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education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

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GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

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SEPTEMBER 2025

MARKS: 150

TIME: 3 HOURS

This question paper consists of 17 pages and 4 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the FOLIO PAPER.
2. This question paper consists of NINE questions. Answer ALL the questions in the FOLIO PAPER.
3. Start EACH question on a NEW page in the FOLIO PAPER.
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. 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.

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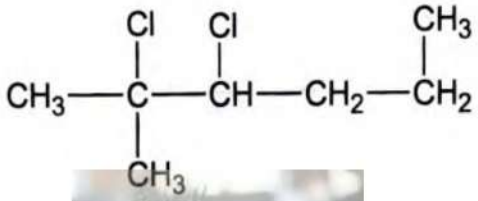
QUESTION 1 : MULTIPLE-CHOICE QUESTIONS

Four 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 number (1.1 – 1.10) in the FOLIO PAPER, for example, 1.11 E.

1.1 Study the structural formula of the organic compound below.



The IUPAC name of this organic compound is...

A 2,3-dichloro-2,5-dimethylpentane

B 3,4-dichloro-1,4-dimethylpentane

C 2,3-dichloro-2-methylhexane

D 4,5-dichloro-4-methylhexane (2)

1.2 Consider the reaction represented by the equation below:

$$C_3H_7Br + H_2O \rightarrow C_3H_8O + HBr$$

This reaction is ...

A hydration.

B hydrolysis.

C dehydration.

D hydrohalogenation. (2)

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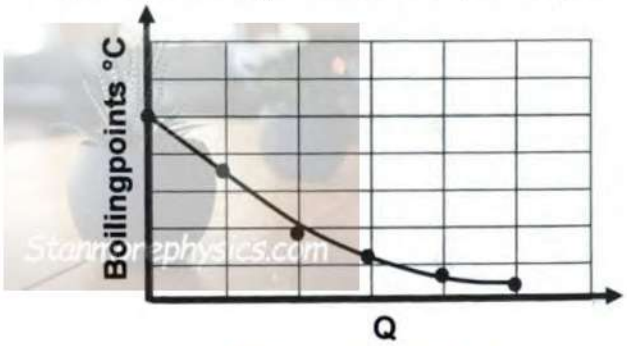
1.3 The graph below shows boiling points of alkanes with the same molecular mass plotted against a quantity **Q**.

Graph of boiling point versus quantity Q



Which ONE of the following is most likely represented by **Q**?

A Chain length

B Increase in strength of intermolecular forces

C Increase in surface area of chain isomers

D Number of methyl side chains in chain isomers (2)

1.4 The equation below represents a hypothetical reaction.

$$A(g) + B(g) \rightleftharpoons C(g) \qquad \Delta H = -50 \text{ kJ·mol}^{-1}$$

The activation energy for the REVERSE reaction is 110 kJ·mol^{-1}.

Which ONE of the following is the activation energy (in kJ·mol^{-1}) for the FORWARD reaction?

A 50

B 60

C 110

D 160 (2)

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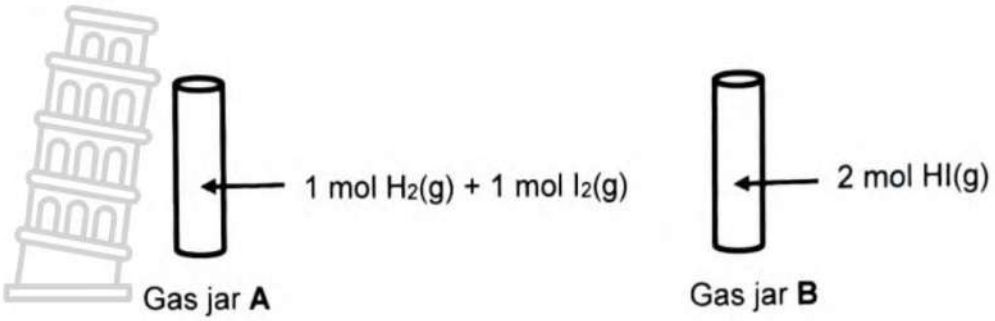
1.5 Two identical sealed gas jars, **A** and **B**, initially contain gases as shown below.



The reaction below reaches equilibrium at 500 °C according to the following balanced equation:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

Which ONE of the following statements is TRUE at equilibrium?

A **B** will contain 1 mole of $I_2(g)$.

B **A** will contain a larger amount of $I_2(g)$ than **B**.

C **A** and **B** will contain the same amount of HI(g).

D **B** will contain a larger amount of HI(g) than **A**. (2)

1.6 Which ONE of the following salts, when dissolved in water, will NOT change the pH of the water?

A Na_2CO_3

B $(COO)_2Na_2$

C $NH_4C\ell$

D $NaC\ell$ (2)

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1.7 Which ONE of the following shows the PRODUCTS for the reaction of oxalic acid with sodium hydroxide?

A $(COO)_2Na_2(aq) + H_2O(\ell) + CO_2(g)$

B $(COO)_2Na_2(aq) + H_2O(\ell)$

C $CH_3COONa(aq) + H_2O(\ell)$

D $CH_3COONa(aq) + H_2O(\ell) + CO_2(g)$ (2)

1.8 Which ONE of the following statements is CORRECT for an ELECTROLYTIC CELL?

A The anode is the positive electrode.

B The cathode is the positive electrode.

C Oxidation takes place at the cathode.

D Reduction takes place at the anode. (2)

1.9 An electrochemical cell was set up using a $Hg(\ell)|Hg^{2+}(aq)$ half-cell and another half-cell under standard conditions.

Which ONE of the following half-cells, when connected to the $Hg(\ell)|Hg^{2+}(aq)$ half-cell, will result in the HIGHEST cell potential?

A $A\ell(s)|A\ell^{3+}(aq)$

B $Zn(s)|Zn^{2+}(aq)$

C $Co(s)|Co^{2+}(aq)$

D $Pt(s)|H_2(g)|H^+(aq)$ (2)

1.10 Which ONE of the following redox reactions is SPONTANEOUS under standard conditions?

A $Br_2 + 2C\ell^- \rightarrow 2Br^- + C\ell_2$

B $2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$

C $Ni^{2+} + H_2 \rightarrow Ni + 2H^+$

D $Cu + Pb^{2+} \rightarrow Cu^{2+} + Pb$ (2)

[20]

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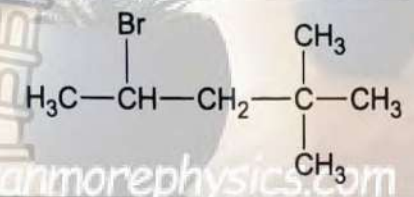
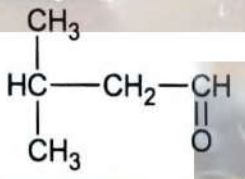
QUESTION 2 (Start on a new page)

The letters **A** to **F** in the table below represent SIX organic compounds. Use the table to answer the questions that follow.

A		**B**	3-ethyl-2,4-dimethylpent-2-ene
C		**D**	$(CH_3)_2C(OH)CH_2CH_3$
E	$CH_3CH_2CO_2CH_2CH_3$	**F**	Pentan-2-one

2.1 Define the term *Homologous series*. (2)

2.2 Write down the LETTER(S) that represent(s) the following:

2.2.1 Haloalkane (1)

2.2.2 A compound with a formyl group. (1)

2.3 Write down the:

2.3.1 IUPAC name of compound **A** (3)

2.3.2 STRUCTURAL FORMULA of compound **B** (3)

2.3.3 The STRUCTURAL FORMULA of the functional group of compound **F**. (1)

2.3.4 IUPAC name of the CHAIN isomer of compound **C**. (2)

2.4 Is compound **D** a PRIMARY, SECONDARY, or TERTIARY alcohol? (1)

2.5 Consider compound **E** and write down the ...

2.5.1 IUPAC name. (2)

2.5.2 STRUCTURAL FORMULA of the FUNCTIONAL isomer of this compound. (2)

[18]

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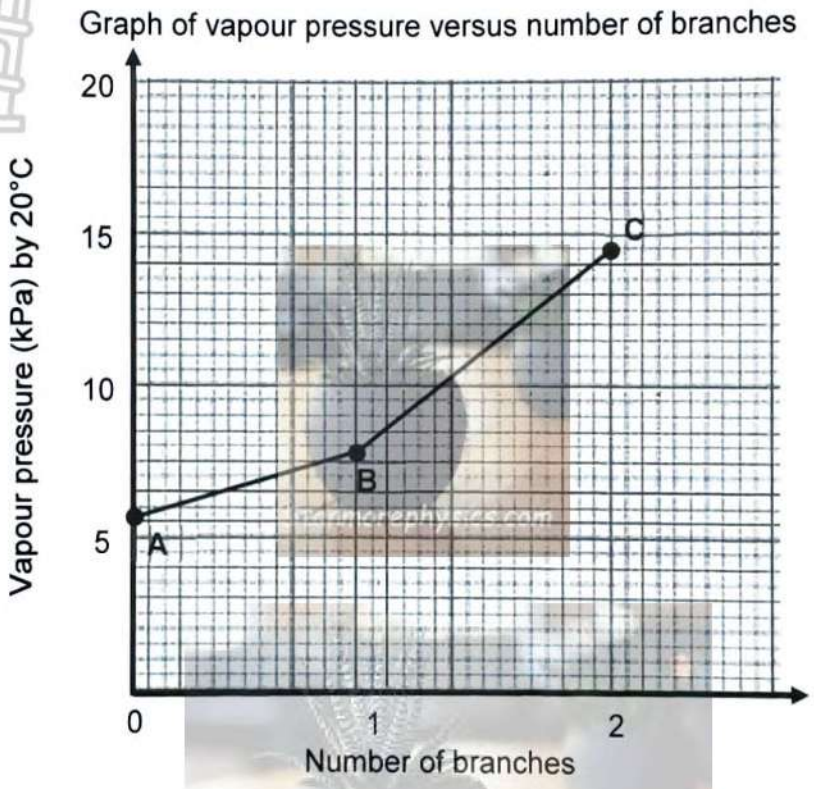
QUESTION 3 (Start on a new page)

3.1 There are three chain isomers with molecular formula, C_5H_{12}. In a practical investigation, vapor pressure data for the three chain isomers **A**, **B**, and **C** were collected and presented on the graph as shown below.



3.1.1 Use the graph to determine the vapour pressure of compound **C**. (1)

3.1.2 Write down the IUPAC name of compound **B**. (2)

3.1.3 Which ONE of the three compounds (**A**, **B** or **C**) has the highest boiling point? (1)

3.1.4 Explain the difference in the vapour pressure of compounds **A**, **B** and **C**. In the explanation, refer to the STRUCTURE of the molecule, the STRENGTH of INTERMOLECULAR FORCE(S) and the ENERGY required. (3)

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3.2 Another experiment was conducted to determine the melting point of organic compounds from three different homologous series, represented by letters **D** to **F**, under the same conditions. The three compounds used were Ethanoic acid, Propan-1-ol and Propanal. The results are shown in the table below.

COMPOUND	MELTING POINT
D	-126°C
E	16,6°C
F	-113,8°C

3.2.1 Define the term *melting point*. (2)

3.2.2 Which compound is a solid at 0°C? Write down only **D**, **E** or **F**. (1)

3.2.3 Write down the MELTING POINT of Propan-1-ol? (1)

3.2.4 Explain the difference in melting points between compounds **D** and **E**. (3)
[14]

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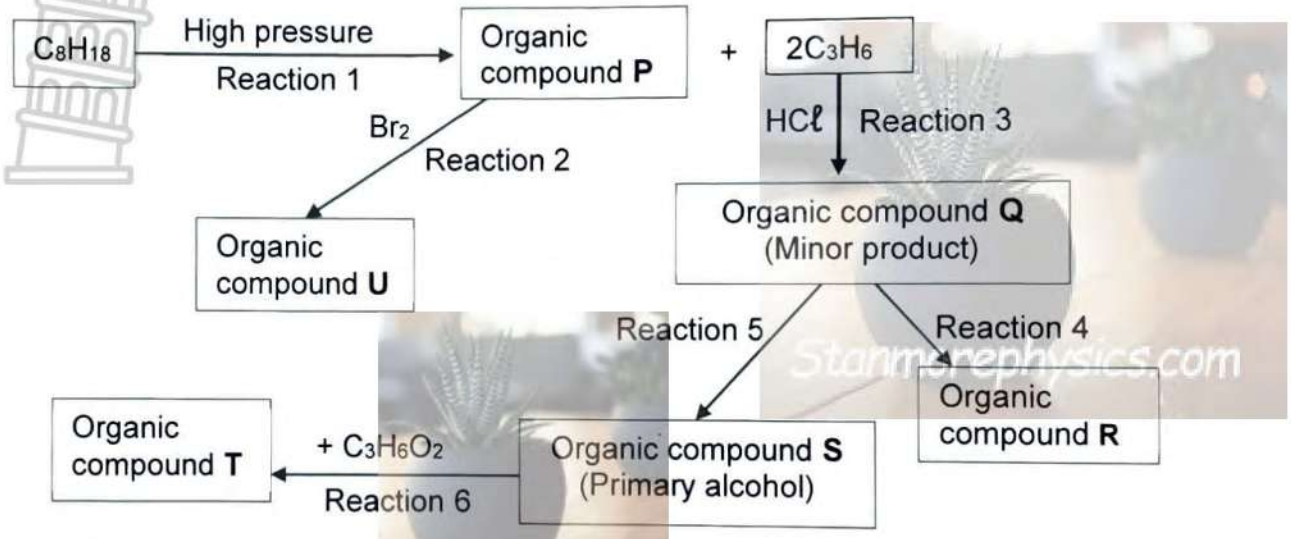
QUESTION 4 (Start on a new page)

Study the flow diagram below representing different organic reactions and answer the questions that follow.



4.1 Write down the type of reaction represented by:

4.1.1 Reaction 2 (1)

4.1.2 Reaction 3 (1)

4.2 For reaction **1**, write down the:

4.2.1 EMPIRICAL formula of compound **P**. (1)

4.2.2 IUPAC name of organic compound **P**. (1)

4.3 Reaction **4** is an ELIMINATION reaction, write down:

4.3.1 TWO reaction conditions (2)

4.3.2 The IUPAC NAME of organic compound **R**. (2)

4.4 For reaction **5**, write down the NAME or FORMULA of the inorganic product that is formed. (1)

4.5 In reaction **6**, organic compound **S** reacts with $C_3H_6O_2$ in the presence of sulphuric acid. Write down the:

4.5.1 Balanced equation using STRUCTURAL FORMULAE. (5)

4.5.2 Function of the sulphuric acid (H_2SO_4) in this reaction. (1)

[15]

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QUESTION 5 (Start on a new page)

A group of learners used the reaction between zinc and EXCESS dilute hydrochloric acid (HCℓ) to investigate the factors that affect the rate of a chemical reaction. The balanced equation for the reaction is:

$$Zn(s) + 2HC\ell \rightarrow ZnC\ell_2(aq) + H_2(g) \qquad \Delta H < 0$$

The same volume of HCℓ and the same mass of Zn were used.

Experiment	Temperature (°C)	Volume HCℓ (cm^3)	Concentration of HCℓ ($mol \cdot dm^{-3}$)	State of division of Zn
A	25	50	0,75	Granules
B	35	50	0,75	Granules
C	25	50	0,75	Powder

5.1 Define the term *reaction rate*. (2)

5.2 Is net energy ABSORBED or RELEASED during the reaction? Give a reason for the answer. (2)

5.3 How does the rate of the reaction in Experiment **A** compare to that of Experiment **B**? Write down only HIGER, LOWER or EQUAL TO. (1)

5.4 Explain the answer to Question 5.3 by using the COLLISION THEORY. (3)

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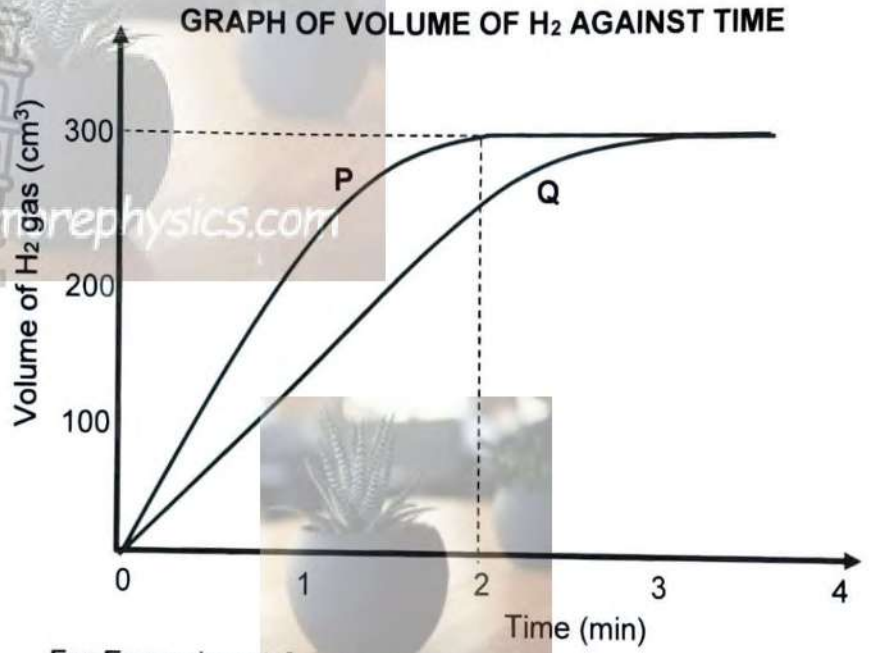
5.5 The volume of H_2 gas formed versus time for the reaction in Experiments **A** and **C** is shown below.



For Exaperiment **A**

5.5.1 Which curve represents the experiment? Write down only **P** or **Q**. (1)

5.5.2 Calculate the average rate of the reaction (in $dm^3.s^{-1}$) in the time 0 to 2 minutes. (3)

5.5.3 Calculate the mass of hydrochloric acid remaining upon completion of this reaction.

Assume that the MOLAR GAS VOLUME at 25 °C is 24 $dm^3.mol^{-1}$. (6)
[18]

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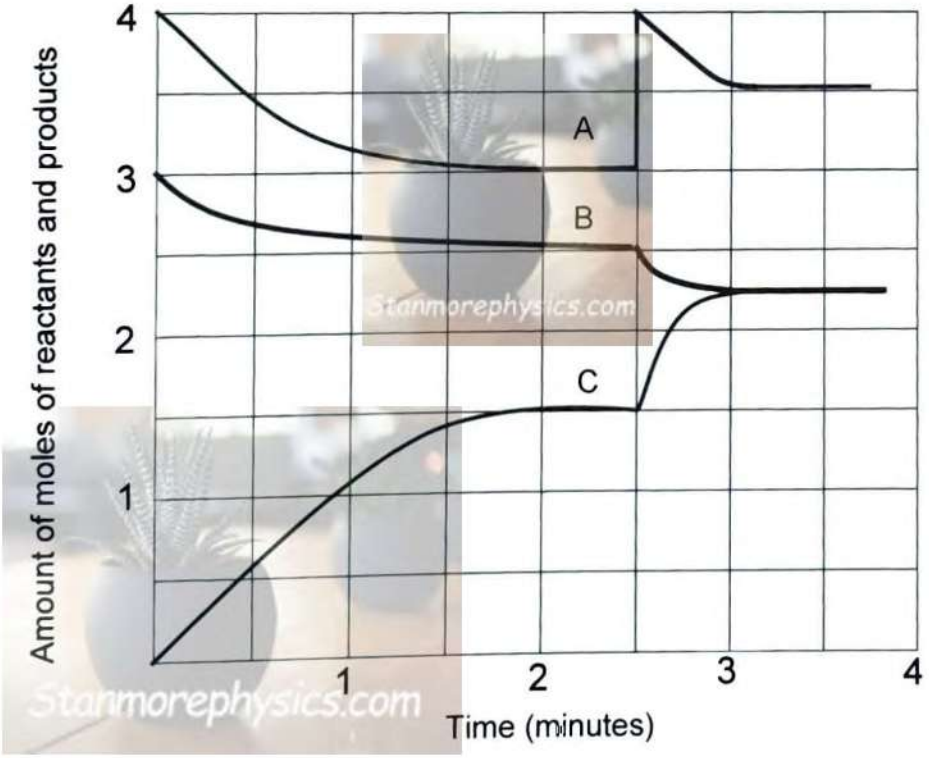
QUESTION 6 (Start on a new page)

The equation below represents a hypothetical reaction that takes place in a closed container at 350°C. The letters **x**, **y** and **z** represent the number of moles in the balanced equation.

$$\mathbf{x}A(g) + \mathbf{y}B(g) \rightleftharpoons \mathbf{z}C(g)$$

6.1 Define the term *chemical equilibrium*. (2)

The graph below shows the change in the number of moles of reactants and products versus time during the reaction.



6.2 After how many minutes did the system reach equilibrium for the first time? (1)

6.3 Using the information on the graph, write down the value of:

6.3.1 **x** (1)

6.3.2 **y** (1)

6.3.3 **z** (1)

6.4 Calculate the equilibrium constant, K_c for this reaction at 350°C if the volume of the container is 4 dm^3. (7)

6.5 Name the change made at 2,5 minutes. (1)

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6.6 Explain the effect of the change on the position of the equilibrium in QUESTION 6.5 using Le Chatelier's principle. (3)

6.7 When the temperature increases the K_c value increases for this reaction. Is the reverse reaction EXOTHERMIC or ENDOTHERMIC? Explain the answer. (3)
[20]

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QUESTION 7 (Start on a new page)

7.1 Barium hydroxide ($Ba(OH)_2$) is regarded as a strong base.

7.1.1 Define a *strong base*. (2)

7.1.2 Calculate the pH of a solution of a barium hydroxide solution, $Ba(OH)_2(aq)$, with a concentration of 0,1 $mol \cdot dm^{-3}$ (4)

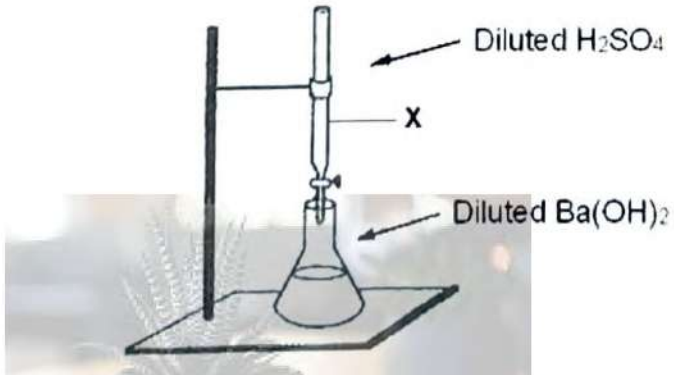
7.2 A standard solution of oxalic acid, $(COOH)_2$ (aq), with concentration 0,2 $mol \cdot dm^{-3}$ is prepared by dissolving a certain amount of oxalic acid crystals, $(COOH)_2 \cdot 2H_2O$, in water. The flask is then filled with distilled water up to the 250 cm^3 mark.

Calculate the mass of oxalic acid needed to prepare the standard solution. (5)

7.3 The apparatus in the diagram below are used for the titration of a dilute base ($Ba(OH)_2$) with a dilute acid (H_2SO_4).

Balanced equation:

$$H_2SO_4\ (aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2H_2O(\ell)$$



7.3.1 Name the apparatus labelled **X**. (1)

7.3.2 During the reaction, 50 cm^3 of the dilute base ($Ba(OH)_2$) reacts completely with 30 cm^3 of the dilute acid. Calculate the mass of barium sulphate that will form during the reaction if the concentration of the dilute base ($Ba(OH)_2$) is 0,1 $mol \cdot dm^{-3}$. (4)

7.4 Write down a balanced equation for the hydrolysis of CH_3COONa. (3)

[19]

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QUESTION 8 (Start on a new page)

Consider the galvanic cell, represented by the cell notation below.

$$Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Ni^{2+}(aq) \mid Ni(s) \quad \text{at } 25\ ^\circ C$$

This cell was set up to determine the standard electrode potential of the $Ni^{2+} \mid Ni$ half-cell.

8.1 Consider the standard hydrogen electrode used in this cell.

8.1.1 Besides the temperature of 25 °C, state the standard condition associated with the gaseous H_2 in the above cell. (1)

8.1.2 Which terminal of the voltmeter should be connected to the standard hydrogen electrode? State only POSITIVE or NEGATIVE. (1)

8.1.3 Calculate the initial reading on the voltmeter. (4)

8.2 The voltmeter is replaced with a resistor, resulting in an average current of 2,25 A being drawn from the cell for 4 hours.

8.2.1 Write down the balanced chemical equation for the SPONTANEOUS reduction half-reaction that occurs. (2)

8.2.2 Calculate the change in mass of the nickel electrode. (7)
[15]

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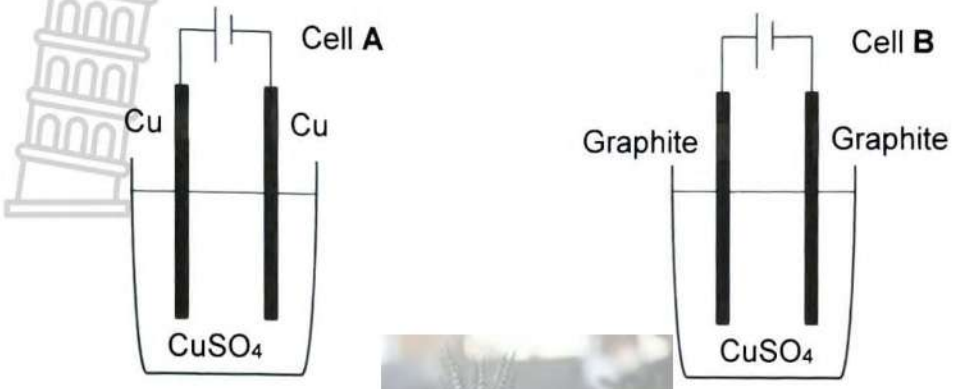
QUESTION 9 (Start on a new page)

In both cells shown below, a concentrated aqueous solution of copper(II) sulphate is electrolysed using pure electrodes.



9.1 In Cell **A**, copper electrodes are used.

9.1.1 Write down the NAME the substance(s) that is/are reduced. (1)

9.1.2 As the reaction proceeds, what will happen to the concentration of the electrolyte? Write down, INCREASES, DECREASES, or STAYS THE SAME. (1)

9.2 In Cell **B**, graphite electrodes are used.

9.2.1 Write down the reduction half reaction. (2)

9.2.2 As the reaction proceeds, what will happen to the concentration of the electrolyte? Choose from, INCREASES, DECREASES, or STAYS THE SAME. (1)

9.3 Chlorine is produced industrially by the electrolysis of a concentrated sodium chloride solution, NaCℓ(aq).

The balanced equation for the net (overall) cell reaction is as follows:

$$2NaC\ell(aq) + 2H_2O(\ell) \rightarrow H_2(g) + 2NaOH(aq) + C\ell_2(g)$$

For the above reaction, write down the:

9.3.1 Half-reaction that takes place at the cathode (2)

9.3.2 NAME or FORMULA of the oxidising agent (1)

9.3.3 Refer to the Table of Standard Reduction Potentials to explain why sodium ions are not reduced during this process. (3)

[11]

TOTAAL [150]

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GRADE/GRAAD 12

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

SEPTEMBER 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/PUNTE: 150

This marking guidelines consists of 14 pages.
Hierdie nasienryglyne bestaan uit 14 bladsye.

APPROVED 30/09/2025

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QUESTION 1 / VRAAG 1

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 B ✓✓ (2)

1.8 A ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)
[20]

QUESTION 2 / VRAAG 2

2.1

Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die korrekte konteks uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

A series of organic compounds that can be described by the same general formula OR in which one member differs from the next with a CH_2 group.✓✓
'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word OF waarin die een lid van die volgende verskil met 'n CH_2-groep (2)

2.2.1 A ✓ (1)

2.2.2 C ✓ (1)

2.3.1 4-bromo-2,2-dimethylpentane / *4-bromo-2,2-dimetielpentaan*

Marking criteria:
- Correct stem i.e. pentane. ✓
- All substituents (Bromo and dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam d.i. pentaan.* ✓
- *Alle substituente (Bromo en dimetiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓ (3)

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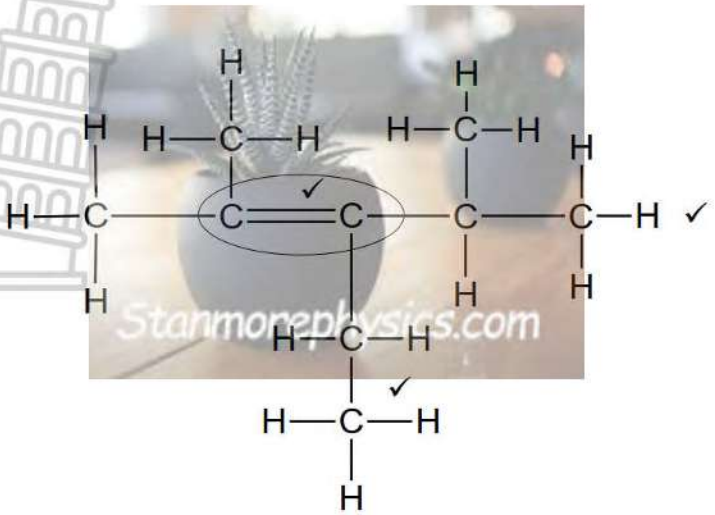
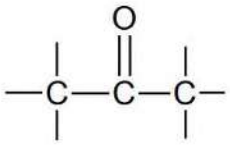
2.3.2



Marking criteria:
- Double bond on C2. ✓
- Methyl groups on C2 and C4 and ethyl group on C3 ✓
- Rest of the chain correct. ✓

Nasienkriteria:
- *Dubbelbinding op C2.*
- *Metielgroepe op C2 en C4 asook etielgroep op C3* ✓
- *Res van die ketting korrek.* ✓ (3)

2.3.3



(1)

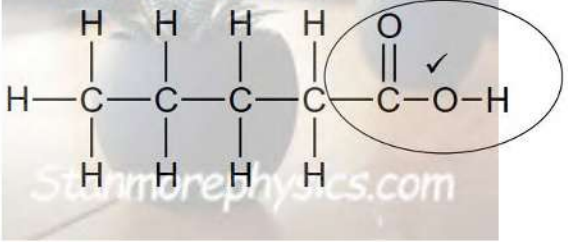
2.3.4 Pentanal/*Pentanaal* OR 2,2-dimethylpropanal/*2,2-dimitielpropanaal* ✓✓ (2)

2.4 Tertiary (alcohol)/*Tersiêre (alkohol)* ✓ (1)

2.5.1 Ethyl ✓propanoate ✓/*Etiel propanoaat* (2)

2.5.2

Marking criteria:
- Correct functional group. ✓
- Whole structure correct ✓



Nasienkriteria:
- *Korrekte funksionele groep* ✓
- *Hele struktuur korrek* ✓

ACCEPT: Branched carboxylic acid

(2)
[18]

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QUESTION 3 / VRAAG 3

3.1.1 14,5 (kPa) ✓ (1)

3.1.2 2-methyl✓butane✓/*2-metielbutaan*

Marking criteria:
- Correct stem i.e. butane. ✓
- One methyl group on Carbon 2. ✓

Nasienkriteria:
- *Korrekte stam d.i. butaan.* ✓
- *Een metielgroep op koolstof 2.* ✓ (2)

3.1.3 A ✓ (1)

3.1.4

Marking criteria:
- Compare the structures of the compounds A, B and C
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:
- *Vergelyk die struktuur van die verbindings A, B en C*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

From A to C/*Van A na C*:

- **Structure/*Struktuur*:**
  More branched / more compact / more spherical/shorter chain length / smaller surface area (over which intermolecular forces act).✓
  Meer vertak / meer kompak / meer sferies / korter kettinglengte / kleiner oppervlak (waaroor intermolekulêre kragte werk).
- **Intermolecular forces/*Intermolekulêre kragte:***
  Weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces.
  Swakker / minder intermolekulêre kragte / Van der Waalskragte / London-kragte / dispersiekragte. ✓
- **Energy/*Energie*:**
  Less energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
  Minder energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / London-kragte te oorkom.

OR/*OF*

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From C to A/*Van C na A*

- **Structure/*Struktuur*:**
  Less branched / less compact / less spherical /longer chain length /larger surface area (over which intermolecular forces act).✓
  Minder vertak / minder kompak / minder sferies / langer kettinglengte / groter oppervlak (waaroor intermolekulêre kragte werk).
- **Intermolecular forces/*Intermolekulêre kragte:***
  Stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
  Sterker /meer intermolekulêre kragte / Van der Waalskragte / Londonkragte / dispersiekragte.
- **Energy/*Energie*:**
  More energy needed to overcome or break intermolecular forces / Van der Waals forces. ✓
- *Meer energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / Londonkragte te oorkom.* (3)

3.2.1 **Marking criteria/*Nasienriglyne***
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark/*Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The temperature at which solid and liquid phases are in equilibrium. ✓✓
Die temperatuur waarby die vastestof- en vloeistoffases van 'n stof in ewewig is. (2)

3.2.2 E ✓ (1)

3.2.3 -113,8 (°C) ✓ (1)

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3.2.4

Marking criteria:
- Identify the type of intermolecular forces for D and E ✓
- Compare the strength of intermolecular forces✓
- Compare the energy required to overcome intermolecular forces ✓

Nasienkriteria:
- *Identifiseer die tiepe intermolekulêre kragte vir D en E*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

- Compounds **E**/ethanoic acid/carboxylic acid has (in addition to London forces and dipole-dipole forces) hydrogen bonding. Compound **D**/propanal/aldehyde has (in addition to London forces) dipole-dipole forces. ✓
  *Verbinding **E**/etanoësuur/karboksielsuur het waterstofbindings (behalwe Londonkragte en dipool-dipoolkragte). Verbinding **D** / propanaal/aldehied het dipool-dipoolkragte (behalwe Londonkragte).*
- Intermolecular forces in compound **E**/ethanoic acid/carboxylic acid are stronger than intermolecular forces in compound **D**/ propanal/aldehyde. *Intermolekulêre kragte in verbinding **D**/etanoësuur/karboksielsuur is sterker as die intermolekulêre kragte in verbinding **E**/ propanaal/aldehied.* ✓
  OR/*OF*
  Intermolecular forces in compound **D**/ propanal/aldehyde are weaker than intermolecular forces in compound E/ethanoic acid/carboxylic acid.
  *Intermolekulêre kragte in verbinding **D**/propanaal/aldehied is swakker as intermolekulêre kragte in verbinding **E**/etanoësuur/karboksielsuur.*
- More energy is needed to overcome/break intermolecular forces in compound E/ethanoic acid/carboxylic acid than in compound **D**/ propanaal/aldehyde. ✓
  *Meer energie word benodig om intermolekulêre kragte in verbinding **E**/etanoësuur as in verbinding **D**/ propanaal/aldehied te oorkom/breek.*
  OR/*OF*
  Less energy is needed to overcome/break intermolecular forces in compound **D**/propanal/aldehyde than in compound **E**/ethanoic acid/carboxylic acid.
  Minder energie word benodig om intermolekulêre kragte in verbinding **E**/ propanaal/aldehied te oorkom/breek as in verbinding **E**/ etanoësuur/ karboksielsuur.

(3)
[14]

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QUESTION 4/ *VRAAG 4*

4.1.1 Substitution/Halogenation / *Substitusie/Halogenering/Halogenasie* ✓ (1)

4.1.2 Addition/hydrohalogenation/*Adissie/hidrohalogenering/hidrohalogenasie* ✓ (1)

4.2.1 CH_3 ✓ (1)

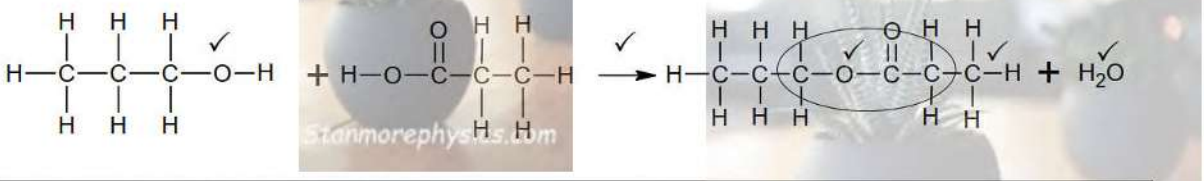
4.2.2 Ethane/*Etaan* ✓ (1)

4.3.1 Concentrated strong bases/*Gekonsentreerde sterk basis/NaOH(c)/KOH(c)/ LiOH(c)* ✓
Strongly heated/*Sterk verhit* ✓ (2)

4.3.2 Prop-1-ene ✓✓ ACCEPT:Propene (2)

4.4 HCℓ /NaCℓ /KCℓ/LiCℓ✓ (1)

4.5.1



Marking Criteria/*Nasienriglyne*

- Whole structural formula of the alcohol is correct ✓
  Hele struktuurformule vir vir die alkohol korrek
- Whole structure of carboxylic acid is correct✓
  Hele struktuur van karboksielsuur is korrek
- Correct functional group of the product (ester)✓
  Korrekte funksionele groep van die produk (ester)
- Whole structure of the ester correct✓
  Hele struktuur van die ester is korrek.
- Water(H_2O) as part of the products✓
  Water (H_2O) as deel van die produkte

(5)

4.5.2 Catalyst/Dehydrating agent/Removes the H_2O / Speeds up the reaction✓
Katalisator/Dehidreermiddel/Verwyder water/Maak die reaksie vinniger (1)

[15]

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QUESTION 5/ *VRAAG 5*

5.1

Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the correct context is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die korrekte konteks uitgelaat is, trek 1 punt af.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

ANY ONE

- The change in concentration ✓of reactants or products per unit time✓
- Rate of change in concentration/amount of moles/number of moles/volume/ mass. ✓✓ **(2 or 0)**

ENIGE EEN

- *Die verandering in konsentrasie ✓van reaktante of produkte per eenheid tyd.* ✓
- *Tempo van verandering in konsentrasie/ hoeveelheid mol/getal mol/ volume/ massa.* ✓✓ ***(2 of 0)*** (2)

5.2 Released/*Vrygestel* ✓
ΔH < 0/Energy of products is less than the energy of reactants/ Reaction exothermic✓
ΔH < 0/ Energie van produkte is minder as die energie van die reaktante/ Reaksie is eksotermies (2)

5.3 Lower/la*er* ✓ (1)

5.4

- At a lower temperature, particles move slower/have a lower (average) kinetic energy. ✓
- Less molecules have enough/sufficient kinetic energy for an effective collision. ✓
  OR Less molecules have kinetic energy/E_k equal to or greater than the activation energy.
- Less effective collisions per unit time/second. ✓
  OR Frequency of effective collisions decreases

- *By 'n laer temperatuur beweeg die deeltjies stadiger/het die deeltjies laer kinetiese energie.* ✓
- *Minder molekule het genoeg/voldoende kinetiese energie/E_k vir 'n effektiewe botsing.* ✓
  ***OF** Minder molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie*
- *Minder effektiewe botsings per eenheidtyd/sekonde*. ✓
  OF Frekwensie van effektiewe botsings verhoog. (3)

5.5.1 Q✓ (1)

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5.5.2 $\text{rate/tempo} = \frac{\Delta V}{\Delta t}$

$= \frac{300 \times 10^{-3} - 0\checkmark}{120 - 0\checkmark}$

$= 2{,}5 \times 10^{-3}\ (\text{dm}^3 \cdot s^{-1})\checkmark$

ACCEPT: any volume between 240 and 300.

(3)

5.5.3

Marking criteria / Nasienkriteria:

a) Substitute 0,3 and 24 in $n = \frac{V}{V_m}$ ✓
b) Use mol ratio n(HCl) : $n(H_2)$ 1:2 ✓
c) Substitute (0,75 x 0,05) in c=nV or m=cMV
d) $n/m_{excess} = n/m_{initial}$ (HCl) – $n/m_{reacted}$ (HCl) ✓
e) Substitude 36,5 $g \cdot mol^{-1}$ in m =nM ✓
f) Final answer ✓

$n(H_2) = \frac{V}{V_m}$

$= \frac{0{,}3}{24}\checkmark$ (a)

$= 0{,}0125$ mol

Afrikaans: Division by 24,3

$n(HCl) = 2n(H_2)$

$= 2(0{,}0125)\checkmark$ (b)

$= 0{,}025$ mol HCl

OPTION 1

$n(HCl)_{initial} = cV$

$= (0{,}75)(0{,}05)\checkmark$ (c)

$= 0{,}0375$ mol

$n(HCl)_{excess} = 0{,}0375 - 0{,}025\ \checkmark$ (d)

$= 0{,}0125$ mol

$m(HCl) = nM$

$= (0{,}0125)(36{,}5)\checkmark$ (e)

$= 0{,}46$ g ✓(0,456) (f)

OPTION 2

$m(HCl)_{reacted} = nM$

$= (0{,}025)(36{,}5)\checkmark$(e)

$= 0{,}9125$ g

$m(HCl)_{initial} = cMV$

$= (0{,}75)(36{,}5)(0{,}05)\checkmark$ (c)

$= 1{,}36875$ g

$m(HCl)_{excess} = 1{,}36875 - 0{,}9125\ \checkmark$ (d)

$= 0{,}46$ g✓ (0,456) (f)

(6)

[18]

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QUESTION 6 / *VRAAG 6*

6.1 When the rate of the forward reaction equals the rate of the reverse reaction. **(2/0)** ✓✓*Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie.* (2)

6.2 2 (min)✓ (1)

6.3.1 2 ✓ (**ACCEPT**: Multiples if ALL are correct) (1)

6.3.2 1 ✓ (1)

6.3.3 3 ✓ (1)

6.4 **POSITIVE MARKING FROM QUESTION 6.3 (FOR X,Y,Z)**
POSITIEWE NASIEN VANAF VRAAG 6.3 (VIR X,Y.Z)

Marking criteria/*Nasienriglyne*:

a) Substitute/Vervang 3 mol in $c = \frac{n}{v}$ ✓
b) Substitute/Vervang 2,5 mol in $c = \frac{n}{v}$ ✓
c) Substitute/Vervang 1 mol in V n $c = \frac{n}{v}$ ✓
d) Substitute V = 4 dm^3 in the above THREE formulae. ✓ *Vervang V = 4 dm^3 in die bostaande DRIE formules.*
e) Kc expression/Kc-uitdrukking ✓
f) Substitution of concentrations into Kc expression ✓ *Vervanging van konsentrasies in Kc-uitdrukking.*
g) Final answer/*Finale antwoord*: 0,15 ✓

OPTION/*OPSIE* 1

$[A] = \frac{3}{4}$ ✓ (a)
$= 0{,}75 \text{ mol} \cdot \text{dm}^{-3}$
$[B] = \frac{2{,}5}{4}$ ✓ (b)
$= 0{,}625 \text{ mol} \cdot \text{dm}^{-3}$
$[C] = \frac{1{,}5}{4}$ ✓ (c)
$= 0{,}375 \text{ mol} \cdot \text{dm}^{-3}$

Divide by / Deel deur 4 dm^3 ✓ (d)

$K_c = \frac{[C]^3}{[A]^2[B]}$ ✓ (e)

$= \frac{(0{,}375)^3}{(0{,}75)^2(0{,}625)}$ ✓ (f)

$= 0{,}15$ ✓ (g)

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OPTION/*OPSIE* 2

	A	B	C
Initial quantity/Aanvanklike hoeveelheid (mol)	4	3	0
Change/Verandering (mol)	-1	-0,5	+1,5
Quantity at equilibrium/ Hoeveelheid by ewewig (mol)	3✓ (a)	2,5✓(b)	1,5✓(c)
Equilibrium concentration/ Ewewigskonsentrasie (mol·dm^{-3})	0,75	0,625	0,375

(d)

Divide by 4 ✓

$$K_c = \frac{[C]^3}{[A]^2[B]} \checkmark \quad (e)$$

$$= \frac{(0,375)^3}{(0,75)^2(0,625)} \checkmark \quad (f)$$

$$= 0,15 \checkmark (g)$$

(7)

6.5 Concentration of A increases/ *Konsentrasie van A verhoog* ✓ (1)

6.6
- When the concentration is increased the reaction that decreases the concentration is favoured. ✓
- The forward reaction is favoured. ✓
- Concentration of C will increase/the concentration of A and B will decrease ✓

- *Wanneer die konsentrasie verhoog gaan die reaksie wat die konsentrasie verlaag bevoordeel word.*
- *Die voorwaartse reaksie word bevoordeel.*
- *Konsentrasie van C sal toeneem/die konsentrasie van A en B sal afneem* (3)

6.7 Exothermic / Eksotermies ✓
- An increase in temperature favours the endothermic reaction ✓
  'n Verhoging in temperatuur bevoordeel die endotermiese reaksie
- (The K_c value increases), the forward reaction was favoured ✓
  (Die K_c waarde verhoog), die voorwaartse reaksie is bevoordeel. (3)

[20]

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QUESTION 7 / VRAAG 7

7.1.1 Strong bases dissociate completely in water to form a high concentration of OH^- ions. *Sterk basis dissosieer volledig in water om 'n hoë konsentrasie OH^--ione te vorm* ✓✓ (2)

7.1.2 $c(OH^-) = 2c(Ba(OH)_2)$
$= (2)(0,1)$✓

$K_w = [H_3O^+][OH^-]$
$1 \times 10^{-14} = [H_3O^+](0,2)$✓
$[H_3O^+] = 5 \times 10^{-14}\ mol \cdot dm^{-3}$
Any one✓

$pH = -\log[H_3O^+]$
$= -\log(5 \times 10^{-14})$✓
$= 13,3$✓ (5)

7.2

OPTION/*OPSIE* 1

$c = \frac{m}{MV}$ ✓
$0,2 = \frac{m}{(0,25)(126)}$ ✓✓
$m = 6,30\ g$✓

OPTION/*OPSIE* 2

$n = cV$
$= (0,2)(0,25)$✓
$= 0,05\ mol$
Any one✓

$m = nM$
$= (0,05)(126)$✓
$= 6,30\ g$✓ (4)

NOTE: Award full marks if 90 $g.mol^{-1}$ was used

7.3.1 Burette ✓ (1)

7.3.2

Marking criteria / Nasienkriteria:
a. Division by volume / Deel deur volume
b. Use mol ratio / Gebruik mol verhouding
c. Substitute 233 in formula / Vervang 233 in formule
d. Answer / Antwoord 1,165 g

$c = \frac{n}{V}$ $0,1 = \frac{n}{0,05}$✓ $n = 0,005\ mol$ $nBaSO_4 = nBa(OH)_2$ $= 0,005\ mol$✓ $m = nM$ $= (0,005)(233)$✓ $= 1,165\ g$✓	$c = \frac{m}{MV}$ ✓ $0,1$✓ $= \frac{m}{(233)(0,05)}$✓ $m = 1,165\ g$✓

(4)

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7.4 CH_3COO^- + H_2O ✓ → OH^- + CH_3COOH ✓ ✓ (Bal) (3)

[19]

QUESTION 8 / VRAAG 8

8.1.1 Pressure is 1 atm / *Druk is 1 atm*✓ (1)

8.1.2 Negative / Negatief ✓ **ACCEPT**: Positive/Positief (1)

8.1.3

	ACCEPT
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ $= -0,27$ ✓ $- (0,0)$ ✓ $= -0,27$ V ✓	$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ $= 0$ ✓ $- (-0,27)$ ✓ $= 0,27$ V ✓

(4)

8.2.1

$Ni^{2+} + 2e^- \rightarrow Ni$ ✓✓	$2H^+ + 2e^- \rightarrow H_2$ ✓✓

(2)

8.2.2

Marking criteria / Nasienkriteria:

a) Formula /*Formule* Q = It ✓
b) Substitution of in (2,25)(4 × 3 600) formula / *Vervang (2,25)(4 × 3 600) in formule* ✓
c) Devide answer by $1,6 \times 10^{-19}$ / *Deel antwoord deur* $1,6 \times 10^{-19}$ ✓
d) Mol ratio / *mol verhoud*ing n(Ni) : n (e^-) (1:2) ✓
e) Substitute $6,023 \times 10^{23}$ in $n = \frac{N}{N_A}$ ✓
f) Substitute 59 in formula / *Vervang 59 in formule* ✓
g) Final answer / *Finale antwoord* 9,918 g (9,91 – 9,93)✓

$Q = It$✓
$= (2,25)(4 \times 3600$✓$)$
$= 32400$ C✓

$n = \frac{Q}{q_e}$
$= \frac{32400}{1,6 \times 10^{-19}}$
$= 2,025 \times 10^{23}$ electrons

$n = \frac{N}{N_A}$
$= \frac{2,025 \times 10^{23}}{6,023 \times 10^{23}}$✓
$= 0,3362$ mol

$n(Ni) = \frac{1}{2}n(e^-)$
$= (0,5)(0,3362)$✓
$= 0,1681$ mol

$m = nM$
$= (0,1681)(59)$✓
$= 9,918$ g✓

NOTE: Mark only the charge calculation (3 marks).

SCALING	
1	2
2	5
3	7

(7)

[15]

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QUESTION 9 / VRAAG 9

9.1.1 Copper (II) ions/*Koper(II)ione*✓ (1)

9.1.2 Stays the same / *Bly dieselfde* ✓ (1)

9.2.1 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

9.2.2 Decreases / Af neem ✓ (1)

9.3.1 $2H_2O + 2e^-$ ✓→ $H_2 + 2OH^-$✓ (2)

9.3.2 H_2O/Water ✓ (1)

9.3.3 H_2O is a stronger oxidising agent ✓ than Na^+ ✓ and will be reduced ✓ (to H_2).
H_2O is 'n sterker oksideermiddel✓ as Na^+ ✓en sal gereduseer word (na H_2).
OR/OF
Na^+ is a weaker oxidizing agent✓than H_2O ✓ and therefore H_2O will be reduced ✓ (to H_2 and OH^-)
Na^+ is 'n swakker oksideermiddel ✓as H_2O ✓en daarom sal H_2O gereduseer word✓ (na H_2 en OH^-) (3)

[11]

GRAND TOTAL/*GROOTTOTAAL* [150]

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