Western Cape Government
Education

METRO NORTH
EDUCATION DISTRICT

NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: Chemistry (P2)

SEPTEMBER 2016

MARKS: 150
TIME: 3 hours

This paper consists of 14 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of TEN questions. Answer ALL the questions.
2. Start EACH question on a NEW page.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to 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, et cetera where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10), for example 1.11 E.

1.1 An example of an unsaturated hydrocarbon is:

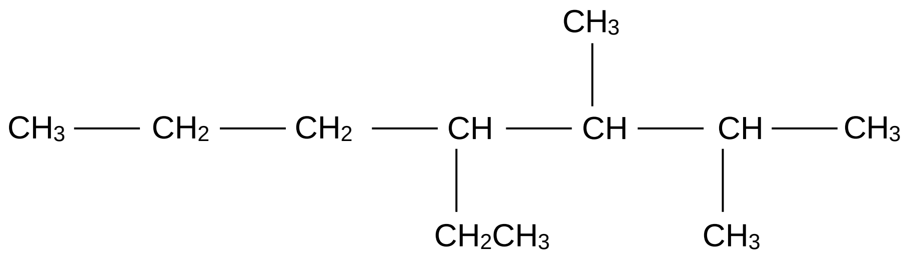
A $C_2HC\ell_3$

B C_4H_8

C C_3H_8

D C_3H_7OH (2)

1.2 The condensed structural formula of an organic compound is indicated below.



Choose the correct IUPAC name for the above compound.

A 3,4-dimethylhexane

B 4-ethyl-2,3-dimethylheptane

C 4-ethyl-5,6-dimethylheptane

D 2,3-dimethyl-4-ethylheptane (2)

1.3 Which ONE of the following reaction types can be used to prepare ethene from octane?

A Cracking

B Addition

C Substitution

D Hydrogenation (2)

1.4 A state of dynamic equilibrium is established in a reaction when the..

A concentration of the reactants is equal to the concentration of the products.

B concentration of the reactants and products remain constant.

C reaction has reached its completion.

D value of the equilibrium constant is equal to zero. (2)

1.5 Consider the following equilibrium reaction:

$$2CrO_4\ (aq) + 2H^+\ (aq) \rightleftharpoons Cr_2O_7^{-2}\ (aq) + H_2O(aq) \qquad \Delta H < 0$$

(yellow) (orange)

Which one of the following changes to the state of equilibrium will cause the colour of the equilibrium solution to turn orange?

A Adding concentrated HCℓ – solution.

B Adding concentrated NaOH – solution.

C Increasing the pressure of the system.

D Increasing the temperature of the system. (2)

1.6 If the [HCℓ] solution is 0,001 mol.dm^{-3}, then the pH-value and the [OH^-] of the HCℓ solution will be ...

	pH – value of HCℓ solution	**[OH^-] mol.dm^{-3}**
A	11	10^{-3}
B	11	10^{-11}
C	3	10^{-11}
D	3	10^{-3}

(2)

1.7 In the reaction **X** + H_2O ⇆ H_3O^+ + HSO_4^-, **X** represents the following:

A acid SO_4^{2-}

B base SO_4^{2-}

C acid H_2SO_4

D base H_2SO_4 (2)

1.8 Which ONE of the following statements regarding the anode of an operating standard galvanic cell is correct?

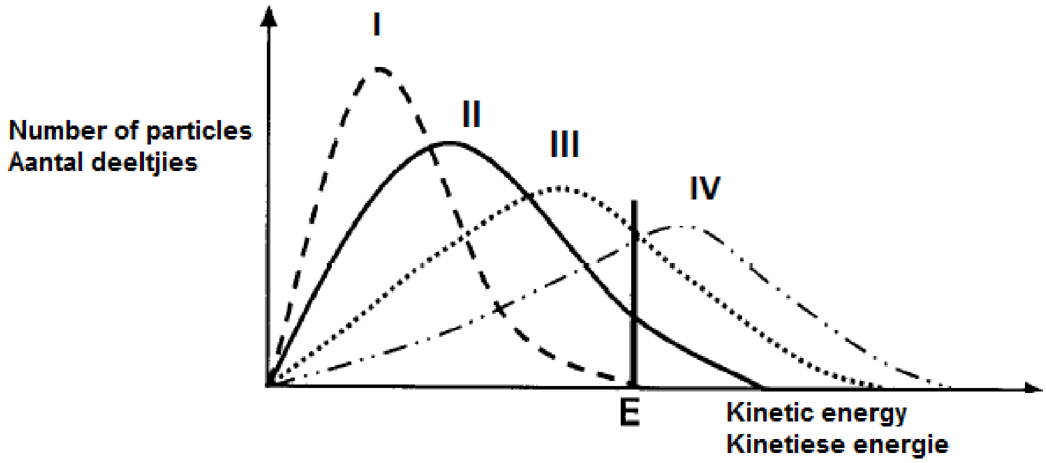
A The anode gains electrons.

B The mass of the anode decreases.

C The concentration of the electrolyte in the half cell that contains the anode decreases initially.

D The anode is the positive terminal of the cell. (2)

1.9 The Maxwell-Boltzmann-energy distribution curve underneath indicates the number of particles as a function of their kinetic energy for a reaction, at four different temperatures. The minimum kinetic energy needed for effective collisions is indicated by E.



Which one of the following curves represent the reaction that take place at the highest temperature?

A I

B II

C III

D IV (2)

1.10 A farmer had the soil tested and is informed that the soil has a shortage of potassium. He is given the choice of four inorganic fertilisers. The four choices are marked as follows:

i)	2: 4 : 1	(30)
ii)	1: 2 : 4	(30)
iii)	4 : 2 : 1	(30)
iv)	2 : 4 : 2	(30)

The fertiliser that best suits the soils nutrient requirements is...

A (i)

B (ii)

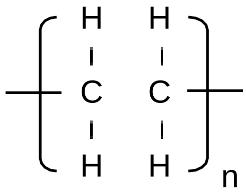
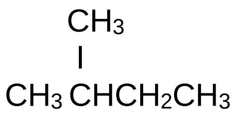
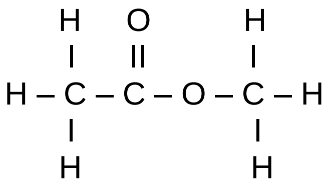
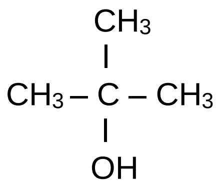
C (iii)

D (iv) (2)

[20]

QUESTION 2 (Start on a new page.)

The letters A to F in the table below represent six organic compounds. Use the information in the table to answer the questions that follow.

A	But-1-ene	**B**	1-bromopentan-2-one	**C**	
D		**E**		**F**	

2.1 Write down the LETTER that represents the following:

2.1.1 A ketone. (1)

2.1.2 A tertiary alcohol (1)

2.1.3 A unsaturated compound (1)

2.2 Write down the IUPAC name of:

2.2.1 compound **D**. (2)

2.2.2 compound **F**. (2)

2.3 Write down the STRUCTURAL FORMULA for the following:

2.3.1 Compound **B** (2)

2.3.2 The functional group for compound **E**. (2)

2.3.3 The monomer used to form compound **C**. (2)

2.3.4 A FUNCTIONAL isomer for compound **B**. (2)

[15]

QUESTION 3 (Start on a new page.)

An experiment is conducted to determine the boiling point of organic compounds with three different homologous series, indicated with letters A to C, determined under the same conditions. The results are given in the table below:

ORGANIC COMPOUND	**MOLECULAR FORMULA**	**BOILING POINT (ºC)**
A	$CH_3CH_2CH_2OH$	+ 97
B	$CH_3CH_2CH_3$	– 42
C	CH_3CH_2CHO	+ 48

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

3.2 Write the name of the homologous series to which **A**, **B** and **C** belong to. (3)

3.3 Formulate an investigative question for this practical investigation. (2)

3.4 Write down the IUPAC name for compound **C**. (1)

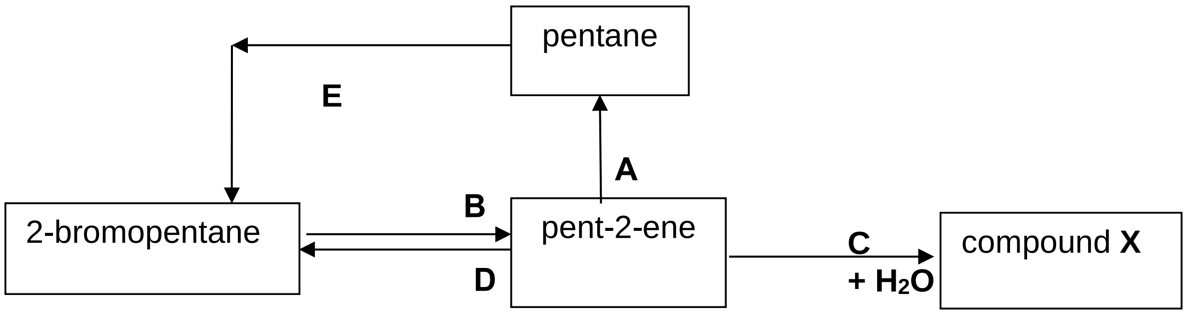
3.5 Fully explain the difference between the boiling point of compound **A** and **B**. (4)

3.6 Which one of the above mentioned compounds will have the highest VAPOUR PRESSURE? Explain your answer. (2)

[14]

QUESTION 4 (Start on a new page.)

The flow diagram illustrates some of the reactions that pent-2-ene undergoes.



Use the information in the flow diagram to answer the questions that follow.

4.1 Name the TYPE of addition reaction that takes place at:

4.1.1 **A** (1)

4.1.2 **C** (1)

4.1.3 **D** (1)

4.2 Name the TYPE of reaction that takes place at E. (1)

4.3 Which reaction conditions are needed so that reaction **B** can take place? (2)

4.4 Write down a balanced chemical equation for reaction **D** using structural formula. (4)

4.5 Write the NAME or SYMBOL for the catalyst used during reaction **A**. (1)

4.6 Write down the CONDENSED STRUCTURAL FORMULA and the IUPAC NAME for compound X. (3)

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QUESTION 5 (Start on a new page.)

5.1 Define the term *reaction rate* in words. (2)

Learners use the reaction between IMPURE POWDERED zinc and excess hydrochloric acid to investigate reaction rate. The balanced equation for the reaction is:

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$$

They perform four experiments under different conditions of concentration, mass and temperature as shown in the table below. They use identical apparatus in the four experiments and measure the volume of gas released in each experiment.

	EXPERIMENT			
	1	**2**	**3**	**4**
Concentration of acid ($mol{\cdot}dm^{-3}$)	1	0,5	1	1
Mass of impure zinc powder (g)	15	15	15	25
Initial temperature of acid (°C)	30	30	40	40

5.2 The results of experiments **1** and **3** are compared in one of these investigation.

Write down the:

5.2.1 Independent variable (1)

5.2.2 dependent variable for this investigation. (1)

5.3 Use the collision theory to explain why the reaction rate in experiment **1** will be higher than that in experiment **2**. (3)

5.4 Experiment 3 and experiment 4 are now compared with each other.

5.4.1 How will the reaction rate of experiment **3** compare to that of experiment **4**? Write down only HIGHER THAN, LOWER THAN or EQUAL TO. (1)

5.4.2 Draw a sketch graph to show the difference between experiment **3** and **4**. Place the volume H_2 gas on the y axis and time on the x axis. No values have to be indicated on the graph. Clearly mark the line graphs as **experiment 3** and **experiment 4**. (4)

5.5 When the reaction in experiment 4 reaches completion, the volume of the gas formed is 8,6 dm^3. Determine the percentage purity of the zinc powder. PLEASE NOTE: The molar gas volume at 40º C is equal to 25,7 dm^3. (NOT 22,4 dm^3) (5)

[17]

QUESTION 6 (Start on a new page.)

Nitrosyl bromide decomposes to form nitrogen(II) oxide and bromide gas according to the balanced equation below:

$$2NOBr\,(g) \rightleftharpoons 2NO\,(g) + Br_2\,(g)$$

55g NOBr is sealed in a 2 dm^3 container and allowed to decompose. At equilibrium 78% of the NOBr has decomposed.

6.1 Calculate the K_c – value for this reaction. (8)

6.2 The same reaction takes place at the **same temperature**, but in a 1 dm^3 container. How will the following be influenced?
(Write only INCREASE, DECREASE or STAY THE SAME.)

6.2.1 K_c value. (2)

6.2.2 Time it takes to reach equilibrium. (2)

6.2.3 The number of moles of Br_2 (2)

6.3 Use Le Chatelier's principle to fully explain your answer in 6.2.3. (3)
[17]

QUESTION 7 (Start on a new page.)

7.1 Ethanoic acid is a weak monoprotic acid.

Give the definition for:

7.1.1 an acid in terms of th Lowry-Brønsted theory. (1)

7.1.2 a weak acid. (2)

7.2 During titration,15 cm^3 of a 0,25 $mol{\cdot}dm^{-3}$ acetic acid solution is neutralised by 20 cm^3 sodium hydroxide solution, according to the following balanced equation below:

$$CH_3COOH(aq) + Na^+(aq) + OH^-(aq) \rightarrow CH_3COO^-(aq) + Na^+(aq) + H_2O(\ell)$$

7.2.1 Write down two conjugate acid base pairs that occurs in this equation. (4)

7.2.2 Which indicator (bromothymol blue or phenolphthalein) is suitable to use in this titration reaction? (1)

7.2.3 Will the pH at the endpoint of the titration be LARGER THAN, SMALLER THAN or EQUAL TO 7? Give a reason for your answer (2)

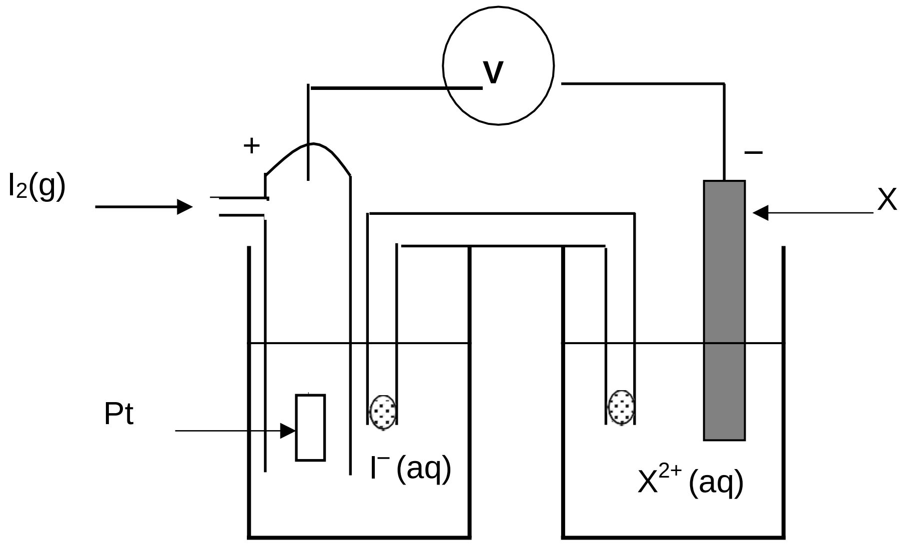
7.2.4 Calculate the concentration of the NaOH solution. (4)

7.2.5 Calculate the pH of the original acetic acid solution. (3)

[17]

QUESTION 8 (Start on a new page.)

A galvanic cell is set up under standard conditions in order to identify an unknown metal X as indicated in the diagram below.
It was found that the mass of metal X decreases as the reaction takes place.



8.1 Which energy conversion takes place in this cell? (2)

8.2 Give TWO functions of the salt bridge. (2)

8.3 Identify metal X if the initial EMF of the cell is 0,82 V. Show how you arrived at the answer. (4)

8.4 Write down the net cell reaction that takes place in this cell. (2)

8.5 Write down the correct cell notation for this cell. (3)

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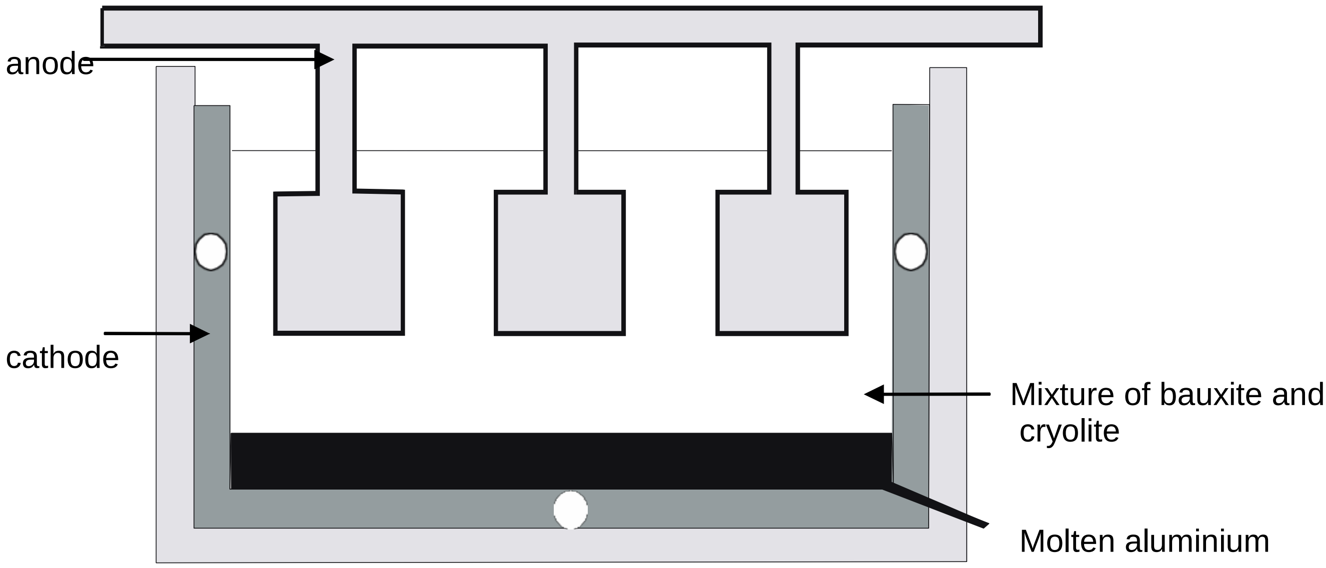
QUESTION 9 (Start on a new page.)

Aluminium oxide is an ionic compound. It is found in the earth's crust as ore and is known as bauxite. The ore contains aluminium oxide. To obtain aluminium the bauxite must be melted and electricity must be passed through it.



9.1 Define the term *electrolytic cell*. (2)

9.2 Why is cryolite added to the bauxite before it is melted? (1)

9.3 Give the symbol of the ions present in the molten aluminium oxide. (2)

9.4 Write down the half reaction that takes place at the cathode. (2)

9.5 Explain why the carbon anode should be replaced regularly. Make use of a chemical reaction to support your answer. (4)

[11]

QUESTION 10 (Start on a new page.)

10.1 In the table below five possible reactions for the fertiliser industry are given.

Reaction I	Methane reacts with steam to form hydrogen.
Reaction II	Hydrogen and nitrogen react in the presence of a catalyst to form ammonia.
Reaction III	Ammonia reacts with oxygen in the presence of a catalyst and form nitrogen oxide and water.
Reaction IV	Sulphur trioxide reacts with sulphuric acid to form oleum. The oleum is diluted to Sulphuric acid.
Reaction V	Ammonia reacts with nitric acid to form a fertiliser.

10.1.1 Write down a balanced chemical equation for Reaction III. Also Give the formula of the catalyst that is used. (4)

10.1.2 What is the name of the industrial process which Reaction II occurs in? (1)

10.1.3 Write down the formula for oleum. (2)

10.1.4 Write down the NAME and FORMULA for the fertiliser that is formed in Reaction V. (2)

10.2 A farmer buys a bag of fertiliser with the following information on it.

20 kg 3:5:2 (30)

Calculate the mass of phosphorous the bag contains. (3)

[12]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1,013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4\ dm^{3}\cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ 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

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	Electronegativity / *Elektronegatiwiteit*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
29	1,9	Cu	63,5

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)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 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	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 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* (↑)

Increasing reducing ability/*Toenemende reduserende 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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓)

Increasing reducing ability/*Toenemende reduserende 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