Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2023

TECHNICAL SCIENCES: CHEMISTRY P2 (DEAF)

MARKS: **75**

TIME: **1½ hours**

* J T P H S C E 2 *

This question paper has of 14 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your FULL NAME and SURNAME on the ANSWER BOOK.

2. This **question paper** has **SIX questions**.
   Answer ALL the **questions** in the **ANSWER BOOK**.

3. Start **EACH question** on a **NEW page** in the ANSWER BOOK.

4. You **may use** a **prescribed calculator**.

5. You may use appropriate mathematical instruments.

6. **Number** the **answers** the **same** as the **numbers** on the **question paper**.

7. **Show** ALL **formulae** and **substitutions** in ALL **calculations**.

8. **Round off** your **FINAL answers** to **TWO decimal places**.

9. Give **explanations** for **your answers** if the **question tells you** to do it.

10. **Use** the **DATA SHEETS**.

11. Write **neatly**.
    Your **work** must be **easy** to **read**.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

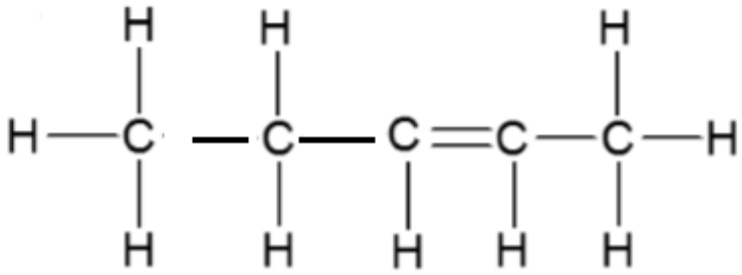
Choose the **answer**.
Write only the **letter** (A–D) **next** to the **question numbers** (1.1 to 1.5), e.g. 1.6 D.

1.1 **Which** ONE of the **combinations** is **correct** about the **name** of the **functional group** and **homologous series**?

	Name of the functional group	Homologous series
A	Carboxyl group	Ketone
B	Formyl group	Carboxylic acid
C	Carboxyl group	Aldehyde
D	Hydroxyl group	Alcohol

(2)

1.2 **Table:**
Look at the **structural formula** of the **compound** below.
Identify its **correct IUPAC name** and the **type** of **hydrocarbon**:



A Pent-3-ene; saturated

B Pent-2-ene; unsaturated

C 2-Pentane; unsaturated

D Pent-2-ene; saturated (2)

1.3 **Study** the **organic reaction**. **Answe**r the **question**.

$$CH_4 + O_2 \longrightarrow CO_2 + \mathbf{Y}$$

The **substance** that **Y represents** is …, and it is an … **compound**.

A water; organic

B water; inorganic

C carbon; organic

D methane; inorganic (2)

1.4 **Table:**
Which of the **set** of **answers** is the **correct arrangement** of **semiconductors**?

	Valence electrons	**Arrangement of covalent bonds**	**Element**	**Material**
A	4	tetrahedral	carbon	diamond
B	4	hexagonal	diamond	carbon
C	5	tetrahedral	arsenic	phosphorous
D	5	pentagonal	germanium	silicon

(2)

1.5 **Extrinsic** and **intrinsic semiconductors**:

(i) In doping, an impurity is added to a semiconductor to improve the conductivity of the semiconductor
(ii) In doping, a catalyst is added to a semiconductor to improve the conductivity of the semiconductor
(iii) A few protons gain enough thermal energy to cross the energy gap (from the valence band) to the conduction band
(iv) Semiconductors are doped with a trivalent impurity
(v) A few electrons gain enough thermal energy to cross the energy gap (from the valence band) to the conduction band

Which **ONE** of the **combinations below** is **CORRECT**?

A (i) and (ii)

B (ii) and (iii)

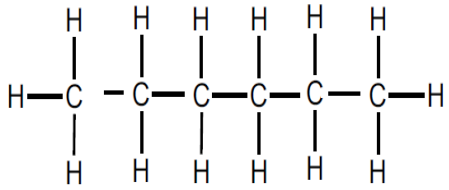
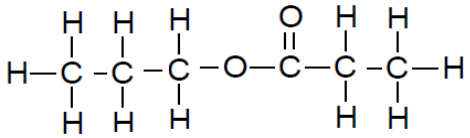
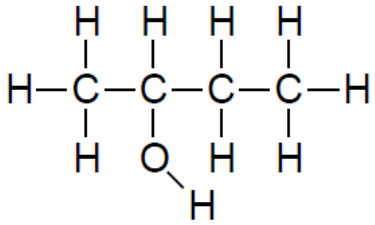
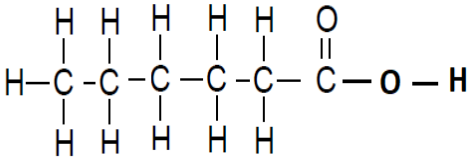
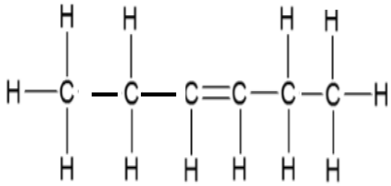
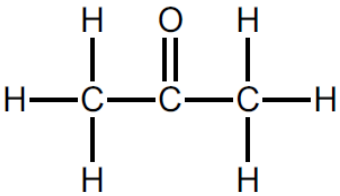
C (i) and (iv)

D (iii) and (iv) (2)

[10]

QUESTION 2 (Start on a NEW page.)

Consider the **organic compounds** represented by the letters **A** to **G.**
Answer the **questions**.

A	Hex-2-ene	**E**	2-methylpropan-2-ol
B		**F**	
C		**G**	
D		**H**	

2.1 **Define** the **term *hydrocarbon***. (2)

2.2 **Write** down the **letter(s)** that **represents**:

2.2.1 A secondary alcohol (1)

2.2.2 A saturated hydrocarbon (1)

2.2.3 Functional isomers (2)

2.2.4 Hydrocarbons (1)

2.2.5 Positional isomers (2)

2.3 **Write** down the **IUPAC name** of:

2.3.1 **D** (1)

2.3.2 **H** (1)

2.3.3 **F** (2)

2.4 **Write** down the:

2.4.1 **STRUCTURAL formula** of compound **A** (2)

2.4.2 **STRUCTURAL formula** for the functional group of compound **D** (1)

2.4.3 **MOLECULAR formula** of compound **B** (1)

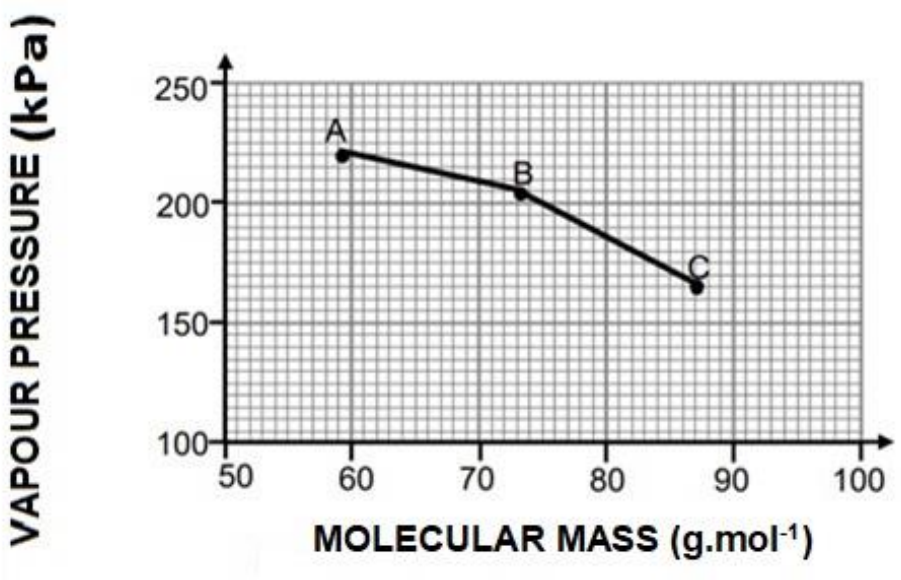
2.4.4 The **name** of a **ketone** (1)

2.4.5 **STRUCTURAL formula** of compound **E** (2)

[20]

QUESTION 3 (Start on a NEW page.)

Students were **observing** the **vapour pressure** of **three (3) organic compounds** from a **homologous series** with a general formula C_nH_{2n+2}, shown by **A**, **B** and **C**.
The number of carbon atoms of these organic compounds ranges between 3 carbon atoms and 5 carbon atoms.
Their **results** were **graphed** as follows:



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

3.2 **What trend** can be **deduced(reasoned)** from the **graph**? (2)

3.3 **Identify** the **type** of **intermolecular forces** that **exist** between the **molecules** of **these organic compounds**. (1)

3.4 **Write** down the **names** of the **compounds** in the **graph**
It is **represented** by the **letters**:

3.4.1 **A** (1)

3.4.2 **B** (1)

3.4.3 **C** (1)

3.5 **Explain** the **difference** in the **vapour pressure** of **compounds B** and **C**.
Refer to the **MOLECULAR MASSES, STRENGTH OF INTERMOLECULAR FORCES** and **THE ENERGY NEEDED**. (4)

3.6 **Which compound** will have the …? (Write only **A**, **B** or **C**.)

3.6.1 highest viscosity (1)

3.6.2 lowest melting point (1)

3.6.3 highest boiling point (1)

[15]

QUESTION 4 (Start on a NEW page.)

Table:
The table **shows** the **boiling points** of **four organic compounds**.
It is represented by the letters **A** to **D**, of comparable molecular mass.

Compound		Molecular mass	Boiling point (°C)
A	Butane	58	0
B	Propanone	58	49
C	Propan-1-ol	60	97
D	Ethanoic acid	60	118

4.1 **Which compound** can be **used** as a **fuel** in **gas burners**? (1)

4.2 **Explain** your **answer to QUESTION 4.1.** (2)

4.3 **How** will the **boiling point of 2-methylpropane compare** to that of compound **A**?

Write **HIGHER THAN, LOWER THAN or EQUAL TO**.

Refer to **MOLECULAR STRUCTURES, INTERMOLECULAR FORCES** and the **ENERGY** needed **to explain** the answer. (4)

4.4 **What** is the **relationship** between **compound A** and **2-methyl propane**? Explain. (2)

4.5 Consider the vapour pressure of compounds **B** and **C**.
These **compounds** have **different vapour pressure**.

4.5.1 Give a reason for this difference in vapour pressure by referring to the intermolecular forces present in EACH of these compounds. (4)

Which ONE of **compounds B** or **C** has the:

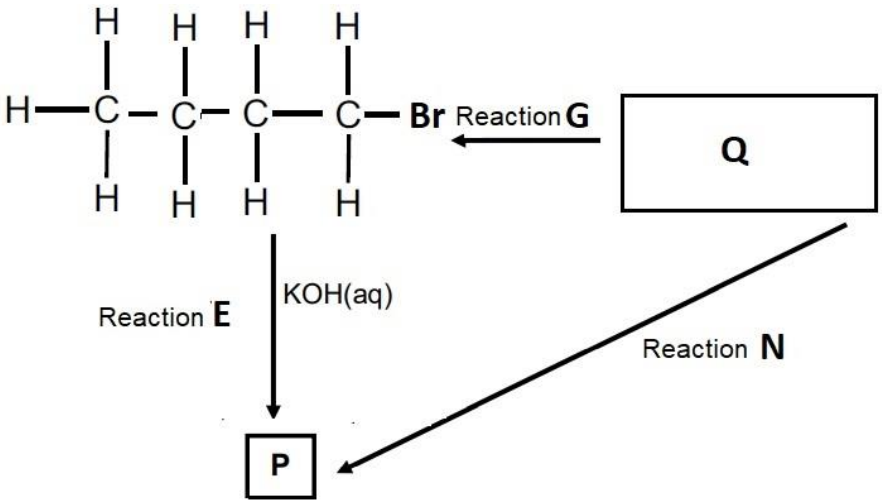
4.5.2 Highest vapour pressure (1)

4.5.3 Highest melting point (1)

4.5.4 Lowest viscosity (1)
[16]

QUESTION 5 (Start on a NEW page.)

Flow diagram: **Organic reactions**. **Answer** the **questions**.



5.1 **Write** down the **TYPE** of **reaction** shown by:

5.1.1 **G** (1)

5.1.2 **E** (1)

5.1.3 **N** (1)

5.2 For Reaction **E**, write down:

5.2.1 The homologous series to which compound **P** belongs (1)

5.2.2 ONE reaction condition (1)

5.2.3 The **balanced chemical equation using STRUCTURAL FORMULAE** (3)

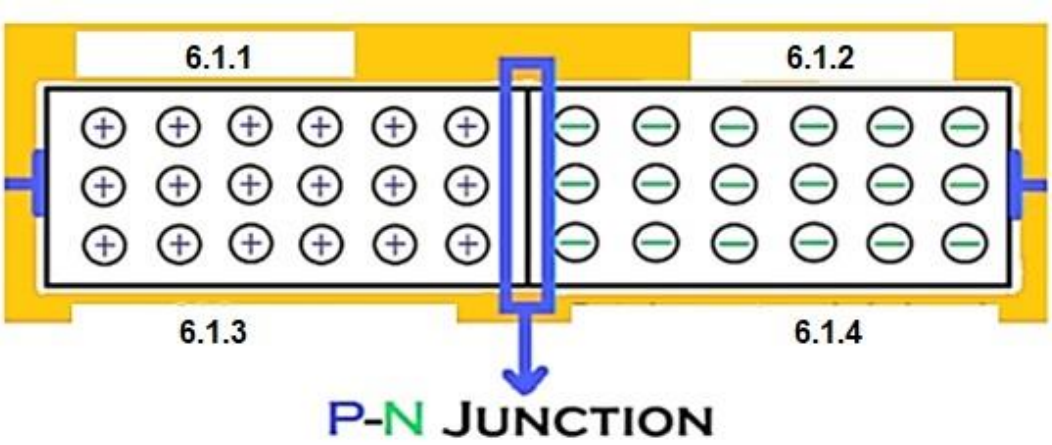
5.3 **Write** down the **structural formula** for compound **Q**. (2)

[10]

QUESTION 6 (Start on a NEW page.)

A **p-n junction** is **formed** when a **p-doped semiconductor** is **connected** to an **n-doped semiconductor**.

6.1 **Label** the following **diagram** of a **p-n junction**.



[4]

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: FISIESE KONSTANTES*

NAAM/*NAME*	SIMBOOL/*SYMBOL*	WAARDE/*VALUE*
Avogadro se konstante Avogadro's constant	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Molêre gaskonstante Molar gas constant	R	$8{,}31\ J{\cdot}K^{-1}{\cdot}mol^{-1}$
Standaarddruk Standard pressure	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molêre gasvolume teen STD Molar gas volume at STP	V_m	$22{,}4\ dm^3{\cdot}mol^{-1}$
Standaardtemperatuur Standard temperature	T^{θ}	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1x10^{-14}$ at /by 298K
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$		

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

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1.5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1.6 31 Ga 70	1.8 32 Ge 73	2.0 33 As 75	2.4 34 Se 79	2.8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1.9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1.7 49 In 115	1.8 50 Sn 119	1.9 51 Sb 122	2.1 52 Te 128	2.5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 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	1.8 81 Tℓ 204	1.8 82 Pb 207	1.9 83 Bi 209	2.0 84 Po	2.5 85 At	86 Rn
0,7 87 Fr	0,9 88 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

KEY/ *SLEUTEL*

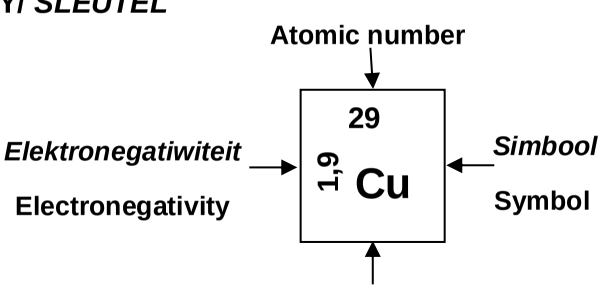


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

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
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 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
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 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
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 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^{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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑