GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2025

11102

TECHNICAL SCIENCES

(PAPER 2)

TECHNICAL SCIENCES: Paper 2

11102E

TIME: 1,5 hours

MARKS: 75

10 pages and 4 data sheets

X05

P.T.O.

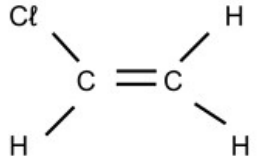
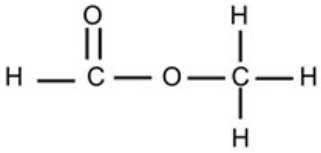
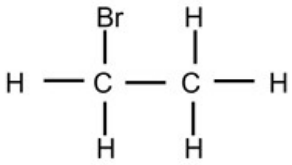
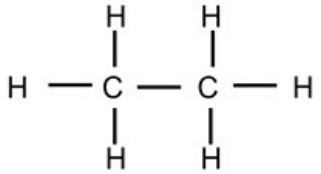
INSTRUCTIONS AND INFORMATION

1. Write your name and grade on the ANSWER BOOK.
2. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page.
4. Number your answers correctly, according to the numbering system used in this question paper.
5. Leave ONE LINE between subquestions, e.g. QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable scientific calculator.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round-off your FINAL answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions etc. where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

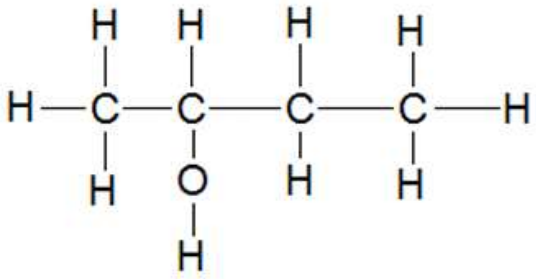
Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question numbers (1.1 to 1.5) in the ANSWER BOOK, e.g. 1.6 D.

1.1 Which of the following compounds has functional isomers?

A		B	
C		D	

(2)

1.2 Consider the following structural formula of the compound below and identify the type of intermolecular forces between the molecules.



A Only hydrogen bonds
B London forces and dipole-dipole forces
C London forces and hydrogen bonds
D Only dipole-dipole forces. (2)

1.3 During the polymerisation process, soft and hard plastics are created. Which factor does NOT influence the softness and hardness of these plastics?

A Temperature
B Chain length of the polymer
C Pressure
D Concentration (2)

1.4 A reducing agent is:

A A substance that gains electrons and undergoes reduction
B A substance that loses electrons and undergoes oxidation
C A substance that gains electrons and undergoes oxidation
D A substance that loses electrons and undergoes reduction (2)

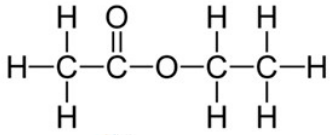
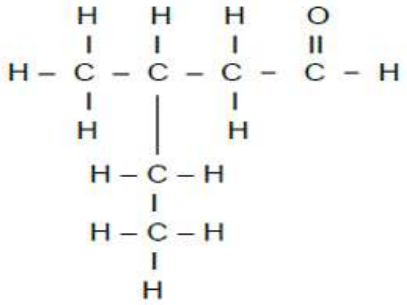
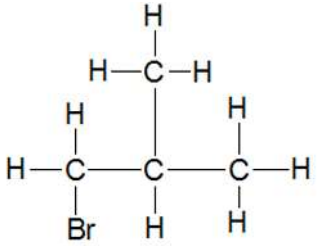
1.5 Identify the correct way to write the cell notation of a Mg-Fe galvanic cell.

A $Mg_{(s)} / Mg^{2+}$ (101,3 kPa) // $Fe^{2+}(1\ mol.dm^{-3}) / Fe_{(s)}$
B $Fe_{(s)} / Fe^{2+}$ (1 mol.dm^{-3}) // $Mg^{2+}(1\ mol.dm^{-3}) / Mg_{(s)}$
C $Fe_{(s)} / Fe^{2+}$ (1 mol.dm^{-3}) // Mg^{2+}(101,3 kPa) / $Mg_{(s)}$
D $Mg_{(s)} / Mg^{2+}$ (1 mol.dm^{-3}) // $Fe^{2+}(1\ mol.dm^{-3}) / Fe_{(s)}$ (2)

[10]

QUESTION 2 (Start on a new page.)

Consider the organic compounds represented by the letters **A** to **F** below and answer the questions that follow.

A	But-1-ene	B	
C		D	
E	Butanoic acid	F	$CH_3CHCHCH_3$

2.1 Define the term *functional group.* (2)

2.2 Write down the:

2.2.1 Letter of the compound that has strong hydrogen bonds (1)

2.2.2 HOMOLOGOUS SERIES to which compound **D** belongs (1)

2.2.3 NAME of the FUNCTIONAL GROUP of compound **C** (1)

2.2.4 IUPAC NAME of compound **B** (2)

2.3 Consider compounds **C**, **D** and **F**.

2.3.1 Draw the structural formula of compound **F**. (2)

2.3.2 Write down the condensed formula of compound **D**. (1)

2.3.3 Write down the molecular formula of compound **C**. (1)

2.4 Define the term *structural isomer*. (2)

2.5 Identify the specific TYPE of structural isomer illustrated by the following compounds:

2.5.1 **A** and **F** (1)

2.5.2 **B** and **E** (1)

[15]

QUESTION 3 (Start on a new page.)

A learner prepared samples of propane and propan-2-ol in a laboratory. During the process the labels of the two samples were lost. Both solutions are colourless. The learner then decided to identify the samples by recording the time that it took for each sample to start boiling. The results were tabulated in the following table:

Sample	Time that it took to boil (s)
A	67
B	21

3.1 Define the term *boiling point.* (2)

3.2 Write down the name of the instrument which was used by the learner to measure the time that it took for the samples to start boiling. (1)

3.3 Which sample, **A** or **B**, is propan-2-ol? (1)

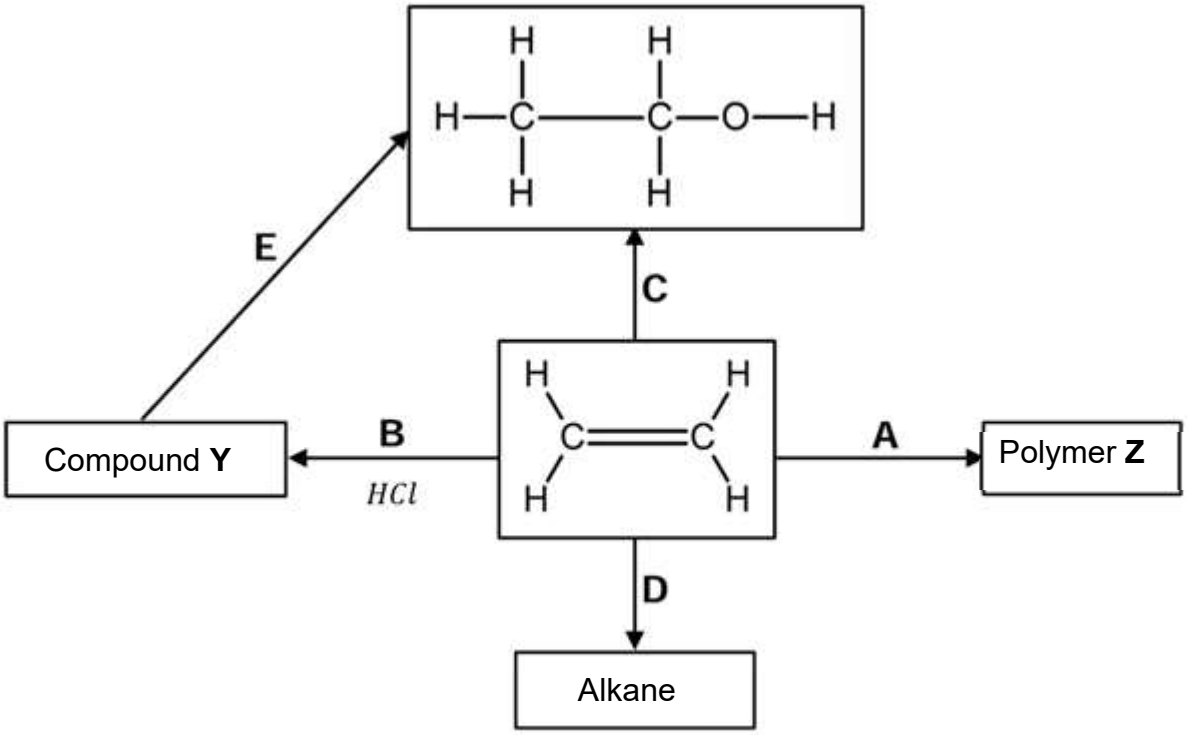
3.4 Explain your answer to QUESTION 3.3 by referring to the TYPE OF INTERMOLECULAR FORCES, STRENGTH OF THE INTERMOLECULAR FORCES and the ENERGY. (3)

3.5 When the learner was conducting the experiment to determine how long it took for each sample to start boiling, it was found that it took longer to pour droplets of propan-2-ol into a test tube using a graduated pipette than to pour droplets of propane. Explain this finding by referring to VISCOSITY. (3)

[10]

QUESTION 4 (Start on a new page.)

The diagram below shows how ETHENE can be converted into other organic compounds. The letters **A**, **B**, **C**, **D** and **E** represent different organic reactions.



4.1 Consider reaction **D**. Write down the:

4.1.1 TYPE of reaction (1)

4.1.2 MOLECULAR FORMULA of the other REACTANT needed (1)

4.1.3 Balanced equation using MOLECULAR FORMULAE, when the PRODUCT undergoes complete combustion (3)

4.2 For reaction **B**, write down:

4.2.1 The IUPAC name of the product formed (2)

4.2.2 A reaction condition for the reaction (1)

4.3 For reaction **C**, write the:

4.3.1 NAME of the other REACTANT needed (1)

4.3.2 NAME of the specific type of reaction (1)

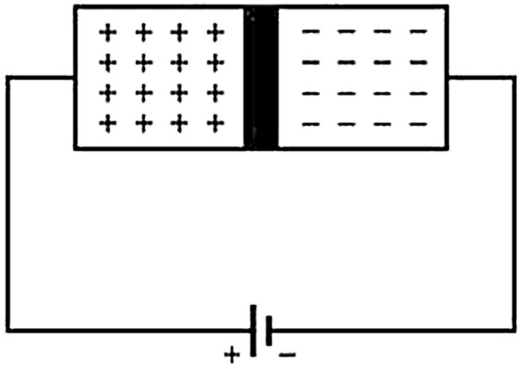
4.4 Reaction **A** forms a polymer as a product.

4.4.1 Define the term *polymerisation*. (2)

4.4.2 Identify whether the monomer needed for reaction **A** to take place, is SATURATED or UNSATURATED. (1)

4.4.3 Give ONE real life application for the PRODUCT (plastic) formed during this reaction. (1)

4.5 The following diagram shows a diode (p-n junction) connected to an external power supply.



4.5.1 Replace the p-n junction by ONLY redrawing the CORRECT SYMBOL for the diode. (1)

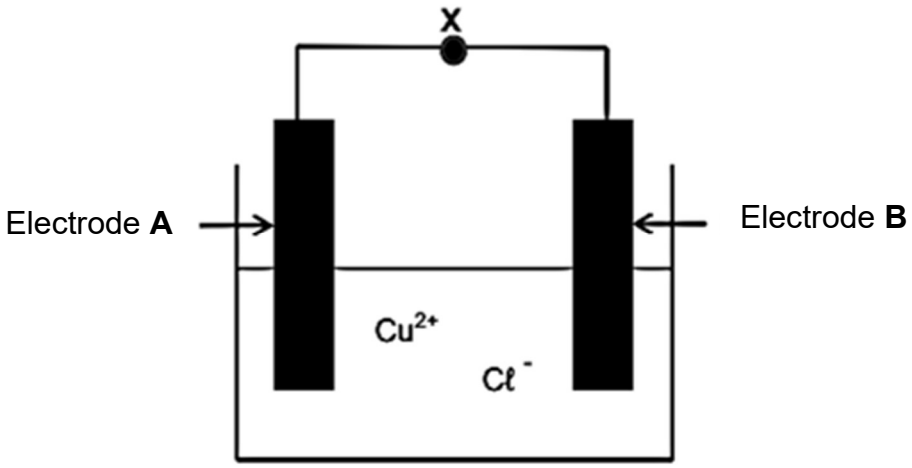
4.5.2 What TYPE of bias is created when connecting the external power source as shown in the diagram? Only write FORWARD or REVERSE. (1)

4.5.3 Give ONE reason why diodes are important in our daily lives? (1)

[17]

QUESTION 5 (Start on a new page.)

The diagram below represents an ELECTROLYTIC CELL for the decomposition of copper(II)chloride. Symbol **X** represents a component of the electrolytic cell. When the cell is in operation, cations (positive ions) are attracted to electrode **A**.



5.1 Define the term *oxidation*. (2)

5.2 Consider electrode **B**.

5.2.1 What OBSERVATION will be made at this electrode? (1)

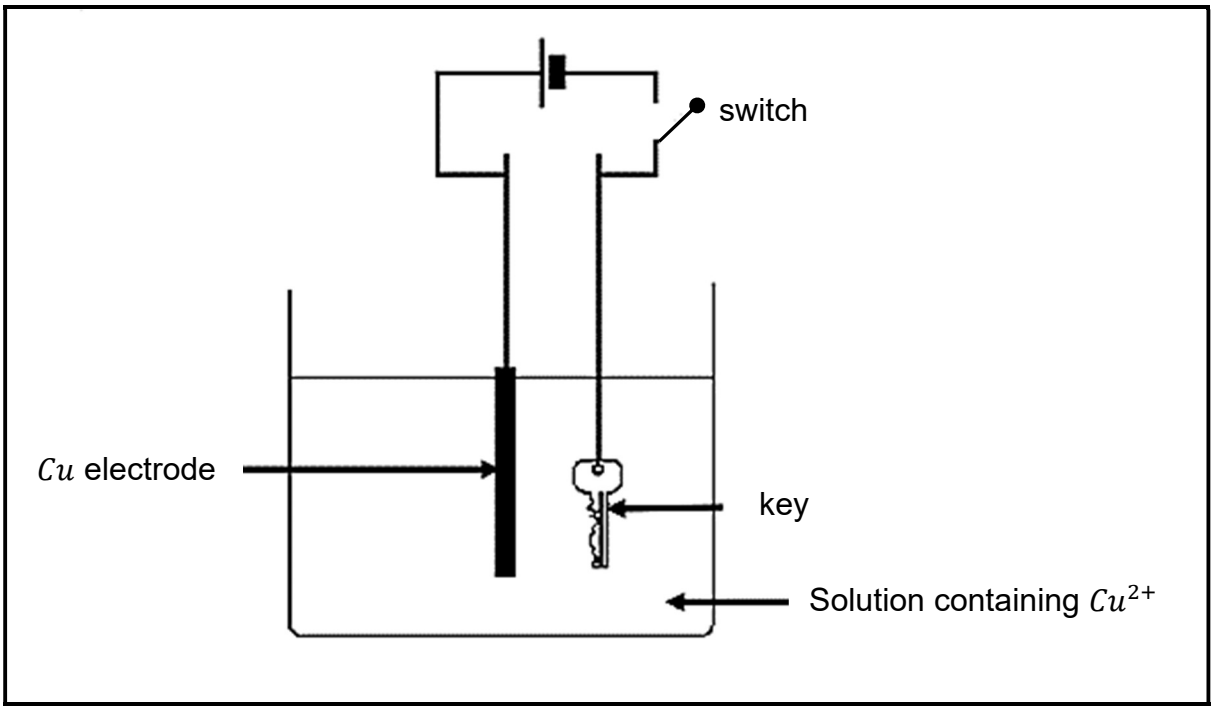
5.2.2 Write down the half-reaction happening at this electrode. (2)

5.3 Consider electrode **A**.

5.3.1 Identify whether this electrode is connected to the positive or negative terminal of component **X**. Only write POSITVE or NEGATIVE. (1)

5.3.2 Give ONE real life application of the PRODUCT that is formed on this electrode. (1)

The Grade 12 learners performed an experiment where they tried to coat a key with copper. They set up the experiment as shown in the diagram below.



5.4 Explain, by ALSO referring to the diagram, why the key will NOT be coated with copper. (3)

The switch is now CLOSED in the circuit.

5.5 Write the NAME of the process when the key is coated with copper. (1)

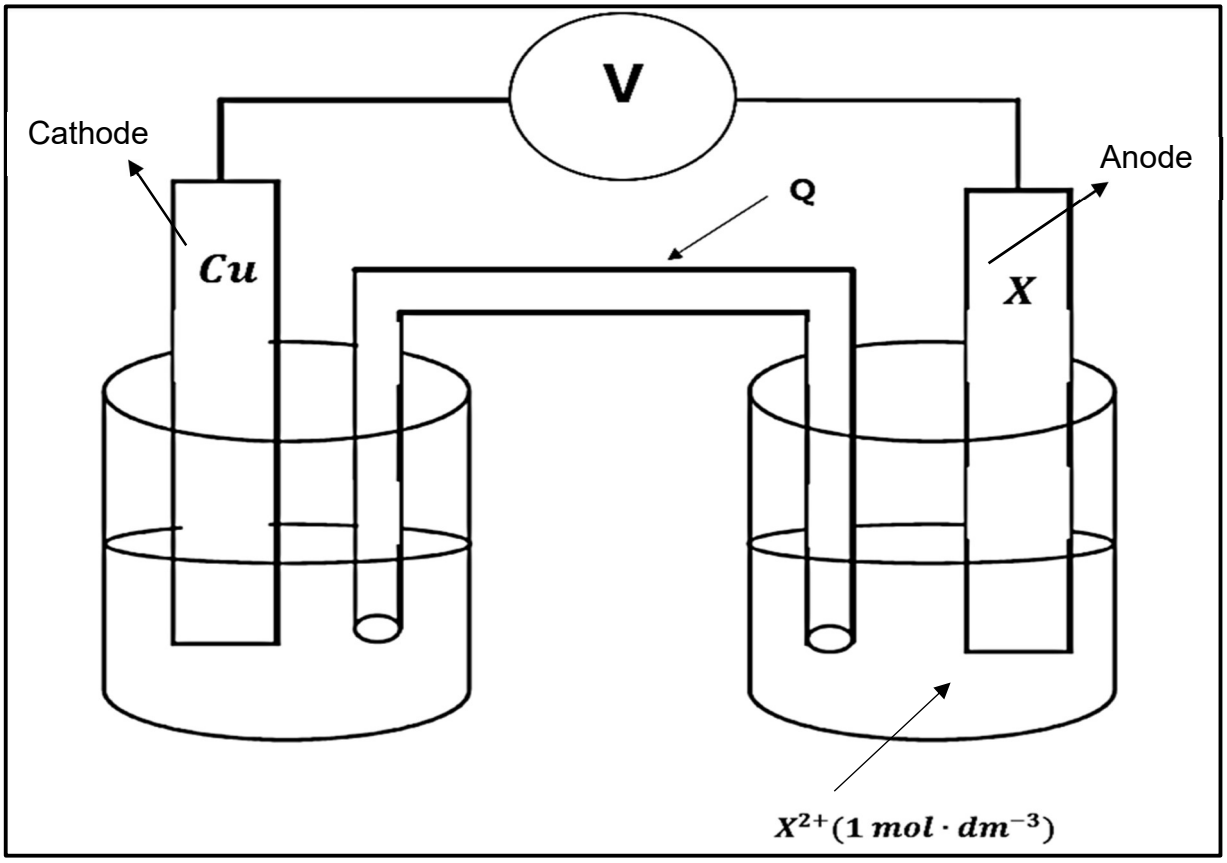
5.6 Identify whether the key will act as the ANODE or CATHODE during this reaction. (1)

5.7 Give a reason why the learners would want to coat the key with copper. (1)

[13]

QUESTION 6 (Start on a new page.)

A standard electrochemical cell is set up using a standard copper half-cell and a standard X/X^{2+} half-cell as shown below. A voltmeter connected across the cell, registered 2,7 V.



6.1 Define the term *galvanic cell.* (2)

6.2 Write the NAME of the component labelled **Q**. (1)

6.3 Identify for the electrochemical cell above, ONE standard condition for this cell EXCEPT for the concentration. (1)

6.4 Determine, through the use of CALCULATIONS, of what element is electrode **X** made. (5)

6.5 Identify the direction in which the ELECTRONS will flow. Only write LEFT TO RIGHT or RIGHT TO LEFT. (1)

[10]

TOTAL: 75

END

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2
GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2

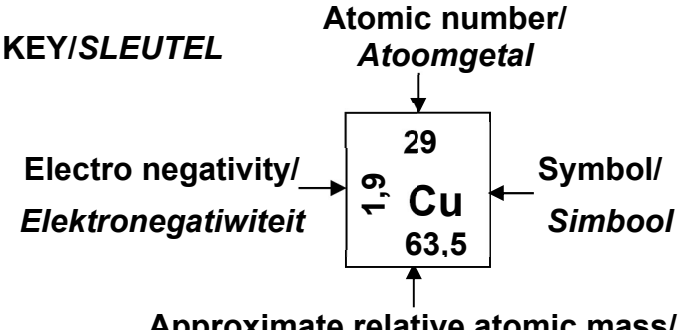
TABLE 1/*TABEL 1*: PHYSICAL CONSTANTS/*FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	$p^{\ominus}$	$1{,}01 \times 10^{5}$ Pa
Standard temperature *Standaardtemperatuur*	$T^{\ominus}$	273 K/0 °C

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	41 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 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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

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 reduserende vermoë* ↓

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

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 reducing ability/*Toenemende reduserende vermoë* ↑