



GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2023

10842

PHYSICAL SCIENCES: CHEMISTRY
(PAPER 2)

TIME: 3 hours

MARKS: 150

PHYSICAL SCIENCES: Paper 2



10842E

Stanmorephysics

X05



19 pages + 4 data sheets

P.T.O.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question (e.g. QUESTION 2 and QUESTION 3) on a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.



QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. 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 EMPIRICAL formula of hexanoic acid is:

A $C_3H_6O_2$

B $C_6H_6O_2$

C $C_6H_{12}O_2$

D C_3H_6O

(2)

1.2 Which intermolecular forces are present between molecules of $C_7H_{15}CHO$?

A Only dipole-dipole forces

B Dipole-dipole forces, dispersion (London) forces and hydrogen bonding forces

C Dispersion (London) forces and hydrogen bonding forces

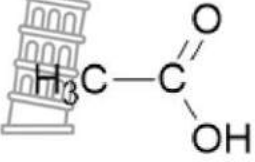
D Dipole-dipole forces and dispersion (London) forces

(2)



P.T.O.

1.3 The structures of four organic compounds are shown below.

COMPOUND 1	COMPOUND 2
	$\text{H}_2\text{C}=\text{CH}_2$
COMPOUND 3	COMPOUND 4
$\text{H}_3\text{C}-\text{CH}=\text{CH}_2$	

Which of these compounds will decolourise bromine water FAST?

- A 1 and 2
- B 2 and 3
- C 3 and 4
- D 1 and 4 (2)

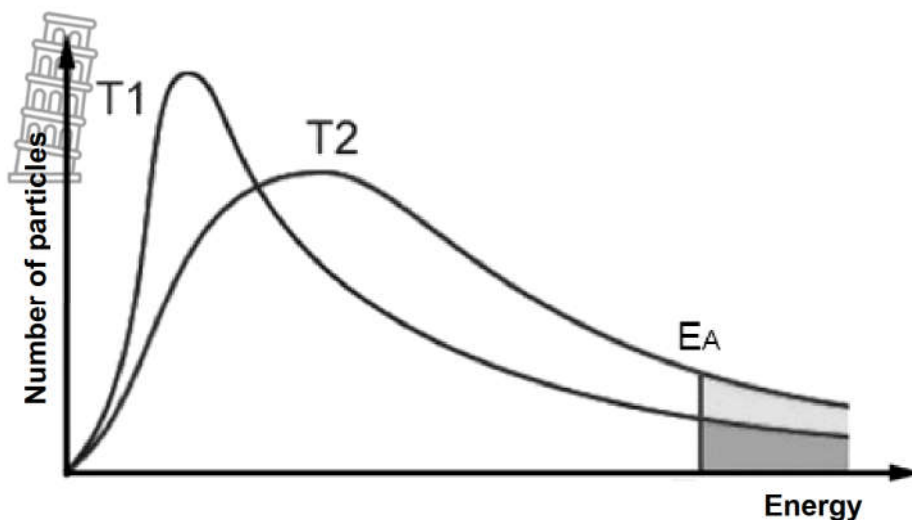
1.4 Which of the following statements best explains the role of a catalyst?

- A It lowers the activated complex.
- B It increases the concentration of the reactants and therefore increases the rate of the reaction.
- C It provides an alternative path with lower activation energy for the reaction.
- D It increases the net activation energy. (2)



P.T.O.

- 1.5 The energy distribution curves for a fixed mass of gas at two different temperatures, T1 and T2, are shown below:



Which ONE of the following is the correct interpretation of the curves for the change in temperature from T1 to T2?

	Activation energy	Number of effective collisions
A	Stays the same	Increased
B	Decreased	Decreased
C	Decreased	Increased
D	Stays the same	Decreased

(2)

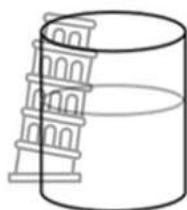
- 1.6 Each of the reactions represented below is at equilibrium in a closed container. In which of these reactions will an INCREASE IN PRESSURE (by decreasing the volume) favour the formation of products?

- A $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
 B $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 C $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 D $\text{NO}_2(\text{g}) + \text{CO}(\text{g}) \rightleftharpoons \text{NO}(\text{g}) + \text{CO}_2(\text{g})$

(2)



1.7 Consider beakers **A** and **B** as illustrated below.



200 cm³ of
0,25 mol·dm⁻³
NaOH (aq)

Beaker A



150 cm³ of
0,1 mol·dm⁻³
NaOH (aq)

Beaker B

20 cm³ of the NaOH(aq) solution in beaker **A** is added to the NaOH(aq) solution in beaker **B**. Which of the following represents the correct calculation for the new concentration of Na⁺(aq) ions in beaker **B**?

A
$$\frac{0,015 + 0,005}{0,17}$$

B
$$\frac{0,015 + 0,05}{0,17}$$

C
$$\frac{0,015 \times 0,005}{0,15}$$

D
$$\frac{0,015 + 0,005}{0,15}$$

(2)

1.8 When a galvanic (voltaic) cell delivers current, the purpose of the salt bridge is to ...

A allow electrons to move in the cell.

B ensure electrical neutrality in the cell.

C prevent the two solutions from mixing.

D allow electrons to travel from the cathode to the anode.

(2)



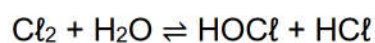
P.T.O.

1.9 Which of the following metals is the strongest reducing agent?

- A Ag
B Zn
C Cu
D Al

(2)

1.10 Gaseous chlorine (Cl_2), used to disinfect the water in public swimming pools, reacts with water according to the following balanced equation:



The addition of chlorine changes the pH of water in swimming pools.

Which of the following substances must be added to public swimming pools periodically to increase the pH?

- A NH_4Cl
B Na_2CO_3
C KCl
D H_2SO_4

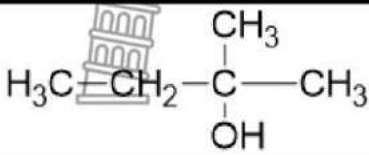
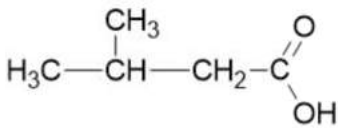
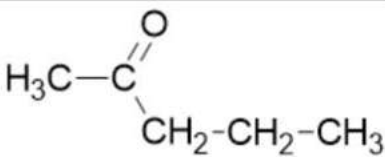
(2)
[20]



P.T.O.

QUESTION 2 (Start on a new page.)

A to **F** in the table below represent six organic compounds.

A		B	Pentan-3-one
C	Methyl butanoate	D	
E		F	$\text{CH}_3(\text{CH}_2)_3\text{CH}_3$

2.1 Consider the organic compound **A**.

- 2.1.1 Is it a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer. (2)
- 2.1.2 Write down the IUPAC name for the above-mentioned compound. (2)
- 2.1.3 The above-mentioned compound undergoes an elimination reaction. Write down the STRUCTURAL FORMULA of the major product that is formed. (2)

2.2 Consider the organic compound **B**.

- 2.2.1 Define the term *functional isomer*. (2)

Write down the:

- 2.2.2 Homologous series to which the above-mentioned compound belongs (1)
- 2.2.3 IUPAC name of its functional isomer (2)
- 2.2.4 Letter that represents its positional isomer (1)

2.3 Write down the balanced equation using MOLECULAR FORMULAE for the complete combustion of compound **F**. (3)

[15]

P.T.O.

QUESTION 3 (Start on a new page.)

Three structural isomers with molecular formula C_6H_{14} are used to investigate the effect of branching on the physical properties of hydrocarbons.

HYDROCARBON	STRUCTURAL FORMULAE
A	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$
B	$\begin{array}{c} \text{H}_3\text{C} \quad \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{CH}-\text{HC} \\ \diagup \quad \diagdown \\ \text{H}_3\text{C} \quad \quad \text{CH}_3 \end{array}$
C	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$

The results obtained for the first TWO investigations are shown in the table below.

HYDROCARBON	INVESTIGATION 1	INVESTIGATION 2
	MELTING POINT (°C)	BOILING POINT (°C)
A	-154	60
B	-129	58
C	-100	50

- 3.1 Define the term *melting point*. (2)
- 3.2 Write down the independent variable for INVESTIGATION 1. (1)
- 3.3 Explain why these three organic compounds are called structural isomers. (2)
- 3.4 Write down the type of intermolecular forces present between molecules of these isomers. (1)
- 3.5 Explain the difference in melting points between molecules **A** and **B**. (4)

P.T.O.

For INVESTIGATION 3, the vapour pressure (in mmHg) measured at 25 °C, is shown in the table below:



VAPOUR PRESSURE (mmHg)		
235	319	211

3.6 Using the information of INVESTIGATION 2 and INVESTIGATION 3, match the correct vapour pressure with the appropriate molecule (**A – C**). Write down the letters (A – C) below each other with the corresponding vapour pressure next to each letter. (2)

3.7 Fully explain the answer in QUESTION 3.6. (3)

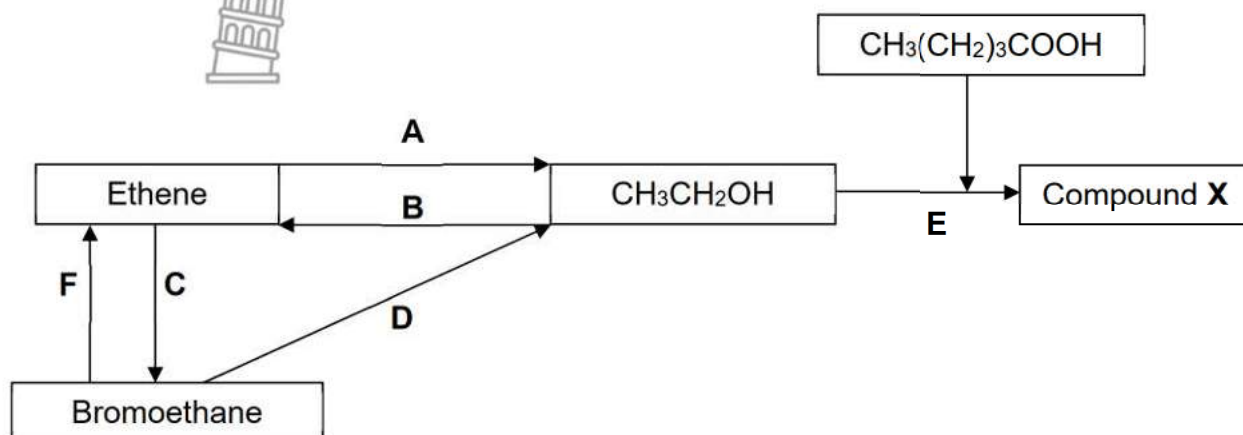
[15]



P.T.O.

QUESTION 4 (Start on a new page.)

The flow diagram below shows how ethene can be used to prepare various organic compounds. The letters **A** to **F** represent different organic reactions.



4.1 Identify the type of reaction represented by:

4.1.1 **B** (1)

4.1.2 **D** (1)

4.2 Write down TWO reaction conditions for reaction **B**. (2)

4.3 For reaction **A**, write down the:

4.3.1 NAME of the inorganic reactant (1)

4.3.2 CHEMICAL FORMULA of the catalyst needed (1)

4.4 For reaction **C**:

4.4.1 Use STRUCTURAL FORMULAE and write down a balanced chemical equation. (3)

4.4.2 Explain why no water should be present during this reaction. (1)



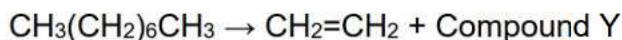
- 4.5 Reaction **E** represents the conversion of the alcohol into organic compound **X**.

Write down the:

- 4.5.1 Type of reaction (1)
- 4.5.2 CHEMICAL FORMULA of the catalyst needed (1)
- 4.5.3 STRUCTURAL FORMULA of compound **X** (2)
- 4.5.4 IUPAC name of compound **X** (2)

- 4.6 Reaction **F** takes place in the presence of warm, concentrated NaOH. Use CONDENSED STRUCTURAL FORMULAE and write down a balanced equation for the reaction. (3)

- 4.7 Large straight-chained alkanes can be catalytically cracked to produce shorter-chained alkenes and branched alkanes which are more suitable for use in petrol. The reaction below indicates the catalytic cracking of octane.



- 4.7.1 Write down the IUPAC name of compound **Y**. (1)
- 4.7.2 Briefly explain why shorter-chained alkenes and branched alkanes are more suitable for use in petrol than large straight-chained alkanes. (2)

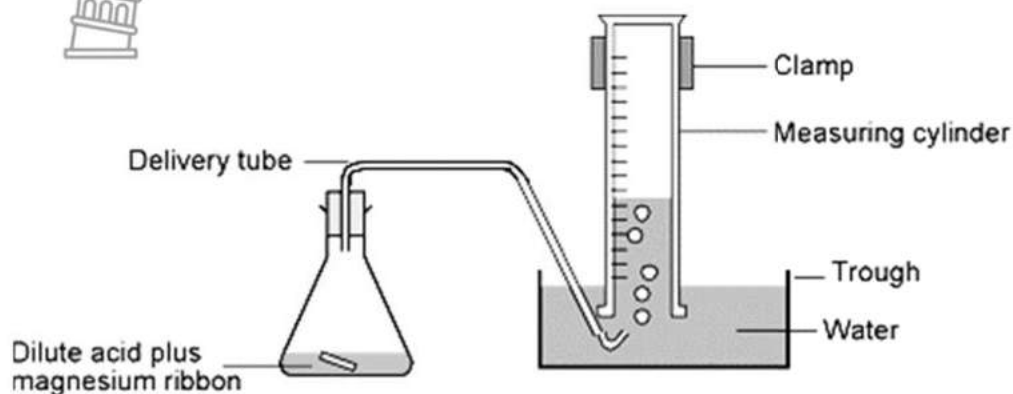
[22]



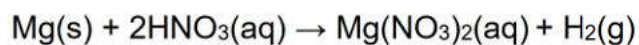
P.T.O.

QUESTION 5 (Start on a new page.)

The following apparatus was used by a group of learners in an investigation to find out how surface area affects the rate of reaction between excess solid magnesium ribbon and dilute nitric acid with a concentration of $0,05 \text{ mol} \cdot \text{dm}^{-3}$.



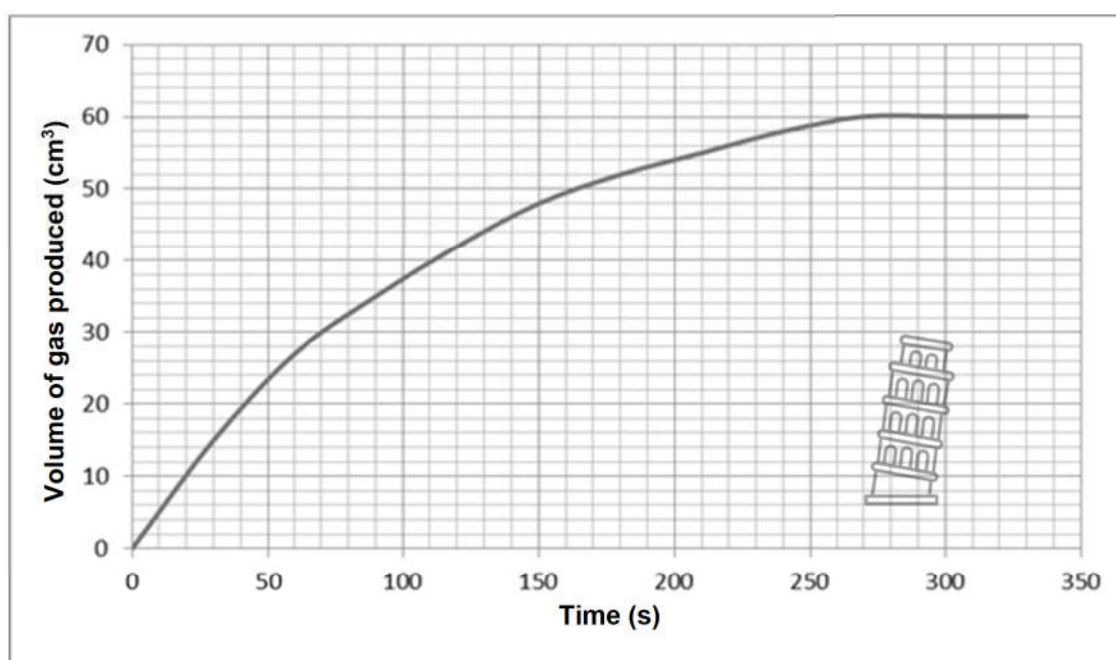
During the reaction, the gas formed is collected in the measuring cylinder. The balanced equation for the reaction is:



The summary of their investigation is tabulated below.

EXPERIMENT	MASS OF MAGNESIUM (g)	STATE OF DIVISION
I	2	Ribbon cut into 5 small pieces
II	2	Ribbon as one large piece

The results for experiment I are plotted on the graph below.

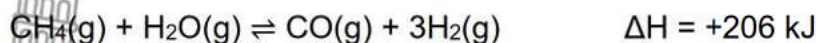
**P.T.O.**

- 5.1 Besides the mass and the volume of the reactants, give ONE other variable that must be kept constant during this investigation. (1)
- 5.2 Write down the dependent variable in this investigation. (1)
- 5.3 Use the graph to calculate the average rate of the reaction (in $\text{cm}^3 \cdot \text{s}^{-1}$) between 2 and 2,5 minutes. (3)
- 5.4 Will the rate of the reaction at 250 s be GREATER THAN, LESS THAN or EQUAL TO the rate calculated in QUESTION 5.3? Give a reason for the answer. (2)
- 5.5 Predict how the gradient of the graph for experiment II will compare to that of experiment I. Write down only INCREASE, DECREASE or STAY THE SAME. (1)
- 5.6 Calculate the mass of magnesium metal that remains in the conical flask when the reaction has stopped. Assume that the molar volume is $24 \text{ dm}^3 \cdot \text{mol}^{-1}$ at room temperature. (5)
- 5.7 Medication used to relieve headaches is available as powders or tablets. Use the collision theory to explain why powders provide faster relief than tablets. (2)

[15]**P.T.O.**

QUESTION 6 (Start on a new page.)

Hydrogen gas is prepared by the reaction of methane and steam, as shown in the following balanced chemical equation:



The methane (CH_4) and steam (H_2O) are sealed in a 2 dm^3 container to react and are allowed to reach equilibrium at temperature T.

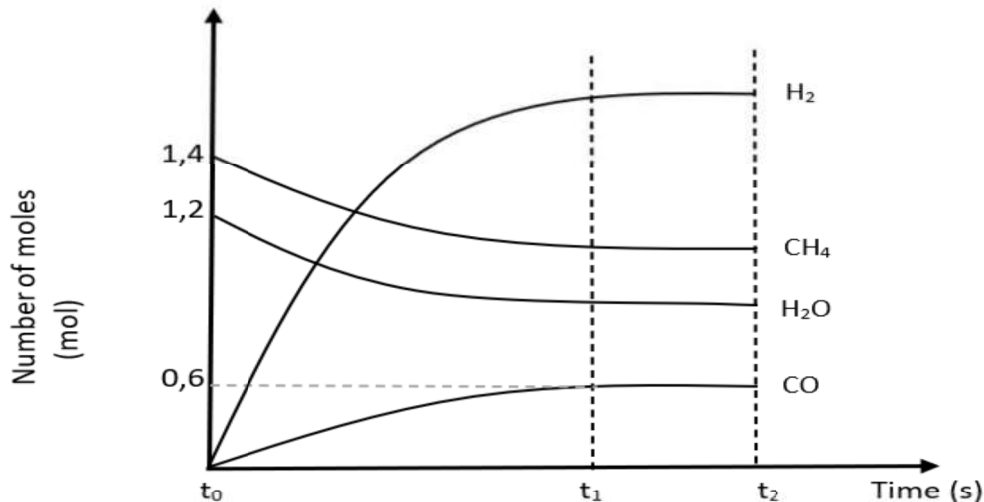
6.1 State *Le Chatelier's Principle*. (2)

6.2 Use Le Chatelier's principle to explain how the following changes will affect the yield of $\text{H}_2(\text{g})$:

6.2.1 Adding more CH_4 (3)

6.2.2 A decrease in the volume of the container (3)

The sketch graph below shows the changes in the number of moles of methane, steam and carbon monoxide as the reaction proceeds for the preparation of H_2 gas in a 2 dm^3 container.



6.3 Write down a reason why there is no change in the number of moles of each of the gases between times t_1 and t_2 . (1)

6.4 Use the information on the graph and calculate the equilibrium constant, K_c , for this reaction at temperature T. (7)

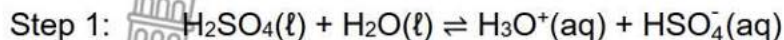
6.5 The temperature T is **decreased**. How will this change affect the K_c -value for the above reaction? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)

[17]

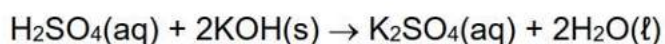
P.T.O.

QUESTION 7 (Start on a new page.)

The balanced equations below represent the ionisation of sulphuric acid in water:



- 7.1 Is H_2SO_4 a STRONG or WEAK acid? Give a reason for the answer. (2)
- 7.2 Write down the FORMULAE of the conjugated acid-base pairs in step 2. (2)
- 7.3 H_2SO_4 is diprotic. Write down the meaning of the term *diprotic*. (2)
- 7.4 Write down the FORMULA of the ampholyte in the above reaction. (1)
- 7.5 An impure sample of potassium hydroxide pellets with a mass of 11,2 g is added to 0,09 mole of sulphuric acid with a volume of 600 cm³. It reacts according to the balanced chemical equation given below:



- 7.5.1 Calculate the initial pH of the sulphuric acid used in this reaction. (5)
- 7.5.2 The percentage purity of the potassium hydroxide pellets used is 80%. Calculate the number of moles of pure potassium hydroxide that react with H_2SO_4 . (4)
- 7.5.3 Determine which reactant is in excess and hence state whether the final solution is ACIDIC, BASIC or NEUTRAL. (3)

[19]**P.T.O.**

QUESTION 8 (Start on a new page.)

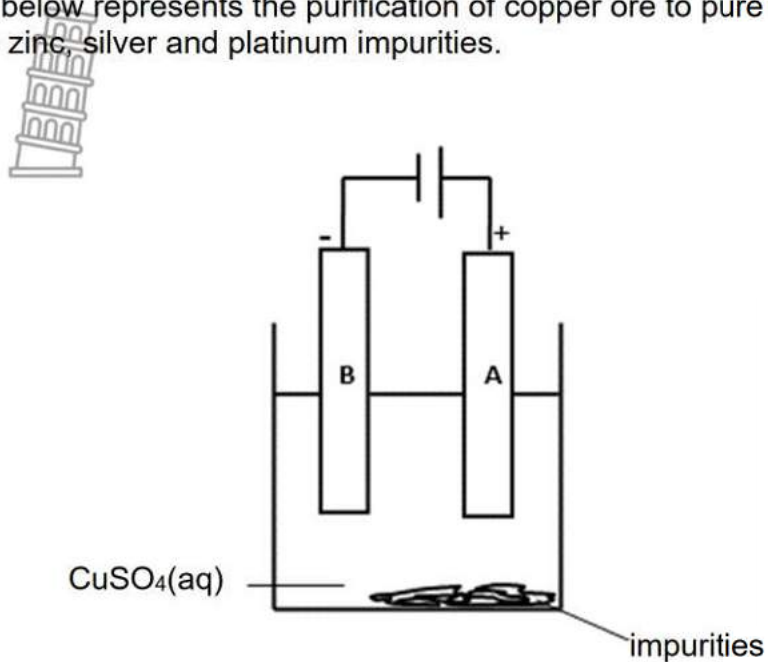
A galvanic cell is set up using a manganese rod, Mn, and an unknown metal **X**. The initial EMF measured under standard conditions is 1,05 V. The electrons flow from manganese to metal **X** in the external circuit.

- 8.1 Is the reaction that occurs in this cell spontaneous? Write down only YES or NO. Give a reason for the answer. (2)
- 8.2 Which electrode, **X** or **Mn**, is the anode? (1)
- 8.3 Use calculations to identify metal **X**. (5)
- 8.4 For this cell, write down the:
- 8.4.1 TWO standard conditions (2)
- 8.4.2 Cell notation (2)
- 8.4.3 Reduction half reaction (2)
- [14]**

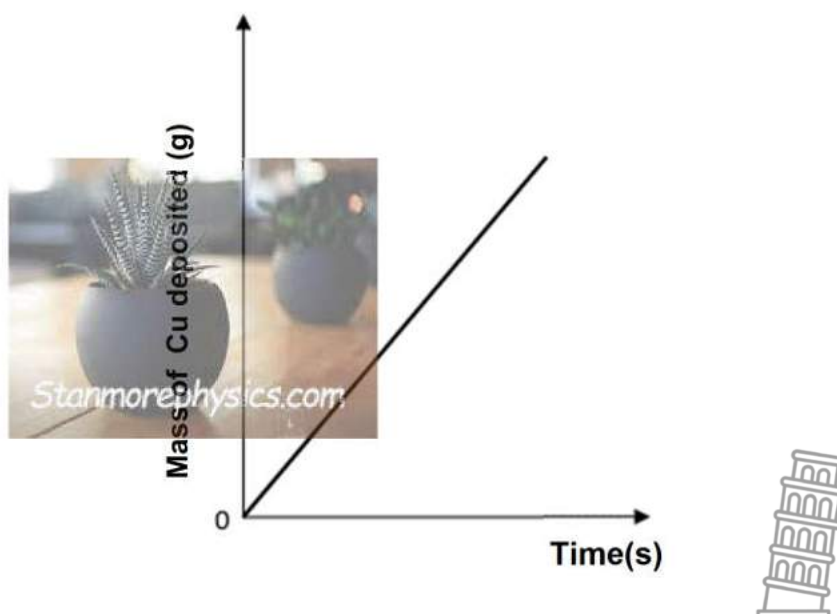


QUESTION 9 (Start on a new page.)

The diagram below represents the purification of copper ore to pure copper. The cell also contains zinc, silver and platinum impurities.



The graph shows the initial relationship between the mass of Cu deposited versus the time.



- 9.1 Write down the energy conversion that takes place in this cell. (1)
- 9.2 At which electrode, **A** or **B**, would pure copper be deposited? (1)
- 9.3 Write down the half-reaction that takes place at the anode. (2)
- 9.4 How will the gradient of the graph be affected as the reaction is allowed to proceed until completion? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)
- 9.5 Refer to the relative strengths of reducing agents to explain why zinc (Zn) will NOT be deposited at the cathode. (3)
- 9.6 When the current flows for 30 minutes, 15 g of pure copper was deposited at one of the electrodes.
- 9.6.1 Calculate the number of moles of copper deposited. (3)
- 9.6.2 Determine the number of moles of electrons that flows through the circuit while 15 g of copper is deposited. (2)
- [13]**

TOTAL: 150



END

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

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

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$E_{\text{cell}}^\theta = E_{\text{cathode}}^\theta - E_{\text{anode}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{katode}}^\theta - E_{\text{anode}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{reduction}}^\theta - E_{\text{oxidation}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{reduksie}}^\theta - E_{\text{oksidasie}}^\theta$ $E_{\text{cell}}^\theta = E_{\text{oxidising agent}}^\theta - E_{\text{reducing agent}}^\theta$ / $E_{\text{sel}}^\theta = E_{\text{oksideermiddel}}^\theta - E_{\text{reduseermiddel}}^\theta$	



TABLE 3: THE PERIODIC TABLE OF ELEMENTS

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

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)
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KEY/SLEUTEL

Atomic number/
Atoomgetal

1 H 1	3 Li 7	11 Na 23	19 K 39	37 Rb 86	55 Cs 133	87 Fr
2,1	1,0	0,9	0,8	0,8	0,7	0,7
	1,5	1,2	1,0	1,0	0,9	0,9
	4 Be 9	12 Mg 24	20 Ca 40	38 Sr 88	56 Ba 137	88 Ra 226

	2 He 4	10 Ne 20	18 Ar 40	36 Kr 84	54 Xe 131	86 Rn
		9 F 19 4,0	17 Cl 35,5 3,0	35 Br 80 2,8	53 I 127 2,5	85 At 2,5
		8 O 16 3,5	16 S 32 2,5	34 Se 79 2,4	52 Te 128 2,1	84 Po 2,0
		7 N 14 3,0	15 P 31 2,1	33 As 75 2,0	51 Sb 122 1,9	83 Bi 209 1,9
		6 C 12 2,5	14 Si 28 1,8	32 Ge 73 1,8	50 Sn 119 1,8	82 Pb 207 1,8
		5 B 11 2,0	13 Al 27 1,5	31 Ga 70 1,6	49 In 115 1,7	81 Tl 204 1,8

29 Cu 63,5	28 Ni 58,7	27 Co 58,9	26 Fe 55,8	25 Mn 54,9	24 Cr 52,0	23 V 50,9	22 Ti 47,9	21 Sc 44,9	20 Ca 40,1	19 K 39,1	18 Ar 39,9	17 Cl 35,5	16 S 32,1	15 P 31,0	14 Si 28,1	13 Al 27,0	12 Mg 24,3	11 Na 23,0	10 Ne 20,2	9 F 19,0	8 O 16,0	7 N 14,0	6 C 12,0	5 B 11,0	4 Be 9,0	3 Li 7,0	2 He 4,0
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Electron Configuration Elektron Konfigurasi	1 H 1	2,1	3 Li 7	1,0	4 Be 9	1,5	11 Na 23	1,2	12 Mg 24	1,3	19 K 39	0,8	20 Ca 40	1,0	21 Sc 45	1,5	22 Ti 48	1,6	23 V 51	0,7	37 Rb 86	0,8	38 Sr 88	1,0	39 Y 89	1,2	40 Zr 91	1,4	41 Nb 92	0,7	55 Cs 133	0,9	56 Ba 137	0,9	57 La 139	1,6	72 Hf 179	1,6	73 Ta 181
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TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/Toenemende oksiderende vermoë

Half-reactions/Halfreaksies	E ⁰ (V)
$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-$	+ 2,87
$\text{Co}^{3+} + \text{e}^- \rightleftharpoons \text{Co}^{2+}$	+ 1,81
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+ 1,51
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$	+ 1,36
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+ 1,33
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}$	+ 1,23
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+ 1,23
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+ 1,20
$\text{Br}_2(\text{l}) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$	+ 1,07
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+ 0,96
$\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg}(\text{l})$	+ 0,85
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}$	+ 0,80
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+ 0,80
$\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+}$	+ 0,77
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{O}_2$	+ 0,68
$\text{I}_2 + 2\text{e}^- \rightleftharpoons 2\text{I}^-$	+ 0,54
$\text{Cu}^+ + \text{e}^- \rightleftharpoons \text{Cu}$	+ 0,52
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+ 0,45
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightleftharpoons 4\text{OH}^-$	+ 0,40
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+ 0,34
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+ 0,17
$\text{Cu}^{2+} + \text{e}^- \rightleftharpoons \text{Cu}^+$	+ 0,16
$\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$	+ 0,15
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+ 0,14
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{Fe}^{3+} + 3\text{e}^- \rightleftharpoons \text{Fe}$	- 0,06
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$	- 0,13
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}$	- 0,14
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}$	- 0,27
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}$	- 0,28
$\text{Cd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cd}$	- 0,40
$\text{Cr}^{3+} + \text{e}^- \rightleftharpoons \text{Cr}^{2+}$	- 0,41
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}$	- 0,44
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}$	- 0,74
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}$	- 0,76
$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	- 0,83
$\text{Cr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cr}$	- 0,91
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}$	- 1,18
$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al}$	- 1,66
$\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$	- 2,36
$\text{Na}^+ + \text{e}^- \rightleftharpoons \text{Na}$	- 2,71
$\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$	- 2,87
$\text{Sr}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sr}$	- 2,89
$\text{Ba}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ba}$	- 2,90
$\text{Cs}^+ + \text{e}^- \rightleftharpoons \text{Cs}$	- 2,92
$\text{K}^+ + \text{e}^- \rightleftharpoons \text{K}$	- 2,93
$\text{Li}^+ + \text{e}^- \rightleftharpoons \text{Li}$	- 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	$E^{\ominus}$ (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\ell)$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

Increasing reducing ability/Toenemende reduserende vermoë





PREPARATORY EXAMINATION ***VOORBEREIDENDE EKSAMEN***

2023

MARKING GUIDELINES ***NASIENRIGLYNE***

PHYSICAL SCIENCES: CHEMISTRY (PAPER 2) (10842)
FISIESE WETENSKAPPE: CHEMIE (VRAESTEL 2) (10842)

16 pages/bladsye



QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- 2.1 2.1.1 TERTIARY alcohol ✓
The carbon atom, to which the functional group/hydroxyl is bonded, is bonded (directly) to three other carbon atoms. ✓
TERSIËRE alkohol ✓
Die koolstofatoom, waaraan die funksionele groep/hidroksiel gebind is, is direk gebind aan drie ander koolstofatome. ✓ (2)
- 2.1.2 2-methyl ✓ butan-2-ol ✓
2-metiel ✓ butan-2-ol ✓ (2)
- 2.1.3
- $$\begin{array}{ccccccc}
 & \text{H} & & \text{H} & & & \text{H} \\
 & | & & | & & & | \\
 \text{H} & - \text{C} & - & \text{C} = & \text{C} & - & \text{C} - \text{H} \\
 & | & & & & & | \\
 & \text{H} & & & & & \text{H} \\
 & & & & & & | \\
 & & & & & & \text{H} - \text{C} - \text{H} \\
 & & & & & & | \\
 & & & & & & \text{H}
 \end{array}$$

- ✓ functional and methyl group
 - ✓ whole structure
 - ✓ funksionele en metielgroep
 - ✓ algehele struktuur
- If double bond on first C and methyl group – maximum one mark
Indien dubbelbinding op eerste C en metielgroep – maksimum 1 punt (2)
- 2.2 2.2.1 Organic compounds with the same molecular formula, ✓ but different functional groups ✓
Organiese verbindings met dieselfde molekulêre formule ✓, maar *verskillende funksionele groepe* ✓ (2)

2.2.2 Ketone ✓
Ketoon ✓

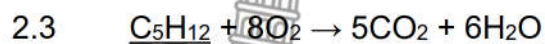
(1)

2.2.3 Pentanal ✓✓ (2 or 0)
Pentanaal ✓✓ (2 of 0)

(2)

2.2.4 E ✓

(1)



✓ reactant/reaktant C_5H_{12}

✓ $\text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

✓ balancing/balansering

(Balancing mark can only be awarded if all reactants and products are also correct)

(Balansering punt kan slegs toegeken word indien alle reaktante en produkte korrek is)

(3)

[15]

Award marks for multiple balancing e.g.

Ken punte toe vir veelvoude van balansering,
vb

2:16:10:12



QUESTION 3

- 3.1 Melting point is the temperature at which the solid and liquid phases of a substance are at equilibrium. ✓✓ (2 or 0)
Smeltpunt is die temperatuur waarby die vaste- en vloeistoffases van 'n stof in ewewig is. ✓✓ (2 of 0) (2)
- 3.2 Branching/Chain length/Surface area ✓
Vertakking/Kettinglengte/Oppervlakarea ✓ (1)
- 3.3 These molecules are structural isomers because they have the same molecular formula ✓ but different structural formulae ✓
Hierdie molekules is struktuurisomere omdat dit dieselfde molekulêre formule ✓ maar verskillende struktuurformules ✓het. (2)
- 3.4 London forces ✓ or dispersion forces or momentary dipole forces or induced dipole forces
London kragte ✓ of dispersie kragte of oombliklike dipoolkragte of geïnduseerde dipoolkragte (1)
- 3.5 **MARKING CRITERIA:**
 A Compare structures. ✓
 B Compare the strength of intermolecular forces. ✓
 C Compare the energy required to overcome intermolecular forces. ✓
 D State the difference in melting point. ✓

NASIENRIGLYNE:

- A Vergelyk strukture. ✓
 B Vergelyk die sterkte van intermolekulêre kragte. ✓
 C Vergelyk die energie benodig om intermolekulêre kragte te oorkom. ✓
 D Stel die verskil in smeltpunt. ✓

OPTION 1/OPSIE 1 (Symmetry/simmetrie)

	MOLECULE A MOLEKUUL A	MOLECULE B MOLEKUUL B
A	Less spherical/symmetrical <i>Minder series/simmetries</i>	More spherical/symmetrical <i>Meer series/simmetries</i>
B	Weaker intermolecular forces <i>Swakker intermolekulêre kragte</i>	Stronger intermolecular forces <i>Sterker intermolekulêre kragte</i>
C	Less energy needed to overcome IMF <i>Minder energie nodig om IMK te oorkom</i>	More energy needed to overcome IMF <i>Meer energie nodig om IMK te oorkom</i>
D	Lower melting point (than B) <i>Laer smeltpunt (as B)</i>	Higher melting point (than A) <i>Hoër smeltpunt (as A)</i>

(4)

OPTION 2/OPSIE 2(Chainlength/Kettinglengte)

	MOLECULE A MOLEKUUL A	MOLECULE B MOLEKUUL B
A	- Less branched <i>Minder vertakkings</i> - Larger surface area <i>Groter oppervlaksarea</i> - Longer chain length <i>Langer kettinglengte</i>	- More branched <i>Meer vertakkings</i> - Smaller surface area <i>Kleiner oppervlaksarea</i> - Shorter chain length <i>Korter kettinglengte</i>
B	Stronger intermolecular forces <i>Sterker intermolekulêre kragte</i>	Weaker intermolecular forces <i>Swakker intermolekulêre kragte</i>
C	More energy needed to overcome IMF <i>Meer energie nodig om IMK te oorkom</i>	Less energy needed to overcome IMF <i>Minder energie nodig om IMK te oorkom</i>
D	Higher melting point (than B) <i>Hoër smeltpunt (as B)</i>	Lower melting point (than A) <i>Laer smeltpunt (as A)</i>

3.6

A	211 (mmHg) ✓
B	235 (mmHg)
C	319 (mmHg) ✓

(2)

3.7

The boiling point of (A) is higher ✓ than the boiling point of (B). ✓
 Therefore the higher the boiling point the less the vapour pressure. ✓
Die kookpunt van (A) is hoër ✓ *as die kookpunt van (B)* ✓.
Hoe hoër die kookpunt, hoe laer is die dampdruk. ✓

OR/OF

(A) has lower vapour pressure ✓ than (B) ✓.
 Therefore the lower the vapour pressure the higher the boiling point. ✓
(A) het 'n laer dampdruk ✓ *as (B).* ✓
Hoe laer die dampdruk, hoe hoër is die kookpunt. ✓

(3)
[15]

QUESTION 4/ VRAAG 4

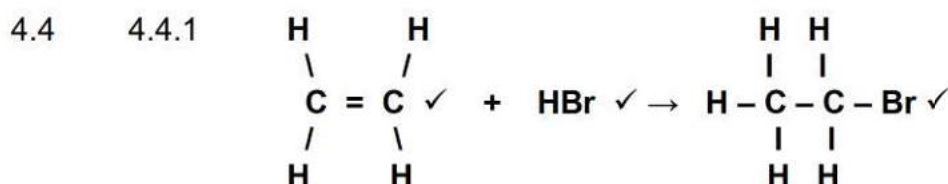
4.1 4.1.1 Elimination/Dehydration ✓
Eliminasie/Dehidrasie ✓ (1)

4.1.2 Substitution/Hydrolysis ✓
Substitusie/Hidrolise ✓ (1)

4.2 • Catalyst/Katalisator: H_2SO_4/H_3PO_4 ✓
• Heat/Hitte ✓ (2)

4.3 4.3.1 Water ✓ (Must be NAME/Moet NAAM wees) (1)

4.3.2 H_2SO_4/H_3PO_4 ✓ (Must be CHEMICAL FORMULA/Moet CHEMIESE FORMULE wees) (1)



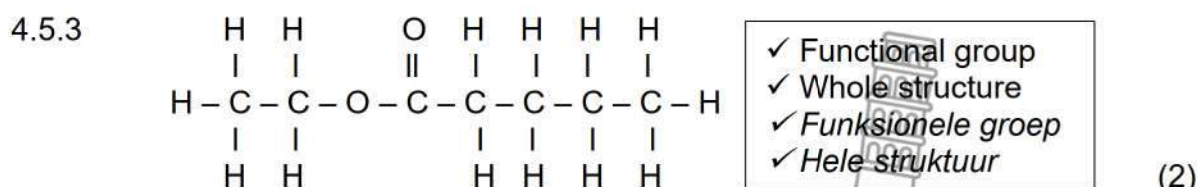
- ✓ Structural formula of ethene
- ✓ HBr
- ✓ Structural formula of bromoethane
- ✓ Struktuurformule van eteen
- ✓ HBr
- ✓ Struktuurformule van bromoetaan

(3)

4.4.2 To avoid the formation of the hydroxyl group/an alcohol ✓
Om die vorming van die hidroksielgroep/n alkohol te voorkom ✓ (1)

4.5 4.5.1 Esterification ✓/ Condensation
Esterifikasie ✓/ Kondensasie (1)

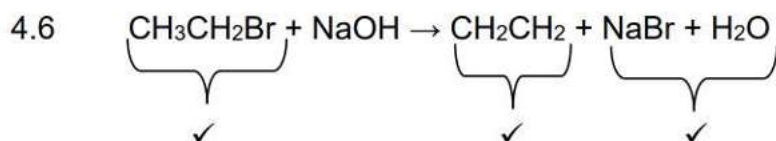
4.5.2 (Concentrated) H_2SO_4 ✓ (Must be CHEMICAL FORMULA)
(Gekonsentreerde) H_2SO_4 ✓ (Moet CHEMIESE FORMULE wees) (1)



- ✓ Functional group
- ✓ Whole structure
- ✓ Funksionele groep
- ✓ Hele struktuur

(2)

4.5.4 Ethyl ✓ pentanoate ✓
Etiel ✓ pentanoaat ✓ (2)



- ✓ Condensed structural formulae of organic reactant
- ✓ Condensed structural formulae of organic product (Accept $\text{CH}_2=\text{CH}_2$)
- ✓ NaBr and H_2O as inorganic products (Both correct for one mark)

Penalised by one mark if structural formulae are used

- ✓ Gekondenseerde struktuurformule van organiese reaktans
- ✓ Gekondenseerde struktuurformule van organiese produk (Aanvaar $\text{CH}_2=\text{CH}_2$)
- ✓ NaBr en H_2O as anorganiese produkte (Beide korrek vir een punt)

Penaliseer met een punt indien struktuurformules gebruik is.

(3)

- 4.7 4.7.1 Hexane ✓ (or any branched alkane with formula C_6H_{14} e.g. 2-methylpentane)
Heksaan ✓ (of enige vertakte alkaan met formule C_6H_{14} vb 2-metielpentaan)

(1)

- 4.7.2 In shorter chained ✓ alkenes and branched alkanes the surface area is less ✓ / will have weaker IMF / less activation energy / more flammable / higher vapour pressure

Korter ketting alkene ✓ en vertakte alkane het verminderde oppervlakarea ✓ / swakker IMK/minder aktiveringsenergie/meer vlambaar/ hoër dampdruk

(2)

[22]



QUESTION 5/ VRAAG 5

- 5.1
- Temperature
 - Concentration of HNO_3 ✓
- (Any ONE)
- *Temperatuur*
- *Konsentrasie van HNO_3* ✓
- (Enige EEN) (1)
- 5.2 Rate of reaction / volume of gas per unit time ✓
Reaksietempo/volume gas per eenheid tyd ✓ (1)
- 5.3 Average rate/*gem tempo* = $\frac{\Delta V}{\Delta t}$
 $= \frac{48-42}{150-120}$ ✓
 $= 0,2 \text{ cm}^3 \cdot \text{s}^{-1}$ ✓ (3)
- 5.4 LESS THAN /KLEINER AS ✓
- The gradient is less steep at 250 s than at 120 s, indicating a decreased reaction rate. ✓
Die gradient is minder steil by 250 s as by 120 s, dit dui op 'n verminderde reaksietempo. ✓
- OR
- There will be fewer reactants left after 250 s resulting in fewer effective collisions per unit time.
Daar sal minder reaktante oor wees na 250 s wat minder effektiewe botsings per eenheid tyd tot gevolg het. (2)
- 5.5 DECREASE/AFNEEM ✓ (1)



5.6

OPTION 1	OPTION 2
✓ (A) Dividing volume of H₂ (from graph) by 24 dm³ ✓ (B) <u>Using</u> mole ratio for H₂ to Mg ✓ (C) Multiplying n(Mg) with M_r(Mg) in the correct formula ✓ (D) Subtract mass Mg used from initial mass of Mg ✓ (E) Final answer	✓ (A) Dividing volume of H₂ (from graph) by 24 dm³ ✓ (B) <u>Using</u> mole ratio for H₂ to Mg ✓ (C) Subtract mole Mg used from initial mole of Mg ✓ (D) Multiplying n(Mg) with M_r(Mg) in correct formula ✓ (E) Final answer
n(H₂) produced = $\frac{V}{V_m}$ $= \frac{0,06}{24}$ ✓ (A) $= 2,5 \times 10^{-3} \text{ mol}$ From the balanced equation: n(Mg) : n(H₂) 1:1 ✓ (B) n(Mg) = $2,5 \times 10^{-3} \text{ mol}$ Calculating mass of magnesium used: m(Mg) = nM $= (2,5 \times 10^{-3})(24)$ ✓ (C) $= 0,06 \text{ g}$ Calculating mass of magnesium left: $\Delta m (\text{Mg}) = 2 - 0,06$ ✓ $= 1,94 \text{ g}$ ✓ (D) (E)	n(H₂) produced = $\frac{V}{V_m}$ $= \frac{0,06}{24}$ ✓ (A) $= 2,5 \times 10^{-3} \text{ mol}$ From the balanced equation: n(Mg) : n(H₂) 1:1 ✓ (B) n(Mg) = $2,5 \times 10^{-3} \text{ mol}$ Calculating initial moles of magnesium: m(Mg) = nM $2 = n(24)$ $= 0,083 \text{ mol}$ Calculating moles of magnesium left: $\Delta n (\text{Mg}) = 0,083 - (2,5 \times 10^{-3})$ ✓ (C) $= 0,08 \text{ mol}$ Calculating mass of magnesium left: m(Mg) = nM $= (0,08)(24)$ ✓ (D) $= 1,94 \text{ g}$ ✓ (E)

(5)



OPSIE 1	OPSIE 2
✓ (A) Deel volume H_2 (vanaf grafiek) deur 24 dm^3 ✓ (B) <u>Gebruik</u> molverhouding H_2 tot Mg ✓ (C) <u>Vermenigvuldig</u> $n(Mg)$ met $M_r(Mg)$ ✓ (D) <u>Trek</u> massa Mg af van aanvanklike massa Mg ✓ (E) <u>Finale</u> antwoord	✓ (A) Deel volume H_2 (vanaf grafiek) deur 24 dm^3 ✓ (B) <u>Gebruik</u> molverhouding H_2 tot Mg ✓ (C) <u>Trek</u> $n(Mg)$ gebruik af van aanvanklike $n(Mg)$ ✓ (D) <u>Vermenigvuldig</u> $n(Mg)$ met $M_r(Mg)$ ✓ (E) <u>Finale</u> antwoord
$n(H_2) \text{ geproduseer} = \frac{V}{V_m}$ $= \frac{0,06}{24} \quad \checkmark \quad \text{(A)}$ $= 2,5 \times 10^{-3} \text{ mol}$ Vanaf die gebalanseerde vergelyking: $n(Mg) : n(H_2)$ $1:1 \quad \checkmark \quad \text{(B)}$ $n(Mg) = 2,5 \times 10^{-3} \text{ mol}$ Bereken die massa magnesium gebruik: $m(Mg) = nM$ $= (2,5 \times 10^{-3})(24) \quad \checkmark \quad \text{(C)}$ $= 0,06 \text{ g}$ Bereken die massa magnesium oor: $\Delta m (Mg) = 2 - 0,06 \quad \checkmark$ $= 1,94 \text{ g} \quad \checkmark \quad \text{(E)}$	$n(H_2) \text{ geproduseer} = \frac{V}{V_m}$ $= \frac{0,06}{24} \quad \checkmark \quad \text{(A)}$ $= 2,5 \times 10^{-3} \text{ mol}$ Vanaf die gebalanseerde vergelyking: $n(Mg) : n(H_2)$ $1:1 \quad \checkmark \quad \text{(B)}$ $n(Mg) = 2,5 \times 10^{-3} \text{ mol}$ Bereken die aanvanklike mol magnesium: $m(Mg) = nM$ $2 = n(24)$ $= 0,083 \text{ mol}$ Bereken die mol magnesium oor: $\Delta n (Mg) = 0,083 - (2,5 \times 10^{-3}) \quad \checkmark \quad \text{(C)}$ $= 0,08 \text{ mol}$ Bereken die massa magnesium oor: $m(Mg) = nM$ $= (0,08)(24) \quad \checkmark \quad \text{(D)}$ $= 1,94 \text{ g} \quad \checkmark \quad \text{(E)}$

5.7

- Powders have increased/larger surface area/ more contact sites than solid tablets. ✓
- More effective collisions per unit time occurs. ✓
- Poeiers het 'n verhoogde/groter oppervlaksarea as soliede tablette. ✓
- Meer effektiewe botsings per eenheid tyd ✓ vind plaas.

(2)
[15]

QUESTION 6/ VRAAG 6

- 6.1 When the equilibrium in a closed system is disturbed, the system will reinstate a new equilibrium by favouring the reaction that will oppose the disturbance. (part marks) ✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, stel die stelsel 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel.



(2)

- 6.2 6.2.1
- Adding more CH_4 will increase the concentration of CH_4 . ✓
 - The forward reaction is favoured. ✓
 - The yield of H_2 will increase. ✓
 - Toevoeging van CH_4 sal die konsentrasie van CH_4 laat toeneem. ✓
 - Die voorwaartse reaksie word bevoordeel. ✓
 - Die opbrengs van H_2 sal toeneem. ✓
- (3)
- 6.2.2
- An increase in pressure favours the reaction that produces the lower number of moles/number of molecules. ✓
 - The reverse reaction is favoured. ✓
 - The yield of H_2 decreases. ✓
 - 'n Toename in druk bevoordeel die reaksie wat die minste mol/hoeveelheid molekules produseer. ✓
 - Die terugwaartse reaksie word bevoordeel. ✓
 - Die opbrengs van H_2 verminder. ✓
- (3)
- 6.3 The reaction is in (dynamic/chemical) equilibrium ✓/ the rates of the forward and reverse reactions are equal.

Die reaksie is in (dinamiese/chemiese) ewewig waar die tempo van die voorwaartse en terugwaartse reaksies dieselfde is. ✓

(1)

6.4 MARKING CRITERIA:

- Mole at equilibrium 0,6 ✓
 - Use mole ratio 1 : 1 : 1 : 3 ✓
 - Subtract CH_4 , H_2O and add H_2 ✓
 - Divide by 2 dm^3 ✓
 - Correct K_c expression (formulae in square brackets) ✓
 - Substitution of concentrations into correct K_c expression ✓
 - Final answer (range 1,82 – 1,83) ✓
- Option with concentration can also be used.

NASIENRIGLYNE:

- Mol by ewewig 0,6 ✓
- Gebruik molverhouding 1 : 1 : 1 : 3 ✓
- Aftrek van CH_4 , H_2O en optel van H_2 ✓
- Deel deur 2 dm^3 ✓
- Korrekte K_c uitdrukking (formules in vierkantige hakies) ✓
- Vervanging van konsentrasies in korrekte K_c uitdrukking ✓
- Finale antwoord 1,8225/1,823/1,82 ✓



	CH ₄	H ₂ O	CO	H ₂	
Initial amount (moles) <i>Aanvangshoeveelheid (mol)</i>	1,4	1,2	0	0	
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	0,6	0,6	0,6	1,8	ratio b)✓
Equilibrium amount (moles) <i>Ewewigshoeveelheid (mol)</i>	0,8	0,6	0,6 a)✓	1,8	-/+ c)✓
Concentration at equilibrium <i>Konsentrasie by ewewig</i>	0,4	0,3	0,3	0,9	÷2 d)✓

$$K_c = \frac{[\text{CO}][\text{H}_2]^3}{[\text{CH}_4][\text{H}_2\text{O}]}$$

$$= \frac{(0,3)(0,9)^3}{(0,4)(0,3)}$$

$$= 1,82 \text{ g)✓}$$

- No K_c expression, correct substitution: Max. ⁶/₇
- No square brackets: Max. ⁶/₇
- Wrong K_c expression: Max. ⁴/₇

- Geen K_c uitdrukking, korrekte substitusie: Maks. ⁶/₇
- Geen blok-hakies: Maks. ⁶/₇
- Verkeerde K_c uitdrukking: Maks. ⁴/₇

(7)

6.5 DECREASE/AFNEEM ✓

(1)
[17]

QUESTION 7/VRAAG 7

7.1 STRONG (acid) ✓
Ionises completely (in water) ✓

STERK (suur) ✓
 Ioniseer volledig in water ✓

(2)

7.2 HSO_4^- ; SO_4^{2-} ✓ AND/EN H_2O ; H_3O^+ ✓

(2)

7.3 It is a 2 proton donor/
 Dit is 'n 2-protonskenker

OR

It donates 2 H^+ / H_3O^+ ions/protons. ✓✓

Dit skenk 2 H^+ / H_3O^+ ione/protone

OR

It ionises to form 2 moles of H^+ / H_3O^+ ions

Dit ioniseer en vorm 2 mol of H^+ / H_3O^+ ione

(2)

7.4 HSO_4^- ✓

(1)

7.5 7.5.1 $c = \frac{n}{v}$
 $= \frac{0,09}{0,6}$ a) ✓
 $= 0,15 \text{ mol} \cdot \text{dm}^{-3}$
 $n(\text{H}_2\text{SO}_4) : n(\text{H}_3\text{O}^+)$
 $1 : 2$
 $0,15 : 0,3$ b) ✓
 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ c) ✓
 $= -\log(0,3)$ d) ✓
 $= 0,52$ e) ✓

MARKING CRITERIA:

- a) Substitution into concentration
- b) Using mole ratio correctly
- c) pH formula
- d) Substitution in pH formula
- e) Final answer

(5)

7.5.2 OPTION 1

$n = \frac{m}{M}$ ✓
 $= \frac{11,2}{56}$ ✓
 $= 0,2 \text{ mol}$
 Thus $0,2 \times 80\%$ ✓
 $n = 0,16 \text{ mol of KOH}$ ✓

OPTION 2

$m = (80\% \text{ of } 11,2)$ ✓ = 8,96 g
 $n = \frac{m}{M}$ ✓
 $n = \frac{8,96}{56}$ ✓
 $n = 0,16 \text{ mol of KOH}$ ✓

(4)

7.5.3 **Positive marking from 7.5.2/Positiewe nasien vanaf 7.5.2**
 ACIDIC/SUUR ✓

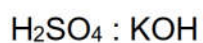
Mol ratio $\text{H}_2\text{SO}_4 : \text{KOH}$
 $1 : 2$
 $0,08 : 0,16$ ✓

MARKING GUIDELINE:

- ✓ Mole ratio
- ✓ Indicating excess
- ✓ Acidic

(3)

OR



0,09 : 0,18 (not enough/nie genoeg)

(the 0,09 is given)



∴ There will be an **excess of H_2SO_4** ✓ (0,01 mol of H_2SO_4 in excess).

∴ Daar sal 'n **oormaat H_2SO_4** ✓ wees (0,01 mol H_2SO_4 in oormaat).

[19]

QUESTION 8/ VRAAG 8

8.1 YES ✓ emf is greater than zero /emf is positive ✓

Accept

reducing and oxidizing agents are used

JA ✓ EMK is groter as nul/is positief ✓

Aanvaar:

Reduseer- en oksideermiddels is gebruik

(2)

8.2 Mn ✓

(1)

8.3 $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}}$ ✓

$$1,05 \checkmark = X - (-1,18) \checkmark$$

$$X = -0,13 \text{ (V)} \checkmark$$

$$X = \text{Pb} \checkmark$$

NOTES:

- Accept any other correct formula from the data sheet
Aanvaar enige ander korrekte formule vanaf die inligtingsbladsy
- Any other formula using unconventional abbreviations, e.g. followed by correct substitutions:

$$E_{\text{cell}} = E_{\text{OM}} - E_{\text{RM}} \quad 4/5$$

(5)

8.4 8.4.1 Concentration/Konsentrasie is $1 \text{ mol} \cdot \text{dm}^{-3}$ ✓

(2)

Temperature/Temperatuur $298 \text{ K}/25^{\circ}\text{C}$ ✓8.4.2 $\text{Mn(s)} \mid \text{Mn}^{2+}(\text{aq}) (1 \text{ mol} \cdot \text{dm}^{-3}) \parallel \text{Pb}^{2+}(\text{aq}) (1 \text{ mol} \cdot \text{dm}^{-3}) \mid \text{Pb(s)}$

(2)

Accept /Aanvaar $\text{Mn} \mid \text{Mn}^{2+} \parallel \text{Pb}^{2+} \mid \text{Pb}$ 8.4.3 $\text{Pb}^{2+} + 2\text{e}^{-} \rightarrow \text{Pb}$ ✓✓ (1/2 if double arrows)

(2)

[14]

QUESTION 9/ VRAAG 9

9.1 Electrical to chemical (energy) ✓
Elektriese na chemiese (energie) ✓ (1)

9.2 B ✓ (1)

9.3 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ ✓✓ (if double arrows maximum ½) (2)

9.4 REMAIN THE SAME /DIESELFDE BLY ✓ (1)

9.5 Zn is a stronger reducing agent ✓ than Cu ✓
 therefore Cu^{2+} ions will be reduced to Cu ✓
Zn is 'n sterker reduseermiddel ✓ as Cu ✓
daarom sal Cu^{2+} ione reduseer tot Cu ✓

OR/OF

Zn^{2+} is a weaker oxidising agent and will not be reduced to deposit on the cathode

Zn^{2+} is 'n swakker oksideermiddel en sal nie reduseer om op die katode neer te slaan nie

OR/OF

Zn will be oxidised to Zn^{2+}

Zn sal oksideer tot Zn^{2+}

(3)

9.6 9.6.1 $n(\text{Cu}) = \frac{m}{M}$ ✓
 $= \frac{15}{63,5}$ ✓
 $= 0,24 \text{ mol}$ ✓ (0,236 mol) (3)

9.6.2 Positive marking from 9.6.1/Positiewe nasien vanaf 9.6.1

$n\text{Cu} : 2n \text{e}^-$

$n = 2 \times 0,236$ ✓

$= 0,472 \text{ mol of e}^-$ ✓

(2)

[13]

TOTAL/TOTAAL : 150

