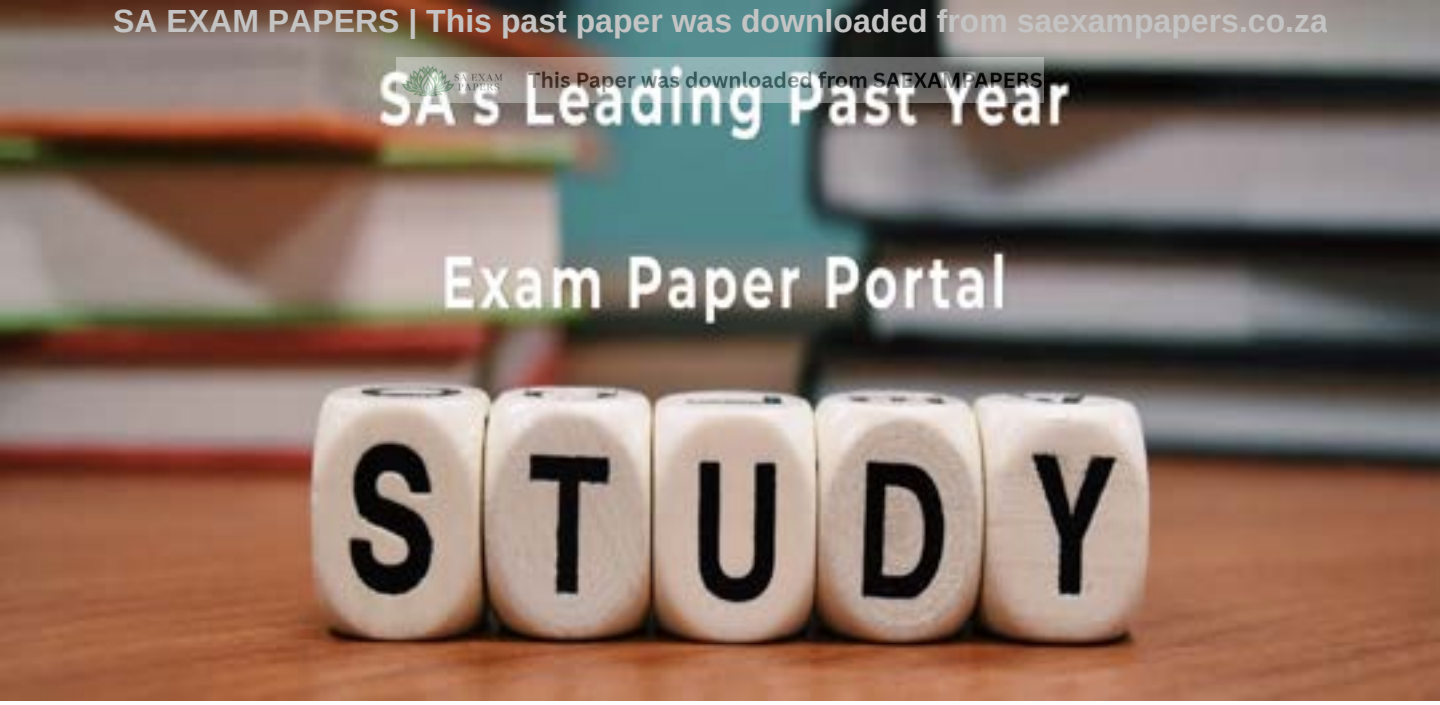


Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjhabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

TECHNICAL SCIENCES P2 (CHEMISTRY)

MARKS: **75**

TIME: **1½ hours**

This question paper consists of 14 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME 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 a line open between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
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. You are advised to use the attached DATA SHEETS
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are given 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, for example 1.6 A.

1.1 Which ONE of the following formulae best describes the general formula for alkanes?

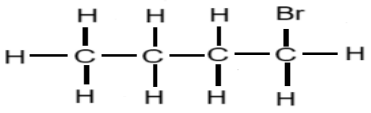
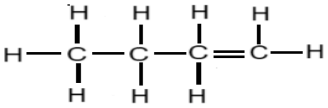
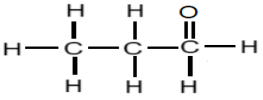
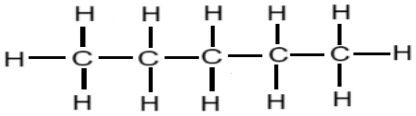
A C_nH_{2n-2}

B C_nH_{2n}

C C_nH_{2n+1}

D C_nH_{2n+2} (2)

1.2 Which ONE of the following organic compounds is an unsaturated hydrocarbon?

A	
B	
C	
D	

(2)

1.3 Which ONE of the following organic compounds is a chain isomer of pentane?

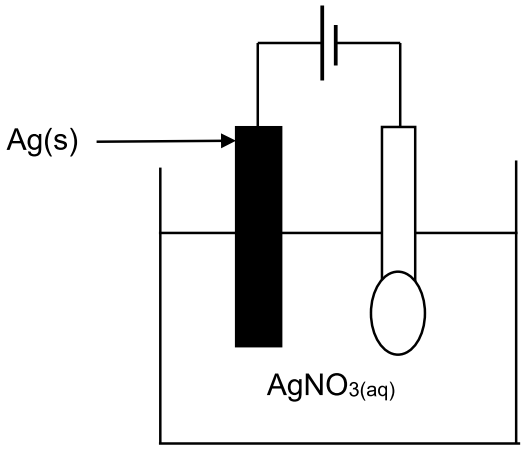
A 2-methylbutane

B 2,3-dimethylbutane

C pent-2-yne

D hexane (2)

1.4 A learner wants to electroplate a spoon with silver. The diagram below represents the electrolytic cell set up for this process.



Which ONE of the following half reactions occurs at the cathode during the electroplating process?

A $Ag^+ + 2e^- \longrightarrow Ag$

B $Ag^+ + e^- \longrightarrow Ag$

C $Ag \longrightarrow Ag^+ + e^-$

D $Ag^+ + e^- \longrightarrow 2Ag$ (2)

1.5 Consider the balanced molecular equation for a magnesium-copper galvanic cell.

$$Mg_{(s)} + CuSO_{4(aq)} \longrightarrow MgSO_{4(aq)} + Cu_{(s)}$$

Which ONE of the following statements is TRUE?

A Mg is the oxidising agent and Cu is the reducing agent.

B Mg is reduced and Cu is oxidised.

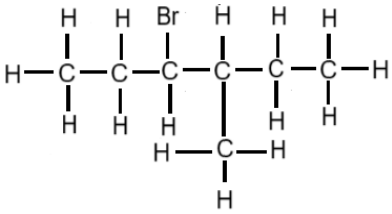
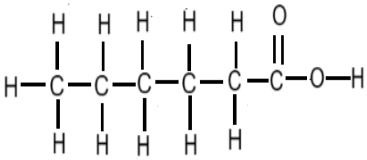
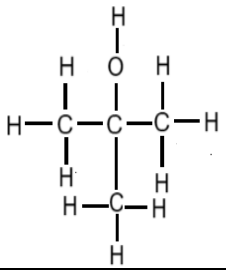
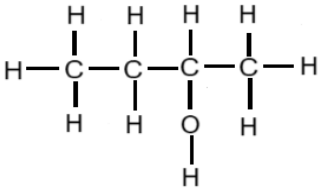
C Mg is oxidised and Cu^{2+} is reduced.

D Mg^{2+} gains electrons and Cu^{2+} loses electrons. (2)

[10]

QUESTION 2 (Start on a new page.)

The table below represents organic compounds with different functional groups.

A		**B**	Propanal
C	Butyl ethanoate	**D**	$(-CH_2-CH_2-)_n$
E		**F**	
G		**H**	C_5H_8

2.1 Define the term *functional group.* (2)

2.2 Write down the name of the functional group for the following compounds:

2.2.1 **B** (1)

2.2.2 **E** (1)

2.3 Write down the letter(s) that represent the following compounds:

2.3.1 A polymer of ethene (1)

2.3.2 An alkyne (1)

2.3.3 A secondary alcohol (1)

2.4 Write down the IUPAC name of compound **A**. (2)

2.5 Draw the structural formula of the following:

2.5.1 Compound **C** (2)

2.5.2 The functional isomer of compound **B** (2)

[13]

QUESTION 3 (Start on a new page.)

A group of Grade 12 learners conducted an experiment to investigate the melting points of various organic compounds. The table below shows the results obtained from the experiment.

Compound	Name	Melting point (°C)
P	Ethanoic acid	16,6
Q	Ethanol	-114,1
R	1-Chloroethane	-138,7
S	Ethane	-182,8

3.1 Define the term *melting point.* (2)

The melting points of compounds **P** to **S** are compared.

3.2 To which homologous series does the compound with the highest melting point belong? (1)

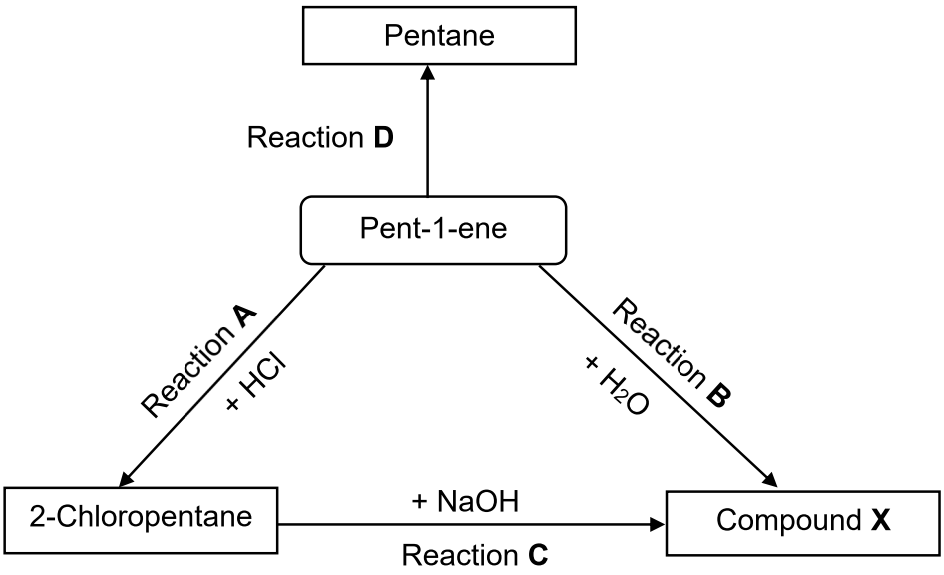
3.3 Write down ONE controlled variable for this investigation. (1)

3.4 Explain the difference in melting points of compound **P** and compound **S** by referring to the TYPE OF INTERMOLECULAR FORCES, STRENGTH OF THE INTERMOLECULAR FORCES and the ENERGY NEEDED. (4)

3.5 Which compound will have the lowest viscosity?
Give a reason for the answer. (2)
[10]

QUESTION 4 (Start on a new page.)

The flow diagram below represents a series of organic reactions where Pent-1-ene is converted to various organic compounds.



4.1 Write down the name of the type of reaction represented by:

4.1.1 Reaction **B** (1)

4.1.2 Reaction **C** (1)

4.1.3 Reaction **D** (1)

4.2 Consider reaction **A.**

4.2.1 Write ONE reaction condition for this reaction. (1)

4.2.2 Using STRUCTURAL FORMULA write down a balanced chemical equation for the formation of 2-chloropentane. (3)

4.3 Consider reaction **B.**

4.3.1 Write down the IUPAC name of compound **X**. (2)

4.3.2 Write down the FORMULA of the catalyst needed in this reaction. (1)

4.4 Pentane which is the product of reaction **D** burns in excess oxygen. Write down a balanced MOLECULAR equation to complete the combustion of pentane. (3)

[13]

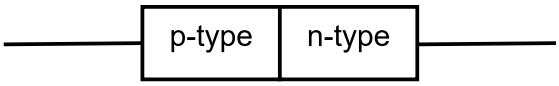
QUESTION 5 (Start on a new page.)

A laboratory technician adds small quantities of phosphorous to pure silicon during the manufacturing process of electronic components, to improve its electrical conductivity.

5.1 Write down a term for the process described above. (1)

5.2 What type of semiconductor (P-type or N-type) is obtained from this process?
Give a reason for the answer. (2)

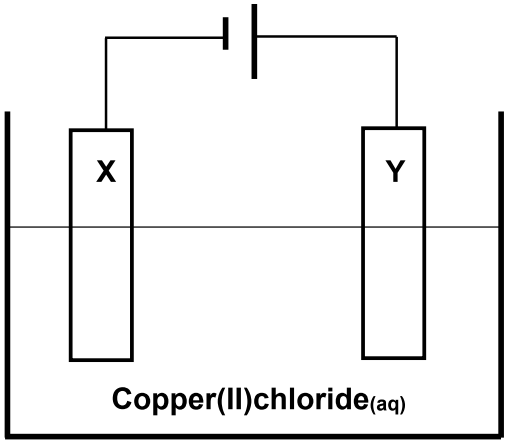
5.3 Consider the diagram below that represents a p-n junction diode.



Draw a diagram showing the diode above connected to a battery in such a way that it is forward bias. (2)
[5]

QUESTION 6 (Start on a new page.)

The diagram below represents an electrolytic cell used for the decomposition of copper (II) chloride. **X** and **Y** represent two inert electrodes.



6.1 Define the term *electrolytic cell.* (2)

6.2 Which electrode **X** or **Y** is the cathode? (1)

6.3 Write down:

6.3.1 The FORMULA of the electrolyte that is used in the above electrolytic cell (1)

6.3.2 The NAME or FORMULA of the gas produced at the anode when this cell is in operation (1)

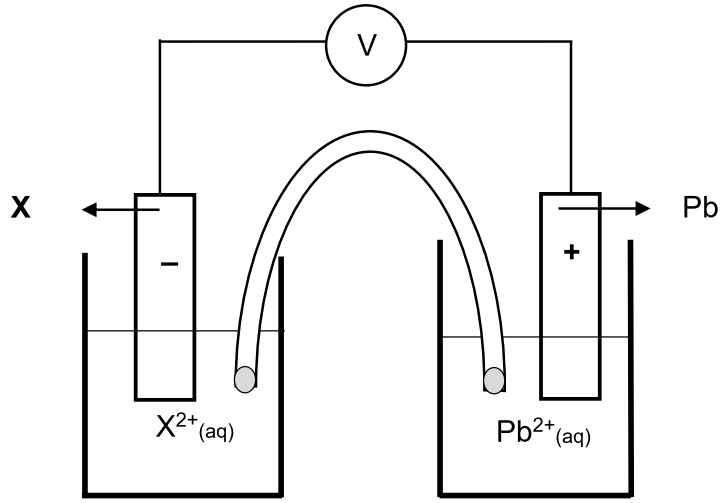
6.3.3 A half reaction that explains the production of the gas (2)

6.3.4 The FORMULA of the oxidising agent (1)

6.4 How will the mass of electrode **X** change as the reaction proceeds? Choose from INCREASE, DECREASE or REMAINS THE SAME.
Give a reason for the answer. (3)
[11]

QUESTION 7 (Start on a new page.)

The diagram below represents a galvanic cell operating under standard conditions. A lead electrode (**Pb**) and an unknown metal electrode (**X**) are in their respective electrolytes. The initial EMF (E^{θ}_{cell}) is 0,63 V.



7.1 Is the reaction taking place in this cell SPONTANEOUS or NON-SPONTANEOUS?
Give a reason for the answer. (2)

7.2 State TWO standard conditions under which this cell operates. (2)

7.3 Make use of a calculation to determine the identity of the unknown metal electrode (**X**). (4)

7.4 Write down:

7.4.1 A half reaction that occurs at the cathode (2)

7.4.2 Cell notation for this galvanic cell (3)
[13]

TOTAL: 75

NATIONAL SENIOR CERTIFICATE
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DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Standard temperature *Standaardtemperatuur*	T^{θ}	0°C/273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$

$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

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

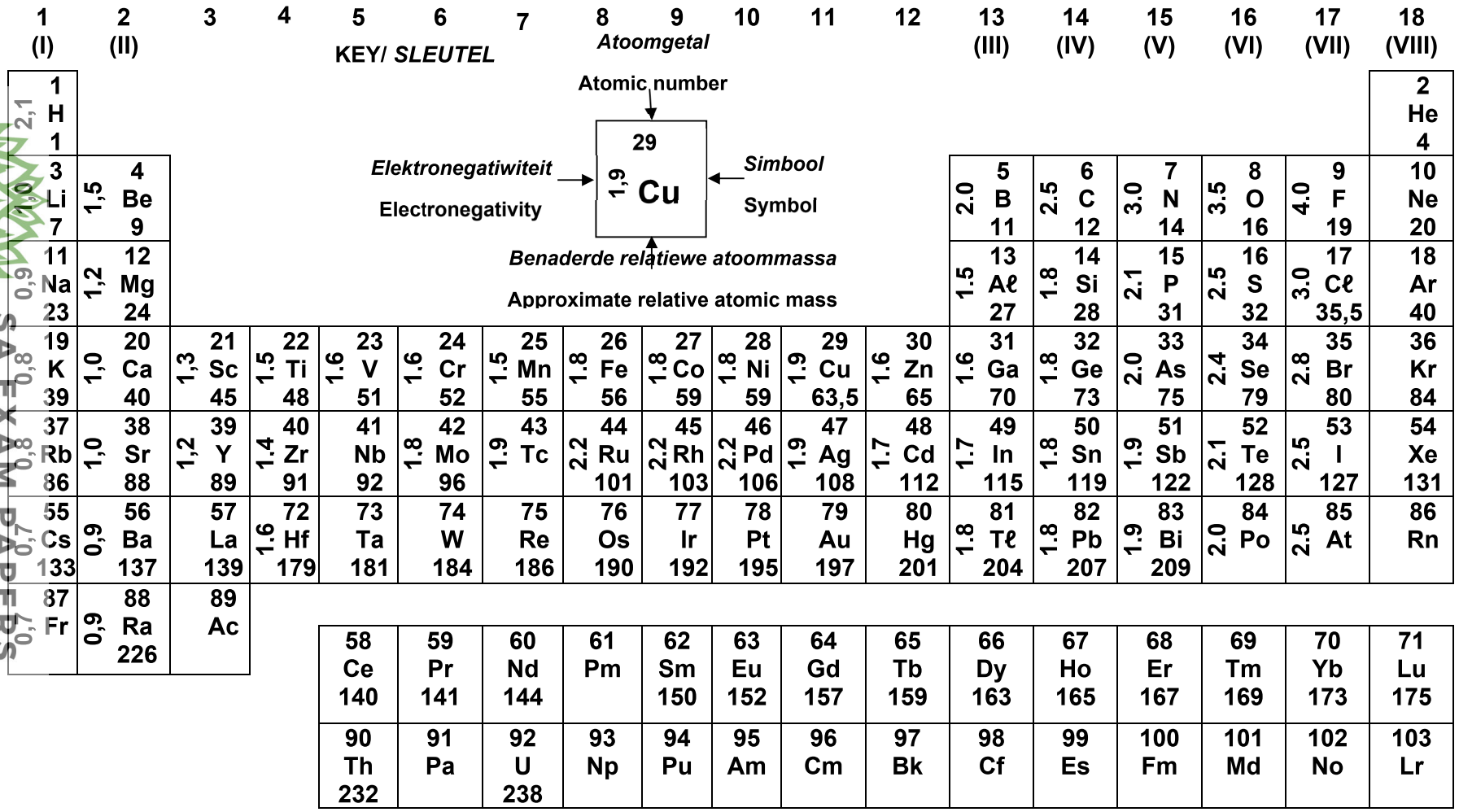

TABLE 4A: STANDARD REDUCTION POTENTIALS/TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^{θ} (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* ↓

↑ Increasing reducing ability/*Toenemende reduserende vermoë*

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