Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2015

PHYSICAL SCIENCES P2

MARKS: **150**

TIME: **3 hours**

This question paper consists of 17 pages including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.

2. The question paper consists of EIGHT questions. Answer ALL the questions.

3. Start EACH question on a new page in the ANSWER BOOK.

4. Number your answers correctly according to the numbering system used in this question paper.

5. Leave ONE line open between sub-questions, for example QUESTION 2.1 and QUESTION 2.2.

6. A non-programmable calculator may be used.

7. Appropriate mathematical instruments may be used.

8. You are advised to use the attached DATA SHEETS and the PERIODIC TABLE.

9. Shows ALL formulae and institutions in ALL your calculations.

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

11. Wherever motivations, discussions, etc. are required, be brief.

12. 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. Write only the correct answer (A−D) next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Iodine crystals (I_2(s)) are soluble in ethanol (CH_3CH_2OH(l)) because the …

A hydrogen bonds between ethanol molecules are much stronger than the dispersion forces between iodine molecules.
B hydrogen bonds between ethanol molecules and the covalent bonds between iodine molecules are of comparable strength.
C iodine molecules and the ethanol molecules are non-polar and "like dissolve like".
D London/dispersion forces between ethanol molecules and iodine molecules are of comparable strength and "like dissolve like". (2)

1.2 Which of the following solutions are considered to be electrolytes?

(i) Sugar in water ($C_{12}H_{22}O_{11}$(aq))
(ii) Table salt in water (NaCℓ(aq))
(iii) Hydrochloric acid ($HCℓ_{(aq)}$)

A (i) and (ii)
B (i) and (iii)
C (ii) and (iii)
D (i), (ii) and (iii) (2)

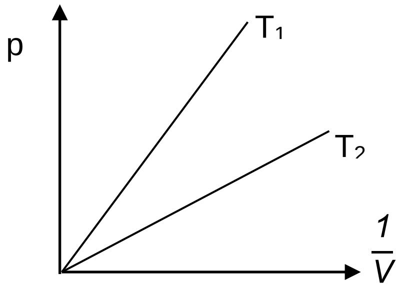
1.3 0.5 dm^3 of a gas at 20 °C and 130 kPa is cooled down while the volume is kept constant. The pressure on the gas at a temperature of -5 °C is …

A 142,13 kPa.
B 123,34 kPa.
C 118,91 kPa.
D 32,5 kPa. (2)

1.4 The calculation in QUESTION 1.3 is an illustration of …

A Avogadro's Law.
B Charles's Law.
C Guy-Lussac's Law.
D The ideal gas law. (2)

1.5 A pupil investigated Boyle's Law and represented his results graphically:



The results show that:

A	$p \alpha \frac{1}{V}$	$T_1>T_2$
B	$p \alpha \frac{1}{V}$	$T_1<T_2$
C	$p \alpha V$	$T_1>T_2$
D	$p \alpha \frac{1}{V}$	$T_1=T_2$

(2)

1.6 Which ONE of the reactions below is a **redox** reaction?

A $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
B $ZnSO_4(aq) + H_2S(g)) \rightarrow ZnS(s) + H_2SO_4(aq)$
C $CO_2(g) + Ca(OH)_2(aq) \rightarrow CaCO_3(g) + H_2O(l)$
D $2NH_4C\ell(s) + Ca(OH)_2(s) \rightarrow 2NH_3(g) + CaC\ell_2(s) + 2H_2O(l)$ (2)

1.7 Consider the following acid-base reactions:

$$NH_3(g) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$$
$$SO_4^{2-}(aq) + HNO_3(aq) \rightarrow HSO_4^-{}_{(aq)} + NO_3^-(aq)$$

The substances acting as proton acceptors in the above reactions are:

A H_2O and SO_4^{2-}
B NH_3 and SO_4^{2-}
C NH_3 and HNO_3
D H_2O and HNO_3 (2)

1.8 Consider the following reversible reaction:

$H_3O^+ + OH^- \leftrightarrow H_2O + H_2O$

The substance which is acting as an ampholyte is …

A H_3O^+ ions.
B OH^- ions.
C H_2O molecules.
D None of the above. (2)

1.9 Gold-bearing rock goes to a grinding mill where the ore is crushed into a powder. The gold is removed from the powder by the following process:

A Filtration
B Adsorption
C Smelting
D Leaching (2)

1.10 Consider the following redox reaction:

$Zn + Au^{3+} \rightarrow Zn^{2+} + Au$

Which of the following statements is INCORRECT?

A Gold is recovered by a process of zinc precipitation.
B Gold ions are oxidised in the recovery process.
C Zinc displaces dissolved gold from a solution of its ions.
D Zinc is added as a reducing agent during the recovery of gold. (2)

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QUESTION 2 (Start on a new page.)

Consider the following molecules and answer the questions that follow.

A	NH_3
B	CO_2
C	C_2H_2
D	H_20
E	BH_3

Which molecule:

2.1 2.1.1 Contains a triple bond? (1)

2.1.2 Is trigonal planar? (1)

2.1.3 Is angular in shape and contains a centre atom with two lone pairs? (1)

2.2 Which TWO molecules can form a dative covalent bond with a hydrogen ion? (2)

2.3 2.3.1 Draw a Lewis structure of the CO_2 molecule. (2)

2.3.2 Briefly explain why the bonds shown in your answer to QUESTION 2.3.1 are considered to be "polar covalent". Refer to the difference in electronegativity of the atoms involved. (4)

[11]

QUESTION 3 (Start on a new page.)

3.1 For the substances mentioned in 3.1.1 to 3.1.3 write down the NAME of the most important intermolecular forces:

3.1.1 Between the molecules in liquid methane (CH_4) (1)

3.1.2 Between water and methanol (CH_3OH) molecules in a mixture of the liquids (1)

3.1.3 In an aqueous solution of lithium chloride (LiC*l)* (1)

3.2 Water has unique properties.
Complete the following table to show your understanding of some of these properties and the effect it has on our climate or living organisms.

Property of water	**2 Reasons for property**	**Effect on our climate or organisms**
E.g.: High boiling point	*(1) Strong hydrogen bonds between molecules.* *(2) Large amount of energy required to vaporise.*	*Most of the water on earth remain in the liquid state.*
High specific heat capacity	3.2.1 ... (2)	3.2.2 ... (1)
Density of ice less than that of water	3.2.3 ... (2)	3.2.4 ... (1)
High capillary action	3.2.5 ... (2)	3.2.6 ... (1)

(9)
[12]

QUESTION 4 (Start on a new page.)

4.1 In an investigation into the relationship between the bond energy and bond length a student looked up the bond energy between various pairs of atoms: He recorded his findings in the table shown below:

BOND	LENGTH (pm)	ENERGY kJ/mol
C≡C	120	839
C=O	123	804
O=O	121	498
C–C	154	348
O–O	148	145
H–O	96	463
C–O	143	358
H–C	109	413

4.1.1 What is the INDEPENDENT VARIABLE in this investigation? (1)

4.1.2 What is the DEPENDENT VARIABLE in this investigation? (1)

4.1.3 Would this be considered a fair test? Write only YES or NO. (1)

4.1.4 Briefly explain your answer to QUESTION 4.1.3. (2)

4.2 Consider the combustion of 1 mol methane:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Use the values provided in the table given above to answer the following questions:

4.2.1 What is the total amount of energy required to break all the bonds in 1 mol CH_4 and 1 mol O_2? (4)

4.2.2 How much energy is released when bonds form to produce 2 mol of H_2O and 1 mol of CO_2? (4)

4.2.3 Hence calculate the energy transferred (ΔH) for the combustion of 1 mol CH_4. (2)

4.2.4 Draw a labelled energy profile for this reaction.

Include the labels: ENTHALPY CHANGE (ΔH)
ACTIVATION ENERGY (E_a) (6)

4.3 Methanol (CH_3OH) can also be burnt in O_2 to produce energy or decomposed to form hydrogen gas which is a useful fuel. Consider the following reaction where methanol is decomposed to form hydrogen:

$$CH_3OH_{(l)} \rightarrow 2H_{2(g)} + CO_{(g)}$$

4.3.1 If 125 g of methanol is decomposed at STP, what is the theoretical yield of hydrogen gas in dm^3? (7)

4.3.2 If only 150 dm^3 of hydrogen gas is obtained, what is the percentage yield of the gas? (3)

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QUESTION 5 (Start on a new page.)

5.1 Gas A and Gas B have the same molecular mass. They are placed in separate sealed containers. The containers are at the same temperature and have the same volume.

The density (number of molecules in a unit volume) of **Gas A** is greater than the density of **Gas B**.

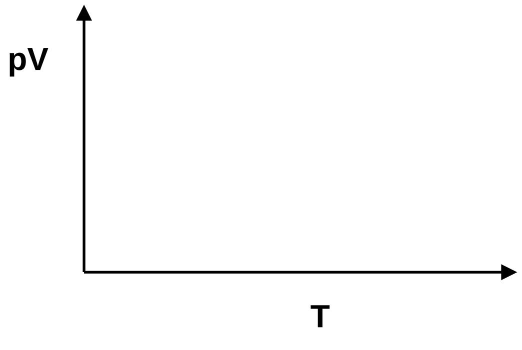
5.1.1 Which gas, **A** or **B**, exerts the greatest pressure on the walls of its container? (1)

5.1.2 Explain your answer to QUESTION 5.1.1. (5)

5.2 Glass tubing is being chosen to produce a neon sign.
The glass must support 250 kPa without breaking. The design for the sign requires the use of 10,5 g Ne gas in a 6,77 dm^3 volume. Operating temperature is expected to reach a maximum of 78 °C.
Will this glass take the strain, or should tubing be sourced? (7)

5.3 Assume that oxygen is an ideal gas.

5.3.1 Complete the sketch graph below of pV versus T (in Kelvin) for the gas at different values of temperature and pressure.



(2)

5.3.2 At very low temperatures it is found that the pV values for oxygen no longer agree with those for an ideal gas. Assuming that no condensation has taken place, state how the pV values would deviate. Write only GREATER THAN or SMALLER THAN. (1)

5.3.3 Mention a single factor to which the deviation in QUESTION 5.3.2 can be ascribed to. (2)

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QUESTION 6 (Start on a new page.)

6.1 Hydrates are compounds containing water molecules loosely bound to the other components.
A 15 g sample of hydrated salt, $Na_2SO_4\ xH_2O$, was found to contain 7,05 g of water. Determine the value indicated by x in the empirical formula. (5)

6.2 6.2.1 Vinegar is a dilute form of acetic acid. A sample of acetic acid has the following percentage composition:

39,9% carbon
6,7% hydrogen
53,4% oxygen

Determine the molecular formula of acetic acid if the molar mass of acetic acid is 60 $g{\cdot}mol^{-1}$. (6)

6.2.2 Give a reason why acetic acid is regarded as a monoprotic acid. (2)

6.3 Stomach acid is hydrochloric acid ($HC\ell$) and it has a pH of about 2. Sometimes our stomachs produce too much acid and this causes heartburn. $CaCO_3$ is available as an antacid tablet used to neutralise stomach acid.

6.3.1 Knowing that one of the products is CO_2, write a balanced equation for this neutralisation reaction. (3)

6.3.2 How much $HC\ell$ (in mg) can be neutralised by a 500 mg tablet? (6)

[22]

QUESTION 7 (Start on a new page.)

A mixture containing a 100 g Aℓ and 200 g MnO was heated to initiate the following redox reaction:

$$2\,A\ell + 3\underline{Mn}O \rightarrow \underline{A\ell}_2O_3 + 3Mn$$

7.1 7.1.1 Define *oxidation*. (2)

7.1.2 Give the value of the oxidation numbers of the underlined elements. (2)

7.1.3 Identify the oxidising agent in the above-mentioned reaction. Justify your answer by referring to oxidation numbers. (3)

7.2 The above-mentioned reaction will proceed until the limiting reactant is completely consumed. Which reactant is the limiting reactant? Show your workings. (5)

7.3 Consider the following reaction:

$$H^+ + Cu + NO_3^- \rightarrow H_2O + Cu^{2+} + NO$$

7.3.1 Use the ion-electron method to write half-reactions for oxidation and reduction. (4)

7.3.2 Balance the reaction. (4)

[20]

QUESTION 8 (Start on a new page.)

8.1 What is the *lithosphere*? (1)

8.2 In what form are most elements in the lithosphere found? (1)

8.3 In South Africa we have a lot of raw gold to be found in the earth.

8.3.1 Write down TWO ways in which gold is used in our everyday lives. Refer to the properties of gold as a noble metal in your answer. (4)

8.3.2 The thermal decomposition of ammonium nitrate (an explosive used in mining) produces a great many molecules in the gas phase so that there is a massive increase in volume.

Consider the following equation:

$$2NH_4NO_3(s) \rightarrow 2N_2(g)) + 4H_2O(g) + O_2(g)$$

How many litres (dm^3) of gas will be produced if 320 g ammonium nitrate is heated at STP? (5)

8.3.3 State TWO ways in which the gold mining operation impact negatively on ground. (2)

8.4 Cyanidation involves chemicals to extract gold:

$$4Au + 8CN^- + O_2 + H_2O \rightarrow 4[Au(CN)_2]^- + 4OH^-$$

Refer to the equation given and briefly explain the process of cyanidation. (3)

[16]

TOTAL: 150

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

KEY/ *SLEUTEL*

Atoomgetal Atomic number	29
Elektronegatiwiteit Electronegativity	1,9
Simbool Symbol	Cu
Benaderde relatiewe atoommassa Approximate relative atomic mass	63,5

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)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2.0 B 11	6 2.5 C 12	7 3,0 N 14	8 3.5 O 16	9 4.0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1.5 Aℓ 27	14 1.8 Si 28	15 2.1 P 31	16 2.5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1.6 V 51	24 1,6 Cr 52	25 1.5 Mn 55	26 1.8 Fe 56	27 1.8 Co 59	28 1.8 Ni 59	29 1.9 Cu 63,5	30 1.6 Zn 65	31 1.6 Ga 70	32 1.8 Ge 73	33 2.0 As 75	34 2.4 Se 79	35 2.8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1.9 Tc	44 2.2 Ru 101	45 2.2 Rh 103	46 2.2 Pd 106	47 1.9 Ag 108	48 1.7 Cd 112	49 1.7 In 115	50 1.8 Sn 119	51 1.9 Sb 122	52 2.1 Te 128	53 2.5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 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	81 1.8 Tℓ 204	82 1.8 Pb 207	83 1.9 Bi 209	84 2.0 Po	85 2.5 At	86 Rn
87 0,7 Fr	88 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

DATA FOR PHYSICAL SCIENCES GRADE 11 PAPER 2 (CHEMISTRY)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 VRAESTEL 2 (CHEMIE)

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}
Molar gas constant *Molêre gaskonstante*	R	$8,31 J \cdot K^{-1} \cdot mol^{-1}$
Standard pressure Standaarddruk	$p^{\ominus}$	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4 dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	$T^{\ominus}$	273 K

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë*

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
$C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-$	+ 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
$\mathbf{2H^+ + 2e^- \rightleftharpoons H_2(g)}$	**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^{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
$A\ell^{3+} + 3e^{-}$	$\rightleftharpoons$	$A\ell$	– 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
$\mathbf{2H^{+} + 2e^{-}}$	$\rightleftharpoons$	$\mathbf{H_2(g)}$	**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