Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2022

TECHNICAL SCIENCES P2 (DEAF)

MARKS: **75**

TIME: **1½ hours**

This question paper has 14 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper has SEVEN questions. Answer ALL the questions.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly.
4. **Leave** ONE **line between two sub-questions**, for example between QUESTION 2.1 and QUESTION 2.2.
5. Use a non-programmable calculator.
6. Use appropriate mathematical instruments.
7. Use the attached DATA SHEETS.
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**, etc. **where** required**(needed).**
11. Write neatly

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various(different) options(choices) are **provided(given)** as **possible(correct)** 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 D.

1.1. **Which** ONE of the **following general formulae represents alkynes**?

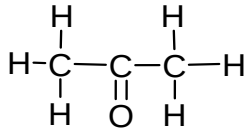
A C_nH_{2n-2}

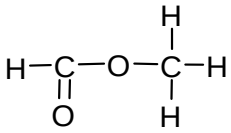
B C_nH_{2n-1}

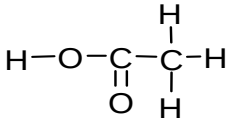
C C_nH_{2n}

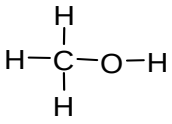
D C_nH_{2n+2} (2)

1.2 **Which ONE** of the following **compounds represents** a **ketone**?

A 

B 

C 

D 

(2)

1.3 **Solar cells use p-n junction** to **convert sunlight directly** into a(n) …

A magnetic field.

B electric field.

C magnetic flux.

D electric current. (2)

1.4 In **which** ONE of the **following options** are the **three compounds listed** in increasing order of **vapour pressure**?

A propanoic acid, pentane, butan-1-ol

B propanoic acid, butan-1-ol, pentane

C pentane, butan-1-ol, propanoic acid

D butan-1-ol, propanoic acid, pentane (2)

1.5 The **cell notation** for a standard **Zn**-**Cu electrochemical** cell is:

A $Cu^{2+}(aq) / Cu(s) // Zn(s) / Zn^{2+}(aq)$

B $Zn(s) / Zn^{2+}(aq) // Cu^{2+}(aq) / Cu(s)$

C $Cu(s) / Zn^{2+}(aq) // Cu^{2+}(aq) / Zn(s)$

D $Zn(s) / Zn^{2+}(aq) // Cu(s) / Cu^{2+}(aq)$ (2)

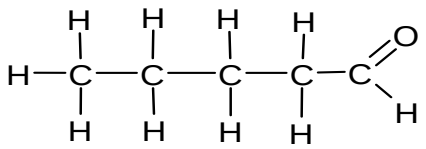
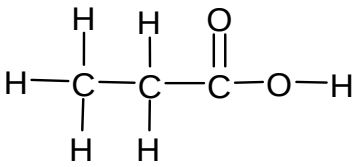
[10]

QUESTION 2 (Start on a new page.)

Organic chemistry is the chemistry of organic molecules divided into homologous series which are identified by the functional groups.

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

2.2 **Consider the organic molecules listed below**:

A hex-2-ene	**B** 
C 3-Chloro-But-1-ene	**D** 

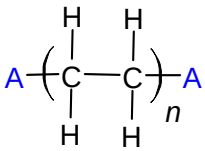
2.2.1 **Define** the term ***isomers*** in **words**. (2)

2.2.2 **Draw** the **structural formula** of a **positional isomer** of **A**. (2)

2.2.3 **Write** down the **name** of the **homologous series** to which **B belongs**. (1)

2.2.4 **Give** the **IUPAC name** for the **chain isomer** of **compound C**. (2)

2.3 The diagram below shows a monomer of the organic compound used for polyethylene. This is the industrial organic product used in the preparation of plastics.



Define the term ***monomer*** in **words**. (2)

[11]

QUESTION 3 (Start on a new page.)

The table below shows the vapour pressure of various organic compounds at 25 ˚C.

Compound	Molar mass ($g\ mol^{-1}$)	Vapour pressure ($x10^2$ Pa)
pentane	72	573,0
hexane	86	160,0
propan-1-ol	60	21,0
propan-2-ol	60	44,0
butan-1-ol	74	6,2
butan-2-ol	74	18,3
pentan-1-ol	88	2,2
pentan-2-ol	88	8,04
ethanoic acid	60	15,3
propanone	58	240,0

3.1 **Write** down the **general formula** of the **homologous series** to which **pentane belongs**. (1)

3.2 **Draw** the **structural formula** of **propanone**. (2)

3.3 **Give** the **name** of a **functional isomer** of **propanone**. (1)

3.4 **Write** down the **name** of the **intermolecular forces involved** in:

3.4.1 Alcohols (1)

3.4.2 Alkanes (1)

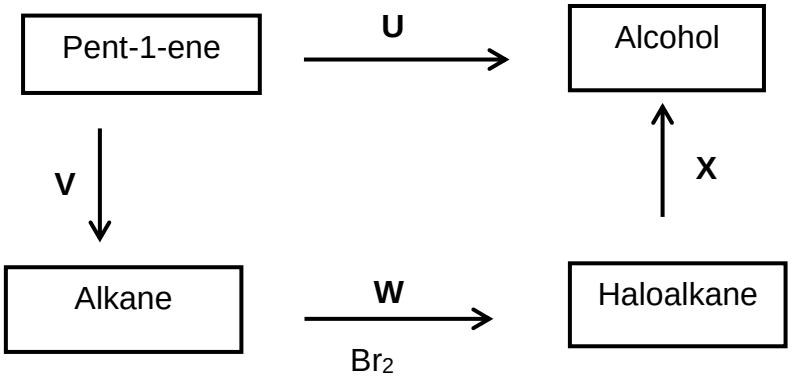
3.5 Refer to the table of organic compounds above to **state** and **explain** the **relationship between vapour pressure** and the **strength** of **intermolecular forces**. (2)

3.6 **Which compound** will **have** the **higher boiling point**:
Ethanoic acid or propan-1-ol?

Explain by **referring** to type of **intermolecular forces** and **energy**. (3)
[11]

QUESTION 4 (Start on a new page.)

Pent-1-ene can be converted to other compounds by means of different organic reactions represented by **U**, **V**, **W** and **X**, as shown below.



4.1 **Write** down the **TYPE** of the **reaction represented** by:

4.1.1 **U** (1)

4.1.2 **W** (1)

4.1.3 **V** (1)

4.2 During reaction **X**, the alkyl halide (haloalkane) reacts.

4.2.1 **Give** the **NAME** of a suitable**(correct)** base used. (1)

4.2.2 **Name TWO** reaction **conditions** for **reaction X**. (2)

4.2.3 **Write** down the **balanced reaction using structural formulae** for the reaction of Pent-1-ene with hydrogen bromide to **form** a **haloalkane**. (3)

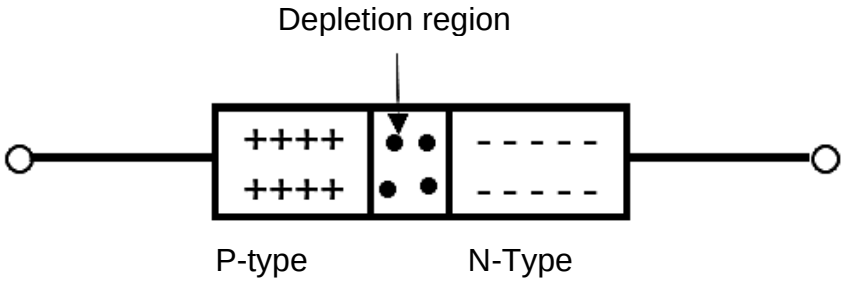
4.3 Fossil fuels are formed by the natural process of decomposition of organisms under heat and pressure. They contain a high percentage of carbon and include fuels such as coal, petrol and natural gases. Alkanes are the most important fossil fuels. The combustion of alkanes (also known as oxidation) is highly exothermic.

Write down a **balanced reaction** for the **complete combustion(fire)** of pentane. (3)

[12]

QUESTION 5 (Start on a new page.)

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



Diode

5.1 **Define** the term ***semiconductor*** in **words**. (2)

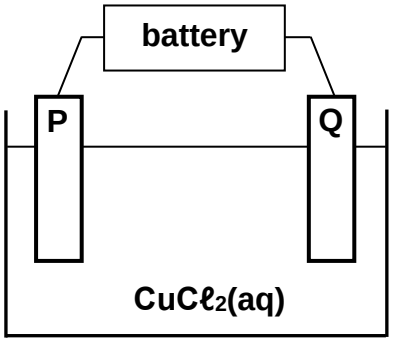
5.2 Phosphorus was added to silicon in small quantities. It was then found that the electrical conductivity of silicon improved.

5.2.1 **Identify(name)** the **described process** in the above **statement**. (1)

5.2.2 What type of a semiconductor material (P-type or N-type) is formed during this process? Give a reason for your answer. (2)
[5]

QUESTION 6 (Start on a new page.)

In the electrolytic cell, represented below, two CARBON RODS are used as electrodes and a concentrated copper (II) chloride solution is used as an electrolyte.



When the cell is functioning, the following **observations** are made:

- A gas is released at electrode **P**
- Electrode **Q** is coated with a reddish-brown layer

6.1 **Define** the term ***electrolyte***. (2)

6.2 **Write** down a **half-reaction** to **explain** the **observation** made at:

6.2.1 Electrode **P** (2)

6.2.2 Electrode **Q** (2)

6.3 **Write** down the **energy conversion** that is **taking place** in this **cell**. (1)

6.4 **Which electrode**, **P** or **Q**, is the **cathode**? **Give** a **reason** for your **answer**. (2)

6.5 The **carbon rods** in the above cell are now **replaced** with **COPPER** RODS. The following observations are made at electrode **P**:

- No gas is released
- Its surface appears rough and eroded

6.5.1 **Refer** to the RELATIVE **STRENGTHS** OF **REDUCING AGENTS** to **explain** this **observation**. (3)

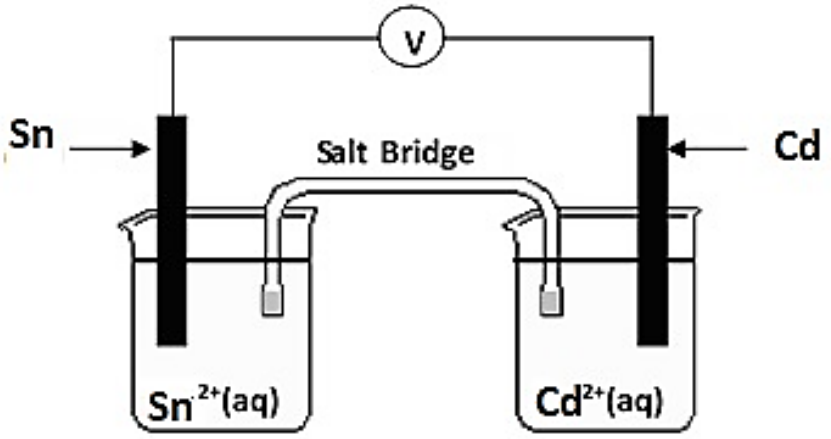
6.5.2 This cell can be used for the electroplating of a bracelet in the industry. **Which electrode** (**P** or **Q**) will be **replaced** with a **bracelet during** the **electroplating process**? (1)

[13]

QUESTION 7 (Start on a new page.)

The potential difference of a galvanic cell, measured experimentally by learners in a Technical Sciences laboratory, is COMPARED with its potential difference calculated at standard conditions.

They set up the galvanic cell shown below.



The voltmeter measures an initial reading of **0,19 V**.

7.1 **Write** down the **energy conversion** that takes place in this cell. (1)

7.2 **State** ONE **function** of the **salt bridge**. (1)

7.3 **Write** down the **half-reaction** that **takes place** at the **anode**. (2)

7.4 In **which direction** do electrons **flow** in the **external circuit** when this cell **delivers** a **current**?

Write down only **FROM Sn TO Cd** or **FROM Cd TO Sn**. (1)

7.5 **Write** down the balanced net (**overall**) **cell reaction**. (3)

7.6 **Use** the **Table** of STANDARD REDUCTION POTENTIALS to **calculate** the **initial potential difference** (emf) of the **above cell** at STANDARD CONDITIONS. (3)

7.7 From the results obtained, the learners concluded that the measured potential difference differs from the calculated potential difference.

Give TWO **possible reasons** for this **difference** in **values**. (2)

[13]

TOTAL: 75

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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*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Standard temperature *Standaardtemperatuur*	T^{θ}	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*

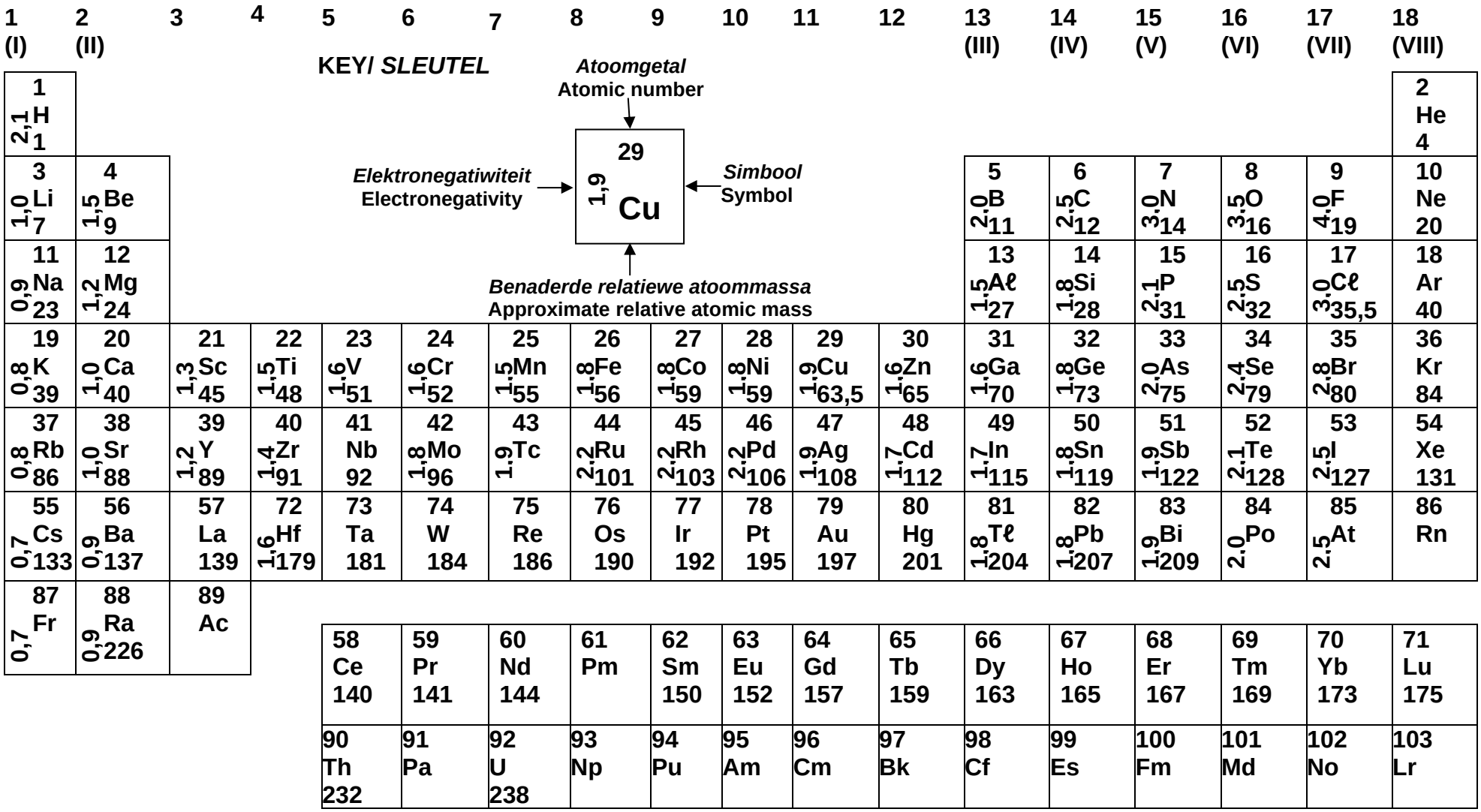

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

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)
$Li^+ + e^-$	⇌	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 oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*