basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2018

MARKS: 150

TIME: 3 hours

This question paper consists of 12 pages, 4 data sheets and 1 answer sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 11A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK except QUESTION 4.3 that must be answered on the attached ANSWER SHEET.
3. Hand in the ANSWER SHEET with the ANSWER BOOK.
4. Start EACH question on a NEW page in the ANSWER BOOK.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
7. You may use a non-programmable calculator.
8. You may use appropriate mathematical instruments.
9. You are advised to use the attached DATA SHEETS.
10. Show ALL formulae and substitutions in ALL calculations.
11. Round off your FINAL numerical answers to a minimum of TWO decimal places.
12. Give brief motivations, discussions, etc. where required.
13. 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 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 The tendency of an atom to attract the bonding pair of electrons is known as …

A electron affinity.

B electronegativity.

C polarity.

D activation energy. (2)

1.2 Bond length is the average distance between the …

A orbitals of two bonded atoms.

B electrons in two bonded atoms.

C nuclei of two bonded atoms.

D molecules of the same substance. (2)

1.3 Hydrogen bonds and London forces (induced dipole forces) have a common characteristic in that they …

A are both stronger than chemical bonds.

B both occur between non-polar molecules.

C both occur between polar molecules.

D are both intermolecular forces. (2)

1.4 In order to double the volume of a fixed amount of moles of an enclosed gas, the temperature in … at constant pressure.

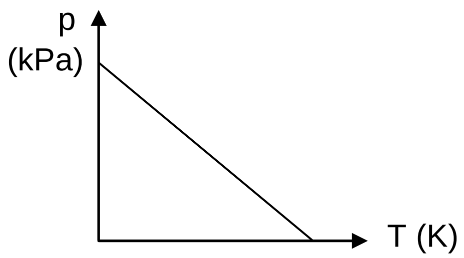
A ^{o}C can be doubled

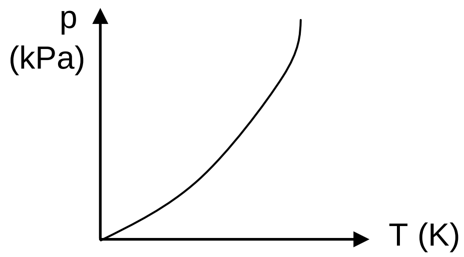
B K can be doubled

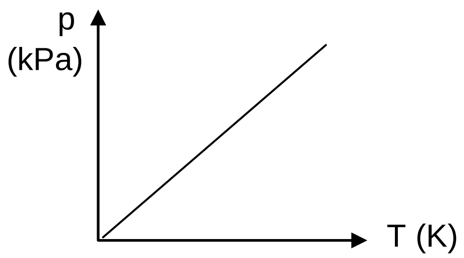
C ^{o}C can be halved

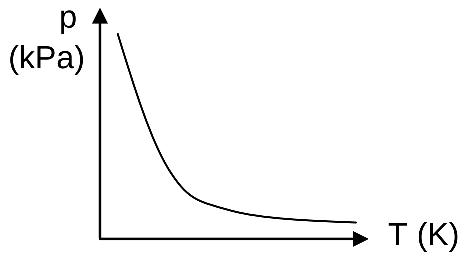
D K can be halved (2)

1.5 The graph that CORRECTLY represents the relationship between the pressure (kPa) and the temperature (K) of an enclosed gas at constant volume is …

A


B


C


D


(2)

1.6 The solution that will have the greatest concentration of H^+ ions if complete ionisation takes place, is …

A 0,4 dm^3 of a 1 $mol \cdot dm^{-3}$ H_2SO_4 solution.

B 0,4 dm^3 of a 1 $mol \cdot dm^{-3}$ $HC\ell$ solution.

C 1 dm^3 of a 1 $mol \cdot dm^{-3}$ $HC\ell$ solution.

D 0,4 dm^3 of a 1 $mol \cdot dm^{-3}$ CH_3COOH solution. (2)

1.7 Which ONE of the following is NOT a typical reaction of hydrochloric acid?

A It neutralises a base with the release of hydrogen gas.

B It forms hydronium ions in water.

C It colours lithmus paper red.

D It forms CO_2 when reacting with a metal carbonate. (2)

1.8 Which ONE of the following pairs represents the conjugate acid and conjugate base of HPO_4^{2-} ?

	CONJUGATE ACID	CONJUGATE BASE
A	PO_4^{3-}	$H_2PO_4^-$
B	$H_2PO_4^-$	PO_4^{3-}
C	$H_2PO_4^-$	H_3PO_4
D	$H_2PO_4^{2-}$	PO_4^{2-}

(2)

1.9 Which ONE of the following indicates the CORRECT colour of bromothymol blue in an acid and a base?

	BROMOTHYMOL BLUE IN AN ACID	BROMOTHYMOL BLUE IN A BASE
A	Orange	Yellow
B	Blue	Red
C	Pink	Colourless
D	Yellow	Blue

(2)

1.10 In which ONE of the following reactions is HCℓ oxidised?

A $HC\ell(aq) + H_2O(\ell) \rightarrow H_3O^+(aq) + C\ell^-(aq)$

B $CaCO_3(s) + 2HC\ell(aq) \rightarrow CaC\ell_2(aq) + H_2O(\ell) + CO_2(g)$

C $NH_3(aq) + HC\ell(aq) \rightarrow NH_4C\ell(aq)$

D $MnO_2(aq) + 4HC\ell(aq) \rightarrow MnC\ell_2(aq) + H_2O(\ell) + C\ell_2(g)$ (2)

[20]

QUESTION 2 (Start on a new page.)

Hydrogen cyanide (HCN) is a very poisonous compound used in the manufacturing of plastics, mining of gold and as a poison.

2.1 Define the term *chemical bond.* (2)

2.2 Draw Lewis structures for:

2.2.1 HCN (2)

2.2.2 H_2O (2)

2.3 What is the shape of the HCN molecule? (1)

2.4 Calculate the electronegativity difference for the CN bond. (1)

2.5 What is polarity of the HCN molecule? Write only POLAR or NON-POLAR. (1)

The table below indicates the values of the bond length and bond energy of the different bonds in HCN.

BOND	**BOND LENGTH (nm)**	**BOND ENERGY ($kJ \cdot mol^{-1}$)**
CH	0,109	413
CN	0,116	890

2.6 Explain why the bond energy of the CN bond is more than the bond energy of the CH bond. (2)

2.7 Explain the difference between the *bond length of the CH bond* and the *bond length of the CN bond*. (2)

2.8 Will HCN be soluble in water? Write only YES or NO. (1)

2.9 Explain the answer to QUESTION 2.8 by referring to the polarity and intermolecular forces of the compounds. (3)
[17]

QUESTION 3 (Start on a new page.)

The reaction below is used in the Haber process to manufacture ammonia.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

The boiling points of the substances in the reaction are as follows:

SUBSTANCE	BOILING POINT (°C)
H_2	-252,9
N_2	-195,8
NH_3	-33,3

3.1 Refer to the intermolecular forces and explain the difference in boiling point between NH_3 and N_2. (3)

3.2 Write down the FORMULA of the substance in the table that will have the lowest melting point. (1)

3.3 Explain why H_2 will evaporate faster than N_2. Refer to the type and relative strength of the intermolecular forces. (3)

3.4 Write down the FORMULA of the substance in the table that will have the highest vapour pressure. Explain your answer. (3)

[10]

QUESTION 4 (Start on a new page.)

A certain amount of gas is sealed in a container of which the volume can change. The relationship between the pressure and volume of the gas at 20 ºC is investigated. The results of the experiment are given in the table below.

PRESSURE (kPa)	VOLUME (dm^3)
70	174
95	128
130	93,6
165	74
205	59
240	51
260	47

4.1 Name the gas law that is represented by the results of the experiment. (1)

4.2 Write down a hypothesis for the investigation. (2)

4.3 Draw a graph of volume versus pressure on the ANSWER SHEET attached. (3)

4.4 Calculate the volume of the gas at 300 kPa. (3)

4.5 When the volume of the gas is measured at 300 kPa, it is 44 dm^3. Explain why the measured volume differs from the volume calculated in QUESTION 4.4. (2)

4.6 Which temperature condition will cause a gas to deviate from ideal behaviour? Write only HIGH or LOW. (1)

4.7 Explain the answer to QUESTION 4.6. (2)

4.8 Calculate the number of moles of the gas in the container at the INITIAL pressure and volume. (4)
[18]

QUESTION 5 (Start on a new page.)

A balloon is filled with 160 g of argon gas (Ar). The pressure of the gas is 120 kPa at a temperature of 15 ºC.

5.1 Calculate the volume of the balloon. (4)

5.2 The temperature of the gas is now increased BY 20 ºC and the initial pressure is doubled. Calculate the new volume of the balloon. (4)
[8]

QUESTION 6 (Start on a new page.)

6.1 In an experiment, a learner added 1,5 g of sodium carbonate (Na_2CO_3) to hydrochloric acid ($HC\ell$). A volume of 306 cm^3 of carbon dioxide gas was formed and collected under standard pressure at room temperature. Take the molar gas volume at room temperature (V_m) as 24,45 dm^3.

The unbalanced equation for the reaction is:

$$Na_2CO_3(s) + HC\ell(aq) \rightarrow NaC\ell(aq) + H_2O(\ell) + CO_2(g)$$

6.1.1 Define the term *one mole of a substance*. (2)

6.1.2 Balance the equation for the reaction. (2)

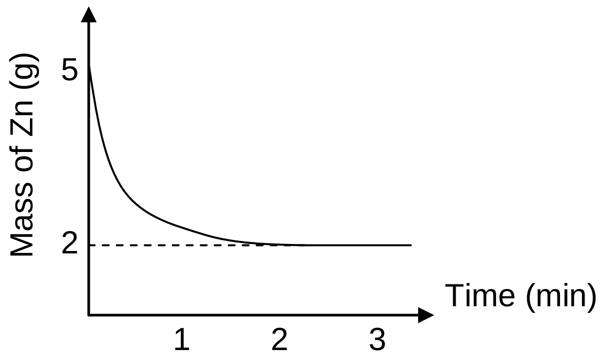
6.1.3 Calculate the mass of sodium carbonate that reacted. (7)

6.1.4 Calculate the percentage of sodium carbonate in excess. (2)

6.2 Zinc reacts with sulphuric acid according to the reaction below.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

The mass of zinc is recorded during the experiment and is shown on the graph below. The reaction stops after 2 minutes.



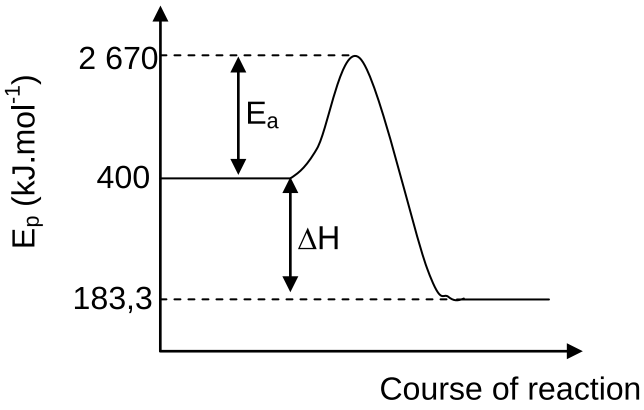
6.2.1 Name the substance that is the limiting reagent. (1)

6.2.2 Calculate the initial concentration of the sulphuric acid if 50 cm^3 of the acid was used. (5)
[19]

QUESTION 7 (Start on a new page.)

The following reaction between ammonia and oxygen takes place in a closed system at constant pressure and temperature:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$



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

7.2 Give a reason why this reaction is exothermic. (1)

7.3 Calculate the heat of reaction. (3)

7.4 Redraw the graph and indicate with a dotted line the effect of a catalyst on the activation energy. (2)

7.5 State *Avogadro's law* in words. (2)

7.6 If 6 dm^3 of NH_3 and 9 dm^3 of O_2 are used, calculate the TOTAL VOLUME of the gases at the end of the reaction. (4)

7.7 The reaction above is the first step in the manufacturing of an acid. This acid contains 1,59% hydrogen, 22,2% nitrogen and 76,2% oxygen. Determine the empirical formula of the acid. (5)
[19]

QUESTION 8 (Start on a new page.)

Ammonia can readily dissolve in water according to the equation below:

$$NH_3(g) + H_2O(\ell) \rightarrow NH_4^+(aq) + OH^-(aq)$$

8.1 Explain why a hydroxide ion is regarded as a Lowry-Brønsted base. (2)

8.2 Identify the type of bond responsible for the formation of the ammonium ion in the above equation. (1)

8.3 Write a balanced equation to show how the ampholyte in the above equation will act as a base when it reacts with hydrochloric acid ($HC\ell$). (2)

5 dm^3 of nitric acid (HNO_3), with a concentration of 0,75 $mol \cdot dm^{-3}$, is spilled accidentally in a small pond of water. The acid and water has a total volume of 1 000 dm^3. To neutralise the acid, calcium hydroxide is added to the water.

$$2HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + 2H_2O(\ell)$$

8.4 Define the term *concentration*. (2)

8.5 Calculate the concentration of the acid AFTER it was spilled in the pond. (4)

8.6 Use calculations to determine if 120 g of calcium hydroxide will be sufficient to react completely with ALL the acid in the pond. (6)
[17]

QUESTION 9 (Start on a new page.)

The reaction between permanganate ions (MnO_4^-) and hydrogen sulphide (H_2S) is given below.

$$MnO_4^-(aq) + H^+(aq) + H_2S(g) \rightarrow Mn^{2+}(aq) + S(s) + H_2O(\ell)$$

9.1 Define *reduction* in terms of oxidation numbers. (2)

9.2 Determine the oxidation number of manganese in the permanganate ion. (1)

9.3 Write down the FORMULA of the substance that undergoes oxidation. (1)

9.4 Explain the answer to QUESTION 9.3 in terms of oxidation numbers. (2)

9.5 Write down the FORMULA for the oxidising agent. (1)

9.6 Write down the oxidation half-reaction. (2)

9.7 Use the ion-electron method and write down the balanced net ionic equation. (3)
[12]

QUESTION 10 (Start on a new page.)

Gold and iron extraction are important mining processes in South Africa. Refining takes place according to the following reactions:

Gold is dissolved using cyanide ions (CN^-) to extract it from the ore:

$$4Au(s) + 8NaCN(aq) + 2H_2O(\ell) + O_2(g) \rightarrow 4NaAu(CN)_2(aq) + 4NaOH(aq)$$

Iron(lll)oxide is burned in a furnace in the presence of CO:

$$Fe_2O_3(s) + 3CO(s) \rightarrow 2Fe(\ell) + 3CO_2(g)$$

10.1 Name TWO disadvantages of deep-shaft mining in comparison with open-cast mining. (2)

10.2 Write down the FORMULA of the substance that is reduced in the reaction used to extract gold. (1)

10.3 Use oxidation numbers to explain how you arrived at the answer to QUESTION 10.2. (1)

10.4 Write the reduction half-reaction for the iron extraction reaction. (2)

10.5 Calculate the percentage of iron present in Fe_2O_3. (2)

10.6 Only 65% of the ore contains iron. If 2 500 kg of ore is used, calculate the mass of iron that can be extracted from the ore. (2)
[10]

TOTAL: 150

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·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*

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

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

KEY/*SLEUTEL*

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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↑)

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	– 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	– 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	– 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	– 0,27
$Co^{2+} + 2e^-$	⇌	Co	– 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	– 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	– 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	– 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	– 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	– 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	– 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$Na^+ + e^-$	⇌	Na	– 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	– 2,93
$Li^+ + e^-$	⇌	Li	– 3,05

Increasing reducing ability/*Toenemende reduserende vermoë* (↓)

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

Half-reactions/*Halfreaksies*			E^θ (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
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 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
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

ANSWER SHEET

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QUESTION 4.3

Graph of volume versus pressure