education

Department:
Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2007

PHYSICAL SCIENCE P2
CHEMISTRY

STANDARD GRADE

FEBRUARY/MARCH 2007

304-2/2

PHYSICAL SCIENCE SG: Paper 2

Marks: 150

Time: 2 hours

304 2 2E SG

This paper consists of 13 pages and a data sheet of 4 pages.

X05

GAUTENG

Please turn over

GENERAL INSTRUCTIONS

1. Answer ALL questions.
2. Non-programmable calculators may be used.
3. Appropriate mathematical instruments may be used.
4. A data sheet is provided for your use.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the answer sheet on the inside cover of your answer book.
2. Use a PENCIL when making the necessary cross on your answer sheet.
3. In the case of a wrong answer, erase the pencil marks completely.
4. Do not make any other marks on your answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be clearly deleted by means of a diagonal line drawn across the page.
5. Four possible answers, indicated by A, B, C and D, are supplied with each question. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on your answer sheet with a cross.
6. Each question has only one correct answer.
7. If more than one block is marked, no marks will be awarded for that answer.

EXAMPLE

QUESTION: The symbol for the unit of time is ...

A t.
B h.
C s.
D m.

ANSWER:

A	B	~~C~~	D

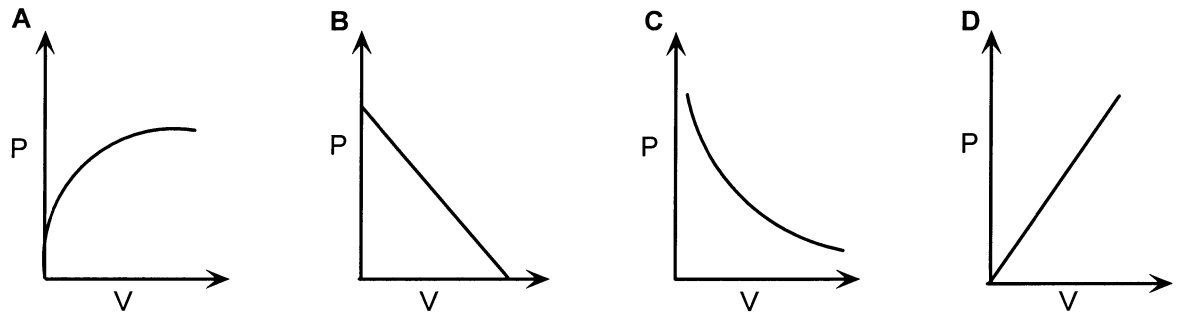
1.1 Ammonia gas can be liquefied under high pressures. This provides evidence of the fact that …

A its molecules are moving.
B its molecules occupy no volume.
C there exist forces between its molecules.
D its molecules have open spaces between them. (3)

1.2 The particles of iodine crystals are held together by …

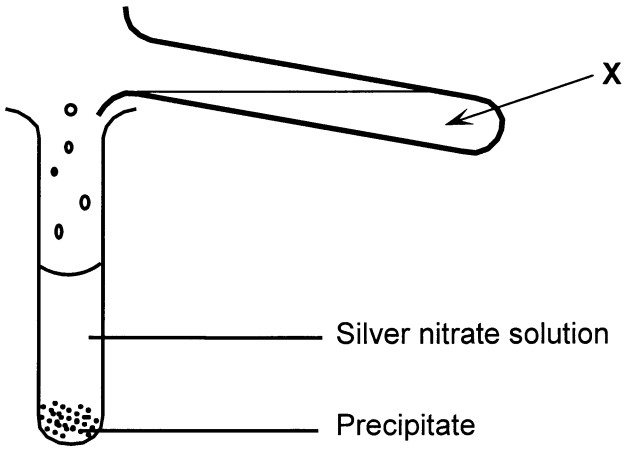
A ionic bonding.
B covalent bonding.
C hydrogen bonding.
D Van der Waals forces. (3)

1.3 Which one of the graphs below shows the correct relationship between the pressure and volume of an enclosed gas while the temperature remains constant?



(3)

1.4 The solution in test tube X is an acid. When it is added to a dilute aqueous solution of silver nitrate, a precipitate forms. The contents of test tube X are probably a solution of …



A HNO_3
B $HC\ell$
C $(COOH)_2$
D CH_3COOH (3)

1.5 Hydrogen sulphide (H_2S) reacts with iron(III) chloride ($FeC\ell_3$). Which one of the following is correct?

	Oxidation half reaction	Reduction half reaction
A	$H_2S \rightarrow S + 2H^+ + 2e^-$	$Fe^{3+} + e^- \rightarrow Fe^{2+}$
B	$Fe^{3+} + e^- \rightarrow Fe^{2+}$	$H_2S \rightarrow S + 2H^+ + 2e^-$
C	$S + 2H^+ + 2e^- \rightarrow H_2S$	$Fe^{2+} \rightarrow Fe^{3+} + e^-$
D	$Fe^{2+} \rightarrow Fe^{3+} + e^-$	$S + 2H^+ + 2e^- \rightarrow H_2S$

(3)

1.6 In which one of the following reactions is nitric acid a product?

A Ammonium chloride is heated.

B Catalytic oxidation of ammonia.

C Calcium hydroxide reacts with ammonium chloride.

D Sodium nitrate reacts with concentrated sulphuric acid. (3)

1.7 Consider the reaction between zinc metal and hydrochloric acid:

$$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$$

In which one of the reactions below will the rate of the reaction be the fastest?

A 3 g of zinc granules reacts with 20 cm^3 of $HC\ell$ at 20 °C

B 3 g of zinc granules reacts with 20 cm^3 of $HC\ell$ at 40 °C

C 3 g of zinc powder reacts with 20 cm^3 of $HC\ell$ at 20 °C

D 3 g of zinc powder reacts with 20 cm^3 of $HC\ell$ at 40 °C (3)

1.8 Which one of the following equations best explains why an **iron** nail should **not** be used to mount a **copper** plate on a wall?

A $Fe^{2+} + Cu \rightarrow Fe + Cu^{2+}$

B $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$

C $2Fe^{3+} + Cu \rightarrow 2Fe + 3Cu^{2+}$

D $2Fe^{2+} + Cu^{2+} \rightarrow 2Fe^{3+} + Cu$ (3)

1.9 Consider the following reaction taking place in a closed container:

$$N_2H_4(g) \rightleftharpoons N_2(g) + 2H_2(g) \qquad \Delta H = -95,4 \text{ kJ mol}^{-1}$$

Which one of the statements below is correct?

A Increasing the temperature favours the forward reaction.

B Increasing the temperature decreases the amount of N_2 and H_2 formed.

C Increasing the temperature has no effect on the amount of products formed.

D Increasing the temperature speeds up both forward and reverse reactions. (3)

1.10 Consider the reaction:

$$HC\ell + NH_3 \rightleftharpoons NH_4^+ + C\ell^-$$

Which one of the combinations below correctly indicates a conjugate acid - base pair in this reaction?

A $HC\ell$ and NH_3

B $HC\ell$ and NH_4^+

C NH_4^+ and $C\ell^-$

D NH_4^+ and NH_3 (3)

1.11 The following table gives the pH values at which the colour change in four acid-base indicators occur:

INDICATOR	pH value
Methyl green	0,2 – 1,8
Bromocresol green	3,8 – 5,4
Cresol red	7,0 – 9,1
Alizarin yellow	10,1 – 12,0

The indicator best suited for use in the titration of sulphuric acid against a solution of sodium hydroxide, is ...

A methyl green.

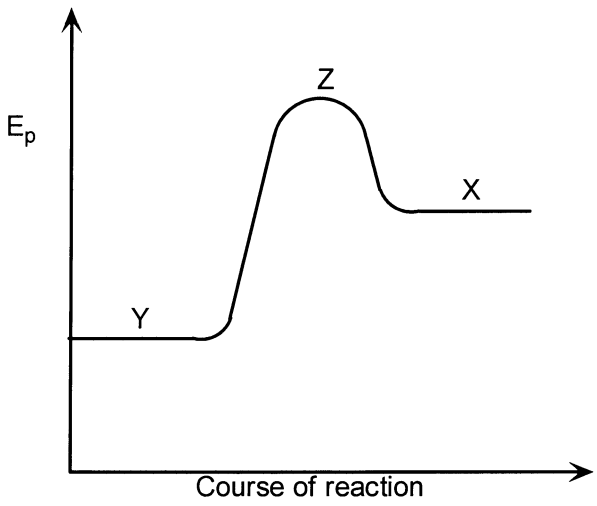
B cresol red.

C alizarin yellow.

D bromocresol green. (3)

1.12 Consider the potential-energy diagram for the reaction:

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$



Which one of the following is correct?

A X represents $CaCO_3$.

B Y represents $CaO + CO_2$.

C X represents $CaO + CO_2$.

D Z represents a catalyst. (3)

1.13 Consider the following redox reaction:

$$Fe + Ni^{2+} \rightarrow Fe^{2+} + Ni$$

The reducing agent in this reaction is ...

A Fe
B Fe^{2+}
C Ni^{2+}
D Ni (3)

1.14 Consider a solution of the following organic compound:

$$C_2H_4$$

Which one of the following statements concerning this compound is TRUE ?

A It has isomers.

B It can undergo hydrogenation.

C It is a saturated hydrocarbon.

D It is used in the dry cleaning industry. (3)

1.15 Ethyne is used in the welding of metals because ...

A it reacts with metals.

B it undergoes addition reactions.

C it produces O_2 and H_2O when it burns.

D its reaction with oxygen is highly exothermic. (3)

[45]

ANSWER QUESTIONS 2 - 8 IN YOUR ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a new page in your answer book.
2. Leave one line open between sub-sections, for example between QUESTION 2.1 and 2.2.
3. Give all formulae used and show your workings (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

QUESTION 2 (START ON A NEW PAGE)

2.1 A learner conducts an investigation to establish the relationship between the pressure and volume of an enclosed gas. The following set of results were obtained:

Reading No.	Pressure (kPa)	Volume (cm^3)
1	60	24,00
2	65	22,15
3	70	20,57
4	75	**X**

2.1.1 State the relationship in words that can be established from the above set of results. (2)

2.1.2 Which experimental factor must be kept constant during this investigation? Choose from temperature, pressure and/or volume. (2)

2.1.3 Calculate the volume **X** in cm^3 in the table. (4)

2.1.4 If the pressure on the enclosed gas were to be increased considerably, the gas will eventually liquefy. Why will the gas liquefy? (2)

2.2 The table below shows the melting points and boiling points of compounds P, Q, R and S.
Use the table to answer the questions below:

COMPOUND	MELTING POINT (^oC)	BOILING POINT (^oC)
P	0	100
Q	-120	-60,7
R	-60	-40
S	30	75

Which one of the compounds ...

2.2.1 has the strongest intermolecular forces between its molecules? (2)

2.2.2 is a solid at room temperature (20 ^oC) ? (2)

2.2.3 will solidify first when the temperature is decreased? (2)

[16]

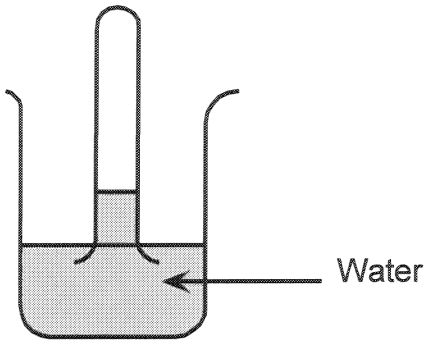
QUESTION 3 (START ON A NEW PAGE)

Sulphur dioxide gas can be prepared in the laboratory by reacting a metal salt with hydrochloric acid.

3.1 Write down the balanced equation for the preparation of sulphur dioxide using hydrochloric acid and sodium sulphite (Na_2SO_3). (3)

The gas is now collected in a dry test tube. The test tube is then inverted in a glass trough with water as indicated in the diagram.

Water starts to move up into the test tube.

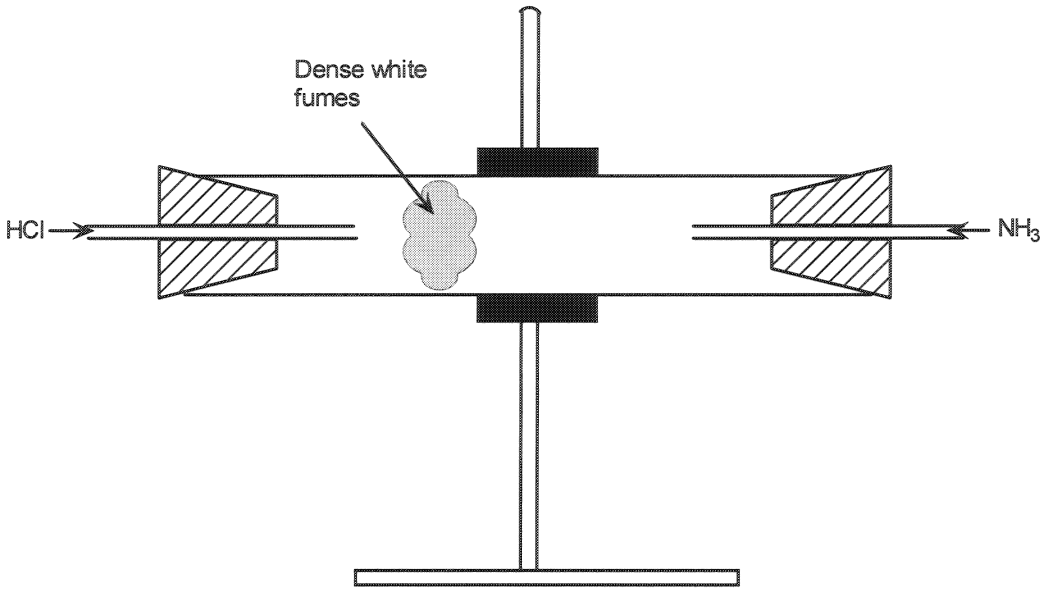


3.2 Write a balanced chemical equation for the reaction between the gas and water. (3)

3.3 Explain why the water moves up into the test tube. (2)
[8]

QUESTION 4 (START ON A NEW PAGE)

4.1 A cylindrical glass pipe is clamped as shown. Hydrogen chloride gas enters the tube from the left end and ammonia gas enters from the right end as shown.



4.1.1 Write a balanced equation for the preparation of hydrogen chloride gas in the laboratory. (3)

In the cylindrical glass pipe dense white fumes are observed closer to the left (HCℓ) than to the right (NH_3) end.

4.1.2 Why are the fumes closer to the HCℓ end? (2)

4.1.3 Write a balanced equation for the reaction that produces the white fumes. (3)

4.2 One step in the industrial preparation of nitric acid is represented by the reaction:

$$2H_2O(\ell) + 4NO_2(g) + O_2(g) \rightarrow 4HNO_3(aq)$$

4.2.1 What is the name given to the industrial preparation of nitric acid? (2)

4.2.2 Write down the balanced equation that shows how the NO_2 is obtained for the industrial process. (3)

4.2.3 What is the function of platinum-rhodium in this industrial preparation of nitric acid? (1)
[14]

QUESTION 5 (START ON A NEW PAGE)

5.1 The reversible reaction below is in equilibrium in a sealed container at 25 °C:

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \quad \Delta H > 0$$

What effect will each of the following changes have on the initial **rate** of the forward reaction?
(Write only: INCREASES, DECREASES or STAYS THE SAME.)

5.1.1 The temperature is changed to 10 °C. (2)

5.1.2 If 0,5 mol NO_2 (g) is added to the container. (2)

5.1.3 A catalyst is added. (2)

*What effect will the following changes have on the **yield** of NO_2?*

5.1.4 The temperature is changed to 30 °C. (2)

5.1.5 The pressure is decreased by increasing the volume at constant temperature. (2)

5.2 A saturated solution of sodium sulphate (Na_2SO_4) is placed in a small beaker.

5.2.1 What is meant by the term saturated solution? (2)

5.2.2 Write down the equation that represents the dissolution process of Na_2SO_4 to form a saturated solution. (3)

A few drops of concentrated sulphuric acid are added to the beaker.

5.2.3 Write down what you will observe in the beaker. (2)

A few drops of barium chloride ($BaC\ell_2$) are now added to the solution in the beaker.

5.2.4 Write down the observation that will be made. (1)

5.2.5 Write down a balanced equation for the reaction that takes place between barium chloride and sodium sulphate. (3)

[21]

QUESTION 6 (START ON A NEW PAGE)

6.1 A learner determined the pH of a number of solutions. She obtained the following results:

Solution	Battery acid	Orange juice	Bicarbonate of Soda
pH	1	4,2	12

Which solution will ...

6.1.1 form a base when mixed with water? (2)

6.1.2 have the highest hydrogen ion concentration ($[H^+(aq)]$)? (2)

6.1.3 How will the pH of battery acid change when:
(Only write INCREASES, DECREASES or STAYS THE SAME)

6.1.3.1 more battery acid of the same concentration is added to it? (2)

6.1.3.2 some of the bicarbonate of soda solution is added to it? (2)

6.2 A learner prepares a 0,1 $mol.dm^{-3}$ solution of sodium hydroxide in a 250 cm^3 volumetric flask.

6.2.1 Calculate the mass of NaOH used. (4)

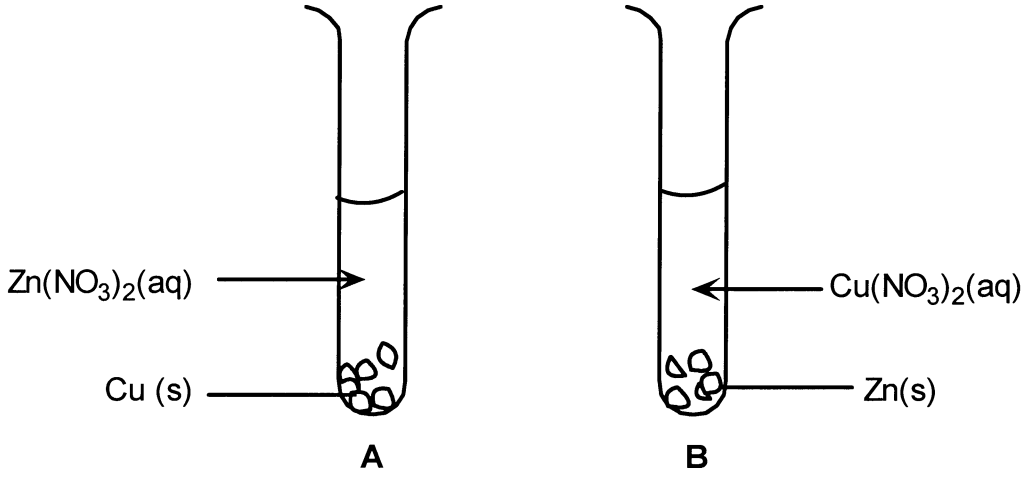
The sodium hydroxide solution is used to determine the concentration of a hydrochloric acid solution by means of a titration. The balanced equation for this reaction is:

$$HC\ell + NaOH \rightarrow NaC\ell + H_2O$$

6.2.2 If 25 cm^3 of the NaOH solution is neutralised by 21 cm^3 of the $HC\ell$ solution, determine the concentration of the $HC\ell$ solution. (4)
[16]

QUESTION 7 (START ON A NEW PAGE)

7.1 Test tube A contains pieces of Cu in $Zn(NO_3)_2$ solution.
Test tube B contains pieces of Zn in $Cu(NO_3)_2$ solution.



7.1.1 By referring to the relative strength of oxidising and reducing agents, explain why a reaction occurs in test tube **B** and not in **A**. (3)

7.1.2 Write down the **name** of the oxidising agent in test tube **B**. (2)

7.1.3 Write down a balanced equation for the reaction in test tube **B**. (3)

7.2 Powdered aluminium metal can reduce iron(II) oxide to molten iron, as used in spot welding. (Use the Table of Standard Reduction Potentials.)

7.2.1 Write down the equation for the half-reaction that the iron(II) undergoes. (2)

7.2.2 Write down the equation for the half-reaction that the aluminium undergoes. (2)

7.2.3 Write down the formula or symbol of the substance acting as the reducing agent. (2)

7.2.4 Can powdered copper be used instead of aluminium? (Write down only YES or NO.) (1)

7.2.5 By referring to the relative strengths of oxidising and reducing agents, write down a reason for the answer in QUESTION 7.2.4. (2)

[17]

QUESTION 8 (START ON A NEW PAGE)

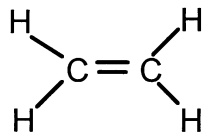
8.1 Hydrocarbons are obtained from crude oil through fractional distillation.

8.1.1 Which physical property of hydrocarbons is used to separate them from crude oil? (2)

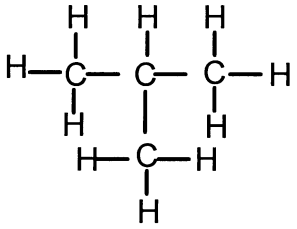
8.1.2 Which of the hydrocarbons, ethane or butane, will be removed first during distillation? (1)

8.1.3 Write down a reason for the answer in QUESTION 8.1.2. (2)

8.2 Write down the IUPAC names of the following:

8.2.1 

(2)

8.2.2 

(2)

8.3 Draw structural formulae for the following:

8.3.1 1,2 – dichloroethane (2)

8.3.2 Ethyne (2)

[13]

TOTAL: 150

Senior Certificate Examination

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

DATA FOR PHYSICAL SCIENCE
PAPER 2 (CHEMISTRY)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTES

Avogadro's constant *Avogadro-konstante*	N_A of/or L	$6{,}02 \times 10^{23}$ mol^{-1}
Molar gas constant *Molêre gaskonstante*	R	8,31 J.K^{-1}.mol^{-1}
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 dm^3.mol^{-1}
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K

TABLE 2: FORMULAE
TABEL 2: FORMULES

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
$pV = nRT$	$K_w = [\mathrm{H^+}][\mathrm{OH^-}] = 10^{-14}$ by/at 298 K
$n = \frac{m}{M}$	$pH = -\log[\mathrm{H^+}]$
$c = \frac{n}{V}$	$E^{\theta}_{cell} = E^{\theta}_{\text{oxidising agent}} - E^{\theta}_{\text{reducing agent}}$
$c = \frac{m}{MV}$	$E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$
	$E^{\theta}_{\text{cell}} = E^{\theta}_{\text{cathode}} - E^{\theta}_{\text{anode}}$
	$E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Relative atomic mass (approximately)
Relatiewe atoommassa (benaderd)

I	II	III	IV	V	VI	VII	0
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	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	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	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	0,9 Ra 226	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

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

Increasing oxidising ability / *Toenemende oksideervermoë* ↑

↓ Increasing reducing ability / *Toenemende reduseervermoë*

Halfreaksie / Half-reaction	E° /volt
$F_2 + 2e^- \rightleftharpoons 2F^-$	+2,87
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
$Au^{3+} + 3e^- \rightleftharpoons Au$	+1,42
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	+1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2\,H_2O$	+1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,21
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1,09
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	+0,96
$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0,80
$Hg^{2+} + 2e^- \rightleftharpoons Hg$	+0,79
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S$	+0,14
$\mathbf{2H^+ + 2e^- \rightleftharpoons H_2}$	**0,00**
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0,04
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0,25
$Co^{2+} + 2e^- \rightleftharpoons Co$	-0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0,40
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0,76
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0,83
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1,18
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	-1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2,37
$Na^+ + e^- \rightleftharpoons Na$	-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

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

Increasing oxidising ability / *Toenemende oksideervermoë* ↓

↑ Increasing reducing ability / *Toenemende reduseervermoë*

Half-reaction / Halfreaksie	E° /volt
$Li^+ + e^- \rightleftharpoons Li$	-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
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2,37
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	-1,66
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1,18
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0,83
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0,76
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0,74
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0,44
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0,40
$Co^{2+} + 2e^- \rightleftharpoons Co$	-0,28
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0,25
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0,14
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0,13
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0,04
$2H^+ + 2e^- \rightleftharpoons H_2$	**0,00**
$S + 2H^+ + 2e^- \rightleftharpoons H_2S$	+0,14
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+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
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
$Hg^{2+} + 2e^- \rightleftharpoons Hg$	+0,79
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0,80
$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	+0,96
$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1,09
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,21
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	+1,36
$Au^{3+} + 3e^- \rightleftharpoons Au$	+1,42
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$F_2 + 2e^- \rightleftharpoons 2F^-$	+2,87