education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2025

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MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 4 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of NINE 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 the two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
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.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various 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 numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which ONE of the following represents the GENERAL FORMULA for the alcohol?

A C_nH_{2n}

B C_nH_{2n+2}

C $C_nH_{2n}O$

D $C_nH_{2n+2}O$ (2)

1.2 Which ONE of the following organic compounds has the STRONGEST intermolecular forces?

A CH_4

B CH_3CH_2OH

C CH_3COOCH_3

D $CH_3CH_2CH_2CH_3$ (2)

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1.3 Which ONE of the following represents the reaction of ethane with chlorine gas?

A Addition reaction

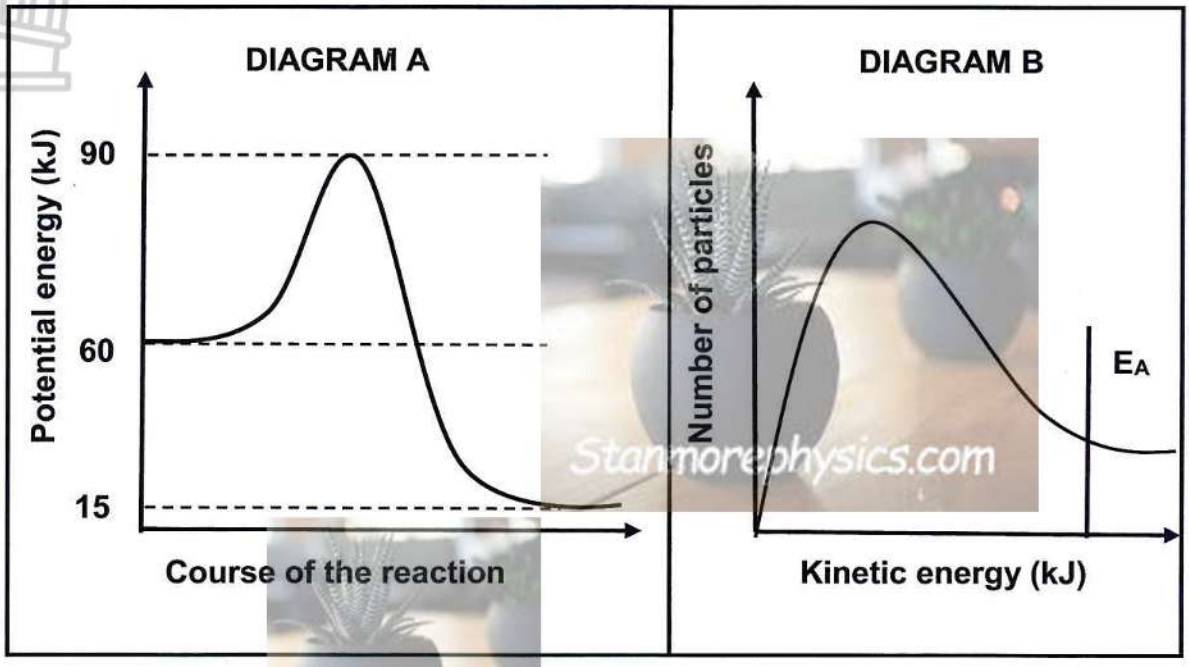
B Hydration reaction

C Hydrolysis reaction

D Substitution reaction (2)

1.4 Consider the following energy diagrams (not drawn to scale) for the reaction between magnesium and hydrochloric acid to investigate the factors affecting the rate of reaction.

$$Mg(s) + 2HC\ell(aq) \longrightarrow MgC\ell_2(aq) + H_2(g)$$



The numerical value represented by the line E_A on the diagram **B** is ...

A 30 kJ

B 45 kJ

C 60 kJ

D 90 kJ (2)

1.5 Consider the following hypothetical reaction in a closed container.

$$A2(g) + 3B2(g) \rightleftharpoons 2AB3(g)$$

Which ONE of the following combinations is CORRECT, when the concentration of the reactants increase?

	RATE OF REACTION	EQUILIBRIUM CONSTANT (K_c)
A	Increases	increases
B	Increases	Remain constant
C	Decreases	Decreases
D	Decreases	Increases

(2)

1.6 Consider the following chemical reaction at equilibrium in a closed container:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The pressure is increased by decreasing the volume of the container while keeping the temperature constant.

Which ONE of the following statements CORRECTLY describes the disturbance above?

A The forward reaction is favoured to decrease the pressure

B The forward reaction is favoured to increase the pressure

C The reverse reaction is favoured to increase the pressure

D The reverse reaction is favoured to decrease the pressure (2)

1.7 The aqueous solution of sodium carbonate, $Na_2CO_3(aq)$, turns red litmus blue.

Consider the following statements:

(i) The $[H^+]$ increases.
(ii) The $[OH^-]$ increases.
(iii) CO_3^{2-} reacts with water.

Which of the above statement(s) is/are TRUE?

A (i) only

B (i) and (ii) only

C (i) and (iii) only

D (ii) and (iii) only (2)

1.8 10 cm^3 of hydrochloric acid of concentration 0,01 $mol \cdot dm^{-3}$ is added to 10 cm^3 ammonium hydroxide of equal concentration according to the following equation:

$$HC\ell(aq) + NH_4OH(aq) \longrightarrow NH_4C\ell(aq) + H_2O(\ell)$$

The pH of the final solution will ...

A not change.

B be equal to 7.

C be lower than 7.

D be greater than 7. (2)

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1.9 Which ONE of the following reactions, when used in a voltaic cell, will give an emf of 2,00 V?

A $Sn^{2+}(aq) + Ni(s) \longrightarrow Ni^{2+}(aq) + Sn(s)$

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

C $2A\ell(s) + 3Cu^{2+}(aq) \longrightarrow 2A\ell^{3+}(aq) + 3Cu(s)$

D $2Cr^{3+}(aq) + 2I^{-}(aq) \longrightarrow 2Cr^{2+}(aq) + I_2(s)$ (2)

1.10 Which ONE of the half reactions below will be the reaction at the CATHODE during the electrolysis of CONCENTRATED SOLUTION of sodium chloride, $NaC\ell(aq)$?

A $Na(s) \longrightarrow Na^{+}(aq) + e^{-}$

B $Na^{+}(aq) + e^{-} \longrightarrow Na(s)$

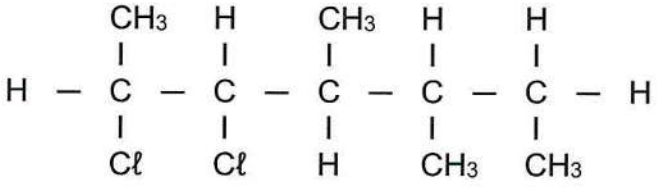
C $C\ell_2(g) + 2e^{-} \longrightarrow 2C\ell^{-}(aq)$

D $H_2O(\ell) + 2e^{-} \longrightarrow H_2(g) + OH^{-}(aq)$ (2)
[20]

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QUESTION 2 (Start on a new page.)

The letters **A** to **G** in the table below represent seven organic compounds.

A	$CH_3CH_2COOCH_3$	**B**	C_3H_8O
C		**D**	3,3-diflourohexane
E		**F**	$CH_3(CH)_2CH_2CH_3$
G	3-methylbutan-2-one		

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

2.2 Write down the STRUCTURAL FORMULA of the FUNCTIONAL GROUP to which compound **A** belongs. (1)

2.3 Write down the:

2.3.1 Letter that represents an UNSATURATED hydrocarbon (1)

2.3.2 IUPAC name of compound **C** (2)

2.3.3 IUPAC name of compound **E** (3)

2.3.4 STRUCTURAL FORMULA of compound **G** (2)

2.3.5 STRUCTURAL FORMULA of compound **D** (2)

2.4 **B** has two STRUCTURAL ISOMERS.

2.4.1 Define the term *structural isomers.* (2)

2.4.2 Write down the IUPAC names of these compounds. (2)

2.5 Write down the NAMES of any two HOMOLOGOUS SERIES that can be FUNCTIONAL ISOMERS. (2)

[19]

QUESTION 3 (Start on a new page.)

The boiling point of four straight chain organic compounds are shown in the table below.

	COMPOUND	MOLECULAR MASS ($g \cdot mol^{-1}$)	BOILING POINT (°C)
A	CH_3COOH	60	118
B	CH_3CH_2COOH	74	141
C	$CH_3CH_2CH_2COOH$	88	163
D	$CH_3CH_2CH_2CH_2COOH$	102	185

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

3.2 Write down the:

3.2.1 Name of the HOMOLOGOUS SERIES to which the compounds belong (1)

3.2.2 Type of Van der Waals forces responsible for the higher boiling point of the organic compounds (1)

3.3 What is the trend of the boiling points of the compounds?

Fully explain the difference in the boiling points of the compounds. (4)

3.4 Which ONE of the compounds, **A**, **B** or **C**, has the lowest vapour pressure?

Explain the answer. (2)

3.5 Write down the IUPAC name of compound **D**. (2)

3.6 The boiling point of compound **D** is compared with an ESTER with the same number of carbon atoms.

Fully explain the difference in the boiling points of these compounds. (4)
[16]

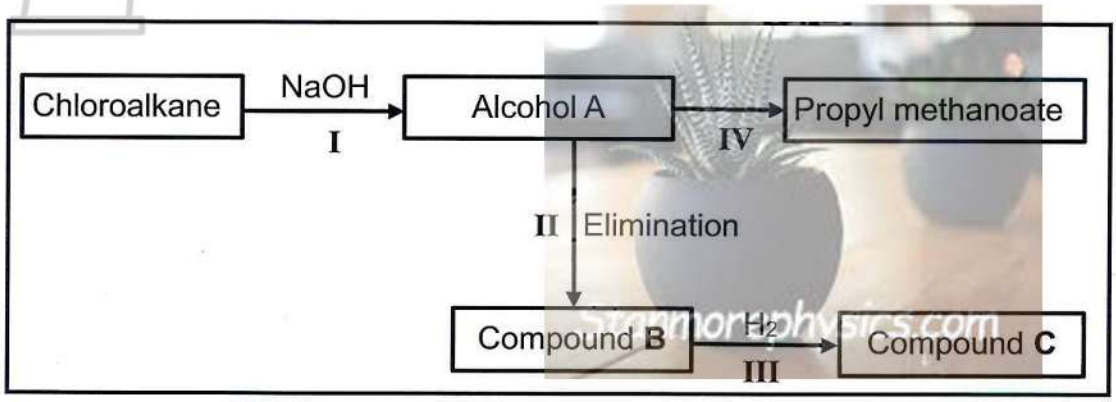
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QUESTION 4 (Start on a new page.)

The flow diagram below shows how a chloroalkane can be used to prepare other organic compounds.

A, B and **C** represent organic compounds.

I, II, III and **IV** represent four organic reactions.



Consider the reaction **I**.

4.1 Write down the:

4.1.1 TYPE of reaction (1)

4.1.2 IUPAC name of the chloroalkane (2)

4.2 Is alcohol **A** primary, secondary or tertiary?

Explain the answer. (3)

Reaction **II** is an elimination reaction.

4.3 Write down the:

4.3.1 TYPE of elimination reaction (1)

4.3.2 Balanced equation using CONDENSED STRUCTURAL FORMULAE for the reaction (3)

4.4 Write down the IUPAC name of Compound **C** formed in reaction **III.** (2)

Consider reaction **IV**.

4.5 Write down the:

4.5.1 NAME or FORMULA of the catalyst used (1)

4.5.2 Balanced equation using STRUCTURAL FORMULAE (4)

[17]

QUESTION 5 (Start on a new page.)

Two experiments, **I** and **II**, are conducted to investigate one of the factors that affects the rate of reaction using the reaction between potassium, K(s) and EXCESS oxygen $O_2(g)$ at a certain temperature.

The balanced equation for the reaction is:

$$4K(s) + O_2(g) \rightarrow 2K_2O(s)$$

The reaction conditions used for each experiment are as follows:

EXPERIMENT **I**

6,92 g of potassium granules react with 4,28g oxygen at 30 °C.

EXPERIMENT **II**

6,92 g of potassium powder react with 4,28g oxygen at 30 °C.

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

5.2 Write down the independent variable for the reaction. (1)

5.3 In which experiment is the reaction rate higher?

Write only Experiment **I** or Experiment **II**. (1)

5.4 Use the COLLISION THEORY to explain the answer in QUESTION 5.3. (3)

7,36 g of potassium oxide is produced when the reaction reaches its completion in EXPERMENT **II** in 5,2 s.

5.5 Calculate the:

5.5.1 Average rate of production of potassium oxide in $g \cdot s^{-1}$ (3)

5.5.2 Percentage purity of potassium (6)

5.6 Is ΔH for the experiments POSITIVE or NEGATIVE?

Explain the answer. (2)

[18]

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QUESTION 6 (Start on a new page.)

The nitrogen dioxide, $NO_2(g)$ decomposes to form Nitric oxide, NO(g) and oxygen, $O_2(g)$ at 330 °C in a 2 dm^3 container.

The reaction reaches equilibrium according to the balanced equation:

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

brown — colourless

6.1 Define the term *chemical equilibrium*. (2)

When the container is cooled down, the reaction mixture turns brown.

6.2 Is the forward reaction EXOTHERMIC or ENDOTHERMIC? (2)

6.3 Use Le Chatelier's principle to explain the answer to QUESTION 6.2. (3)

Initially x moles of $NO_2(g)$ is introduced into the container. At equilibrium the concentration of $NO_2(g)$ is found to be 0,3 $mol \cdot dm^{-3}$. The equilibrium constant, K_c, for the reaction at 330 °C is 0,48.

6.4 Calculate the initial number of moles of $NO_2(g)$. (8)
[15]

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QUESTION 7 (Start on a new page.)

7.1 A learner prepares a standard solution by dissolving 4 g of sodium hydroxide, NaOH in 500 cm^3 of water.

7.1.1 Define the term *standard solution*. (2)

7.1.2 Calculate the concentration of the sodium hydroxide solution. (4)

The learner uses the above standard solution to find the concentration of hydrochloric acid.

In one of the titrations exactly 30 cm^3 of sodium hydroxide, NaOH neutralises 35 cm^3 of hydrochloric acid, HCℓ.

The balanced equation for the reaction is:

$$HC\ell(aq) + NaOH(aq) \longrightarrow NaC\ell(aq) + H_2O(\ell)$$

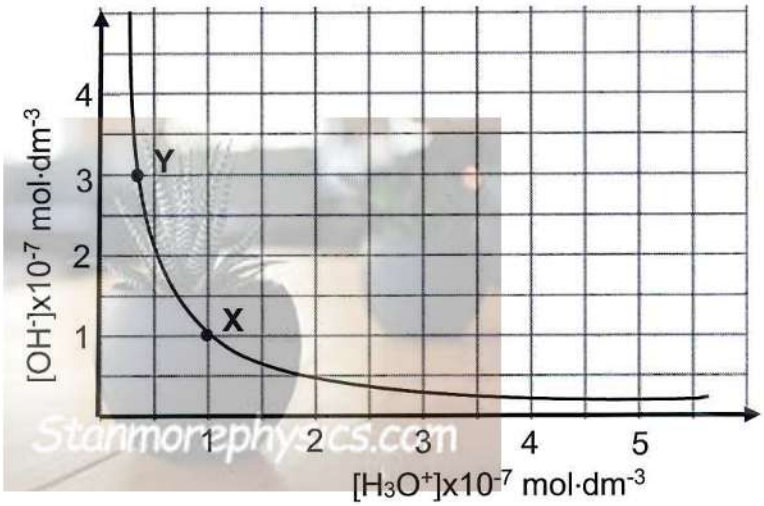
7.1.3 Calculate the concentration of HCℓ. (4)

7.1.4 Will the salt formed in the above reaction undergo HYDROLYSIS?

Write YES or NO.

Give a reason for the answer. (2)

7.2 The graph below shows pairs of $H_3O^+(aq)$ and $OH^-(aq)$ ion concentrations that can exist together at equilibrium in water at 25 °C.



7.2.1 Is the compound at point **X**, ACIDIC, BASIC or NEUTRAL?

Give a reason for the answer. (2)

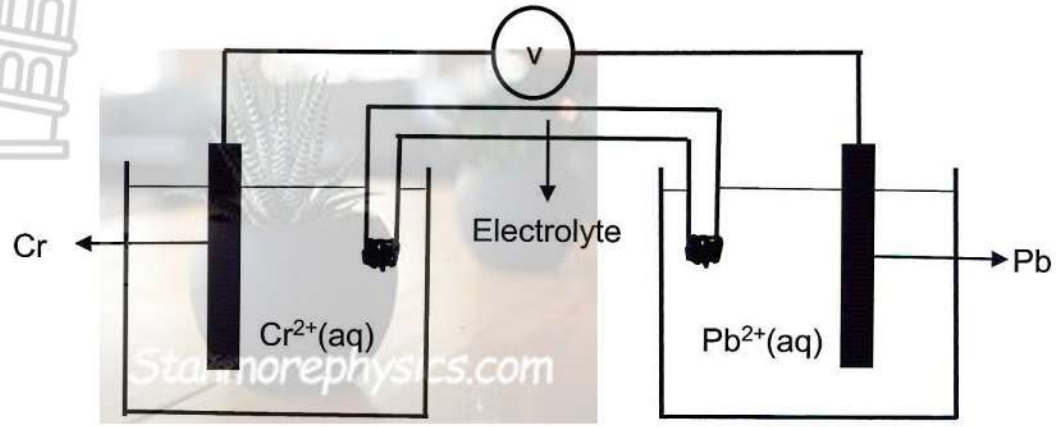
7.2.2 Calculate the pH of the compound at point **Y**. (5)

[19]

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QUESTION 8 (Start on a new page.)

The electrochemical cell is set up under standard conditions using two half cells. The simplified diagram of the cell is shown below.



8.1 State the standard conditions under which the cell functions. (2)

8.2 Write down the NAME or FORMULA for the electrolyte used in the salt bridge. (1)

8.3 Define the term *cathode*. (2)

8.4 Write down the half reaction that takes place at the CATHODE. (2)

8.5 Calculate the initial emf of the cell. (4)

8.6 Write down the cell notation of the above cell. (3)

8.7 How will the concentration of Cr^{2+} be affected as the cell goes flat.

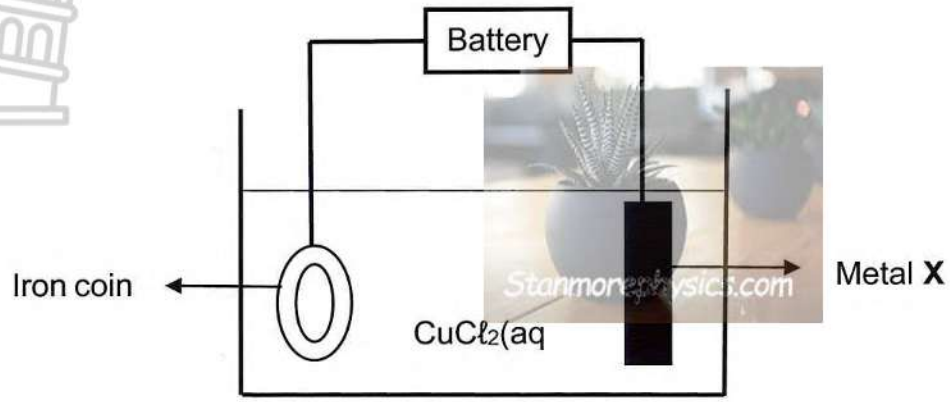
Choose from INCREASE, DECREASE or REMAIN THE SAME.

Give a reason for the answer. (2)
[16]

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QUESTION 9 (Start on a new page.)

The simplified diagram below represents the cell used for electroplating the iron coin with metal **X**.



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

9.2 Write down the NAME or FORMULA of metal **X**. (1)

9.3 Which electrode is POSITIVE?

Write only X or coin. (2)

Give a reason for the answer. (2)

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

The two electrodes in the above electrolytic cell are replaced with carbon electrodes.

9.5 Write down the balanced equation for the reaction that takes place in the new cell. (3)

[10]

TOTAL: 150

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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* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$		

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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																	**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	**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	**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	**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	**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*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit*

Symbol *Simbool*

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

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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 strength of oxidising agents/*Toenemende sterkte van oksideermiddels*

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

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

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	$\rightleftharpoons$	Li	− 3,05
$K^+ + e^-$	$\rightleftharpoons$	K	− 2,93
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	− 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	− 2,90
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	− 2,89
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	− 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	− 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,36
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,91
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	− 0,74
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	− 0,44
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	− 0,40
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	− 0,28
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	− 0,27
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	− 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	− 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	− 0,06
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+1,77
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

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Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels ↓

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels ↑

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