Education and Sport Development

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NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL SCIENCES P2

SEPTEMBER 2019

MARKS: 150

TIME: 3 hours

This question paper consists of 13 pages and 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, e.g. between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

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

7. Round off your FINAL numerical answers to a minimum of TWO decimal places.

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

9. 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 number (1.1- 1.10) in the ANSWER BOOK, e.g. 1.2. B.

1.1 Which of the following is the general formula for alkynes?

A C_nH_{2n}

B $C_nH_{2n + 2}$

C $C_nH_{2n ï 2}$

D $C_nH_{2n}O$ (2)

1.2 Which ONE of the following hydrocarbons is saturated?

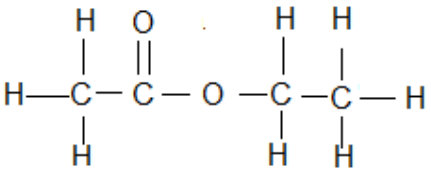
A C_3H_6

B C_4H_6

C C_3H_8

D C_4H_8 (2)

1.3 To which of the following homologous series does the compound below belong?



A Alkane

B Esters

C Haloalkanes

D Carboxylic acid (2)

1.4 Which monomer is used to produce polythene?

A Chloroethene

B Bromoethene

C Ethane

D Ethene (2)

1.5 A certain standard electrochemical cell can be represented as follows:
$Zn + Cu^{2+}$ Ÿ $Zn^{2+} + Cu$
Which ONE of the following will serve as the reducing agent?

A Cu^{2+}

B Zn^{2+}

C Cu

D Zn (2)

1.6 Which statement is true for an electrochemical cell?

A Oxidation occurs at the anode.

B Reduction occurs at the anode.

C Oxidation occurs at both the cathode and the anode.

D Reduction occurs at both the cathode and the anode. (2)

1.7 What will be the independent variable in an experiment to determine the path of a ray of light through a glass prism at different angles of incidence?

A Angle of reflection

B Emergent angle

C Angle of incidence

D Angle of refraction

(2)

1.8 What is the angle of incidence, where the angle of refraction is 90° and the light travel from an optically denser medium to an optically less dense medium?

A Emergent angle

B Critical angle

C Angle of reflection

D Angle of refraction (2)

1.9 The frequeny of electromagnetic wave is 2 GHz and its wavelength is 1 cm. The speed of the wave be equal to:

A $2\times 10^{6}\times 0,01$

B $2\times 10^{-9}\times 0,01$

C $2\times 10^{-6}\times 0,01$

D $2\times 10^{9}\times 0,01$ (2)

1.10 Which electromagnetic radiation is used by soldiers in night vision devices to see objects at night?

A Infrared light

B Ultraviolet light

C Gamma rays

D Visible spectrum (2)
[20]

QUESTION 2

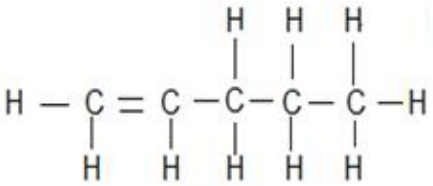
2.1 Define the following terms:

2.1.1 Homologous series (2)

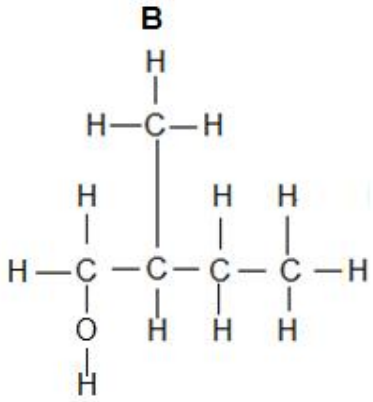
2.1.2 Hydrocarbon (2)

2.2 Consider the following molecules **A** and **B** and answer the questions below:

A



B



Write down the:

2.2.1 Structural formula of the functional group of compound **B**. (2)

2.2.2 Molecular formula of compound **A**. (1)

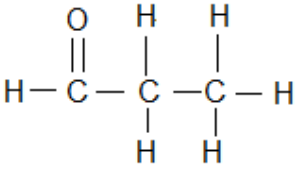
2.2.3 IUPAC name of compound **B**. (2)

2.2.4 Letter representing an unsaturated compound. (1)

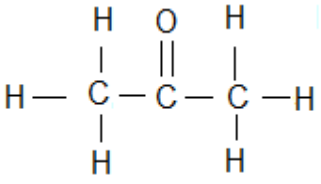
2.2.5 Homologous series of compound **A**. (1)

2.3 Consider the following structural isomers:

C



D



2.3.1 Define the term structural isomer. (2)

2.3.2 What type of isomers are compounds **C** and **D**. (1)

2.3.3 What is the NAME of the functional group of compound **D**? (1)

2.3.4 Write down the general formula of these compounds. (1)

2.4 Draw the structural formula of 2ï bromo ï 3ï methylbutane. (3)
[19]

QUESTION 3

The grade 12 learners conducted an experiment to compare the boiling points of organic compounds (**A–D**) .

The results are recorded in the table below:

	COMPOUNDS	**MOLECULAR MASS ($g \cdot mol^{-1}$)**	**BOILING POINT (□)**
A	Propanoic acid	74	141
B	Propanol	60	97
C	Propane	44	ï 42
D	Propene	42	ï 48

3.1 Define the term boiling point. (2)

3.2 The boiling point of compound **C** is much lower than that of compound **A**. Name the type of intermolecular forces that are responsible for this difference in:

3.2.1 Compound **A** (1)

3.2.2 Compound **C** (1)

3.3. Is compound **C** a gas or liquid at room temperature? (1)

3.4 Consider the boiling points of compound **A** and **D**. Give a reason for this difference in the boiling point by referring to the TYPE, STRENGTH OF INTERMOLECULAR FORCES AND THE ENERGY NEEDED. (3)

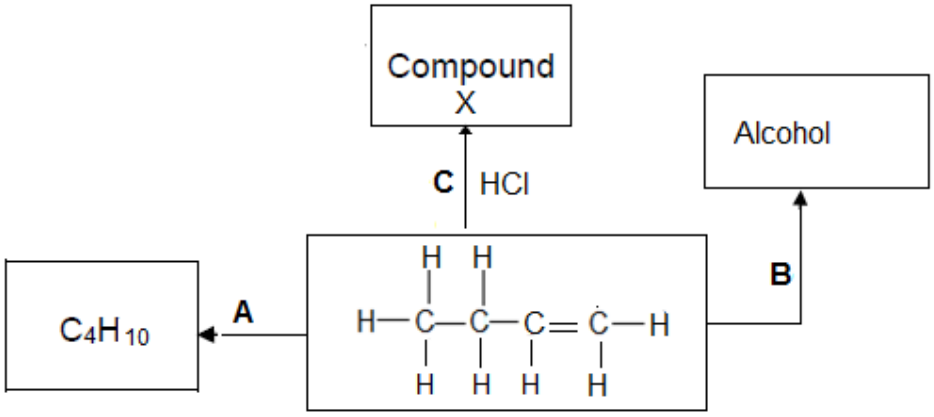
3.5 Which compound has the highest vapour pressure? (1)

3.6 Explain the answer in QUESTION 3.5. (2)

3.7 Explain the trend in the boiling points of these organic compounds. (2)
[13]

QUESTION 4

The flow diagram below shows some of the reactions of butene.



4.1 What type of addition reaction is represented by EACH of the following letters?

4.1.1 **C** (1)

4.1.2 **A** (1)

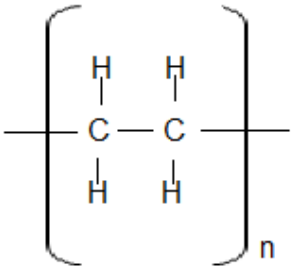
4.1.3 **B** (1)

4.2 C_4H_{10} is used in household gas stoves. The gas is ignited in sufficient oxygen.

Write down a balanced molecular equation for the reaction that will occur. (3)

4.3 Use a STRUCTURAL FORMULAE to write down a balanced chemical equation for reaction **B.** (5)

4.4 A polymer is given below:

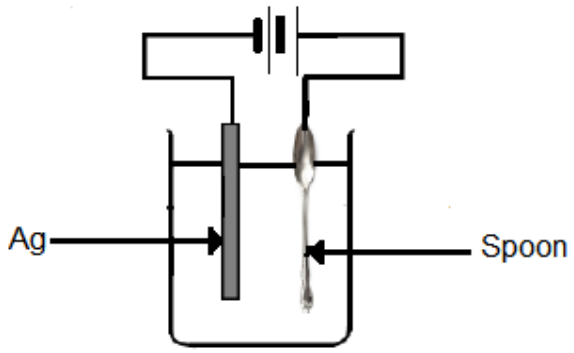


4.4.1 Define the term plastic. (2)

4.4.2 Write down the NAME of the polymer represented above. (1)
[14]

QUESTION 5

Electrolytic cell used to electroplate a metal (spoon) with silver is shown below.



5.1 Explain what electroplating means. (2)

5.2 Write down the energy conversion taking place in this cell. (2)

5.3 Is this cell spontaneous or nonï spontaneous? (1)

5.4 Explain your answer in QUESTION 5.3. (2)

5.5 Write down the NAME or FORMULA of the oxidising agent. (1)

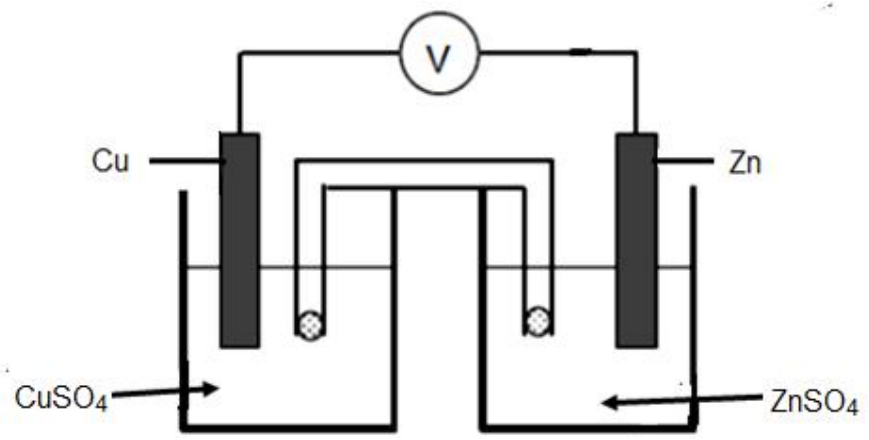
5.6 What is the function of the battery in this cell? (2)

5.7 Give the NAME or FORMULA of the electrolyte that should be used in this process. (1)

5.8 Write TWO observations that can be made during this process. (2)
[13]

QUESTION 6

The diagram below represents the setup of a galvanic cell.



6.1 Define a galvanic cell. (2)

6.2 Write down TWO standard conditions applicable to this cell. (2)

6.3 In which direction will the electrons flow in the external circuit? Write down from Zn ELECTRODE TO Cu ELECTRODE or Cu ELECTRODE TO Zn ELECTRODE. (1)

6.4 What type of reaction is this? (ENDOTHERMIC or EXOTHERMIC). Explain your answer. (2)

6.5 Define the term reduction. (2)

6.6 Write down the:

6.6.1 Half reaction that takes place at the anode. (2)

6.6.2 Cell notation for this cell. (3)

6.7 Calculate the emf of this cell. (4)

6.8 Write TWO functions of a salt bridge. (2)

6.9 Why would KNO_3 be a suitable electrolyte that can be used in the salt bridge? (2)
[22]

QUESTION 7

7.1 State the law of reflection. (2)

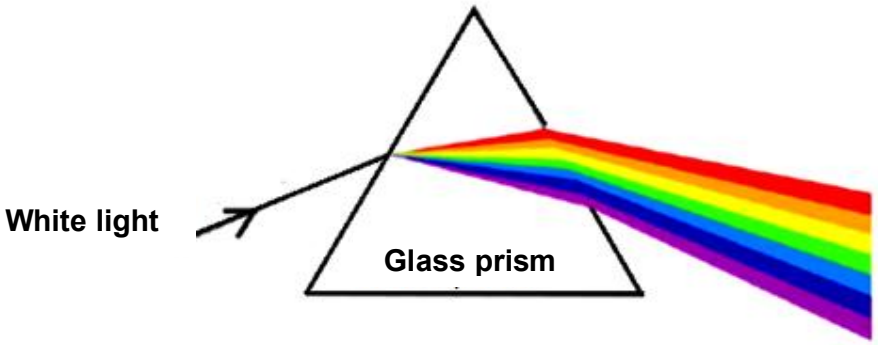
7.2 Write down FOUR properties of an image in a flat mirror. (4)

7.3 Write ONE word for the following:

7.3.1 The imaginary line perpendicular to the surface of an object. (2)

7.3.2 When the light is incident on an irregular surface and is reflected in all directions. (2)

7.4 When white light falls into a triangular prism, the following phenomenon is observed:



7.4.1 Define *dispersion.* (2)

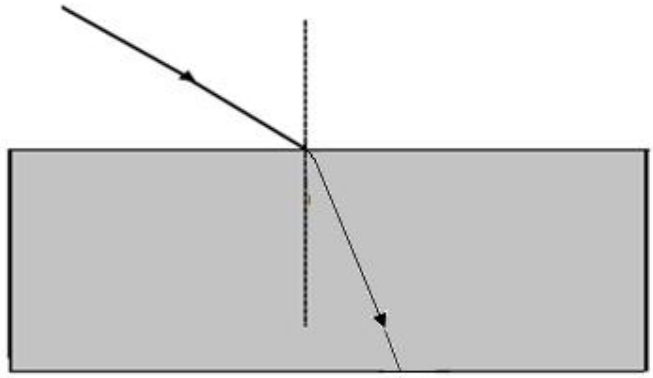
7.4.2 Which colour of light is refracted the least? (1)

7.4.3 Explain the answer to QUESTION 7.4.2 in terms of wavelength. (2)

7.4.4 Which colour of light will have the shortest wavelength? (1)
[16]

QUESTION 8

8.1. Study the diagram of refraction of light in water and answer the following questions.



8.1.1 Define the term refraction. (2)

8.1.2. Redraw the DIAGRAM and label it including the TWO media used. (7)

8.1.3 What happens to the speed of light when it enters water? (1)

8.2 Give TWO conditions of total internal reflection. (4)

8.3 Name TWO application of total internal reflection. (2)

8.4 An object 30 mm high is placed 50 mm from a convex lens of focal length 15 mm. Draw a ray diagram accurately to scale showing the formation of the image. (5)

8.5 Name TWO visual defects that are corrected by spectacles. (2)
[23]

QUESTION 9

9.1 Define *electromagnetic wave*. (2)

9.2 Electromagnetic waves are divided into SEVEN categories depending on their wavelength and frequency.

Name them according to their decreasing wavelength. (2)

9.3 Which radiation is used?

9.3.1 For treatment of skin disorders. (1)

9.3.2 For communication and television. (1)

9.4 Calculate the frequency of the light, if a photon has $3,44 \times 10^{-23}$ J of energy. (4)
[10]

TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 12

PAPER 2

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	$1,01 \times 10^{5}$ Pa
Standard temperature	T^{θ}	273 K/ 0° C
Speed of light in a vacuum	c	$3,0 \times 10^{8}$ m·s^{-1}
Planck's constant	h	$6,63 \times 10^{-34}$ J·s

TABLE 2: WAVES, SOUND AND LIGHT

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or $E = h\frac{c}{\lambda}$	

TABLE 3: FORMULAE

$$\Delta p = m\Delta v$$

or

$$F_{net}\Delta t = \Delta p$$

or

$$F_{net}\Delta t = mv_f - mv_i$$

TABLE 4A: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↑

Half-reactions	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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(aq) + 2e^- \rightleftharpoons 2Br^-$	+ 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
$Al^{3+} + 3e^- \rightleftharpoons Al$	− 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 ↓

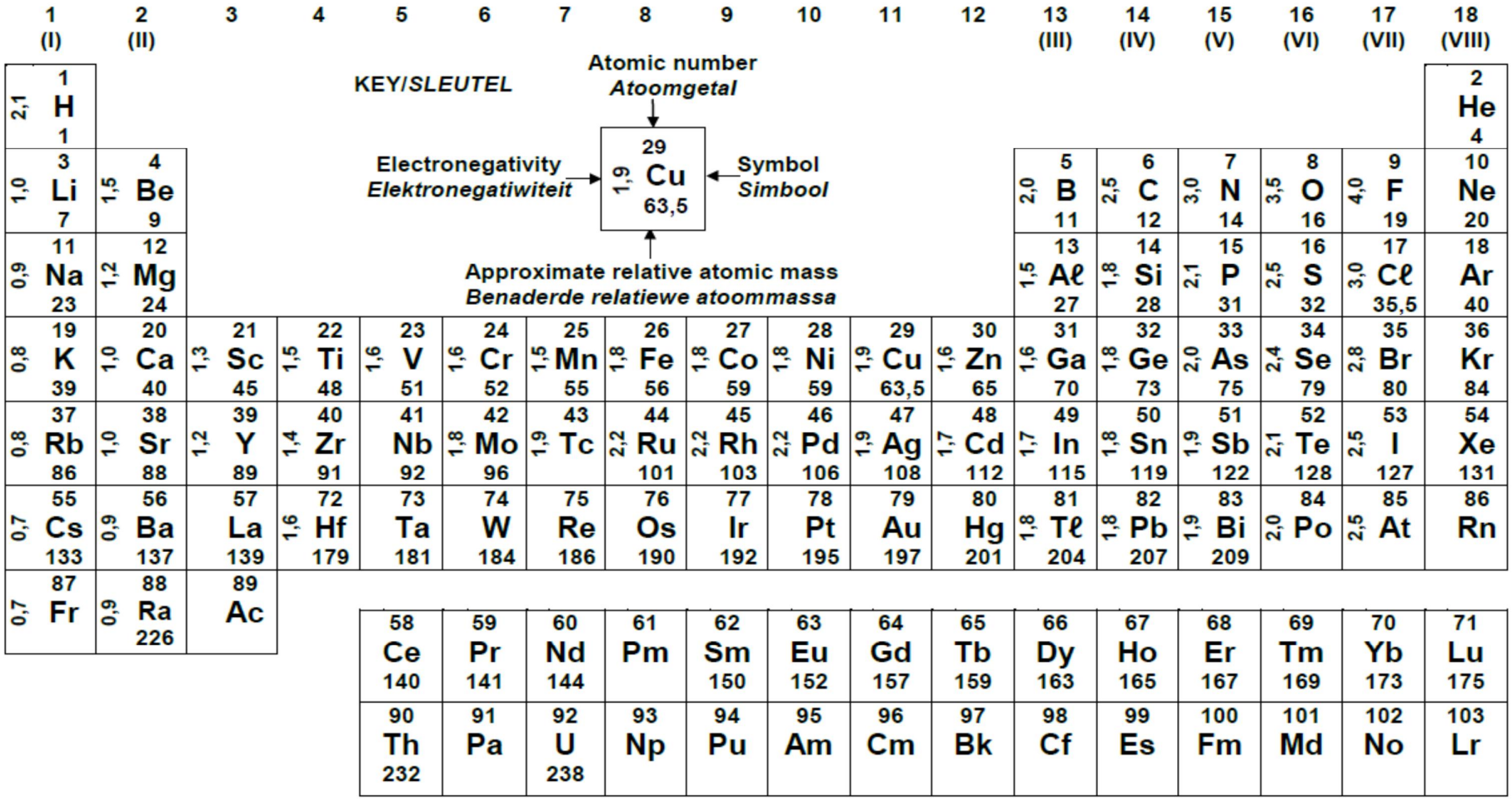
TABLE 4B: STANDARD REDUCTION POTENTIALS

Increasing oxidising ability ↓

Increasing reducing ability ↑

Half-reactions	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
$Ač^{3+} + 3e^- \rightleftharpoons Aă$	- 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
$SO_4^{\ï} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 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
$NO_3^{\ï} + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$Hg^{2+} + 2e^- \rightleftharpoons Hg(ă)$	+ 0,85
$NO_3^{\ï} + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Br_2(ă) + 2e^- \rightleftharpoons 2Br^-$	+ 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
$Cr_2O_7^{\ï} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$Că_2(g) + 2e^- \rightleftharpoons 2Că$	+ 1,36
$MnO_4^{\ï} + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 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



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 Cs 133	0,9 Ba 137	57 La 139	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	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr 87	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