education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

JUNE 2024

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 4 datasheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of EIGHT 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 sub-questions, 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.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 Which ONE of the following compounds belongs to the same homologous series as an ester?

A CH_3COCH_3
B $CH_3CH_2CH_2OH$
C CH_3COOCH_3
D CH_3CH_2CHO (2)

1.2 Molecules with the same molecular formulae, but different types of chains are called ...

A positional isomers.
B chain isomers.
C structural isomers.
D functional isomers. (2)

1.3 Consider the reaction represented below.

$$CH_3CH_2CHBrCH_3 + H_2O \longrightarrow CH_3CH_2CHOHCH_3 + HBr$$

Which ONE of the following CORRECTLY gives the type of reaction that takes place and its reaction conditions?

	TYPE OF REACTION	REACTION CONDITIONS
A	Addition	Excess H_2O + acid as catalyst
B	Addition	Pt, Pd or Ni as catalyst
C	Substitution	Dilute strong base + mild heat
D	Substitution	Excess H_2O + mild heat

(2)

1.4 The activation energy for a certain reaction is 70 kJ.mol⁻¹. Energy is released when this reaction takes place.

Which ONE of the following is correct for the reverse reaction?

	ACTIVATION ENERGY (E_A)	HEAT OF REACTION (ΔH)
A	$E_A < 70\ kJ.mol^{-1}$	$\Delta H > 0$
B	$E_A < 70\ kJ.mol^{-1}$	$\Delta H < 0$
C	$E_A > 70\ kJ.mol^{-1}$	$\Delta H < 0$
D	$E_A > 70\ kJ.mol^{-1}$	$\Delta H > 0$

(2)

1.5 The following reaction has reached equilibrium in a closed container at a temperature of 359 K:

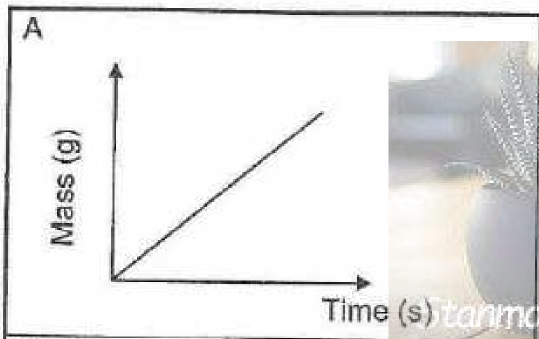
$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) + \text{energy}$$

Which ONE of the following will increase the equilibrium concentration of NH_3?

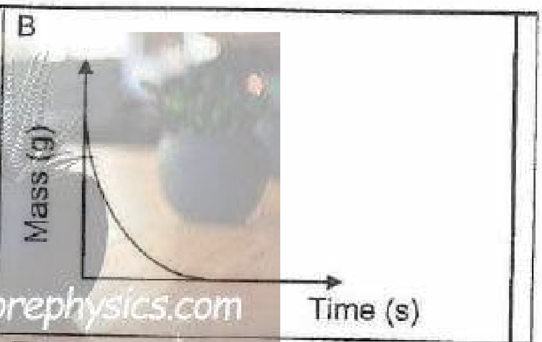
A Add a catalyst.
B Remove NO(g) from the container.
C Increase the volume of the container.
D The temperature is increased to 400 K. (2)

1.6 Which ONE of the following graphs shows the mass of a catalyst against time at the end of the chemical reaction?

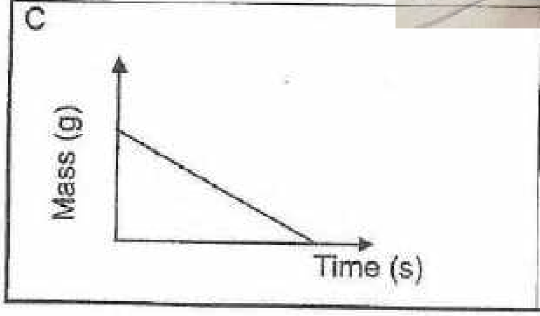
A



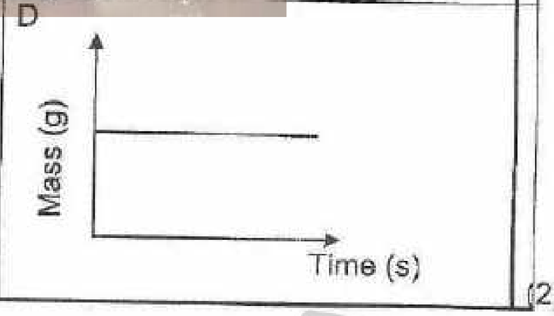
B



C



D



(2)

1.7 At a temperature of 150°C substances A(g) and B(s) are placed in a closed container. The concentration of A(g) is 0,0002 $mol.dm^{-3}$ at equilibrium.
Equal amounts of P(g) and Q(g) are formed.
The Kc value = 0,123
The equilibrium concentrations of P and Q will be ...

A $1,57 \times 10^{-2} mol.dm^{-3}$
B $2,46 \times 10^{-4} mol.dm^{-3}$
C $1,23 \times 10^{-4} mol.dm^{-3}$
D $4,92 \times 10^{-4} mol.dm^{-3}$ (2)

1.8 Which ONE of the following is a conjugate acid-base pair in the following reaction?

$$CH_3COOH + NH_3 \longrightarrow CH_3COO^- + NH_4^+$$

	ACID	CONJUGATE BASE
A	NH_3	NH_4^+
B	CH_3COO^-	NH_4^+
C	CH_3COOH	NH_3
D	CH_3COOH	CH_3COO^-

(2)

1.9 A weak acid HA dissociates in aqueous solution as shown below.

$$HA(aq) \leftrightharpoons H^+(aq) + A^-(aq) \qquad \Delta H = +20 \ kJ \cdot mol^{-1}$$

Which ONE of the following changes will result in an increase in the $[H^+]$ of the solution?

A Addition of a little aqueous sodium hydroxide solution
B Raising the temperature of the solution
C Dissolving a little of the sodium salt,NaA, in the solution.
D Adding a catalyst to the solution (2)

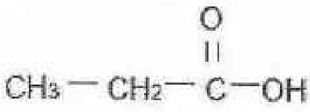
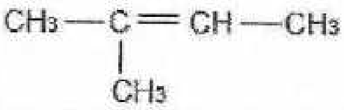
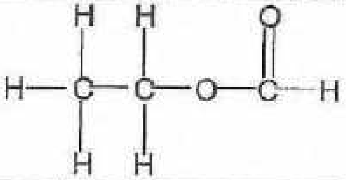
1.10 Which ONE of the following solutions has the HIGHEST pH value?

A $0,1 \ mol \cdot dm^{-3} \ Mg(OH)_2$
B $0,1 \ mol \cdot dm^{-3} \ NH_3$
C $0,1 \ mol \cdot dm^{-3} \ HCl$
D $0,1 \ mol \cdot dm^{-3} \ H_2SO_4$

(2)
[20]

QUESTION 2 (Start on a new page)

Study the following organic compounds, represented by the letters **A** to **I** in the table below:

A	2-methylpropane	**F**	 $CH_3-CH_2-\overset{\overset{O}{\|\|}}{C}-OH$
B	Butane	**G**	 $CH_3-\underset{\underset{CH_3}{\|}}{C}=CH-CH_3$
C	C_2H_3Br	**H**	$HC=CH$
D	Butan-1-ol	**I**	
E	Butan-2-ol		

2.1 Write down the letter(s) that represent(s) the following:

2.1.1 Two compounds that are CHAIN ISOMERS. (1)

2.1.2 A PRIMARY alcohol. (1)

2.1.3 A weak MONOPROTIC ACID (1)

2.2 Compound **G** is a hydrocarbon.

2.2.1 Define the term *hydrocarbon*. (2)

2.2.2 Is compound **G** SATURATED or UNSATURATED?

Give a reason for your answer. (3)

2.2.3 Write down the IUPAC name of compound **G**. (2)

2.3 Write down the NAME of the homologous series to which compound **C** belongs. (2)

2.4 Compound **I** is the product of an esterification reaction.

Write down the:

2.4.1 IUPAC name for compound **I** (2)

2.4.2 STRUCTURAL FORMULA of the alcohol from which compound **I** is synthesized (2)

2.4.3 IUPAC name of the carboxylic acid from which **it** is synthesized (2)

2.5 The table contains compounds which are functional isomers.

2.5.1 Define the term *functional isomers*. (2)

2.5.2 Write down the LETTERS that represent two compounds that are functional isomers. (2)
[22]

QUESTION 3 (Start on a new page.)

A student performs an experiment to compare the boiling points of organic compounds belonging to different homologous series.
Butan-1-ol, butanoic acid and butanal are used.
He then recorded the results on the table given below.

Name	Boiling point (^{0} C)
Compound A	76
Compound B	118
Compound C	164

3.1 Define the term *vapour pressure* (2)

3.2 For this experiment give the:

3.2.1 Independent variable (1)

3.2.2 Dependent variable (1)

3.3 Is the boiling point of butan-1-ol HIGHER or LOWER than the boiling point of propan-1-ol? Explain the answer by referring to the INTERMOLECULAR FORCES. (3)

3.4 Write down the STRUCTURAL FORMULA for the FUNCTIONAL group of:

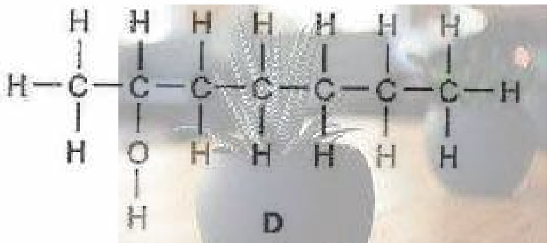
3.4.1 Compound **A** (2)

3.4.2 Compound **C** (2)

3.5 Is the vapour pressure of butanal be LOWER or HIGHER than the vapour pressure of butan-1-ol? Explain your answer by referring to the type of INTERMOLECULAR FORCES present and ENERGY. (4)
[15]

QUESTION 4 (Start on a new page)

Consider the following organic reactions **I** to **IV** involving organic compounds **A** to **E**.

I	$A + Br_2 \xrightarrow{\text{UV light}} B + HBr$
II	B + concentrated alcoholic KOH $\rightarrow C + KBr + H_2O$
III	$C + H_2O \xrightarrow{\text{Dilute } H_3PO_4}$  **D**
IV	$A \xrightarrow[\text{Catalyst}]{600\ (^0C)} C_4H_{10} + E$

4.1 For the above reactions, write down the type of:

4.1.1 Reaction **I** (1)

4.1.2 Reaction **III** (1)

4.1.3 Reaction **IV** (1)

4.2 Write down the IUPAC name for compound **D**. (2)

4.3 Write the molecular formula for each of the following:

4.3.1 Compound **A** (2)

4.3.2 Compound **E** (2)

4.4 Draw the structural formula of compound **B**. (2)

4.5 Write down the balanced chemical equation for complete COMBUSTION of C_4H_{10} using MOLECULAR FORMULAE. (3)

4.6 For Reaction **II**

4.6.1 Draw the STRUCTURAL FORMULA of compound **C** (2)

4.6.2 State TWO reaction conditions. (2)

[18]

QUESTION 5 (Start on a new page.)

5.1 A group of learners uses the reaction of hydrochloric acid with magnesium ribbon to investigate the factors that influence rate of reaction.

The balanced equation for the reaction is given below:

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

The hydrochloric acid is in EXCESS, and the same mass of magnesium is used in ALL the experiments.

Experiment	REACTION CONDITIONS			
	Concentration of HCℓ(ag)(mol.dm^{-3})	Temperature (^{0}C)		State of division of 0,24g Magnesium
		Before	After	
1	2	35	57	Powder
2	2	30	48	Ribbon
3	2	20	33	Ribbon
4	1,5	30	45	Ribbon

5.1.1 Define the term *rate of reaction*. (2)

5.1.2 In which experiment is the reaction rate HIGHEST? Explain your answer. (3)

5.2 The reaction in Experiment 2 is compared to the reaction in Experiment 4.

5.2.1 Write down ONE control variable for this comparison. (1)

5.2.2 How does the amount of hydrogen gas produced in Experiment 2 compare to the amount produced in Experiment 4 if the same volume of acid is used in both experiments?

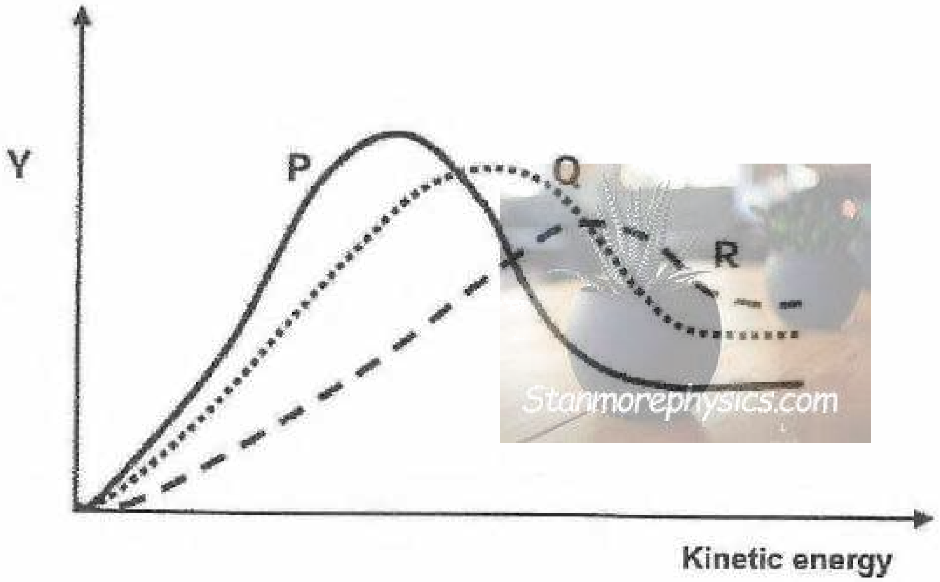
Write down only HIGHER THAN, SMALLER THAN or EQUAL TO.

Give a reason for your answer. (2)

5.3 Give a reason why it is not a fair test to compare the rate of reaction of Experiment 1 with that of Experiment 3. (1)

5.4 Calculate the mass of hydrochloric acid that remains in the flask at the completion of the reaction in Experiment 1 if the initial volume of the hydrochloric acid is 80 cm^3. (7)

5.5 The Maxwell-Boltzman distribution curves labelled **P**, **Q** and **R** for the reactions in experiments **1**, **2** and **3** in random order are shown below.



5.5.1 Write down the name of the label, **Y**, on the vertical axis. (1)

5.5.2 Which curve (**Q**, **P** or **R**) represents the results of Experiment **3**? (1)

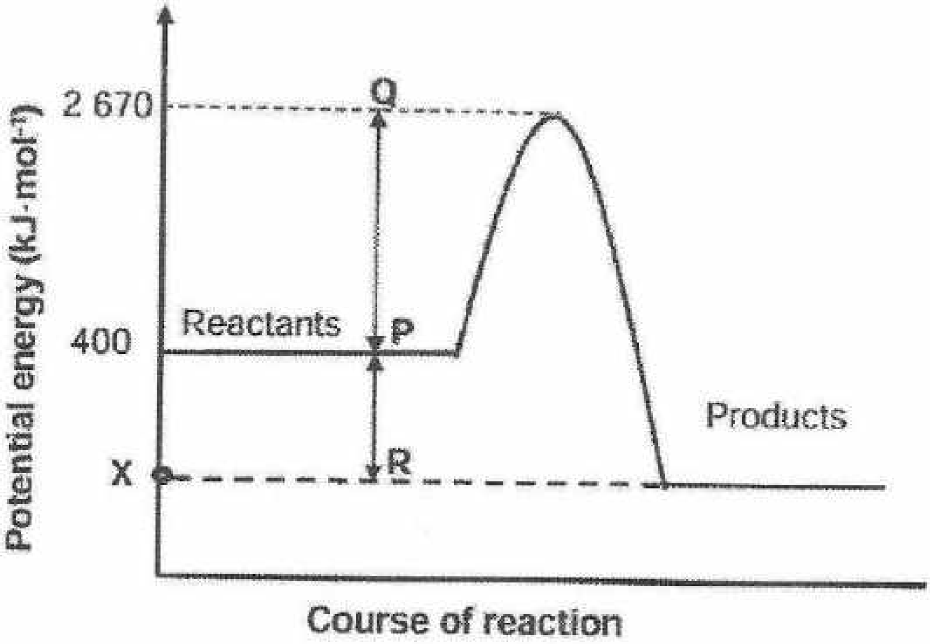
5.5.3 With the aid of the collision theory explain the effect of TEMPERATURE on reaction rate. (4)
[22]

QUESTION 6 (Start on a new page)

Consider the following balanced chemical equation:

$CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(\ell)$ $\Delta H = -216,7\ kJ\cdot mol^{-1}$

The graph below shows the potential energy against the course of this reaction.



6.1 Define the term *activation energy*. (2)

6.2 Is the reaction Endothermic or Exothermic? Give a reason for the answer. (3)

6.3 What do the following sections of the graph represents?

6.3.1 **RP** (1)

6.3.2 **QP** (1)

6.4 Determine BY CALCULATION the value of **X**. (3)

6.5 What effect will the addition of suitable catalyst to the reaction mixture have on the activation energy of the reaction? Choose from INCREASES, DECREASES or NO EFFECT. (1)

[11]

QUESTION 7 (Start on a new page.)

Consider the reaction represented by the balance equation below.

$$4HC\ell(g) + O_2(g) \rightleftharpoons 2H_2O(g) + 2C\ell_2(g) \quad \Delta H < 0$$

Initially 1,5 mole of $HC\ell(g)$ and 2 mole of $O_2(g)$ were mixed in a sealed 5 dm^3 container which had 18g of $H_2O(g)$. The reaction reached equilibrium after 20 minutes at 600°C and 0,6 mole of $C\ell_2(g)$ was present in the container.

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

7.2 How does the rate of forward reaction compare to the rate of the reverse reaction after 10 minutes? Choose from HIGHER THAN, LOWER THAN or EQUAL TO. (1)

7.3 Calculate the value of Kc at 600°C (8)

7.4 State *Le Chatelier's principle* (2)

7.5 The volume of the container is now decreased to 2,5 dm^3 while the temperature is kept constant.
How will each of the following be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME.

7.5.1 The value of Kc (1)

7.5.2 The mass of $C\ell_2(g)$ in the container. (1)

7.6 Explain your answer to QUESTION 7.5.2 by referring to *Le Chatelier's Principle* (2)

7.7 The temperature of the container is now increased, and equilibrium is re-established

7.7.1 How does the new value of Kc at this temperature compare to the one obtained at 600°C? Choose from HIGHER THAN, LOWER THAN or EQUAL TO (1)

7.7.2 Explain the answer to QUESTION 7.7.1 by referring to *Le Chatelier's Principle* (2)
[20]

QUESTION 8 (Start on a new page.)

A group of learners use 35 cm^3 standard solution of 0,1 $mol.dm^{-3}$ sodium hydroxide solution to standardize an oxalic acid solution of volume 40 cm^3.
At the endpoint, 12 cm^3 of the sodium hydroxide remains unreacted.

8.1 Define a *standard* solution (2)

The net ionic equation is given below:

$$C_2H_2O_4 + 2OH^- \rightleftharpoons C_2O_4^{2-} + 2H_2O$$

8.2 Identify the conjugate acid-base pairs. (4)

8.3 Is oxalic acid a weak or a strong acid? Explain the answer (3)

8.4 H_2CO_3 undergoes ionisation in a TWO step process as shown below:

I $H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$

II $HCO_3^- + H_2O \rightleftharpoons X + H_3O^+$

8.4.1 Identify a substance in the above reactions that can act as an *ampholyte*. (2)

8.4.2 Write down the formula of the substance(s) that is represented by **X** in reaction **II.** (2)

8.5 A sulphuric acid solution is prepared by dissolving 5,25 g of H_2SO_4 in 250 $cm^3$of water.

Calculate the following:

8.5.1 The number of moles of sulphuric acid in the original standard solution. (4)

8.5.2 pH of the solution. (5)

[22]

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 electron*	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* $c=\frac{m}{MV}$	$n=\frac{V}{V_m}$
$\frac{c_aV_a}{c_bV_b}=\frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ 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* $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	
$n = \frac{Q}{e}$ $n = \frac{Q}{q_e}$	
$q = I\Delta t$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

29 1,9 Cu 63,5

Atomic number / *Atoomgetal*

Electronegativity / *Elektronegatiwiteit*

Symbol / *Simbool*

Approximate relative atomic mass / *Benaderde relatiewe atoommassa*

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

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* ↓

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* ↑