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.

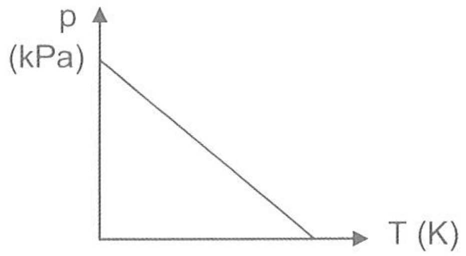
A °C can be doubled

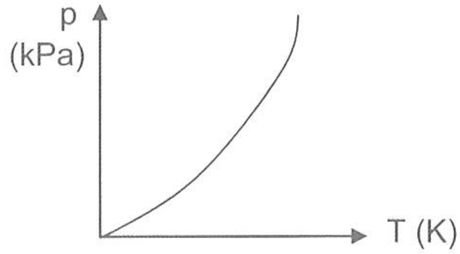
B K can be doubled

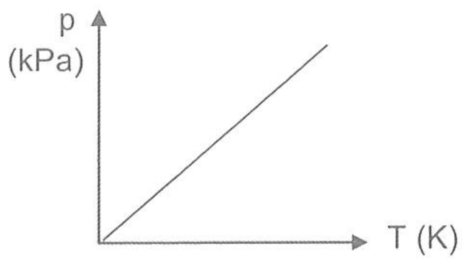
C °C can be halved

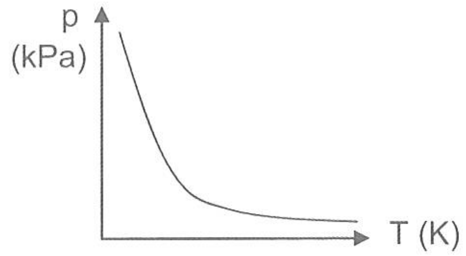
D K can be halved (2)

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]

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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 °C 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 °C.

5.1 Calculate the volume of the balloon. (4)

5.2 The temperature of the gas is now increased BY 20 °C 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)

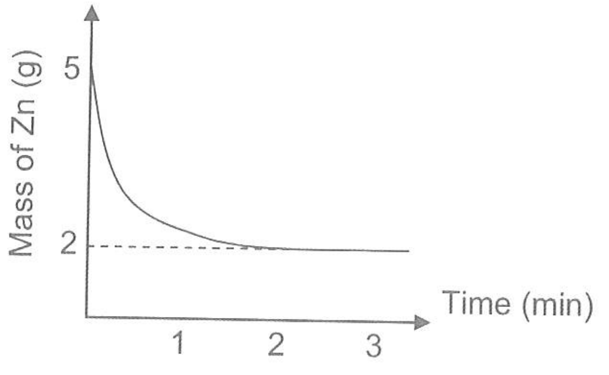
6.1.3 Calculate the mass of sodium carbonate that reacted. (7)

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.



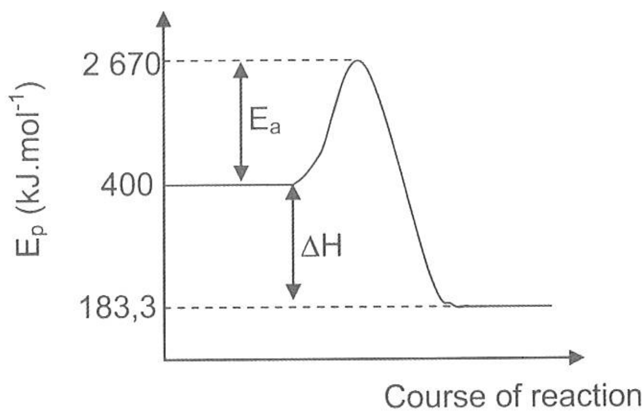
6.2.1 Name the substance that is the limiting reagent. (1)

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(III)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*

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

KWAZULU-NATAL

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓ down the table)

Increasing reducing ability/*Toenemende reduserende vermoë* (↑ up the table)

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

ANSWER SHEET

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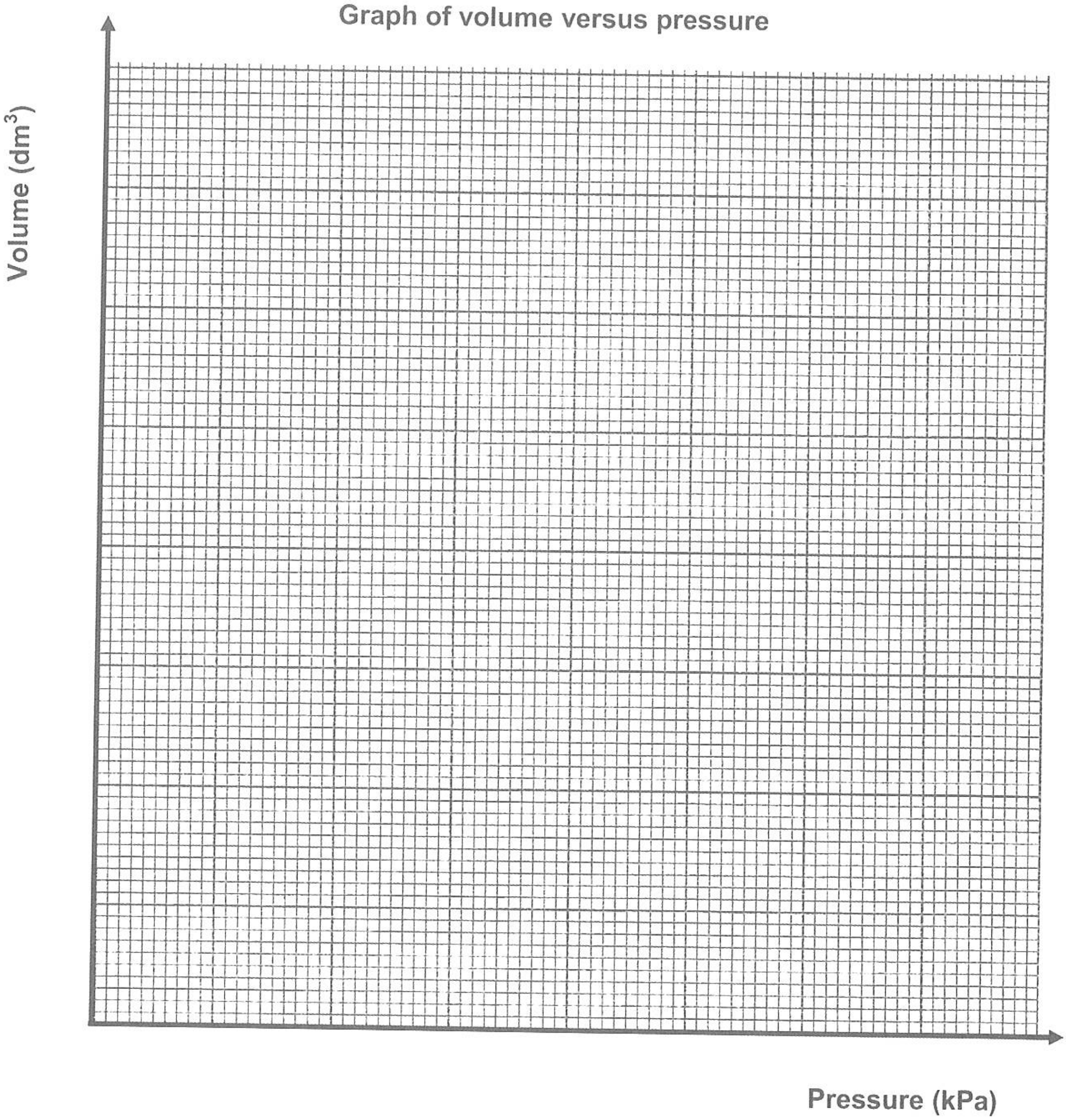
NAME ____ **CLASS**____

QUESTION 4.3



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

NOVEMBER 2018

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 16 pages.
Hierdie nasienriglyne bestaan uit 16 bladsye.

QUESTION 1/*VRAAG 1*

1.1	B ✓✓	(2)
1.2	C ✓✓	(2)
1.3	D ✓✓	(2)
1.4	B ✓✓	(2)
1.5	C ✓✓	(2)
1.6	A ✓✓	(2)
1.7	A ✓✓	(2)
1.8	B ✓✓	(2)
1.9	D ✓✓	(2)
1.10	D ✓✓	(2) **[20]**

QUESTION 2/*VRAAG 2*

2.1 Chemical bond is mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and (outer) electrons. ✓✓
Chemiese binding is die wedersydse aantrekking tussen twee atome as gevolg van die gelyktydige aantrekking tussen hulle kerne en (buite)-elektrone. (2)

2.2.1  ✓✓ (2)

2.2.2  ✓✓ (2)

2.3 Linear ✓
Lineêr (1)

2.4 3 – 2,5 = 0,5 ✓ (1)

2.5 Polar ✓
Polêr (1)

2.6 CN has a higher order bond/triple bond with more orbitals overlapping ✓ than CH, which is a single bond. ✓ Thus CN bond needs more energy to break.
CN het 'n hoër orde/drievoudige binding met meer orbitale wat oorvleuel as die CN enkel binding. Dus benodig die CN-binding meer energie om te breek. (2)

2.7 CN has a longer bond length than CH ✓ because the H atom is smaller than the N atom. ✓
CN het 'n groter bindingslengte as CH omdat die H-atoom kleiner as die N-atoom is (2)

Please turn over/*Blaai om asseblief*

2.8 Yes/*Ja* ✓ (1)

2.9
- HCN has polar molecules with dipole-dipole forces. ✓
- H_2O has polar molecules with hydrogen bonds (dipole-dipole forces). ✓
- If the forces are of the same order/comparable the substances will dissolve. ✓

OR
- Both molecules are polar ✓
- HCN has dipole-dipole forces and H_2O has (dipole-dipole forces) hydrogen bonds ✓
- Like dissolve like. ✓

- *HCN het polêre molekules met dipool-dipoolkragte.*
- *H_2O het polêre molekules met waterstofbindings.*
- *Indien die intermolekulêre kragte van dieselfde orde is, sal stowwe oplos*

OF
- *Beide molekules is polêr* ✓
- *HCN het dipool-dipool kragte en H_2O het (dipool-dipool kragte) waterstofbindings* ✓
- *Soort los op in soort* ✓ (3)

[17]

QUESTION 3/*VRAAG 3*

3.1
- NH_3 has hydrogen bonds between the molecules ✓
- N_2 has London forces/induced dipole forces ✓
- NH_3 has stronger intermolecular forces than N_2 and therefore a higher boiling point than N_2 ✓
(Accept: more energy requires to overcome stronger forces of NH_3)

OR
- N_2 has weaker intermolecular forces than NH_3 and therefore a lower boiling point than NH_3
(Accept: less energy requires to overcome weaker forces of H_2)

- *NH_3 het waterstofbindings tussen die molekules*
- *N_2 het Londonkragte/geïnduseerde dipoolkragte*
- *NH_3 het sterker intermolekulêre kragte as N_2 en daarom 'n hoër kookpunt as N_2*

OF
- *N_2 het swakker intermolekulêre kragte as NH_3 en daarom 'n laer kookpunt as NH_3*
(Aanvaar: NH_3 vereis meer energie om sterker kragte te oorkom) (3)

3.2 H_2 ✓ (1)

Please turn over/*Blaai om asseblief*

3.3
- H_2 and N_2 both have weak London forces/induced dipole forces ✓
- N_2 is a larger molecule/has a greater molecular mass/has a larger surface area than H_2 ✓
- and therefore N_2 has stronger intermolecular forces. ✓

OR
- H_2 is a smaller molecule/has a smaller molecular mass/has a smaller surface area than N_2 ✓
- and therefore H_2 has weaker intermolecular forces. ✓

- *H_2 en N_2 het beide swak Londonkragte/geïnduseerde dipoolkragte*
- *N_2 is 'n groter molekule/groter molekulêre massa/groter oppervlakarea as H_2*
- *en daarom het N_2 sterker intermolekulêre kragte.*

OF
- *H_2 is 'n kleiner molekule/het kleiner molekulêre massa/kleiner oppervlakarea as N_2*
- *en daarom swakker intermolekulêre kragte.*

(3)

3.4 H_2 ✓
It has the weakest intermolecular forces/London forces ✓
It has the lowest boiling point ✓
OR
It has the weakest intermolecular forces/London forces ✓
Boiling point is inversely proportional to vapour pressure ✓
Dit het die swakste intermolekulêre kragte
Dit het die laagste kookpunt
OF
Dit het die swakste intermolekulêre kragte/Londonkragte
Kookpunt is omgekeerd eweredig aan die dampdruk
(3)
[10]

QUESTION 4/*VRAAG 4*

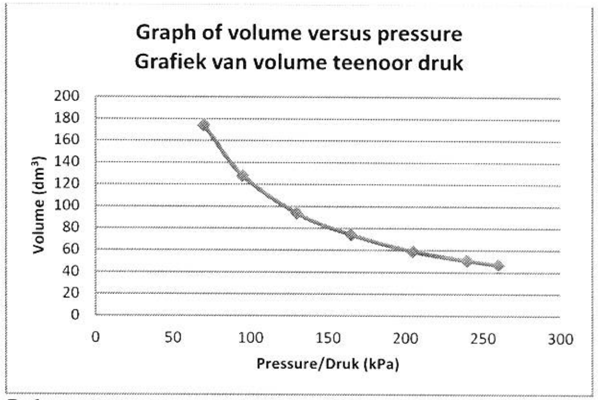
4.1 Boyle's law/*Boyle se wet* ✓ (1)

4.2

Criteria for hypothesis/*Riglyne vir hipotese*	
The dependent and independent variables are stated correctly. *Die afhanklike en onafhanklike veranderlikes korrek genoem.*	✓
State the relationship between the dependent and independent variables. *Stel die verwantskap tussen die afhanklike en onafhanklike veranderlike.*	✓
Dependent variable/*afhanklike veranderlike*: volume Independent variable/*onafhanklike veranderlike*: pressure/*druk*	

Example:/*Voorbeeld*:
If the pressure of and enclosed gas increases the volume will decreases at constant temperature.
The pressure of an enclosed gas is inversely proportional to the volume it occupies if the temperature is kept constant.
Die druk van 'n ingeslote gas is omgekeerd eweredig aan die volume wat dit beslaan indien die temperatuur konstant gehou word.
Indien die druk van 'n ingeslote gas toeneem, sal die volume afneem.
(2)

4.3



Refer to the last page of the memo for the graph drawn to scale
Verwys na die laaste bladsy van die memo vir die skaalgrafiek

Criteria for marking the graph/*Nasienkriteria vir grafiek*	
Use of correct scale on both axis (If learners used table values as scale values maximum $^1/_3$ for line drawn) *Korrekte skaal op die asse* *(Indien leerders tabelwaardes as skaalwaardes gebruik maksimum $^1/_3$ vir lyn getrek)*	✓
At least five (5) points plotted correctly *Ten minste vyf (5) punte korrek gestip*	✓
Curve is drawn *Kurwe getrek*	✓

(3)

4.4 Any set of values can be used from the table :
Enige stel waardes vanaf die tabel kan gebruik word:

$p_1V_1 = p_2V_2$ ✓
$70(174) = (300)V_2$ ✓
$V_2 = 40{,}6\ dm^3$ ✓
(Accept/*Aanvaar* 40,32 – 40,8 dm^3) (3)

4.5 At high pressure a gas starts to deviate from ideal gas behaviour ✓ because the volume of the molecules of a gas and the intermolecular forces start to influence the measured value, causing it to be greater than the theoretical value calculated/Forces of repulsion between the gas particles prevents them from moving closer ✓
By hoë druk sal 'n gas begin afwyk van ideale gasgedrag want die volume van die gasdeeltjies en intermolekulêre kragte begin die waarde van die volume beïnvloed, wat veroorsaak dat die gemete waarde groter is as die berekende waarde/Afstotingskragte veroorsaak dat gasdeeltjies nie nader aan mekaar kan beweeg nie (2)

4.6 Low/*Laag*✓ (1)

4.7 Temperature is an indication of the average kinetic energy of the molecules of a gas. If the temperature of a gas decreases, the molecules move slower and closer together ✓up to a point where the gas will start to condense ✓ and not behave like an ideal gas.
OR
The intermolecular forces of attraction becomes significant ✓ then the gas condenses. ✓
Temperatuur is die aanduiding van die gemiddelde kinetiese energie van die molekules van 'n gas. Indien die temperatuur afneem sal die molekules stadiger en nader aan mekaar beweeg tot by die punt waar die gas sal begin kondenseer sodat dit nie meer soos 'n ideale gas optree nie.
OF
Die intermolekulêre kragte word beduidend en dit veroorsaak dat die gas kondenseer. (2)

4.8 $pV = nRT$ ✓
$(70\ 000)(174 \times 10^{-3})$ ✓ $= n(8{,}31)(293)$ ✓
n = 5 moles ✓ (4)
[18]

QUESTION 5/*VRAAG 5*

5.1 $n = \frac{m}{M}$

$n = \frac{160}{40}$ ✓

n = 4 mole

$pV = nRT$ ✓
$(120\ 000)V = (4)(8{,}31)(288)$ ✓
$V = 0{,}08\ m^3$ ✓ (4)

5.2 **POSITIVE MARKING FROM QUESTION 5.1**
POSITIEWE NASIEN VANAF VRAAG 5.1
OPTION 1/*OPSIE 1*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ ✓

$\frac{120(0{,}08)}{288} = \frac{240V_2}{308}$ ✓ ✓

$V_2 = 0{,}043\ m^3$ ✓ (427,78 dm^3)

OPTION 2/*OPSIE 2*
$pV = nRT$ ✓
$(240\ 000)V$ ✓ $= (4)(8{,}31)(308)$ ✓
$V = 0{,}043\ m^3$ ✓ (426,58 dm^3) (4)
[8]

QUESTION 6/*VRAAG 6*

6.1.1 One mole is the amount of a substance having the same number of particles as there are atoms in 12 g carbon-12. ✓✓
Een mol is die stofhoeveelheid wat dieselfde getal deeltjies het as wat daar atome in 12 g koolstof-12 is.
[2 or 0] (2)

6.1.2 $Na_2CO_3 + 2HCl$ ✓ $\rightarrow 2NaCl + H_2O + CO_2$ ✓ (2)

6.1.3 **Mark allocation/Nasienriglyne:**
- Formula for/ *Formule vir* volume ✓
- Substitution of 0,306 and 24,45 ✓/*Vervanging van 0,306 en 24,45*
- Using ratio/*Gebruik verhouding* ✓
- Formula for/*Formule vir* mass ✓
- Substitutions of moles ✓and 106 ✓ /*Vervanging van mole en 106*
- Answer with units/*Antwoord met eenheid* ✓

$n = \frac{V}{V_m}$ ✓

$n = \frac{0{,}306}{24{,}45}$ ✓

n = 0,0125 mol of CO_2

$Na_2CO_3 : CO_2$
1 : 1 ✓ (use of the ratio/*gebruik die verhouding*)
n = 0,0125 mol of Na_2CO_3

$n = \frac{m}{M}$ ✓

✓ $0{,}0125 = \frac{m}{106}$ ✓

m = 1,33 g ✓ (1,325 – 1,33 g) (7)

6.1.4 **POSITIVE MARKING FROM QUESTION 6.3**
POSITIEWE NASIEN VANAF VRAAG 6.3

OPTION 1/*OPSIE 1*

$\% \ CaCO_3 \text{ unreacted} = \frac{1,5 - 1,33}{1,5} \times 100$ ✓

$= 11,33\%$ ✓ (11,33% - 11,67%)

OPTION 2/*OPSIE 2*

$\% \ CaCO_3 \text{ reacted} = \frac{1,33}{1,5}$ ✓ $\times 100 = 88,67\%$

% unreacted = 100 – 88,67 = 11,33% ✓

OPTION 3/*OPSIE 3*

$n = \frac{m}{M}$

$n = \frac{1,5}{106}$

n = 0,0142 mol

initial mol – reacted mol = 0,0142 – 0,0125 = 0,0017 mol unreacted

$\% \ CaCO_3 \text{ unreacted} = \frac{0,0017}{0,0142}$ ✓ $\times 100 = 11,97\%$ ✓ (2)

6.2.1 Sulphuric acid ✓
Swawelsuur (1)

6.2.2 **Mark allocation/Punte toekenning:**

- Any one of the formulae/Enige een van formules ✓
- Substitution of/*Vervanging van* 3 g (5 g – 2 g) ✓
- Ratio/*Verhouding 1:1* ✓
- Substitution of moles and volume in dm³ /*Vervanging van mol en volume in dm³* ✓
- Answer with units/*Antwoord met eenheid* ✓

OPTION 1/*OPSIE 1*

$n = \frac{m}{M}$

$= \frac{3}{65}$ ✓ (5 – 2)

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4
1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

$c = \frac{n}{V}$

$= \frac{0,0462}{0,05}$ ✓

$= 0,92 \text{ mol·dm}^{-3}$ ✓

OPTION 2/*OPSIE 2*

$n = \frac{m}{M}$

$= \frac{3}{65}$ ✓

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4
1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

m = nM
= (0,0462)(98)
= 4,5276 g of H_2SO_4

$c = \frac{m}{MV}$

$= \frac{4,5276}{(98)(0,05)}$ ✓

$= 0,92 \text{ mol·dm}^{-3}$ ✓

OPTION 3/*OPSIE 3*

$n = \frac{m}{M}$

$= \frac{5}{65}$

= 0,0769 mol of Zn initial

✓ any one of the two formula/Enige een van formules

$n = \frac{m}{M}$

$= \frac{2}{65}$

= 0,0308 mol of Zn final

n_{used} = 0,0769 – 0,0308 ✓ = 0,0461 mol

Ratio Zn : H_2SO_4
1 : 1 ✓

$n(H_2SO_4)$ = 0,0461 mol

$c = \frac{n}{V}$

$= \frac{0,0461}{0,05}$ ✓

$= 0,92 \text{ mol·dm}^{-3}$ ✓ (5)

[19]

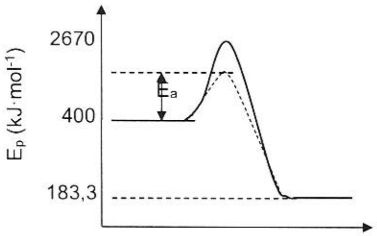
QUESTION 7/VRAAG 7

7.1 The minimum energy needed for a reaction to take place. ✓✓
Die minimum energie benodig vir die reaksie om plaas te vind.
[2 or 0] (2)

7.2 More energy is released than absorbed **OR** energy of products is less than energy of reactants **OR** $\Delta H < 0$ **OR** ΔH is negative ✓
*Meer energie word afgegee as opgeneem **OF** energie van die produkte is minder as die energie van reaktante **OF** $\Delta H < 0$ **OF** ΔH is negatief* (1)

7.3 $\Delta H = H_{products} - H_{reactants}$
$= 183,3$ ✓ $- 400$ ✓
$= -216,7\ kJ \cdot mol^{-1}$ ✓ (3)

7.4



Criteria for marking/*Nasienkriteria*	
Lower curved line/*Laer kurwelyn*	✓
Lower activation energy indicated *Laer aktiveringsenergie aangedui*	✓

(2)

7.5 One mole of any gas occupies the same volume at the same temperature and pressure. ✓✓
Een mol van enige gas beslaan dieselfde volume by dieselfde temperatuur en druk.
[2 or 0] (2)

7.6 **OPTION 1/*OPSIE 1***

	$4NH_3$	$5O_2$	$4NO$	$6H_2O$	
Initial vol	6	9 ✓	0	0	
Change in vol	6	7,5	6	9	Ratio ✓
Final vol	0	1,5	6	9 ✓	

Total volume = 1,5 + 6 + 9 = 16,5 dm^3 ✓

OPTION 2/*OPSIE 2*
Mol ratio 4 : 5 : 4 : 6 from balanced equation
Mol verhouding 4 : 5 : 4 : 6 vanuit gebalanseerde vergelyking

Volume ratio reacting 6 : 7,5 : 6 : 9 ✓
Volume verhouding wat reageer 6 : 7,5 : 6 : 9

O_2 in excess/*in oormaat*
Only/*Slegs* 7,5 dm^3 of/*van* 9 dm^3 reacts/*reageer*
9 – 7,5 = 1,5 dm^3 ✓

Total volume at the end of reaction = (6 + 9) ✓ + 1,5 = 16,5 dm^3 ✓
Totale volume aan die einde van die reaksie = 6 + 9 + 1,5 = 16,5 dm^3 (4)

7.7 $n = \frac{m}{M}$

$n(H) = \frac{1,59}{1}$ ✓
$= 1,59$ mol

$n(N) = \frac{22,2}{14}$ ✓
$= 1,5857$ mol

$n(O) = \frac{76,2}{16}$ ✓
$= 4,625$ mol

$$H : N : O$$
$$\frac{1,59}{1,5857} : \frac{1,5857}{1,5857} : \frac{4,625}{1,5857}$$ ✓ divide by smallest number/ *deel deur kleinste getal*
$$1 : 1 : 3$$

Empirical formula/*Empiriese formule* is HNO_3 ✓ (5)

[19]

QUESTION 8/*VRAAG 8*

8.1 A hydroxide ion can act as proton acceptor. ✓✓
'n Hidroksiedioon kan optree as protonontvanger. (2)

8.2 Dative covalent bond ✓
Datiefkovalente binding (1)

8.3 $HC\ell(aq) + H_2O(\ell)$ ✓ $\rightarrow H_3O^+(aq) + C\ell^-(aq)$ ✓
OR/*OF*
$HC\ell(aq) + NH_3(g)$ ✓ $\rightarrow NH_4^+(aq) + C\ell^-(aq)$ ✓ (2)

8.4 Concentration is the amount of solute per litre of solution. ✓✓
Konsentrasie is die hoeveelheid opgeloste stof per liter van 'n oplossing.
OR/*OF*
Concentration is the number of moles of a substance per dm^3 of solution.
Konsentrasie is die aantal mol van 'n stof per dm^3–oplossing. (2)

8.5

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$c = \frac{n}{V}$ ✓ $0,75 = \frac{n}{5}$ ✓ $n = 3,75$ mol $c = \frac{n}{V}$ $= \frac{3,75}{1000}$ ✓ $= 3,75 \times 10^{-3}$ mol·dm^{-3} ✓	$c_1V_1 = c_2V_2$ ✓ $(0,75)(5)$ ✓ $= c_2(1000)$ ✓ $c_2 = 3,75 \times 10^{-3}$ mol·dm^{-3} ✓ **OPTION 3/*OPSIE 3*** $\frac{5}{1000}$ ✓ ✓ $= \frac{c}{0,75}$ ✓ $c = 3,75 \times 10^{-3}$ mol·dm^{-3} ✓

(4)

8.6 **Mark allocation/Punte toekenning**

- Usage of formula(e) of c = n/V and/or n = m/M
- Usage or calculation of number of moles (3,75 mol) of HNO_3
- Ratio/*Verhouding* 2:1
- Usage of 74 g.mol^{-1} in formula n = m/M
- Answer/*Antwoord*
- Correct conclusion/*Korrekte gevolgtrekking*

OPTION 1/*OPSIE 1*

$c = \frac{n}{V}$

$0,75 = \frac{n}{5}$

$n = 3,75$ mol ✓

✓ any one of the two formula/Enige een van formules

Ratio $HNO_3 : Ca(OH)_2$
2 : 1 ✓
$n(Ca(OH)_2) = 1,875$ mol

$n = \frac{m}{M}$

$1,875 = \frac{m}{74}$ ✓

$m = 138,75$ g ✓

No, it is insufficient. ✓
Nee, dit is nie genoeg nie

POSITIVE MARKING FROM 8.5
POSITIEWE NASIEN VANAF 8.5
OPTION 2/*OPSIE 2*

$c = \frac{n}{V}$

$3,75 \times 10^{-3} = \frac{n}{1000}$

$n = 3,75$ mol ✓

✓ any one of the two formula/Enige een van formules

Ratio $HNO_3 : Ca(OH)_2$
2 : 1 ✓
$n(Ca(OH)_2) = 1,875$ mol

$n = \frac{m}{M}$

$1,875 = \frac{m}{74}$ ✓

$m = 138,75$ g ✓

No, it is insufficient. ✓
Nee, dit is nie genoeg nie

POSITIVE MARKING FROM 8.5
POSITIEWE NASIEN VANAF 8.5
OPTION 3/OPSIE 3

$n = \frac{m}{M}$

$n = \frac{120}{74}$ ✓

$n = 1,62$ mol

✓ any one of the two formula/Enige een van formules

$n = cV$
$= 3,75 \times 10^{-3}(1000)$
$= 3,75$ mol ✓

$HNO_3 : Ca(OH)_2$
2 : 1 ✓
$n(Ca(OH)_2) = ½(3,75)$
$= 1,875$ mol ✓

$1,875 > 1,62$ mol

No it is insufficient ✓
Nee dis nie genoeg nie

(6)
[17]

QUESTION 9/*VRAAG 9*

9.1	Reduction is a decrease in oxidation number ✓✓ *Reduksie is die afname in oksidasiegetalle*	(2)
9.2	Mn is +7 / Mn^{7+} ✓	(1)
9.3	H_2S / S^{2-} ✓	(1)
9.4	The oxidation number of S increases ✓ from -2 to 0 ✓ *Die oksidasiegetal van S neem toe van -2 na 0*	(2)
9.5	MnO_4^- / Mn^{+7} ✓	(1)
9.6	$H_2S(g) \rightarrow S + 2H^+ + 2e^-$ ✓✓	(2)
9.7	$H_2S \rightarrow S + 2H^+ + 2e^-$ $MnO_4^- + 8H^+ + 5e^- \rightarrow 2Mn^{2+} + 4H_2O$ ✓ $2MnO_4^- + 5H_2S + 6H^+ \rightarrow 2Mn^{2+} + 5S + 8H_2O$ ✓ balancing ✓ equation	(3) **[12]**

QUESTION 10/*VRAAG10*

10.1
- Dangerous for workers because they can be trapped underground. ✓
- Sinkholes ✓

(Any relevant answer)
- *Gevaarlik vir werkers want hulle kan ondergronds vasgekeer word*
- *Sinkgate*

(Enige relevante antwoord) (2)

10.2 O_2 ✓ (1)

10.3 Oxidation number of O decreases from 0 (in O_2) to -2 (in NaOH) ✓
Die oksidasiegetal van O neem af van 0 (in O_2) na -2 (in NaOH) (1)

10.4 $Fe^{3+} + 3e^- \rightarrow Fe$ ✓✓ (2)

10.5 $\%Fe = \frac{2(56)}{160} \times 100\%$ ✓
$= 70\ \%$ ✓ (2)

10.6 m(Fe) = (0,65)(2 500) ✓ or/*of* $\frac{65}{100}(2\ 500)$
= 1 625 kg Fe extracted/*ontgin* ✓ (Accept/*Aanvaar* $1{,}625 \times 10^6$ g) (2)
[10]

TOTAL/*TOTAAL*: 150

Please turn over/*Blaai om asseblief*

SUBMIT THIS SHEET WITH THE ANSWER BOOK/
LEWER SAAM MET DIE ANTWOORDEBOEK IN

NAME/*NAAM* ______________________ **CLASS/*KLAS*** ________
QUESTION/*VRAAG* 4.3