



education

Department of
Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES P2 (CHEMISTRY)

SEPTEMBER 2023

Stanmorephysics

MARKS: 150

TIME: 3 HOURS

This question paper consists of 13 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other applicable information in the appropriate spaces on the ANSWER BOOK.
2. The question paper consists of TEN 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 subquestions, for example between QUESTION 3.1 and QUESTION 3.2.
6. You may use a non-programmable pocket 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 where necessary.
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. 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 your ANSWER BOOK, for example, 1.11 E.

1.1 Which ONE of the following is a TERTIARY alcohol?

- A Butan-1-ol
- B Propan-2-ol
- C 2-methylbutan-1-ol
- D Methylpropan-2-ol (2)

1.2 Consider the following organic compounds:

- (i) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_3$
- (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)\text{CH}_2$
- (iii) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- (iv) $\text{CH}_3\text{CCCH}(\text{CH}_3)_2$

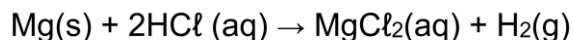
Which of the above are chain isomers?

- A (i) and (iv).
- B (i) and (ii).
- C (ii) and (iv).
- D (i) and (iii). (2)

1.3 Which homologous series is the formyl group the functional group of?

- A Carboxylic acids
- B Ketones
- C Aldehydes
- D Haloalkanes (2)

- 1.4 A piece of magnesium ribbon reacts with excess hydrochloric acid according to the following equation:



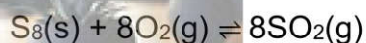
Which ONE of the following changes will NOT affect the reaction rate?

- A Putting the reaction mixture in a hot water bath
B Using the same mass of powdered magnesium
C Increasing the volume of the hydrochloric acid
D Increasing the concentration of the hydrochloric acid (2)

- 1.5 Which ONE of the following statements is correct for a chemical reaction at equilibrium?

- A The concentration of reactants and products remains constant.
B The concentration of reactants is equal to the concentration of products.
C The reaction has stopped.
D The number of moles of reactants is equal to the number of moles of products. (2)

- 1.6 Solid sulphur (S_8) reacts with oxygen (O_2) to produce sulphur dioxide ...



What is the correct K_c expression for the equilibrium constant for the above reaction?

- A $K_c = \frac{[\text{SO}_2]}{[\text{S}_8][\text{O}_2]}$
B $K_c = \frac{[\text{SO}_2]^8}{[\text{O}_2]^8}$
C $K_c = \frac{[\text{S}_8][\text{O}_2]}{[\text{SO}_2]}$
D $K_c = \frac{[\text{SO}_2]}{[\text{O}_2]}$ (2)

1.7 According to the Arrhenius theory, a base is ...

A a proton donor.

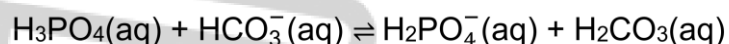
B a proton acceptor.

C a substance that dissociates in water to form H^+ .

D a substance that dissociates in water to form OH^- .

(2)

1.8 Consider the reaction below:



Which ONE of the following are two acids in the above reaction?

A HCO_3^- and $H_2PO_4^-$

B H_3PO_4 and $H_2PO_3^-$

C H_3PO_4 and H_2CO_3

D HCO_3^- and H_2CO_3

(2)

1.9 A galvanic cell is constructed from cadmium and nickel. What is the correct cell notation for this cell?

A $Cd^{2+} | Cd || Ni^{2+} | Ni$

B $Ni | Ni^{2+} || Cd^{2+} | Cd$

C $Cd | Cd^{2+} || Ni^{2+} | Ni$

D $Ni^{2+} | Ni || Cd^{2+} | Cd$

(2)

1.10 Which ONE of the following half-reactions takes place at the CATHODE of an electrochemical cell used to electroplate an iron spoon with silver?

A $Ag^+ + e^- \rightarrow Ag$

B $Ag \rightarrow Ag^+ + e^-$

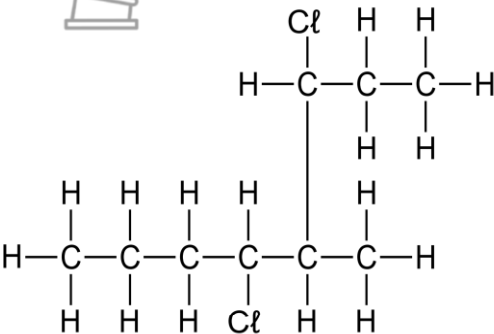
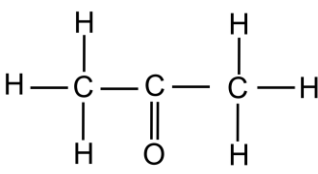
C $Fe^{2+} + 2e^- \rightarrow Fe$

D $Fe \rightarrow Fe^{2+} + 2e^-$

(2)
[20]

QUESTION 2 (Start on a new page.)

The letters **A** to **E** in the table below represent six organic compounds.

A	Butane 	B	$\text{CH}_3\text{CH}_2\text{CCCH}_3$
C		D	
E	Butanoic acid		

2.1 Write down the letter(s) representing:

2.1.1 A compound with the general formula $\text{C}_n\text{H}_{2n-2}$ (1)

2.1.2 A ketone (1)

2.1.3 A compound that can be used as fuel (1)

2.1.4 An unsaturated hydrocarbon (1)

2.2 For compound **E**, write down the:

2.2.1 NAME of the functional group (2)

2.2.2 Structural formula of its FUNCTIONAL ISOMER (2)

2.3 Write down the IUPAC name of:

2.3.1 Compound **C** (3)

2.3.2 Compound **D** (2)

2.4 Write down the IUPAC name of the functional isomer of **D**.  (2)

2.5 Write down the structural formula of:

2.5.1 A CHAIN ISOMER of compound **A** (2)

2.5.2 Compound **E** (2)
[19]

QUESTION 3 (Start on a new page.)

3.1 The vapour pressures of two organic compounds at a specific temperature are compared.

	COMPOUND	MOLAR MASS (g·mol ⁻¹)
A	Butane	58
B	Methylpropane	58

3.1.1 Define the term *vapour pressure*. (2)

3.1.2 Which ONE of the two compounds has the highest vapour pressure?
 Write down only **A** or **B**. (1)

3.1.3 Fully explain the answer to QUESTION 3.1.2 (3)

3.1.4 Give a reason why the above comparison can be considered fair. (1)

3.2 The compounds propan-1-ol and propanone are compared. Which compound has a higher boiling point? Fully explain the answer. (4)

3.3 The table below shows the results of an investigation regarding the melting points of organic molecules.

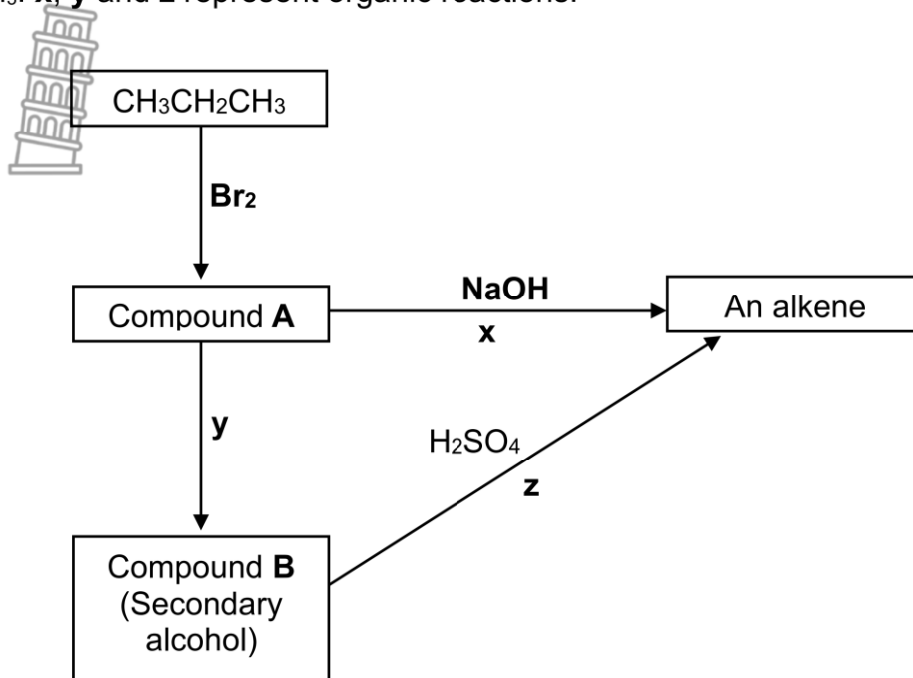
	Organic compound	Boiling point (°C)
A	2,2-dimethylbutane	50
B	2,3-dimethylbutane	58
C	3-methylpentane	63

3.3.1 Write down the independent variable for this investigation. (1)

3.3.2 Explain the trend in boiling points of the above investigation. (3)
[15]

QUESTION 4 (Start on a new page.)

The flow diagram below shows the preparation of different organic compounds from $\text{CH}_3\text{CH}_2\text{CH}_3$. **x**, **y** and **z** represent organic reactions.



4.1 Write down the type of reaction represented by reaction:

4.1.1 **x** (1)

4.1.2 **y** (1)

4.1.3 **z** (1)

4.2 Reaction **x** takes place in the presence of a strong base. Write down the:

4.2.1 IUPAC name of compound **A** (2)

4.2.2 Balanced equation for the reaction **x**, using STRUCTURAL FORMULAE (4)

4.2.3 IUPAC name of the alkene produced (2)

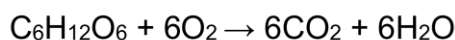
4.3 State TWO differences in the reaction conditions for **x** and **y**. (2)

4.4 Compound **B** is a secondary alcohol. Define the term *secondary alcohol*. (2)

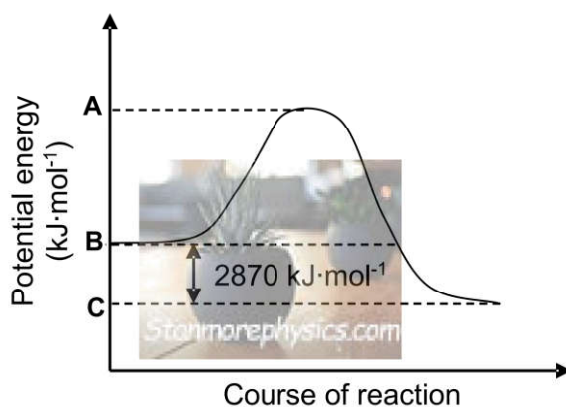
[15]

QUESTION 5 (Start on a new page.)

- 5.1 Glucose is metabolised in the human body through the following simplified equation.



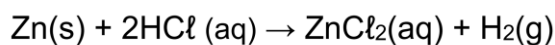
The graph below shows the energy changes for the above reaction.



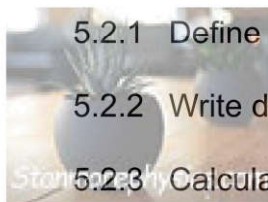
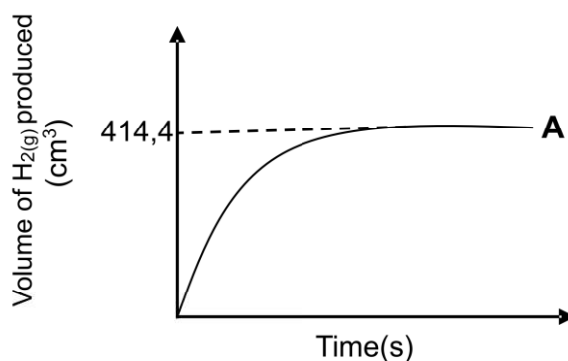
- 5.1.1 Is this reaction ENDOTHERMIC or EXOTHERMIC? Give a reason for the answer. (2)
- 5.1.2 Express the following in terms of the energy values **A**, **B** and **C** shown in the graph:
- (a) The energy of the activated complex (1)
 - (b) The activation energy for the reverse reaction (2)
 - (c) ΔH for the forward reaction (2)



- 5.2 In an investigation of the rate of reaction, an EXCESS 200 cm³ solution of HCl, concentration 0,5 mol·dm⁻³ reacts with zinc powder at STP. The following spontaneous reaction takes place:



The volume of hydrogen gas produced is measured at regular time intervals and the following graph is drawn:



5.2.1 Define the term *concentration*. (2)

5.2.2 Write down the limiting reagent for the above reaction. (1)

5.2.3 Calculate the mass of the zinc used. (5)

5.2.4 The same mass of zinc granules is used instead of zinc powder.

(a) How will this affect the rate of reaction? Choose INCREASES, DECREASES or STAYS THE SAME. (1)

(b) Use the collision theory to explain the answer to QUESTION 5.2.4(a). (3)

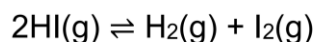
5.2.5 A suitable catalyst is added to the reaction mixture.

Redraw the graph above in your ANSWER BOOK and label the given curve as **A**. On the same set of axes, sketch the curve that will be obtained if a catalyst is added. Label this as curve **B**. (2)
[21]



QUESTION 6 (Start on a new page.)

Hydrogen Iodide (HI) is allowed to decompose in a 5 dm³ closed container at a temperature of 425 °C, according to the following balanced equation:



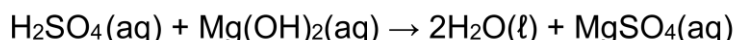
When the mixture reaches equilibrium at 425 °C, it is found that 0,02 mol of H₂ is present in the container. The equilibrium constant for this reaction at 425 °C is 0,016.

- 6.1 Define the term *closed system*. (2)
- 6.2 Calculate the initial number of moles of HI in the container. (8)
- 6.3 How will EACH of the following changes affect the amount of H₂(g) produced? Write down only INCREASES, DECREASES or REMAINS THE SAME.
- 6.3.1 More I₂(g) is added at 425 °C (1)
- 6.3.2 The pressure is increased (1)
- 6.4 At 325 °C, the equilibrium constant (K_c) for the reaction above is 0,014. Is the reaction EXOTHERMIC or ENDOTHERMIC? Fully explain the answer. (4)

[16]

QUESTION 7 (Start on a new page.)

- 7.1 Two grams (2g) of magnesium hydroxide is reacted with 30 cm³ sulphuric acid solution of concentration 1,5 mol·dm⁻³, according to the following balanced equation:

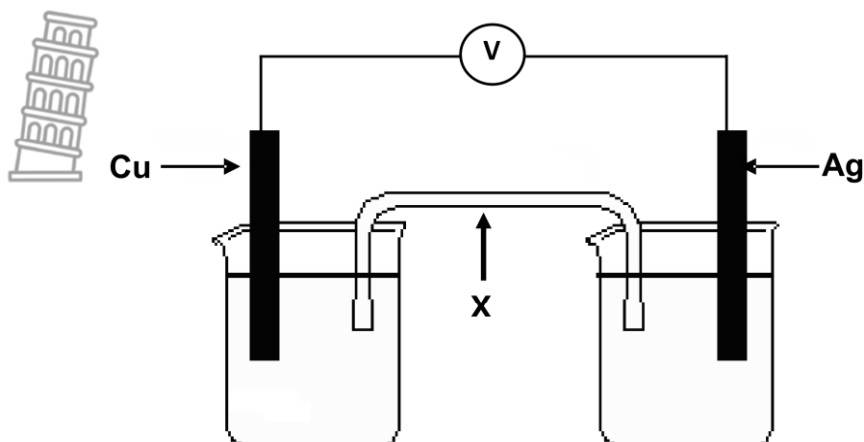


- 7.1.1 Why is H₂SO₄ considered a STRONG ACID? (2)
- 7.1.2 Calculate the concentration of the final solution. (8)
- 7.2 A dilute HCl solution has a concentration of 0,15 mol·dm⁻³. This dilute solution reacts with a concentrated solution of Na₂CO₃.
- 7.2.1 Define the term *dilute acid*. (2)
- 7.2.2 Calculate the pH of the HCl solution. (3)
- 7.3 A solution is made by dissolving Na₂CO₃ (s) in water.
- 7.3.1 Is the solution of Na₂CO₃ ACIDIC or BASIC? (1)
- 7.3.2 Write down a balanced chemical equation that explains the answer to QUESTION 7.3.1. (3)

[19]

QUESTION 8 (Start on a new page.)

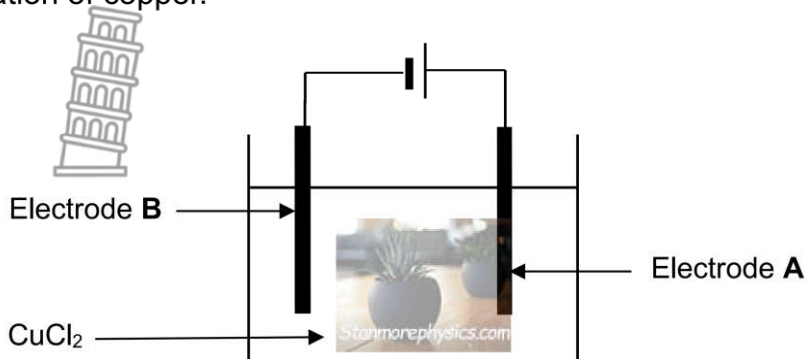
An electrochemical cell is set up under STANDARD CONDITIONS.



- 8.1 Write down ONE function of the part labelled **X**. (1)
- 8.2 Which electrode of the cell is the anode? Write down only **Cu** or **Ag**. (1)
- 8.3 Write down the name or formula of the electrolyte in:
- 8.3.1 The copper half-cell (1)
- 8.3.2 The silver half-cell (1)
- 8.4 Write down the balanced net (overall) equation for the above cell. (3)
- 8.5 Calculate the emf of the cell. (4)
- 8.6 State the standard conditions under which this cell operates. (2)
- [13]**

QUESTION 9 (Start on a new page.)

The simplified diagram below represents an electrochemical cell used for the purification of copper.



- 9.1 State the energy conversion that takes place in this cell. (2)
- 9.2 Define the term *electrolyte*. (2)
- 9.3 Which electrode contains impure copper? Write down Electrode **A** OR Electrode **B**. (1)
- 9.4 Write down the half-reaction which takes place at electrode **B**. (2)
- 9.5 Is electrode **A** the ANODE or the CATHODE? (1)
- 9.6 The two electrodes are replaced with CARBON RODS.
- 9.6.1 Write down what will now be observed at electrode **A**. (2)
- 9.6.2 Write down a relevant half-reaction that explains the observation made in QUESTION 9.6.1. (2)

[12]

TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
 PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
 VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIESE KONSTANTES

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

TABLE 2: FORMULAE / TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log [H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{cell}^\theta = E_{cathode}^\theta - E_{anode}^\theta$ OR $E_{cell}^\theta = E_{reduction}^\theta - E_{oxidation}^\theta$ OR $E_{cell}^\theta = E_{oxidising agent}^\theta - E_{reducing agent}^\theta$	$E_{sel}^\theta = E_{katode}^\theta - E_{anode}^\theta$ OF $E_{sel}^\theta = E_{reduksie}^\theta - E_{oksidasie}^\theta$ OR $E_{sel}^\theta = E_{oksideermiddel}^\theta - E_{reduseermiddel}^\theta$

5

6

KEY/SLEUTEL

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




Half-reactions / Halfreaksies	E^{θ} (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	0,00
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	- 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	- 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	- 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	- 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	- 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	- 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	- 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	- 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	- 0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	- 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	- 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	- 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	- 1,18
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	- 2,36
$Na^+ + e^- \rightleftharpoons Na$	- 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	- 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	- 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	- 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	- 2,92
$K^+ + e^- \rightleftharpoons K$	- 2,93
$Li^+ + e^- \rightleftharpoons Li$	- 3,05

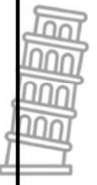
TABLE 4B: STANDARD REDUCTION POTENTIALS
 TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE



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Half-reactions / Halfreaksies	E^{θ} (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
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\text{l})$	+ 0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+ 0,96
$\text{Br}_2(\text{l}) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+ 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





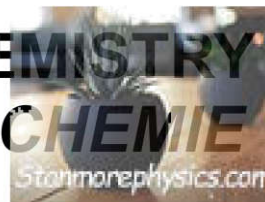
education

Department of
Education
FREE STATE PROVINCE

**PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN**

GRADE/GRAAD 12

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



SEPTEMBER 2023

MARKS/PUNTE: 150

MARKING GUIDELINES/NASIENRIGLYNE

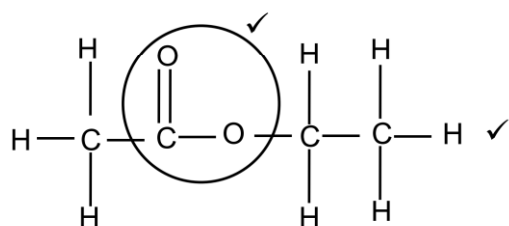
**These marking guidelines consist of 15 pages.
Hierdie nasienriglyne bestaan uit 15 bladsye.**

QUESTION 1/VRAAG 1

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

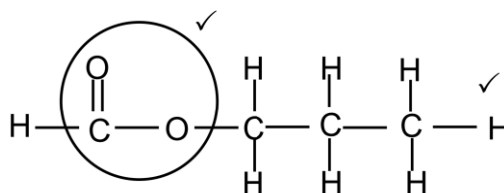
QUESTION 2/VRAAG 2

- 2.1.1 B ✓ (1)
- 2.1.2 D ✓ (1)
- 2.1.3 A / B ✓ (1)
- 2.1.4 B ✓ (1)
- 2.2.1 Carboxyl/Karboksiel ✓✓ (2)
- 2.2.2

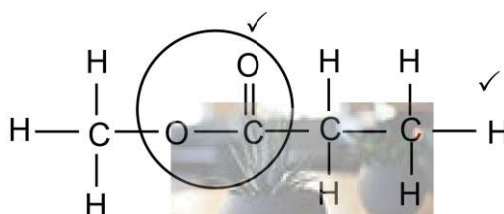


OR/OF





OR/OF



Marking criteria/Nasienkriteria:

- Whole structure correct/*Hele struktuur korrek:* $\frac{2}{2}$
- Only functional group correct/single bonds between carbon atoms:
Slegs funksionele groep korrekte/enkelbindings tussen koolstofatome: $\frac{1}{2}$

(2)

2.3.1 3,5-dichloro/*dichloor* ✓ -4-methyl/*metiel* ✓ octane/*oktaan* ✓

Marking criteria/Nasienkriteria:

- 3,5-dichloro/*dichloor* ✓
- 4-methyl/*Metiel* ✓
- Octane/*Oktaan* ✓

(3)

2.3.2 Propanone/propan-2-one/*Propanoon/propaan-2-ee*n ✓✓

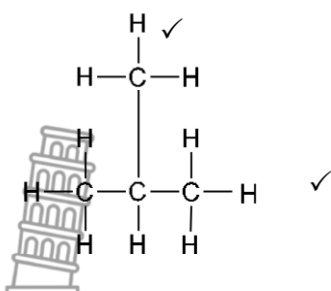
(2)

2.4 Propanal/*Propanaal* ✓✓

(2)



2.5.1



Marking criteria/Nasienkriteria:

- Whole structure correct/*Hele struktuur korrek:*
- One methyl substituent/*Een metielsubstituent:*

$\frac{2}{2}$

Notes/Aantekeninge:

Condensed formulae or semi-structural formula:

Gekondenseerde formules of semi-struktuurformule:

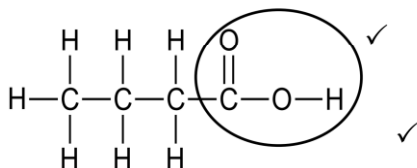
Max./Maks. $\frac{1}{2}$

Molecular formula/*Molekulêre formule:*

$\frac{0}{2}$

(2)

2.5.2



Marking criteria/Nasienkriteria:

- Whole structure correct/*Hele struktuur korrek:*
- Only functional group correct/*Slegs funksionele groep korrek:*

$\frac{2}{2}$

$\frac{1}{2}$

(2)

[19]



QUESTION 3/VRAAG 3

3.1.1 **Marking criteria/Nasienkriteria:**

If any of the underlined key phrases in the correct context is omitted, deduct 1 mark.

Indien enige van die onderstreepte sleutel frases in die korrekte konteks weggelaat word, trek 1 punt af.

The pressure exerted by vapour at equilibrium with its liquid in a closed system. ✓✓

Die druk wat uitgeoefen word deur damp by ewewig met sy vloeistof in 'n geslote sisteem.

(2)

3.1.2 B ✓

(1)

3.1.3 **B/methylpropane/metielpropaan**

- Smaller surface area/*Kleiner oppervlakte* ✓
- Weaker intermolecular forces/*Swakker intermolekulêre kragte* ✓
- Less energy needed to break the intermolecular forces/*Minder energie benodig om die intermolekulêre kragte te breek* ✓

A/butane/butaan

- Larger surface area/*Groter oppervlakte* ✓
- Stronger/more intermolecular forces/*Sterker/meer intermolekulêre kragte* ✓
- More energy needed to break the intermolecular forces/*Meer energie benodig om die intermolekulêre kragte te breek* ✓

(3)

3.1.4 One independent variable/same homologous series and are (chain) isomers/same molecular mass and are (chain) isomers. ✓

Een onafhanklike veranderlike/dieselfde homoloë reeks en is (ketting) isomere/dieselfde molekulêre massa en is (ketting) isomere.

(1)

3.2

- propan -1-ol ✓
- propan -1-ol has hydrogen bonding, (dipole-dipole and London forces) between molecules propanone has dipole-dipole forces (and London forces). ✓
- Intermolecular forces in propan-1-ol are stronger than intermolecular forces in propanone. ✓
- *propaan -1-ol*
- *propaan -1-ol het waterstofbinding, (dipool-dipool en Londen-kragte) tussen molekules propanoon het dipool-dipool kragte (en Londen-kragte).*
- *Intermolekulêre kragte in propaan-1-ol is sterker as intermolekulêre kragte in propanoon.*

OR/OF

- Intermolecular forces in propanone are weaker than intermolecular forces in propan-1-ol.
- More energy needed to overcome or break intermolecular forces/van der Waals forces in propan-1-ol ✓ than propanone.



OR

- Less energy needed to overcome or break intermolecular forces/Van der Waals forces in compound D than compound C.
- *Intermolekulêre kragte in propanoon is swakker as intermolekulêre kragte in propaan-1-ol.*
- Meer energie benodig om intermolekulêre kragte/Van der Waals kragte in propaan-1-ol te oorkom of te breek as propanoon.

OF

- Minder energie benodig om intermolekulêre kragte/Van der Waals kragte in verbinding D te oorkom as in verbinding C. (4)

3.3.1 Branching/Vertakking ✓

(1)

3.3.2

- From **A** to **C**: less branching/greater surface area ✓
- Stronger/more intermolecular forces (London forces) ✓
- More energy needed to break the intermolecular forces (London forces) ✓
- *Vanaf **A** tot **C**: minder vertakking/groter oppervlakte*
- *Sterker/meer intermolekulêre kragte (Londen-kragte)*
- *Meer energie benodig om die intermolekulêre kragte te breek (Londen-kragte)*

(3)
[15]



QUESTION 4/VRAAG 4

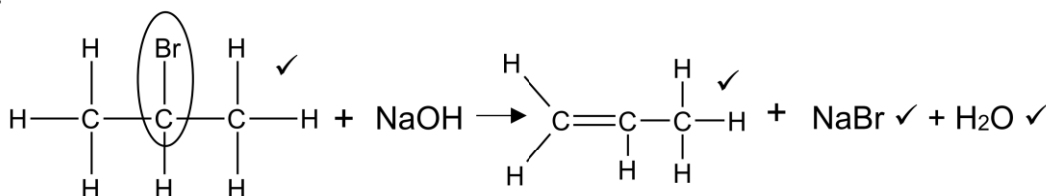
4.1.1 Elimination/dehydrohalogenation/dehydrobromination ✓
Eliminasie/dehidrohalogenering/dehidrobromering (1)

4.1.2 Substitution/hydrolysis/Substitusie/hidrolise ✓ (1)

4.1.3 Elimination/dehydration/Elimasie/dehidrasie ✓ (1)

4.2.1 2-bromo ✓ propane/propaan ✓ (2)

4.2.2



Notes/Aantekeninge:

- Ignore/Ignoreer ⇌
- Any additional reactants and/or products./Enige addisionele reaktanse en/of ander produkte. Max./Maks. $\frac{3}{4}$
- Accept coefficients that are multiples./Aanvaar koëffisiënte wat veelvoude is.
- Condensed or semi-structural formulae/Gekondenseerde of semi-struktuurformules: Max./Maks. $\frac{2}{4}$
- Molecular formulae/Molekulêre formules: Max./Maks. $\frac{2}{4}$

(4)

4.2.3 prope-1-ene/propene/prope-1-een/propeen ✓✓ (2)

4.3 X – concentrated strong base, heat/gekonsentreerde sterk basis, hitte ✓
 Y – dilute strong base, mild heat/verdunde sterk basis, matige hitte ✓ (2)

4.4 Alcohol where the C atom bonded to hydroxyl/functional group (-OH) is bonded to two other carbon atoms. ✓✓
Alkohol waar die C-atoom gebind aan hidroksiel/funksionele groep (-OH) aan twee ander koolstofatome gebind is.

OR/OF

The functional group () is bonded to two other carbon atoms.
 Die funksionele groep is aan twee ander koolstofatome gebind. (2)

[15]

QUESTION 5/VRAAG 5

5.1.1 Exothermic/Eksotermies ✓

Energy of products is less than that of reactants/energy is given off/

$$\Delta H < 0. ✓$$

Energie van produkte is minder as dié van reaktanse/energie wat afgegee word $\Delta H < 0.$ (2)

5.1.2 (a) A ✓ (1)

(b) A – C ✓✓ (2)

(c) C – B ✓✓ (2)

5.2.1 The amount of a substance per volume of water/solution ✓✓

Die hoeveelheid van 'n stof per volume water/oplossing (2)

5.2.2 Zinc/Zn ✓ (1)

$$5.2.3 \quad n(\text{H}_2) = \frac{V}{V_m} ✓$$

$$= \frac{0,4144}{22,4} ✓$$

$$= 0,0185 \text{ mol}$$

$$n(\text{Zn}) = n(\text{H}_2) = 0,0185 \text{ mol} ✓$$

$$m(\text{Zn}) = n(\text{Zn}) \times M$$

$$= 0,0185 \times 65 ✓$$

$$= 1,2025 \text{ g} ✓$$

(RANGE/GEBIED: 1,19 g to 1,3 g) (5)

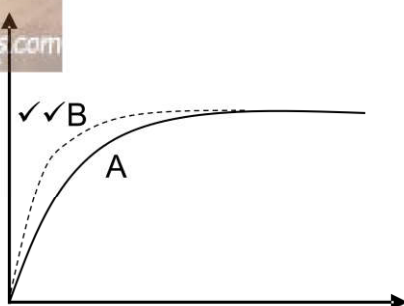
5.2.4 (a) DECREASES/AFNEEM ✓ (1)

(b) • Decrease in surface area/Afname in oppervlakte ✓

• Fewer particles with correct orientation/Minder deeltjies met korrekte oriëntasie ✓

• Fewer effective collisions per unit time/Minder effektiewe botsings per eenheidstyd ✓ (3)

5.2.5



Note: If both graphs are not labelled

Let Wel: Indien beide grafiek nie benoem is nie $0/2$ (2)

[21]

QUESTION 6/ VRAAG 6

- 6.1 A system that is isolated from its surroundings./A system where substances cannot leave/escape the container. ✓✓
 'n Sisteem wat van sy omgewing geïsoleer is./'n Sisteem waar stowwe nie die houer kan verlaat/ontsnap nie. (2)

6.2 OPTION/OPSIE 1

CALCULATIONS USING NUMBER OF MOLES/ BEREKENINGE MET GEBRUIK VAN AANTAL MOL

Mark allocation/Puntetoekenning:

- (a) Change $n(\text{H}_2)$ = equilibrium $n(\text{H}_2)$ = 0,02
 Verandering $n(\text{H}_2)$ = ewewig $n(\text{H}_2)$ = 0,02
 (b) **USING** ratio $\text{HI}:\text{H}_2:\text{I}_2 = 2:1:1$
GEBRUIK verhouding $\text{HI}:\text{H}_2:\text{I}_2 = 2:1:1$
 (c) Equilibrium mole of I_2 = Change mole I_2 ✓
 Ewewig mol van I_2 = Verander mol I_2
 (d) Divide 0,02 by 5 AND multiplying 0,0316 by 5 ✓
 Deel 0,02 deur 5 EN vermenigvuldig 0,0316 met 5
 (e) Correct K_c expression (formulae in square brackets) ✓
 Korrekte K_c uitdrukking (formules tussen vierkantige hakies)
 (f) Substitution of K_c 0,016
 Vervanging van K_c 0,016
 (g) Substitution of concentrations into K_c expression ✓
 Vervanging van konsentrasies in K_c uitdrukking
 (h) Initial mole of HI = Equilibrium + Change = 0,198 mol ✓
 Range/Gebied: 0,19 – 0,2 mol

	HI	H ₂	I ₂	
Initial quantity (mol) Aanvanklike hoeveelheid (mol)	0,198✓(h)		0	
Change/Verander (mol)	0,04	0,02 } ✓ (a)	0,02 } ratio ✓(b) verhouding	
Quantity at equilibrium (mol) $n = cv$ Hoeveelheid by ewewig (mol) $n = cv$	0,158	0,02 } ✓ (c)	0,02 } ✓ (c)	
Equilibrium concentration (mol·dm ⁻³) Ewewig konsentrasie (mol·dm ⁻³)	0,0316	0,004	0,004	✓(d)

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} \quad \checkmark (e)$$

$$\checkmark (f) \quad 0,016 = \frac{(0,004)^2}{[\text{HI}]^2} \quad \checkmark (g)$$

$$[\text{HI}] = 0,0316 \text{ mol} \cdot \text{dm}^{-3}$$

Wrong K_c expression/Verkeerde K_c uitdrukking	Max/Maks: $\frac{5}{8}$
No K_c expression followed by correct substitutions/Geen K_c -uitdrukking nie gevolg deur korrekte vervangings	Max/Maks: $\frac{7}{8}$

OPTION/OPSIE 2

CALCULATIONS USING CONCENTRATIONS/ BEREKENINGE MET GEBRUIK VAN KONSENTRASIES

Mark allocation/Puntetoekenning:

- Change $[H_2]$ = equilibrium $[H_2]$ = 0,04
Verandering $[H_2]$ = ewewig $[H_2]$ = 0,04
- USING** ratio $HI:H_2:I_2 = 2:1:1$
GEBRUIK verhouding $HI:H_2:I_2 = 2:1:1$
- Equilibrium concentration of I_2 = Change concentration I_2 ✓
Ewewig konsentrasie van I_2 = Verander konsentrasie I_2
- Correct K_c expression (formulae in square brackets) ✓
Korrekte K_c uitdrukking (formules tussen vierkantige hakies)
- Substitution of concentrations into K_c expression ✓
Vervanging van konsentrasies in K_c uitdrukking
- Substitution of K_c 0,016
Vervanging van K_c 0,016
- Initial concentration of HI = Equilibrium + Change ✓
Aanvanklike konsentrasie van HI = Ekwilibrium + Verandering
- Divide 0,2 by 5 AND multiplying ,0396 by 5
Deel 0,2 deur 5 EN vermenigvuldig ,0396 met 5
Range/Gebied: 0,19 – 0,2 mol

Equilibrium/Ewewig $[H_2] = \frac{0,02}{5} = 0,004 \text{ mol} \cdot \text{dm}^{-3}$ (h) ✓

	HI	H ₂	I ₂	
Initial quantity (concentration) Aanvanklike hoeveelheid (konsentrasie)	0,0396✓(g)		0	
Change (concentration) Verander (konsentrasie)	0,008	0,004	0,004	ratio ✓(b) verhouding
Equilibrium concentration (mol·dm ⁻³) Ewewig konsentrasie (mol·dm ⁻³)	0,0316	0,004	0,004	✓(c)

$$K_c = \frac{[H_2][I_2]}{[HI]^2} \text{ (d) } \checkmark$$

$$\checkmark \text{ (f) } 0,016 = \frac{(0,004)^2}{[HI]^2} \checkmark \text{ (e)}$$

$$[HI] = 0,0396 \text{ mol} \cdot \text{dm}^{-3}$$

$$n(HI)_{\text{initial/aanvanklike}} = 0,0396 \times 5 = 0,198 \text{ mol}$$

(8)

Wrong K_c expression/Verkeerde uitdrukking:	Max/Maks: $\frac{5}{8}$
No K_c expression followed by correct substitutions/Geen K_c -uitdrukking nie gevolg deur korrekte vervangings:	Max/Maks: $\frac{7}{8}$

6.3.1 Decreases/Neem af ✓ (1)

6.3.2 Remains the same/Bly dieselfde ✓ (1)

6.4 Endothermic ✓

- K_c decreases with a decrease in temperature ✓
- Reverse reaction is favoured/concentration of reactants increases/
concentration of products decreases/yield decreases ✓
- Decrease in temperature favours an exothermic reaction ✓

Endotermies

- K_c neem af met 'n afname in temperatuur
- Omgekeerde reaksie word bevoordeel/konsentrasie van reaktanse neem
toe/konsentrasie van produkte neem af/opbrengs neem af
- Afname in temperatuur bevoordeel 'n eksotermiese reaksie

(4)
[16]



QUESTION 7/VRAAG 7

7.1.1 It dissociates/ionises completely ✓ in water. ✓
Dit dissosieer/ioniseer heeltemal in water.

(2)

7.1.2

Marking criteria/Nasienriglyne:

- a) Formula/Formule $n = \frac{m}{M}$ / $c = \frac{n}{V}$ ✓
b) Substitute/Vervang 58 in $n = \frac{m}{M}$ ✓
c) **USING** ratio/**GEBRUIK** verhouding $n(\text{H}_2\text{SO}_4) : n(\text{Mg}(\text{OH})_2) = 1:1$ ✓
d) Substitute/Vervang 1,5 and/en 0,03448 in $n = cV$ ✓
e) $n(\text{H}_2\text{SO}_4)_{\text{final}} = n_{\text{initial}} - n_{\text{reacted}}$ ✓ ✓
f) Substitute/ Vervang $n(\text{H}_2\text{SO}_4)_{\text{final}}$ and/en 0,03 in $c = \frac{n}{V}$ ✓
g) Final answer/*Finale antwoord*: $0,5 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Range/*Gebied*: 0,5 to 0,67 $\text{mol} \cdot \text{dm}^{-3}$

$n(\text{MgOH})$:

$$n = \frac{m}{M} \quad \checkmark (a)$$

$$= \frac{2}{58} \quad \checkmark (b)$$

$$= 0,03448 \text{ mol}$$

$$n_{\text{reacted}}(\text{H}_2\text{SO}_4) = n(\text{MgOH})$$

$$n(\text{H}_2\text{SO}_4) = 0,03 \text{ mol} \quad \checkmark (c)$$

$$\begin{aligned} n_{\text{initial}}(\text{H}_2\text{SO}_4) &= c \times V \\ &= 1,5 \times 0,03 \quad \checkmark (d) \\ &= 0,05 \text{ mol} \end{aligned}$$

$$\begin{aligned} n_{\text{final}}(\text{H}_2\text{SO}_4) &= 0,05 - 0,03 \quad \checkmark \checkmark (e) \\ &= 0,02 \text{ mol} \end{aligned}$$

$$\begin{aligned} [\text{H}_2\text{SO}_4] \quad c &= \frac{n}{V} \\ &= \frac{0,02}{0,03} \quad \checkmark (f) \end{aligned}$$

$$= 0,67 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark (g)$$

(8)



- 7.2.1 Contain a small amount (number of moles) of acid ✓ in proportion to the volume of water. ✓
Bevat 'n klein hoeveelheid (aantal mol) suur in verhouding tot die volume water. (2)

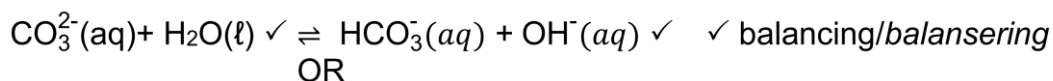
- 7.2.2 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓
 $\text{pH} = -\log(0,15)$ ✓
 $\text{pH} = 0,82$ ✓ (3)

- 7.3.1 Basic/Basis ✓ (1)

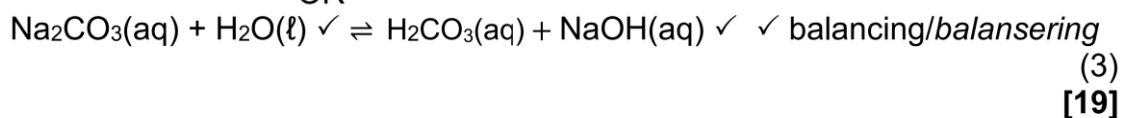
7.3.2

Marking criteria/Nasienkriteria:

- a) Reactants/Reaktanse ✓ Products/Produkte ✓
Balancing/Balansering ✓
b) Ignore single arrows and phases/Ignoreer enkel pyle en fases
c) Marking rule/Nasienreël 3.10



OR



QUESTION 8/VRAAG 8

- 8.1 Completes the circuit/maintains electrical neutrality/provides path for movement of ions. ✓
 Voltooi die stroombaan/handhaaf elektriese neutraliteit/verskaf pad vir beweging van ione. (1)

- 8.2 Cu ✓ (1)

- 8.3.1 CuSO₄/copper(II) sulphate/koper(II)sulfaat ✓ (1)

Accept: Salt that contains Cu²⁺ ions/Aanvaar: Sout wat Cu²⁺ ione bevat

- 8.3.2 AgNO₃/silver nitrate/silwernitraat ✓ (1)

Accept: Salt that contains Ag⁺ ions/Aanvaar: Sout wat Ag⁺ ione bevat

- 8.4 Cu + 2Ag⁺ ✓ → Cu²⁺ + 2Ag ✓ ✓balancing/balansering (3)

Marking criteria/Nasienkriteria:

- Reactant/Reaktanse ✓ Products/Produkte ✓
- Balancing/Balansering ✓
- Ignore double arrows/Ignoreer dubbel pyle
- Marking rule/Nasienreël 6.3.10

8.5 OPTION/OPSIE 1

$$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \quad \checkmark$$

$$= 0,8 \checkmark - 0,34 \checkmark$$

$$= 0,46 \text{ V} \checkmark$$

Notes/Aantekeninge:

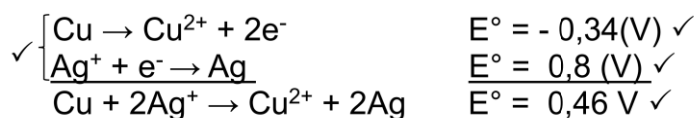
Accept any other correct formula from the data sheet.
 Aanvaar enige ander korrekte formule vanaf gegewensblad.

Any other formula using unconventional abbreviations, e.g. $E_{\text{cell}}^{\theta} - E_{\text{ox}}^{\theta}$, followed by correct substitutions: $\frac{3}{4}$

Enige ander formule wat onkonvensionele afkortings gebruik, bv.

$E_{\text{cell}}^{\theta} - E_{\text{ox}}^{\theta}$ gevolg deur korrekte vervangings: $\frac{3}{4}$

OPTION/OPSIE 2



(4)

- 8.6 Temperature/Temperatuur: 25 °C/ 298 K ✓
 Concentration/Konsentrasie: 1 mol·dm⁻³ ✓ (2)

[13]

QUESTION 9/VRAAG 9

9.1 Electrical to chemical/*Elektries tot chemies* ✓✓ (2)

9.2 A solution that conducts electricity through the movement of ions ✓✓
'n Oplossing wat elektrisiteit gelei deur die beweging van ione (2)

9.3 (Electrode/*Elektrode*) A ✓ (1)

9.4 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓✓

Marking criteria/Nasienkriteria:

- $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$ $\frac{1}{2}$ $\text{Cu} \rightleftharpoons \text{Cu}^{2+} + 2\text{e}^-$ $\frac{0}{2}$
 $\text{Cu} \leftarrow \text{Cu}^{2+} + 2\text{e}^-$ $\frac{2}{2}$ $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ $\frac{0}{2}$
- Ignore if charge omitted on electron/*Ignoreer as lading op elektron weggelaat is*
- If charge (+) omitted on Cu^{2+} /*Indien lading (+) weggelaat is op Cu^{2+}*
 Max./Maks: $\frac{1}{2}$
- Example/*Voorbeeld*: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

(2)

9.5 Anode ✓ (1)

9.6.1 A yellow green gas/chlorine / Cl_2 gas will form ✓✓
'n Geelgroen gas/chloor/ Cl_2 gas sal vorm (2)

9.6.2 $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ ✓✓

Marking criteria/Nasienkriteria:

- $2\text{Cl}^- \rightleftharpoons \text{Cl}_2 + 2\text{e}^-$ $\frac{1}{2}$ $\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$ $\frac{0}{2}$
 $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ $\frac{0}{2}$ $\text{Cl}_2 + 2\text{e}^- \leftarrow 2\text{Cl}^-$ $\frac{2}{2}$
- Ignore if charge omitted on electron/*Ignoreer as lading electron op weggelaat is*
- If charge (+) omitted on Cl^- /*Indien lading (+) weggelaat is op Cl^-*
 Max./Maks: $\frac{1}{2}$
- Example/*Voorbeeld*: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$

(2)

[12]



TOTAL/TOTAAL: 150