GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2018

11102

TECHNICAL SCIENCES

PAPER 2

TIME: 3 hours

MARKS: 150

15 pages + 4 data sheets

INSTRUCTIONS AND INFORMATION

1. This question paper consists of NINE 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 question paper.

4. Leave ONE line between two sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. You are advised to use the attached DATA SHEETS.

8. Show ALL formulae and substitutions in ALL calculations.

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

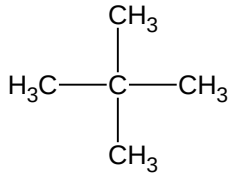
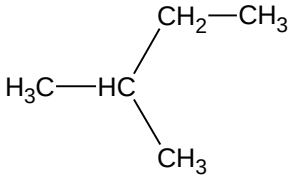
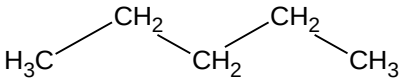
10. Give brief motivations, discussions etc. where required.

11. 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. Choose the correct answer and write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Which of the following are structural isomers?

1	2	3
		

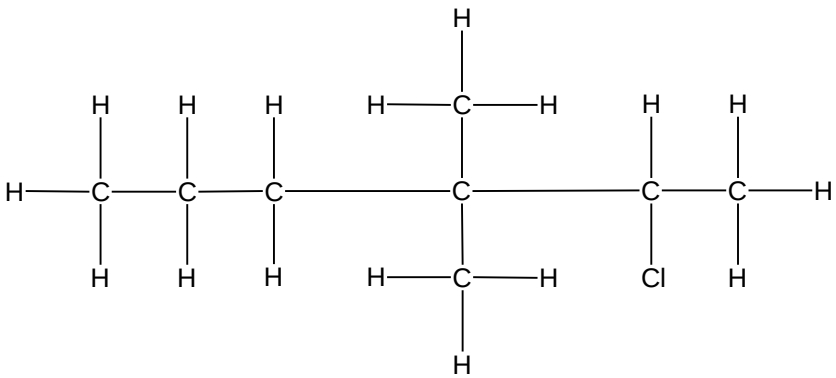
A Only 1 and 2

B Only 2 and 3

C Only 1 and 3

D 1, 2 and 3 (2)

1.2 Which ONE of the IUPAC names below is CORRECT for the given structure?



A 4-dimethyl-5-chlorohexane

B 3,3-dimethyl-2-chlorohexane

C 2-methyl-3,3-chlorohexane

D 2-chloro-3,3-dimethylhexane (2)

1.3 Which ONE of the following cannot be an ester or a carboxylic acid?

A C_3H_6O

B $C_3H_6O_2$

C CH_2O_2

D $C_2H_4O_2$ (2)

1.4 Which monomer is used to produce polythene?

A Chloroethene

B Propene

C Benzene

D Ethene (2)

1.5 A certain standard, electrochemical cell can be presented as follows:

$Pt , I^- / I_2 // Fe^{3+} / Fe^{2+} , Pt$

Which ONE of the following will serve as the reducing agent?

A I^-

B I_2

C Fe^{3+}

D Fe^{2+} (2)

1.6 In an electrochemical cell, what relationship must be TRUE about the values of $E^{\ominus}_{\text{oxidising agent}}$ and $E^{\ominus}_{\text{reducing agent}}$ for the reaction to occur spontaneously under standard conditions?

A $E^{\ominus}_{\text{reducing agent}} > 0$ and $E^{\ominus}_{\text{oxidising agent}} > 0$

B $E^{\ominus}_{\text{reducing agent}} < 0$ and $E^{\ominus}_{\text{oxidising agent}} < 0$

C $E^{\ominus}_{\text{reducing agent}} > E^{\ominus}_{\text{oxidising agent}}$

D $E^{\ominus}_{\text{reducing agent}} < 0$ and $E^{\ominus}_{\text{oxidising agent}} > 0$ (2)

1.7 When a ray of light moves from an optically more dense medium to an optically less dense medium, then the …

A wavelength and the speed of the light will increase.

B wavelength of the light will decrease, but the speed of the light will increase.

C frequency and speed of the light will decrease.

D wavelength, frequency and speed of the light will increase. (2)

1.8 Which ONE of the following is NOT true regarding EM rays?

A Can be reflected

B Can undergo interference

C Can undergo refraction

D Is a longitudinal wave (2)

1.9 A ray of light hits the surface between water and air at a right angle. Which ONE of the following statements is correct?

A The angle of incidence is 90˚.

B Total internal reflection occurs.

C The frequency of the ray of light remains constant.

D The angle of incidence is equal to the critical angle. (2)

1.10 Which ONE of the following uses does not fit with the type of electromagnetic wave?

A Micro wave – Television broadcasts

B Gamma rays – Cancer radiation

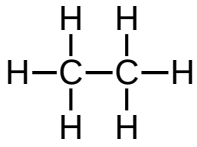
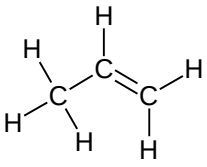
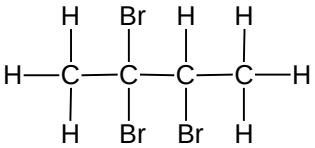
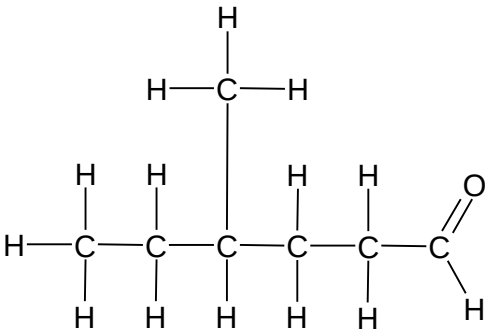
C Infrared – Heating of food

D Ultraviolet light – Sterilisation of food (2)

[20]

QUESTION 2 (Start on a new page.)

Consider the representation of organic molecules **A** to **F** below.

A		**B**	
C		**D**	Ethyl ethanoate
E	Propan-1-ol	**F**	

2.1 Define a *homologous series*. (2)

2.2 Write down the NAME of the homologous series to which EACH of the following compounds belong:

2.2.1 B (1)

2.2.2 D (1)

2.2.3 E (1)

2.2.4 F (1)

2.3 Write down the letter that represents a compound that:

2.3.1 Is a saturated hydrocarbon (1)

2.3.2 Is a halo alkane (1)

2.3.3 Has a general formula $C_nH_{2n+1}OH$ (1)

2.4 Write down the:

2.4.1 Molecular formula of the next compound in the same homologous series as compound **B** (2)

2.4.2 Structural formula of compound **E** (3)

2.4.3 IUPAC name of compound **B** (3)

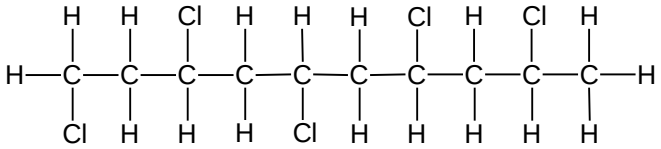
2.4.4 Structural formula of the functional group of compound **D** (2)
[19]

QUESTION 3 (Start on a new page.)

3.1 The earliest known work with polymers was the rubber industry in pre-Columbian Mexico. The Mesoamericans knew how to combine latex of the rubber tree with the juice of the morning glory plant in different proportions to get rubber with different properties for different products, such as bouncing balls, sandals, and rubber bands. Polymers are large molecules composed of smaller monomer units.

3.1.1 Define a *monomer*. (2)

3.1.2 Identify and draw the recurring monomer in the following polymer. (1)



3.1.3 Polythene is the most common plastic. The annual global production is around 80 million tonnes.

(a) Name TWO properties of polythene which makes it useful. (2)

(b) Name TWO uses of polythene. (2)

3.2 Consider the table below and answer the questions that follow.

SYSTEMATIC NAME	FORMULA	BOILING POINT (˚C)
Chloromethane	$CH_3C\ell$	-24,1
Dichloromethane	$CH_2C\ell_2$	40,1
Trichloromethane	$CHC\ell_3$	61,8
Tetrachloromethane	$CC\ell_4$	76,6

3.2.1 Name the intermolecular forces in alkyl halides (1)

3.2.2 Describe the relationship between the number of chlorine atoms and boiling points as presented in the above table. (2)

3.2.3 Write down the formula of the alkyl halide that is dangerous at 25˚C. (1)

3.2.4 Provide a reason for your answer to Question 3.2.3. (2)

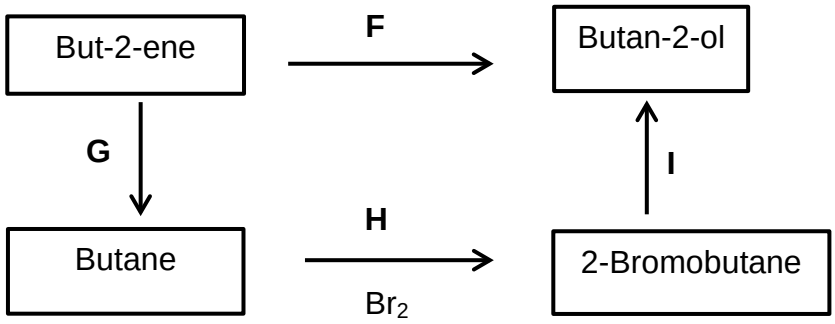
[13]

QUESTION 4 (Start on a new page.)

Fossil fuel is a general term for buried combustible geologic deposits of organic materials. These deposits are formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years. Alkanes are the most important of fossil fuels. Some countries like Canada produce 18.3 billion cubic feet of natural gas per day. Propane is produced as a by-product of two other processes, natural gas processing and petroleum refining. Propane is a cleaner-burning alternative fuel. Butane is another gaseous fuel derived from petroleum.

4.1 Write a balanced equation to show the complete combustion reaction of butane in excess oxygen. (3)

4.2 But-2-ene can be converted to other compounds by means of different organic reactions represented by **F**, **G**, **H** and **I**, as shown below.



Write down the TYPE of the reaction represented by:

4.2.1 **F** (2)

4.2.2 **G** (2)

4.2.3 **H** (2)

During reaction **I**, the alkyl halide (haloalkane) reacts in the presence of a base to form an alcohol.

4.2.4 Give the NAME of a suitable base used. (1)

4.2.5 Name TWO reaction conditions that are required. (2)
[12]

QUESTION 5 (Start on a new page.)

Steel ships needs to be protected from corrosion. One method of protecting ships is by means of the Sacrificial anode system. Sacrificial anodes or metals have been used since 1824. Zinc is popularly used as a sacrificial metal.

5.1 What is the purpose of attaching the zinc bars to the hulls of steel ships? (1)

5.2 Use the Table of Standard Reduction Potentials to explain the answer to Question 5.1. (2)

5.3 A magnesium rod is placed in an iron (II) chloride solution. Write down the following:

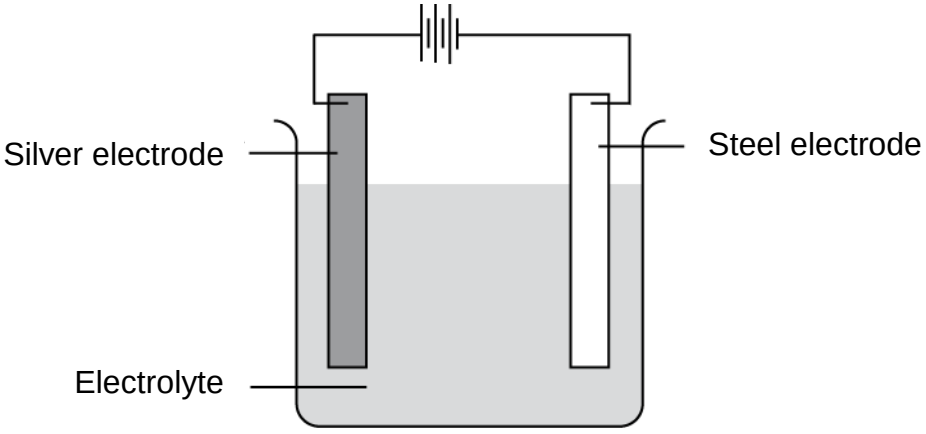
5.3.1 The chemical equation (1)

5.3.2 The oxidation half-reaction (2)

5.3.3 The reduction half-reaction (2)

5.3.4 The balanced net reaction (2)

5.4 Electrolytic cells are commonly used in the process of electroplating. Electroplating involves passing an electric current through a solution called an electrolyte. Silver plating is shown in the diagram below.



5.4.1 Define an *electrolytic cell*. (2)

5.4.2 Which electrode will act as the anode? (Write only SILVER or STEEL.) (1)

5.4.3 Which reaction occurs at the cathode? (1)

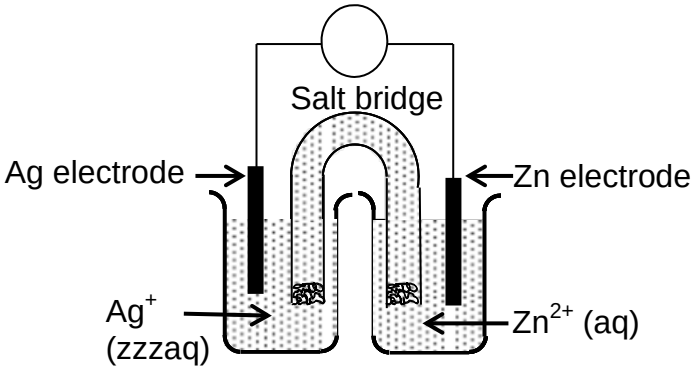
5.4.4 Write down the half-reaction that occurs at the anode. (2)

5.4.5 Which solution can be used as an electrolyte? (1)

[17]

QUESTION 6 (Start on a new page.)

6.1 A learner constructed an electrochemical cell using silver and zinc electrodes. The cell was set up as illustrated below.



6.1.1 Identify the type of electrochemical cell shown in the diagram above. (1)

6.1.2 Which energy conversion occurs in this type of cell? (2)

6.1.3 Describe the movement of the ions in the solutions. (2)

6.1.4 Write down TWO functions of the salt bridge. (2)

6.1.5 What is the direction of electron flow in the external circuit? (2)

6.1.6 Why is KNO_3 the preferred electrolyte to be used in the salt bridge, instead of $BaCl_2$? (2)

6.2 For this cell:

6.2.1 Write down the net reaction. (2)

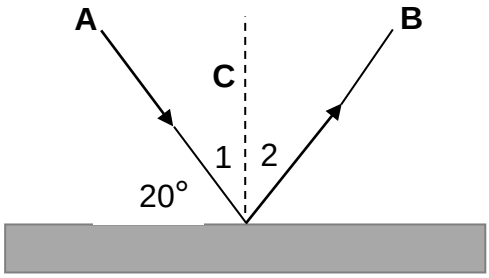
6.2.2 Give the standard conditions. (2)

6.2.3 Write down the cell notation. (3)

6.2.4 Use the Table of Standard Reduction Potentials to calculate the emf. (2)
[20]

QUESTION 7 (Start on a new page.)

The following ray diagram shows reflection on a flat plane.



7.1 Write down the laws of reflection. (2)

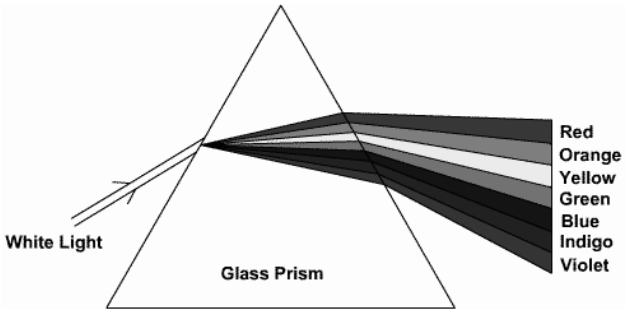
7.2 Give suitable NAMES for lines **A**, **B** and **C**. (3)

7.3 Write down the NAME and the MAGNITUDE of the following:

7.3.1 Angle 1 (2)

7.3.2 Angle 2 (2)

7.4 When white light falls onto a triangular prism, the following phenomenon is observed.



7.4.1 What do we call this phenomenon? (1)

7.4.2 Write a definition for the phenomenon named in Question 7.5.1. (2)

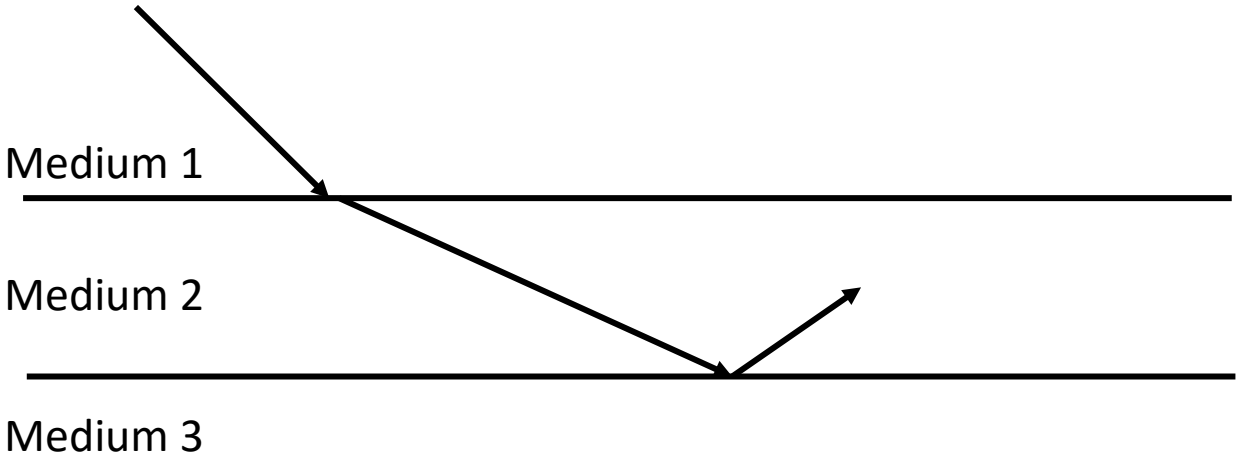
7.4.3 Which colour of light is refracted the least? (1)

7.4.4 Explain the answer to Question 7.4.3 in terms of the wavelength. (2)

[15]

QUESTION 8 (Start on a new page.)

Light moves from medium 1 to medium 2 to medium 3. The diagram below illustrates the path of a ray of light through the different media.



8.1 Define *refraction*. (2)

8.2 Identify the phenomenon taking place between medium 2 and medium 3. (1)

8.3 The media in the diagram above have different optical densities.

8.3.1 Which medium is optically denser, medium **1** or medium **2**? (1)

8.3.2 Explain the answer to Question 8.3.1. (2)

8.4 8.4.1 In which medium, **1**, **2** or **3**, is the angle of incidence larger than the critical angle? (1)

8.4.2 Justify the answer to Question 8.4.1. (2)

8.5 How does the optical density between medium **2** and medium **3** compare? (1)

8.6 Name TWO:

8.6.1 Conditions for total internal reflection (2)

8.6.2 Applications of total internal reflection (2)

8.7 Short-sighted people cannot see faraway objects because their eyeballs are too long. This results in light from distant objects falling in front of the retina, thus making the image blurred. To correct this defect, optometrists prescribe lenses that enable patients to see distant objects.

Use a labelled diagram to illustrate how such a lens will correct short-sightedness. (5)

[19]

QUESTION 9 (Start on a new page.)

In physics, electromagnetic radiation refers to the waves of the electromagnetic field, propagating through space-time, carrying electromagnetic radiant energy.

9.1 Define an *electromagnetic wave*. (2)

9.2 The diagram below represents radiations of the electromagnetic spectrum.

Infrared	Radio waves	X-rays	Microwaves	Gamma rays	Ultraviolet rays	Visible light

9.2.1 Arrange the spectrum in order of decreasing wavelength. (2)

9.2.2 In which radiation will a photon have the lowest energy? (1)

9.2.3 Explain the answer to Question 9.2.2. (2)

9.3 Calculate the energy of a photon of an electromagnetic wave with a wavelength of 520 pm. (5)

9.4 How will the energy of a photon with a wavelength of 350 pm compare with that calculated in Question 9.3? (Write only GREATER THAN, SMALLER THAN or EQUAL TO). (1)

9.5 Identify the electromagnetic radiation best suited for use in the following:

9.5.1 Security scanners (1)

9.5.2 Sterilisation of food and appliances (1)

[15]

TOTAL: 150

END

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2

TABLE 1/*TABEL 1*

PHYSICAL CONSTANTS/*FISIESE KONSTANTES*		
CONSTANT/*KONSTANTE*	**SYMBOL/*SIMBOOL***	**VALUE/*WAARDE***
Planck's constant *Planck se konstante*	h	$6{,}63 \times 10^{-34}$ J.s
Speed of light *Spoed van lig*	c	3×10^{8} m.s^{-1}

TABLE 2/*TABEL 2*

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*	
Speed/*Spoed*	$c = f\lambda$
Energy/*Energie*	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$

TABLE 3/*TABEL 3*

ELECTROCHEMISTRY/*ELEKTROCHEMIE*	
Emf/*Emk*	$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidising\,agent} - E^{\theta}_{reducing\,agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			$E^{\ominus}$ (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*	$E^{\ominus}$(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

TABLE 5: THE PERIODIC TABLE OF ELEMENTS / *TABEL 5: 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																	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	41 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 63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

END