education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

-

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL SCIENCES P2

SEPTEMBER 2024

MARKS: 75

TIME: 1½ hour

This question paper consists of 11 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN questions. 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. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You are advised to use the attached DATA SHEETS.

7. Round off your FINAL numerical answers to a minimum of TWO decimal places.

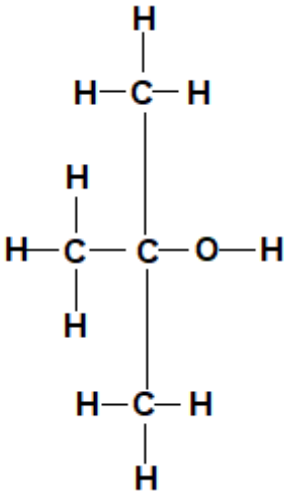
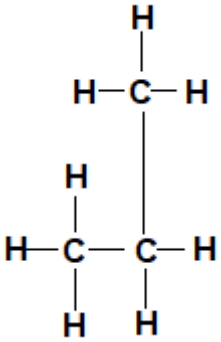
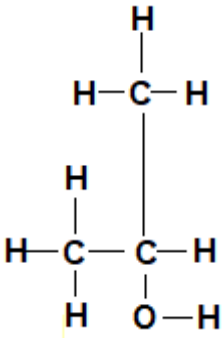
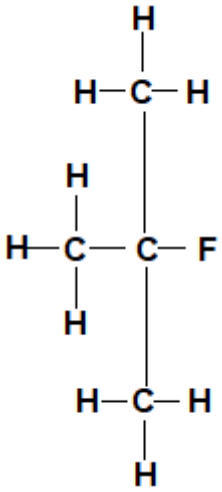
8. Give brief motivations, discussions, etc. where required.

9. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

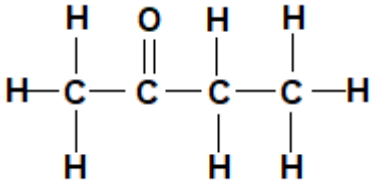
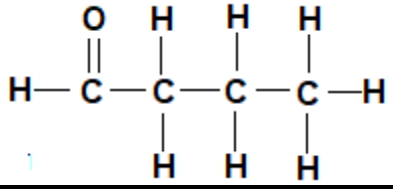
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.5) in the ANSWER BOOK, e.g. 1.6 D.

1.1 Identify the tertiary alcohol in the following compounds.

A		B	
C		D	

(2)

1.2 Consider compound **P**, **Q**, **R** and **S**.

P	2–methylethane	**Q**	
R		**S**	2–methylbutane

Which ONE of the following pairs will be isomers?

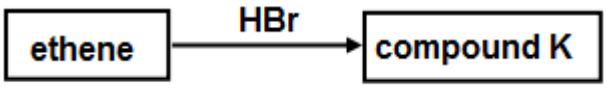
A **P** and **R**

B **R** and **S**

C **S** and **P**

D **R** and **Q** (2)

1.3 Consider the flow diagram below:



What will be the name of compound **K**?

A bromoethane

B ethane

C ethanol

D 1,2–dibromoethane (2)

1.4 The ionic substance that is dissolved in water to give solution that conduct electricity is a/an …

A positive ion.

B negative ion.

C electrolyte.

D electrolysis. (2)

1.5 In an electrolytic cell cations migrate …

A to the positive electrode.

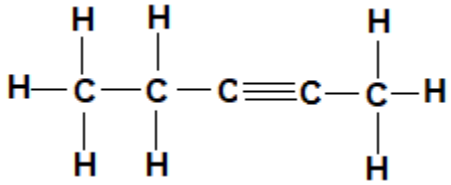
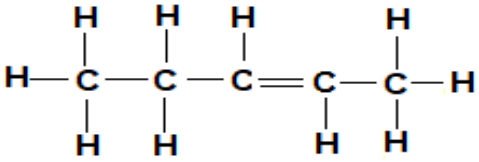
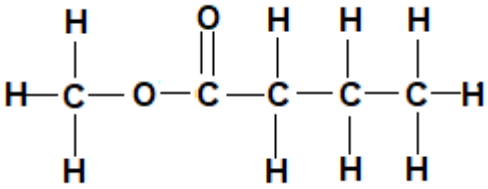
B to the negative electrode.

C from the negative to positive electrode.

D from the positive to negative electrode. (2)
[10]

QUESTION 2 (Start on a new page.)

Consider the table below of compounds **A** to **F** to answer the questions that follow:

A		**B**	
C	2,2–dimethylpropane	**D**	$CH_3CH_2CH_2CH_2CH_2OH$
E		**F**	Polyethene

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

2.2 Write down the LETTER that represents the following:

2.2.1 Plastic (1)

2.2.2 Unsaturated hydrocarbon (1)

2.2.3 A compound with a hydroxyl as a functional group (1)

2.2.4 Alkane (1)

2.3 Write down the IUPAC name of the following compounds:

2.3.1 **D** (2)

2.3.2 **B** (2)

2.4 Write down the:

2.4.1 STRUCTURAL FORMULA of compound **C** (3)

2.4.2 GENERAL FORMULA of compound **A** (1)

2.5 Compound **E** is formed when a carboxylic acid reacts with another organic compound. Write down the/a:

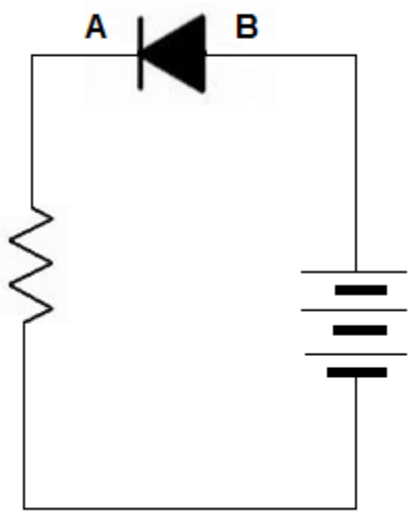
2.5.1 NAME of the other organic reactant (1)

2.5.2 STRUCTURAL FORMULA of the functional group of compound **E** (2)
[17]

QUESTION 3 (Start on a new page.)

3.1 What is the difference between n–type and p–type semiconductor. (2)

3.2 Consider a circuit with a p–n junction diode below and answer the questions that follow.

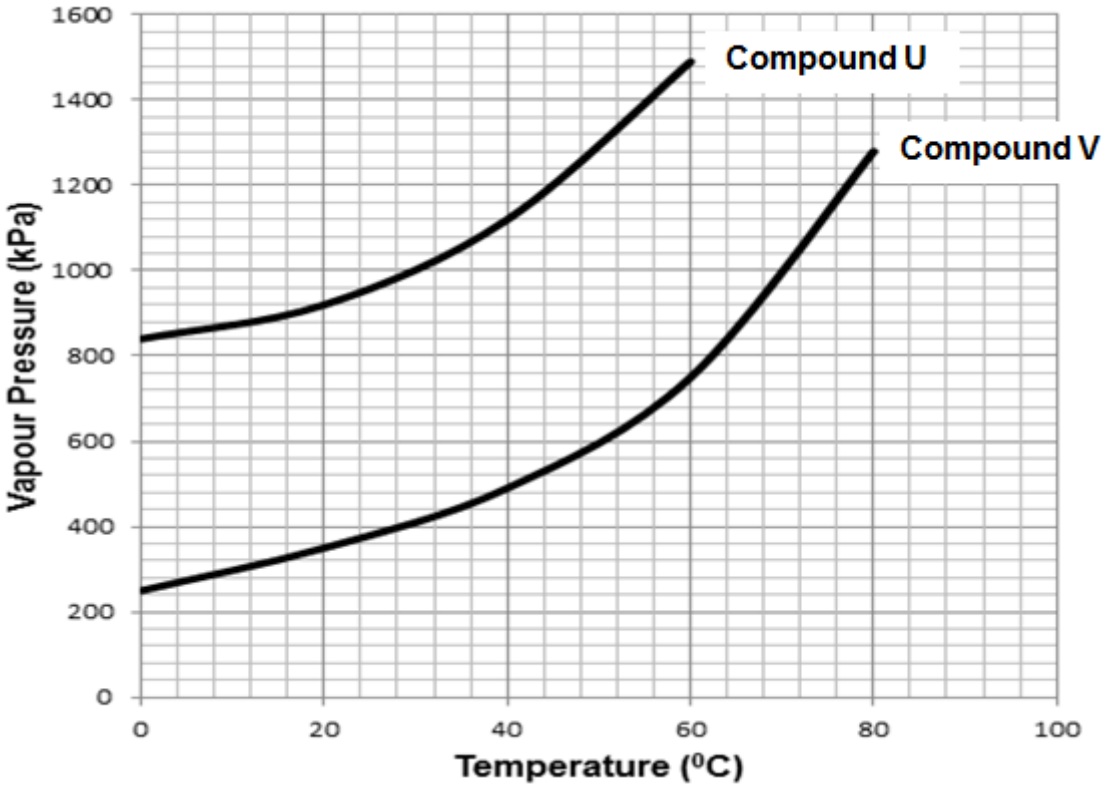


3.2.1 Identify the TYPE of biased connection in this circuit. (1)

3.2.2 Re-draw ONLY the symbol of a diode and label it. (2)
[5]

QUESTION 4 (Start on a new page.)

In the graph below the vapour pressure of compounds **U** and **V**, with comparable temperatures, were investigated and the results obtained were recorded.



4.1 Define the term *vapour pressure*. (2)

4.2 The two compounds are identified as pentan–2–one and hex–2–yne.

Which ONE will be compound **U**? (1)

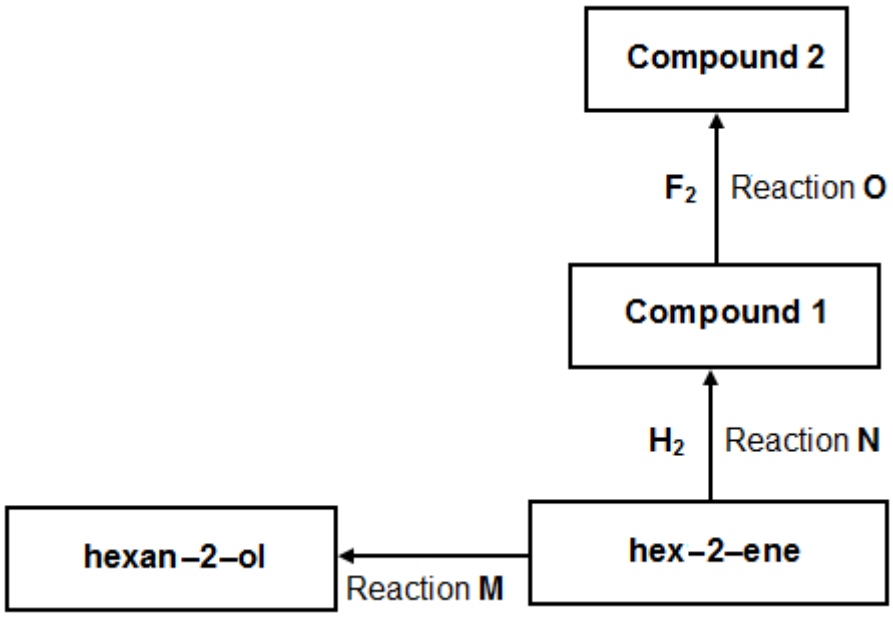
4.3 Support the answer to QUESTION 4.2 above. (2)

4.4 Compound pentan–2–one is now replaced by pent–2–yne.

Explain the difference in the vapour pressure of pent–2–yne and hex–2–yne by referring to the TYPE OF THE INTERMOLECULAR FORCES, STRENGTH OF THE INTERMOLECULAR FORCES, CHAIN LENGTH and PRESSURE. (4)
[9]

QUESTION 5 (Start on a new page.)

In the flow diagram below hex–2–ene is a starting compound.



5.1 NAME the type of addition reaction represented by:

5.1.1 Reaction **M** (1)

5.1.2 Reaction **N** (1)

5.2 What is the other reactant of reaction **M**? (1)

5.3 Write down a balanced chemical equation for reaction **O** by using STRUCTURAL FORMULAE. (4)

5.4 Write down ONE reaction condition of reaction **M**. (1)

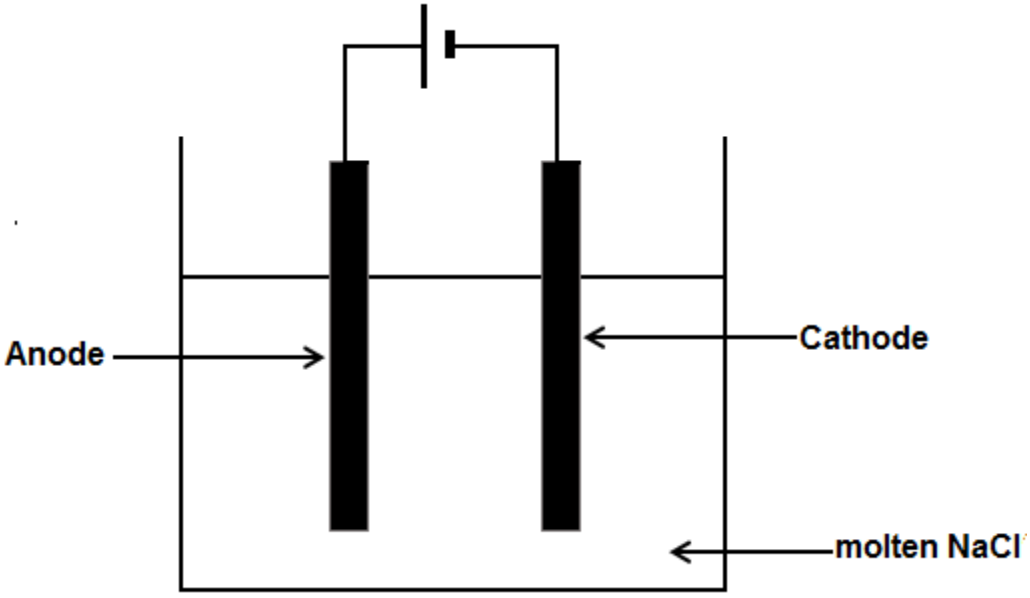
5.5 Hex–2–ene (C_6H_{12}) reacts in excess oxygen.

Write down a balanced chemical equation of this reaction by using MOLECULAR FORMULA. (3)

[11]

QUESTION 6 (Start on a new page.)

The diagram below shows a cell for the electrolysis of molten sodium chloride using carbon electrodes.



6.1 Define the following terms:

6.1.1 *Electrolysis* (2)

6.1.2 *Reduction* in terms of *electron transfer* (2)

6.2 Write down the:

6.2.1 Half reaction at the anode (2)

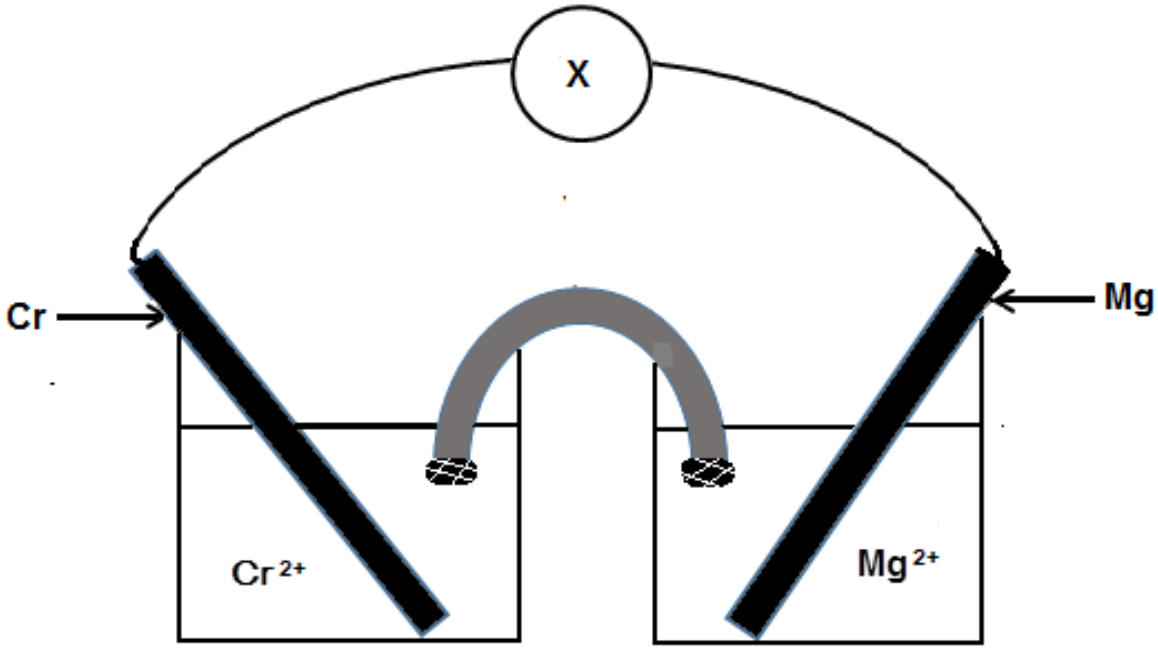
6.2.2 Half reaction at the cathode (2)

6.2.3 Balanced net ionic reaction for this cell (3)

6.3 What observation is made at the anode electrode? (1)
[12]

QUESTION 7 (Start on a new page.)

Learners set up an electrochemical cell as illustrated below.



7.1 What TYPE of electrochemical cell is illustrated above? (1)

7.2 Write down the energy conversion for this cell. (1)

7.3 Write down the:

7.3.1 NAME of component **X** (1)

7.3.2 NAME or FORMULA of the reducing agent (1)

7.3.3 Cell notation for this cell (3)

7.4 Electrode **Mg** is now replaced by another electrode **Y**. The reading on the voltmeter is **0,15V**.

Use calculation to determine the NAME or FORMULA of electrode **Y** under the standard conditions. (4)
[11]

TOTAL: 75

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^{θ}	$1{,}01 \times 10^5$ Pa
Standard temperature *Standaardtemperatuur*	T^{θ}	$0\,^{\circ}C$ /273 K

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

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*

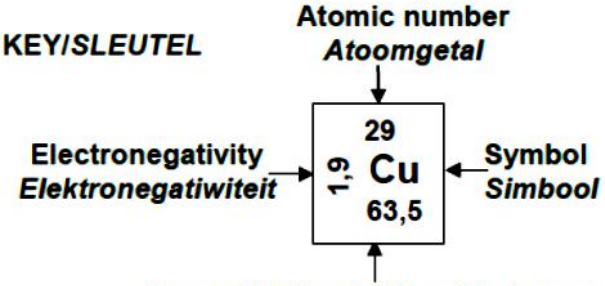


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD–REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende sterkte van oksideermiddels* ↑

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 sterkte van reduseermiddels* ↓

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
$SO_4^{-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 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
$Cr_2O_7^{-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 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 sterkte van oksideermiddels* ↓

Increasing reducing ability/ *Toenemende sterkte van reduseermiddels* ↑