Bergvliet High School

GRADE 11

Physical Science

Physics P2

25 November 2024

MARKS: 150

TIME: 3 hours

EXAMINER: K. Stuck

MODERATOR/S: Z. Booysen/ S. van Harte

This question paper consists of 13 pages and 3 data sheets.

Detach this sheet and attach it to the front of your answer sheets.

Name: _____ Teacher: Bo / Vh / Su

For official use only							
Question 1	Marker	**20**	Moderator	**Question 6**	Marker	**22**	Moderator
Question 2	Marker	**20**	Moderator	**Question 7**	Marker	**13**	Moderator
Question 3	Marker	**22**	Moderator	**Question 8**	Marker	**15**	Moderator
Question 4	Marker	**15**	Moderator	**Total**	Marker	**150**	Moderator
Question 5	Marker	**23**	Moderator	**Percentage**	Marker	**%**	Moderator
Signature	Marker			**Signature**	Moderator		

INSTRUCTIONS

1. Write your **NAME** and science teacher code (**Bo/Vh/Su**) in the appropriate space on the Cover Page and all scripts handed in.
2. The question paper consists 8 questions. Answer ALL the questions.
3. Start EACH question on a NEW page.
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, et cetera where required.
12. Write neatly and legibly.

Answer Sheet

Name: _____ **Teacher Code: Bo/Vh/Su**

Question 1

Make a **cross (X)** in the appropriate box next to the relevant question number (1.1 – 1.10)

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
		Total		/20

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 answer and make a cross (**X**) in the block (**A-D**) next to the question number (**1.1-1.10**) on the ANSWER SHEET **on previous page**.

1.1 Which ONE of the following statements concerning bond energy in NOT TRUE?

A Bond energy increases as bond length decreases.
B Bond energy increases as atomic radius decreases.
C The higher the bond energy, the stronger the bond.
D Bond energy is smaller in multiple bonds than in single bonds.

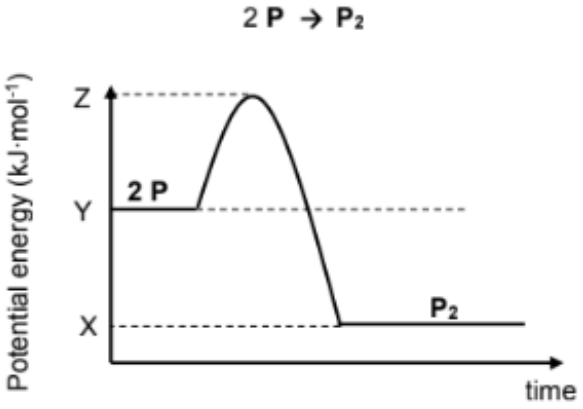
1.2 The VSEPR shape for BH_3.

A Angular
B Linear
C Tetrahedral
D Trigonal planar

1.3 ONE mole of water (H_2O) and ONE mole of carbon dioxide (CO_2) will have the same…

A mass.
B molar mass.
C number of molecules.
D density.

1.4 Consider the potential energy graph for the hypothetical reaction:



The heat of the reaction (ΔH) is represented by ...

A Z – Y.
B X – Y.
C Y – X.
D Y – Z.

(2)

1.5 A catalyst can speed up the rate of a given chemical reaction by:

A Increasing the equilibrium constant in favour of the products.
B Lowering the activation energy required for the reaction to occur.
C Raising the temperature at which the reaction occurs.
D Increasing the pressure of reactants, thus favouring products.

1.6 A compound has the following composition:

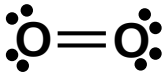
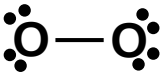
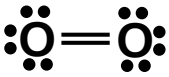
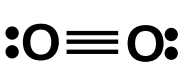
15,79% aluminium; 28,07% sulphur; 56,14% oxygen

What is the empirical formula for the compound:

A AlS_2O_6
B $Al_2S_2O_{12}$
C Al_2SO_4
D $Al_2S_3O_{12}$

(2)

1.7 Which of the following is a correct Lewis structure for oxygen?

A.	B.	C.	D.
			

(2)

1.8 What is the oxidation number of sulphur in $BaSO_4$?

A -2

B 1

C +6

D +8

1.9 The equation below represents an equilibrium reaction.

$$HNO_3(aq) + NH_3(aq) \rightleftharpoons NO_3^-(aq) + NH_4^+(aq)$$

Which chemical in the reactants of the forward reaction is a Lowry-Brønsted- base?

A HNO_3

B NH_3

C NO_3^-

D NH_4^+

1.10 What occurs when Cr^{3+} ions are reduced to Cr^{2+} ions?

A Electrons are donated and the oxidation number of chromium increases.

B Electrons are donated and the oxidation number of chromium decreases.

C Electrons are gained and the oxidation number of chromium increases.

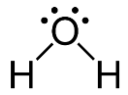
D Electrons are gained and the oxidation number of chromium decreases.

(2)

[20]

QUESTION 2 (Start on a new page.)

Use the following table to answer the questions that follow.

A.	$CF_4(l)$	**B.**	
C.	Li*Cl* (aq)	**D.**	Au(s)
E.	NH_3	**F.**	H^+
G.	$N_2(g)$	**H.**	MgO
I.	CH_2O		

2.1 Define the term *electronegativity*. (2)

2.2 Choose the **letter(s)** from the table:

2.2.1 Which shows a molecule that has third order bonds between the atoms. (1)

2.2.2 Where ionic bonds occur. (2)

2.2.3 Where hydrogen bonding occur between the molecules. (2)

2.2.4 Of a molecule whose molecular geometry is angular. (1)

2.2.5 Where the molecule possesses polar bonds, but the molecule itself is non-polar. (1)

2.2.6 Of a substance that has delocalized valence electrons. (1)

2.3 Substances **B** and **F** react to form hydronium ions.

2.3.1 What type of bond occurs at the hydronium molecule? (1)

2.3.2 Draw a Lewis structure of the hydronium ion. (2)

2.4 Draw the Lewis structure of the following molecules.

2.4.1 Molecule **A.** (2)

2.4.2 Molecule **H.** (2)

2.5 Provide the intermolecular forces that exist between a sample of:

2.5.1 Molecule **G** (1)

2.5.2 Molecule **I** mixed with molecule **H** (1)

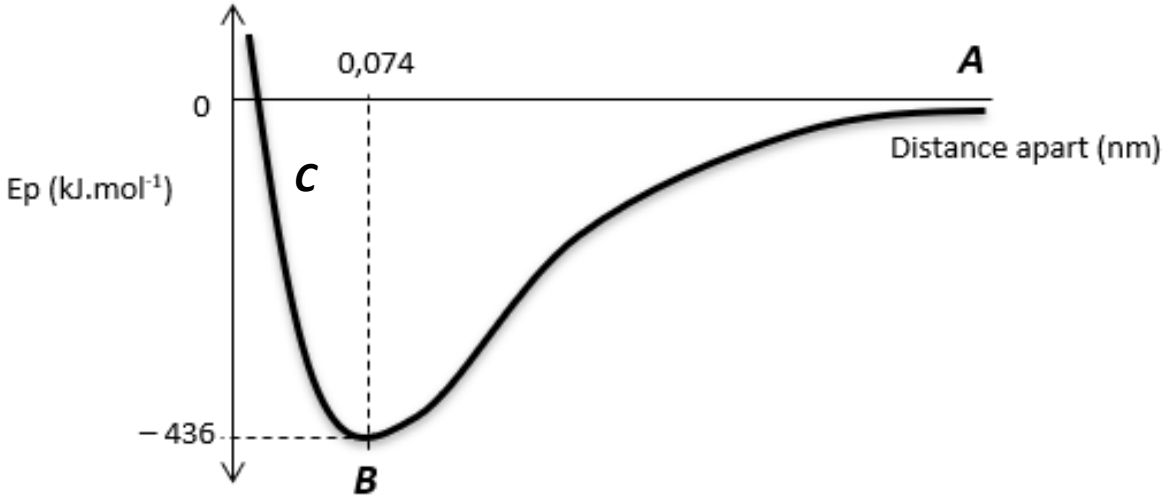
2.5.3 Molecule **A** mixed with molecule **C** (1)

[20]

QUESTION 3 (Start on a new page.)

Use the following graph to answer the questions that follow.

The graph below shows the potential energy changes of a system of two hydrogen atoms as the distance between the two hydrogen nuclei changes.



3.1 Define *bond energy*. (2)

3.2 Is energy RELEASED or ABSORBED during the formation of a chemical bond? (1)

3.3 Determine the bond length. (1)

3.4 Determine the bond energy. (1)

3.5 Provide the **letter** where:

3.5.1 The molecule is most stable. (1)

3.5.2 The repulsion forces are greater than the attractive forces. (1)

3.6 How would the bond energy change if there was more than one bond. Provide a reason for your answer. (2)

3.7 The following table shows the molecular mass, melting point and boiling point of four chemical substances:

	Chemical substances	Molecular mass ($g.mol^{-1}$)	Melting point (°C)	Boiling point (°C)
A	Hydrogen fluoride	20	-83.6	19.5
B	Hydrogen chloride	36,5	-114.2	-85.1
C	Hydrogen bromide	?	-85	-66.8
D	Hydrogen iodide	128	-50.8	-35.4

3.7.1 Define *melting point.* (1)

3.7.2 What phase is hydrogen fluoride in at -90 °C? (1)

3.7.3 Calculate the molecular mass of Hydrogen bromide. (2)

3.7.4 What intermolecular forces exist between hydrogen iodide molecules? (1)

3.7.5 Why does the boiling point increase from substance **B** to substance **D**? (3)

3.7.6 Why does substance **A** not follow this trend seen above? (3)

3.7.7 Identify the substance with the highest vapour pressure. Provide a reason for your answer. (2)

[22]

QUESTION 4 (Start on a new page.)

Learners study **endothermic** and **exothermic** reactions by conducting experiments **I** and **II** in which the reactions shown in the table below take place.

EXPERIMENT	BALANCED EQUATION
I	$2\ H_2O_2\ (\ell) \rightarrow 2\ H_2O\ (\ell) + O_2(g)$
II	$2\ H_2O\ (\ell) \rightarrow 2\ H_2\ (g) + O_2\ (g)$

The activation, initial and final energies were recorded for each experiment.

Experiment	Reactants energy (kJ/mol)	Products energy (kJ/mol)	Activation energy (kJ/mol)
I	1139	1041	75
II	1852	2336	237

4.1 Define the term *activation energy*. (2)

4.2 In which experiment (I or II) Is the reaction ENDOTHERMIC? Provide a reason for your answer. (3)

4.3 Calculate the following for **experiment I**:

4.3.1 Potential energy of the activated complex. (2)

4.3.2 Heat of the reaction. (3)

4.3.3 The potential energy of the reactants of the reverse reaction. (1)

4.4 Draw a potential energy graph for **experiment I**. The following must be indicated on your graph:

- Energy of reactants and products
- Activation energy (E_a)
- Heat of reaction (ΔH) (4)

[15]

QUESTION 5 (Start on a new page.)

5.1 If a solution of silver nitrate ($AgNO_3$) is mixed with a solution of potassium chloride (KCl), a precipitate of AgCl is produced according to the following reaction:

$$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$$

Reagents	Volume (cm^3)	Concentration ($mol.dm^{-3}$)
KCl(aq)	55	0,25
$AgNO_3$(aq)	70	0,15

5.1.1 What is meant by *limiting reagent*? (2)

5.1.2 Determine which substance is the limiting reagent. (5)

5.1.3 What is the mass of AgCl that is formed? (4)

5.1.4 Calculate the mass left over of the substance in excess. (5)

5.2 Magnesium burns in the air to form magnesium oxide according to the following balanced equation.

$$2\ Mg(s) + O_2(g) \rightarrow 2\ MgO\ (s)$$

If the percentage yield of magnesium oxide is only 80%, calculate the mass of magnesium required to produce 30 g of magnesium oxide.

(7)

[23]

QUESTION 6 (Start on a new page.)

6.1 A learner performed a titration using 25 cm^3 of a 0,3 $mol.dm^{-3}$ solution of a weak base, namely calcium hydroxide ($Ca(OH)_2$) with 40 cm^3 of a strong acid, hydrochloric acid (HCl).

6.1.1 Define a *weak base*. (2)

6.1.2 Write a balanced chemical equation for the reaction between HCl and $Ca(OH)_2$. (3)

6.1.3 Calculate the concentration of the HCl solution. (4)

6.1.4 Select the predicted approximate pH of the salt produced using the following table. Write down the category only.

Categories	***Predictable approximate pH at endpoint.***
A	$0 \ to \ \pm 3$
B	$\pm 3 \ \ to \ \pm 6{,}5$
C	$\pm 6{,}5 \ to \ \pm 9$

(1)

6.1.5 Name a suitable indicator for this titration based on your answer above. (1)

6.2 Consider the reaction below and answer the questions that follow:

$$HSO_4^- + H_2O \rightleftarrows H_30^+ + SO_4^{2-}$$

6.2.1 Define an *acid* in terms of the Lowry-Brønsted model. (1)

6.2.2 Identify the conjugate acid-base pairs in the above reaction. (4)

6.2.3 Write the acid half reaction. (2)

6.2.4 Name TWO species that can act as ampholytes from the above reaction. (2)

6.2.5 Can the proticity of the acid above be described as monoprotic, diprotic or triprotic? Provide a reason for your answer. (2)

[22]

QUESTION 7 (Start on a new page.)

The following reaction occurs when solid copper is placed in a solution of silver nitrate:

$$\boldsymbol{Cu(s) + 2\,AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)}$$

7.1 Define *reduction* in terms of electron transfer and oxidation numbers. (2)

7.2 Write down the oxidation half reaction. (2)

7.3 Provide the formula of the oxidizing agent. (1)

7.4 Which substance acts as a spectator ion? Motivate your answer. (2)

7.5 Write the balanced net ionic equation. (3)

7.6 Provide the oxidation number of:

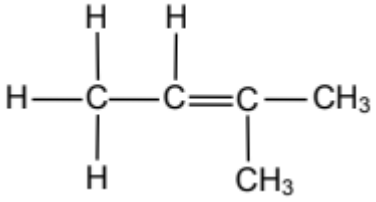
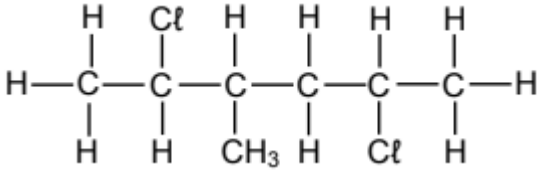
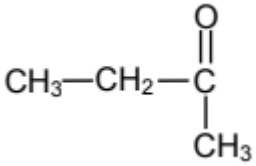
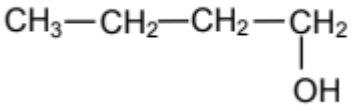
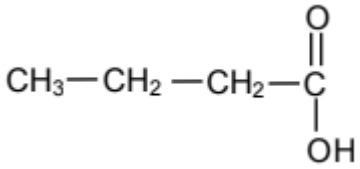
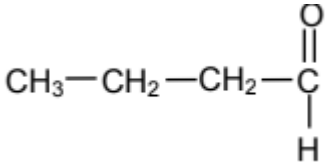
7.6.1 $Ag(s)$ (1)

7.6.2 Copper in $Cu(NO_3)_2(aq)$ (2)

[13]

QUESTION 8 (Start on a new page.)

A to F in the table below represent six organic compounds.

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

8.1 Is compound **A** described as saturated or unsaturated. Provide a reason for your answer. (2)

8.2 Which compound is a hydrocarbon? (1)

8.3 Write the condensed formula for compound **F**. (1)

8.4 Provide the IUPAC name for compounds:

8.4.1 A (2)

8.4.2 B (3)

8.4.3 C (2)

8.5 Can compound **D** be described as a primary, secondary or tertiary alcohol? Provide a reason for your answer. (2)

8.6 Name the ester that compounds **D** and **E** produce. (2)

[15]

DATA FOR PHYSICAL SCIENCES GRADE 11
(CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard pressure *Standaarddruk*	$p^\ominus$	$1{,}013 \times 10^5\ Pa$
Molar gas constant *Molêre gaskonstante*	R	$8{,}31\ J.K^{-1}.mol^{-1}$
Standard temperature *Standaardtemperatuur*	$T^\ominus$	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$	$n = \frac{N}{N_A}$
$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$		

THE PERIODIC TABLE OF ELEMENTS // *DIE PERIODIEKE TABEL VAN ELEMENTE*

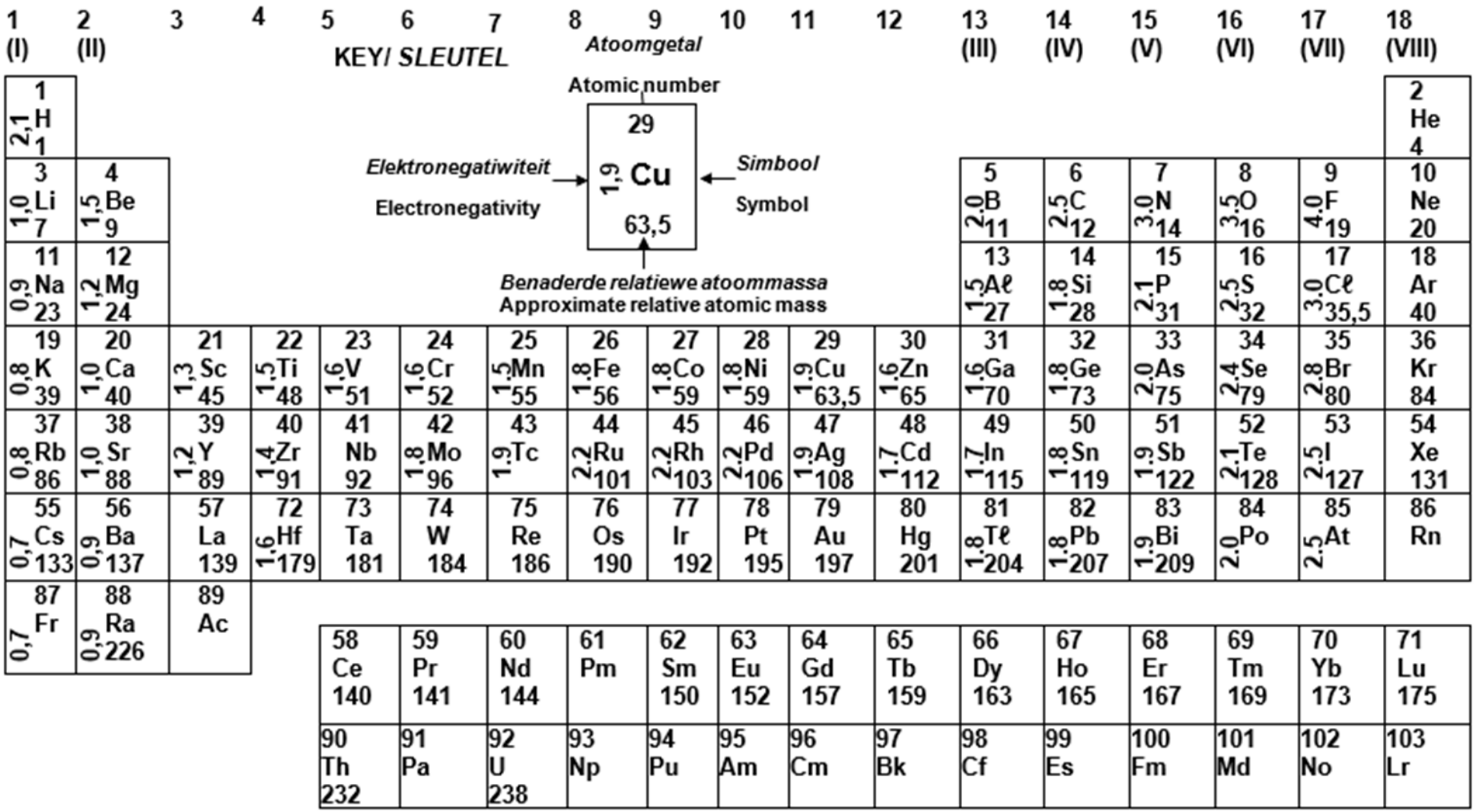


TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARDREDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende 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

Increasing reducing ability/*Toenemende reduserende vermoë* ↓