basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

TECHNICAL SCIENCES P2

MAY/JUNE 2026

MARKS: 75

TIME: 1½ hours

This question paper consists of 10 pages and 4 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number 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 ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You are advised to use the attached DATA SHEETS.
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 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 Plastic is produced through a reaction called …

A hydrolysis.

B electrolysis.

C polymerisation.

D decomposition. (2)

1.2 Which ONE of the following rules is INCORRECT regarding the IUPAC naming of compounds?

A The halogen atoms must always get preference over alkyl groups when numbering the carbon atoms in the parent chain.

B The multiple (double or triple) bond must get preference over alkyl groups when numbering the carbon atoms in the parent chain.

C Numbering should start from the end nearest to the first substituent, which includes either the alkyl group or the halogen.

D In haloalkanes, Br gets alphabetical preference in the case where both Br and Cℓ have the same location when numbered from different ends of the chain. (2)

1.3 An experiment involves measuring of the melting points of 2,2-dimethylpropane, 2-methylbutane and pentane.

Which ONE of the following would be an appropriate investigative question relevant to this experiment?

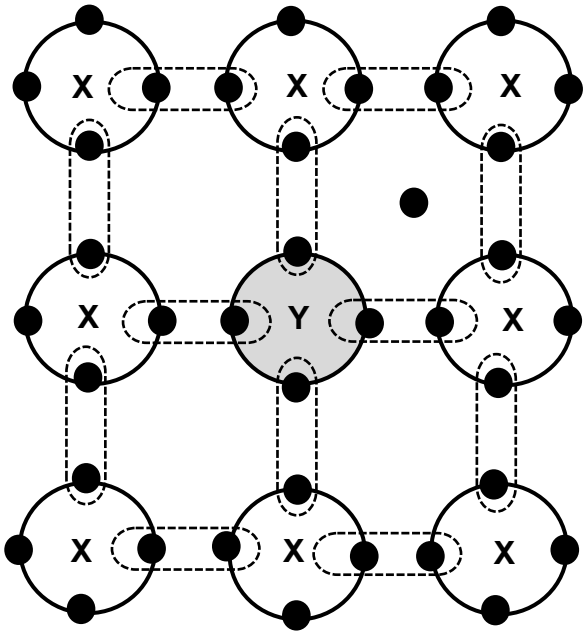
A What is the relationship between the molar mass of the organic compounds and their melting points?

B What is the relationship between the surface area of the organic compounds and their melting points?

C What is the trend in melting points when comparing organic compounds in different homologous series?

D What is the trend in melting points when comparing organic compounds with different types of intermolecular forces? (2)

1.4 Consider the diagram of a doped semiconductor material below.



Which ONE of the following combinations of elements in the table below is CORRECT?

	NAME OF ELEMENT X	NAME OF ELEMENT Y
A	Carbon	Boron
B	Boron	Carbon
C	Phosphorus	Carbon
D	Carbon	Phosphorus

(2)

1.5 A spontaneous electrochemical cell reaction occurring under standard conditions is …

A exothermic with a positive standard cell potential.

B exothermic with a negative standard cell potential.

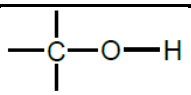
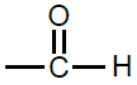
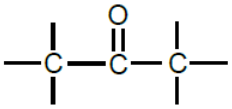
C endothermic with a positive standard cell potential.

D endothermic with a negative standard cell potential. (2)

[10]

QUESTION 2 (Start on a new page.)

Study the table below and answer the questions that follow.

COMPOUNDS	HOMOLOGOUS SERIES	FUNCTIONAL GROUPS	
		NAME	STRUCTURE
A	…	Hydroxyl group	
B	Aldehydes	…	
C	Ketones	Carbonyl group	
D	Carboxylic acids	Carboxyl group	…

2.1 Define the term *organic molecule*. (2)

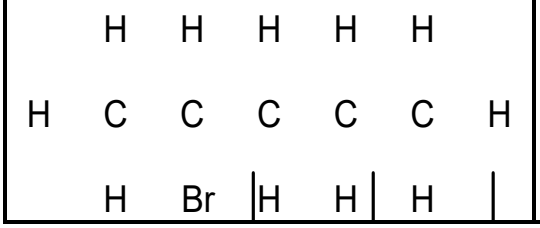
2.2 Identify the homologous series of **A**. (1)

2.3 Name the functional group of **B**. (1)

2.4 Draw the structural formula of the functional group of **D**. (1)

2.5 Write down the general formula of **C**. (1)

2.6 Consider compounds **A** and **B** in the table below.

COMPOUND A	COMPOUND B
	2-bromo-2-methylbutane

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

2.6.2 Draw the structural formula of compound **B**. (3)

2.6.3 Define the type of isomers represented by compounds **A** and **B**. (2)
[13]

QUESTION 3 (Start on a new page.)

Learners investigate factors that influence the boiling points of the alkanes in the table below.

ALKANES	BOILING POINT (°C)
Hexane	…
Pentane	36,1
Butane	…

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

3.2 Explain why alkanes are considered to be saturated hydrocarbons. (2)

3.3 During the investigation, it was found that the boiling points of the other TWO alkanes are -1 °C and 68,7 °C respectively.

Write down the value of the boiling point of:

3.3.1 Hexane (1)

3.3.2 Butane (1)

3.4 In a second investigation the learners compared the physical properties of pentane and pentan-1-ol and gathered the following information:

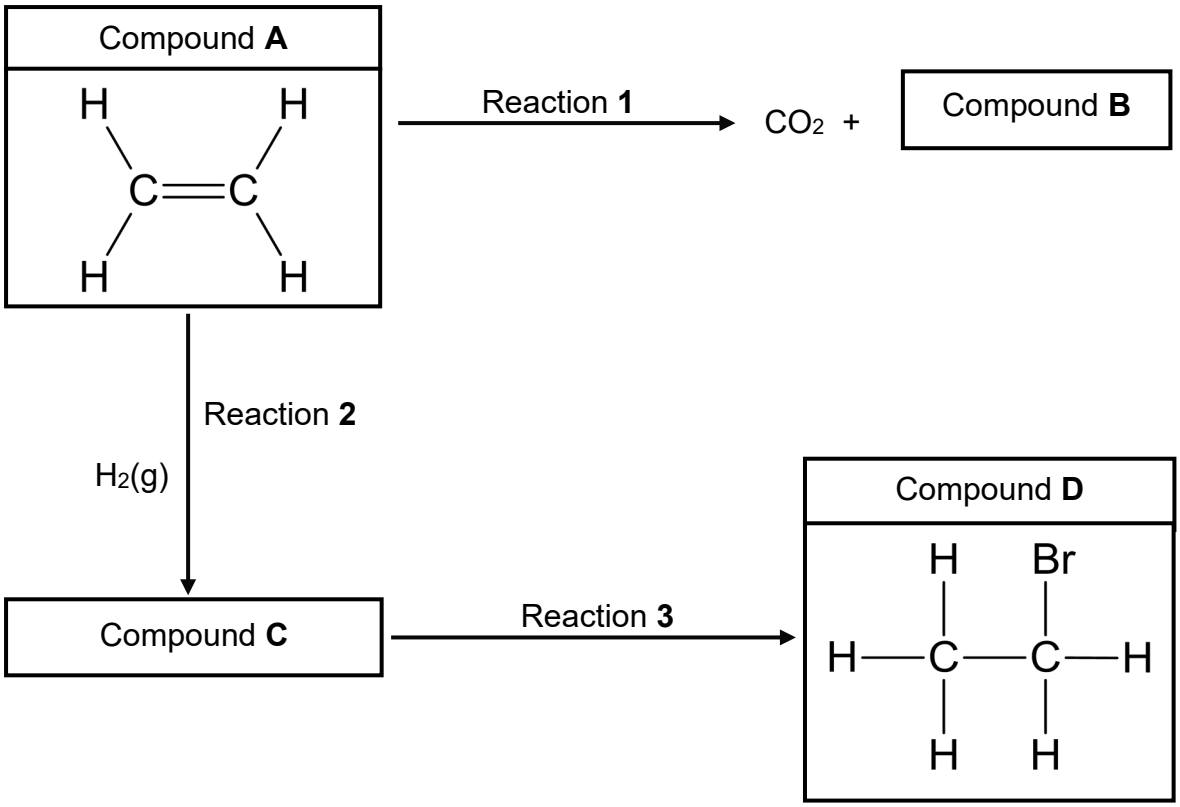
PHYSICAL PROPERTIES	PENTANE	PENTAN-1-OL
Melting point (°C)	-129,8	-78,0

3.4.1 The melting point of pentan-1-ol is higher than that of pentane. Explain this observation by referring to the TYPE and STRENGTH of the intermolecular forces. (2)

3.4.2 How will the viscosity of pentan-1-ol compare to that of pentane? Choose only between LOWER THAN or HIGHER THAN. (1)
[9]

QUESTION 4 (Start on a new page.)

Consider the organic reactions in the flow chart below.



4.1 Consider reaction **1**.

Write down the NAME of:

4.1.1 This reaction (1)

4.1.2 Compound **B** (1)

4.2 In reaction **2**, compound **A** reacts with hydrogen to form compound **C**.

4.2.1 Write down the NAME of the addition reaction that takes place. (1)

4.2.2 Draw the structural formula of compound **C**. (2)

4.2.3 Write down the NAME of the catalyst used in this reaction. (1)

4.3 In reaction **3**, compound **C** is converted to compound **D**.

For this reaction, write down:

4.3.1 The chemical formula of the other reactant that is used (1)

4.3.2 ONE reaction condition (1)

4.4 Compound **A** is the monomer of polythene.

4.4.1 Define the term *monomer*. (2)

4.4.2 State TWO uses of polythene. (2)

[12]

QUESTION 5 (Start on a new page.)

Semiconductors are widely used in the manufacturing of various electronic components, such as diodes and transistors.

5.1 Define the term *semiconductor*. (2)

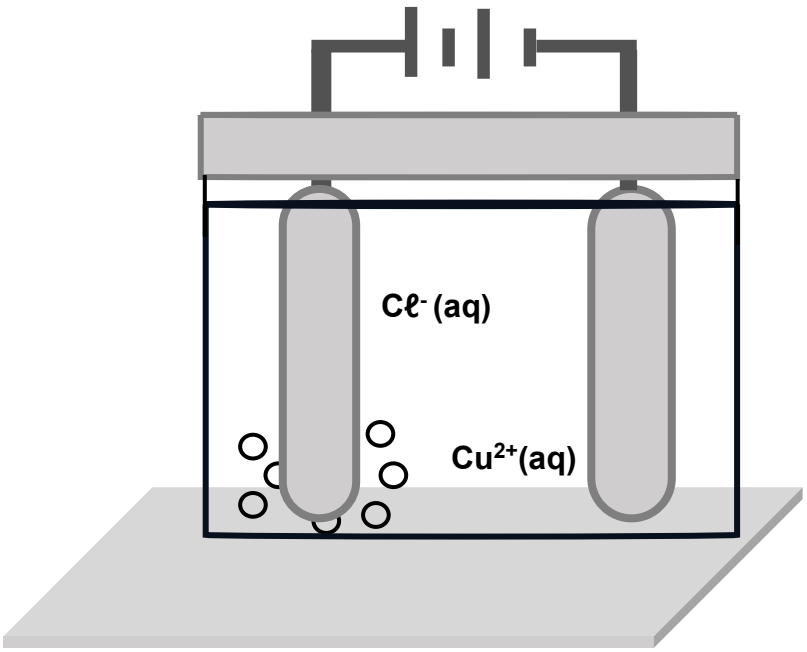
5.2 Tabulate the differences between a *forward biased diode* and a *reverse biased diode* in terms of the following:

- Connection
- Depletion region
- Resistance
- Conduction (4)

[6]

QUESTION 6 (Start on a new page.)

The diagram below represents an electrolytic cell used in the decomposition of a copper(II) chloride solution.



6.1 Which energy conversion takes place IN THIS CELL while it is in operation? (2)

6.2 Identify the reducing agent in the electrochemical cell above. (1)

6.3 Explain the answer to QUESTION 6.2. (2)

6.4 Which changes will be observed in the electrolyte as the cell is in operation? (1)

6.5 Use a chemical equation to support the answer to QUESTION 6.4. (2)

6.6 Write down a balanced overall reaction for this cell. (3)

Alternative energy sources are now used due to the energy crisis in the world.

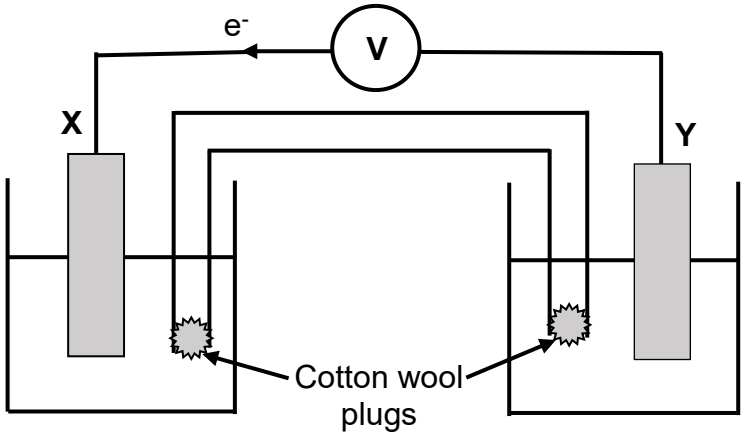
6.7 State ONE disadvantage of wind as a source of alternative energy. (1)

6.8 Write down ONE source of alternative energy other than those indicated in QUESTION 6.7. (1)

[13]

QUESTION 7 (Start on a new page.)

The galvanic cell represented in the diagram below consists of a Cu rod dipped into a $CuSO_4$ solution and a Zn rod dipped into a $ZnSO_4$ solution. The cell operates under standard conditions.



7.1 State ONE standard condition under which this cell operates. (1)

7.2 Calculate the emf of this cell. (4)

7.3 Write down the half-reaction that takes place in electrode **X**. (2)

7.4 The electrodes are labelled **X** and **Y**.

7.4.1 Which electrode (**X** or **Y**) is the anode? (1)

7.4.2 Give a reason for the answer to QUESTION 7.4.1. (2)

7.5 When glass instead of cotton wool is used to plug the salt bridge, the voltmeter reading becomes zero.

Explain this observation. (2)
[12]

TOTAL: 75

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DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2
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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 °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 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	Rn
0,7 Fr	0,9 Ra 226	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*

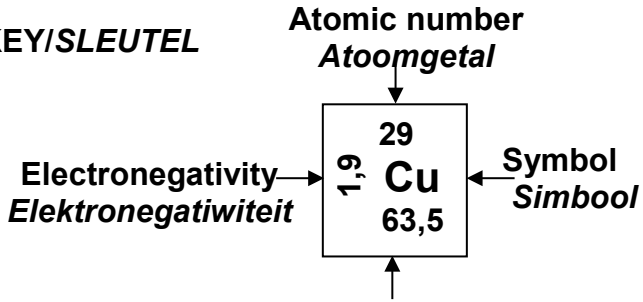


TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing strength of oxidising agents/*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 strength of reducing agents/*Toenemende sterkte van reduseermiddels* ↓

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

Increasing strength of oxidising agents/*Toenemende sterkte van oksideermiddels*

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 strength of reducing agents/*Toenemende sterkte van reduseermiddels*

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