basic education

Department:
Basic Education
**REPUBLIC OF SOUTH AFRICA**

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## TECHNICAL SCIENCES P2

## NOVEMBER 2025

**MARKS: 75**

**TIME: 1½ hours**

**This question paper consists of 13 pages and 4 data sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of SEVEN 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 subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You are advised to use the attached DATA SHEETS.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Which ONE of the following reaction types can be used to prepare propane from propene?

A Oxidation

B Hydrolysis

C Halogenation

D Hydrogenation (2)

1.2 Which ONE of the following lists of compounds are arranged in order of decreasing boiling points?

A Pentanoic acid; butan-1-ol; propane

B Propane; pentanoic acid; butan-1-ol

C Butan-1-ol; propane; pentanoic acid

D Propane; butan-1-ol; pentanoic acid (2)

1.3 … is a saturated hydrocarbon.

A $CH_3(CH_2)_2CHCH_2$

B $CH_3CHCHCH_2CH_3$

C $CH_3C(CH_3)_2CHCH_2$

D $CH_3CH_2CH(CH_3)CH_3$ (2)

1.4 The elements in the periodic table that can be used for doping are …

| | TRIVALENT MATERIAL | PENTAVALENT MATERIAL |
|---|---|---|
| A | Aℓ | Be |
| B | B | As |
| C | C | N |
| D | B | S |

(2)

1.5 Consider the following statements:

(i) The anode of a galvanic cell is positive.

(ii) Electroplating of metals takes place in an electrolytic cell.

(iii) Oxidation takes place at the negative electrode of a galvanic cell.

Which statement(s) is/are CORRECT?

A Only (i)

B Only (iii)

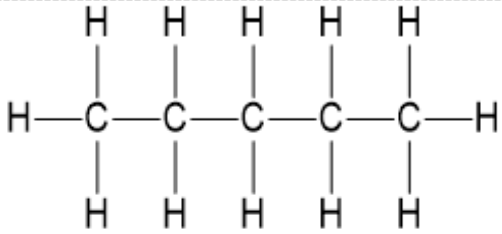
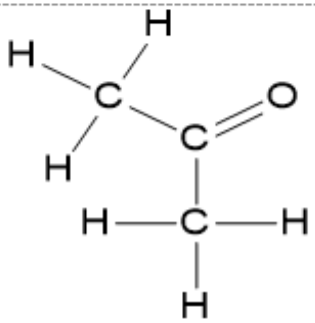
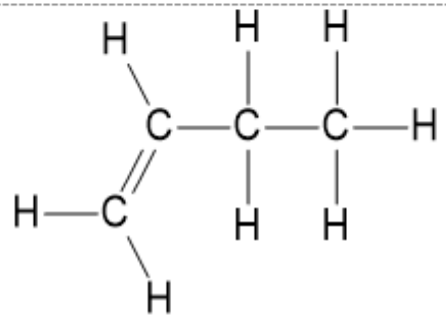
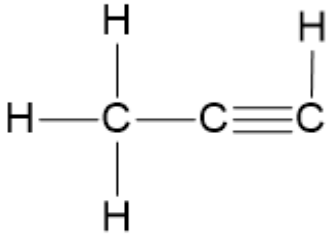
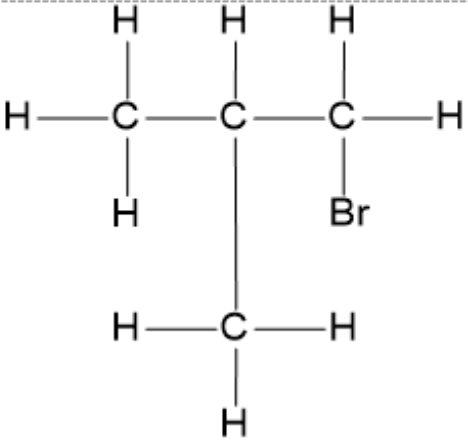
C (ii) and (iii)

D (i), (ii) and (iii) (2)

**[10]**

**QUESTION 2 (Start on a new page.)**

The letters **A** to **F** in the table below represent six organic compounds.

| | |
|---|---|
| **A**  | **B** Ethyl butanoate |
| **C**  | **D**  |
| **E**  | **F**  |

2.1 Write down the letter that represents the following:

2.1.1 A saturated hydrocarbon (1)

2.1.2 A compound which is an isomer of but-2-ene (1)

2.1.3 An alkyne (1)

2.2 Write down the:

2.2.1 NAME of the functional group of compound **C** (1)

2.2.2 IUPAC name of compound **F** (2)

2.3 Consider compound **B** and write down the:

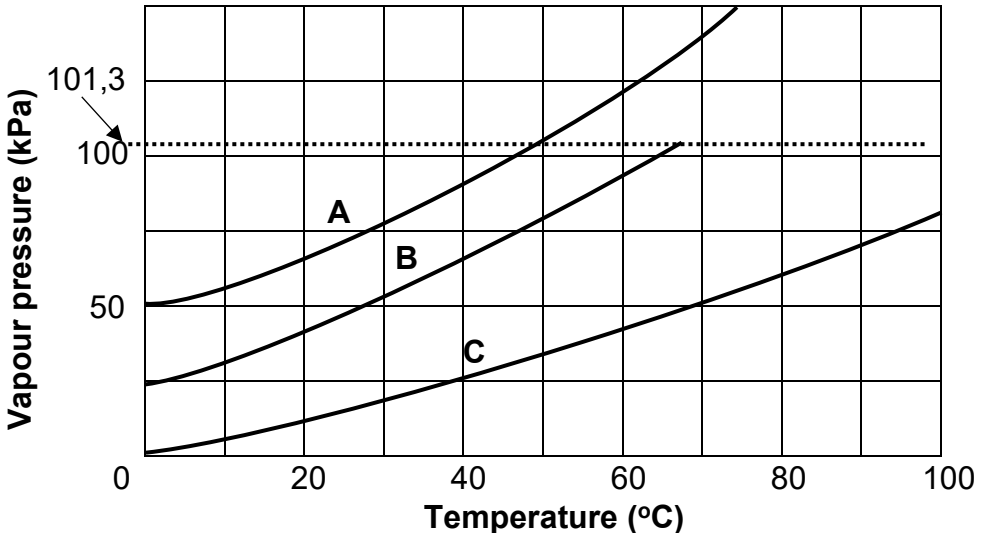
2.3.1 Homologous series to which it belongs (1)

2.3.2 Structural formula (2)

2.3.3 General formula (1)
**[10]**

**QUESTION 3 (Start on a new page.)**

The graph below shows the relationship between vapour pressure and temperature for three straight chain alkanes (**A**, **B** and **C**). The atmospheric pressure is 101,3 kPa.




3.1 Define the term *vapour pressure*. (2)

3.2 Use the information in the graph above to answer the following questions.

3.2.1 How does an increase in temperature affect the vapour pressure? Write down only INCREASES, DECREASES or NO EFFECT. (1)

3.2.2 Which compound has a boiling point of approximately 68 °C? (1)

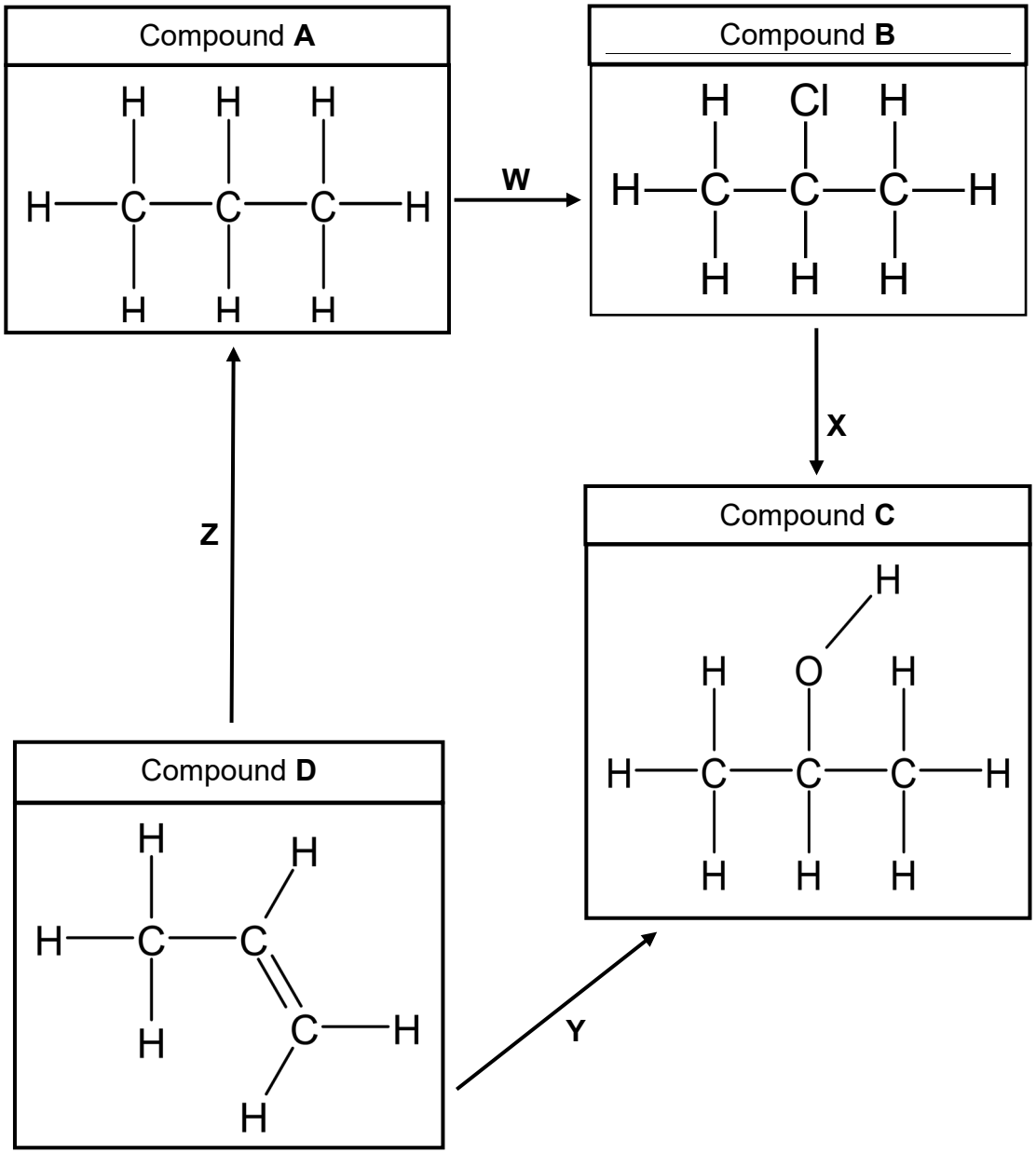
3.2.3 Give a reason for the answer to QUESTION 3.2.2. (2)

3.2.4 Which compound has the longest chain length?

Explain the answer by referring to the VAPOUR PRESSURE and RELATIVE STRENGTH OF THE INTERMOLECULAR FORCES of the compounds. (3)
**[9]**

**QUESTION 4 (Start on a new page.)**

Study organic reactions **W**, **X**, **Y** and **Z** in the flow chart below and answer the questions that follow.




4.1 For reaction **Y**, write down:

4.1.1 The NAME of the reaction (1)

4.1.2 TWO conditions that are required for this reaction (2)

4.2 Identify the type of reaction **Z**. (1)

4.3 Write down the CHEMICAL FORMULA for the substance that reacts with compound **A** to form compound **B**. (1)

4.4 Write down the NAME of reaction **X**. (1)

4.5 Consider the organic compounds in the list below.

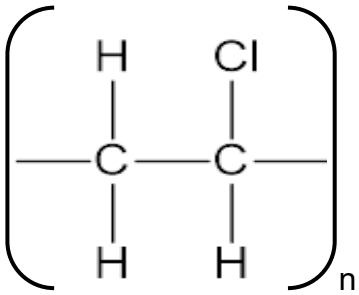
| | | | |
|---|---|---|---|
| **Propan-2-ol** | **Propanal** | **Propanoic acid** | **Propanone** |

4.5.1 In the list above, identify TWO compounds that are functional isomers. (2)

4.5.2 Explain and use STRUCTURAL FORMULAE to support the answer to QUESTION 4.5.1. Label each structural formula. (4)

4.6 Define the term *polymer*. (2)

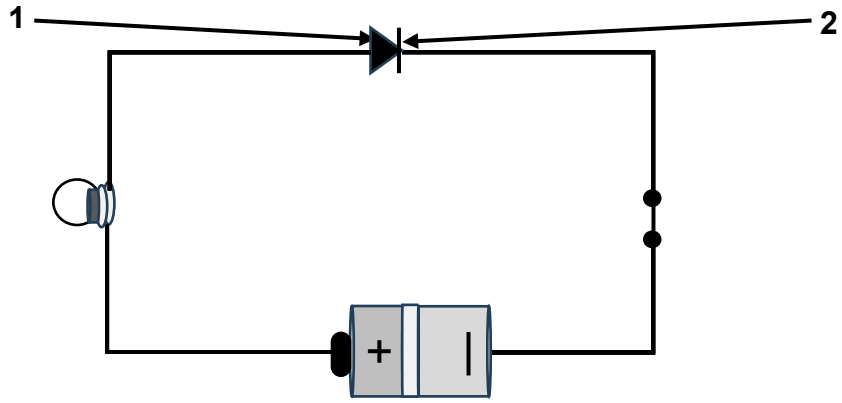
4.7 Draw the structural formula of the monomer used in the production of the polymer below.




(2)
**[16]**

**QUESTION 5 (Start on a new page.)**

Study the diagram below and answer the questions that follow.




5.1 Name part **1**. (1)

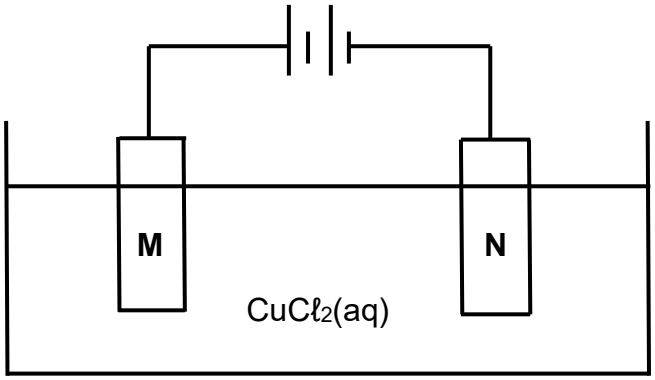
5.2 What type of p-n junction diode is this? Write only FORWARD BIASED or REVERSE BIASED or ZERO BIASED. (1)

5.3 Give a reason for the answer to QUESTION 5.2. (2)

5.4 Write down TWO characteristics of the p-n junction diode in QUESTION 5.2. (2)
**[6]**

**QUESTION 6 (Start on a new page.)**

The diagram below represents an electrolytic cell used in the decomposition of a copper (II) chloride solution.




6.1 Define the term *electrolyte*. (2)

6.2 Which electrode, **M** or **N**, is the anode? (1)

6.3 Write down the half-reaction that occurs at electrode **M**. (2)

6.4 Write down the:

6.4.1 Chemical formula of the substance that forms at electrode **N** (1)

6.4.2 Name of the oxidising agent in this reaction (1)

6.5 Consider the forms of alternative energy sources in the table below and answer the questions that follow.

| | TYPE OF ENERGY | DIAGRAM |
|---|---|---|
| A | Wind energy |  |
| B | Solar energy |  |
| C | Hydroelectric energy |  |
| D | Biodiesel |  |

6.5.1 Name ONE advantage of alternative energy. (1)

6.5.2 Write down the letter of the energy source that is linked to the operation of a photovoltaic cell. (1)

6.5.3 Write down the energy conversion that takes place in the cell referred to in QUESTION 6.5.2. (1)

6.5.4 What is *biodiesel*? (2)
**[12]**

**QUESTION 7 (Start on a new page.)**

The table below shows half-cell **A** and an unknown half-cell **B** used to assemble a galvanic cell under standard conditions.

| | |
|---|---|
| Half-cell **A** | $Ni^{2+}(aq)/Ni(s)$ |
| Half-cell **B** | Unknown |

The initial emf reading of the cell when in operation is 0,17 V and the polarity of half-cell **B** is NEGATIVE.

7.1 Define the term *reduction* in terms of electron transfer. (2)

7.2 Use a calculation to identify the electrode in half-cell **B**. (5)

7.3 For this cell, write down the:

7.3.1 Half-reaction for half-cell **A** (2)

7.3.2 Cell notation (3)
**[12]**

**TOTAL: 75**

# DATA FOR TECHNICAL SCIENCES GRADE 12
# PAPER 2
# *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12*
# *VRAESTEL 2*

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

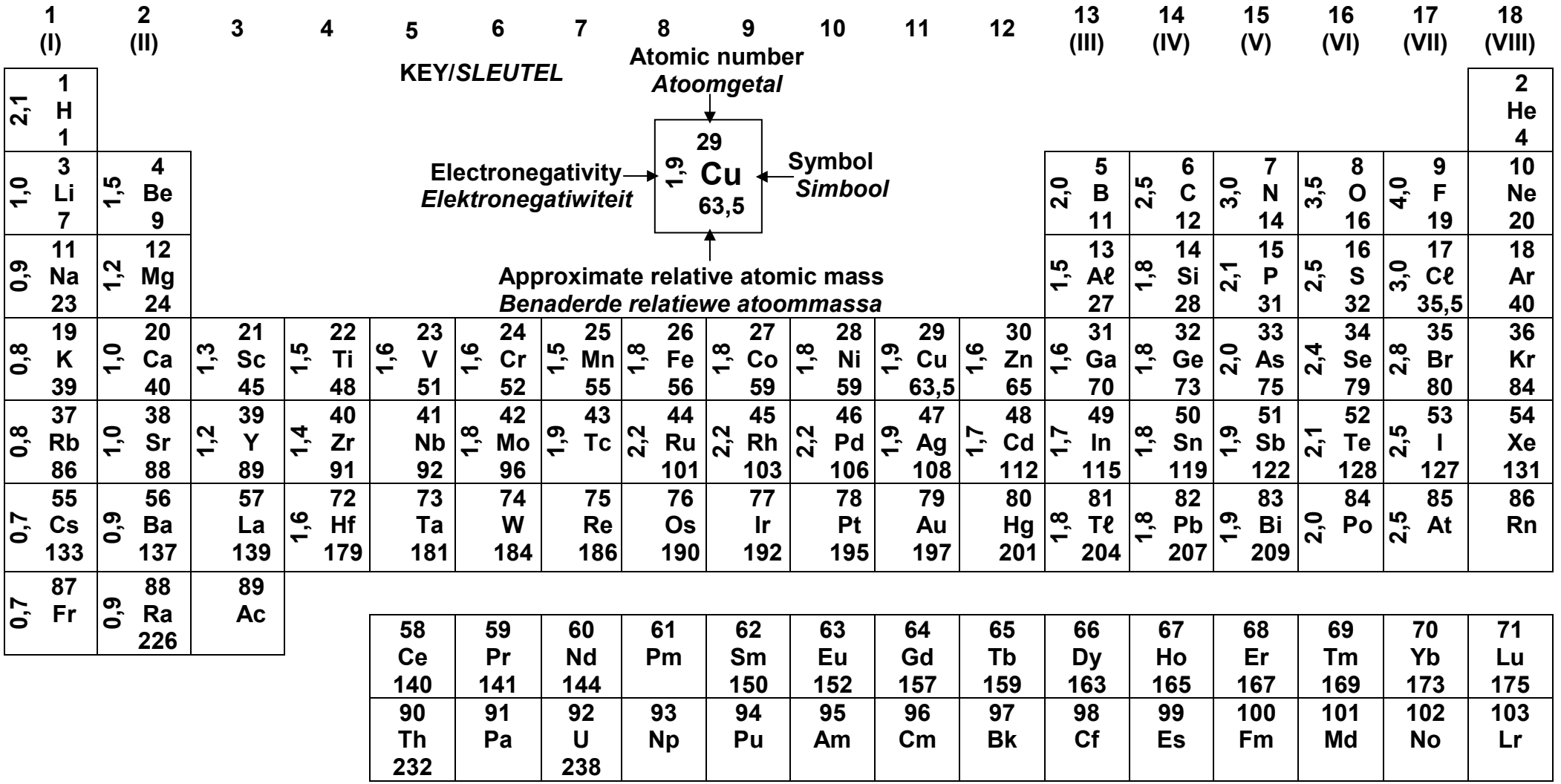
| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Standard pressure<br>*Standaarddruk* | $p^{\theta}$ | $1{,}01 \times 10^{5}$ Pa |
| Standard temperature<br>*Standaardtemperatuur* | $T^{\theta}$ | 0 °C/273 K |

## TABLE 2/*TABEL 2*: FORMULAE/*FORMULES*

| | |
|---|---|
| Emf/*Emk* | $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$<br><br>or/*of*<br><br>$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$<br><br>or/*of*<br><br>$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$ |

## TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*



## TABLE 4A: STANDARD REDUCTION POTENTIALS
## *TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE*

**Increasing strength of oxidising agents/*Toenemende sterkte van oksideermiddels*** ↑

| Half-reactions/*Halfreaksies* | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $F_2(g) + 2e^-$ | ⇌ | $2F^-$ | + 2,87 |
| $Co^{3+} + e^-$ | ⇌ | $Co^{2+}$ | + 1,81 |
| $H_2O_2 + 2H^+ + 2e^-$ | ⇌ | $2H_2O$ | +1,77 |
| $MnO_4^- + 8H^+ + 5e^-$ | ⇌ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $C\ell_2(g) + 2e^-$ | ⇌ | $2C\ell^-$ | + 1,36 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | ⇌ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $O_2(g) + 4H^+ + 4e^-$ | ⇌ | $2H_2O$ | + 1,23 |
| $MnO_2 + 4H^+ + 2e^-$ | ⇌ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $Pt^{2+} + 2e^-$ | ⇌ | Pt | + 1,20 |
| $Br_2(\ell) + 2e^-$ | ⇌ | $2Br^-$ | + 1,07 |
| $NO_3^- + 4H^+ + 3e^-$ | ⇌ | $NO(g) + 2H_2O$ | + 0,96 |
| $Hg^{2+} + 2e^-$ | ⇌ | $Hg(\ell)$ | + 0,85 |
| $Ag^+ + e^-$ | ⇌ | Ag | + 0,80 |
| $NO_3^- + 2H^+ + e^-$ | ⇌ | $NO_2(g) + H_2O$ | + 0,80 |
| $Fe^{3+} + e^-$ | ⇌ | $Fe^{2+}$ | + 0,77 |
| $O_2(g) + 2H^+ + 2e^-$ | ⇌ | $H_2O_2$ | + 0,68 |
| $I_2 + 2e^-$ | ⇌ | $2I^-$ | + 0,54 |
| $Cu^+ + e^-$ | ⇌ | Cu | + 0,52 |
| $SO_2 + 4H^+ + 4e^-$ | ⇌ | $S + 2H_2O$ | + 0,45 |
| $2H_2O + O_2 + 4e^-$ | ⇌ | $4OH^-$ | + 0,40 |
| $Cu^{2+} + 2e^-$ | ⇌ | Cu | + 0,34 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | ⇌ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + e^-$ | ⇌ | $Cu^+$ | + 0,16 |
| $Sn^{4+} + 2e^-$ | ⇌ | $Sn^{2+}$ | + 0,15 |
| $S + 2H^+ + 2e^-$ | ⇌ | $H_2S(g)$ | + 0,14 |
| **$2H^+ + 2e^-$** | **⇌** | **$H_2(g)$** | **0,00** |
| $Fe^{3+} + 3e^-$ | ⇌ | Fe | – 0,06 |
| $Pb^{2+} + 2e^-$ | ⇌ | Pb | – 0,13 |
| $Sn^{2+} + 2e^-$ | ⇌ | Sn | – 0,14 |
| $Ni^{2+} + 2e^-$ | ⇌ | Ni | – 0,27 |
| $Co^{2+} + 2e^-$ | ⇌ | Co | – 0,28 |
| $Cd^{2+} + 2e^-$ | ⇌ | Cd | – 0,40 |
| $Cr^{3+} + e^-$ | ⇌ | $Cr^{2+}$ | – 0,41 |
| $Fe^{2+} + 2e^-$ | ⇌ | Fe | – 0,44 |
| $Cr^{3+} + 3e^-$ | ⇌ | Cr | – 0,74 |
| $Zn^{2+} + 2e^-$ | ⇌ | Zn | – 0,76 |
| $2H_2O + 2e^-$ | ⇌ | $H_2(g) + 2OH^-$ | – 0,83 |
| $Cr^{2+} + 2e^-$ | ⇌ | Cr | – 0,91 |
| $Mn^{2+} + 2e^-$ | ⇌ | Mn | – 1,18 |
| $A\ell^{3+} + 3e^-$ | ⇌ | $A\ell$ | – 1,66 |
| $Mg^{2+} + 2e^-$ | ⇌ | Mg | – 2,36 |
| $Na^+ + e^-$ | ⇌ | Na | – 2,71 |
| $Ca^{2+} + 2e^-$ | ⇌ | Ca | – 2,87 |
| $Sr^{2+} + 2e^-$ | ⇌ | Sr | – 2,89 |
| $Ba^{2+} + 2e^-$ | ⇌ | Ba | – 2,90 |
| $Cs^+ + e^-$ | ⇌ | Cs | – 2,92 |
| $K^+ + e^-$ | ⇌ | K | – 2,93 |
| $Li^+ + e^-$ | ⇌ | Li | – 3,05 |

**Increasing strength of reducing agents/*Toenemende sterkte van reduseermiddels*** ↓

## TABLE 4B: STANDARD REDUCTION POTENTIALS
## *TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE*

Increasing strength of oxidising agents/*Toenemende sterkte van oksideermiddels* ↓

Increasing strength of reducing agents/*Toenemende sterkte van reduseermiddels* ↑

| Half-reactions/*Halfreaksies* | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $Li^+ + e^-$ | ⇌ | $Li$ | − 3,05 |
| $K^+ + e^-$ | ⇌ | $K$ | − 2,93 |
| $Cs^+ + e^-$ | ⇌ | $Cs$ | − 2,92 |
| $Ba^{2+} + 2e^-$ | ⇌ | $Ba$ | − 2,90 |
| $Sr^{2+} + 2e^-$ | ⇌ | $Sr$ | − 2,89 |
| $Ca^{2+} + 2e^-$ | ⇌ | $Ca$ | − 2,87 |
| $Na^+ + e^-$ | ⇌ | $Na$ | − 2,71 |
| $Mg^{2+} + 2e^-$ | ⇌ | $Mg$ | − 2,36 |
| $A\ell^{3+} + 3e^-$ | ⇌ | $A\ell$ | − 1,66 |
| $Mn^{2+} + 2e^-$ | ⇌ | $Mn$ | − 1,18 |
| $Cr^{2+} + 2e^-$ | ⇌ | $Cr$ | − 0,91 |
| $2H_2O + 2e^-$ | ⇌ | $H_2(g) + 2OH^-$ | − 0,83 |
| $Zn^{2+} + 2e^-$ | ⇌ | $Zn$ | − 0,76 |
| $Cr^{3+} + 3e^-$ | ⇌ | $Cr$ | − 0,74 |
| $Fe^{2+} + 2e^-$ | ⇌ | $Fe$ | − 0,44 |
| $Cr^{3+} + e^-$ | ⇌ | $Cr^{2+}$ | − 0,41 |
| $Cd^{2+} + 2e^-$ | ⇌ | $Cd$ | − 0,40 |
| $Co^{2+} + 2e^-$ | ⇌ | $Co$ | − 0,28 |
| $Ni^{2+} + 2e^-$ | ⇌ | $Ni$ | − 0,27 |
| $Sn^{2+} + 2e^-$ | ⇌ | $Sn$ | − 0,14 |
| $Pb^{2+} + 2e^-$ | ⇌ | $Pb$ | − 0,13 |
| $Fe^{3+} + 3e^-$ | ⇌ | $Fe$ | − 0,06 |
| **$2H^+ + 2e^-$** | **⇌** | **$H_2(g)$** | **0,00** |
| $S + 2H^+ + 2e^-$ | ⇌ | $H_2S(g)$ | + 0,14 |
| $Sn^{4+} + 2e^-$ | ⇌ | $Sn^{2+}$ | + 0,15 |
| $Cu^{2+} + e^-$ | ⇌ | $Cu^+$ | + 0,16 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | ⇌ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + 2e^-$ | ⇌ | $Cu$ | + 0,34 |
| $2H_2O + O_2 + 4e^-$ | ⇌ | $4OH^-$ | + 0,40 |
| $SO_2 + 4H^+ + 4e^-$ | ⇌ | $S + 2H_2O$ | + 0,45 |
| $Cu^+ + e^-$ | ⇌ | $Cu$ | + 0,52 |
| $I_2 + 2e^-$ | ⇌ | $2I^-$ | + 0,54 |
| $O_2(g) + 2H^+ + 2e^-$ | ⇌ | $H_2O_2$ | + 0,68 |
| $Fe^{3+} + e^-$ | ⇌ | $Fe^{2+}$ | + 0,77 |
| $NO_3^- + 2H^+ + e^-$ | ⇌ | $NO_2(g) + H_2O$ | + 0,80 |
| $Ag^+ + e^-$ | ⇌ | $Ag$ | + 0,80 |
| $Hg^{2+} + 2e^-$ | ⇌ | $Hg(\ell)$ | + 0,85 |
| $NO_3^- + 4H^+ + 3e^-$ | ⇌ | $NO(g) + 2H_2O$ | + 0,96 |
| $Br_2(\ell) + 2e^-$ | ⇌ | $2Br^-$ | + 1,07 |
| $Pt^{2+} + 2e^-$ | ⇌ | $Pt$ | + 1,20 |
| $MnO_2 + 4H^+ + 2e^-$ | ⇌ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $O_2(g) + 4H^+ + 4e^-$ | ⇌ | $2H_2O$ | + 1,23 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | ⇌ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $C\ell_2(g) + 2e^-$ | ⇌ | $2C\ell^-$ | + 1,36 |
| $MnO_4^- + 8H^+ + 5e^-$ | ⇌ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $H_2O_2 + 2H^+ + 2e^-$ | ⇌ | $2H_2O$ | +1,77 |
| $Co^{3+} + e^-$ | ⇌ | $Co^{2+}$ | + 1,81 |
| $F_2(g) + 2e^-$ | ⇌ | $2F^-$ | + 2,87 |