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**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2023

TECHNICAL SCIENCES P2

MARKS: 75

TIME: 1½ hours

This question paper consists of 15 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. 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. You may use a non-programmable calculator.
5. Leave ONE line open between sub questions, i.e. QUESTION 2.1 and QUESTION 2.2.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
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.

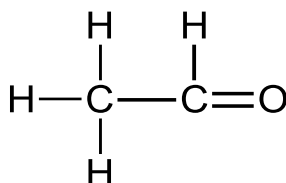
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 $C_nH_{2n+1}OH$ is the GENERAL FORMULA for ...

- A alkanes.
- B aldehydes.
- C alcohols.
- D alkenes. (2)

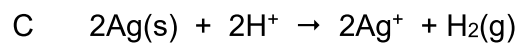
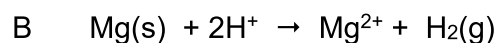
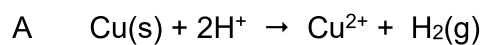
1.2 Consider the structural formula of an organic compound below.



Which ONE of the following is the correct IUPAC name of this compound?

- A Ethanone
 - B Ethene
 - C Ethanol
 - D Ethanal (2)
- 1.3 Which ONE of the following is an unsaturated hydrocarbon?
- A $CH_3CH_2CH_2OH$
 - B CH_2CHCH_3
 - C $CH_3CH_2(CH_2)_2CH_2CH_3$
 - D CH_3COOCH_3 (2)

1.4 Which ONE of the following redox reactions will occur spontaneously?



1.5 What will happen at the negative electrode of a voltaic (galvanic) cell and at the negative electrode of an electrolytic cell?

	Voltaic (galvanic) cell	Electrolytic cell
A	Oxidation	Reduction
B	Reduction	Oxidation
C	Oxidation	Oxidation
D	Reduction	Reduction

(2)
[10]

QUESTION 2 (Start on a new page.)

Organic chemistry is the chemistry of organic molecules divided into homologous series which are identified by their functional groups. The letters **A** to **H** in the table below represent eight organic compounds.

A	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$	B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$
C	$ \begin{array}{cccc} \text{H} & \text{Br} & \text{H} & \text{H} \\ & & & \\ \text{H} - \text{C} - & \text{C} - & \text{C} - & \text{C} - \text{Cl} \\ & & & \\ \text{Cl} & \text{H} & \text{H} & \text{H} \end{array} $	D	CH_2CH_2
E	Hexane	F	$ \begin{array}{c} \text{O} - \text{H} \\ \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $
G	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} = \text{O} \\ \quad \quad \quad \quad \\ \text{H} \quad \quad \text{H} \quad \quad \text{H} \end{array} $	H	$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$

- 2.1 Define the term *functional group*. (2)
- 2.2 Write down the:
- 2.2.1 Letter that represents a SECONDARY alcohol (1)
- 2.2.2 Name of the functional group of compound **H** (1)
- 2.2.3 Name of the homologous series to which compound **G** belongs (1)
- 2.2.4 IUPAC name of compound **C** (2)
- 2.2.5 NAME of the polymer formed from compound **D** (1)
- 2.2.6 Balanced equation, using MOLECULAR FORMULAE, for the combustion of compound **E** in excess oxygen (3)
- 2.2.7 IUPAC name of compound **A** (2)
- 2.2.8 General formula of the homologous series to which compound **B** belongs (1)

2.3. A few drops of fresh reddish-brown bromine water are added to compound **D** in a test tube.

2.3.1 Describe what will be observed in the test tube. (1)

2.3.2 Use structural formulae to write down a balanced equation for the reaction that takes place in the test tube. (4)

[19]

QUESTION 3 (Start on a new page.)

Two compounds **P** and **Q**, have the molecular formula $C_2H_4O_2$. (2)

3.1. What is meant by the term *structural isomers*?

3.2. Compound **P** has a lower vapour pressure than compound **Q**.

3.2.1 How will the boiling point of compound **P** compare to that of compound **Q**?

Only write HIGHER THAN, LOWER THAN, or EQUAL TO. (1)

3.2.2 Write down the NAME of compound **P**. (1)

3.2.3 To which class of organic compound does compound **Q** belong? (1)

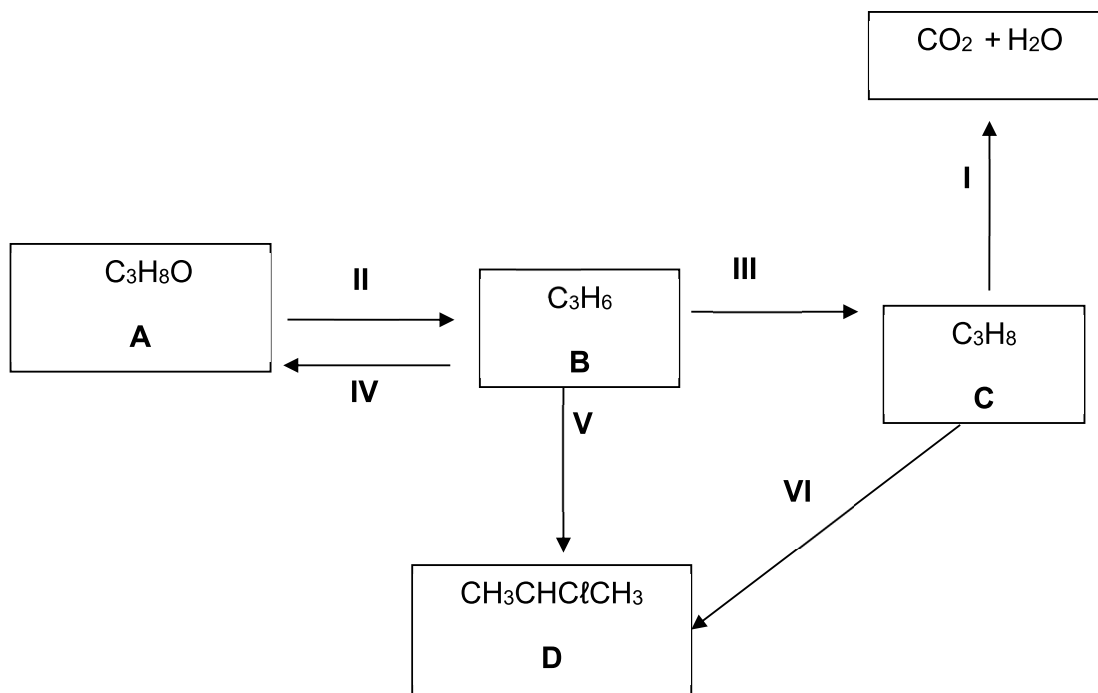
3.2.4 Write down the structural formula for compound **Q** and give its IUPAC name. (3)

3.2.5 Explain in terms of INTERMOLECULAR FORCES and ENERGY why compound **P** has a lower vapour pressure than compound **Q**. (3)

[11]

QUESTION 4 (Start on a new page.)

Consider the following sequence of organic reactions and answer the questions that follow. Reactions are labelled from **I** to **VI** while organic compounds are labelled from **A** to **D**.



4.1 Give the reagent needed for each of the following reactions:

4.1.1 Reaction **III** (1)

4.1.2 Reaction **V** (1)

4.2 Compound **A** is a major product of reaction **IV**.

4.2.1 Name the type of reaction that takes place. (1)

4.2.2 Write down the structural formula of compound **A**. (2)

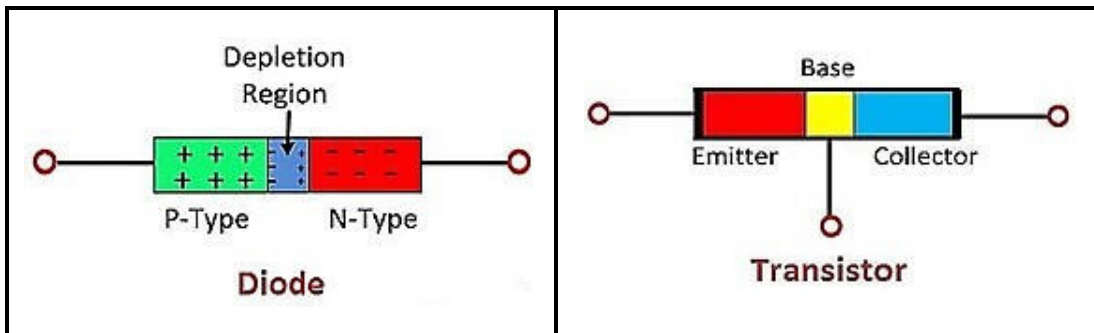
4.3 Reaction **I** is a combustion reaction.

Write down the balanced chemical equation for this reaction. (2)

[7]

QUESTION 5 (Start on a new page.)

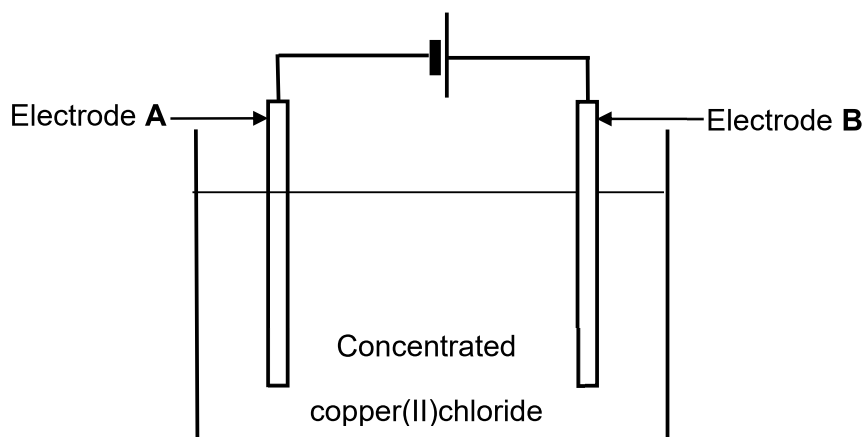
Semiconductor devices such as diodes and transistors are widely used in modern electronics.



- 5.1. Define the term *semiconductor*. (2)
- 5.2. Arsenic was added to silicon in small quantities. It was then found that the electrical conductivity of silicon has improved.
- 5.2.1 Name the process described in the above statements. (1)
- 5.2.2 What type of a semiconductor material is formed during this process? (1)
- 5.2.3 Give a reason for your answer in QUESTION 5.2.2. (1)
- [5]**

QUESTION 6 (Start on a new page.)

The diagram below represents an electrochemical cell used to decompose a concentrated copper(II)chloride solution using inactive electrodes.



- 6.1. Define the term *electrolysis* in words. (2)
- 6.2. Write down the energy conversion that takes place in this cell. (1)
- 6.3. At which electrode does reduction take place? Write down **A** or **B** only. (1)
- 6.4. Write down the:
- 6.4.1. NAME of the gas formed while the cell is functioning (1)
- 6.4.2. Half-reaction that takes place at electrode **A** (2)
- 6.4.3. NAME or FORMULA of the oxidising agent.
Give a reason for the answer (2)
- 6.4.4. NAME of a substance that can be used as electrodes in this cell (1)
- 6.5. How does the concentration of the copper(II)chloride solution change as the reaction proceeds?

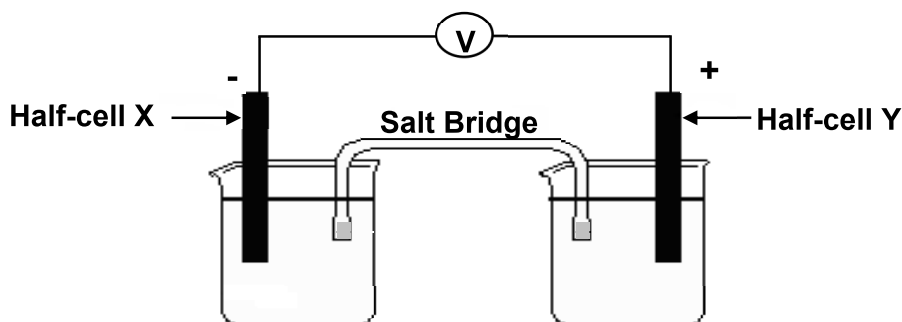
Write down INCREASES, DECREASES or NO CHANGE.

Give a reason for your answer.

(2)
[12]

QUESTION 7 (Start on a new page.)

Learners use an electrochemical cell as shown in the diagram below in an investigation to compare the reducing abilities of different metals.



- 7.1 Name the type of electrochemical cell depicted in the diagram above. (1)
- 7.2 What will the voltmeter reading be if the salt bridge is removed? (2)
- 7.3 Name TWO standard conditions for this experiment. (2)
- 7.4 In their investigation, they use different combinations of half reactions as depicted in the table below, to compare the reducing abilities of Cu, Zn and Al. The cell potential for each combination of the half cells is recorded in the table below.

COMBINATION	Half-Cell X	Half-Cell Y	VOLTMETER READING (V)
1	Cu/Cu ²⁺	Al/Al ³⁺	-1,8
2	Al/Al ³⁺	Zn/Zn ²⁺	+0,8
3	Zn/Zn ²⁺	Cu/Cu ²⁺	+1,0

Write down a:

- 7.4.1 Possible reason why the voltmeter reading for a copper-aluminium cell is negative (2)
- 7.4.2 Suitable conclusion for this investigation (2)
- 7.5 Write down the NAME or SYMBOL of the:
- 7.5.1 Metal which is oxidised in COMBINATION 2 (1)
- 7.5.2 Reducing agent in COMBINATION 3 (1)

[11]

TOTAL: 75

**NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT**

**DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAAM/NAME	SIMBOOL/SYMBOL	WAARDE/VALUE
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume teen STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro se konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$ OR/OF	$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$n = \frac{N}{N_A}$ OR/OF	$\frac{c_a V_a}{c_b V_b} = \frac{n_a P}{n_b}$	$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at /by 298K
$n = \frac{V}{V_m}$	$pV = nRT$	
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sel}} = E^\theta_{\text{reduksie}} - E^\theta_{\text{oksidasie}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$		
$q = I\Delta t$	$n = \frac{Q}{e}$	OR/OF $n = \frac{Q}{q_e}$

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
(I)	(II)	KEY/ SLEUTEL																(VIII)
1 H 1	2 He 4	3 Li 7	4 Be 9	5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20	11 Na 23	12 Mg 24	13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35,5	18 Ar 40	
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 63,5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84	
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc 98	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131	
55 Cs 133	56 Ba 137	57 La 139	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po 209	85 At 210	86 Rn 222	
87 Fr 223	88 Ra 226	89 Ac	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259	103 Lr	104 Rf 261	
107 Bohrium	108 Hassium	109 Meitnerium	110 Darmstadtium	111 Roentgenium	112 Copernicium	113 Nihonium	114 Flerovium	115 Moscovium	116 Livermorium	117 Tennessine	118 Oganesson	119 Unbinoidium	120 Unbinoidium	121 Unbinoidium	122 Unbinoidium	123 Unbinoidium	124 Unbinoidium	

Elektronenegatiwiteit →

Electronegativity

Atomiese nommer ↓

Atomic number

Simbool

Symbol

Benaderde relatiewe atoommassa

Approximate relative atomic mass

↑



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

Half-reactions/Halfreaksies	E^{θ} (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^2+ + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	0,00
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	- 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	- 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	- 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	- 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	- 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	- 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	- 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	- 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	- 0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	- 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	- 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	- 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	- 1,18
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	- 2,36
$Na^+ + e^- \rightleftharpoons Na$	- 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	- 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	- 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	- 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	- 2,92
$K^+ + e^- \rightleftharpoons K$	- 2,93
$Li^+ + e^- \rightleftharpoons Li$	- 3,05

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë

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

Half-reactions/Halfreaksies		E^{\ominus} (V)
$\text{Li}^+ + \text{e}^-$	\rightleftharpoons Li	- 3,05
$\text{K}^+ + \text{e}^-$	\rightleftharpoons K	- 2,93
$\text{Cs}^+ + \text{e}^-$	\rightleftharpoons Cs	- 2,92
$\text{Ba}^{2+} + 2\text{e}^-$	\rightleftharpoons Ba	- 2,90
$\text{Sr}^{2+} + 2\text{e}^-$	\rightleftharpoons Sr	- 2,89
$\text{Ca}^{2+} + 2\text{e}^-$	\rightleftharpoons Ca	- 2,87
$\text{Na}^+ + \text{e}^-$	\rightleftharpoons Na	- 2,71
$\text{Mg}^{2+} + 2\text{e}^-$	\rightleftharpoons Mg	- 2,36
$\text{Al}^{3+} + 3\text{e}^-$	\rightleftharpoons Al	- 1,66
$\text{Mn}^{2+} + 2\text{e}^-$	\rightleftharpoons Mn	- 1,18
$\text{Cr}^{2+} + 2\text{e}^-$	\rightleftharpoons Cr	- 0,91
$2\text{H}_2\text{O} + 2\text{e}^-$	\rightleftharpoons $\text{H}_2(\text{g}) + 2\text{OH}^-$	- 0,83
$\text{Zn}^{2+} + 2\text{e}^-$	\rightleftharpoons Zn	- 0,76
$\text{Cr}^{3+} + 3\text{e}^-$	\rightleftharpoons Cr	- 0,74
$\text{Fe}^{2+} + 2\text{e}^-$	\rightleftharpoons Fe	- 0,44
$\text{Cr}^{3+} + \text{e}^-$	\rightleftharpoons Cr^{2+}	- 0,41
$\text{Cd}^{2+} + 2\text{e}^-$	\rightleftharpoons Cd	- 0,40
$\text{Co}^{2+} + 2\text{e}^-$	\rightleftharpoons Co	- 0,28
$\text{Ni}^{2+} + 2\text{e}^-$	\rightleftharpoons Ni	- 0,27
$\text{Sn}^{2+} + 2\text{e}^-$	\rightleftharpoons Sn	- 0,14
$\text{Pb}^{2+} + 2\text{e}^-$	\rightleftharpoons Pb	- 0,13
$\text{Fe}^{3+} + 3\text{e}^-$	\rightleftharpoons Fe	- 0,06
$2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons $\text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons $\text{H}_2\text{S}(\text{g})$	+ 0,14
$\text{Sn}^{4+} + 2\text{e}^-$	\rightleftharpoons Sn^{2+}	+ 0,15
$\text{Cu}^{2+} + \text{e}^-$	\rightleftharpoons Cu^+	+ 0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons $\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+ 0,17
$\text{Cu}^{2+} + 2\text{e}^-$	\rightleftharpoons Cu	+ 0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	\rightleftharpoons 4OH^-	+ 0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^-$	\rightleftharpoons $\text{S} + 2\text{H}_2\text{O}$	+ 0,45
$\text{Cu}^+ + \text{e}^-$	\rightleftharpoons Cu	+ 0,52
$\text{I}_2 + 2\text{e}^-$	\rightleftharpoons 2I^-	+ 0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons H_2O_2	+ 0,68
$\text{Fe}^{3+} + \text{e}^-$	\rightleftharpoons Fe^{2+}	+ 0,77
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^-$	\rightleftharpoons $\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+ 0,80
$\text{Ag}^+ + \text{e}^-$	\rightleftharpoons Ag	+ 0,80
$\text{Hg}^{2+} + 2\text{e}^-$	\rightleftharpoons $\text{Hg}(\ell)$	+ 0,85
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^-$	\rightleftharpoons $\text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+ 0,96
$\text{Br}_2(\ell) + 2\text{e}^-$	\rightleftharpoons 2Br^-	+ 1,07
$\text{Pt}^{2+} + 2\text{e}^-$	\rightleftharpoons Pt	+ 1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons $\text{Mn}^{2+} + 2\text{H}_2\text{O}$	+ 1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^-$	\rightleftharpoons $2\text{H}_2\text{O}$	+ 1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^-$	\rightleftharpoons $2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+ 1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^-$	\rightleftharpoons 2Cl^-	+ 1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	\rightleftharpoons $\text{Mn}^{2+} + 4\text{H}_2\text{O}$	+ 1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons $2\text{H}_2\text{O}$	+ 1,77
$\text{Co}^{3+} + \text{e}^-$	\rightleftharpoons Co^{2+}	+ 1,81
$\text{F}_2(\text{g}) + 2\text{e}^-$	\rightleftharpoons 2F^-	+ 2,87

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reduserende vermoë