GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2024

11102

TECHNICAL SCIENCES

(PAPER 2)

TIME: 1,5 hours

MARKS: 75

10 pages + 4 data sheets

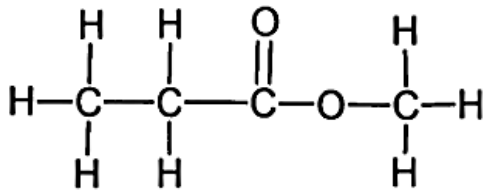
INSTRUCTIONS AND INFORMATION

1. Write your name and grade on the ANSWER BOOK.
2. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the answer book.
4. Number your answers correctly, according to the numbering system used in this question paper.
5. Leave ONE line between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable scientific calculator.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round-off your FINAL answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions etc. where required.
11. 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 Study the organic compound's structural formula below.



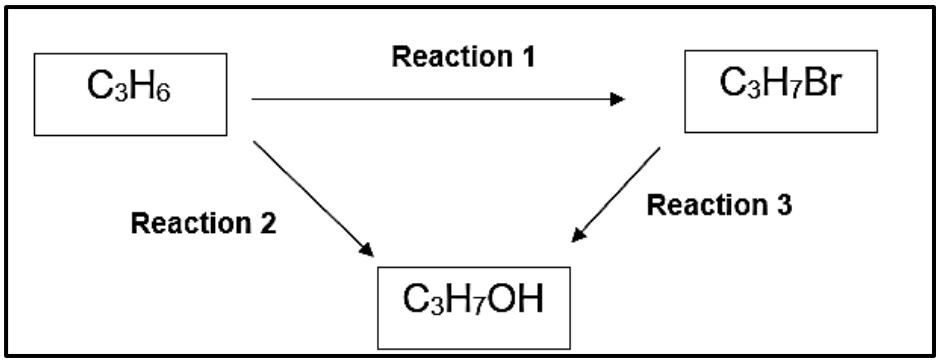
The homologous series to which this compound belongs is ...

A aldehyde.
B carboxylic acid.
C ester.
D ketone. (2)

1.2 The temperature where the vapor pressure of a substance is equal to atmospheric pressure is known as the ...

A freezing point.
B boiling point.
C vapor pressure.
D melting point. (2)

1.3 Consider the flowchart below that shows different organic reactions with C_3H_6 as the starting reactant.



Which of the following correctly describes the NAMES of the reactions in the following order?

	REACTION 1	REACTION 2	REACTION 3
A	Substitution	Addition	Addition
B	Halogenation	Hydrolyses	Hydration
C	Hydrohalogenation	Hydration	Hydrolysis
D	Addition	Substitution	Substitution

(2)

1.4 Which of the following half-reactions occurs at the CATHODE during the electrolysis of a solution of $CuC\ell_2$?

A $C\ell_2 + 2e^- \rightarrow 2C\ell^-$
B $Cu \rightarrow Cu^{2+} + 2e^-$
C $2C\ell^- \rightarrow C\ell_2 + 2e^-$
D $Cu^{2+} + 2e^- \rightarrow Cu$ (2)

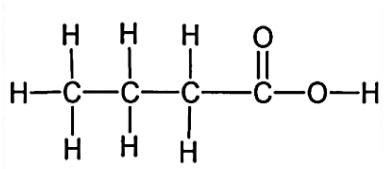
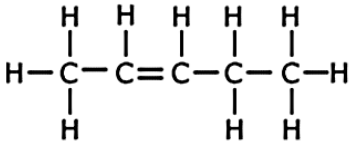
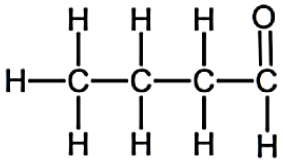
1.5 Which of the following metals is the strongest reducing agent?

A Ag
B Zn
C Cu
D Aℓ (2)

[10]

QUESTION 2 (Start on a new page.)

Consider the organic compounds represented by the letters **A** to **H** below and answer the questions that follow.

A	Polyethene	**B**	Ethanol
C	C_4H_9Cl	**D**	
E	3-methylbut-1-yne	**F**	$CH_3CH(CH_3)CH_2CH_3$
G		**H**	

2.1 Define the term *homologous series.* (2)

2.2 Write down the letter (**A** – **H**) which represents the following:

2.2.1 A compound containing a hydroxyl group as a functional group (1)

2.2.2 A compound of which the general formula is C_nH_{2n-2} (1)

2.2.3 An aldehyde (1)

2.3 Write down the IUPAC name of:

2.3.1 Compound **G** (2)

2.3.2 The product formed when compound **B** reacts with compound **D** (2)

2.4 Draw the structural formula of the compound represented by the:

2.4.1 Secondary haloalkane of compound **C** (2)

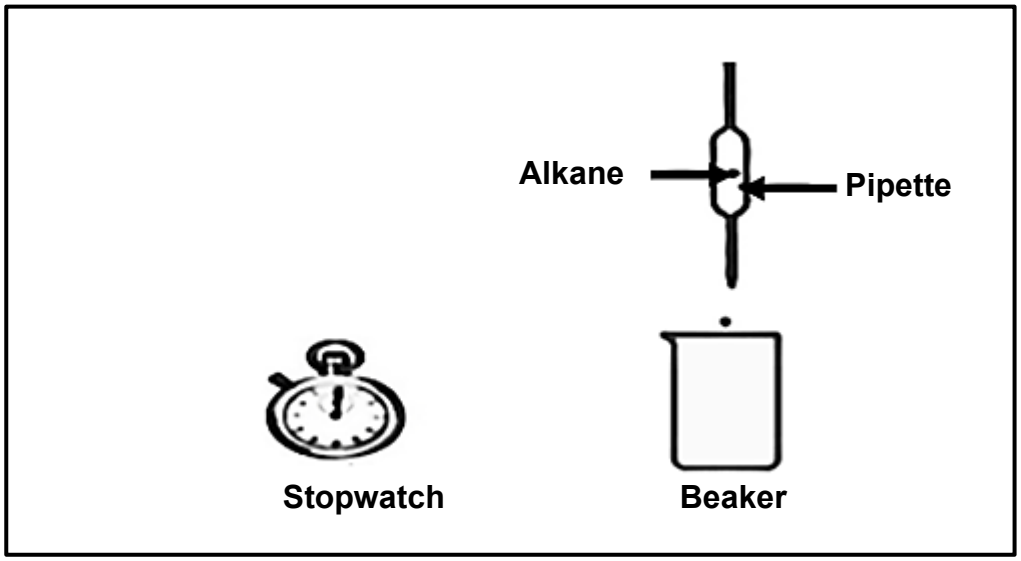
2.4.2 Positional isomer of compound **G** (1)

2.4.3 Monomer of compound **A** (2)

[14]

QUESTION 3 (Start on a new page.)

During an investigation to compare the viscosity of alkanes, learners used a stopwatch to measure the time it takes a fixed volume of each alkane to flow from a pipette, as shown in the diagram below.



The learners' results are recorded in the table below.

COMPOUND	ALKANE	TIME OF FLOW (Seconds)
A	Propane	19,3
B	Butane	20,7
C	Pentane	29,1

3.1 Define the term *viscosity.* (2)

3.2 Identify the dependent variable in the experiment. (1)

3.3 Which compound has the lowest viscosity? Write only **A, B,** or **C**. (1)

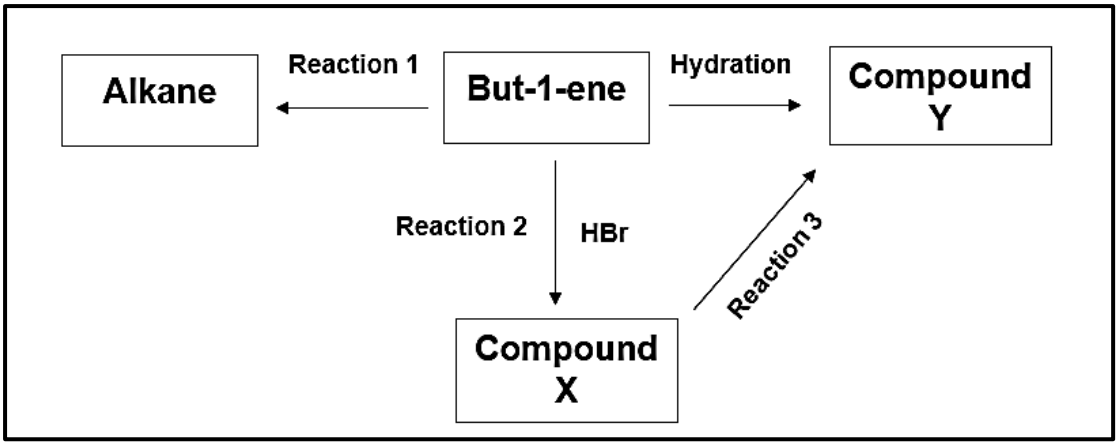
3.4 Identify the type of intermolecular forces present in the compounds. (1)

3.5 Which compound has the highest boiling point? (1)

3.6 Explain the answer to QUESTION 3.5 by referring to the CHAIN LENGTH, the STRENGTH OF THE INTERMOLECULAR FORCES and the ENERGY NEEDED. (3)
[9]

QUESTION 4 (Start on a new page.)

4.1 The flow diagram below shows how but-1-ene can be converted into other organic compounds.



4.1.1 Is the alkane a SATURATED or UNSATURATED hydrocarbon? Explain. (2)

4.1.2 Identify the TYPE of reaction represented by the following:

a) Reaction **1** (1)

b) Reaction **3** (1)

4.1.3 For reaction **2,** write down a balanced equation using STRUCTURAL FORMULAE for the organic compounds. (3)

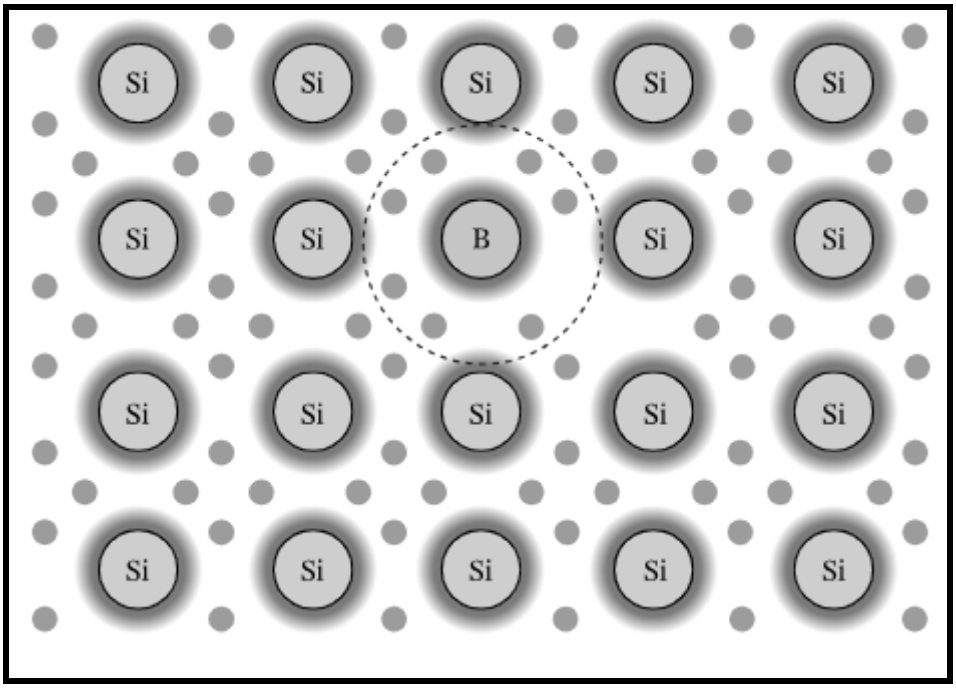
4.1.4 Write down ONE reaction condition that is required for reaction **2**. (1)

4.1.5 Write the NAME of the reactant to be added to but-1-ene to form compound **Y.** (1)

4.1.6 Butane is used in kitchen stoves. The gas burns in the presence of excess oxygen. Write down a balanced equation using MOLECULAR FORMULAE for the reaction that will occur. (3)

4.1.7 Identify the TYPE of reaction in QUESTION 4.1.6. (1)

4.2 The following diagram shows a lattice of silicon atoms that contains one atom of boron.



4.2.1 Silicon is a material with electrical conductivity between that of a conductor and an insulator.

Give ONE WORD for the underlined words in the above statement. (1)

4.2.2 What is the NAME given to the process for the addition of boron atoms to the surface of silicon, as depicted in the diagram above? (1)

4.2.3 What is the name given to a conductor material with an excess number of electrons? (1)

4.2.4 Give ONE word for the following phrase:

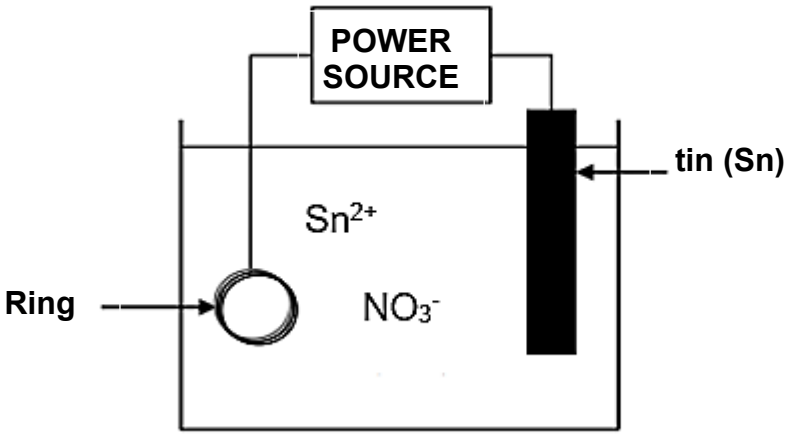
An external voltage (V) is applied across the diode such that the n-side is positive and the p-side is negative. (1)

4.3 What happens to the resistance of a conductor when it is heated? Write only INCREASE, DECREASE, or REMAINS THE SAME. (1)

[18]

QUESTION 5 (Start on a new page.)

A solution of tin(II)nitrate, $Sn(NO_3)_2$, is used to plate tin metal onto a ring made of steel. A simplified diagram of such an electroplating cell is shown below.



5.1 Define the term *electrolyte*. (2)

5.2 Is the above cell SPONTANEOUS or NON-SPONTANEOUS? (1)

5.3 Give a reason to support your answer to QUESTION 5.2. (1)

5.4 Redraw ONLY the power source and indicate the polarity (positive and negative). (2)

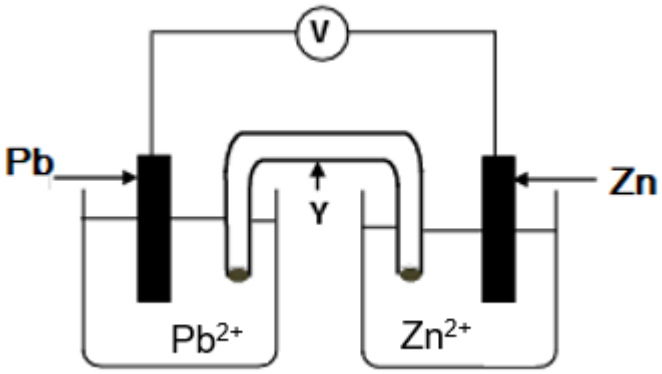
5.5 Identify an anion in $Sn(NO_3)_2$. (1)

5.6 Write down the half-reaction that takes place at the ring. (2)

5.7 Give a reason why the concentration of tin(II)nitrate remains constant. (1)
[10]

QUESTION 6 (Start on a new page.)

Learners assembled the apparatus for a zinc-lead cell as shown in the diagram below. The experiment was performed under standard conditions.



6.1 Define the term *oxidising agent.* (2)

6.2 Identify TWO oxidising agents in the cell above. (1)

6.3 Write ONE standard condition under which this cell functions. (1)

6.4 Write ONE function of component **Y**. (1)

6.5 Write a balanced net ionic reaction of the cell. (3)

6.6 Calculate the emf of the cell. (4)

6.7 If component **Y** is removed from the above cell, what will be the reading on voltmeter V? Give a reason for the answer. (2)

[14]

TOTAL: 75

END

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 *Standaarddruk*	$p^{\ominus}$	$1{,}01 \times 10^{5}$ Pa
Standard temperature *Standaardtemperatuur*	$T^{\ominus}$	273 K/0 °C

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

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

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

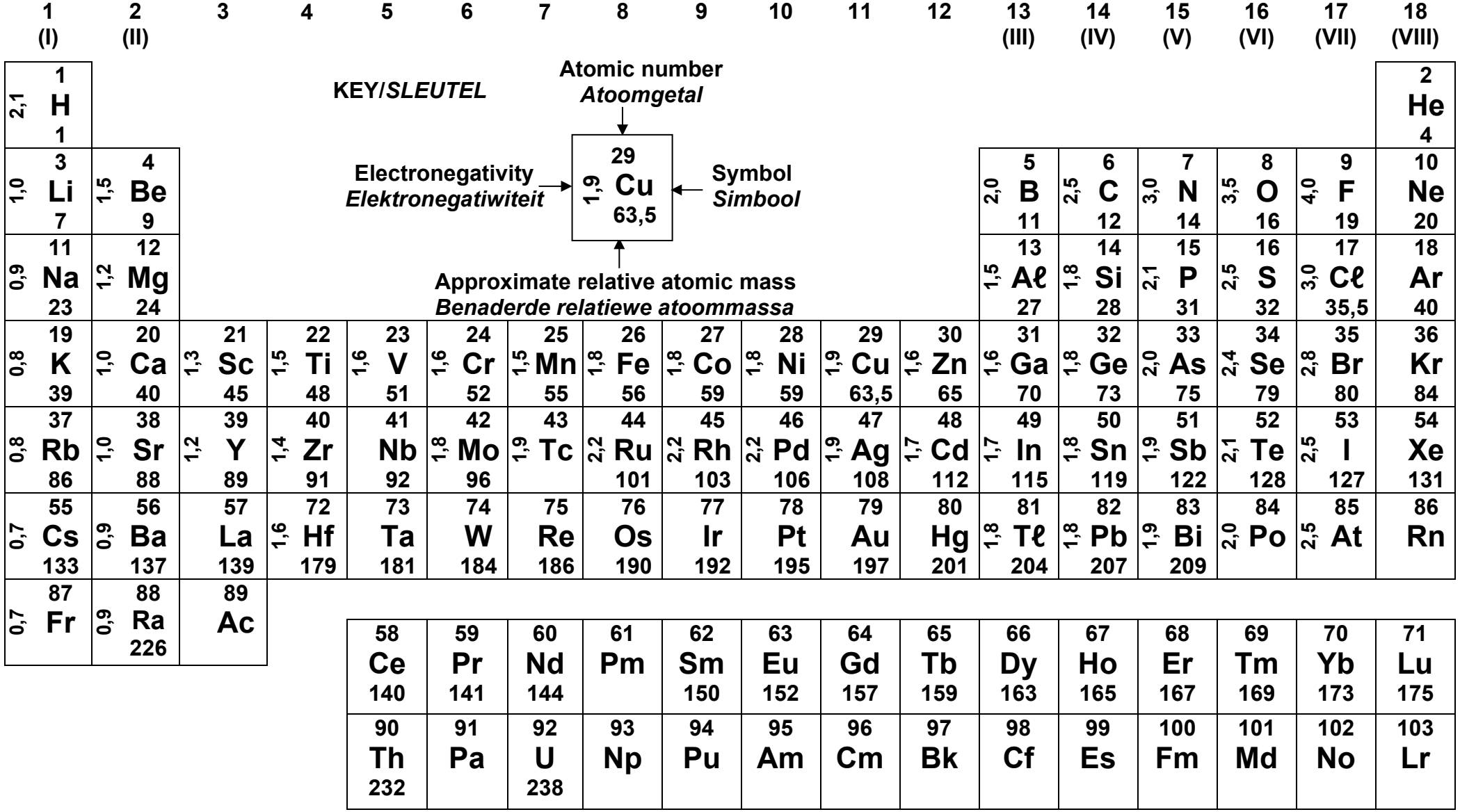


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			$E^{\ominus}$ (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 reducing ability/*Toenemende reduserende vermoë* ↓

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Half-reactions/*Halfreaksies*			$E^{\ominus}$ (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

Increasing reducing ability/*Toenemende reduserende vermoë* ↑