



**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

JUNE 2023

**TECHNICAL SCIENCES: CHEMISTRY P2
(DEAF)**

MARKS: 75

TIME: 1½ hours



This question paper has of 14 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your **FULL NAME** and **SURNAME** on the **ANSWER BOOK**.
2. This **question paper** has **SIX questions**.
Answer ALL the **questions** in the **ANSWER BOOK**.
3. Start **EACH question** on a **NEW page** in the **ANSWER BOOK**.
4. You **may use** a **prescribed calculator**.
5. You may use appropriate mathematical instruments.
6. **Number** the **answers** the **same** as the **numbers** on the **question paper**.
7. **Show** **ALL formulae** and **substitutions** in **ALL calculations**.
8. **Round off** your **FINAL answers** to **TWO decimal places**.
9. Give **explanations** for **your answers** if the **question tells you** to do it.
10. **Use** the **DATA SHEETS**.
11. Write **neatly**.
Your **work** must be **easy** to read.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Choose the answer.

Write only the letter (A–D) next to the question numbers (1.1 to 1.5), e.g. 1.6 D.

- 1.1 Which ONE of the combinations is correct about the name of the functional group and homologous series?

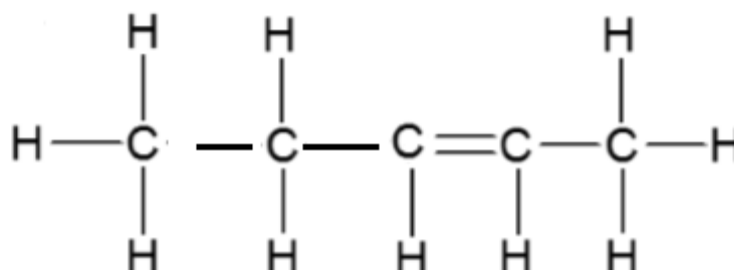
	Name of the functional group	Homologous series
A	Carboxyl group	Ketone
B	Formyl group	Carboxylic acid
C	Carboxyl group	Aldehyde
D	Hydroxyl group	Alcohol

(2)

- 1.2 **Table:**

Look at the structural formula of the compound below.

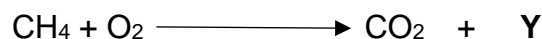
Identify its correct IUPAC name and the type of hydrocarbon:



- A Pent-3-ene; saturated
- B Pent-2-ene; unsaturated
- C 2-Pentane; unsaturated
- D Pent-2-ene; saturated

(2)

1.3 Study the organic reaction. Answer the question.



The **substance** that **Y** represents is ..., and it is an ... **compound**.

- A water; organic
- B water; inorganic
- C carbon; organic
- D methane; inorganic (2)

1.4 Table:

Which of the set of answers is the correct arrangement of semiconductors?

	Valence electrons	Arrangement of covalent bonds	Element	Material
A	4	tetrahedral	carbon	diamond
B	4	hexagonal	diamond	carbon
C	5	tetrahedral	arsenic	phosphorous
D	5	pentagonal	germanium	silicon

(2)

1.5 Extrinsic and intrinsic semiconductors:

- (i) In doping, an impurity is added to a semiconductor to improve the conductivity of the semiconductor
- (ii) In doping, a catalyst is added to a semiconductor to improve the conductivity of the semiconductor
- (iii) A few protons gain enough thermal energy to cross the energy gap (from the valence band) to the conduction band
- (iv) Semiconductors are doped with a trivalent impurity
- (v) A few electrons gain enough thermal energy to cross the energy gap (from the valence band) to the conduction band

Which **ONE** of the combinations below is **CORRECT**?

- A (i) and (ii)
- B (ii) and (iii)
- C (i) and (iv)
- D (iii) and (iv) (2)

[10]

QUESTION 2 (Start on a NEW page.)

Consider the **organic compounds** represented by the letters **A** to **G**.
Answer the questions.

A	Hex-2-ene	E	2-methylpropan-2-ol
B	$ \begin{array}{cccccc} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	F	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & \text{O} & \text{H} & \text{H} \\ & & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{O} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & \text{H} & \text{H} & & & \text{H} & \text{H} \end{array} $
C	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{H} & \text{O} & \text{H} & \text{H} \\ & & & & \\ & & \text{H} & & \end{array} $	G	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{O} \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{O} & - \text{H} \\ & & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array} $
D	$ \begin{array}{cccccc} & \text{H} & \text{H} & & \text{H} & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - \text{C} & = \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	H	$ \begin{array}{ccc} & \text{H} & \text{O} & \text{H} \\ & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & \\ & \text{H} & & \text{H} \end{array} $

- 2.1 **Define the term *hydrocarbon*.** (2)
- 2.2 **Write down the letter(s) that represents:**
- 2.2.1 A secondary alcohol (1)
- 2.2.2 A saturated hydrocarbon (1)
- 2.2.3 Functional isomers (2)
- 2.2.4 Hydrocarbons (1)
- 2.2.5 Positional isomers (2)

2.3 Write down the IUPAC name of:

2.3.1 D (1)

2.3.2 H (1)

2.3.3 F (2)

2.4 Write down the:

2.4.1 STRUCTURAL formula of compound A (2)

2.4.2 STRUCTURAL formula for the functional group of compound D (1)

2.4.3 MOLECULAR formula of compound B (1)

2.4.4 The name of a ketone (1)

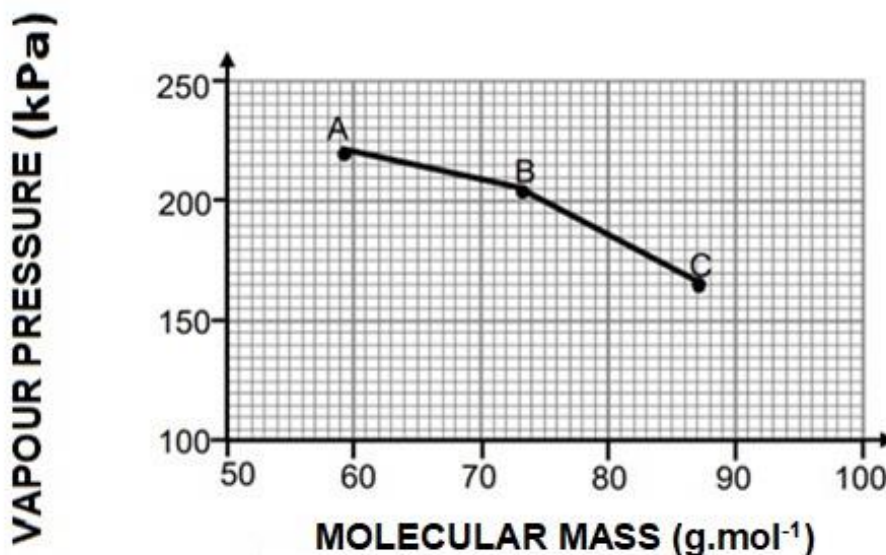
2.4.5 STRUCTURAL formula of compound E (2)

[20]

QUESTION 3 (Start on a NEW page.)

Students were observing the vapour pressure of three (3) organic compounds from a homologous series with a general formula C_nH_{2n+2} , shown by A, B and C. The number of carbon atoms of these organic compounds ranges between 3 carbon atoms and 5 carbon atoms.

Their results were graphed as follows:



- 3.1 Define the term *homologous series*. (2)
- 3.2 What trend can be deduced_(reasoned) from the graph? (2)
- 3.3 Identify the type of intermolecular forces that exist between the molecules of these organic compounds. (1)
- 3.4 Write down the names of the compounds in the graph
It is represented by the letters:
- 3.4.1 A (1)
- 3.4.2 B (1)
- 3.4.3 C (1)
- 3.5 Explain the difference in the vapour pressure of compounds B and C.
Refer to the MOLECULAR MASSES, STRENGTH OF INTERMOLECULAR FORCES and THE ENERGY NEEDED. (4)
- 3.6 Which compound will have the ...? (Write only A, B or C.)
- 3.6.1 highest viscosity (1)
- 3.6.2 lowest melting point (1)
- 3.6.3 highest boiling point (1)

[15]

QUESTION 4 (Start on a NEW page.)**Table:**

The table shows the **boiling points** of **four organic compounds**.

It is represented by the letters **A** to **D**, of comparable molecular mass.

	Compound	Molecular mass	Boiling point (°C)
A	Butane	58	0
B	Propanone	58	49
C	Propan-1-ol	60	97
D	Ethanoic acid	60	118

4.1 **Which compound** can be **used** as a **fuel** in **gas burners**? (1)

4.2 **Explain** your **answer** to **QUESTION 4.1**. (2)

4.3 **How** will the **boiling point** of **2-methylpropane** compare to that of compound **A**?

Write **HIGHER THAN**, **LOWER THAN** or **EQUAL TO**.

Refer to **MOLECULAR STRUCTURES**, **INTERMOLECULAR FORCES** and the **ENERGY** needed to **explain** the answer. (4)

4.4 **What** is the **relationship** between **compound A** and **2-methyl propane**? Explain. (2)

4.5 Consider the vapour pressure of compounds **B** and **C**. These **compounds** have **different vapour pressure**.

4.5.1 Give a reason for this difference in vapour pressure by referring to the intermolecular forces present in **EACH** of these compounds. (4)

Which ONE of **compounds B** or **C** has the:

4.5.2 Highest vapour pressure (1)

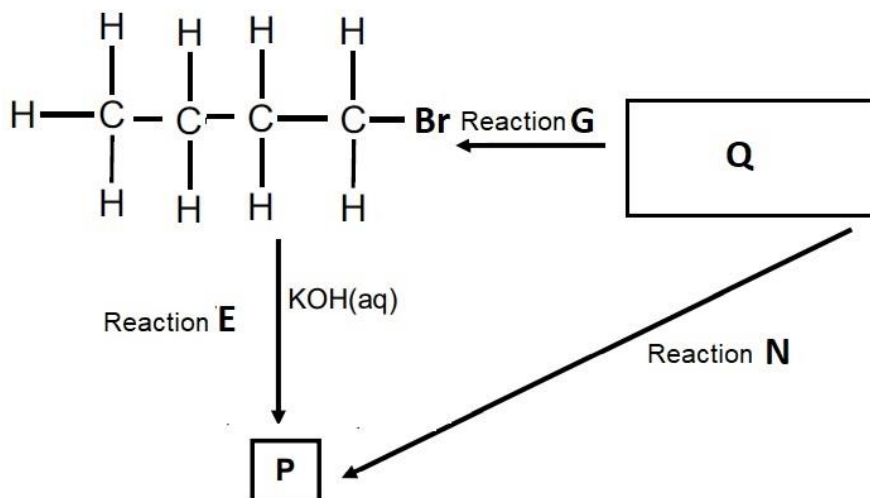
4.5.3 Highest melting point (1)

4.5.4 Lowest viscosity (1)

[16]

QUESTION 5 (Start on a NEW page.)

Flow diagram: Organic reactions. Answer the questions.



5.1 Write down the **TYPE** of reaction shown by:

5.1.1 **G** (1)

5.1.2 **E** (1)

5.1.3 **N** (1)

5.2 For Reaction **E**, write down:

5.2.1 The homologous series to which compound **P** belongs (1)

5.2.2 ONE reaction condition (1)

5.2.3 The **balanced chemical equation using STRUCTURAL FORMULAE** (3)

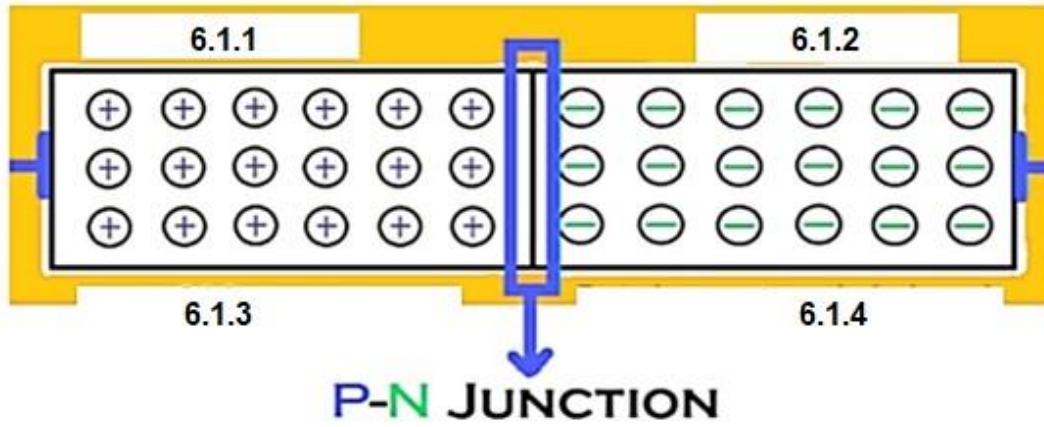
5.3 Write down the **structural formula** for compound **Q**. (2)

[10]

QUESTION 6 (Start on a NEW page.)

A **p-n junction is formed** when a **p-doped semiconductor** is **connected** to an **n-doped semiconductor**.

6.1 **Label** the following **diagram** of a **p-n junction**.



[4]

TOTAL: 75

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR TEGNIESE WETENSAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAAM/NAME	SIMBOOL/SYMBOL	WAARDE/VALUE
Avogadro se konstante Avogadro's constant	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molêre gaskonstante Molar gas constant	R	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standaarddruk Standard pressure	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molêre gasvolume teen STD Molar gas volume at STP	V_m	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standaardtemperatuur Standard temperature	T^θ	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at /by 298K
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sel}} = E^\theta_{\text{reduksie}} - E^\theta_{\text{oksidasie}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$		

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

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

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
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 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
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 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

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

Half-reactions/Halfreaksies	E^θ (V)
$\text{Li}^+ + \text{e}^- \rightleftharpoons \text{Li}$	- 3,05
$\text{K}^+ + \text{e}^- \rightleftharpoons \text{K}$	- 2,93
$\text{Cs}^+ + \text{e}^- \rightleftharpoons \text{Cs}$	- 2,92
$\text{Ba}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ba}$	- 2,90
$\text{Sr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sr}$	- 2,89
$\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$	- 2,87
$\text{Na}^+ + \text{e}^- \rightleftharpoons \text{Na}$	- 2,71
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	- 2,36
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	- 1,66
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}$	- 1,18
$\text{Cr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cr}$	- 0,91
$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	- 0,83
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	- 0,76
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}$	- 0,74
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	- 0,44
$\text{Cr}^{3+} + \text{e}^- \rightleftharpoons \text{Cr}^{2+}$	- 0,41
$\text{Cd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cd}$	- 0,40
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}$	- 0,28
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$	- 0,27
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}$	- 0,14
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	- 0,13
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	- 0,06
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+ 0,14
$\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$	+ 0,15
$\text{Cu}^{2+} + \text{e}^- \rightleftharpoons \text{Cu}^+$	+ 0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+ 0,17
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+ 0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightleftharpoons 4\text{OH}^-$	+ 0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+ 0,45
$\text{Cu}^+ + \text{e}^- \rightleftharpoons \text{Cu}$	+ 0,52
$\text{I}_2 + 2\text{e}^- \rightleftharpoons 2\text{I}^-$	+ 0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{O}_2$	+ 0,68
$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+ 0,77
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+ 0,80
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$	+ 0,80
$\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg}(\ell)$	+ 0,85
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+ 0,96
$\text{Br}_2(\ell) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$	+ 1,07
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+ 1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+ 1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+ 1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+ 1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+ 1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+ 1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+ 1,77
$\text{Co}^{3+} + \text{e}^- \rightleftharpoons \text{Co}^{2+}$	+ 1,81
$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+ 2,87

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