SOUTH AFRICAN COMPREHENSIVE ASSESSMENT INSTITUTE

SUID-AFRIKAANSE KOMPREHENSIEWE ASSESSERINGSINSTITUUT

PHYSICAL SCIENCES

2021

GRADE 12 PRELIMINARY EXAMINATION

PAPER 2

TOTAL: 150

TIME: 3 hours

This question paper consists of 22 pages.

PHYSICAL SCIENCES

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INSTRUCTIONS AND INFORMATION

1. This paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this paper.
4. Leave ONE line between two subsections, e.g. between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions etc. where required.
10. You are advised to use the attached INFORMATION SHEETS (see p. 17-22).
11. 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 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question only has ONE correct answer.

1.1 The type of intermolecular forces found between the molecules of ethanoic acid.

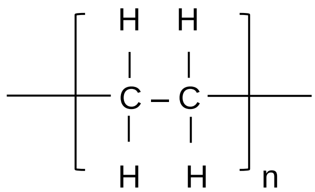
A Dipole-dipole forces

B London forces

C Hydrogen bonding

D Carbonile bonding (2)

1.2 The given formula is the product of this sort of reaction...



A Addition

B Elimination

C Substitution

D Polymerisation (2)

1.3 Which one of the following reactants will produce an alkaline solution as product of a hydrolysis reaction?

A Sodium hydroxide and carbonic acid

B Hydrochloric acid and ammonia

C Hydrochloric acid and sodium hydroxide

D Sulphuric acid and potassium hydroxide (2)

1.4 Consider the following conditions:

i 1 $mol.dm^{-3}$
ii 25 ˚C
iii 1 atmosphere
iv 101,3 kPa
v 298 K

Which one of the following combinations represent standard conditions for electrochemical cells?

A i, iii and v

B i, ii and iv

C All of the above

D i, ii and iii (2)

1.5 H_2SO_4 is the product of this process...

A Fractional distillation

B Contact process

C Haber process

D Ostwald process (2)

1.6 Decane is broken down into two more useful products, ethene and octane, at 500 ˚C in the presence of a platinum catalyst. This reaction is an example of...

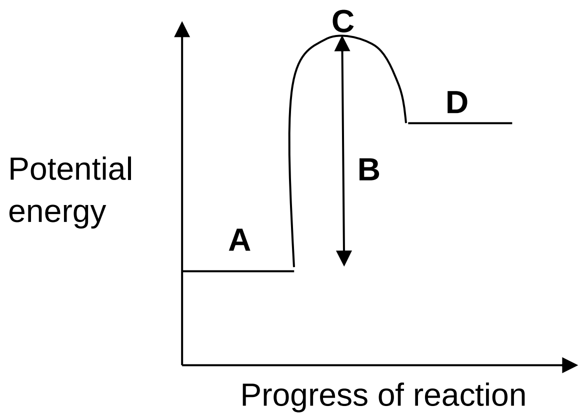
A Dehydration

B Cracking

C Hydrogenation

D Hydrolysis (2)

1.7 Consider the following energy profile:



Which one of the following statements is NOT true?

A **A** represents the reactants and **D** represents the products.

B **B** represents the activation energy.

C This reaction is exothermic.

D **C** represents the activated complex. (2)

1.8 Which of the following compounds are positional isomers?

A But-2-ene and methylpropene

B Butane and 2-methyllpropane

C Propanoic acid and methyl methanoate

D Pentane and 2-methylbutane (2)

1.9 Consider the following cell notation:

$$Pt \mid C\ell(aq) \mid C\ell(g) \parallel F_2(g) \mid F(aq) \mid Pt$$

The oxidising agent in this electrolytical cell is...

A Pt

B $F_2(g)$

C $C\ell(aq)$

D $C\ell(g)$ (2)

1.10 The following information appears on a bag of fertiliser:

2:3:2 (22)

Which one of the following conclusions is correct?

A There is 28,6 % nitrogen in the fertiliser.

B There is 9,43% phosphorus in the fertiliser.

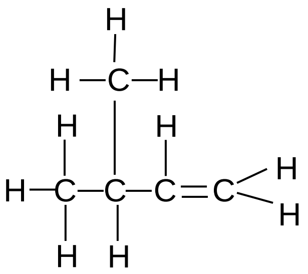
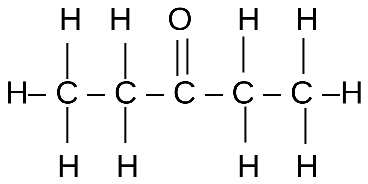
C There is 9,10% potassium in the fertiliser.

D 22% of the bag consists of fillers. (2)

[20]

QUESTION 2

The letters **A** to **E** in die table below represent five organic compounds.

A		**B**	
C	Butane	**D**	CH_3CH_2OH
E	Pentanal		

2.1 Write down the LETTER that represents the following:

2.1.1 An aldehyde (1)

2.1.2 A compound with the general formula C_nH_{2n} (1)

2.1.3 A functional isomer of compound **E** (1)

2.2 Write down the IUPAC name for compound **A**. (2)

2.3 Write down the balanced equation for the oxidation reaction between compound **C** and an excess oxygen. (3)

2.4 Compound **D** reacts with pentanoic acid to form an organic and an inorganic product.

2.4.1 What is this type of reaction called? (1)

2.4.2 Write down the molecular formula of the inorganic substance that catalyses this reaction. (1)

2.4.3 Write down the STRUCTURAL FORMULA of the organic product that forms during this reaction. (2)

2.4.4 Write down the IUPAC name of the organic product that forms during this reaction. (2)

[14]

QUESTION 3

The boiling point of six organic compounds that belong to two different homologous series, is given in the table below.

	Name of organic compound	**Boiling point (˚C)**
A	Propane	-42
B	Propanol	97
C	Butane	-0,5
D	Butanol	**X**
E	Pentane	36
F	Pentanol	138

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

3.2 Explain the difference in the boiling points of compounds **E** and **F**. (3)

3.3 Write down the letter of the organic compound with the highest vapour pressure. Use the information in the table to explain your answer. (3)

3.4 Compound **D** has an unknown boiling point.

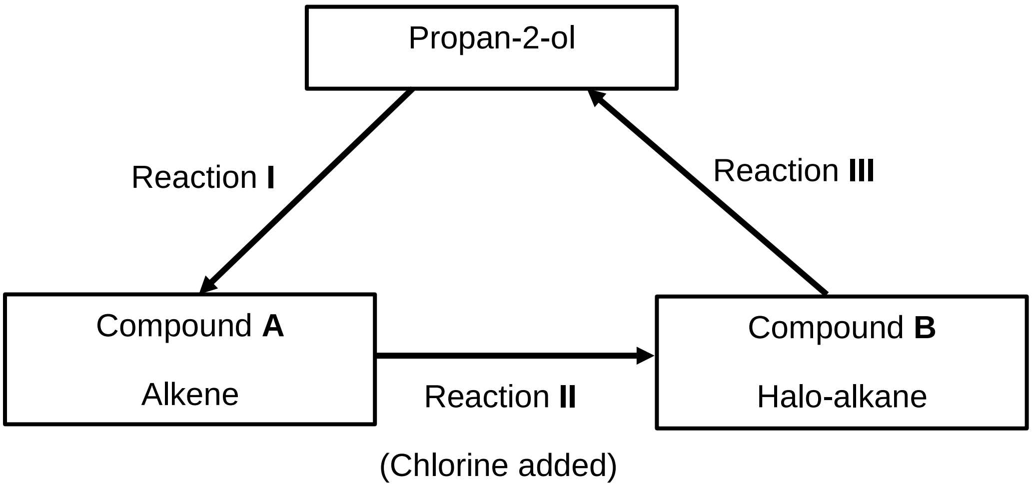
3.4.1 How will the boiling point of compound **D** compare with the boiling point of compound **B**? Choose between: LOWER THAN, HIGHER THAN or THE SAME AS. (1)

3.4.2 Explain your answer in QUESTION 3.4.1 (3)

[12]

QUESTION 4

The flow diagram below shows the preparation of different organic compounds.



4.1 For Reaction **I**:

4.1.1 Name the type of elimination reaction represented by reaction I. (1)

4.1.2 Name the acid that catalyses this reaction. (1)

4.1.3 Name the inorganic product that forms during this reaction. (1)

4.1.4 Write down the STRUCTURAL FORMULA for compound **A** that forms during this reaction. (2)

4.1.5 Write down the IUPAC name for compound **A**. (1)

4.2 For Reaction **II**:

4.2.1 Name the type of addition reaction represented by reaction II. (1)

4.2.2 Write down the STRUCTURAL FORMULA for compound **B** that forms during this reaction. (2)

4.2.3 Write down the IUPAC name for compound **B**. (2)

4.3 For Reaction **III**:

4.3.1 Name the type of reaction represented by reaction III. (1)

4.3.2 Write down two reaction conditions for this reaction. (2)

[14]

QUESTION 5

An excess sodium hydrogen carbonate (baking soda) reacts with ethanoic acid (vinegar) according to the following balanced equation:

$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

This reaction is used to investigate the factors that influence reaction rate. The experiment is repeated under different circumstances and the reaction conditions are summarised in the table below.

Experiment	Volume vinegar (cm^3)	Mass baking soda (g)	Temperature of vinegar (˚C)
I	20	10	40
II	20	10	60

5.1 Define *reaction rate*. (2)

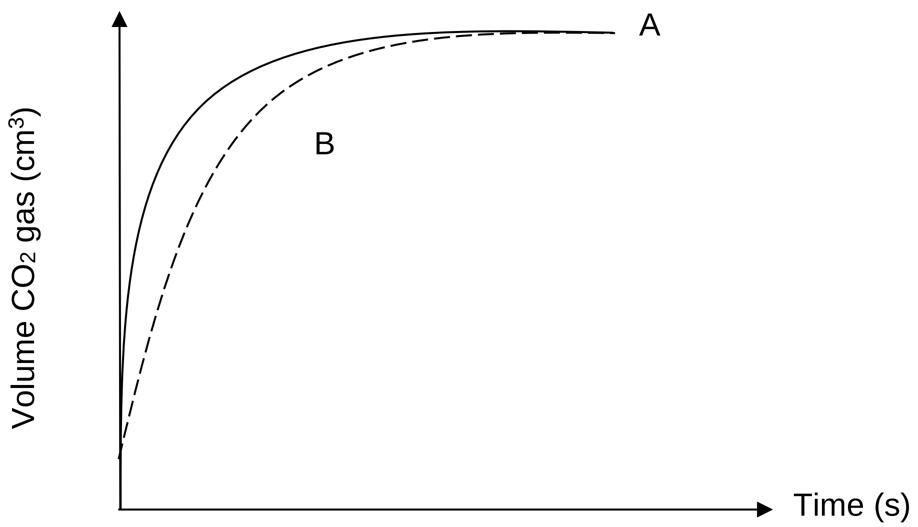
5.2 For this investigation, write down the:

5.2.1 Investigative question (2)

5.2.2 Independent variable (1)

5.2.3 Dependant variable (1)

The carbon dioxide gas, CO_2(g), that forms during this reaction, gets collected in a gas syringe for each of the experiments. The volume of gas that is collected, gets measured every 30 seconds and the results are shown in the graph below.



5.3 5.3.1 Which graph (**A** or **B**) represents experiment I? (1)

5.3.2 Use the collision theory to explain the trend seen in the graphs for the two experiments. (3)

5.4 If experiment I gets repeated again, but this time in the presence of a catalyst, how would the new reaction rate compare with the original reaction rate? Choose between: HIGHER THAN, LOWER THAN or THE SAME. (1)

The experiment is repeated again with the same volume of vinegar (ethanoic acid) and the same mass of baking soda (sodium hydrogen carbonate) that was used in experiments I and II. The ethanoic acid used, has a concentration of 2,5 $mol.dm^{-3}$.

5.5 Calculate the mass of the sodium hydrogen carbonate that will be present in the flask at the end of the reaction. (5)

[16]

QUESTION 6

0,8 moles of hydrogen gas and 0,8 moles of carbon dioxide gas gets injected into a 5 dm^3 flask and the reaction reaches equilibrium at 1650 ˚C. The balanced equation for this reaction is:

$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g) \qquad \Delta H = +41,2\ kJ.mol$$

6.1 State *Le Chatelier's principle* in words. (2)

6.2 Is this reaction endothermic or exothermic? (1)

6.3 How will the following changes influence the amount of moles CO(g) present at equilibrium?

Choose from: INCREASE, DECREASE or STAY THE SAME

6.3.1 Pressure increases (1)

6.3.2 Temperature decreases (1)

6.3.3 Explain your answer to QUESTION 6.3.2 according to Le Chatelier's principle. (3)

6.4 Draw a simple, labelled graph to show the reaction rate versus time for this reaction. (3)

6.5 When equilibrium is reached, there are 0,55 moles of CO(g) in the flask. Calculate the equilibrium constant K_c for this reaction at the given temperature. (7)

[18]

QUESTION 7

During an acid-base titration 20 cm^3 diluted hydrochloric acid with a concentration of 0,4 $mol.dm^{-3}$ is needed to neutralise a sodium carbonate solution with a volume of 16 cm^3.

7.1 Write down a balanced equation for this reaction. (3)

7.2 Is diluted hydrochloric acid a strong acid or a weak acid? Explain your answer. (2)

7.3 What is an ampholyte?
Which substance in the balanced equation in QUESTION 7.1 is an example of an ampholyte? (2)

7.4 Which solution in this titration is the standard solution? (1)

7.5 Suggest an indicator that can be used during this titration. (1)

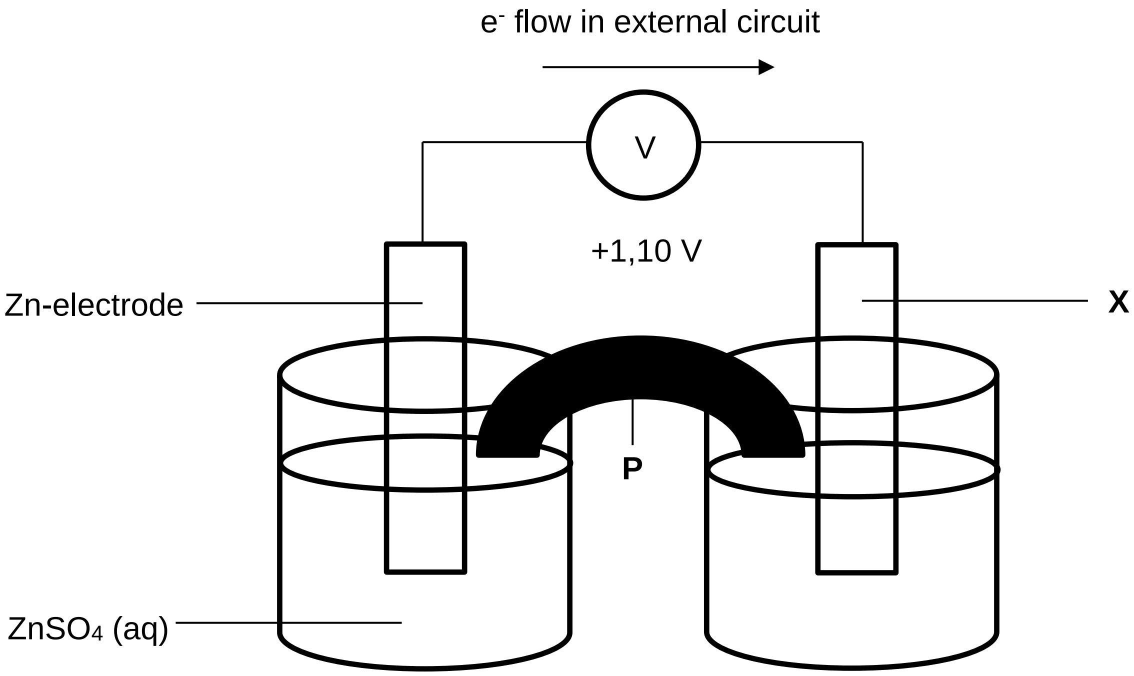
7.6 Calculate the mass of sodium carbonate crystals in grams that had to be diluted to obtain the exact concentration and volume needed for this titration. (7)

7.7 Calculate the pH of the 0,4 $mol.dm^{-3}$ hydrochloric acid used in this titration. (3)

[19]

QUESTION 8

Study the following diagram of an electrochemical cell.



8.1 Is this cell a galvanic cell or an electrolytic cell? Explain your answer. (2)

8.2 Use a calculation to identify electrode **X**. (4)

8.3 Name component **P** and give one function of this component in this cell. (2)

8.4 Is the Zink in this cell the oxidising agent or the reducing agent? (1)

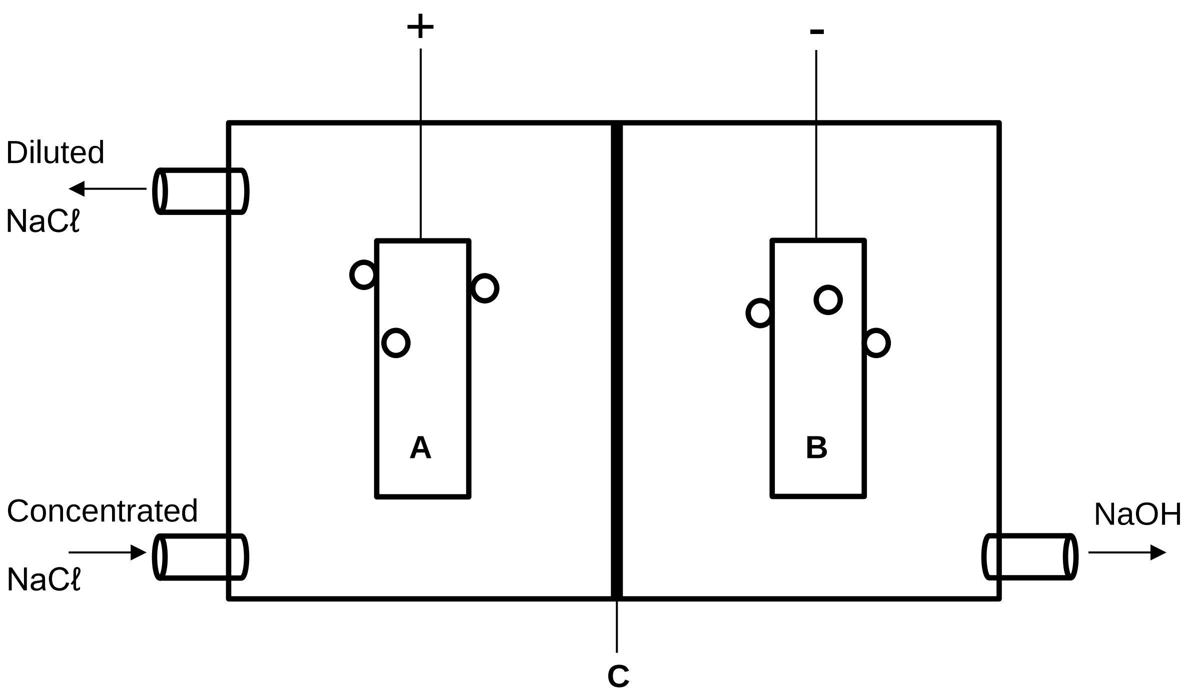
8.5 Write down the half reaction that occur at the cathode of this cell. (2)

8.6 The $ZnSO_4$ is an electrolyte. Define *electrolyte*. (2)

[13]

QUESTION 9

In the chloro-alkali industry an electrolytic process is used to form chlorine, hydrogen and sodium hydroxide by using a saltwater solution. The diagram below shows the membrane cell which is used for this process.



9.1 Define *electrolysis*. (2)

9.2 Which letter (**A** or **B**) represents the:

9.2.1 Anode (1)

9.2.2 Give the name of the gas that forms at the anode (1)

9.3 Write down the net reaction for this process. (3)

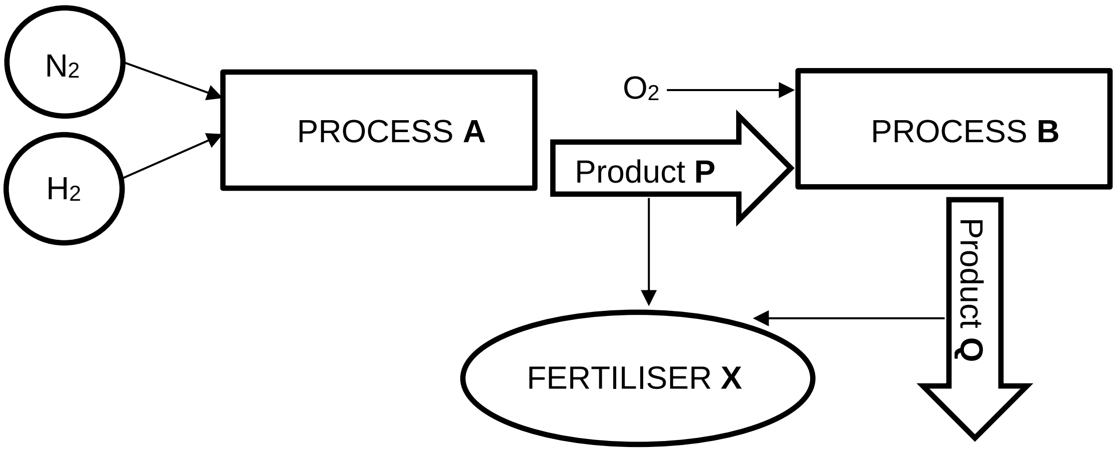
9.4 What characteristic does part **C** have that ensures the correct functioning of this cell? (1)

9.5 Describe the risks associated with the production of chlorine in this industrial process and how these risks are managed. (2)

[10]

QUESTION 10

Study the following flow diagram of processes involved in the production of industrial fertilisers.



10.1 For process **A**:

10.1.1 Name this process. (1)

10.1.2 Write down the balanced equation for this process. (2)

10.2 For process **B**:

10.2.1 Name this process. (1)

10.2.2 Write down the balanced equation for the last step in this process. (2)

10.3 Give the molecular formula for:

10.3.1 Product **P** (1)

10.3.2 Product **Q** (1)

10.4 Write down the name of fertiliser **X**. (1)

10.5 A spinach farmer has two bags of fertiliser in his store room. Fertiliser **A** has the N:P:K ratio of 4:5:8 while fertiliser **B** has the N:P:K ratio of 13:5:9. Which fertiliser should he rather use? Explain your answer. (3)

10.6 Explain the term *eutrophication*. (2)

[14]

GRAND TOTAL: [150]

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^θ	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard temperature	T^θ	273 K
Charge on electron	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ or $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ or $E^\theta_{cell} = E^\theta_{oxidising agent} - E^\theta_{reducing agent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number	Electronegativity	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* (↑)

Half-reactions/*Half-reaksies*			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
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 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
$Br_2(l) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(l)$	+ 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
$Al^{3+} + 3e^-$	⇌	Al	− 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* (↓)

Increasing reducing ability/*Toenemende reduserende vermoë* (↑)

Half-reactions/*Half-reaksies*			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