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REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

TECHNICAL SCIENCES P2

NOVEMBER 2025

MARKS: 75

TIME: 1½ hours

This question paper consists of 13 pages and 4 data sheets.



INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of SEVEN 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 subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You are advised to use the attached DATA SHEETS.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. 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 numbers (1.1 to 1.5) in the ANSWER BOOK, e.g. 1.6 D.

- 1.1 Which ONE of the following reaction types can be used to prepare propane from propene?
- A Oxidation
- B Hydrolysis
- C Halogenation
- D Hydrogenation (2)
- 1.2 Which ONE of the following lists of compounds are arranged in order of decreasing boiling points?
- A Pentanoic acid; butan-1-ol; propane
- B Propane; pentanoic acid; butan-1-ol
- C Butan-1-ol; propane; pentanoic acid
- D Propane; butan-1-ol; pentanoic acid (2)
- 1.3 ... is a saturated hydrocarbon.
- A $\text{CH}_3(\text{CH}_2)_2\text{CHCH}_2$
- B $\text{CH}_3\text{CHCHCH}_2\text{CH}_3$
- C $\text{CH}_3\text{C}(\text{CH}_3)_2\text{CHCH}_2$
- D $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_3$ (2)
- 1.4 The elements in the periodic table that can be used for doping are ...

	TRIVALENT MATERIAL	PENTAVALENT MATERIAL
A	Al	Be
B	B	As
C	C	N
D	B	S

(2)



1.5 Consider the following statements:

- (i) The anode of a galvanic cell is positive.
- (ii) Electroplating of metals takes place in an electrolytic cell.
- (iii) Oxidation takes place at the negative electrode of a galvanic cell.

Which statement(s) is/are CORRECT?

- A Only (i)
- B Only (iii)
- C (ii) and (iii)
- D (i), (ii) and (iii)

(2)
[10]



QUESTION 2 (Start on a new page.)

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

<p>A</p> <pre> H H H H H H - C - C - C - C - C - H H H H H H </pre>	<p>B</p> <p>Ethyl butanoate</p>
<p>C</p> <pre> H C / \ H C=O C-H H </pre>	<p>D</p> <pre> H H H C C - C - H // H-C H H \ H </pre>
<p>E</p> <pre> H H H - C - C ≡ C - H H </pre>	<p>F</p> <pre> H H H H - C - C - C - H H Br C-H H </pre>

2.1 Write down the letter that represents the following:

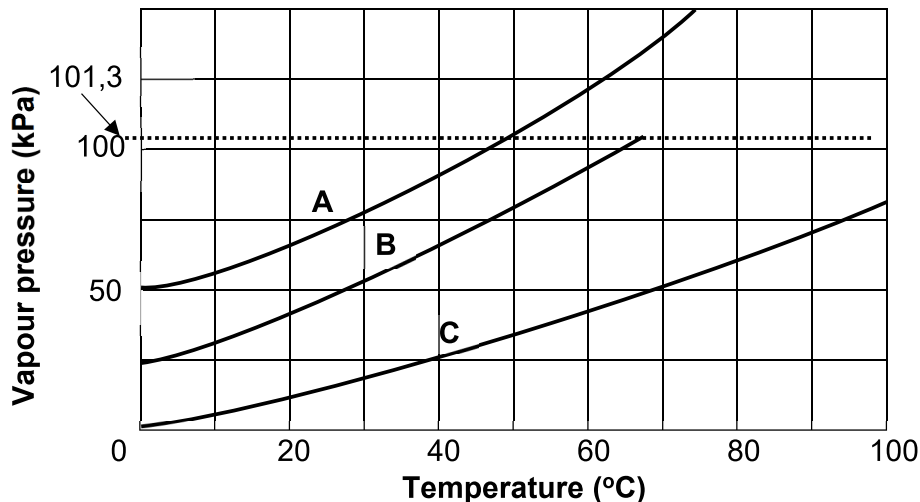
- 2.1.1 A saturated hydrocarbon (1)
- 2.1.2 A compound which is an isomer of but-2-ene (1)
- 2.1.3 An alkyne (1)

- 2.2 Write down the:
- 2.2.1 NAME of the functional group of compound **C** (1)
 - 2.2.2 IUPAC name of compound **F** (2)
- 2.3 Consider compound **B** and write down the:
- 2.3.1 Homologous series to which it belongs (1)
 - 2.3.2 Structural formula (2)
 - 2.3.3 General formula (1)
- [10]**



QUESTION 3 (Start on a new page.)

The graph below shows the relationship between vapour pressure and temperature for three straight chain alkanes (**A**, **B** and **C**). The atmospheric pressure is 101,3 kPa.



3.1 Define the term *vapour pressure*. (2)

3.2 Use the information in the graph above to answer the following questions.

3.2.1 How does an increase in temperature affect the vapour pressure?
Write down only INCREASES, DECREASES or NO EFFECT. (1)

3.2.2 Which compound has a boiling point of approximately 68 °C? (1)

3.2.3 Give a reason for the answer to QUESTION 3.2.2. (2)

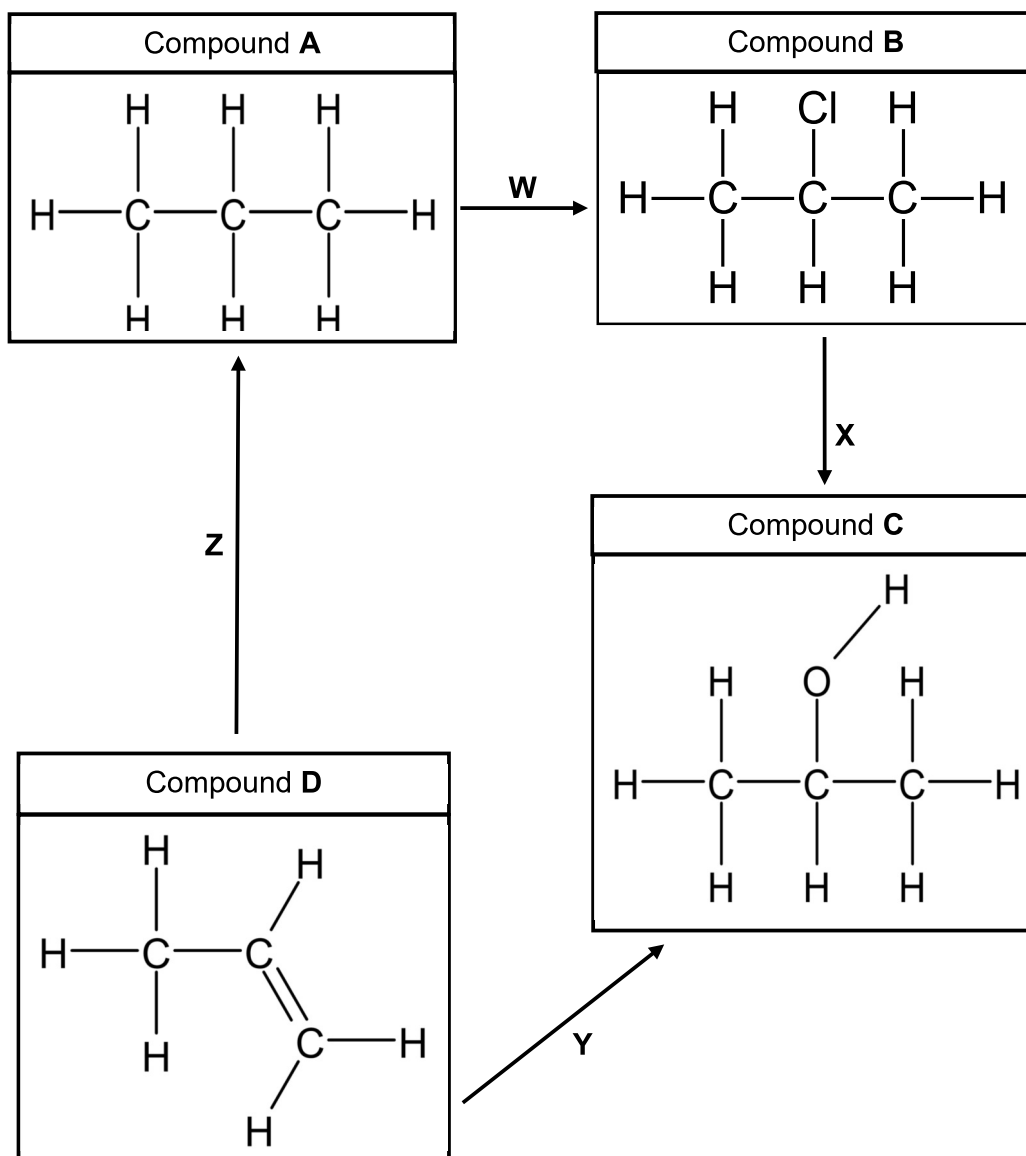
3.2.4 Which compound has the longest chain length?

Explain the answer by referring to the VAPOUR PRESSURE and RELATIVE STRENGTH OF THE INTERMOLECULAR FORCES of the compounds.

(3)
[9]

QUESTION 4 (Start on a new page.)

Study organic reactions **W**, **X**, **Y** and **Z** in the flow chart below and answer the questions that follow.



4.1 For reaction **Y**, write down:

4.1.1 The NAME of the reaction (1)

4.1.2 TWO conditions that are required for this reaction (2)

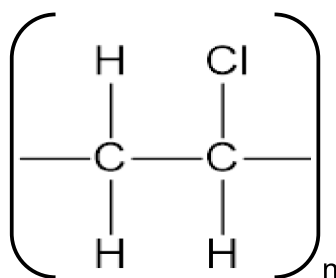
4.2 Identify the type of reaction **Z**. (1)



- 4.3 Write down the CHEMICAL FORMULA for the substance that reacts with compound **A** to form compound **B**. (1)
- 4.4 Write down the NAME of reaction **X**. (1)
- 4.5 Consider the organic compounds in the list below.

Propan-2-ol	Propanal	Propanoic acid	Propanone
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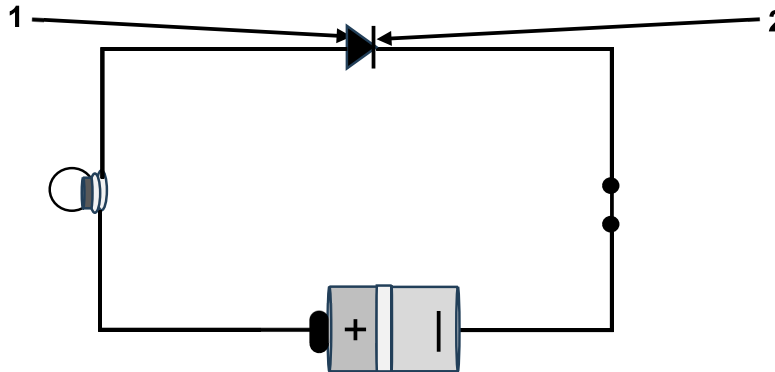
- 4.5.1 In the list above, identify TWO compounds that are functional isomers. (2)
- 4.5.2 Explain and use STRUCTURAL FORMULAE to support the answer to QUESTION 4.5.1. Label each structural formula. (4)
- 4.6 Define the term *polymer*. (2)
- 4.7 Draw the structural formula of the monomer used in the production of the polymer below.



(2)
[16]

QUESTION 5 (Start on a new page.)

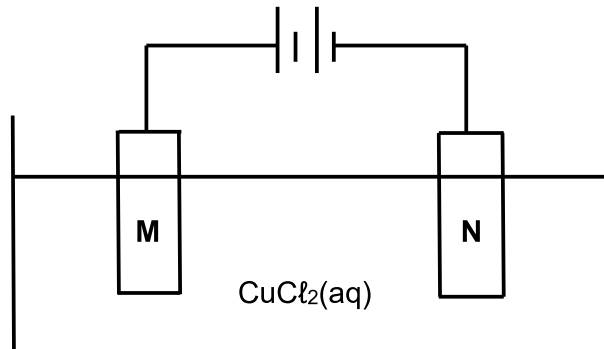
Study the diagram below and answer the questions that follow.



- 5.1 Name part 1. (1)
- 5.2 What type of p-n junction diode is this? Write only FORWARD BIASED or REVERSE BIASED or ZERO BIASED. (1)
- 5.3 Give a reason for the answer to QUESTION 5.2. (2)
- 5.4 Write down TWO characteristics of the p-n junction diode in QUESTION 5.2. (2)
- [6]**





QUESTION 6 (Start on a new page.)

The diagram below represents an electrolytic cell used in the decomposition of a copper (II) chloride solution.



- 6.1 Define the term *electrolyte*. (2)
- 6.2 Which electrode, **M** or **N**, is the anode? (1)
- 6.3 Write down the half-reaction that occurs at electrode **M**. (2)
- 6.4 Write down the:
- 6.4.1 Chemical formula of the substance that forms at electrode **N** (1)
- 6.4.2 Name of the oxidising agent in this reaction (1)

- 6.5 Consider the forms of alternative energy sources in the table below and answer the questions that follow.

	TYPE OF ENERGY	DIAGRAM
A	Wind energy	
B	Solar energy	
C	Hydroelectric energy	
D	Biodiesel	

- 6.5.1 Name ONE advantage of alternative energy. (1)
- 6.5.2 Write down the letter of the energy source that is linked to the operation of a photovoltaic cell. (1)
- 6.5.3 Write down the energy conversion that takes place in the cell referred to in QUESTION 6.5.2. (1)
- 6.5.4 What is *biodiesel*? (2)
- [12]**

QUESTION 7 (Start on a new page.)

The table below shows half-cell **A** and an unknown half-cell **B** used to assemble a galvanic cell under standard conditions.

Half-cell A	$\text{Ni}^{2+}(\text{aq})/\text{Ni}(\text{s})$
Half-cell B	Unknown

The initial emf reading of the cell when in operation is 0,17 V and the polarity of half-cell **B** is NEGATIVE.

- 7.1 Define the term *reduction* in terms of electron transfer. (2)
- 7.2 Use a calculation to identify the electrode in half-cell **B**. (5)
- 7.3 For this cell, write down the:
- 7.3.1 Half-reaction for half-cell **A** (2)
- 7.3.2 Cell notation (3)
- [12]**

TOTAL: 75



**DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2
GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2**

TABLE 1/TABEL 1: PHYSICAL CONSTANTS/FISIËSE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p^{θ}	$1,01 \times 10^5 \text{ Pa}$
Standard temperature <i>Standaardtemperatuur</i>	T^{θ}	$0 \text{ }^{\circ}\text{C}/273 \text{ K}$

TABLE 2/TABEL 2: FORMULAE/FORMULES

Emf/Emk	$E^{\theta}_{\text{cell}} = E^{\theta}_{\text{cathode}} - E^{\theta}_{\text{anode}} \quad / \quad E^{\theta}_{\text{sel}} = E^{\theta}_{\text{katode}} - E^{\theta}_{\text{anode}}$ <i>or/of</i> $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{reduction}} - E^{\theta}_{\text{oxidation}} \quad / \quad E^{\theta}_{\text{sel}} = E^{\theta}_{\text{reduksie}} - E^{\theta}_{\text{oksidasie}}$ <i>or/of</i> $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{oxidising agent}} - E^{\theta}_{\text{reducing agent}} \quad / \quad E^{\theta}_{\text{sel}} = E^{\theta}_{\text{oksideermiddel}} - E^{\theta}_{\text{reduseermiddel}}$
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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18				
(I)	(II)	KEY/SLEUTEL										(III)	(IV)	(V)	(VI)	(VII)	(VIII)				
Atomic number Atoomgetal		Electronegativity Elektronegatiwiteit										Approximate relative atomic mass Benaderde relatiewe atoommassa									
Symbol Simbool		Symbol Simbool										Symbol Simbool									
1 H 1,01	2 He 4,00	3 Li 6,94	4 Be 9,01	5 B 10,81	6 C 12,01	7 N 14,01	8 O 16,00	9 F 18,99	10 Ne 20,18	11 Na 22,99	12 Mg 24,31	13 Al 26,98	14 Si 28,09	15 P 30,97	16 S 32,06	17 Cl 35,45	18 Ar 39,95				
19 K 39,10	20 Ca 40,08	21 Sc 44,96	22 Ti 47,88	23 V 50,94	24 Cr 51,99	25 Mn 54,94	26 Fe 55,85	27 Co 58,93	28 Ni 58,71	29 Cu 63,55	30 Zn 65,38	31 Ga 69,72	32 Ge 72,64	33 As 74,92	34 Se 78,96	35 Br 79,90	36 Kr 83,80				
37 Rb 85,47	38 Sr 87,62	39 Y 88,91	40 Zr 91,22	41 Nb 92,91	42 Mo 95,94	43 Tc 98,91	44 Ru 101,07	45 Rh 102,91	46 Pd 106,42	47 Ag 107,87	48 Cd 112,41	49 In 114,82	50 Sn 118,71	51 Sb 121,76	52 Te 127,60	53 I 126,91	54 Xe 131,29				
55 Cs 132,91	56 Ba 137,33	57 La 138,91	72 Hf 178,49	73 Ta 180,95	74 W 183,84	75 Re 186,21	76 Os 190,23	77 Ir 192,22	78 Pt 195,08	79 Au 196,97	80 Hg 200,59	81 Tl 204,38	82 Pb 207,20	83 Bi 208,98	84 Po 209	85 At 210	86 Rn 222				
87 Fr 223	88 Ra 226	89 Ac	58 Ce 140,12	59 Pr 140,91	60 Nd 144,24	61 Pm	62 Sm 150,36	63 Eu 151,96	64 Gd 157,25	65 Tb 158,93	66 Dy 162,50	67 Ho 164,93	68 Er 167,26	69 Tm 168,93	70 Yb 173,05	71 Lu 174,97					
			90 Th 232,04	91 Pa 231,04	92 U 238,03	93 Np	94 Pu 244	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr					

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

Half-reactions/Halfreaksies		E° (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
$Li^+ + e^-$	$\rightleftharpoons Li$	- 3,00

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels

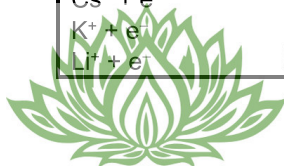


TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/Halfreaksies		E ⁰ (V)
Li ⁺ + e ⁻	⇌ Li	- 3,05
K ⁺ + e ⁻	⇌ K	- 2,93
Cs ⁺ + e ⁻	⇌ Cs	- 2,92
Ba ²⁺ + 2e ⁻	⇌ Ba	- 2,90
Sr ²⁺ + 2e ⁻	⇌ Sr	- 2,89
Ca ²⁺ + 2e ⁻	⇌ Ca	- 2,87
Na ⁺ + e ⁻	⇌ Na	- 2,71
Mg ²⁺ + 2e ⁻	⇌ Mg	- 2,36
Al ³⁺ + 3e ⁻	⇌ Al	- 1,66
Mn ²⁺ + 2e ⁻	⇌ Mn	- 1,18
Cr ²⁺ + 2e ⁻	⇌ Cr	- 0,91
2H ₂ O + 2e ⁻	⇌ H ₂ (g) + 2OH ⁻	- 0,83
Zn ²⁺ + 2e ⁻	⇌ Zn	- 0,76
Cr ³⁺ + 3e ⁻	⇌ Cr	- 0,74
Fe ²⁺ + 2e ⁻	⇌ Fe	- 0,44
Cr ³⁺ + e ⁻	⇌ Cr ²⁺	- 0,41
Cd ²⁺ + 2e ⁻	⇌ Cd	- 0,40
Co ²⁺ + 2e ⁻	⇌ Co	- 0,28
Ni ²⁺ + 2e ⁻	⇌ Ni	- 0,27
Sn ²⁺ + 2e ⁻	⇌ Sn	- 0,14
Pb ²⁺ + 2e ⁻	⇌ Pb	- 0,13
Fe ³⁺ + 3e ⁻	⇌ Fe	- 0,06
2H⁺ + 2e⁻	⇌ H₂(g)	0,00
S + 2H ⁺ + 2e ⁻	⇌ H ₂ S(g)	+ 0,14
Sn ⁴⁺ + 2e ⁻	⇌ Sn ²⁺	+ 0,15
Cu ²⁺ + e ⁻	⇌ Cu ⁺	+ 0,16
SO ₄ ²⁻ + 4H ⁺ + 2e ⁻	⇌ SO ₂ (g) + 2H ₂ O	+ 0,17
Cu ²⁺ + 2e ⁻	⇌ Cu	+ 0,34
2H ₂ O + O ₂ + 4e ⁻	⇌ 4OH ⁻	+ 0,40
SO ₂ + 4H ⁺ + 4e ⁻	⇌ S + 2H ₂ O	+ 0,45
Cu ⁺ + e ⁻	⇌ Cu	+ 0,52
I ₂ + 2e ⁻	⇌ 2I ⁻	+ 0,54
O ₂ (g) + 2H ⁺ + 2e ⁻	⇌ H ₂ O ₂	+ 0,68
Fe ³⁺ + e ⁻	⇌ Fe ²⁺	+ 0,77
NO ₃ ⁻ + 2H ⁺ + e ⁻	⇌ NO ₂ (g) + H ₂ O	+ 0,80
Ag ⁺ + e ⁻	⇌ Ag	+ 0,80
Hg ²⁺ + 2e ⁻	⇌ Hg(l)	+ 0,85
NO ₃ ⁻ + 4H ⁺ + 3e ⁻	⇌ NO(g) + 2H ₂ O	+ 0,96
Br ₂ (l) + 2e ⁻	⇌ 2Br ⁻	+ 1,07
Pt ²⁺ + 2e ⁻	⇌ Pt	+ 1,20
MnO ₂ + 4H ⁺ + 2e ⁻	⇌ Mn ²⁺ + 2H ₂ O	+ 1,23
O ₂ (g) + 4H ⁺ + 4e ⁻	⇌ 2H ₂ O	+ 1,23
Cr ₂ O ₇ ²⁻ + 14H ⁺ + 6e ⁻	⇌ 2Cr ³⁺ + 7H ₂ O	+ 1,33
Cl ₂ (g) + 2e ⁻	⇌ 2Cl ⁻	+ 1,36
MnO ₄ ⁻ + 8H ⁺ + 5e ⁻	⇌ Mn ²⁺ + 4H ₂ O	+ 1,51
H ₂ O ₂ + 2H ⁺ + 2e ⁻	⇌ 2H ₂ O	+ 1,77
Co ³⁺ + e ⁻	⇌ Co ²⁺	+ 1,81
F ₂ (g) + 2e ⁻	⇌ 2F ⁻	+ 2,87

Increasing strength of oxidising agents/Toenemende sterkte van oksideermiddels

Increasing strength of reducing agents/Toenemende sterkte van reduseermiddels

