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Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2023

PHYSICAL SCIENCES P2 (CHEMISTRY)

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MARKS: 150

TIME: 3 hours

PHSCE2

This question paper consists of 23 pages including 4 data sheets.

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INSTRUCTIONS AND INFORMATION

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

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for an example 1.11 E.

1.1 Which ONE of the following has the STRONGEST intermolecular forces?

A CH_3COCH_3

B CH_3CH_2CHO

C $CH_3CH_2CH_2OH$

D CH_3CH_2COOH (2)

1.2 Consider the reaction below:

$$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$$

What TYPE of reaction is represented by the above equation?

A Hydration

B Halogenation

C Hydrogenation

D Hydrohalogenation (2)

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1.3 The name of the functional group of aldehydes is …

A formyl.

B carbonyl.

C hydroxyl.

D carboxyl. (2)

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1.4 Compound **Q** undergoes a cracking reaction to produce organic compound **P** and ethene, C_2H_4 as shown below.

Compound **Q** $\rightarrow$ Compound **P** + C_2H_4

Compound **P** further undergoes a combustion reaction according to the balanced equation.

P + 8 $O_2 \rightarrow$ 5 CO_2 + 6 H_2O

The IUPAC name of compound **Q** is ...

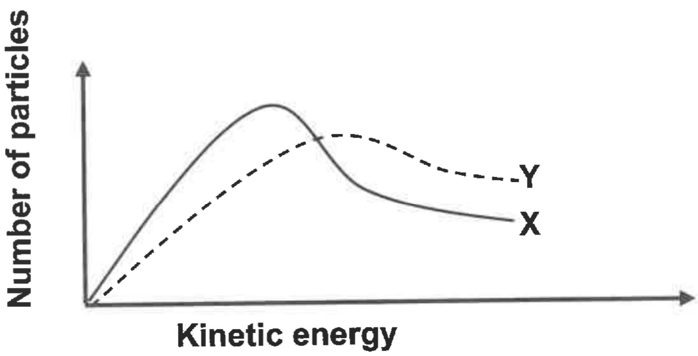
A butane.

B pentane.

C hexane.

D heptane. (2)

1.5 The Maxwell-Boltzmann distribution curve **X** represents the number of molecules against kinetic energy for a certain reaction. Curve **Y** was obtained when one of the reaction conditions was changed.



Which ONE of the following factors was changed to obtain curve **Y**?

A Pressure

B Temperature

C Concentration

D Addition of a catalyst (2)

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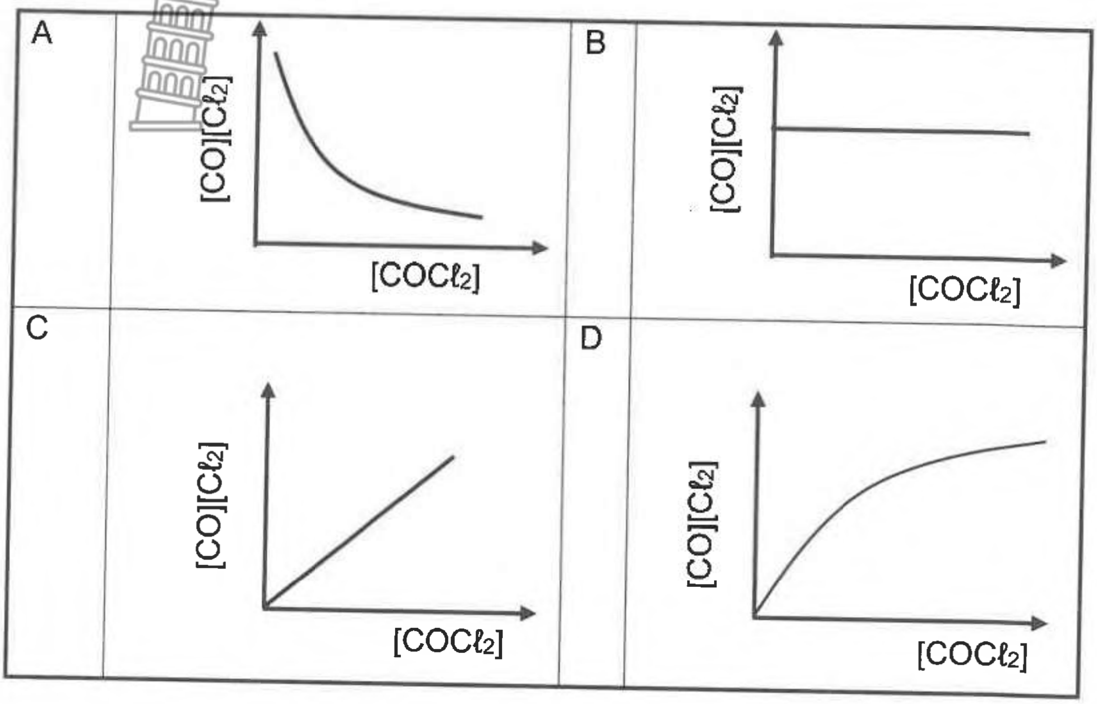
1.6 The following decomposition reaction is allowed to reach equilibrium:

$$COC\ell_2\ (g) \rightleftharpoons CO\ (g) + C\ell_2\ (g)$$

Which ONE of the following graphs of $[CO][C\ell_2]$ versus $[COC\ell_2]$ is CORRECT at equilibrium?



(2)

1.7 Which ONE of the salts below can be produced by the reaction of a strong base with a weak acid?

A Na_2SO_4

B $NH_4C\ell$

C $NaC\ell$

D $KHCO_3$

(2)

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1.8 The reaction represented by the equation below reaches equilibrium.

$CH_3COOH (aq) + H_2O (\ell) \rightleftharpoons CH_3COO^- (aq) + H_3O^+ (aq)$

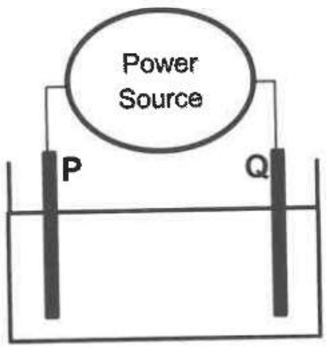
A few drops of a concentrated solution of CH_3COONa (aq) are added to the equilibrium mixture.

Which ONE of the following regarding the pH and the equilibrium position is CORRECT as the reaction approaches a new equilibrium?

	pH	Equilibrium position shifts towards the:
A	Increases	Left
B	Decreases	Right
C	Increases	Right
D	Decreases	Left

(2)

1.9 The simplified diagram below represents an electrolytic cell that is used in the purification of copper (Cu).



Electrode **P** is the CATHODE of the cell.

Which ONE of the following combinations regarding electrode **P** is correct?

	Reaction taking place at electrode P	Terminal to which electrode P is connected
A	Oxidation	Positive
B	Oxidation	Negative
C	Reduction	Positive
D	Reduction	Negative

(2)

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1.10 Consider the following hypothetical spontaneous reactions:

$$Q^{2+} + R \rightarrow R^{2+} + Q$$

$$P^{2+} + Q \rightarrow P + Q^{2+}$$

Which ONE of the following lists the oxidising agents in order of increasing strength?

A Q^{2+}, R^{2+}, P^{2+}

B R^{2+}, Q^{2+}, P^{2+}

C P^{2+}, Q^{2+}, R^{2+}

D P^{2+}, R^{2+}, Q^{2+}

(2)
[20]

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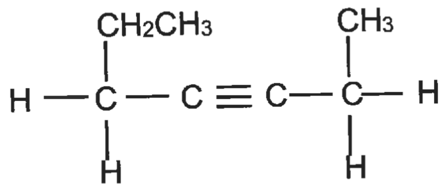
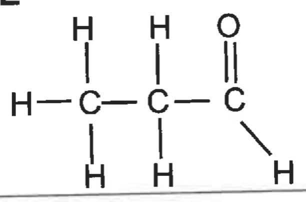
QUESTION 2 (Start on a new page.)

2.1 Consider the organic compounds **A** to **F** below.

A 2-methylpent-2-ene	**B** $(CH_3)_3COH$
C 2,3-dimethylpentanoic acid	**D** 
E 	**F** CH_3CH_2Br

2.1 Write down the LETTER of the compound that:

2.1.1 Is an alkyne (1)

2.1.2 Is a haloalkane (1)

2.1.3 Has the general formula $C_nH_{2n+2}O$ (1)

2.2 Is compound **A** SATURATED or UNSATURATED?

Give a reason for your answer. (2)

2.3 Write down the:

2.3.1 Structural formula of compound **C** (2)

2.3.2 IUPAC name of compound **D** (2)

2.4 Is compound **B** a PRIMARY, SECONDARY OR TERTIARY alcohol?

Give a reason for your answer. (2)

2.5 Write down the IUPAC name of a CHAIN isomer of compound **B**. (2)

2.6 Compound **E** has a functional isomer.

2.6.1 What are *functional isomers*? (2)

2.6.2 Write down the CONDENSED STRUCTURAL formula of the functional isomer of compound **E** (2)

[17]

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QUESTION 3 (Start on a new page.)

Compounds **A** to **C** are used to investigate a factor that influences boiling point of organic compounds. The table below shows the results obtained.

	Compound	Boiling point (˚C)
A	Propan-1-ol	97
B	Butan-1-ol	117,7
C	Pentan-1-ol	138

3.1 Define *boiling point.* (2)

3.2 For this investigation, write down the:

3.2.1 Independent variable (1)

3.2.2 Controlled variable (1)

3.3 Name the intermolecular force that is responsible for the observed trend in boiling points. (1)

3.4 The boiling points of three branched alcohols are given below.

108 ˚C	129 ˚C	149 ˚C

Which ONE of the three temperatures is most likely to be the boiling point of 2-methylbutan-1-ol? (1)

3.5 Fully explain your answer to QUESTION 3.4. (4)

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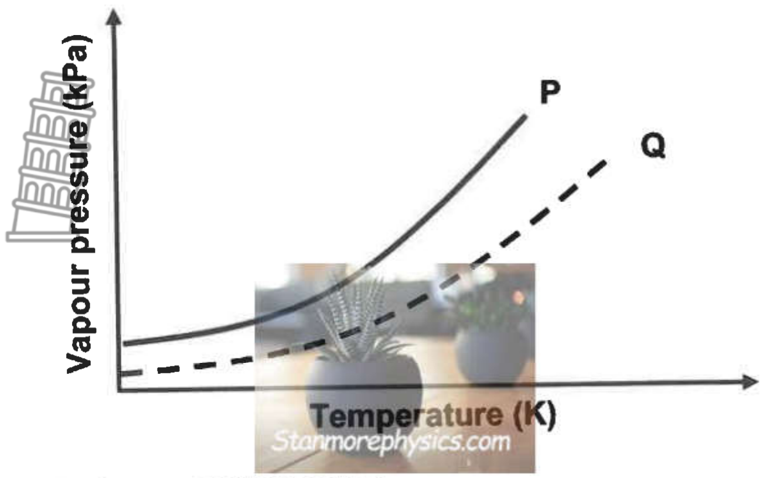
3.6 The graphs below represent the relationship between vapour pressure and temperature for propan-1-ol and propanal.



3.6.1 Define *vapour pressure.* (2)

3.6.2 Which curve, **P** or **Q**, represents the graph for propan-1-ol? (1)

3.6.3 Explain your answer to QUESTION 3.6.2 by referring to the TYPE of intermolecular forces. (4)

[17]

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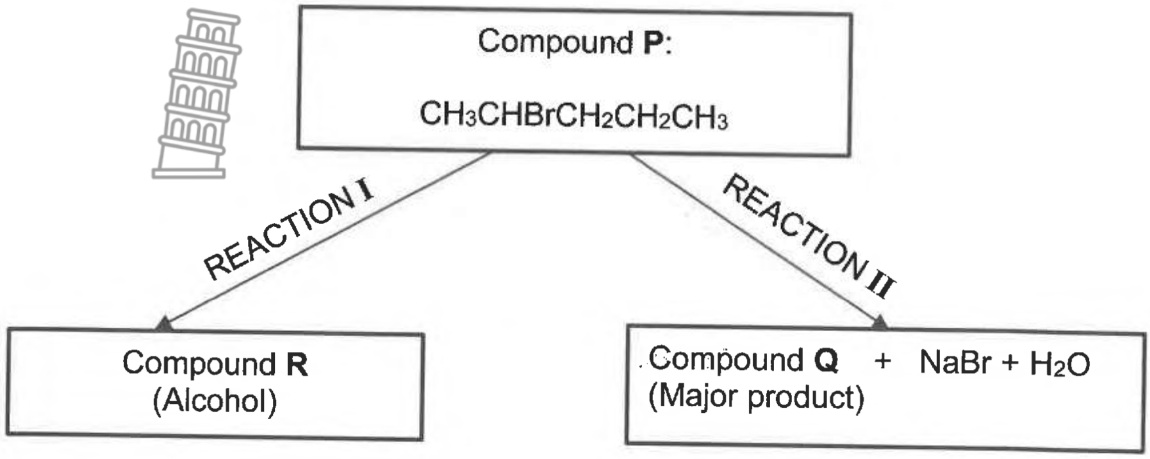
QUESTION 4 (Start on a new page.)

4.1 The flow diagram below shows how compound **P** can be converted to organic compounds **Q** and **R.**



For reaction **I** write down the:

4.1.1 Name of the type of substitution reaction (1)

4.1.2 IUPAC name of compound **R** (2)

For reaction **II** write down:

4.1.3 One reaction condition other than heat (1)

4.1.4 The structural formula of compound **Q** (2)

Compound **R** can be converted to compound **Q**.

For the conversion of compound **R** to compound **Q** write down the:

4.1.5 Formula or name of the inorganic reagent needed (1)

4.1.6 Type of reaction (1)

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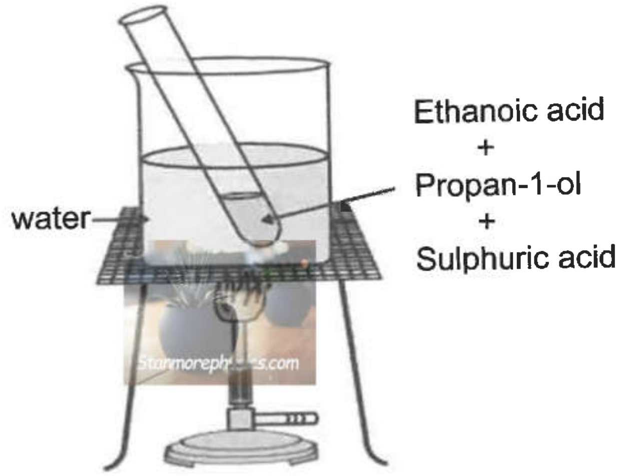
4.2 A mixture of ethanoic acid (CH_3COOH) and propan-1-ol ($CH_3CH_2CH_2OH$) is heated in the presence of concentrated sulphuric acid (H_2SO_4) in a water bath as shown below.



4.2.1 Write down the name of the reaction that takes place. (1)

4.2.2 Give a reason why the reaction mixture is heated in a water bath. (1)

4.2.3 Write down the structural formula and IUPAC name of the product formed (4)
[14]

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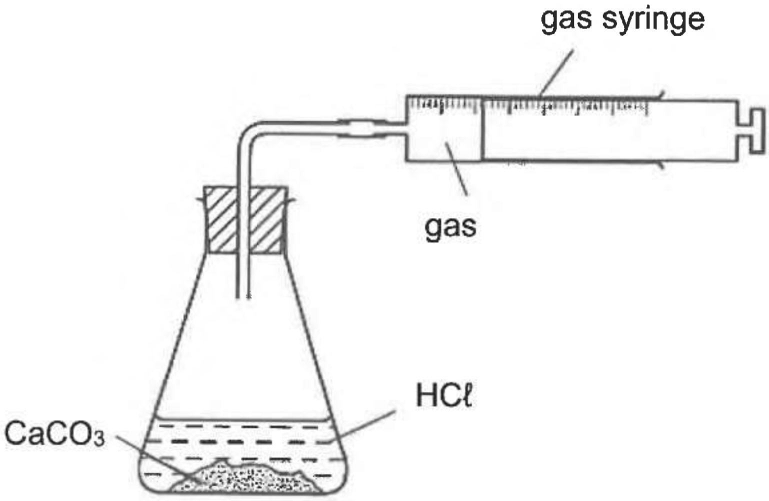
QUESTION 5 (Start on a new page.)

A group of learners investigate the relationship between reaction rate and concentration. They used the reaction between calcium carbonate powder, $CaCO_3$ (s) and EXCESS hydrochloric acid solution, HCℓ (aq), at 25 °C.

The balanced equation for this reaction is:

$CaCO_3$ (s) + 2 HCℓ (aq) → $CaCℓ_2$ (aq) + H_2O (ℓ) + CO_2 (g) $\Delta H < 0$

The apparatus used is illustrated below.



The table below shows the reaction conditions for Experiments **1** and **2**.

EXPERIMENT	CONCENTRATION OF HCℓ ($mol.dm^{-3}$)	VOLUME OF HCℓ (cm^3)	TIME TAKEN BY THE REACTION TO REACH COMPLETION (minutes)
1	0,9	50	5,28
2	1,2	50	Y

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

5.2 Name the apparatus needed for this investigation that is not shown in the sketch above. (1)

5.3 Give a reason why the temperature of the reaction mixtures does not remain constant during the reactions. (1)

5.4 Will time **Y** for experiment **2** be LONGER or SHORTER than 5,28 minutes? (1)

5.5 Explain your answer to QUESTION 5.4 by referring to the collision theory. (2)

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5.6 In experiment **1**, exactly 250 cm^3 of CO_2 is produced in 5,28 minutes.

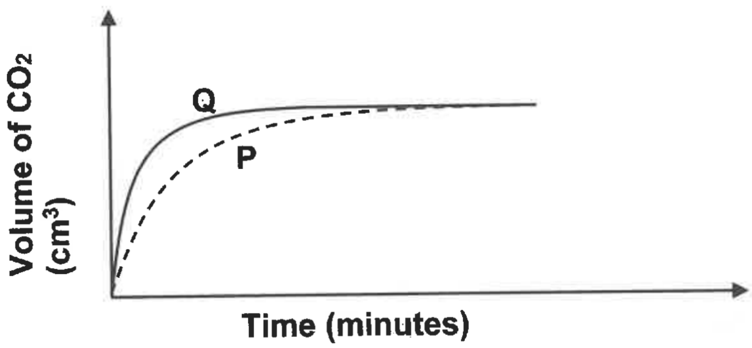
5.6.1 Calculate the average rate of production of CO_2 in $cm^3 \cdot min^{-1}$ (3)

Shortly after the reaction in experiment **1** is completed, the flask is sealed tightly and it is found that 100 cm^3 of CO_2 has escaped out of the flask.

5.6.2 Calculate of mass of CO_2 remaining in the flask after the flask is sealed. Take the molar volume of CO_2 at 25 °C to be 25 000 $cm^3 \cdot mol^{-1}$. (4)

5.7 In **experiment 3** the learners now add 50 cm^3 of EXCESS ethanoic acid ($C_2H_4O_2$) solution with a concentration of 0,9 $mol \cdot dm^{-3}$ to $CaCO_3$ powder at 25 °C and compare the results to those of experiment **1**.

The graph of volume of CO_2 against time for the two experiments is shown below.



5.7.1 Which graph **P** or **Q** represents the results of experiment **3**? (1)

5.7.2 Explain your answer to QUESTION 5.7.1. (2)

5.7.3 How does the amount of $CaCO_3$ used in experiment **1** compare to the amount of $CaCO_3$ used in experiment **3**?

Choose from LARGER THAN, SMALLER THAN or EQUAL TO.

Give a reason for your answer. (2)
[19]

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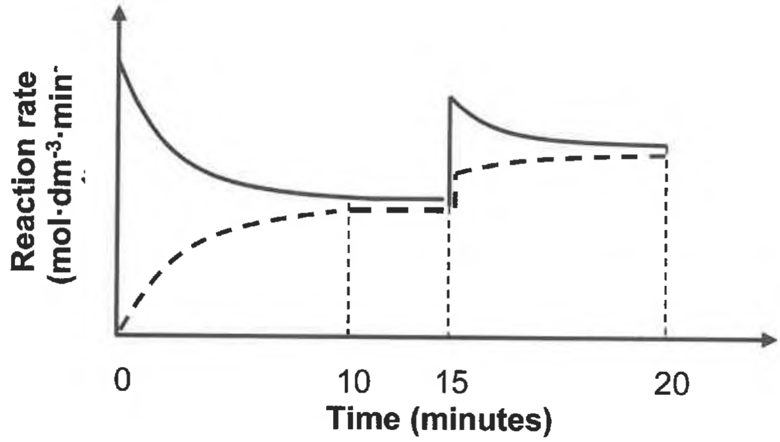
QUESTION 6 (Start on a new page.)

6.1 Sulphur trioxide (SO_3) gas is injected into an empty container which is then sealed. The following reaction takes place inside the container:

$$2\,SO_3\,(g) \rightleftharpoons 2\,SO_2\,(g) + O_2\,(g)$$

The graph below shows the changes in the reaction rates against time for the first 20 minutes.



6.1.1 Write down the meaning of the double arrow "⇌" in the equation. (1)

6.1.2 What is represented by the horizontal section of the graph between t = 10 minutes and t = 15 minutes (1)

At **t** = 15 minutes the temperature of the reaction mixture in the container was changed.

6.1.3 Was the container COOLED or HEATED at **t** = 15 minutes? (1)

6.1.4 Is the forward reaction EXOTHERMIC or ENDOTHERMIC? (1)

6.1.5 Explain your answer to QUESTION 6.1.4 by referring to Le Chatelier's principle. (2)

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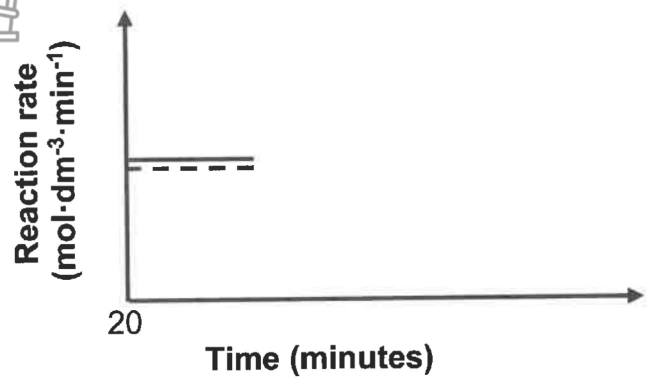
After 20 minutes the pressure inside the reaction container is increased by decreasing the volume at constant temperature.

6.1.6 Redraw the graph below and indicate the effect that the increase in pressure will have on the reaction rate up until a new equilibrium is established.

GRAPH OF RATE VERSUS TIME



(2)

6.2 Carbon (C) and carbon dioxide (CO_2) are mixed in an empty 2 dm^3 container which is then sealed.

The following balanced equation represents the reaction that reaches equilibrium in the container at 700 °C.

$$C\ (s) + CO_2\ (g) \rightleftharpoons 2\ CO\ (g)$$

At equilibrium, it is found that the concentration of CO_2 is 0,05 $mol.dm^{-3}$ and 0,4 moles of C (s) are present. The equilibrium constant for this reaction at 700 °C is 0,05.

Calculate the percentage of carbon that has reacted. (8)

[16]

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QUESTION 7 (Start on a new page.)

7.1 Consider the ionisation of oxalic acid, $H_2C_2O_4$ (aq), represented by the following balanced equation:

$H_2C_2O_4 (aq) + H_2O (\ell) \rightleftharpoons HC_2O_4^- (aq) + H_3O^+ (aq)$

The concentration of EACH of the substances found in 0,1 mol·dm^{-3} solution of $H_2C_2O_4$ at equilibrium is given in the table below.

Substances	$H_2C_2O_4$	$HC_2O_4^-$	H_3O^+
Concentration (mol·dm^{-3})	0,046	0,054	0,054

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

7.1.2 Write down the formula of a base in the above reaction other than H_2O. (1)

7.1.3 Is oxalic acid ($H_2C_2O_4$) a STRONG or a WEAK acid? (1)

7.1.4 Explain your answer to QUESTION 7.1.3 by referring to the data in the table. (2)

7.2 A concentrated sodium hydroxide solution, NaOH(aq), is diluted with water to one tenth of its original concentration.

Exactly 35 cm^3 of the dilute sodium hydroxide solution is mixed with 25 cm^3 of hydrochloric acid solution, HCℓ (aq) of concentration 0,1 mol·dm^{-3} in a flask.

A neutralisation reaction occurs in the flask according to the balanced equation:

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

7.2.1 Calculate the initial number of moles of HCℓ in the flask. (3)

The pH of the final solution is 12.

Calculate the CONCENTRATION of the:

7.2.2 Hydroxide ions (OH^-) in the final solution (4)

7.2.3 Concentrated sodium hydroxide (NaOH) (6)
[19]

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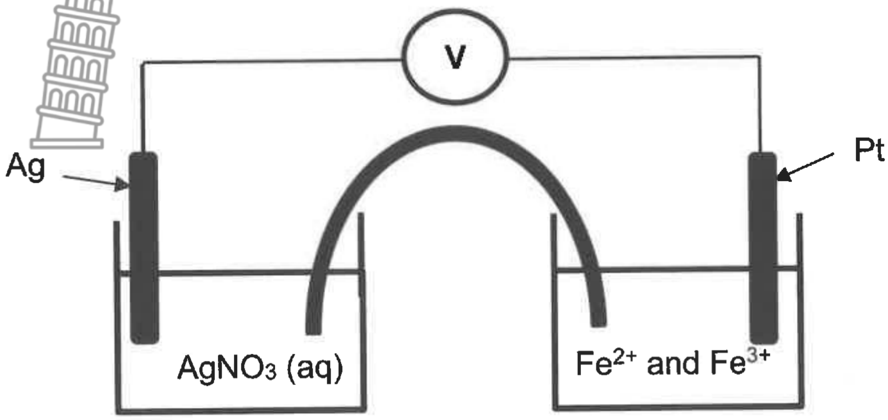
QUESTION 8 (Start on a new page.)

A galvanic cell is set up under standard conditions. One half cell consists of a silver plate, Ag, in an aqueous solution of $AgNO_3$, while the other half cell consists of an inert platinum plate in an aqueous solution containing, Fe^{2+} and Fe^{3+}, as shown in the simplified diagram below.



8.1 Write down the energy change that takes place when this cell is in operation. (2)

8.2 For this galvanic cell, write down the:

8.2.1 Oxidation half-reaction (2)

8.2.2 Cell notation (3)

8.2.3 TWO standard conditions for the Fe^{2+}, Fe^{3+} half cell (2)

8.3 Calculate the initial emf of this cell. (4)

8.4 What would happen to the emf calculated in QUESTION 8.3, if a solution of NaCℓ were to be used as a salt bridge in the cell under standard conditions?

Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

8.5 Explain your answer to QUESTION 8.4. (2)
[16]

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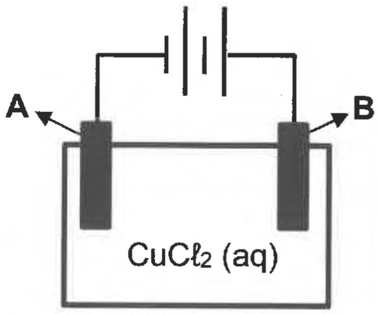
QUESTION 9 (Start on a new page.)

The electrolytic cell shown below is used for the electrolysis of $CuCl_2$ solution.



A and **B** are carbon electrodes.

9.1 Define *electrolysis.* (2)

9.2 Is the process of electrolysis EXOTHERMIC of ENDOTHERMIC? (1)

9.3 Write down the half reaction that occurs at electrode **B**.

0,369 g of Cu is deposited on the cathode in 27 minutes. (2)

9.4 Calculate the electrical current used during this process. (7)
[12]

TOTAL: 150

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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*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at /by 298K

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$

$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

$q = I\Delta t$ $\quad n = \frac{Q}{e}$ $\quad$ or/of $n = \frac{Q}{q_e}$

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

KEY/ *SLEUTEL*

Elektronegatiwiteit / Electronegativity	*Atoomgetal* / Atomic number	*Simbool* / Symbol	*Benaderde relatiewe atoommassa* / Approximate relative atomic mass
1,9	29	Cu	63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↑)

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	– 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	– 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	– 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	– 0,27
$Co^{2+} + 2e^-$	⇌	Co	– 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	– 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	– 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	– 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	– 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	– 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	– 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$Na^+ + e^-$	⇌	Na	– 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	– 2,93
$Li^+ + e^-$	⇌	Li	– 3,05

Increasing reducing ability/*Toenemende reduserende vermoë* (↓)

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓)

Increasing reducing ability/*Toenemende reduserende vermoë* (↑)

Half-reactions/*Halfreaksies*			**E^θ (V)**
$Li^+ + e^-$	⇌	Li	– 3,05
$K^+ + e^-$	⇌	K	– 2,93
$Cs^+ + e^-$	⇌	Cs	– 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	– 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	– 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	– 2,87
$Na^+ + e^-$	⇌	Na	– 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	– 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	– 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	– 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	– 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	– 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	– 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	– 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	– 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	– 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	– 0,40
$Co^{2+} + 2e^-$	⇌	Co	– 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	– 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	– 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	– 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	– 0,06
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

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GRADE/*GRAAD* 12

SEPTEMBER 2023

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

MARKS: 150

This marking guideline consists of 19 pages./
Hierdie nasienriglyn bestaan uit 19 bladsye.

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QUESTION 1/*VRAAG* 1

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

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QUESTION 2/*VRAAG 2*

2.1.1 D ✓ (1)

2.1.2 F ✓ (1)

2.1.3 B ✓ (1)

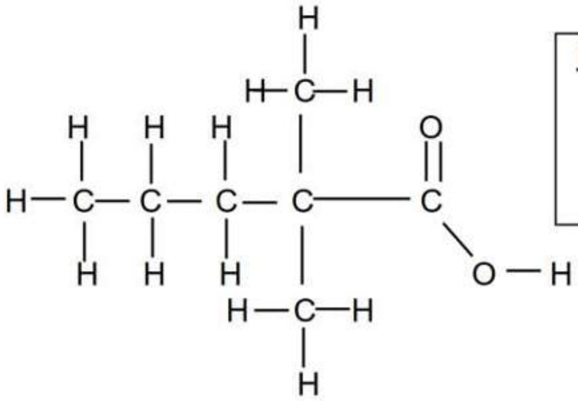
2.2 UNSATURATED ✓

It is an organic compound that <u>contains double/triple/multiple bonds</u>. ✓

ONVERSADIG

Dit is 'n organiese verbinding wat <u>dubbel/drievoudige/meervoudige bindings bevat</u>. (2)

2.3.1



Marking criteria/*Nasienkriteria*
- Functional group correct ✓ *Funksionele groep korrek*
- Whole structure correct ✓ *Hele struktuur korrek*

(2)

2.3.2 <u>hept-3-yne ✓ ✓ / 3-heptyne</u>

<u>hept-3-yn / 3-heptyn</u>

Marking criteria/ *Nasienkriteria*
- Parent name and suffix correct (heptyne)✓ *Stam naam en agtervoegsel korrek (heptyn)*
- Everything correct e.g. hyphens and numbering ✓ *Alles korrek bv koppeltekens en nommering*

(2)

2.4 Tertiary. ✓

The carbon that is bonded to the hydroxyl group (-OH) is bonded to three other carbons. ✓

OR

The carbon of the functional group is bonded to three other carbons.

Tersiêre

Die koolstof wat verbind is aan die hidroksielgroep (-OH) is verbind aan drie ander koolstowwe.

OF

Die koolstof van die funksionele groep is aan drie ander koolstowwe verbind. (2)

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2.5 Butan-2-ol / 2-butanol ✓✓ ***NOTE/LET WEL:*** Butan-1-ol / 1-butanol (1/2) (2)

2.6.1 Compounds with the <u>same molecular formula</u> ✓ but <u>different functional groups</u> ✓/belong to different homologous series.

Verbindings met <u>dieselfde molekulêre formule</u>, maar <u>verskillende funksionele groepe</u> / behoort aan verskillende homoloë reeks. (2)

2.6.2 CH_3COCH_3 ✓✓ **OR/*OF***

O
||
CH_3CCH_3 (2)

[17]

QUESTION 3/*VRAAG* 3

3.1

<u>Marking criteria/ Nasienriglyne</u>
If any of the underlined key words/phrases in the **correct context** are omitted: -1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per woord/frase*

The <u>temperature</u> at which the <u>vapour pressure</u> of a liquid <u>equals the atmospheric pressure</u> ✓✓

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

3.2.1 Molecular size ✓ / Surface area / Chain length / London forces
Molekulêre grootte / Oppervlakte / kettinglengte / Londonkragte (1)

3.2.2 Functional group ✓/ Homologous series
Funksionele groep / Homoloë reeks (1)

3.3 London forces / induced dipole forces / dispersion forces ✓
Londonkragte / geïnduseerde dipoolkragte / verspreidingskragte (1)

3.4 129 ˚C ✓ (1)

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3.5

Marking criteria/*Nasienkriteria*

- Compare the molecular size of 2-methylbutan-1-ol to butan-1-ol ✓
- Relate the molecular size to London forces/induced dipole forces/dispersion forces. ✓

- Compare the chain length of 2-methylbutan-1-ol to pentan-1-ol ✓
- Relate the chain length to London forces/induced dipole forces/dispersion forces ✓

- *Vergelyk die molekulêre grootte van 2-metielbutan-1-ol aan butan-1-ol*
- *Verwys die molekulêre grootte na die Londonkragte/ geïnduseerde dipoolkragte / verspreidingkragte*

- *Vergelyk die kettinglengte van 2-metielbutan-1-ol met pentan-1-ol*
- *Verwys die kettinglengte na die Londonkragte / geïnduseer dipoolkragte / verspreidingkragte*

- 2-methylbutan-1-ol has a larger molar mass/molecular size than butan-1-ol ✓
- London forces/induced dipole forces/dispersion forces of 2-methylbutan-1-ol is stronger than that butan-1ol ✓
- The boiling point will higher than that of butan-1-ol

- 2-methyl butan-1-ol has a shorter chain length than pentan-1-ol✓
- London forces of 2-methyl butan-1-ol is weaker than that of pentan-1-ol ✓
- The boiling point will be lower than that of pentan-1-ol

- *2-metielbutan-1-ol het 'n groter molekulêre massa/molekulêre grootte as butan-1-ol*
- *Londonkragte/geïnduseerde dipoolkragte/verspreidings van 2-metielbutan-1-ol is sterker as dié van butan-1-ol*
- *Die kookpunt is hoër as dié van butan-1-ol*

- *2-metielbutan-1-ol het 'n korter kettinglengte as pentan-1-ol*
- *Londonkragte van 2-metielbutan-1-ol is swakker as dié van pentan-1-ol*
- *Die kookpunt sal laer wees as dié van pentan-1-ol* (4)

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OR /*OF*

- Butan-1-ol has a smaller molar mass/molecular size than 2-methylbutan-1-ol
- London forces/induced dipole forces/dispersion forces of butan-1-ol is weaker than that 2-methylbutan-1-ol
- The boiling point will higher than that of butan-1-ol

- Pentan-1-ol has a larger chainlength than 2-methyl butan-1-ol
- London forces/induced dipole forces/dispersion forces of pentan-1-ol is stronger than that of 2-methyl butan-1-ol
- The boiling point will be lower than that of pentan-1-ol

- *Butan-1-ol het 'n kleiner molekulêre massa/molekulêre grootte as 2-metielbutan-1-ol*
- *Londonkragte/geïnduseerde dipoolkragte/verspreidings van butan-1-ol is swakker as dié van 2-metielbutan-1-ol*
- *Die kookpunt is hoër as dié van butan-1-ol*

- *Pentan-1-ol het 'n langer kettinglengte as 2-metielbutan-1-ol*
- *Londonkragte van pentan-1-ol is sterker as dié van 2-metielbutan-1-ol*
- *Die kookpunt sal laer wees as dié van pentan-1-ol*

3.6.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase*

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

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. (2)

3.6.2 **Q** ✓ (1)

3.6.3 **Marking criteria/*Nasienkriteria***

- Propan-1-ol has hydrogen bonds ✓(and London forces/induced dipole forces/dispersion forces
- Propanal has dipole-dipole forces ✓(and London/induced dipole forces/dispersion forces
- Compare the strength of the hydrogen bonds to dipole-dipole forces ✓
- Relate strength of intermolecular forces to vapour pressure ✓

- *Propan-1-ol het waterstofbindings (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Propanal het dipool-dipoolkragte (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Vergelyk die sterkte van die waterstofbindings met die dipool-dipoolkragte*
- *Verwys die sterkte van die intermolekulêrekragte met die dampdruk*

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- Propan-1-ol has hydrogen bonds ✓(and London forces/induced dipole forces/dispersion forces)
- Propanal has dipole-dipole forces (and London forces/induced dipole forces/dispersion forces) ✓
- Hydrogen bonds are stronger than the dipole-dipole forces ✓
- Stronger intermolecular forces result in lower vapour pressure ✓

- *Propan-1-ol het waterstofbindings (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Propanal het dipool-dipoolkragte (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Waterstofbindings is sterker as dipool-dipoolkragte*
- *Sterker intermolekulêrekragte het laer dampdruk*

OR / *OF*

- Propan-1-ol has Hydrogen bonds ✓ (and London forces/induced dipole forces/dispersion forces)
- Propanal has dipole-dipole forces ✓(and London/induced dipole forces/dispersion forces)
- Dipole-dipole forces are weaker than the hydrogen bonds✓
- Weaker intermolecular forces result in higher vapour pressure ✓

- *Propan-1-ol het waterstofbindings (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Propanal het dipool-dipoolkragte (en Londonkragte/geïnduseerde dipoolkragte/verspreidingskragte)*
- *Dipool-dipoolkragte is swakker as waterstofbindings*
- *Swakker intermolekulêrekragte het hoër dampdruk* (4)

[17]

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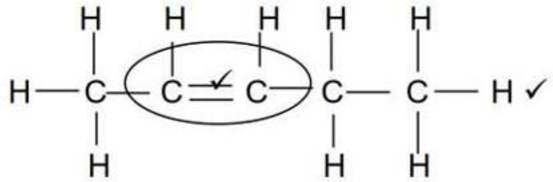
QUESTION 4/*VRAAG 4*

4.1.1 Hydrolysis / *Hidrolise* ✓ (1)

4.1.2 Pentan-2-ol / 2-pentanol ✓✓ (2)

4.1.3 Concentrated strong base✓ **OR** concentrated NaOH **OR** concentrated KOH **OR** concentrated LiOH
Gekonsentreerde sterk basis ***OF*** *gekonsentreerde NaOH* ***OF*** *gekonsentreerde KOH* ***OF*** *gekonsentreerde LiOH* (1)

4.1.4



Marking criteria/*Nasienkriteria*
- Functional group correct ✓ *Funksionele groep korrek*
- Whole structure correct ✓ *Hele struktuur korrek*

(2)

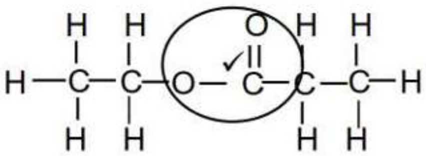
4.1.5 Sulphuric acid / *Swawelsuur* ✓ (1)

4.1.6 Dehydration / *Dehidrasie / Dehidratering* ✓ (1)

4.2.1 Esterification / Condensation / *Esterifikasie / Verestering* ✓ (1)

4.2.2 Alcohols are flammable✓ /prevent fire
Alkohole is vlambaar / om 'n vuur te voorkom (1)

4.2.3



Marking criteria/*Nasienkriteria*
- Functional group correct ✓ *Funksionele groep korrek*
- Whole structure correct ✓ *Hele struktuur korrek*

ethyl ✓propanoate ✓ / *etiel-propanoaat* (4)
[14]

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QUESTION 5/*VRAAG 5*

5.1

Marking criteria/ *Nasienriglyne*
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase

ANY ONE

Change in concentration ✓of reactant or product per (unit) time.✓

Change in amount/number of moles/volume/mass of products or reactants per (unit) time.

Change in amount/number of moles/volume/mass of products formed or reactants used reactants per (unit) time.

ENIGE EEN

Verandering in konsentrasie van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van reaktanse of produkte per (eenheid) tyd.

Verandering in hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.

OR/*OF*

The rate of change in concentration / amount of moles / number of moles / volume / mass. **(2 or 0)**

Die tempo van verandering in konsentrasie/hoeveelheid mol/getal mol/volume/massa ✓✓ ***(2 of 0)*** (2)

5.2 Stopwatch ✓/Timer/ Measuring cylinder
Stophorlosie / Tydhouer / Meetsilinder (1)

5.3 Reaction is exothermic / reaction releases heat ✓
Reaksie is eksotermies / reaksie gee hitte af (1)

5.4 SHORTER / *KORTER* ✓ (1)

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5.5 For Exp. **2**

- Higher concentration results in more particles colliding with correct orientation✓
- The number of effective collision per unit time increases / frequency of the effective collisions increases ✓

Vir Eksp. ***2***

- *Hoër konsentrasie beteken meer deeltjies bots met die korrekte orientasie*
- *Die aantal effektiewe botsings per eenheid tyd neem toe/ frekwensie van die effektiewe botsings neem toe.*

OR / *OF*

For Exp. **1**

- Low concentration results in fewer particles colliding with correct orientation ✓
- The number of effective collision per unit time decreases / frequency of effective collisions decreases ✓

Vir Eksp. ***1***

- *Lae konsentrasie beteken minder deeltjies bots met die korrekte orientasie*
- *Die aantal effektiewe botsings per eenheid tyd neem af / frekwensie van die effektiewe botsings neem af.* (2)

5.6.1 Rate/ *Tempo* = $\frac{\Delta c}{\Delta t}$

$= \frac{250-0 ✓}{5,28-0 ✓}$ Accept / *Aanvaar* $\frac{250}{5,28}$

$= 0,95$✓$(cm^3 \cdot min^{-1})$ (3)

5.6.2 **Marking criteria / Nasienkriteria**

- V_{CO2} remaining / *oorbly* = 150 cm^3
- Substitution into / *Vervanging in* n = V/Vm
- Subst. into / *Vervanging in* n = m/M
- Final answer / *Finale antwoord*

$V(CO_2)$ remaining / *oorbly* = 250 – 100 = 150 cm^3 ✓

n = V/Vm = 150/25 000 ✓

$= 6 \times 10^{-3}$ mol

$n(CO_2)$ = m/M

6×10^{-3} = m / 44 ✓

m = 0,264 g ✓/0,26 g (4)

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5.7.1 **P** ✓ (1)

5.7.2 <u>$C_2H_4O_2$ is a weaker acid</u> ✓(than $HC\ell$) which will result in a <u>LOWER reaction rate</u> ✓ (for Expt. 3) / Lower gradient/Longer reaction time

<u>$C_2H_4O_2$ is 'n swakker suur</u> (as $HC\ell$) wat sal lei na 'n <u>LAER reaksietempo</u> (vir Eksp. 3) / laer gradiënt / langer reaksietyd

OR / *OF*

<u>$HC\ell$ is stronger acid</u> ✓(than $C_2H_4O_2$) which will result in a <u>HIGHER reaction rate</u> ✓ for Expt. 1/ Higher gradient/Shorter reaction time

<u>$HC\ell$ is 'n sterker suur</u> (as $C_2H_4O_2$) wat sal lei na 'n <u>HOËR reaksietempo</u> (vir Eksp. 1) / hoër gradiënt / korter reaksietyd (2)

5.7.3 EQUAL TO ✓
Final amount of CO_2 is the same ✓ (in both experiments)

GELYK AAN
Finale hoeveelheid van CO_2 is gelyk (in beide eksperimente) (2)
[19]

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QUESTION 6 / *VRAAG 6*

6.1.1 Reversible reaction ✓ /Products can be converted back to reactants
Omkeerbare reaksie / Produkte kan na reaktanse omgeskakel word

NOTE: Do not accept "Reaction is at equilibrium"
LET WEL: Moenie "Reaksie is by ewewig" aanvaar nie. (1)

6.1.2 (Chemical) Equilibrium / *(Chemiese) Ewewig* ✓ (1)

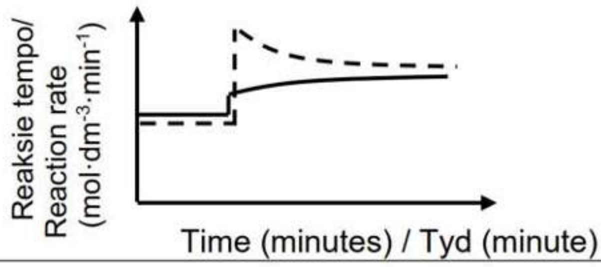
6.1.3 HEATED / *VERHIT* ✓ (1)

6.1.4 ENDOTHERMIC / *ENDOTERMIES* ✓ (1)

6.1.5
- Increase in temperature favoured the forward reaction ✓ / The rate of the forward reaction increased more than the rate of the reverse reaction.
- Increase in temperature favours the endothermic reaction. ✓

- *Toename in temperatuur bevoordeel die voortwaartse reaksie / Die tempo van die voortwaartse reaksie is hoër as die terugwaartse reaksie*
- *'n Toename in temperatuur bevoordeel die endotermiese reaksie* (2)

6.1.6



Marking criteria/ *Nasienkriteria*

- Both rates increase; new equilibrium at a higher rate when P is increased ✓
  Beide tempos neem toe; nuwe ewewig is by 'n hoër tempo wanneer P verhoog

- The increase in reverse reaction is HIGHER than for the forward reaction and eventually there is horizontal section for both ✓
  Die toename in die terugwaartse reaksie is HOËR as die voortwaartse reaksie en daar is horisontale gedeelte by die einde vir beide.

NOTE: *Do not penalise if axes are not labelled.*
LET WEL: *Moenie penaliseer as asse nie benoem is nie.* (2)

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6.2 **MOLE CALCULATIONS / *MOL BEREKENINGE***

a. Correct K_C expression (formula in square brackets) ✓
b. Substitution of equilibrium concentration of CO_2 into K_C expression ✓
c. Determining the $n_{equilibrium}$ CO ✓
d. Determining the n CO $_{reacted}$
e. Correct mol ratio for CO:C ✓
f. Determining the initial mol of C✓
g. Correct substitution into percentage formula ✓
h. Final answer ✓

a. Korrekte K_c-uitdrukking (Formule formule tussen vierkanthakies)
b. Vervanging van ewewigkonsentrasie van CO_2 in K_C – uitdrukking
c. Bepaal die n_{ewewig} CO
d. Bepaal n CO $_{reageer}$
e. Korrekte molverhouding vir CO : C
f. Bepaal die aanvanklike mol van C
g. Korrekte vervanging in persentasie formule
h. Finale antwoord

- No K_c expression, correct substitution / *Geen K_c-uitdrukking, korrekte, korrekte substitusie.* Max. / *Maks. 7/8*
- Wrong K_c expression / *Verkeerde K_c-uitdrukking*. Max. *Maks. 5/8*

$$K_c = \frac{[CO]^2}{[CO_2]} \checkmark \text{ (a)}$$

$$0,05 = \frac{[CO]^2}{0,05 \checkmark} \text{ (b)}$$

$[CO] = 0,05\ mol.dm^{-3}$

	C (s)	CO_2 (g)	2 CO (g)
Initial mol /Aanvangs-hoeveelheid (mol)	0,45 ✓(f)		0
Change/ *Verandering* in mol	0, 05✓(e)		0,1✓ (d)
Equilibrium/ *Ewewig* mol	0,40		0,1✓ (c)
Concentration/ *Konsentrasie* ($mol{\cdot}dm^{-3}$)	-		0,05

% C reacted = $\Delta n/n_{initial}$ x 100

= 0,05/0,45 x 100 ✓ (g)

= 11,11%✓ (h)

(8)
[16]

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QUESTION 7/*VRAAG 7*

7.1.1 An acid is a proton (H^+ -ion) donor ✓✓
'n Suur is 'n proton (H^+ -ioon) skenker (2)

7.1.2 $HC_2O_4^-$ ✓ (1)

7.1.3 Weak acid / *Swaksuur* ✓ (1)

7.1.4 The acid did not fully/completely ionise ✓✓ (in water). **OR** ionised incompletely.
Die suur ioniseer nie volledig (in water) nie ***OF*** *Suur ioniseer onvolledig* (2)

7.2.1 **Marking criteria/*Nasienkriteria***

- n = cV
- Subst. into / *Vervanging in* n = cV
- Final answer / *Finale antwoord*

$n(CH_3COOH) = cV$ ✓
$= 0{,}1 \times 25 \times 10^{-3}$ ✓
$= 2{,}5 \times 10^{-3}$ mol ✓ (3)

7.2.2

Marking criteria/*Nasienkriteria*	**Marking criteria/*Nasienkriteria***
• Formula pH = - log [H_3O^+] ✓ • pH value substituted into formula ✓ • Substitution in K_w formula ✓ • Final answer ✓ • *Formule pH = - log [H_3O^+]* • *pH waarde vervang in formule* • *Vervang in K_W formule* • *Finale antwoord*	• Formula pOH + pH = 14 ✓ • pH value substituted into formula ✓ • Substitution in pOH formula ✓ • Final answer ✓ • *Formule pOH + pH = 14* • *pH waarde vervang in formule* • *Vervang van pOH waarde in formule* • *Finale antwoord*

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OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$pH = -\log[H_3O^+]$ ✓	$pOH + pH = 14$ ✓
12 ✓ $= -\log[H_3O^+]$	$pOH + 12$ ✓ $= 14$
$[H_3O^+] = 1 \times 10^{-12}$ mol·dm^{-3}	$pOH = 2$
$K_w = [OH^-][H_3O^+] = 1 \times 10^{-14}$	$pOH = -\log[OH^-]$
$[OH^-][H_3O^+] = 1 \times 10^{-14}$	$2 = -\log[OH^-]$ ✓
$[OH^-](1 \times 10^{-12}) = 1 \times 10^{-14}$ ✓	$[OH^-] = 0{,}01$ mol·dm^{-3} ✓
$[OH^-] = 0{,}01$ mol·dm^{-3} ✓	

(4)

7.2.3 **Positive marking from / *Positiewe nasien vanaf* 7.2.1 and/ *en* 7.2.2**
Marking criteria / *Nasienkriteria*

- Using ratio Acid : Base 1 : 1
- Subst. of base values into $n_{NaOH\ excess} = cV$
- Addition of n remaining and n initial (NaOH)
- Subst. into c = n/V
- Multiplication of c_{dilute} by 10
- Final answer

- ***Gebruik** verhouding Suu r: Basis = 1 : 1*
- *Vervanging van basis waarde in $n_{NaOH\ oormaat} = cV$*
- *Addisie van n oorbly en n aanvanklik (NaOH)*
- *Vervanging in c = n / V*
- *Vermenigvulding van c_{verdun} met 10*
- *Finale antwoord*

n (NaOH) $_{reacting/\ reageer}$ = $2{,}5 \times 10^{-3}$ mol ✓ ***From/Vanaf* 7.2.1**

n (NaOH) $_{in\ excess/\ oormaat}$ = cV

n (NaOH) $_{excess/\ oormaat}$ = $(0{,}01)(60 \times 10^{-3})$ ✓

n (NaOH) $_{excess/\ oormaat}$ = 6×10^{-4} mol

n (NaOH)$_{total/\ totaal}$ = $2{,}5 \times 10^{-3} + 6 \times 10^{-4}$ ✓

n (NaOH) = $3{,}1 \times 10^{-3}$ mol (6)

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$c_{dilute/verdun} = \frac{n}{V}$

$c_{dilute/verdun} = \frac{3,1 \times 10^{-3}}{35 \times 10^{-3}}$ ✓

$c_{dilute/verdun} = 0,08857 \text{ mol}\cdot \text{dm}^{-3}$

$c_{concentrated\,/\,gekonsentreerd} = 0,08857 \times 10$ ✓
$= 0,8857 \text{ mol}\cdot\text{dm}^{-3}$ ✓/ $0,89 \text{ mol}\cdot \text{dm}^{-3}$

[19]

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QUESTION 8/*VRAAG 8*

8.1 Chemical energy is converted into electrical energy ✓✓
Chemiese energie word na elektriese energie omgeskakel. (2)

8.2.1 $Fe^{2+} \rightarrow Fe^{3+} + e^-$ ✓✓ (2)

Marking criteria / *Nasienkriteria*

- $Fe^{3+} + e^- \leftarrow Fe^{2+}$ 2/2
- $Fe^{2+} \rightleftharpoons Fe^{3+} + e^-$ ½
- $Fe^{3+} + e^- \rightarrow Fe^{2+}$ 0/2
- $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ 0/2

- Ignore if the charge omitted on electron
Ignoreer indien lading op elektron weggelaat is

- If a charge of an ion is omitted
As lading weggelaat is op 'n ioon.
e.g. / *bv.* $Fe^2 \rightarrow Fe^3 + e^-$ Max. / *Maks.* ½

8.2.2 Ag | Ag⁺✓ || ✓ Fe^{3+}, Fe^{2+}✓| Pt ✓ (3)

Marking criteria/*Nasienkriteria*

- Ag | Ag^+ ✓
- Fe^{3+}, Fe^{2+} | Pt ✓
- || ✓

8.2.3 Concentration: 1 $mol \cdot dm^{-3}$ ✓ and temperature: 25 °C ✓ / 298 K
Konsentrasie: 1 $mol \cdot dm^{-3}$ en temperatuur: 25 °C / 298 K (2)

8.3 $E^\theta_{cell} = E^\theta_{cathode/reduction/oxidising\ agent} - E^\theta_{anode/oxidation/reducing\ agent}$ ✓

$E^\theta_{cell} = (0{,}80)$ ✓ $- (0{,}77)$ ✓

$E^\theta_{cell} = 0{,}03$ V ✓

Marking criteria/*Nasienkriteria*

- Any other formula using unconventional abbreviation , e.g.
Enige ander formule wat onkonvensionele afkortings gebruik bv.
- $E^\theta_{cell} = E^\theta_{OA} - E^\theta_{RA}$ followed by the correct substitution./ *gevolg deur korrekte vervangings* ¾

(4)

8.4 Decrease / *Afneem* ✓ (1)

8.5 $C\ell^-$ would form an insoluble salt/precipitate with the Ag^+✓✓ / $AgC\ell$ will precipitate out. The Ag^+ half-cell would no longer be neutral / Circuit would be incomplete / Not enough electrolyte in half cell.

$C\ell^-$ sal 'n neerslag vorm/presipiteer met Ag^+/ $AgC\ell$ vorm 'n neerslag / Die Ag^+halfsel sal nie meer neutraal wees nie / Stroombaan sal onvoltooïed wees / Nie genoeg elektroliet in die halfsel nie. (2)

[16]

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QUESTION 9/*VRAAG 9*

9.1

> **<u>Marking criteria/ Nasienriglyne</u>**
> If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
> *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase*

The chemical process in which <u>electrical energy</u> is converted <u>to chemical energy</u>. ✓✓
Die chemiese proses waarin <u>elektriese energie</u> word na <u>chemiese energie</u> omgeskakel.

OR / *OF*

The use of <u>electrical energy</u> to <u>produce a chemical change</u>. ✓✓
Die gebruik van <u>elektriese energie</u> om <u>chemiese energie te produseer</u> (2)

9.2 ENDOTHERMIC / *ENDOTERMIES* ✓ (1)

9.3 $2\,C\ell^- \rightarrow C\ell_2(g) + 2e^-$ ✓✓ Ignore phases / *Ignoreer fases* (2)

> **<u>Marking criteria / *Nasienkriteria*</u>**
> - $2\,C\ell^- \rightleftharpoons C\ell_2(g) + 2e^-$ ½
> - $C\ell_2(g) + 2e^- \leftarrow 2\,C\ell^-$ 2/2
> - $C\ell_2(g) + 2e^- \rightleftharpoons 2\,C\ell^-$ 0/2
>
> Ignore if the charge omitted on electron /
> *Ignoreer as lading op elektron weggelaat is*

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9.4

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

$$n = \frac{0,369}{63,5} \checkmark$$

$$n = 5,811 \times 10^{-3}$$

$$n(e^-) = 2 \times 5,811 \times 10^{-3} \checkmark$$

$$n(e^-) = 0,01162$$

$$n = \frac{N}{N_A}$$

$$0,01162 = \frac{N}{6,02 \times 10^{23}} \checkmark$$

$$N = 6,9964 \times 10^{21}$$

$$Q = Nq$$

$$Q = 6,9964 \times 10^{21} \times 1,6 \times 10^{-19} \checkmark$$

$$Q = 1\,119,4310 \text{ C}$$

$$I = \frac{Q}{\Delta t} \checkmark$$

$$I = \frac{1\,119,4310}{27 \times 60} \checkmark$$

$$I = 0,69 \text{ A} \checkmark$$

Marking criteria/*Nasienkriteria*

- Subst. into n = m/M
- Use of mole ratio Cu : e^-
- Subst. into n = N/N_A
- Subst. into n = Q/q_e
- Formula Q = IΔt
- Subst. into Q = IΔt
- Final answer with unit

- *Vervang in n = m/M*
- *Gebruik van mol-verhouding Cu : e^-*
- *Vervang in n = N/N_A*
- *Vervang in n = Q/q_e*
- *Formule Q = IΔt*
- *Vervang in Q= IΔt*
- *Finale antwoord met eenheid*

(7)
[12]

TOTAL/*TOTAAL*: 150

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