Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2014

PHYSICAL SCIENCES P2

MARKS: **150**

TIME: **3 hours**

* P H S C E 2 *

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

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.

2. Answer ALL the questions.

3. This question paper consists of TWO sections:
   SECTION A: 20 marks
   SECTION B: 130 marks

4. Answer SECTION A and SECTION B in the ANSWER BOOK.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

7. Number your answers correctly according to the numbering system used in this question paper.

8. You are advised to use the attached data sheets and the periodic table.

9. Wherever motivations, discussions, etc. are required, be brief.

10. Round off your final numerical answers to a minimum of TWO decimal places.

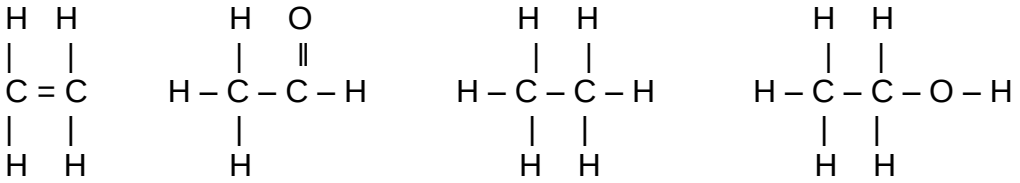
SECTION A

Answer this section in the ANSWER BOOK.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Write only the correct letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Which ONE of the following compounds will decolourise bromine water the fastest under normal conditions?



A **B** **C** **D** (2)

1.2 A renewable source of energy that can be produced by the fermentation of the sugar in sugarcane or corn is …

A ethane.
B ethanol.
C methanol.
D methane. (2)

1.3 Which ONE of the following polymers is the product of a condensation polymerisation reaction?

A Polypropylene
B Polyvinyl chloride
C Polytetrafluoroethene
D Polyactic acid (2)

1.4 Which ONE of the following is a balanced equation for the combustion of octane?

A $\mathbf{2}C_8H_{18} + \mathbf{25}O_2 \rightarrow \mathbf{16}CO_2 + \mathbf{18}H_2O$
B $C_8H_{18} + \mathbf{16}O_2 \rightarrow \mathbf{8}CO_2 + \mathbf{9}H_2O$
C $C_8H_{18} + \mathbf{32}O_2 \rightarrow \mathbf{8}CO_2 + \mathbf{18}H_2O$
D $\mathbf{2}C_8H_{18} + \mathbf{8}O_2 \rightarrow \mathbf{16}CO_2 + \mathbf{9}H_2O$ (2)

1.5 Water undergoes auto-ionisation. During this process …

A a proton is transferred from one water molecule to another.
B water molecules act as proton donors only.
C water molecules act as proton acceptors only.
D the pH of water will decrease. (2)

1.6 A small quantity of concentrated hydrochloric acid is gradually added to 1 dm^3 of distilled water at 25 °C. After testing the resultant solution, it is found that the value of K_w, $[H_3O^+]$ and $[OH^-]$ in $mol \cdot dm^{-3}$ are:

A	$K_w = 10^{-14}$	$[H_3O^+] < 10^{-7}$	$[OH^-] > 10^{-7}$
B	$K_w < 10^{-14}$	$[H_3O^+] < 10^{-7}$	$[OH^-] < 10^{-7}$
C	$K_w = 10^{-14}$	$[H_3O^+] > 10^{-7}$	$[OH^-] < 10^{-7}$
D	$K_w = 10^{-14}$	$[H_3O^+] = 10^{-7}$	$[OH^-] = 10^{-7}$

(2)

1.7 During the extraction of aluminium from pure aluminium oxide (alumina), a substance known as cryolite ($Na_3A\ell F_6$) is added. The cryolite …

A reduces the fluoride emissions during electrolysis.
B lowers the melting point of the alumina.
C prevents oxidation at the carbon electrodes.
D prevents rusting of the electrolytic cell. (2)

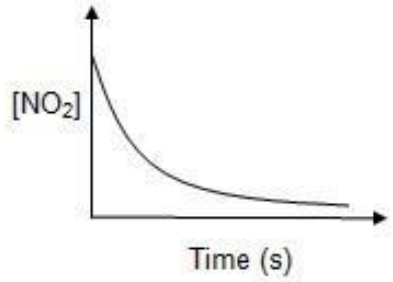
1.8 $N_2O_{4(g)}$ is placed in a sealed container.

After a while the following reaction takes place in the container at constant temperature:

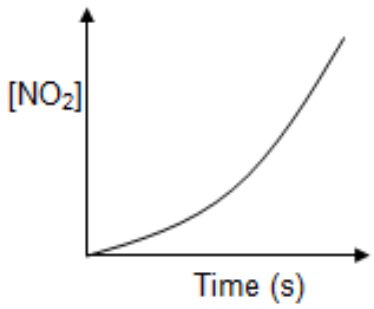
$$N_2O_{4(g)} \leftrightharpoons 2NO_{2(g)}$$

Which ONE of the following graphs correctly illustrates the relationship between the nitrogen dioxide (NO_2) concentration, and time?

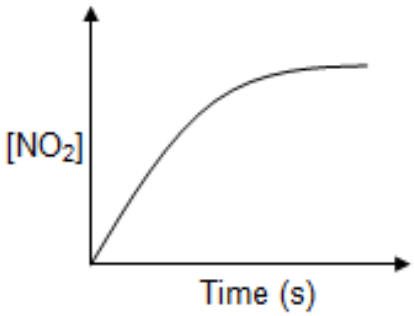
A



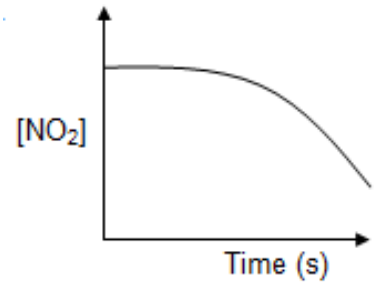
B



C



D



(2)

1.9 Consider the following reaction taking place in an <u>open</u> vessel at a certain temperature:

$$2H_2O_{2(aq)} \rightarrow 2H_2O_{(\ell)} + O_{2(g)} \quad \Delta H < 0$$

The initial reaction rate of the above reaction may be DECREASED by …

A cooling the system.
B adding MnO_2 as a catalyst.
C adding O_2 gas to the system.
D increasing the pressure of the system. (2)

1.10 Eutrophication …

A causes soil acidification.
B can lead to agricultural pests becoming resistant to pesticides.
C is caused by bacterial nitrogen fixation.
D is a process whereby excess plant nutrients stimulate excessive growth of algae. (2)

TOTAL SECTION A: 20

SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave one line open between two subsections, for example between QUESTION 2.1 and QUESTION 2.2.
2. Start each question on a NEW page.
3. The formulae and substitutions must be shown in ALL calculations.
4. Round off your numerical answers to a minimum of TWO decimal places.

QUESTION 2 (Start on a new page.)

A few organic compounds (**A**–**E**) are represented in the table below.

A	CH_3–CH*Br*–CH*Br*–CH_3
B	$CH_3CH_2CH_2OH$
C	pentanal
D	2-methylpentanoic acid
E	$CH_3 - CH = C(CH_3) - CH_3$

Write down the:

2.1 IUPAC name for compound **A** (2)

2.2 GENERAL FORMULA of the homologous series to which compound **B** belongs (1)

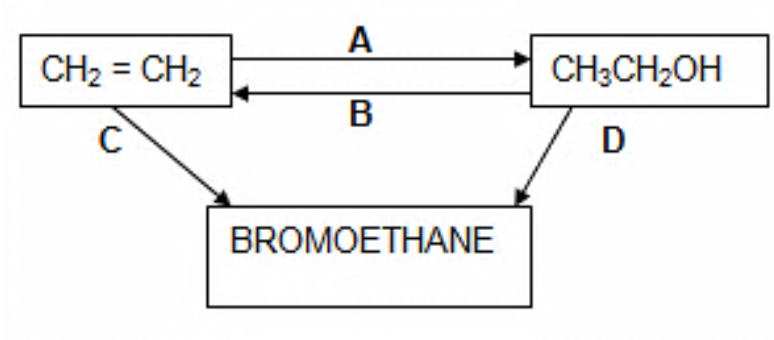
2.3 STRUCTURAL FORMULA of the functional group for compound **C** (1)

2.4 STRUCTURAL FORMULA for compound **D** (2)

2.5 STRUCTURAL FORMULA of a positional isomer for compound **E** (2)
[8]

QUESTION 3 (Start on a new page.)

The letters **A–D** in the flow diagram below represent some organic reactions that involve ethene.



3.1 Name the type of reaction (ADDITION, SUBSTITUTION or ELIMINATION) represented by:

3.1.1 **A** (1)

3.1.2 **B** (1)

3.1.3 **D** (1)

3.2 Apart from the alkene, another reactant and a catalyst are needed in Reaction **A**.

Write down the NAME of the: (1)

3.2.1 Other reactant

3.2.2 Catalyst which was added to the alkene (1)

3.3 Use STRUCTURAL FORMULAE to write down a balanced chemical equation for the reaction represented by **C**. (4)

3.4 The ethanol produced in reaction **A** is made to react with a carboxylic acid in the presence of an acid catalyst. The compound formed is a STRAIGHT CHAIN ESTER which is a functional isomer of pentanoic acid.

Write down the:

3.4.1 IUPAC NAME of the carboxylic acid that reacted with the alcohol (2)

3.4.2 Name given to this type of reaction (1)

3.4.3 STRUCTURAL FORMULA of the ester formed (2)

3.5 The polymerisation of ethene to produce polythene is represented by the equation below:

$$nCH_2 = CH_2 \rightarrow -[CH_2\text{-}CH_2]_n-$$

3.5.1 Define the term *macromolecule*. (1)

3.5.2 Classify this type of polymerisation. (1)

3.5.3 Name TWO industrial uses of polythene. (2)

[18]

QUESTION 4 (Start on a new page.)

The table below shows data collected for three organic compounds, represented by the letters **A**, **B** and **C**, during a practical investigation:

	Organic compound	Relative molecular mass	Boiling point (°C)
A	$CH_3CH_2CH_2CH_3$	58	-0,5
B	$CH_3CH_2CH_2OH$	60	97
C	CH_3COOH	60	118

4.1 Which variable was controlled during this investigation? (1)

4.2 Name the following in this investigation:

4.2.1 The dependent variable (1)

4.2.2 The independent variable (1)

4.3 Consider compound **A**:

4.3.1 Is compound **A** a saturated or an unsaturated hydrocarbon? Give a reason for your answer. (2)

4.3.2 The compound 2-methylpropane is an isomer of compound **A**.

Predict whether the boiling point of 2-methylpropane will be HIGHER THAN, LOWER THAN or THE SAME as the boiling point of compound **A**. (1)

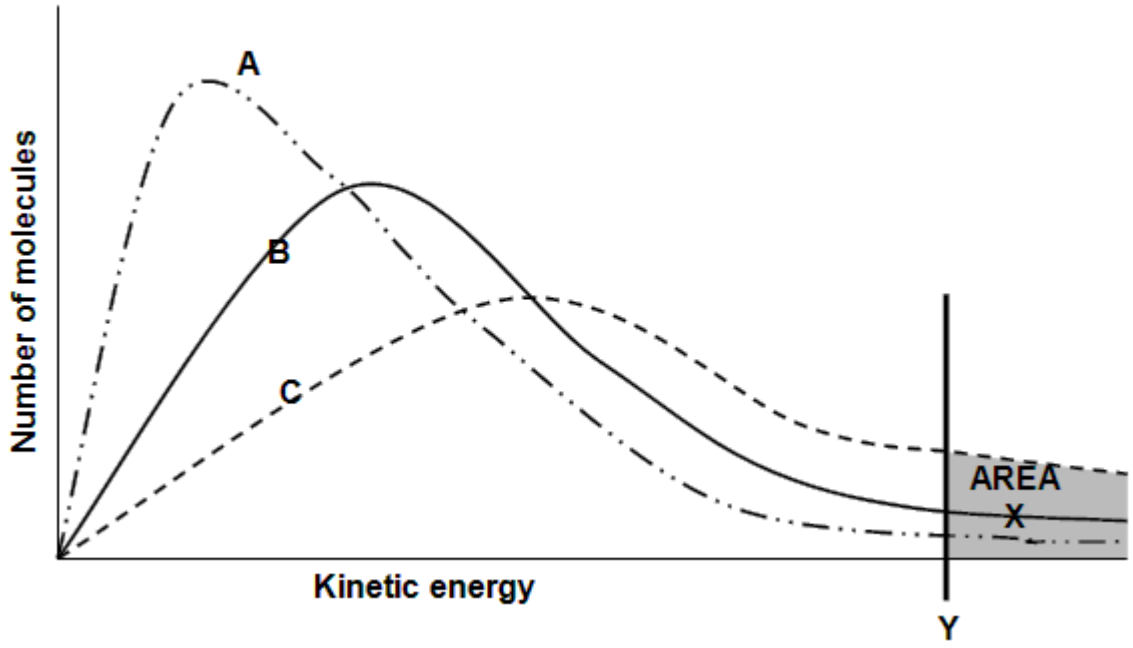
4.3.3 Explain your prediction in QUESTION 4.3.2. (3)

4.4 Refer to intermolecular forces and energy to explain why compound **B** will have a higher vapour pressure than compound **C** at 20 °C. (3)

[12]

QUESTION 5 (Start on a new page.)

Graph **B** below represents the Maxwell-Boltzmann energy distribution curve for a reaction mixture at a temperature of 300°C. Area **X** represents the number of molecules in the mixture that have enough kinetic energy for the reaction to take place.



5.1 Give a term for the "minimum energy needed for a reaction to take place", as indicated by **Y**. (1)

5.2 The temperature of the mixture is now increased to 500 °C.

5.2.1 Which ONE of graph **A** or **C** represents the distribution curve of the mixture at this higher temperature? Give a reason for the answer. (2)

5.2.2 Use the collision theory to explain how this increase in temperature will influence the rate of the reaction. (4)

5.3 A catalyst is added to the mixture.

5.3.1 Write down the definition of a *positive catalyst*. (2)

5.3.2 How will the above-mentioned action affect the size of **area X** (shaded area)?

Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

5.3.3 Explain your answer to QUESTION 5.3.2. (2)

[12]

QUESTION 6 (Start on a new page.)

The catalytic oxidation of ammonia is represented by the equation below:

$$4NH_{3(g)} + 5O_{2(g)} \leftrightharpoons 4NO_{(g)} + 6H_2O_{(g)}$$

2,0 mol of ammonia gas and 1,0 mol of oxygen gas are placed in a 2,0 dm^3 container at 1 000 kPa and allowed to reach equilibrium at 1 000 °C. At this temperature and pressure the amount of water vapour present is 0,6 mol.

6.1 Calculate the value of the equilibrium constant at this temperature. (8)

6.2 Briefly explain the significance of the value obtained in QUESTION 6.1. (1)

6.3 What effect will the addition of a platinum catalyst have on the yield of $NO_{(g)}$ at the given temperature?

Write down only INCREASE, DECREASE or REMAIN THE SAME. (1)

6.4 The pressure on the system is decreased by increasing the volume.
Use Le Chatelier's principle to explain how this change affects the yield of $NO_{(g)}$. (3)

6.5 It is found that at a temperature of 500 °C the value of the equilibrium constant is greater than the value calculated in QUESTION 6.1.

What is the sign of ΔH for the reaction mentioned above? (1)

6.6 Explain your answer to QUESTION 6.5. (4)
[18]

QUESTION 7 (Start on a new page.)

7.1 Define a *strong acid*. (2)

7.2 A solution of an unknown, monoprotic acid has a concentration of 0,01 mol·dm^{-3} and a pH of 3.

7.2.1 Calculate the concentration of the hydrogen ions in this solution. (2)

7.2.2 How will the strength of this unknown acid compare to that of hydrochloric acid of the same concentration?

Write down only STRONGER THAN, WEAKER THAN or EQUAL TO (1)

7.2.3 Give a reason for your answer in QUESTION 7.2.2. (2)

7.3 Ammonium chloride is an example of a salt that can undergo hydrolysis.

7.3.1 Define the underlined term. (2)

7.3.2 Write an equation to show the hydrolysis of ammonium chloride. (3)

7.3.3 Methyl orange is red in an acidic medium and yellow in an alkaline medium. What will the colour of methyl orange be in an ammonium chloride solution? (2)

7.4 A learner adds a sample of calcium carbonate to 50,0 cm^3 of sulphuric acid. The sulphuric acid is in excess and has a concentration of 1,0 mol·dm^{-3}.

The balanced equation for the reaction that takes place is:

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$$ ..... (1)

The reaction is allowed to proceed until all the $CaCO_3$ is used up.

The H_2SO_4 **left over** from REACTION 1 is now neutralised by 28,0 cm^3 of a 0,5 mol·dm^{-3} sodium hydroxide solution.

The balanced equation for this reaction is:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$ ..... (2)

Calculate the **mass** of calcium carbonate in the sample used in REACTION 1. (10)
[24]

QUESTION 8 (Start on a new page.)

8.1 Consider the following half reaction involving oxalic acid: solution.

$$2CO_2 + 2H^+ + 2e^- \rightleftharpoons H_2C_2O_4 \qquad E^\theta = -0,49\ V$$

A solution of potassium dichromate ($K_2Cr_2O_{7\ (aq)}$) is added to an oxalic acid ($H_2C_2O_{4\ (aq)}$) solution.

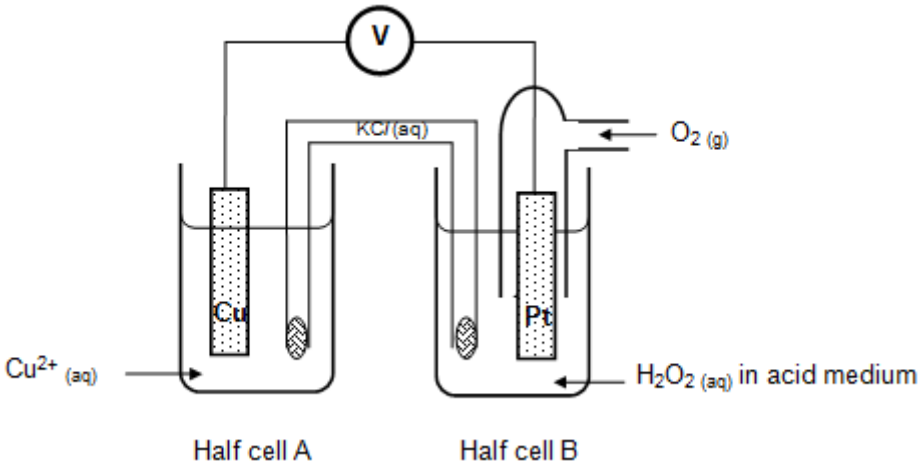
8.1.1 Explain why the reaction between the solution of oxalic acid and potassium dichromate will be spontaneous. Refer to the relative strengths of the oxidising and reducing agents in your answer. (3)

8.1.2 Use half-reactions to write down a balanced equation for the reaction between oxalic acid and potassium dichromate. Leave the answer in ionic form without spectator ions. (4)

8.2 A learner sets up a standard electrochemical cell using the following half-cells:

$$Pt_{(s)}/O_{2(g)}/H^+_{(aq)},\ H_2O_{2(aq)} \quad \text{and} \quad Cu^{2+}_{(aq)}/Cu_{(s)}$$

Potassium chloride ($KC\ell_{(aq)}$) solution is used in the salt bridge.



8.2.1 Which half cell (A or B) contains the cathode? (2)

8.2.2 Write down the oxidation half-reaction. (2)

8.2.3 Write down the cell notation for this cell. (3)

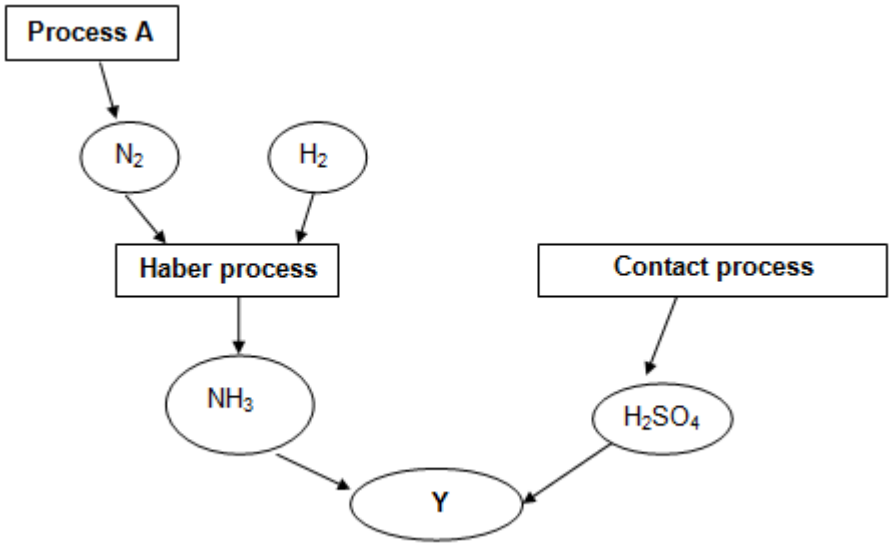
8.2.4 Calculate the potential difference of the cell ($E^\ominus_{cell}$). (4)

8.2.5 After several days, the reading on the voltmeter is 0,00 V. Explain why this reading is obtained. (4)

[22]

QUESTION 9 (Start on a new page.)

The flow diagram below shows three industrial processes that result in the production of fertiliser **Y**.



9.1 Write down the name of the **process A**. (1)

9.2 Write down a balanced equation for the **Haber process**. (3)

9.3 **Y** is a fertiliser which can be used to lower the pH of alkaline soil. Write down the NAME of compound **Y**. (2)

9.4 Name the catalyst used in the production of sulphuric acid and explain why this process is called the ***"contact"* process**. (2)

9.5 Briefly discuss TWO disadvantages associated with the use of organic fertiliser like kraal-manure or compost. (4)

9.6 A bag of N:P:K fertiliser is labelled 3:1:5(26).

9.6.1 Calculate the percentage of potassium in the bag. (2)

9.6.2 Briefly discuss the role that potassium play in the development and growth of plants. (2)

[16]

TOTAL SECTION B: 130
GRAND TOTAL: 150

NATIONAL SENIOR CERTIFICATE
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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*

NAAM/*NAME*	SIMBOOL/*SYMBOL*	WAARDE/*VALUE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume teen 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 se konstante	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_o}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at /by 298K

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$

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

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 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1.5 22 Ti 48	1.6 23 V 51	1,6 24 Cr 52	1.5 25 Mn 55	1.8 26 Fe 56	1.8 27 Co 59	1.8 28 Ni 59	1.9 29 Cu 63,5	1.6 30 Zn 65	1.6 31 Ga 70	1.8 32 Ge 73	2.0 33 As 75	2,4 34 Se 79	2.8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1.4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1.9 43 Tc	2.2 44 Ru 101	2.2 45 Rh 103	2.2 46 Pd 106	1.9 47 Ag 108	1.7 48 Cd 112	1.7 49 In 115	1.8 50 Sn 119	1.9 51 Sb 122	2.1 52 Te 128	2.5 53 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

KEY/ *SLEUTEL*

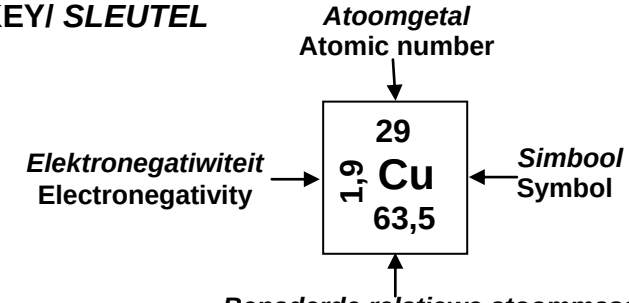

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^{θ} (V)
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 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 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/*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

