *solute*. (1)

50 cm^3 of the KOH(aq) solution is reacted completely with sulphuric acid, $H_2SO_4(aq)$, according to the balanced equation:

6.2 How many moles of KOH are present in the 50 cm^3 solution? (3)

$$2\ KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2\ H_2O(l)$$

6.3 Calculate the maximum mass of K_2SO_4 that can be produced. (4)

When this experiment was done in the school laboratory, 0,87 g of K_2SO_4 was produced.

6.4 Calculate the percentage yield of K_2SO_4. (3)

[11]

QUESTION 7

7.1 Consider the following balanced chemical equation:

$$2\boldsymbol{X}(s) + 6\ HCl(aq) \rightarrow 2\boldsymbol{X}Cl_3(aq) + 3H_2(g)$$

During the reaction 0,405 g of metal ***X*** reacts completely with hydrochloric acid solution to produce 504 cm³ hydrogen gas at STP.

7.1.1 Calculate the number of moles of $H_2(g)$ produced at STP. (3)

7.1.2 How many hydrogen atoms are present in the $H_2(g)$ produced? (2)

7.1.3 Determine the molar mass of metal ***X***. (4)

7.1.4 Identify metal ***X***. (1)

7.2 50 cm³ of a solution of $MgCl_2$ of concentration 0,25 mol.dm³ is added to 30 cm³ of a solution of NaCl of concentration 0,15 mol.dm^{-3}.

7.2.1 Write down the balanced equation for the dissociation of $MgCl_2(s)$ in water. (2)

7.2.2 Calculate the concentration of chloride ions in this solution. (5)

[17]

TOTAL: 100

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10

(CHEMIE)
DATA FOR PHYSICAL SCIENCES GRADE 10
(CHEMISTRY)

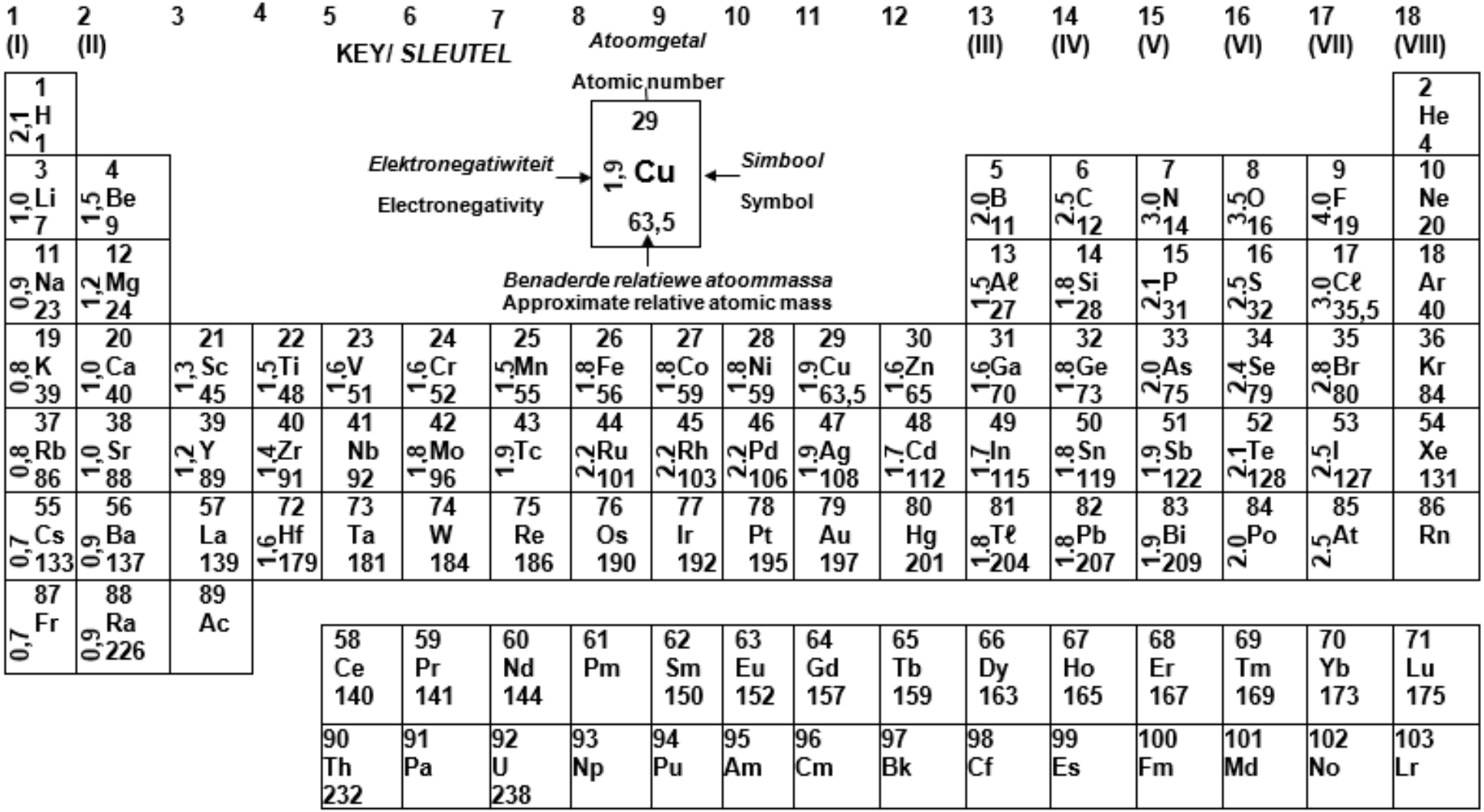
TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

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	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard pressure *Standaarddruk*	$p^\ominus$	$1{,}013 \times 10^5\ Pa$

TABLE 2: FORMULAE/TABEL 2: FORMULES

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

THE PERIODIC TABLE OF ELEMENTS // *DIE PERIODIEKE TABEL VAN ELEMENTE*



PHYSICAL SCIENCE
GRADE 10
2025 September
FINAL EXAM – CHEMISTRY PAPER 2
MARKS: 100
MARKING GUIDELINE

QUESTION 1 **REASON:**

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 C ✓✓ (2)

1.5 D ✓✓ (2)

[10]

QUESTION 2

2.1 Homogeneous ✓ mixtures & heterogeneous✓ mixtures (2)

2.2 In homogeneous mixtures the individual substances are all in the same phase. ✓
In heterogeneous mixtures the substances are in more than one phase. ✓ (2)

2.3.1 Distillation ✓/ Fractional distillation (1)

2.3.2 Separating funnel ✓ (1)

2.4.1 Pure substance ✓ (1)

2.4.2 Mixture ✓ (1)

2.4.3 Pure substance ✓ (1)

2.4.4 Mixture ✓ (1)

[10]

QUESTION 3

3.1 The temperature of a liquid at which its vapour pressure equals the external (atmospheric) pressure. ✓✓ (2)

3.2 COOLING CURVE ✓
The temperature of the particles decreases over time. ✓ (2)

3.3 56,08 ✓ (°C) (1)

3.4 liquid ✓ (1)

3.5 liquid to solid ✓ (1)

3.6 REMAIN THE SAME ✓ (1)

3.7 The temperature remains constant ✓ (1)

[9]

QUESTION 4

4.1.1 B ✓ (1)

4.1.2 C ✓ (1)

4.1.3 A ✓ (1)

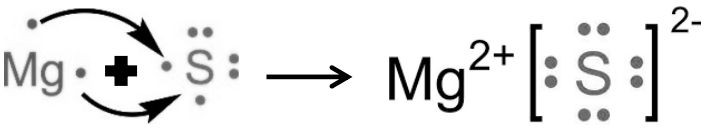
4.1.4 E ✓ (1)

4.1.5 B ✓ (1)

4.2 10 ✓ (1)

4.3 SMALLER THAN ✓
A lithium atom has two energy levels, while a lithium ion has lost one valence electron and therefore only has one energy level.✓ The volume of a metal atom is larger than the volume of a metal ion.✓ (3)

4.4 ✓ ✓ ✓ ✓



(4)

4.5 Ionic (bond) ✓ (1)

4.6.1 12 ✓ ($g.mol^{-1}$) (1)

4.6.2 6 ✓ (p^+) (1)

4.6.3 8 ✓ (n^0) (1)

4.7.1 Energy needed to remove the first electron from an atom in the gaseous phase.✓✓ (2)

4.7.2 Sodium ✓
Sodium has a lower first ✓ ionization energy than lithium. Less energy is required to overcome the forces that the nucleus exerts on the valence electrons.✓ (3)

4.7.3 Alkali metals ✓ (1)

[23]

QUESTION 5

5.1.1 Atoms of an element having the same number of protons, but different numbers of neutrons. ✓✓ (2)

5.1.2 50% = 106,9 amu
50% = 109,1 ame ✓

$A_r = \frac{(50\times106,9)\checkmark+(50\times109,1)\checkmark}{100\checkmark} = 108\ amu\ \checkmark$ (5)

5.1.3 Silver / Ag ✓✓ (2)

5.2.1 m (water) = 14,2 – 5,3 = 8,9 g ✓

Na_2CO_3 : H_2O

$\frac{5,3}{2(23)+12+3(16)}$ ✓ : $\frac{8,9}{2(1)+16}$ ✓

$\frac{0,05}{0,05}$: $\frac{0,49}{0,05}$ ✓ (divide by smallest mole)

1 : 9,88

∴ n = **10** ✓ (5)

5.3 %C = 48,7% → 48,7 g ∴ $n = \frac{m}{M} = \frac{48,7}{12}\checkmark = 4,06\ mol$

%H = 8,1% → 48,7 g ∴ $n = \frac{m}{M} = \frac{8,1}{1} = 8,1\ mol$

%O = 43,2% → 43,2 g ∴ $n = \frac{m}{M} = \frac{43,2}{16} = 2,7\ mol$

C : H : O

$\frac{4,06}{2,7}$: $\frac{8,1}{2,7}$: $\frac{2,7}{2,7}$ (**divide by 2,7**) ✓

(1,5 : 3 : 1) **x2** ✓

3 : 6 : 2

Empirical formula: $(C_6H_6O_2)_x$ $x = \frac{Mr(molecular\ mass)}{Mr(empirical\ mass)} = \frac{72}{72\ \checkmark} = 1\checkmark$

Molecular formula: $C_6H_6O_2$ ✓

(6)

[20]

QUESTION 6

6.1 Potassium oxide / $K_2O(s)$ ✓ (1)

6.2 $n = cV$ ✓
$n = 0,25(50 \times 10^{-3})$ ✓
$n = 0,0125\ mol$ ✓ (3)

6.3 KOH : K_2SO_4
2 : 1

m = nM ✓
m = ½(0,0125) ✓ (2(39)+32+4(16)) ✓
m = 1,09 g✓ (4)

6.4 $\%\ Yield = \frac{experimental\ yield}{theoretical\ yield} \times 100$ ✓

$= \frac{0,87}{1,09}$ ✓ $\times 100$

$= 79,82\ \%$✓ (3)

[11]

QUESTION 7

7.1.1 $n = \frac{V}{V_m}$✓

$n = \frac{504 \times 10^{-3}}{22,4}$ ✓

$n = 0,0225\ mol$ ✓ (3)

7.1.2 $N = nN_A$

$N = 0,0225(6,02 \times 10^{23}) \times 2$ ✓

$N = 2,709 \times 10^{22}$ ✓ $H - atoms$ (2)

7.1.3 X : H_2
2 : 3

$m = nM$✓

$0,405$✓ $= \frac{2}{3}(0,0225)$✓M

$M = 27\ g.mol^{-1}$ ✓ (4)

7.1.4 Aluminium ✓ / Al (1)

7.2.1 $MgCl_2(s) \rightarrow Mg^{2+}(aq) + 2Cl^-(aq)$ ✓✓ (2)

7.2.2 $n(MgCl_2) = cV = 0,25(50 \times 10^{-3})$ ✓ = 0,0125 mol
$n(NaCl) = cV = 0,15(30 \times 10^{-3})$ ✓= $4,5 \times 10^{-3}$ mol

$c = \frac{n}{V}$ ✓

$c = \frac{2(0,0125)+4,5\times10^{-3}}{80\times10^{-3}}$ ✓

$c = 0,37\ mol.dm^{-3}$✓ (5)

[17]

TOTAL: 100

TAXONOMY LEVELS					
GRADE 10					
PHYSICAL SCIENCES – Chemistry P2					
FINAL EXAM - TERM 4 - 2025					
MARKS: 100					
QUESTION	**RECALL**	**COMPREHENSION**	**ANALYSIS APPLICATION**	**EVALUATION SYNTHESIS**	**TOTAL**
DESIRED %	**15%**	**35%**	**40%**	**10%**	**100%**
1.1	2				2
1.2	2				2
1.3		2			2
1.4		2			2
1.5				2	2
2.1	2				2
2.2		2			2
2.3.1	1				1
2.3.2	1				1
2.4.1		1			1
2.4.2		1			1
2.4.3		1			1
2.4.4		1			1
3.1	2				2
3.2		2			2
3.3		1			1
3.4		1			1
3.5		1			1
3.6		1			1
3.7		1			1
4.1.1		1			1
4.1.2		2			2
4.1.3				1	1
4.1.4				1	1
4.1.5		1			1
4.2			1		1
4.3			3		3
4.4			4		4
4.5		1			1
4.6.1		1			1
4.6.2		1			1
4.6.3		1			1
4.7.1	2				2

4.7.2				3	3
4.7.3		1			1
5.1.1	2				2
5.1.2			5		5
5.1.3		2			2
5.2.1			5		5
5.3			6		6
6.1	1				1
6.2			3		3
6.3			4		4
6.4			3		3
7.1.1			3		3
7.1.2			2		2
7.1.3			4		4
7.1.4		1			1
7.2.1		2			2
7.2.2			5		5
Total	**15**	**30**	**48**	**7**	**100**
Actual %	**15**	**30**	**48**	**7**	**100**
Desired %	**15%**	**35%**	**40%**	**10%**	**100**