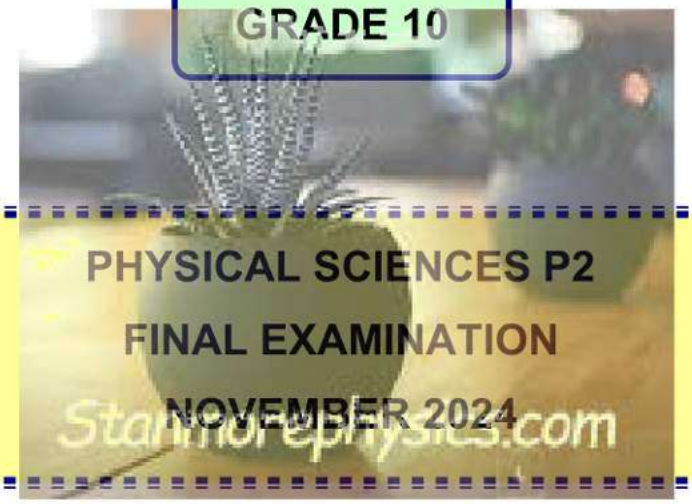
KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10



PHYSICAL SCIENCES P2

FINAL EXAMINATION

NOVEMBER 2024

MARKS: 100

DURATION: 2 hours

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

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 of the following is an example of a chemical change?

A The melting of ice.

B The separation of Nitrogen from air using fractional distillation.

C Dissolving potassium iodide in water.

D Milk turning sour (2)

1.2 Which one of the following is the correct description of a substance in the liquid phase?

A The particles of the substance are bonded in fixed positions.

B The substance has a fixed volume but not a fixed shape.

C The particles of the substance always occupy the total volume of the container.

D The temperature of the substance is greater than its boiling point. (2)

1.3 Which one of the following has the largest atomic radius?

A Be

B Mg

C Ne

D Ar (2)

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1.4 Which one of the following pairs of ions and atoms have the same number of electrons?

A S^{2-} and Ar

B Mg^{2+} and Mg

C Mg^{2+} and Ar

D N^{3-} and He (2)

1.5 Consider the balanced chemical equation for the reaction below:

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

The number of Oxygen atoms in the SO_3 formed when 22,4 dm^3 SO_2 reacts with excess oxygen (O_2) at STP is …

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

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

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

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

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QUESTION 2 (Start on a new page.)

2.1 A bag of cement has the following percentage composition by mass:

Ingredient	**Percentage composition (by mass)**
Calcium oxide (CaO)	62
Silicon dioxide (SiO_2)	22
Aluminium oxide (Al_2O_3)	5
Calcium sulphate ($CaSO_4$)	4
Fe_2O_3	3
Magnesium oxide (MgO)	2
Sulphur	1
Alkalis	1
TOTAL	**100**

2.1.1 Is the cement a MIXTURE or a PURE SUBSTANCE?
Give a reason for the answer? (2)

2.1.2 Identify the type of chemical bond that forms when calcium and oxygen combine to form calcium oxide (CaO). (1)

2.1.3 Draw the Lewis structure for calcium oxide (CaO). (2)

2.1.4 Write down the name of the compound Fe_2O_3. (2)

2.1.5 Determine the number of calcium oxide (CaO) particles in a 750 g sample of the cement. (5)

2.2 In a process called Calcination, Calcium carbonate ($CaCO_3$) is heated to form the calcium oxide found in cement.

This balanced chemical equation for this calcination is:

$$CaCO_3 \rightarrow CaO + CO_2$$

2.2.1 Is the reaction described above a SYNTHESIS or DECOMPOSITION reaction? (1)

2.2.2 Is calcination of $CaCO_3$ an example of a PHYSICAL or CHEMICAL change?
Explain the answer. (2)

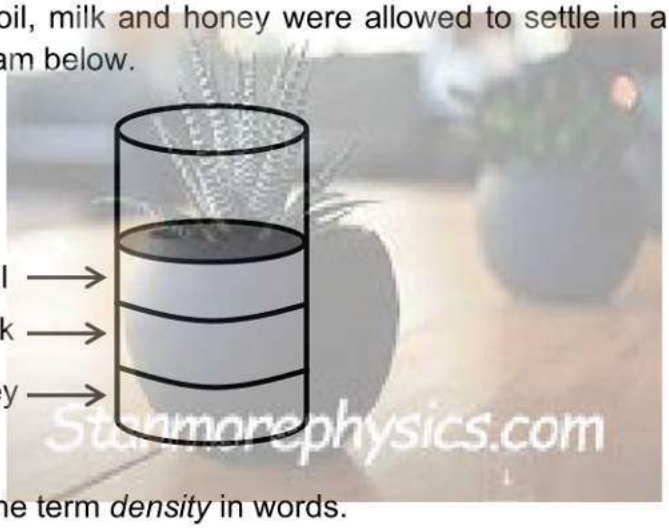
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2.3 Calcium carbonate reacts with Hydrochloric acid (hydrogen chloride) to form Calcium chloride, Water and Carbon dioxide.

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

2.3.2 Explain why tiny bubbles are noticed during this reaction. (1)

2.4 Equal volumes of oil, milk and honey were allowed to settle in a cylinder as shown in the diagram below.



2.4.1 Define the term *density* in words. (2)

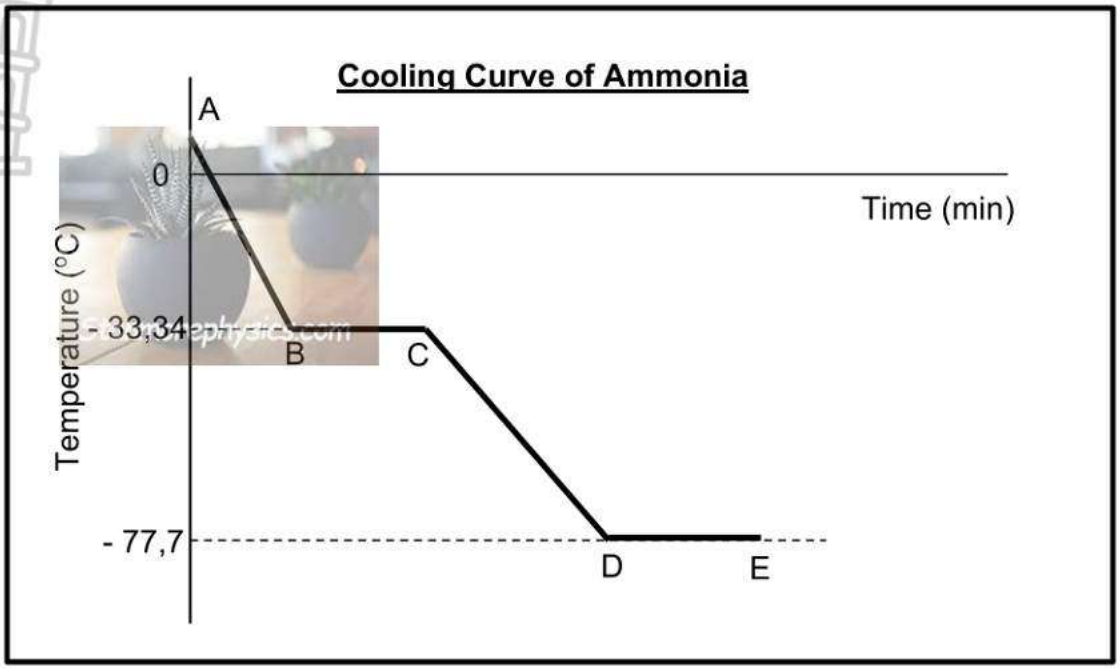
2.4.2 Arrange the liquids from lowest to highest density. (1)

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QUESTION 3 (Start on a new page.)

3.1 The cooling curve of AMMONIA is represented in the graph below. The graph is not drawn to scale.



3.1 Write down the boiling point of ammonia. (1)

3.2 Explain in terms of temperature, energy and movement of particles, the changes that takes place between Point C and Point D. (3)

3.3 Explain the change taking place between Point D and Point E. (1)

3.4 At which region of the graph, **A to B** or **C to D**, are the particles closer together. Explain your answer. (3)

3.5 The melting and boiling points of three substances is indicated in the table below.

Substance	**Water**	**Ethanol**	**Ethanoic acid**
Melting Point (°C)	0	- 114,1	16,6
Boiling Point (°C)	100	78,37	117,9

3.5.1 Define the term *melting point* in words. (2)

3.5.2 Which substance from the table has the weakest forces between its particles? Explain your answer. (2)

3.5.3 What is the phase of Ethanoic acid at room temperature? (1)

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QUESTION 4 (Start on a new page.)

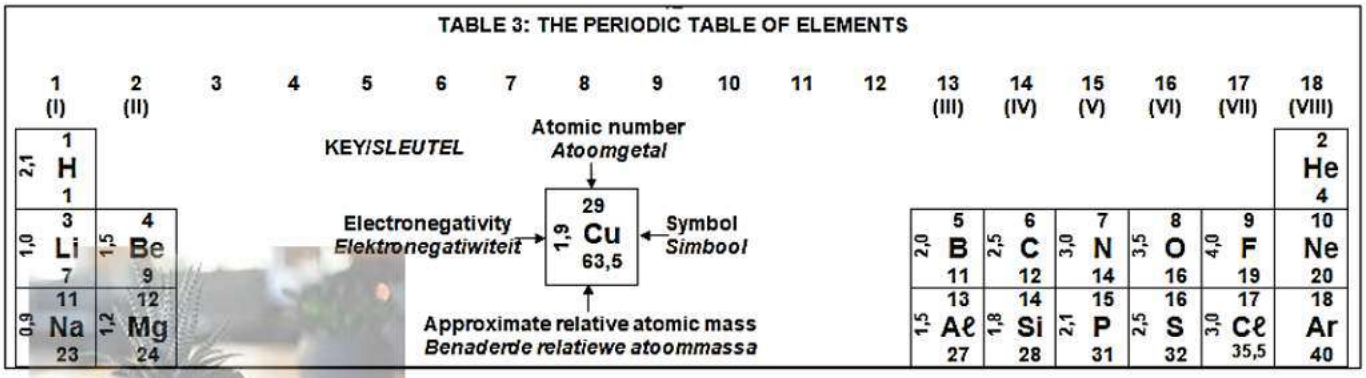
4.1 The three stable isotopes of Magnesium and their percentage abundance is indicated below:

Isotope	Percentage Abundance
Mg - 24	78,99 %
Mg - 25	10 %
Mg - 26	REMAINDER

4.1.1 Why does the atomic mass of Mg – 24 differ from that of Mg – 26? (1)

4.1.2 Determine the relative atomic mass of magnesium (3)

4.2 The following is an extract from the periodic table (refer to page 12).



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4.2.1 Define the term *electronegativity* in words. (2)

4.2.2 Describe the trend in electronegativity from left to right across a period. (1)

4.2.3 Explain the trend described in QUESTION 4.2.2. (2)

4.2.4 No electronegativity value is indicated for Neon (Ne).
Provide a reason for this observation. (2)

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

$$2Ca_3(PO_4)_2 + 6SiO_2 \rightarrow 6CaSiO_3 + P_4O_{10}$$ (3)

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QUESTION 5 (Start on a new page)

Aluminium powder (Al) reacts with Sulphuric acid (H_2SO_4) according to the balanced equation below.

$$2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$$

In one such reaction exactly 5 g Aluminium (Al) reacts with Sulphuric acid (H_2SO_4) of concentration 0,1 $mol.dm^{-3}$ at STP.

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

5.2 Calculate the :

5.2.1 Number of moles of Al that reacted (3)

5.2.2 Volume of H_2SO_4 (in dm^3) that reacted (4)

5.2.3 Volume of H_2 gas (in dm^3) that formed at STP (4)

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QUESTION 6 (Start on a new page)

6.1 A compound is made up of Sodium (Na), Phosphurus (P) and Oxygen (O) only. A 10 g sample of this compound consists of 4,21 g Sodium (Na) and 1,89 g Phosphurus (P).
Determine the empirical formula of this compound. (6)

6.2 15,75 g of hydrated oxalic acid, $H_2C_2O_4.\mathbf{x}H_2O$ is dissolved in water to make a 250 cm^3 solution of concentration 0,5 $mol.dm^{-3}$.

6.2.1 Calculate the molar mass of $H_2C_2O_4.\mathbf{x}H_2O$ (3)

6.2.2 Determine "**x**", the number of moles of water of crystallization. (3)

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6.3 The reaction between lead (II) nitrate ($Pb(NO_3)_2$) and potassium iodide(KI) is given by the balanced chemical equation below:

$$Pb(NO_3)_2(s) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

The percentage yield of lead (II) iodide (PbI_2) is 75 %.

Determine the mass of potassium iodide (KI) required to form 80 g of PbI_2. (6)

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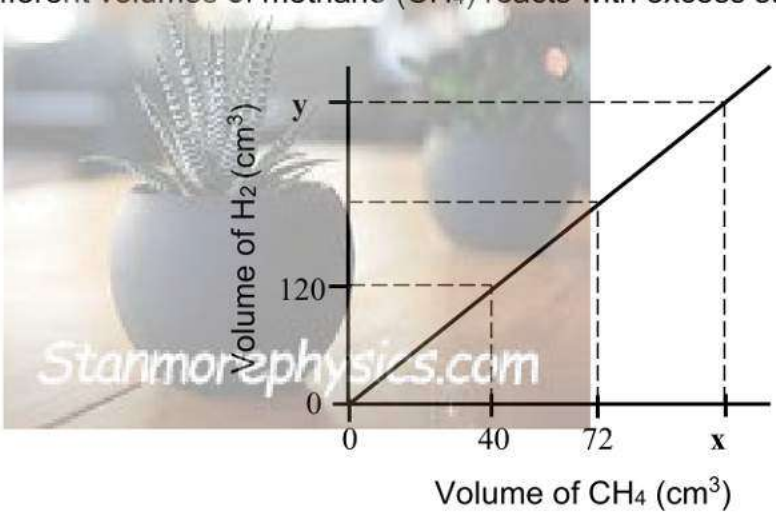
QUESTION 7 (Start on a new page)

Hydrogen gas (H_2) is prepared from the reaction between methane (CH_4) and steam (H_2O).

The reaction is represented by the following balanced equation:

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

The graph below (not drawn to scale), shows the **volume of hydrogen (H_2) formed** when different volumes of methane (CH_4) reacts with excess steam (H_2O) at STP.



7.1 Calculate the gradient of the graph (2)

7.2 What does the gradient of the graph represent? (2)

7.3 Determine the volume of H_2 (in cm^3) formed when 72 cm^3 of methane (CH_4) reacted with excess steam. (2)

7.4 The TOTAL VOLUME of gas formed when **x** cm^3 of CH_4 reacts with excess H_2O to form **y** cm^3 of H_2 is 420 cm^3.
Determine the values of **x** and **y** on the graph. (4)

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DATA FOR PHYSICAL SCIENCES GRADE 10

CHEMISTRY

TABLE 1: PHYSICAL CONSTANTS

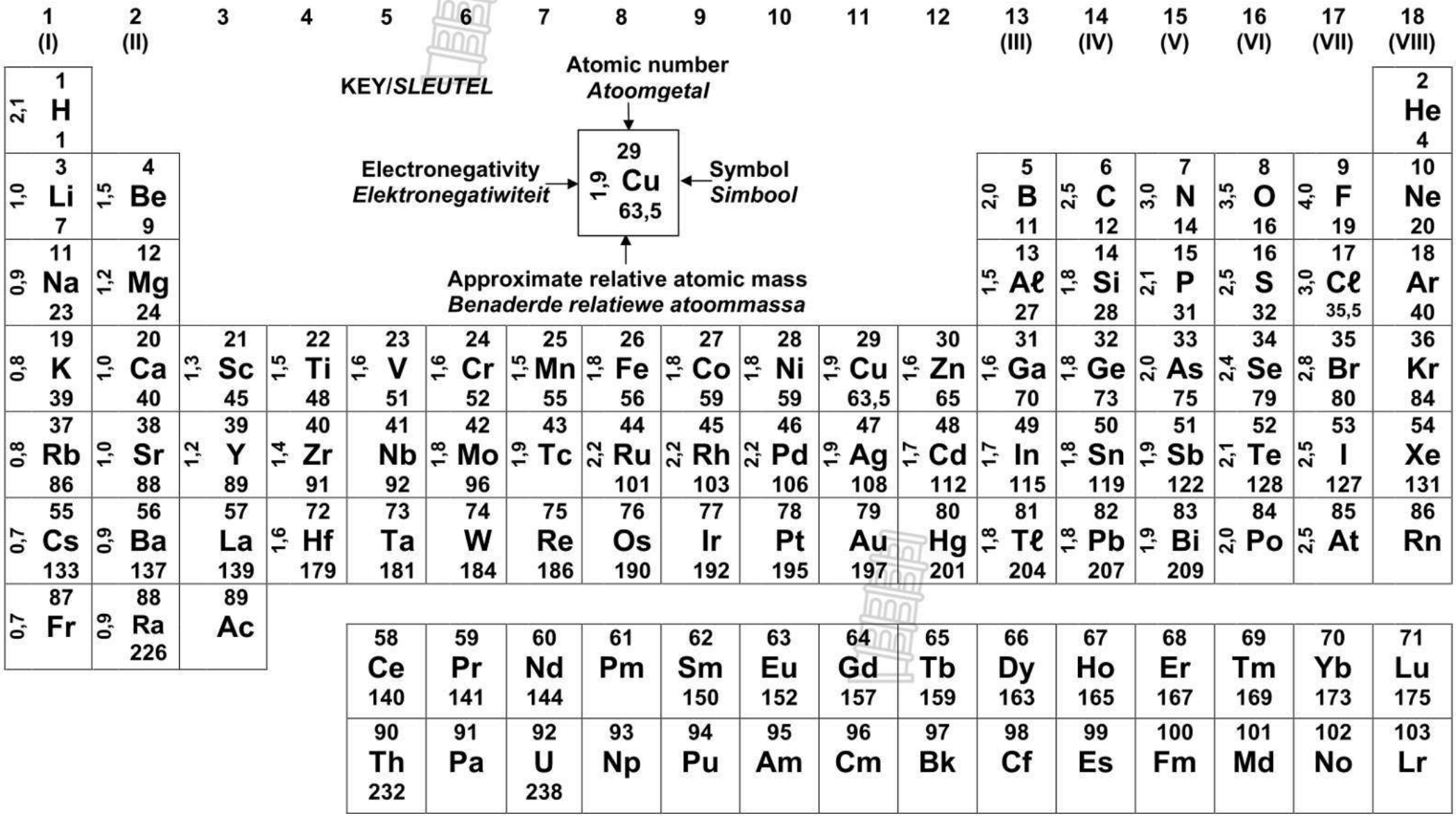
NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature	T^{θ}	273 K
Avogadro's constant	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

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



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