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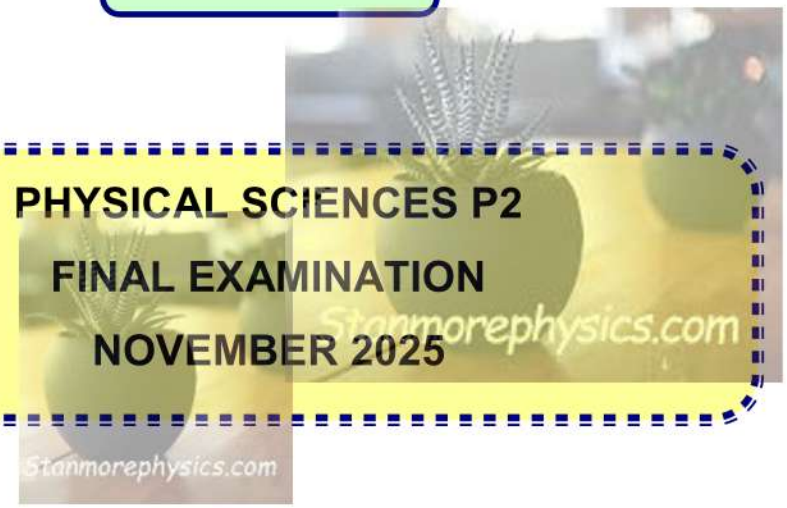
KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10



PHYSICAL SCIENCES P2

FINAL EXAMINATION

NOVEMBER 2025

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MARKS: 100

DURATION: 2 hours

This question paper consists of 10 pages and 2 data sheets.

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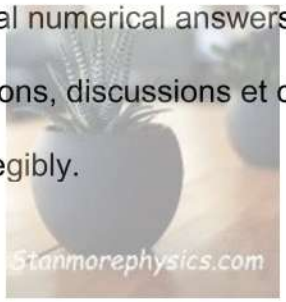
INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
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 a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. Write neatly and legibly.



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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 Which one of the following is an example of a pure substance?

A Carbon dioxide

B Air

C Steel

D Aqueous sodium chloride (2)

1.2 Which one of the following has the highest first ionization energy?

A Li

B F

C Na

D Cl (2)

1.3 Which of the following is true for the process of condensation?

A The substance is heated and changes phase to gas.

B The substance is heated and changes phase to liquid.

C The substance is cooled and changes phase to gas.

D The substance is cooled and changes phase to liquid. (2)

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1.4 Which one of the following contains $6,02 \times 10^{23}$ ATOMS?

A 10 g of Ne

B 28 g of N_2 gas

C 4,48 dm^3 of CH_4 gas at STP

D 22,4 dm^3 of NH_3 gas at STP (2)

1.5 Consider the balanced chemical equation for the reaction below:

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

The number of CH_4 molecules required to form 22,4 dm^3 of H_2 at STP is …

A $6,02 \times 10^{23}$

B $\frac{1}{2} \times 6,02 \times 10^{23}$

C $\frac{1}{3} \times 6,02 \times 10^{23}$

D $\frac{1}{4} \times 6,02 \times 10^{23}$ (2)

[2 x 5 = 10]

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QUESTION 2 (Start on a new page.)

2.1 Two hypothetical gases, $\mathbf{X_2}$ and $\mathbf{Y_2}$, react in a closed container to form **XY** gas according to the equation:

$$X_2(g) + Y_2(g) \rightarrow 2XY(g)$$

After the reaction, the container is found to contain both **XY** gas and some unreacted $\mathbf{Y_2}$ gas.

2.1.1 Would you classify the contents of the container, after the reaction, as a MIXTURE or a PURE SUBSTANCE? (1)

2.1.2 To separate XY from Y_2 the following steps take place:

STEP 1: The contents of the container is cooled to liquify BOTH gases.

STEP 2: The liquid is thereafter gradually heated to a maximum temperature of – 60 °C, to separate Y_2 and XY

The boiling points of Y_2 and XY is shown in the table below:

Substance	Boiling Point (°C)
Y_2	- 180
XY	- 50

(a) At which temperature will both gases be in their liquid phase.
Choose from: 20 °C, -70 °C, -190 °C. (1)

(b) Which of the two substances, Y_2 or XY, will more easily be converted to gas when the temperature is increased in STEP 2. (1)

(c) Does STEP 2 represent a PHYSICAL or CHEMICAL change?
Explain the answer. (2)

(d) The substance that is more easily converted to gas is collected. It is observed that the collected gas is not 100% pure.

Give a reason for the observation. (2)

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2.2 Ammonium sulphate is one of the most common fertilizers used worldwide.

Ammonia reacts with sulphuric acid (hydrogen sulphate) to form ammonium sulphate.

2.2.1 Write a balanced chemical equation for the above reaction. (3)

2.2.2 Is the above reaction an example of a SYNTHESIS or DECOMPOSITION reaction? (1)

2.3 A farmer chooses to use ammonium nitrate (NH_4NO_3) as a fertilizer. He needs to supply 30 kg of NITROGEN to a field.

2.3.1 Calculate the percentage nitrogen (N) in ammonium nitrate (NH_4NO_3). (3)

2.3.2 Determine the mass of ammonium nitrate (NH_4NO_3) required. (3)

2.4 Use the balanced chemical equation below to prove the law of conservation of mass.

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$ (3)

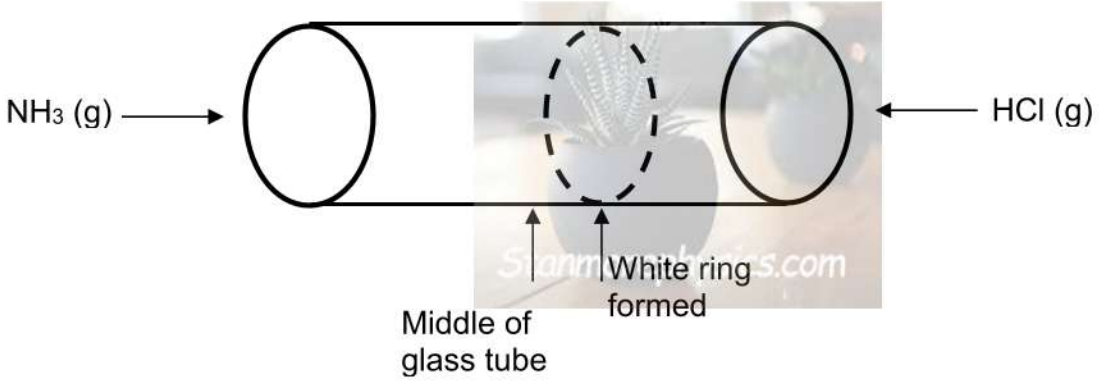
[20]

QUESTION 3 (Start on a new page.)

3.1 A teacher performs a demonstration using ammonia (NH_3) and hydrochloric acid (HCl) GASES in a long glass tube.

Ammonia and hydrochloric acid are simultaneously released from opposite ends of a long glass tube. A white ring of ammonium chloride (NH_4Cl) form where the gases react.

The position of the white ring formed is shown on the diagram below.



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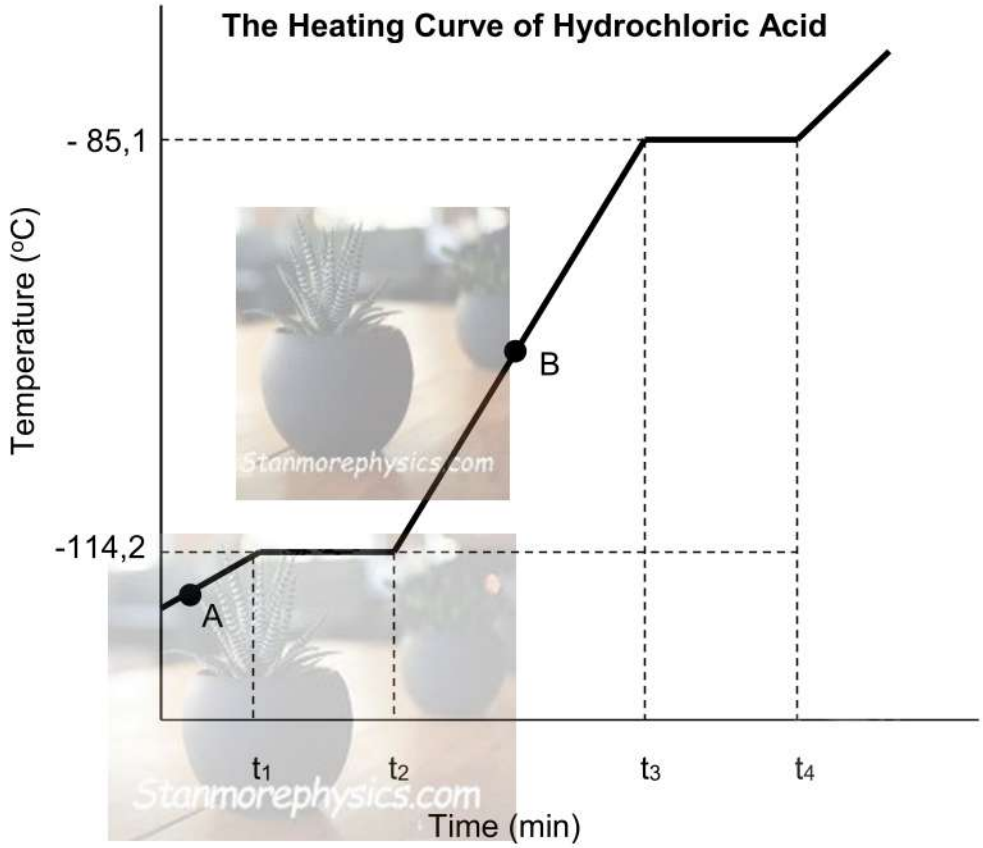
3.1.1 Define the term *diffusion* in words. (2)

3.1.2 Provide a reason why the white ring formed closer to HCl than NH_3. (1)

3.1.3 The temperature of the gases in the glass tube is now increased.

How would this effect the TIME taken for the white ring to appear? Choose from INCREASE, DECREASE or REMAIN THE SAME. Explain the answer using the kinetic molecular theory. (3)

3.2 The heating curve of Hydrochloric acid (HCl) is represented by the graph below. The graph is not drawn to scale.



3.2.1 Define the term *boiling point* in words. (2)

3.2.2 Write down the boiling point of hydrochloric acid. (1)

3.2.3 At which point, A or B, are the forces between HCl particles stronger? (1)

3.2.4 Refer to the temperature, energy and movement of particles to explain the changes that take place between t_2 and t_3. (3)

[13]

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QUESTION 4 (Start on a new page.)

4.1 Silicon occurs naturally as three stable isotopes:

- Si – 28
- Si – 29
- Si – 30

The percentage abundance of Si - 28 is 92,2 % and the relative atomic mass of silicon is 28,1 AMU.

4.1.1 Define the term isotope in words. (2)

4.1.2 Determine the percentage abundance of Si – 29. (5)

4.1.3 Fill in the table below for the most abundant isotope of silicon. Write down only the letter (a – c) and the correct answer.

Number of protons	(a)
Number of neutrons	(b)
Number of valence electrons	(c)

(3)

4.2 Magnesium combines with chlorine to form magnesium chloride.

4.2.1 Identify the type of bond that forms when magnesium and chlorine combine. (1)

4.2.2 Draw the Lewis dot diagram for magnesium chloride. (2)

4.2.3 Draw the Aufbau diagram for the magnesium ion. (2)

4.2.4 Write down the name of the noble gas that has the same electronic configuration as the chloride ion. (1)

4.3 How does the atomic radius of Chlorine (Cl) compare to Magnesium (Mg)? Choose from GREATER THAN, LESS THAN or EQUAL TO.
Explain your answer by referring to the atomic structure. (4)

[20]

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QUESTION 5 (Start on a new page)

Magnesium nitride (Mg_3N_2) reacts with hydrochloric acid (HCl) according to the balanced equation below:

$$Mg_3N_2(s) + 6HCl(aq) \rightarrow 3MgCl_2(aq) + 2NH_3(g)$$

In one such reaction a learner completely reacts 10 g magnesium nitride (Mg_3N_2) with 1,2 dm^3 hydrochloric acid (HCl) at standard temperature and pressure (STP).

5.1 Define the term *concentration* in words. (2)

5.2 Calculate the number of moles of Mg_3N_2 that reacted. (3)

5.3 Determine the:

5.3.1 Concentration of HCl (4)

5.3.2 Volume of NH_3 gas (in dm^3) that formed at STP (4)

5.3.3 Number of chloride ions (Cl^-) present in the $MgCl_2$ produced (5)

[18]

QUESTION 6 (Start on a new page)

6.1 Analysis of a compound that is made up of Magnesium (Mg), Phosphorus (P) and Oxygen (O) only, provided the following percentage composition by mass.

- Magnesium: 27,7 %
- Phosphorus: 23,6 %
- Oxygen: 48,7 %

(6)

Determine the empirical formula of this compound.

6.2 Determine the mass of hydrated potassium sulphate($K_2SO_4.7H_2O$) needed to prepare 100 ml of a 0,2 $mol \cdot dm^{-3}$ potassium sulphate solution. (4)

[10]

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QUESTION 7 (Start on a new page)

A metal **Y** reacts with copper (ii) oxide (CuO) according to balanced chemical below:

$$2Y + 3CuO \rightarrow Y_2O_3 + 3Cu$$

A 5 g sample of **Y** reacts with excess copper (ii) oxide (CuO) to produce 15 g of copper (Cu).

The percentage yield of copper (Cu) in this reaction is 85 %.

7.1 Determine the theoretical mass of copper (Cu) formed. (3)

7.2 Use relevant calculations to determine the NAME of metal **Y**. (6)

[9]

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DATA FOR PHYSICAL SCIENCES GRADE 10

CHEMISTRY

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	1,013 x 10^5 Pa
Molar gas volume at STP	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature	T^{θ}	273 K
Avogadro's constant	N_A	6,02 x 10^{23} mol^{-1}

TABLE 2: FORMULAE

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

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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	**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	**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**

Atomic number
Atoomgetal

29
1,9 **Cu**
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES P2

FINAL EXAMINATION MARKING MEMORANDUM

NOVEMBER 2025

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MARKS: 100

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QUESTION 1:

1.1 A ✓✓ (2)
1.2 B ✓✓ (2)
1.3 D ✓✓ (2)
1.4 C ✓✓ (2)
1.5 C ✓✓ (2)
[10]

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QUESTION 2

2.1.1 Mixture ✓ (1)

2.1.2a) - 190°C ✓ (1)

2.1.2b) Y_2 ✓ (1)

2.1.2c) Physical (change). ✓
No new substance is formed. OR No chemical reaction took place. ✓ (2)

2.1.2d) Some of the XY would evaporate below its boiling point.✓ ✓ (2)

2.2.1 $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
LHS ✓
RHS ✓
Balancing ✓ (3)

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2.2.2 Synthesis ✓ (1)

2.3.1 $$\%\ N = \frac{14 \times 2 \checkmark}{14 \times 2 + 1 \times 4 + 16 \times 3 \checkmark} \times 100$$
$= 35\ \%$ ✓ (3)

2.3.2 **POSITIVE MARKING FROM 2.3.1**
m (NH_4NO_3) = 30 ✓ ÷ 0,35 ✓
= 85,71 kg ✓ (3)

2.4 Mass of reactants = 4[14 + 1x3] + 5[16x2] ✓ = 228 g
Mass of products = 4[14 + 16] + 6[1x2 + 16] ✓ = 228 g
Mass of reactants is equal to the mass of products. Therefore mass is conserved. ✓ (3)

[20]

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QUESTION 3

3.1.1 The movement of atoms or molecules ✓ from an area of higher concentration to an area of lower concentration. ✓ (2)

3.1.2 Ammonia diffuses faster than hydrochloric acid ✓ (1)

3.1.3 Decrease. ✓
At a higher temperature the particles move faster OR have more kinetic energy ✓.
Therefore, the gases diffuse faster. ✓ (3)

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

3.2.2 - 85,1 °C ✓ (1)

3.2.3 (point) A✓ (1)

3.2.4 The temperature of HCl increase. ✓ The average kinetic energy of the particles increases. ✓ Particles move faster. ✓ (3)

[13]

QUESTION 4

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

4.1.2 Let the % of Si – 29 be X.
The % of Si – 30 will be 7,8 – X

$$28{,}1 \checkmark = 28 \times \frac{92{,}2}{100} \checkmark + 29 \times \frac{X}{100} \checkmark + 30 \times \frac{7{,}8 - X}{100} \checkmark$$

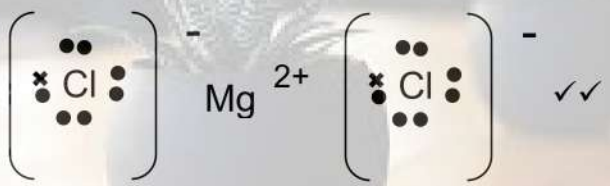
X = 5,6 % ✓ (5)

4.1.3 (a) =14 ✓
(b) = 14 ✓
(c) = 4 ✓ (3)

4.2.1 Ionic bonds ✓ (1)

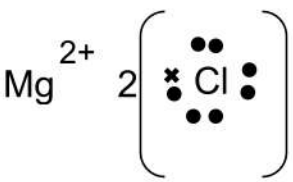
4.2.2 (2)

OPTION 1



✓✓

OPTION 2



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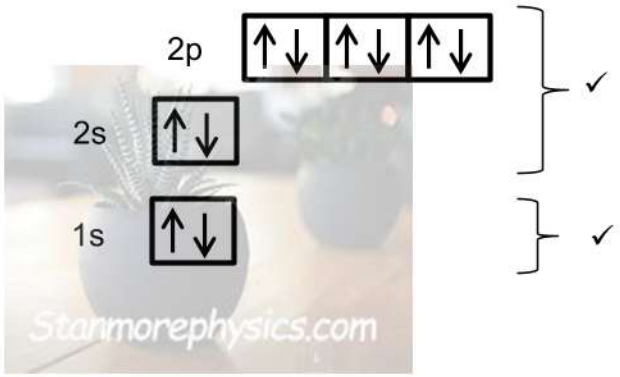
4.2.3 (2)



4.2.4 Argon ✓ (1)

4.3 Less than. ✓

- Both chlorine and magnesium are in the same period OR have the same number of energy levels. ✓
- The effective nuclear charge of chlorine is higher than magnesium. ✓
- The force of attraction between the nucleus and the outer orbital is stronger in chlorine. ✓ (4)

[20]

QUESTION 5

5.1 The number of moles of solute per cubic decimetre of solution. ✓✓ (2)

5.2 $n(Mg_3N_2) = \frac{m}{M}$ ✓

$= \frac{10}{24\times3+14\times2}$ ✓

$= 0,1$ mol ✓ (3)

5.3.1 **POSITIVE MARKING FROM 5.2**

$Mg_3N_2 : HCl$

1 : 6 ✓

$n(HCl) = 0,6$ mol

$c(HCl) = \frac{n}{V}$ ✓

$= \frac{0,6}{1,2}$ ✓

$= 0,5$ mol·dm^3 ✓ (4)

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5.3.2 **POSITIVE MARKING FROM 5.2 AND 5.3.1**

$Mg_3N_2 : NH_3$
1 : 2 ✓

OR

$HCl : NH_3$
6 : 2 (or 3:1) ✓

$n(NH_3) = 0,2$ mol

$n(NH_3) = \frac{V}{V_m}$ ✓

$0,2 = \frac{V}{22,4}$ ✓

$V(H_2) = 4,48\ dm^3$ ✓ (4)

5.3.3 **POSITIVE MARKING FROM 5.2, 5.3.1 AND 5.3.2**

$Mg_3N_2 : MgCl_2$
1 : 3 ✓

OR

$HCl : MgCl_2$
6 : 3 (or 2:1) ✓

OR

$NH_3 : MgCl_2$
2 : 3 ✓

$n(MgCl_2) = 0,3$ mol

$n(MgCl_2) = \frac{N}{N_A}$ ✓

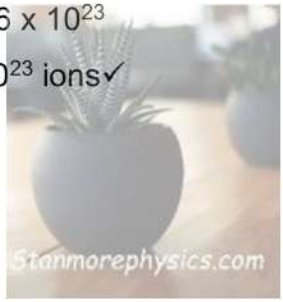
$0,3 = \frac{N}{6,02 \times 10^{23}}$ ✓

$N(MgCl_2) = 1,806 \times 10^{23}$ formula units

$N(Cl^-) =$ 2 x ✓$1,806 \times 10^{23}$

$= 3,612 \times 10^{23}$ ions✓ (5)

[18]



QUESTION 6

6.1

Marking criteria:

- Calculate the number of moles of each element (3 x 1 = 3) ✓✓✓
- Determine the simplest ratio of all elements ✓
- Multiplying by 2 ✓
- Final answer: $Mg_3P_2O_8$ ✓

Element	mass (g)	$n = \frac{m}{M}$	Simplest Ratio			
Mg	27,7	$\frac{27,7}{24} = 1,15$ ✓	$\frac{1,15}{0,76} = 1,51$	✓	x 2 ✓	3
P	23,6	$\frac{23,6}{31} = 0,76$ ✓	$\frac{0,76}{0,76} = 1$			2
O	48,7	$\frac{48,7}{16} = 3,04$ ✓	$\frac{3,04}{0,76} = 4$			8

Empirical Formula: $Mg_3P_2O_8$ ✓ (6)

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6.2.1 $M(K_2SO_4.7H_2O) = 39x2 + 32 + 16x4 + 7x18$ ✓

$= 300\ g.mol^{-1}$

OPTION 1

$c = \frac{m}{MV}$ ✓

$0,2 = \frac{m}{300(0,1)}$ ✓

$m = 6\ g$ ✓

OPTION 2

$c = \frac{n}{V}$ ✓

$0,2 = \frac{n}{0,1}$

$n(K_2SO_4.7H_2O) = 0,02\ mol$ ✓

$m = n \times M$

$= 0,02 \times 300$

$= 6\ g$ ✓

(4)

[10]

QUESTION 7

7.1

$$\%\ yield = \frac{actual\ yield}{theoretical\ yield} \times 100$$

$$85✓ = \frac{15✓}{theoretical\ yield} \times 100$$

$m(Cu)_{theoretical} = 17,65\ g$ ✓

OR

$m(Cu)_{actual} = m(Cu)_{theoretical} \times 0,85$

$15✓ = m(Cu)_{theoretical} \times 0,85$ ✓

(3)

7.2 **POSITIVE MARKING FROM 7.1**

Marking criteria:

- Divide by 63,5 ✓
- Ratio (2:3) ✓
- Formula: $n(Y) = \frac{m}{M}$ ✓
- Substitute n(Y) ✓
- Substitute 5g ✓

Final answer: Aluminium ✓

$n(Cu) = \frac{m}{M}$

$= \frac{17,65}{63,5}$ ✓

$= 0,278\ mol$

Y : Cu

2 : 3✓

$n(Y) = 0,185\ mol$

$n(Y) = \frac{m}{M}$ ✓

$0,185✓ = \frac{5✓}{M}$

$M(Y) = 27,03\ g$

Y is Aluminium ✓

(6)

[9]

TOTAL: **100**

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