Education and Sport Development

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NORTH WEST PROVINCE

PROVINCIAL MID YEAR EXAMINATIONS

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

MAY/JUNE 2019

MARKS: 150

DURATION: 3 hours

This question paper consists of 15 pages, and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on your 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 two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etcetera where required.
12. 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. Write the letter (A-D) next to the question number (1.1-1.10) in the ANSWER BOOK, for example 1.11 D.

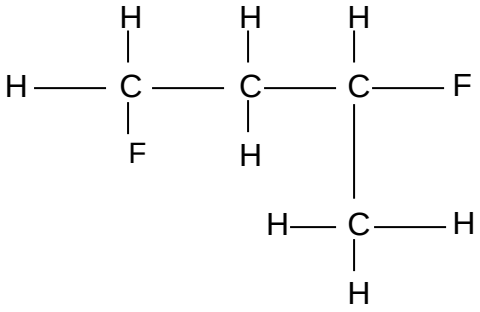
1.1 Which ONE of the following is a ketone?

A Pentan-1-ol
B Pentanone
C Pentanal
D Pentanoate (2)

1.2 Which ONE of the following pairs of reactants can be used to prepare the ester methylmethanoate in the laboratory?

A Methane and methanol
B Methanol and methanoic acid
C Ethanol and methanoic acid
D Ethane and methanol (2)

1.3 Consider the structure of an organic compound below:



The IUPAC name of this compound is …

A 2,4-diflouro-2-methylpropane
B 1,3-diflouro-3-methylpropane
C 1,3-diflourobutane
D 2,4-diflourobutane (2)

1.4 A simple reaction scheme is shown below:

$$CH_3CH = CH_2 \xrightarrow{HBr(g} \mathbf{X} \xrightarrow[NaOH(aq)]{\text{reflux with}} \mathbf{Y} + HBr$$

The formula for Y is …

A. CH_3CH_2COOH

B. $CH_3CHOHCH_3$

C. $CH_3CHBrCH_2OH$

D. $CH_3CHOHCH_2Br$ (2)

1.5 Two learners, A and B, prepared hydrogen gas in the laboratory by adding hydrochloric acid to an excess of zinc. The equation for the reaction is:

$$Zn\,(s) + 2HC\ell\,(aq) \rightarrow ZnC\ell_2\,(aq) + H_2\,(g) \qquad \Delta H < 0$$

Each learner was given the same mass of Zn and the same volume of HCℓ.
Their results were tabulated as follows:

Time (minutes)	Learner A Volume of H_2 (cm^3)	Learner B Volume of H_2 (cm^3)
1	10	20
2	20	25
3	30	35
4	30	35

The reasons for the different volumes that A and B obtained are:

A B used a catalyst and a higher temperature than A.

B B used a catalyst and a higher concentration of HCℓ than A.

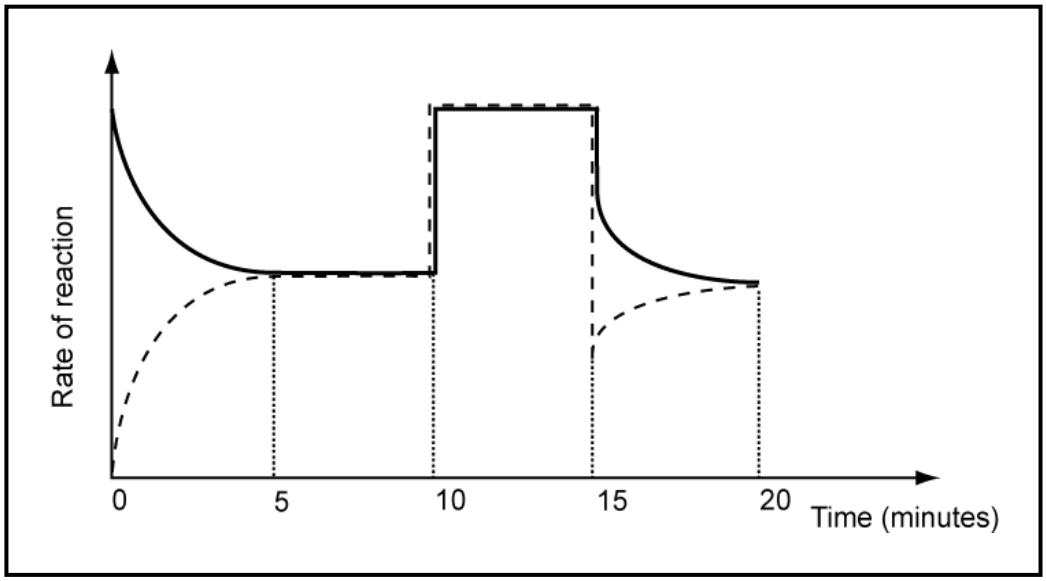
C B used a catalyst and powdered zinc.

D B used powdered zinc and a higher temperature than A. (2)

1.6 The following reversible reaction reaches equilibrium in a closed container:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI_3(g) \qquad \Delta H < 0$$

Equilibrium was first established after 5 minutes. (The broken line represents the reverse reaction.)



What change in the conditions was made at 10 minutes to change the rate of the reaction as indicated on the graph?

A A catalyst was added.

B The temperature was increased.

C The temperature was decreased.

D The external pressure on the reaction mixture was decreased. (2)

1.7 Which ONE of the following is NOT a conjugate acid-base pair?

A H_2SO_4 and HSO_4^-

B H_2O and CH_3COO^-

C F^- and HF

D HNO_3^- and NO_3^- (2)

1.8 In endothermic reactions the reactants...

A have more energy than the products
B have less energy than the products
C have the same energy as the products
D are at a lower temperature than the products (2)

1.9 A metal carbonate is a compound made up of a metal ion combined with the carbonate ion. Consider the following incomplete reaction:

$HNO_3 + Na_2CO_3 \rightarrow \ldots + \ldots..$

If the acid reacts with the metal carbonate, as indicated by the reactants above, the PRODUCTS formed for this reaction will be …

A $NaNO_3 + H_2O$
B $NaNO_3 + CO_2$
C $NaNO_3 + H_2O + CO_2$
D $NO_3^- + H_2O + CO_2$ (2)

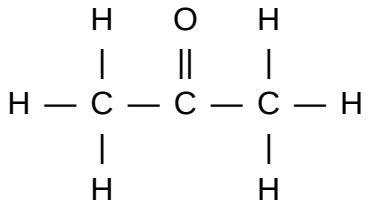
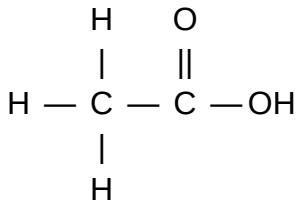
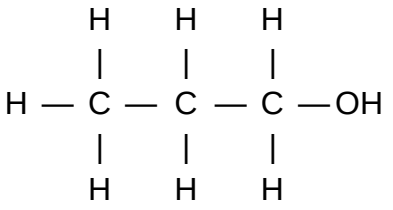
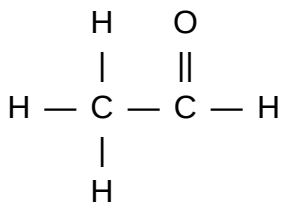
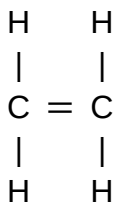
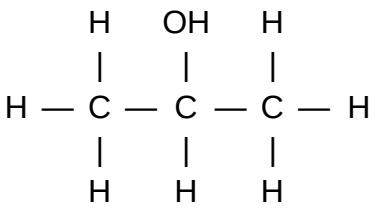
1.10 If 12 moles of ammonia (NH_3) consist of 1,806 $x10^{24}$ molecules, then the number of atoms present in this amount of NH_3 is …

A $7,22 \times 10^{24}$
B $1,23 \times 10^{26}$
C $2,17 \times 10^{25}$
D $1,51 \times 10^{23}$ (2)

[20]

QUESTION 2 (Start on a new page)

Study the following organic compounds:

 **A**	 **B**	 **C**
 **D**	 **E**	 **F**

Answer the following questions:

2.1 Define the term *positional isomers*. (2)

2.2 Identify **TWO** POSITIONAL ISOMERS. Only write down the corresponding letters for the correct answer. (2)

2.3 Write down the:

2.3.1 general formula for alkenes. (1)

2.3.2 letter that represents aldehydes (1)

2.3.3 IUPAC name of compound **A** (2)

2.4 Cracking is one of the most important processes in the oil industry

2.4.1 Explain the term cracking. (2)

2.4.2 Write down the balanced equation for the reaction that takes when ethane is cracked in a steam-cracking furnace to produce compound **E** and hydrogen gas. (3)

2.5 **B** and **C** react in the presence of concentrated sulphuric acid. Give the STRUCTURAL FORMULAE of the products formed. (4)

2.6 The polymerisation of compound **E** to produce polythene is represented by the equation below:

$$\mathbf{n(CH_2 = CH_2) \rightarrow - [CH_2\text{-}CH_2]_n -}$$

2.6.1 Explain the term *monomer*. (2)

2.6.2 Write down the type of polymerisation reaction occurring in compound **E**. (1)

2.6.3 Write down the structural formula of the polymer to show the type of polymerisation reaction for the formation of compound **E**. (2)

[22]

QUESTION 3 (Start on a new page)

Learners use compounds **A** to **C**, shown in the table below, to investigate a factor which influences the boiling points of organic compounds.

	IUPAC name	**Molecular formula**
A	Pentane	C_5H_{12}
B	2-methylbutane	C_5H_{12}
C	2,2-dimethylpropane	C_5H_{12}

3.1 Define the term boiling point? (2)

3.2 Write down the:

3.2.1 Independent variable. (1)

3.2.2 Dependent variable (1)

3.2.3 Type of isomer that is illustrated by compounds **A**, **B** and **C**. (1)

3.2.4 Write down the structural formula of compound **C**. (2)

3.3 Which ONE of the compounds (**A**, **B** or **C**) has the highest boiling point? Explain your answer. (3)

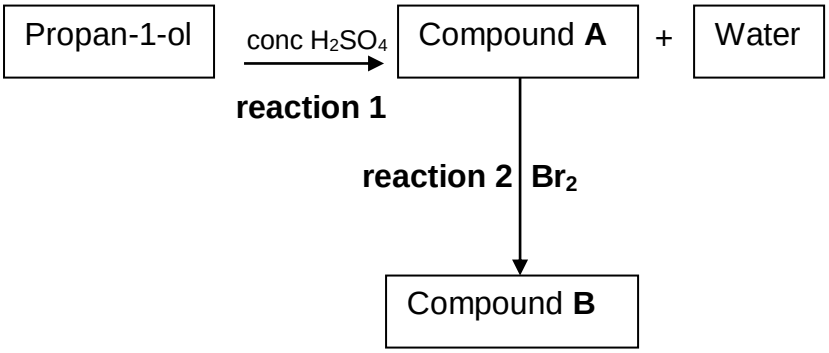
3.4 Write down the conclusion from this experiment. (2)

3.5 How will the vapour pressure of compound **A** compare to that of compound **C**? Write down only HIGHER THAN, LOWER THAN or EQUAL TO. (1)

[13]

QUESTION 4 (Start on a new page)

The flow diagram below shows the steps that a learner follows to convert propan-1-ol to a halo-alkane.



4.1 Compound **A** is the major product formed in **reaction 1**.

Write down the:

4.1.1 Structural formula of compound **A**. (2)

4.1.2 Type of reaction that takes place. (1)

4.1.3 Name of the dehydrating agent that can be used in this reaction. (1)

4.2 For compound **B,** using **reaction 2**, write down the:

4.2.1 IUPAC name of compound **B.** (2)

4.2.2 Structural formula of compound **B.** (2)

4.2.3 Type of addition reaction that occurs. (1)

4.3 In **reaction 2**, the reaction of compound **A** and bromine illustrates one important test for organic compounds.

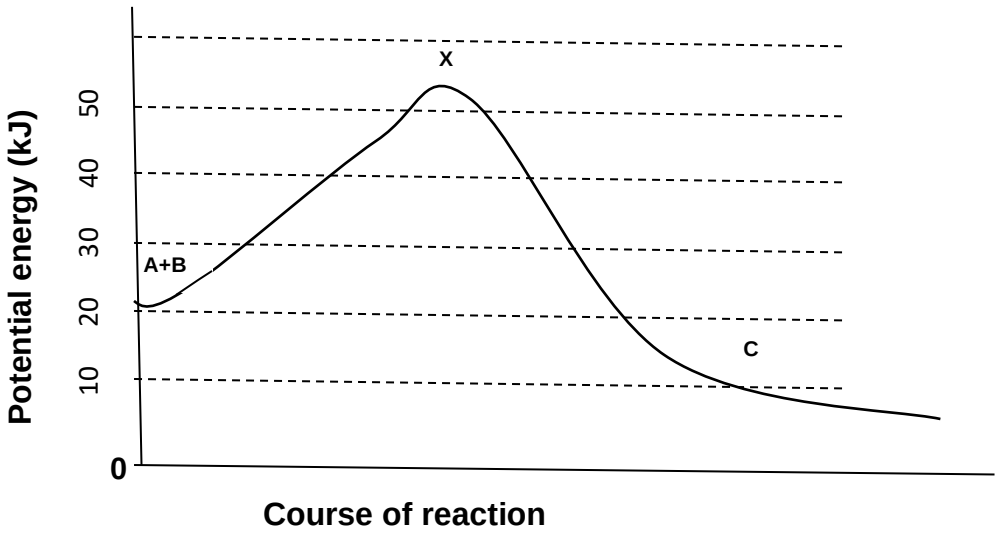
4.3.1 Write down the NAME of the test used. (2)

4.3.2 Explain how you would use the test to distinguish between an alkane and an alkene. (4)

[15]

QUESTION 5 (Start on a new page.)

The Potential energy graph for the reaction between A and B to form C is shown below:



5.1 Explain the term enthalpy change. (2)

5.2 Determine the enthalpy change for this reaction. (3)

5.3 Is the reaction exothermic or endothermic? Explain your answer. (3)

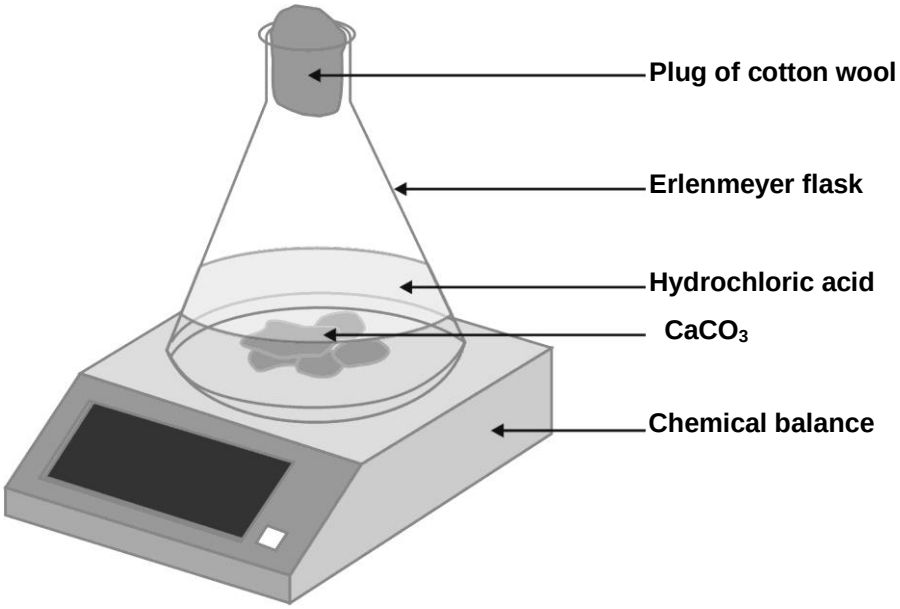
5.4 What is represented by **X** on the graph? (2)

5.5 Determine the activation energy of the reaction as represented on the graph. (3)

[13]

QUESTION 6 (Start on a new page)

Learners performed an investigation to determine the influence of a specific factor on the rate of a reaction. They reacted calcium carbonate powder and calcium carbonate chunks respectively with an excess of diluted hydrochloric acid solution. The mass of the container and the contents was recorded every 30 seconds.



Experiment A: Reaction of calcium carbonate powder and hydrochloric acid

Time (s)	0	1,0	2,0	3,0	4,0	5,0	6,0	7,0
Mass of calcium carbonate powder (g)	92	91,1	90,4	90,1	90	90	90	90
Decrease in mass(g)	0	0,9	1,6	1,9	2,0	2,0	2,0	2,0

Experiment B: Reaction of calcium carbonate chunks and hydrochloric acid

Time (s)	0	1,0	2,0	3,0	4,0	5,0	6,0	7,0
Mass of calcium carbonate chunks (g)	92	91,4	91	90,6	90,3	90,1	90	90
Decrease in mass (g)	0	0,5	1,0	1,4	1,7	1,9	2,0	2,0

6.1 Write down:

6.1.1 An investigative question for this investigation. (2)

6.1.2 The balanced chemical equation for the reaction between calcium carbonate and diluted hydrochloric acid to form calcium chloride, water and carbon dioxide. (3)

6.2 Which reaction reaches completion first (**A** or **B**)? Explain your answer. (2)

6.3 How does the rate of the reaction in Experiment **1** compare to that of Experiment **2**? Write down only HIGHER THAN, LOWER THAN or SAME AS. (1)

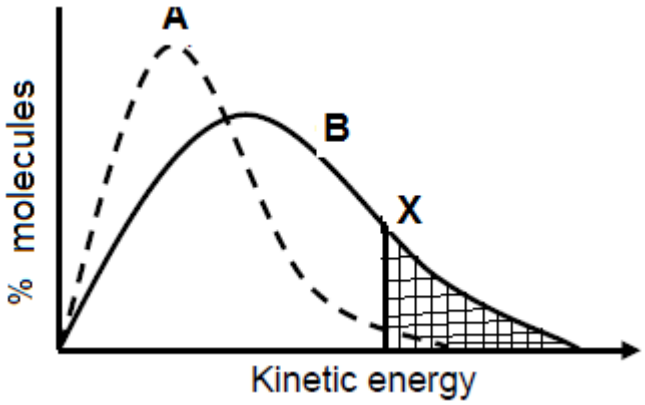
6.4 Use the Collision Theory to explain their observation in QUESTION 6.3. (4)

6.5 Calculate the volume of carbon dioxide gas that forms if 150 cm^3 HCℓ with a concentration of 0,5 $mol.dm^{-3}$ reacts with excess of calcium carbonate at STP. (6)

[18]

QUESTION 7 (Start on a new page.)

The following graph represents the percentage of molecules with a certain amount of E_k vs the kinetic energy of the molecules.



7.1 What does point **X** on the graph indicates? (1)

7.2 Which curve, **A** or **B**, will represent a reaction at a low temperature? (1)

7.3 Do all the molecules have the same kinetic energy at low temperatures? Motivate your answer. (2)

7.4 What do the shaded areas to the right of the vertical line represent? (4)

7.5 If a catalyst is to be added to the reagents, will it cause the **vertical line at X** to move to the LEFT or RIGHT? Explain your answer. (4)

[12]

QUESTION 8 (Start on a new page.)

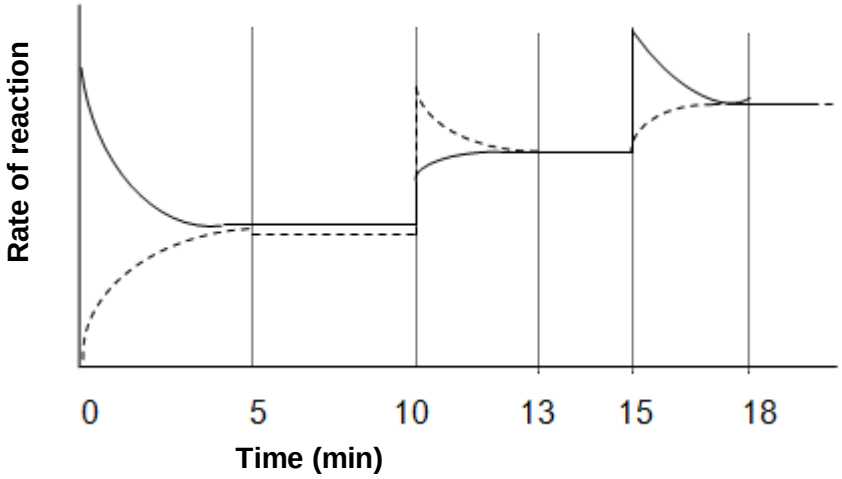
A mixture of 0,25 moles of AX and 0,10 moles of BY is placed in a 250 cm^3 container at 300K. A reaction takes place in the sealed container according to the following equation:

$$2AX_{(g)} + BY_{(g)} \rightleftharpoons 2(AB_{(g)} + XY_{(g)}) \qquad \Delta H < 0$$

Equilibrium is established after 5 minutes, and at equilibrium it is found that 0,20 moles of AX is present in the container.

8.1 Determine the equilibrium constant of this reaction. (8)

The following graph shows the reaction rate against time after certain changes were made:



8.2 Write down the chemical equations represented by each of the solid and broken lines. (4)

8.3 Explain the changes that occur at the following intervals:

8.3.1 10^{th} minute (2)

8.3.2 15^{th} minute (2)

8.4 Which ONE of the changes will have an effect on the K_c value of this reaction? Explain your answer. (4)

[20]

QUESTION 9 (Start on a new page)

One gram of calcium carbonate is dissolved in 50 cm^3 of dilute hydrochloric acid. After the calcium carbonate has reacted completely with the acid, 25 cm^3 of sodium hydroxide of 0,1 $mol.dm^{-3}$ is added to neutralize the excess acid. The reaction for the neutralization is as follows:

$$HC\ell\,(aq) + NaOH(aq) \rightarrow NaC\ell\,(aq) + H_2O(l)$$

9.1 Define an acid according to the Lowry- Brønsted model. (1)

9.2 Calculate the following:

9.2.1 the concentration of the original $HC\ell$ solution. (7)

9.2.2 the pH of the original $HC\ell$ solution. (4)

9.3. Consider the reaction below:

$$H_3PO_4\,(aq) + H_2O(l) \rightarrow H_2PO_4^-aq) + H_3O^+(aq)$$

9.3.1 Define the term *ampholyte*. (2)

9.3.2. Write down the conjugate acid-base pairs in this reaction. (2)

9.3.3 Write down the formula of a substance in the reaction given in 9.3 that can act as an ampholyte. (1)

[17]

TOTAL MARKS: 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 x 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 x 10^{-19} C
Avogadro's constant *Avogadro-konstante*	N_A	6,02 x 10^{23} mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = N/N_A$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = V/Vm$
$\frac{CaVa}{CbVb} = \frac{n_a}{n_b}$	pH = -log$\left[H_3O^+\right]$
Kw = $\left[H_3O^+\right]\left[OH^-\right]$ = 1x10^{-14} at 298K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

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																	2 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	10 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	18 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	36 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	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*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

29
1,9 **Cu**

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 4A: STANDARD REDUCTION POTENTIALS

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+}	+ 1,82
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Fe^{3+} + e^-$	$\rightleftharpoons$	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
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 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	– 0,04
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	– 0,25
$Co^{2+} + 2e^-$	$\rightleftharpoons$	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
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,74
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,37
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,92
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,04

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

TABLE 4B: STANDARD REDUCTION POTENTIALS

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	$\rightleftharpoons$	Li	− 3,04
$K^+ + e^-$	$\rightleftharpoons$	K	− 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	− 2,90
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	− 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	− 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,37
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,74
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	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	− 0,25
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	− 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	− 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	− 0,04
$2H^+ + 2e^-$	$\rightleftharpoons$	$H_2(g)$	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
$SO_4^{2-} + 4H^+ + 4e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 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
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,78
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,78
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,06
$O_2(g) + 4H^+ + 3e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,28
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,52
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,82
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑