Province of the EASTERN CAPE EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2023

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKS: **150**

TIME: **3 hours**

This question paper consists of 21 pages including 4 data sheets and an answer sheet.

INSTRUCTIONS AND INFORMATION

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

2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.

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

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

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

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. Show ALL formulae and substitutions in ALL calculations.

9. Round off your FINAL numerical answers to a minimum of TWO decimal places.

10. Give brief motivations, discussions, et cetera where required.

11. You are advised to use the attached DATA SHEETS.

12. 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, for example 1.11 D.

1.1 Consider the definition given below:

The high energy transition state between products and reactants.

This is the definition of …

A a catalyst.

B heat of reaction.

C activation energy.

D activated complex. (2)

1.2 Which ONE of the following ions can act as an ampholyte?

A HCO_3^-

B NH_4^+

C NO_3^-

D H_3O^+ (2)

1.3 Consider the interatomic bonds shown below:

C – H	C – O

Which ONE of the following combinations regarding the bond length and polarity of the bonds is CORRECT?

	Shortest bond length	Most polar bond
A	C – H	C – O
B	C – O	C – H
C	C – O	C – O
D	C – H	C – H

(2)

1.4 The conjugate base of the ion, $H_2PO_4^-$ is …

A PO_4^{3-}.

B H_2O.

C HPO_4^{2-}.

D H_3PO_4. (2)

1.5 The table below shows the melting points of water (H_2O) and hydrogen bromide (HBr).

Compounds	**Melting point (K)**
H_2O	273
HBr	159

Which combination below CORRECTLY lists the strongest intermolecular forces in H_2O and HBr that explain the relatively high melting points of these compounds?

	In H_2O there are:	**In HBr there are:**
A	Hydrogen bonds	London forces
B	Hydrogen bonds	Dipole-dipole forces
C	Dipole-dipole forces	Hydrogen bonds
D	London forces	Hydrogen bonds

(2)

1.6 A pair of electrons that is shared between two atoms in a covalent bond is called …

A lone pair.

B bond length.

C bonding pair.

D valence electrons. (2)

1.7 Air in a gas syringe is compressed to half its original volume while the temperature remains constant.

Which ONE of the following combinations are CORRECT regarding the gas pressure and the average speed of the gas particles?

	Pressure	Average speed of gas particles
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Remain constant
D	Decreases	Remain constant

(2)

1.8 Consider the following reaction:

$$2\ H_2S(g) + SO_2(g) \rightarrow 3\ S(s) + 2\ H_2O$$

Which ONE of the combinations regarding the reducing agent and oxidising agent in this reaction is CORRECT?

	Reducing agent	Oxidising agent
A	H_2S	SO_2
B	SO_2	H_2S
C	S	H_2O
D	SO_2	S

(2)

1.9 Which ONE of the following has polar covalent bonds but has only London dispersion forces between its molecules?

A NH_3

B HBr

C CO_2

D H_2S (2)

1.10 Consider the following incomplete reactions of sulphuric acid, H_2SO_4:

(I) $CuO + H_2SO_4 \longrightarrow$

(II) $CuCO_3 + H_2SO_4 \longrightarrow$

(III) $Cu(OH)_2 + H_2SO_4 \longrightarrow$

Which reaction(s) will produce $CuSO_4$ and water as the only products of the reaction?

A **I** only

B **II** only

C Both **I** and **III**

D Both **II** and **III** (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 Consider the following compounds:

NH_3	H_3O^+	$BCℓ_3$	NaCℓ	HCN

2.1.1 Define the term *molecule.* (2)

Write down the formula of the compound from the given list that has:

2.1.2 A dative covalent bond (1)

2.1.3 Ionic bonds (1)

2.1.4 Ion-dipole forces when dissolved in water (1)

2.2 Draw the Lewis structure for the following molecules:

2.2.1 NH_3 (2)

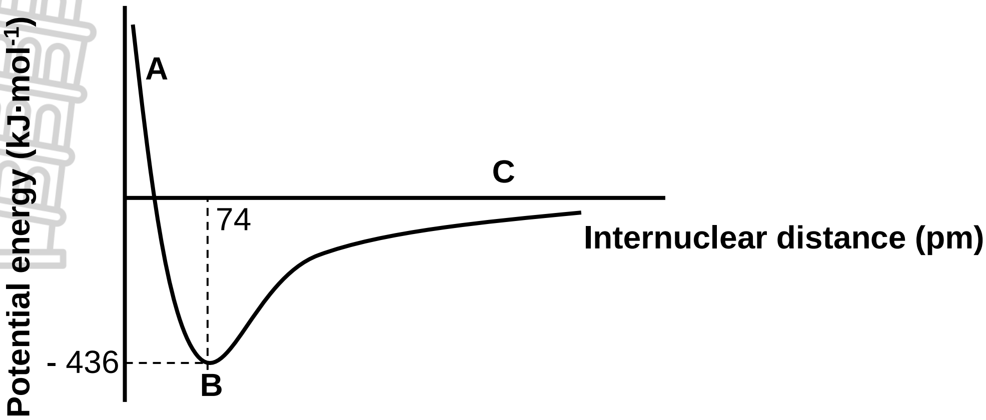
2.2.2 HCN (2)

2.3 How many lone pairs of electrons are in one molecule of NH_3? (1)

2.4 Is $BCℓ_3$ a POLAR or NON-POLAR molecule?

Explain your answer by referring to molecular shape and polarity of the bonds in the molecule. (4)

2.5 The graph below shows the relationship between potential energy and the internuclear distance between two hydrogen atoms.



2.5.1 Define the term *bond energy.* (2)

2.5.2 Which point (**A**, **B** or **C**) on the graph represents the point of maximum force of attraction between the nuclei of the two hydrogen atoms? (1)

2.6 Consider the following table.

Bond	**Bond energy (kJ·mol^{-1})**
C – C	346
C = C	610
C ≡ C	835

2.6.1 Which ONE of the bonds shown in the table above will have the shortest bond length? (1)

2.6.2 Give a reason for your answer to QUESTION 2.6.1. (2)
[20]

QUESTION 3 (Start on a new page.)

The table below shows the boiling points of group 4 compounds.

Compound		Boiling point (°C)
A	CH_4	-161,6
B	SiH_4	-112,0
C	GeH_4	-88,5
D	SnH_4	-52,0
E	HCℓ	**X**

3.1 Define *boiling point.* (2)

3.2 Write down the phase of compounds **A** to **D** at room temperature. (1)

3.3 Explain the trend in the boiling points of compounds **A** to **D**. (3)

3.4 Which compound in the table (**A** to **D**) will have the highest vapour pressure?

Give a reason for your answer by referring to the data in the table. (2)

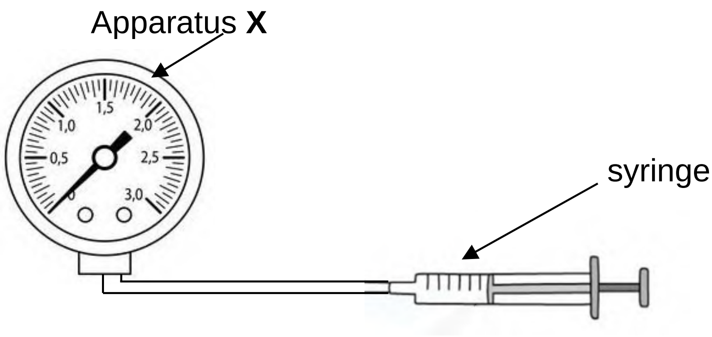
3.5 How will the value of **X** compare to the boiling point of CH_4?

Choose from HIGHER THAN, LOWER THAN or EQUAL to. (1)

3.6 Fully explain your answer to QUESTION 3.5. (3)
[12]

QUESTION 4 (Start on a new page.)

A group of learners investigate the relationship between the pressure and the volume of a gas. The gas syringe is connected to apparatus **X** as shown below.



The learners vary the volume and record the pressure and volume. They calculated the inverse of the volume and recorded it with the pressure readings in table shown below.

	Pressure (kPa)	**1/volume (cm^{-3})**
1	92,5	0,05
2	111	0,06
3	129,5	0,07
4	148	0,08

4.1 Write down the name of the gas law that is being investigated. (1)

4.2 For this investigation, write down ONE controlled variable. (1)

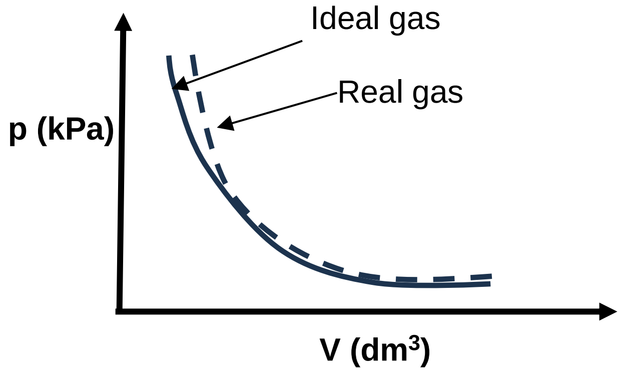
4.3 Give the name of apparatus **X**. (1)

4.4 Use the data in the table and draw a pressure against 1/ volume graph on the attached ANSWER SHEET marked ANNEXURE A. (4)

4.5 Using information from the graph write down the learners' conclusion. (2)

4.6 Calculate the volume of the gas at a pressure of 184 kPa. (4)

4.7 The graph of pressure versus volume of an enclosed gas at constant temperature for a real gas and an ideal gas is shown below.



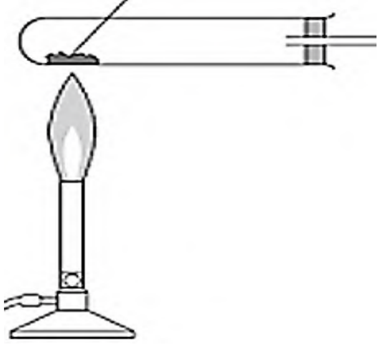
Explain the deviation of a real gas from ideal gas behaviour as shown in the graph above. (2)

4.8 Give ONE reason in terms of the TYPE and STRENGTH of intermolecular forces why ammonia gas, NH_3 will deviate from ideal gas at low temperatures. (2)

[17]

QUESTION 5 (Start on a new page.)

5.1 1,56 g of calcium carbonate is heated as shown in diagram below.



The calcium carbonate decomposes according to the balanced equation:

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g) \quad \Delta H > 0$$

0,163 g of CO_2 is produced during this decomposition.

5.1.1 Is this reaction ENDOTHERMIC or EXOTHERMIC? (1)

5.1.2 Give a reason for your answer in QUESTION 5.1.1. (2)

5.1.3 Describe *Avogadro's number*. (1)

5.1.4 Calculate the:

(a) Number of CO_2 molecules produced (4)

(b) Mass of $CaCO_3$ that remains unreacted in the flask at the completion of the reaction (5)

5.2 A compound with a molar mass of 162 $g \cdot mol^{-1}$ has the following mass composition:

44,4% C	6,21% H	39,5% S	9,86% O

Determine the molecular formula of the compound. (7)
[20]

QUESTION 6 (Start on a new page.)

x grams sodium carbonate (Na_2CO_3) reacts with 0,028 mol of hydrochloric acid (HCℓ) at 25 °C. The balanced equation for the reaction is:

$$Na_2CO_3\ (s) + 2\ HCℓ \rightarrow 2\ NaCℓ\ (aq) + H_2O\ (ℓ) + CO_2\ (g)$$

448 cm^3 of CO_2 gas is produced during this reaction. The molar volume at 25 °C is 24,47 $dm^3 \cdot mol^{-1}$.

6.1 Define the term *limiting reagent*. (2)

6.2 Name the law that states that:

ONE mole of any gas occupies the same volume at the same temperature and pressure. (1)

6.3 Determine by calculation which substance is the liming reagent, Na_2CO_3 or HCℓ. (5)

6.4 Calculate the value of **x**. (4)

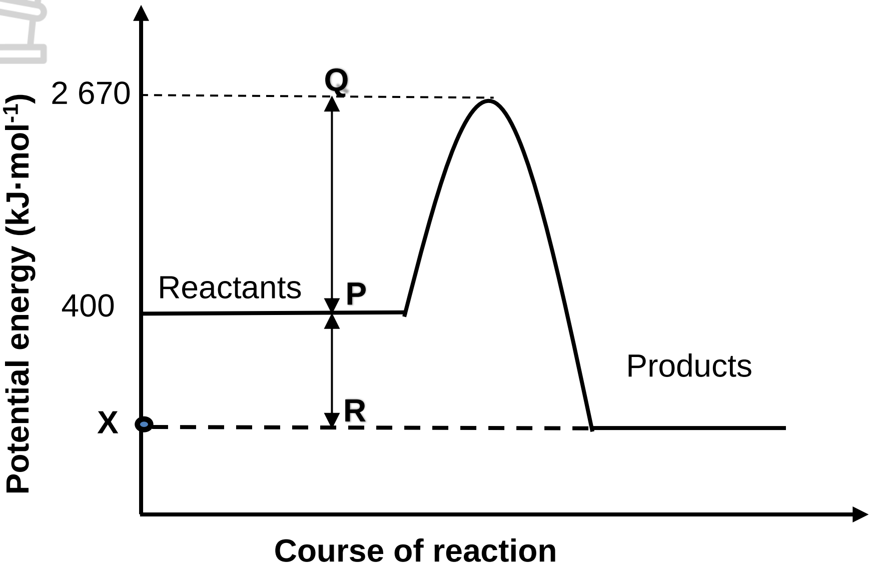
[12]

QUESTION 7 (Start on a new page.)

Consider the following reaction:

$$4\ NH_3(g) + 5\ O_2(g) \rightleftharpoons 4\ NO(g) + 6\ H_2O(g) \quad \Delta H = -216{,}7\ kJ \cdot mol^{-1}$$

The graph below shows the potential energy against the course of this reaction.



7.1 Define *activation energy*. (2)

7.2 What do the following sections of the graph represent?

7.2.1 **RP** (1)

7.2.2 **QP** (1)

7.3 Determine by calculation the value of **X.** (3)

7.4 What effect will the addition of suitable catalyst to the reaction mixture have on the activation energy of the reaction?

Choose from INCREASES, DECREASES or NO EFFECT. (1)

7.5 60 cm^3 of NH_3 reacts completely with 90 cm^3 of O_2 at the same temperature and pressure in a container that can expand.

Calculate the TOTAL THEORETICAL VOLUME (in dm^3) of the gases present in the container at the completion of the reaction. (5)

7.6 Will the measured TOTAL volume of the gases at the completion of the reaction be HIGHER or LOWER than the value calculated in QUESTION 7.5? (1)

[14]

QUESTION 8 (Start on a new page.)

8.1 Consider the following acid-base reaction that occurs in an indicator, HIn:

$$HIn\,(aq) + H_2O(\ell) \rightleftharpoons In^-\,(aq) + \mathbf{X}\,(aq)$$

8.1.1 Define an *acid* according to the Lowry-Brønsted theory. (2)

8.1.2 Is the indicator (HIn) an acid or a base in the reaction?

Give a reason for your answer. (2)

8.1.3 Write down the formula of **X**. (1)

The indicator has the following colours in different solutions:

Acid	**Neutral**	**Base**
Yellow	Green	Blue

8.1.4 What will the colour of the indicator be when it is added to a sodium hydroxide (NaOH) solution?

Choose from YELLOW, GREEN or BLUE. (1)

8.2 A school laboratory has 100 cm^3 of hydrochloric acid (HCℓ) solution with a concentration of 0,9 $mol{\cdot}dm^{-3}$ available.

8.2.1 Define *concentration* in words. (2)

8.2.2 Calculate the number of moles of hydrochloric acid (HCℓ) present in 100 cm^3 of this solution. (3)

All of the 100 cm^3 hydrochloric acid solution is allowed to react with 3,5 g of an unknown metal carbonate (MCO_3) according to the balanced equation:

$$MCO_3\,(s) + 2\,HC\ell\,(aq) \rightarrow MC\ell_2\,(aq) + 2\,H_2O\,(\ell) + CO_2\,(g)$$

The hydrochloric acid solution is found to be in EXCESS.

The EXCESS hydrochloric acid (HCℓ) is neutralised by 25 cm^3 of a sodium hydroxide (NaOH) solution with a concentration 0,8 $mol{\cdot}dm^{-3}$.

The neutralisation reaction of the excess HCℓ solution is shown below:

$$NaOH\,(aq) + HC\ell\,(aq) \rightarrow NaC\ell\,(aq) + H_2O\,(\ell)$$

8.2.3 Determine by calculation the symbol of the unknown metal, M. (7)

[18]

QUESTION 9 (Start on a new page.)

9.1 A clean piece of copper (Cu) is placed in a solution of silver nitrate ($AgNO_3$). The balanced net ionic equation is:

$$Cu\ (s) + 2\ Ag^{+}\ (aq) \rightleftharpoons Cu^{2+}\ (aq) + 2\ Ag\ (s)$$

9.1.1 Define *reduction* in terms of electron transfer. (2)

9.1.2 What type of reaction does copper, Cu undergo in this equation?

Choose from OXIDATION or REDUCTION.

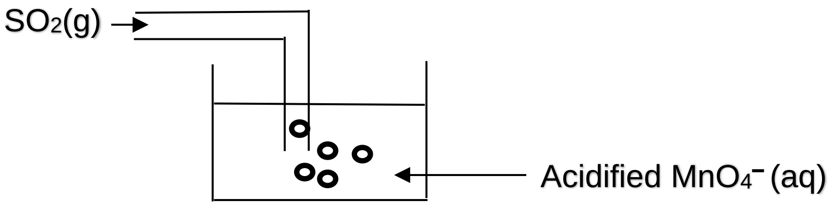
Explain your answer by referring to oxidation numbers. (3)

Write down the:

9.1.3 Formula or name of the spectator ions in the reaction (1)

9.1.4 Reduction half reaction (2)

9.2 Sulphur dioxide gas (SO_2) is bubbled into an acidified solution of potassium permanganate as shown in the diagram below.



It is observed that the solution turns from purple to colourless due to the reduction of MnO_4^- ions to Mn^{2+} ions. During the reaction SO_2 is oxidised to sulphate ions, SO_4^{2-}.

9.2.1 Determine the oxidation number of sulphur, S in SO_4^{2-}. (2)

Write down the:

9.2.2 Oxidation half reaction (2)

9.2.3 Balanced net ionic equation using the half reaction method (5)
[17]

TOTAL: 150

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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*

NAAM/*NAME*	**SIMBOOL/*SYMBOL***	**WAARDE/*VALUE***
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume teen STD*	V_m	$22{,}4\ dm^{3}\cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron Lading op elektron	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant Avogadro se konstante	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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

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* (↓)

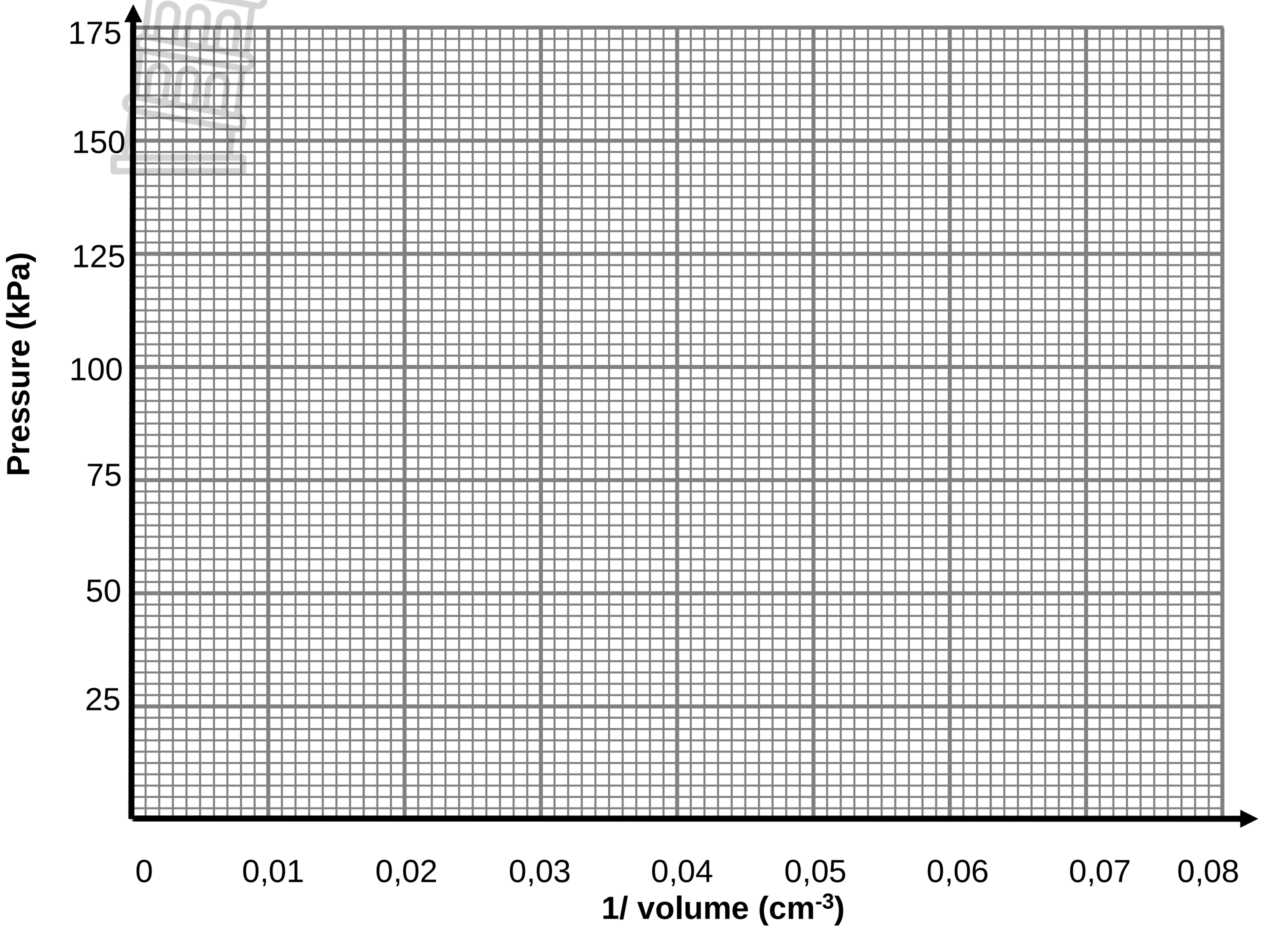
Half-reactions/*Halfreaksies*			E^θ (V)
$Li^+ + e^-$	⇌	Li	– 3,05
$K^+ + e^-$	⇌	K	– 2,93
$Cs^+ + e^-$	⇌	Cs	– 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Na^+ + e^-$	⇌	Na	– 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	– 1,66
$Mn^{2+} + 2e^-$	⇌	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 reducing ability/*Toenemende reduserende vermoë* (↑)

ANNEXURE A:

NAME AND SURNAME: ___________________________

QUESTION 4.4



Province of the EASTERN CAPE EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIORSERTIFIKAAT*

GRADE/*GRAAD* 11

NOVEMBER 2023

PHYSICAL SCIENCES P2 MARKING GUIDELINE/ *FISIESE WETENSKAPPE V2 NASIENRIGLYN*

MARKS/*PUNTE:* **150**

This marking guideline consists of 12 pages./
Hierdie nasienriglyn bestaan uit 12 bladsye.

QUESTION/*VRAAG* 1

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

QUESTION/*VRAAG* 2

2.1 2.1.1 A group of two or more atoms covalently bonded ✓ that function as a unit. ✓

'n Groep van twee of meer atome wat kovalent verbind ✓ is en wat as 'n eenheid funksioneer. ✓ (2)

2.1.2 H_3O^+ ✓ (1)

2.1.3 NaCℓ ✓ (1)

2.1.4 NaCℓ ✓ (1)

2.2 2.2.1 H : N̈ : H ✓✓
H
(2)

2.2.2 H :C⋮⋮N̈ ✓✓ (2)

2.3 1 ✓ (1)

2.4 Non-polar ✓
- B – Cℓ is a polar bond ✓ (ΔEN = 3,0 – 2,0 = 1)
- $BC\ell_3$ is a trigonal planar ✓
- Charge distribution /molecular geometry / molecule is symmetrical ✓ / The polar bonds cancel each other out

Nie-polêr
- *B – Cℓ is 'n polêre binding (ΔEN = 3,0 – 2,0 = 1)*
- *$BC\ell_3$ het 'n trigonaal planêre vorm*
- *Lading verspreiding / molekulêre vorm(geometrie) / molekule is simmetries / Die polêre bindings kanselleer mekaar uit.* (4)

2.5 2.5.1 It is the energy needed to break one mole ✓of a compound's molecules into separate atoms. ✓

Dit is die energie wat benodig word om een mol van 'n verbinding se molekules in aparte atome op te breek. (2)

2.5.2 B ✓ (1)

2.6 2.6.1 C ≡ C ✓ (1)

2.6.2
- The higher the bond energy the stronger the forces of attraction between the nuclei. ✓
- The nuclei come closer resulting in a shorter length. ✓

- *Hoe hoër die bindingsenergie hoe sterker is die aantrekkingskragte tussen die kerne.*
- *Die kerne kom nader aan mekaar wat na korter lengte lei.* (2)

[20]

QUESTION/*VRAAG* 3

3.1 The temperature at which the vapour pressure ✓of a liquid equals the atmospheric pressure ✓

Die temperatuur waarby die dampdruk van 'n vloeistof gelyk aan die atmosferiese druk is. (2)

3.2 Gas phase / *Gasfase* ✓ (1)

3.3 **From A to D / *Van A tot D***

- The molecular size / surface area increases ✓
- The strength of the London forces / dispersion forces/ induced dipole forces increases ✓
- More energy is needed to overcome the intermolecular forces. ✓

- *Die molekulêre grootte / oppervlakte neem toe.*
- *Die sterkte van die London-krag / Dispersiekrag / geïnduseerde dipool-kragte neem toe.*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom.*

OR / *OF*

From D to A / *Van D tot A*

- The molecular size / surface area decreases ✓
- The strength of the London forces / dispersion forces/ induced dipole forces decreases ✓
- Less energy is needed to overcome the intermolecular forces. ✓

- *Die molekulêre grootte / oppervlakte neem af*
- *Die sterkte van die London-krag / dispersiekrag /geïnduseerde dipool-kragte neem af*
- *Minder energie word benodig om die intermolekulêrekragte te oorkom.* (3)

3.4 CH_4 ✓
Lowest boiling point / *Laagste kookpunt* ✓ (2)

3.5 Higher than / *Hoër as* ✓ (1)

3.6
- HCℓ has dipole-dipole forces ✓
- CH_4 have London/dispersion/induced dipole forces
- Dipole forces are stronger than the London/dispersion/induced dipole forces ✓
- More energy is needed to overcome the intermolecular forces in HCℓ ✓

- *HCℓ het dipool-dipoolkragte*
- *CH_4 het London / verpreidings / geïnduseerde dipool-kragte*
- *Dipoolkragte is sterker as die London/verpreidings/geïnduseerde dipool-kragte*
- *Meer energie word benodig om die intermolekulêrekragte in HCℓ te oorkom*

OR / *OF*

- HCℓ has dipole-dipole forces ✓
- CH_4 have London/dispersion/induced dipole forces
- The London/dispersion/induced dipole forces are weaker than the dipole-dipole forces ✓
- Less energy is needed to overcome the intermolecular forces in CH_4 ✓

- *HCℓ het dipool-dipoolkragte*
- *CH_4 het London/verspreidings/geïnduseerde dipoolkragte*
- *Die London/verpreidings/ geïnduseerde dipoolkragte is swakker as die dipool-dipoolkragte*
- *Minder energie word benodig om die intermolekulêrekragte in CH_4 te oorkom* (3)

[12]

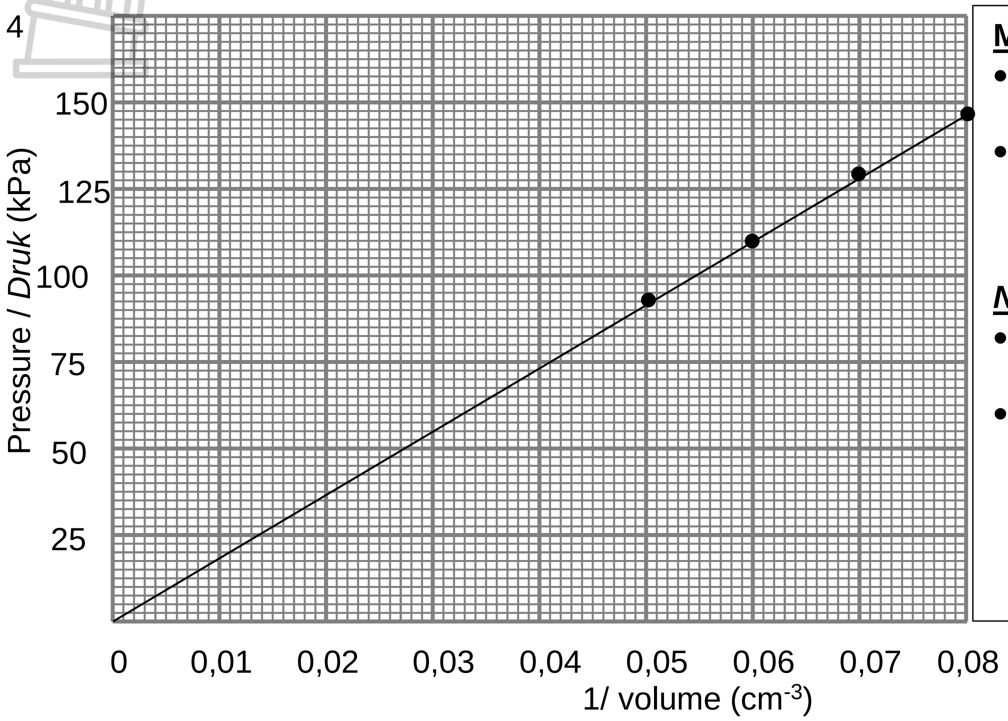
QUESTION/*VRAAG* 4

4.1 Boyles law / *Boyle se wet* ✓ (1)

4.2 Temperature or amount of gas / *Temperatuur of hoeveelheid gas*✓ (1)

4.3 (Bourdon) Pressure gauge / *(Bourdon) drukmeter* ✓ (1)

4.4



<u>Marking criteria</u>

- Points correctly plotted 2
- Straight line graph drawn through the points 2

<u>Nasienkriteria</u>

- *Twee punte korrek geplot*
- *Reguitlyn grafiek deur 2 punte*

(4)

4.5 Pressure is directly proportional to the inverse of volume ✓/Pressure is inversely proportional to volume. ✓
Druk is direk eweredig aan die omgekeerde volume / Druk is omgekeerd eweredig aan die volume. (2)

4.6 $p_1V_1 = p_2V_2$ ✓

$(148)(1/0,08)$ ✓ $= (184)V_2$ ✓

$V_2 = 10,05\ cm^3$ ✓ (Any other correct point / *Enige ander punte wat korrek is*) (4)

4.7 At high pressure ✓ the volume of (real gas) particles become significant. ✓

By hoë temperatuur sal die volume van 'n (egtegas) deeltjies aansienlik word. (2)

4.8 NH_3 has strong ✓ hydrogen bonds ✓ (and at low temperature it will easily liquify).

NH_3 het sterk ✓ waterstofbindings ✓(en by lae temperature sal dit maklik 'n vloeistof word.) (2)

[17]

QUESTION/*VRAAG* 5

5.1 5.1.1 ENDOTHERMIC/*ENDOTERMIES* ✓ (1)

5.1.2 ΔH > 0 ✓✓/Net energy is absorbed/Energy of products greater than that of reactants.

ΔH > 0 / Netto energie word geabsorbeer / Energie van die produkte is hoër as dié van die reaktanse. (2)

5.1.3 Number of particles / atoms / molecules / formula-units in one mole. ✓

Aantal deeltjies / atome / molekules / formule-eenhede in een mol. (1)

5.1.4 (a) $n = m / M$

$n = 0{,}163 / 44$ ✓

$n = 0{,}0037$ mol

$N = nN_A$ ✓

$N = (0{,}0037)(6{,}02 \times 10^{23})$ ✓

$N = 2{,}227 \times 10^{21}$ particles/deeltjies ✓ (4)

5.1.4 (b) **Marking criteria / *Nasienkriteria***

- Mole ratio / *Mol verhouding* $CO_2 : CaCO_3$
- Subst. n($CaCO_3$) mole into/ *Vervang n ($CaCO_3$) in* m = nM

n(CO_2) formed /*gevorm* = 0,0037 mol

n($CaCO_3$) reacting / *reageer* = 0,0037 mol ✓

n($CaCO_3$) initial / *aanvanklik* = m/M = 1,56/100 ✓ = 0,0156 mol

OPTION 1 / *OPSIE 1*	OPTION 2 / *OPSIE 2*
Marking criteria / *Nasienkriteria* • Subtraction of $CaCO_3$ mole/ *Aftrekking van $CaCO_3$ mol* • Mole remaining into / *Mol oorbly in* m = nM • Final answer / *Finale antwoord*	**Marking criteria / *Nasienkriteria*** • Mole reacting into / *Mol reageer* in m = nM • Subtraction of $CaCO_3$ mass/ *Aftrekking van $CaCO_3$ massa* • Final answer / *Finale antwoord*
n (remaining / *oorbly*) = 0,0156 – 0,0037 ✓ n (remaining / *oorbly*) = 0,0119 mol m (remaining / *oorbly*) = 0,0119 x 100 ✓ m (remaining / *oorbly*) = 1,19 g ✓	m (react / reageer) = 0,0037 x 100 ✓ m (react / reageer) = 0,37 g m (remaining / *oorbly*) = 1,56 – 0,37✓ m (remaining / *oorbly*) = 1,19 g ✓

(5)

5.2 **Marking criteria**

- Subst. into n = m / M e.g. 44,4 / 12 ; 6,21 /1 ; 39,5 / 32 ; 9,86 / 16
- Dividing by the smallest mole number 0,62
- Ratio molecular mass: Formula mass
- Molecular formula

Nasienkriteria

- *Vervanging in n = m / M bv 44,4 / 12 ; 6,21 /1 ; 39,5 / 32 ; 9,86 / 16*
- *Deel deur die kleinste mol getal 0,62*
- *Verhouding molekulêre massa : Formule massa*
- *Molekulêre formule*

Element	Mass / *Massa*	Mole (n = m /M)	Simplest ratio/ *Vereenvoudigste verhouding*	
C	44,4	44,4 / 12 ✓ = 3,7	3,7 / 0,62 = 6	
H	6,21	6,21 / 1 ✓ = 6,21	6,21 / 0,62 = 10	
S	39,5	39,5 / 21 ✓ = 1,23	1,23 / 0,62 = 2	Div. by / *Deel deur* 0,62 ✓
O	9,86	9,86 / 16 ✓ = 0,62	0,62 / 0,62 = 1	

Empirical formula / *Emperiese formule*: $C_6H_{10}S_2O$

Formula mass/ *Formule massa* = 6(12) + 10(1) + 2(32) + 16 = 162

Ratio = Molar mass: Emprical formula
Verhouding = Molekulêre massa: Emperiese formule

Ratio/ *Verhouding* = 1 : 1 ✓

Molecular formula / *Molekulêre formule*: $C_6H_{10}S_2O$ ✓ (7)

[20]

QUESTION/*VRAAG* 6

6.1 The substance that is completely used up/reacted ✓✓ during a chemical reaction.
Dit is die stof wat heeltemal opgebruik word / volledig gereageer tydens 'n chemiese reaksie. (2)

6.2 Avogadro's ✓(law / *se wet*) (1)

6.3 **Marking criteria / *Nasienkriteria***

- Formula / *Formule* $n = V / V_m$
- Subst. into / *Vervanging in* $n = V / V_m$
- Mole ratio / *Mol verhouding* CO_2 : HCℓ
- Compare required and available mole / *Vergelyk die vereiste en beskikbare mol*
- Correct identification of limiting reagent / *Identifiseer die korrekte beperkende reagens*

n (CO_2) = V / V_m ✓

n (CO_2) = 0,448 / 24,47 ✓

n (CO_2) = 0,018 mol

n (HCℓ) required/*benodig* = 1/2 n (CO_2)

n (HCℓ) required/*benodig* = 1/2 n (0,018) ✓

n (HCℓ) required/*benodig* = 0,009 mol }

n (HCℓ) available/beskikbaar= 0,028 mol } ✓

∴ Na_2CO_3 is the limiting reagent / *is die beperkende reagens* ✓ (5)

6.4 n (CO_2) = n (Na_2CO_3) = 0,018 mol ✓

m = nM ✓

m = (0,018)(106) ✓

m = 1,908 g ✓ (4)

[12]

QUESTION/*VRAAG* 7

7.1 The minimum energy required ✓ for a chemical reaction to start. ✓
Die minimum energy benodig vir 'n chemiese reaksie om te begin. (2)

7.2 7.2.1 **RP** = Δ H ✓/Heat of reaction/Enthalpy / *Reaksiewarmte / Entalpie* (1)

7.2.2 **QP** = Activation energy / *Aktiveringsenergie* ✓ (1)

7.3 $\Delta H_{\text{reaction / reaksie}} = H_{\text{products / produkte}} - H_{\text{reactants / reaktanse}}$ ✓

$-216,7 = H_{\text{products / produkte}} - 400$ ✓

$H_{\text{products / produkte}}$ (**X**) = 183,3✓ (kJ·mol^{-1}) (3)

7.4 DECREASES / *NEEM AF* ✓ (1)

7.5 **Marking Criteria**

- Use volume ratios to find V(O_2), V(NO and V(H_2O)
- Finding V(O_2) remaining
- Adding V(O_2), V(NO and V(H_2O)
- Conversion to dm^3
- Final answer

Nasienkriteria

- *Gebruik die volume verhouding om V(O_2), V(NO en V(H_2O) te vind.*
- *Vind V(O_2) wat oorbly*
- *Tel V(O_2), V(NO en V(H_2O) bymekaar*
- *Herlei na dm^3*
- *Finale antwoord*

V (O_2) reacting/*reageer* = 5/4 x 60 = 75 cm^3

V (NO) formed/*gevorm* = V(NH_3) reacting/reageer = 60 cm^3 ✓ (for the three lines)

V (H_2O) formed/ *gevorm* = 6/4 x 60 = 90 cm^3

V O_2 remaining/*oorbly* = (90 – 75) = 15 cm^3 ✓

V total / *totaal* = 15 + 60 + 90 ✓

V total / *totaal* = 165/1 000 dm^3 ✓

= 0,165 dm^3 ✓ (5)

7.6 HIGHER / *HOËR* ✓ (1)

[14]

QUESTION/*VRAAG* 8

8.1 8.1.1 Acid is a proton/ H^+ -ion donor ✓✓
'n Suur is 'n proton / H^+-oonskenker (2)

8.1.2 Acid/ *Suur*. ✓
Donates a proton / *Skenk 'n proton* ✓ /(H^+ -ion) (2)

8.1.3 H_3O^+ ✓ (1)

8.1.4 Blue / *Blou* ✓ (1)

8.2.1 The amount of solute ✓ per litre of solution ✓
Die hoeveelheid opgeloste stof per liter oplossing (2)

8.2 8.2.2 n = cV ✓

n = (0,9) (0,1) ✓

n = 0,09 mol ✓ (3)

8.2.3 **Positive marking from / *Positiewe nasien vanaf* 8.2.3**

Marking criteria / *Nasienkriteria*

- Subst. conc. and volume of / *Vervang kons. en volume van* NaOH into n = cV
- Use of mol ratio / *Gebruik mol verhouding* NaOH : HCℓ
- Subtract mol in reaction 2 with total mol / *Trek mol in reaksie 2 af van totale mol*
- Use mol ratio/ *Gebruik mol verhouding* HCℓ:MCO_3
- Subst into / *Vervang in* M = m / n
- Determine the molar mass of / *Bepaal die molêre massa van* M
- Correctly identify M / *Identifiseer M korrek*

n(NaOH) = cV

n(NaOH) = (0,8)(0,025) ✓

n(NaOH) = 0,02 mol

n(NaOH) = n(HCℓ) in excess / *in oormaat* = 0,02 mol ✓

n(HCℓ) reacting with carbonate/reageer met karbonaat = 0,09 – 0,02 ✓

n(HCℓ) = 0,07 mol

n(MCO_3) = ½ (0,07) ✓

n(MCO_3) = 0,035 mol

M = m / n

M = 3,5 / 0,035 ✓
M = 100 g·mol^{-1}

M + 12 + 3 (16) = 100 ✓

M = 40 g·mol^{-1}

M = Ca ✓ (7)
[18]

QUESTION/*VRAAG* 9

9.1.1 Gain of electrons / *Wins aan elektrone* ✓✓ (2)

9.1.2 OXIDATION / *OKSIDASIE* ✓ (1)

Oxidation number of Cu increases ✓ from 0 to +2 ✓
Oksidasiegetal van Cu neem toe vanaf 0 na +2 (2)

9.1.3 NO_3^- ✓ (1)

9.1.4 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

9.2.1 x + 4(-2) = -2 ✓

x = + 6 ✓ (2)

9.2.2 $SO_2(g) + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$ ✓✓
(*1/2* if double arrow is used / *as dubbelpyltjie gebruik is*) (2)

9.2.2 **Marking criteria / *Nasienkriteria***
- Reduction half reaction / *Reduksie halfreaksie* ✓✓
- Reactants / *Reaktanse* ✓
- Products / *Produkte* ✓
- Balanced / *Gebalanseer* ✓

Oxidation ½ reaction / *Oksidasie ½ reaksie*: $SO_2(g) + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$

Reduction ½ reaction / Reduksie ½ reaksie: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ ✓✓

Net ionic equation/netto ioniese reaksie:
$5SO_2(g) + 2MnO_4^- + 2H_2O$ ✓ $\rightarrow 5SO_4^{2-} + 2Mn^{2+} + 4H^+$ ✓ (✓ bal) (5)
[17]

TOTAL/*TOTAAL*: 150

Province of the
EASTERN CAPE
EDUCATION

CHIEF DIRECTORATE: EXAMINATIONS AND ASSESSMENT
Steve Vukile Tshwete Complex, Zone 6 Zwelitsha, 5608, Private Bag X0032, Bhisho, 5605 REPUBLIC OF SOUTH AFRICA:
Enquiries: **Mrs P. Japhta Tel: 040 602 7031 . Fax : 040 608 7026. E-mail: Penny.Japhta@ecdoe.gov.za**
Website: www.ecdoe.gov.za

Ref. no. 13/P
Enquire: Mrs P. Japhta
Tel.: (040) 608 7026/082 523 7689
Fax: 040 608 7295

ERRATUM

TO: **ALL PRINCIPALS OF SCHOOLS IN THE FET BAND AND DISTRICT HEADS OF EXAMINATIONS**

FROM: **MRS P. JAPHTA**
(a) CES: ASSESSMENTS INSTRUMENT DEVELOPMENT AND ITEM BANK MANAGEMENT SUBDIRECTORATE

SUBJECT: **PHYSICAL SCIENCES P2 GR11 EXAMINATIONS ERRATUM**

DATE: **23 NOVEMBER 2023**

The Physical Sciences P2 Grade 11 for the November Examinations 2023 was written on Monday, the 20 November 2023. We were made aware of errors and omissions that was discovered during the marking process.

The amendment with regards to the marking was prepared in conjunction with the examiner and the moderator of the paper. This amendment addresses the errors and omissions and also ensures that learners are not disadvantaged. The following standardised approach to marking must be adopted across the Province.

Page	Question		Marks
13	6.3	Determine by calculation which substance is the liming reagent, Na_2CO_3 or HCℓ.	(5)
	6.4	Calculate the value of **x**.	(4)

Page	Error		Marks
13		With HCℓ as the limiting reagent the amount of CO_2 yield will not be possible.	
		Learners will not be able to calculate sub-questions 6.3 and 6.4.	

Remedial action

Teachers must NOT mark QUESTIONS 6.3 AND 6.4.

Mark the paper out of 141 and convert it to 150 using the following conversion factor to get the learner's mark out 150 marks.

Example

90 / 141 x 150 = 96

The erratum is issued as a measure to assure that a fair and equitable approach is applied to assessment across the Province.

We request that this must be brought to the attention of all educators marking these papers and sincerely apologise for the inconvenience.

Yours in education.

23 November 2023

MRS P.E. JAPHTHA
(a) CES: ASSESSMENTS INSTRUMENT DEVELOPMENT AND ITEM BANK MANAGEMENT SUBDIRECTORATE

DATE