Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2022

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKS: 150

TIME: 3 hours

This question paper consists of 21 pages, including 4 data sheets.

INSTRUCTIONS AND INFORMATION

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

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

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

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

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

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. Show ALL formulae and substitutions in ALL calculations.

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

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

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

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 The name of the functional group of propanoic acid is ...

A formyl.

B carboxyl.

C carbonyl.

D hydroxyl. (2)

1.2 Which ONE of the following is the CORRECT name for the addition reaction of water to an alkene?

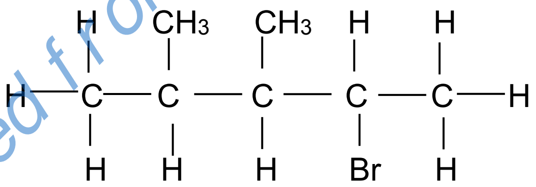
A hydration

B hydrolysis

C dehydration

D hydrohalogenation (2)

1.3 Consider the compound shown below:



The CORRECT IUPAC name of the above compound is:

A 4-bromo-2,3-dimethylpentane

B 2-bromo-3,4-dimethylpentane

C 2,3-dimethyl-4-bromopentane

D 3,4-dimethyl-2-bromopentane (2)

1.4 Which ONE of the following organic molecules will react rapidly with bromine water?

A CH_3CH_2OH

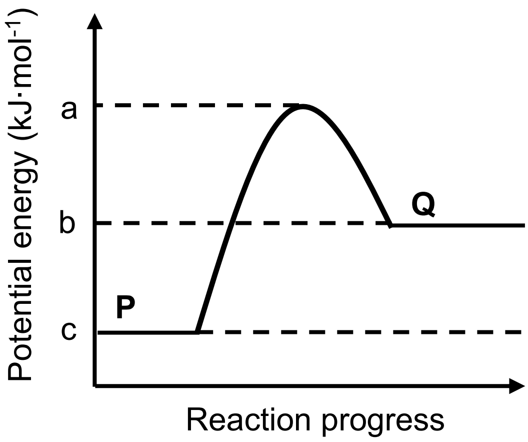
B CH_3CH_3

C CH_2CH_2

D $CH_3CH_2CH_3$ (2)

1.5 Consider the potential energy profile below for the following hypothetical reaction:

$$P \rightleftharpoons Q$$



Which ONE of the following combinations correctly indicates both the activation energy and the heat of reaction (ΔH) for the REVERSE REACTION?

	Activation energy (kJ·mol^{-1})	Heat of reaction (ΔH)
A	**a – b**	**b – c**
B	**b – a**	**a – c**
C	**a – b**	**c – b**
D	**b – c**	**a – b**

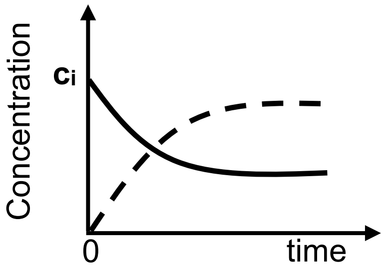
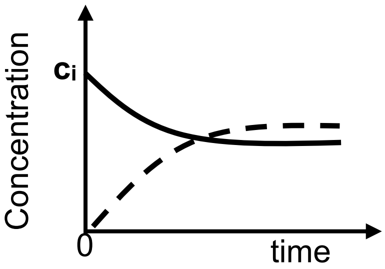
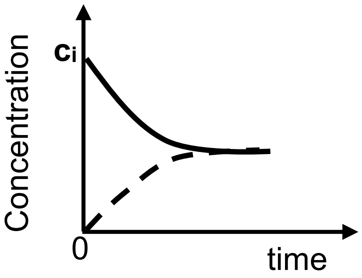
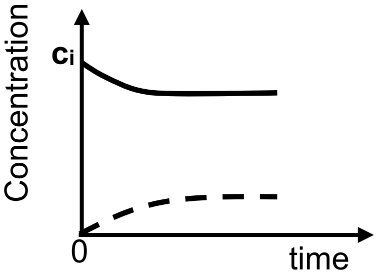
(2)

1.6 H_2S (g) decomposes according to the following balanced equation:

$$H_2S\ (g) \rightleftharpoons H_2\ (g) + S\ (s)$$

In each of four separate experiments, **A** to **D**, H_2S of initial concentration $\mathbf{c_i}$ is placed in identical empty flasks which are then sealed and heated. The graphs below display the results of the experiments **A** to **D**.

Which experiment has the largest K_c value?

A		B	
C		D	

(2)

1.7 The reaction below represents the general equation for the reaction of an acid-base indicator.

$$\underset{\text{yellow}}{HIn\ (aq)} + H_2O\ (\ell) \rightleftharpoons H_3O^+\ (aq) + \underset{\text{blue}}{In^-\ (aq)}$$

In which ONE of the following salt solutions will this indicator turn yellow?

A $KC\ell(aq)$

B $NH_4C\ell(aq)$

C $NaHCO_3(aq)$

D $CH_3COONa(aq)$ (2)

1.8 The function of a salt bridge in a galvanic cell is to …

A allow for the movements of protons.

B allow for the movements of electrons.

C provide a site for reduction to occur.

D ensure electrical neutrality of solutions. (2)

1.9 Which ONE the substances can act as an ampholyte in some reactions?

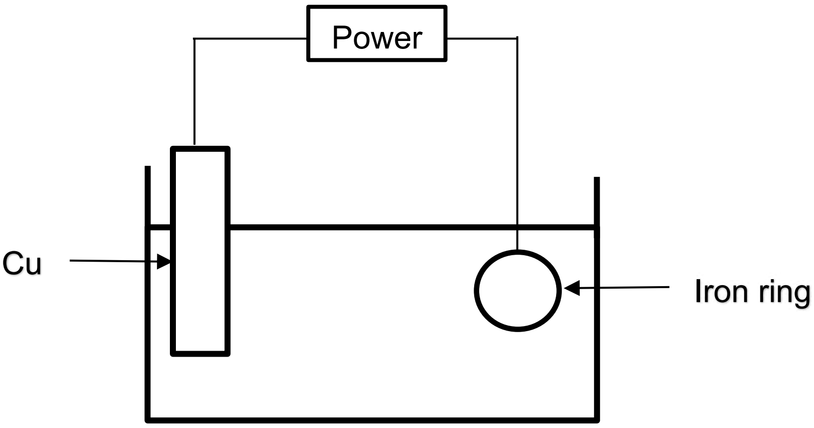
A CH_3COO^-

B HSO_4^-

C H_3O^+

D NH_4^+ (2)

1.10 The electrolytic cell below is used during the electroplating of an iron ring with copper.



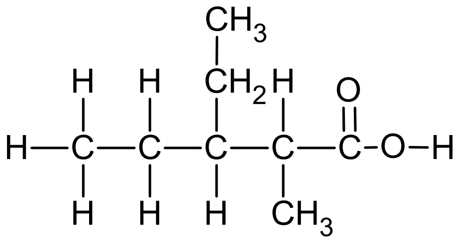
Which ONE of the following combinations is CORRECT about the ions in the electrolyte when the cell is operating?

Concentration		Positive ions
A	Remain constant	Cu^{2+}
B	Remain constant	Fe^{2+}
C	Increases	Fe^{3+}
D	Increases	Cu^{2+}

(2)
[20]

QUESTION 2 (Start on a new page.)

The letters **A** to **D** in the table below represent four organic compounds that belong to different homologous series.

A 2-methylpropanal	**B** 
C $CH_3C \equiv CCH_2CH_3$	**D** Pentane

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

2.2 Write down the:

2.2.1 Letter that represents a saturated hydrocarbon (1)

2.2.2 General formula of the homologous series to which compound **C** belongs (1)

2.2.3 Structural formula of compound **A** (2)

2.3 Write down the IUPAC name of compound **B**. (3)

2.4 Compound **D** has three structural isomers.

Write down the:

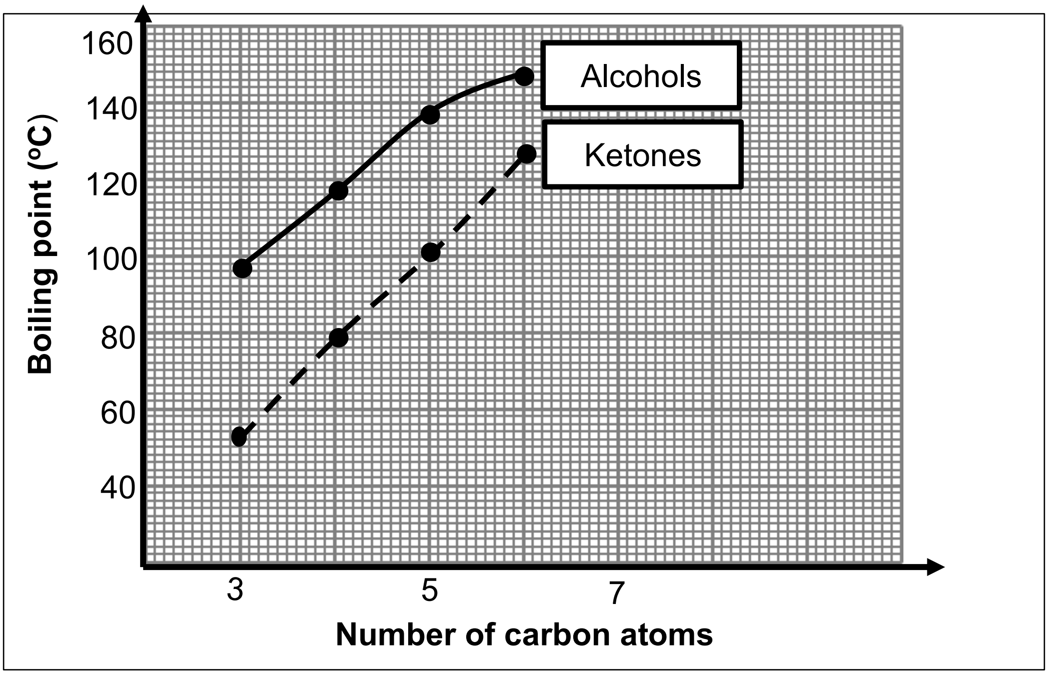
2.4.1 Structural formula of the isomer with the shortest chain (3)

2.4.2 Balanced equation for the combustion reaction of compound **D** in EXCESS oxygen using molecular formulae (3)

[15]

QUESTION 3 (Start on a new page.)

3.1 The graphs below show the boiling points of straight chain primary alcohols and straight chain ketones with different number of carbon atoms.



3.1.1 Define the term *boiling point.* (2)

3.1.2 Explain why the boiling points of alcohols increase as the number of carbon atoms increase by referring to TYPE and STRENGTH of intermolecular forces only. (2)

3.1.3 Explain why the curve of the alcohols is higher than that of the ketones.

Refer to the TYPE and STRENGTH of intermolecular forces involved. (3)

The vapour pressure of the alcohol is compared to that of a ketone at the same temperature.

3.1.4 Why must the alcohol and ketone which are used for the comparison have the same number of carbon atoms? (1)

3.1.5 Which ONE will have a higher vapour pressure: ALCOHOL or KETONE?

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

3.2 The boiling points of propanoic acid and propan-1-ol are compared.

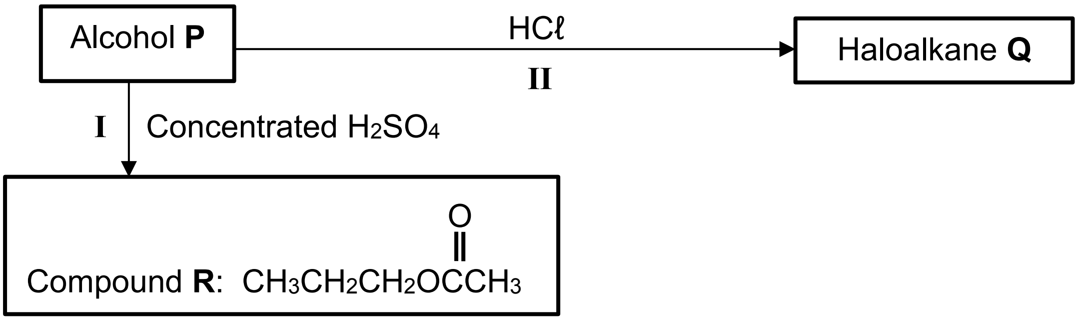
3.2.1 Which compound has the higher boiling point? (1)

3.2.2 Explain the answer to QUESTION 3.2.1 by referring to TYPE, STRENGTH of intermolecular forces and ENERGY. (3)

[14]

QUESTION 4 (Start on a new page.)

4.1 Compound **P** can be used to prepare organic compounds **R** and **Q** as shown in the flow diagram below.



In reaction **I**, alcohol **P** reacts with another organic compound in the presence of concentrated sulphuric acid.

4.1.1 Name the type of reaction represented by **I**. (1)

4.1.2 Besides the presence of a catalyst write down another reaction condition for reaction **I.** (1)

Write down the:

4.1.3 Structural formula of alcohol **P** (2)

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

4.1.5 IUPAC name of a straight chain FUNCTIONAL isomer of compound **R** (2)

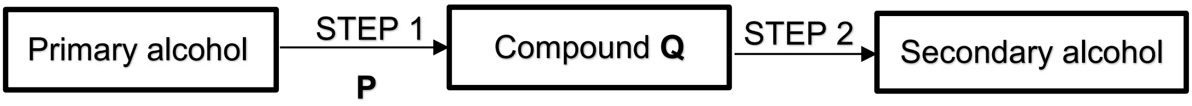
For reaction **II** write down the:

4.1.6 Type of reaction taking place (1)

4.1.7 Formula of the inorganic product (1)

4.1.8 Condensed structural formula of compound **Q** (2)

4.2 A primary alcohol that contains 3 carbon atoms is converted to a secondary alcohol in a TWO step process as shown in the flow diagram below:



P is an inorganic reagent while compound **Q** is an organic compound.

Write down the:

4.2.1 Formula of reagent **P** (2)

4.2.2 One reaction condition for the reaction in STEP 2 (1)

4.2.3 A balanced equation for the reaction in STEP 2 by using structural formulae for the organic compounds. (5)

[20]

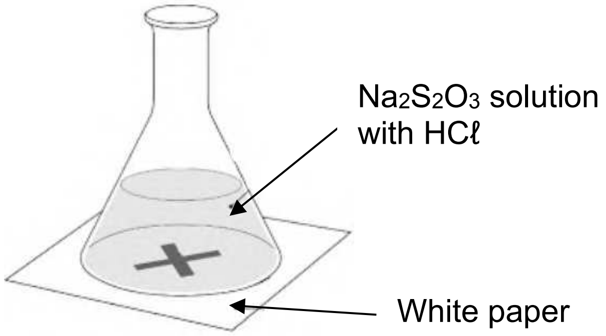
QUESTION 5 (Start on a new page.)

The reaction between sodium thiosulphate ($Na_2S_2O_3$) and EXCESS hydrochloric acid ($HC\ell$) is used to investigate the effect of concentration and temperature on the rate of reaction.

The balanced equation for this reaction is:

$$Na_2S_2O_3\ (aq) + 2\ HC\ell \rightarrow 2\ NaC\ell\ (aq) + S\ (s) + SO_2\ (g) + H_2O\ (\ell)$$

An Erlenmeyer flask is placed on a white paper marked with a light cross on it. The time taken for the visibility of the cross (X) to disappear is measured. See the diagram below.



NOTE: The same volume of $Na_2S_2O_3$ solution was used for all three reactions.

The table below shows the reaction conditions.

Exp	**Concentration of $Na_2S_2O_3$**	**Concentration of $HC\ell$ ($mol \cdot dm^{-3}$)**	**Temperature (˚C)**	**Volume of $HC\ell$ (cm^3)**
1	0,05	2	25	25
2	0,05	1	25	25
3	0,05	2	40	25

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

5.2 Write down the name of the independent variable for the comparison of experiment **1** and **2**. (1)

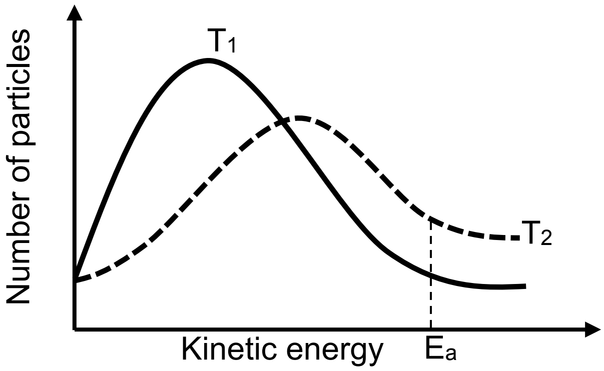
5.3 How will the amount of sulphur (S) formed in experiment **1** compare to the amount of sulphur (S) produced in experiment **2** at the completion of the reaction?

Choose from HIGHER THAN, LOWER THAN or EQUAL TO.

Give a reason for the answer. (2)

5.4 Experiments **1** and **3** are now compared.

The Maxwell-Boltzmann energy distribution curves for Experiments **1** and **3** are shown below.



5.4.1 Which experiment **1** or **3** is represented by curve **T_2**? (1)

5.4.2 Explain the answer to QUESTION 5.4.1 by referring to the collision theory. (3)

5.4.3 Sketch the curve of **T_2** ONLY in the answer book and indicate the effect that a catalyst would have on E_a.

Indicate the new activation energy as **X** on the graph. (2)

5.5 0,7118 g of $Na_2S_2O_3$ reacted completely with HCℓ in **experiment 1** in 34 s.

Calculate the rate at which HCℓ reacted in **experiment 1** in $mol{\cdot}s^{-1}$. (5)

The volume of HCℓ used in **experiment 1** is now **doubled**. All other reaction conditions remain the same.

5.6 How would the reaction rate be affected by the change in volume?

Choose from INCREASES, DECREASES or REMAIN THE SAME. (1)

[17]

QUESTION 6 (Start on a new page.)

6.1 The following reversible reaction can be used to demonstrate how certain factors influence chemical equilibrium:

$$\underset{\text{Blue}}{CoC\ell_4^{2-}\,(aq)} + 6\,H_2O\,(\ell) \rightleftharpoons \underset{\text{Pink}}{Co(H_2O)_6^{2+}\,(aq)} + 4\,C\ell^-\,(aq)$$

6.1.1 Define the term *reversible reaction.* (2)

Initially, the solution is **BLUE**.

Write down either TURNS MORE BLUE or TURNS MORE PINK to describe what happens to the reaction mixture if some:

6.1.2 $CoC\ell_4^{2-}$ is added (1)

6.1.3 Concentrated $HC\ell$ is added (1)

The test tube containing the reaction mixture is placed in a hot water bath. It is observed that the solution becomes more blue.

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

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

6.2 $3{,}01 \times 10^{23}$ molecules of N_2O_4 are sealed into a 4 dm^3 container and then heated to 400 K.

The following balanced equation represents the reaction that reaches equilibrium in the container at 400 K.

$$N_2O_4\,(g) \rightleftharpoons 2\,NO_2\,(g)$$

At equilibrium, it is found that 0,4 mol of N_2O_4 have decomposed to NO_2

Calculate the equilibrium constant (K_c) at 400 K. (8)

[15]

QUESTION 7 (Start on a new page.)

7.1 The equations below show the reactions occurring in hydrochloric acid ($HC\ell$) and ethanoic acid (CH_3COOH) solutions. Both acids have a concentration of 1 mol·dm^{-3}, and are kept at a temperature of 25° C.

I: $HC\ell\,(aq) + H_2O\,(\ell) \rightleftharpoons C\ell^-\,(aq) + H_3O^+\,(aq)$ $K_a = 1{,}3 \times 10^6$

II: $CH_3COOH\,(aq) + H_2O\,(\ell) \rightleftharpoons CH_3COO^-\,(aq) + H_3O^+\,(aq)$ $K_a = 1{,}8 \times 10^{-5}$

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

7.1.2 Write down ONE conjugate acid pair-base pair in reaction **I**. (2)

7.1.3 Which solution, **I** or **II**, will have the lower pH value?

Explain the answer. (3)

7.2 10 cm^3 of a 1 mol·dm^{-3} sodium hydroxide (NaOH) solution is diluted with water until its pH is 13.

7.2.1 Calculate the number of moles of NaOH in the 10 cm^3 of the initial solution. (3)

7.2.2 Calculate the volume of the diluted solution in dm^3. (5)

All of the diluted sodium hydroxide solution is poured into a burette. During a titration, 15 cm^3 of oxalic acid of concentration 0,09 mol·dm^{-3} is exactly neutralised by a certain volume of the diluted sodium hydroxide solution.

The balanced equation for the reaction is:

$$2\,NaOH\,(aq) + H_2C_2O_4\,(aq) \rightarrow Na_2C_2O_4\,(aq) + 2\,H_2O\,(\ell)$$

7.2.3 Calculate the volume of the diluted sodium hydroxide that is left in the burette after the titration. (5)

[20]

QUESTION 8 (Start on a new page.)

A galvanic cell is set up under standard conditions using half-cells **A** and **B** shown below.

Half-cell **A**: $Cu(s)/Cu^{2+}(aq)$ Half-cell **B**: $H_2O(\ell)$ /$O_2(g)$/ $H^+(aq)$

8.1 Define *oxidation* in terms of electron transfer. (2)

8.2 Write down the:

8.2.1 Initial concentration of the $H^+(aq)$ solution in half-cell **B** (1)

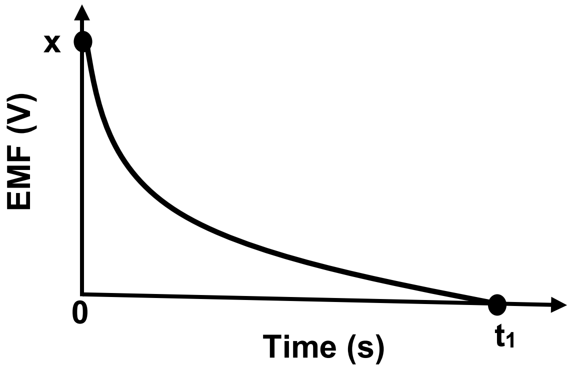
8.2.2 Name of the metal used as the electrode in half-cell **B** (1)

8.2.3 Formula of the reducing agent (1)

8.2.4 Reduction half reaction (2)

8.2.5 Balanced ionic equation for the overall cell reaction (3)

8.3 The graph below shows the EMF of this cell against time.



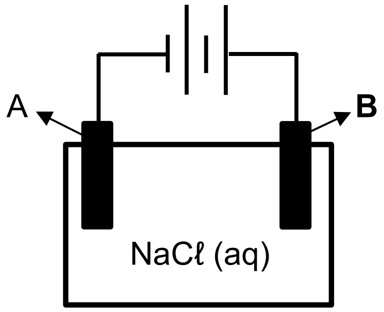
8.3.1 Calculate the value of **x** on the graph. (4)

8.3.2 Explain the decrease in the EMF of the cell as time proceeds. (2)

8.3.3 What has happened to the reaction in the cell at time **t_1**? (1)
[17]

QUESTION 9 (Start on a new page.)

9.1 The diagram represents the apparatus used in the electrolysis of a concentrated NaCℓ solution. **A** and **B** are two carbon electrodes.



9.1.1 Define an *electrolytic cell.* (2)

9.1.2 Write down the half reaction that occurs at electrode **B**. (2)

Gas bubbles are observed at the cathode of the cell.

9.1.3 Write down the NAME or FORMULA of the gas formed at the cathode. (1)

9.1.4 Refer to the relative strengths of the oxidising agents to explain why the gas in QUESTION 9.1.3 and not Na, is formed at the cathode. (2)

9.2 An electrolytic cell is using an impure copper electrode consisting of 95% Cu and a pure copper electrode. Copper (II) chloride ($CuCℓ_2$) solution is used as the electrolyte.

9.2.1 Is the pure copper the ANODE or CATHODE? (1)

9.2.2 When all the copper in the impure copper electrode has been deposited on the copper electrode, it is found that 6 mol of electrons were transferred.

Calculate the initial mass of the IMPURE copper electrode. (4)

[12]

TOTAL: 150

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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 $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	pH= $-\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1x10^{-14}$ at /by 298K
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$		

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

KEY/ *SLEUTEL*

Atoomgetal
Atomic number
→ 29

Elektronegatiwiteit
Electronegativity → 1,9

Cu ← *Simbool*
Symbol

63,5 ← *Benaderde relatiewe atoommassa*
Approximate relative atomic mass

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2.0 B 11	6 2.5 C 12	7 3.0 N 14	8 3.5 O 16	9 4.0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1.5 Aℓ 27	14 1.8 Si 28	15 2.1 P 31	16 2.5 S 32	17 3.0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1.6 V 51	24 1,6 Cr 52	25 1.5 Mn 55	26 1.8 Fe 56	27 1.8 Co 59	28 1.8 Ni 59	29 1.9 Cu 63,5	30 1.6 Zn 65	31 1.6 Ga 70	32 1.8 Ge 73	33 2.0 As 75	34 2.4 Se 79	35 2.8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1.9 Tc	44 2.2 Ru 101	45 2.2 Rh 103	46 2.2 Pd 106	47 1.9 Ag 108	48 1.7 Cd 112	49 1.7 In 115	50 1.8 Sn 119	51 1.9 Sb 122	52 2.1 Te 128	53 2.5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1.8 Tℓ 204	82 1.8 Pb 207	83 1.9 Bi 209	84 2.0 Po	85 2.5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															

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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

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

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

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

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

Province of the
EASTERN CAPE
EDUCATION

CHIEF DIRECTORATE: EXAMINATIONS AND ASSESSMENT
Steve Vukile Tshwete Complex, Zone 6 Zwelitsha, 5608, Private Bag X0032, Bhisho, 5605 REPUBLIC OF SOUTH AFRICA:
Enquiries**: Mrs F. Ntsangani Tel: 040 602 7099 . Fax : 040 602 7295. E-mail:** fezeka.ntsangani@ecdoe.gov.za
Website: www.ecdoe.gov.za

Ref. no.	13/P	Tel.:	(040) 602 7099/082 888 5419
Enquire:	Mrs F. Ntsangani	Fax:	040 602 7295

TO: **DISTRICTS HEADS OF EXAMINATIONS**
PRINCIPALS OF SCHOOLS IN THE FET BAND

FROM: **(A) CES: ASSESSMENT INSTRUMENT DEVELOPMENT AND ITEM BANK MANAGEMENT**
MRS F. NTSANGANI

SUBJECT: **ERRATA – PHYSICAL SCIENCES P2**
GRADE 12 PREPARATORY EXAMS

DATE: **22 SEPTEMBER 2022**

Physical Sciences P2 was written on 19 September 2022. We were made aware of certain errors, amendments and omissions that were discovered during the marking process.

In order to address this and to ensure that the learners are not disadvantaged, the following standardised approach to marking must be adopted across the Province. The following guidelines with regard to marking was prepared in conjunction with the examiner and moderator.

ERRATA: PHYSICAL SCIENCES P2 (MARKING GUIDELINE)

QUESTION	CORRECTION
2.3	Correct answer: 3-ethyl-2-methyl pentanoic acid√√√
3.2.1 and 3.2.2	No NEGATIVE Marking
3.2.2	Correction • Both have hydrogen bonds√

	• Intermolecular forces are stronger in propanoic acid are stronger√(than in propan-1-ol) • More energy is needed to overcome intermolecular forces in propanoic acid√ (than in propan-1-ol) (Note: Do not penalize for "breaking bonds" in place of overcoming intermolecular forces since these are hydrogen bonds) OR • Both have hydrogen bonds • Intermolecular forces in propan-1-ol are weaker than in propanoic acid • Less energy is needed to overcome intermolecular forces in propan-1-ol (than in propanoic acid)
4.1.5	Afrikaans version should read: Pentanoesuur
4.2.1	Add a second tick on Memo
4.2.3	Remove the extra bond and hydrogen in the organic reactant
5.4.2	**Third bullet** *Accept* Frequency of effective collision increases OR Frequency of effective collisions decreases (in Option 2)
5.4.3	Both **X** and E_a must be on graph for marks to be awarded
6.1.4 and 6.1.5	No NEGATIVE Marking

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

Yours in quality education.

Mrs F. Ntsangani

22 SEPTEMBER 2022
DATE

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2022

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

MARKS/ *PUNTE*: **150**

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

QUESTION/*VRAAG* 1

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

QUESTION/*VRAAG* 2

2.1 It is a series of organic compounds that can be described by the same general formula. ✓✓ **(2 or 0)**

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word. ***(2 of 0)***

OR/*OF*

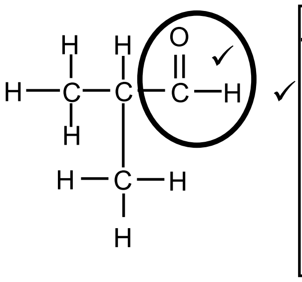
A series/group of organic compounds in which one member differs from the next with -CH_2- group. ✓✓ **(2 or 0)**

'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH_2-groep. (2)

2.2.1 D ✓ (1)

2.2.2 C_nH_{2n-2} ✓ (1)

2.2.3



Marking criteria/ Nasienkriteria

- Only functional group correct / *Slegs funksionele groep korrek*: Max/ *Maks* ½
- *Whole structure correct/ Hele struktuur korrek: 2/2*

(2)

2.3 3-ethyl-2-methylhexanoic acid / *3-etiel-2-metielheksanoësuur*

Marking criteria

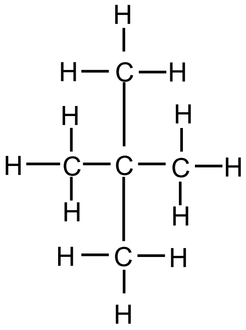
- Correct stem i.e hexanoic acid ✓
- All substituents (ethyl and methyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence and hyphens ✓

Nasienkriteria

- *Korrekte stam d.i heksanoësuur*
- *Alle substituente (etiel en metiel) korrek geïdentifiseer*
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde en koppeltekens*

(3)

2.4.1



Marking criteria/*Nasienkriteria*

- Longest chain contains 3 carbons / *Langste koolstofketting bevat 3 koolstowwe* ✓
- Two methyl substituents on C2 / *Twee metielsubstituente op C2* ✓
- Whole structure is correct / *Hele struktuur korrek* ✓

(3)

2.4.2 $C_5H_{12} + 8\ O_2$ ✓→ $6\ H_2O + 5\ CO_2$ ✓ (bal ✓)

Marking criteria/ *Nasienkriteria*

- Reactants / *Reaktanse*
- Products / *Produkte*
- Balancing / *Balansering*

(3)

[15]

QUESTION/*VRAAG* 3

3.1.1 **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 temperature at which the vapour pressure of a liquid equals the atmospheric pressure. ✓✓

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

3.1.2 As the number of C atoms increases:

- The surface area/chain length/molecular mass of the alcohols increases ✓
- The strength of London forces/induced dipole forces/dispersion forces increase. ✓

Soos die aantal C-atome toeneem:

- *Die oppervlak-area/kettinglengte/molekulêre massa van die alkohole verhoog.*
- *Die sterkte van die Londonkragte/geïnduseerde dipoolkragte/ verspreidingskragte verhoog*

OR/*OF*

As the number of C atoms decreases:

- The surface area/chain length/molecular mass of the alcohols decreases ✓
- The strength of London forces/induced dipole forces/dispersion forces decrease. ✓

Soos die aantal C-atome afneem:

- *Die oppervlak-area/kettinglengte/molekulêre massa van die alkohole verlaag.*
- *Die sterkte van die Londonkragte/geïnduseerde dipoolkragte/ verspreidingskragte verswak*

(2)

3.1.3

Marking criteria

- Identify the intermolecular forces in both compounds. ✓✓
- Compare the strength of the intermolecular forces. ✓

Nasienkriteria

- *Die intermolekulêre kragte korrek geïdentifiseer in beide verbindings*
- *Vergelyk die sterkte van die intermolekulêre kragte*

- Alcohols have both (London forces) and hydrogen bonds ✓
- Ketones have both (London forces) and dipole-dipole forces ✓
- Hydrogen bonds in the alcohols are stronger than the dipole-dipole forces in ketones ✓

- *Alkohole het beide (Londonkragte) en waterstofbindings*
- *Ketone het beide (Londonkragte) en dipool-dipool kragte*
- *Waterstofbindings in die alkohole is sterker as die dipool-dipoolkragte in ketone*

OR/*OF*

- Alcohols have both (London forces) and hydrogen bonds ✓
- Ketones have both (London forces) and dipole-dipole forces ✓
- the dipole-dipole forces in Ketones are weaker than the hydrogen bonds in the alcohols ✓

- *Alkohole het beide (Londonkragte) en waterstofbindings*
- *Ketone het beide (Londonkragte) en dipool-dippol kragte*
- *Die dipool-dipoolkragte in ketone is swakker as die waterstofbindings in die alkohole* (3)

3.1.4 To have one independent variable✓ **OR** To have a fair test
*Om slegs een onafhanklike veranderlike te het **OF** Om ŉ regverdige toets te hê* (1)

3.1.5 Ketone ✓

Lower boiling point / *Laer kookpunt* ✓ (2)

3.2.1 Propanoic acid / *Propanoësuur* ✓ (1)

3.2.2

Marking criteria
- Identify the intermolecular forces correctly in both compounds. ✓
- Compare the strength of the intermolecular forces. ✓
- Compare the energy required to overcome the intermolecular forces. ✓

Nasienkriteria
- *Die intermolekulêre kragte is korrek in beide verbindings geïdentifiseer*
- *Vergelyk die sterkte van die intermolekulêre kragte.*
- *Vergelyk die energie wat benodig word om die intermolekulêre kragte te oorkom.*

- Both have hydrogen bonds
- Propan-1-ol has ONE site for hydrogen bonds
- Propanoic acid has TWO sites for hydrogen bonds } ✓
- The intermolecular forces of propanoic acid are stronger than that of propan-1-ol ✓
- More energy is needed to overcome the intermolecular forces of propanoic acid. ✓

- *Beide het waterstofbindings*
- *Propan-1-ol het EEN plek vir waterstofbindings*
- *Propanoësuur het TWEE plekke vir waterstofbindings*
- *Die intermolekulêrekragte in propanoësuur is sterker as dié in propan-1-ol*
- *Meer energie word benodig om die intermolekulêre kragte te oorkom in propanoësuur*

OR/OF

- Both have hydrogen bonds.
- Propan-1-ol has ONE site for hydrogen bonds
- Propanoic acid has two sites for hydrogen bonds } ✓
- The intermolecular forces of propan-1-ol are weaker than that of propanoic acid ✓
- Less energy is needed to overcome the intermolecular forces of propan-1-ol. ✓

- *Beide het waterstofbindings*
- *Propan-1-ol het EEN plek vir waterstofbindings*
- *Propanoësuur het TWEE plekke vir waterstofbindings*
- *Die intermolekulêrekragte in propan-1-ol is swakker as dié in propanoësuur.*
- *Minder energie word benodig om die intermolekulêre kragte te oorkom in propan-1-ol.*

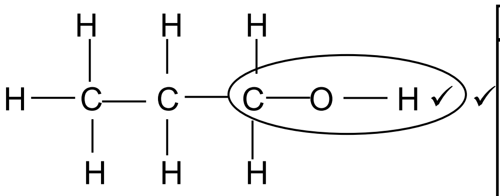
(3)
[14]

QUESTION/*VRAAG* 4

4.1.1 Esterification / condensation / *Esterifikasie / konsensasie*✓ (1)

4.1.2 (Mild) heat / *(Matige) hitte* ✓ (1)

4.1.3



Marking criteria/ Nasienkriteria

- Only functional group correct *Slegs funksionele groep korrek*: Max/*Maks* ½
- *Whole structure correct/ Hele struktuur korrek: 2/2*

(2)

4.1.4 Propyl ✓ethanoate ✓ / *Propiel etanoaat* (2)

4.1.5 Pentanoic acid / *Propanoësuur* ✓✓ (2)

4.1.6 Substitution reaction / *Substitusie-reaksie* ✓ (1)

4.1.7 H_2O ✓ (1)

4.1.8 $CH_3CH_2CH_2Cℓ$ ✓✓

Marking criteria/ Nasienkriteria

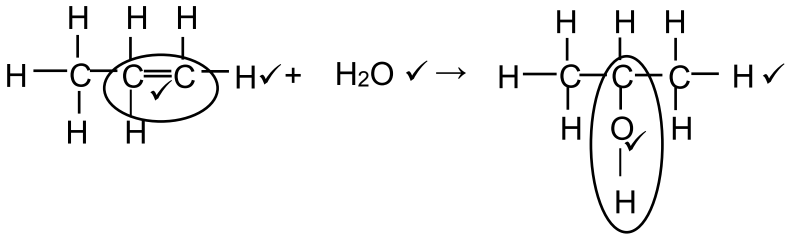
- Only functional group correct / *Slegs funksionele groep korrek*: Max/*Maks* ½
- *Whole structure correct / Hele struktuur korrek: 2/2*

(2)

4.2.1 (Concentrated / *Gekonsentreerde*) H_2SO_4 ✓ (2)

4.2.2 <u>H_2O in excess</u> ✓ / catalyst/ (Add small amount of $HCℓ/H_3PO_4$) (1)

4.2.3



Marking criteria/ Nasienkriteria
(Organic molecules / _Organiese molekules_)

- Only functional group correct / *Slegs funksionele groep korrek*: Max/*Maks* ½
- *Whole structure correct/ Hele struktuur korrek: 2/2*

(5)
[20]

QUESTION/*VRAAG* 5

5.1

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

ANY ONE

- Change in concentration ✓of reactant / product per (unit) time.✓
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
- Amount/number of moles/volume/mass of products formed/reactants used reactants per (unit) time.

ENIGE EEN

- *Verandering in konsentrasie van reaktanse/produkte per (eenheid) tyd*
- *Verandering in hoeveelheid/getal mol/volume/massa van reaktanse of produkte per (eenheid) tyd.*
- *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 Concentration / *Konsentrasie* (of/*van* HCℓ) ✓ (1)

5.3 Equal to / *Gelyk aan* ✓

The same amount of (the limiting reagent), $Na_2S_2O_3$, is used. ✓
Dieselfde hoeveelheid (van beperkde reagens) $Na_2S_2O_3$ *was gebruik.* (2)

5.4.1 Experiment 3 / *Eksperiment 3* ✓ (1)

5.4.2 For T_2

- Higher temperature increases kinetic energy of particles ✓
- Greater number of particles have sufficient energy. ✓
- More effective collision per unit time ✓

Vir T_2

- *Hoër temperatuur verhoog die kinetiese energie van die deeltjies*
- *Groter aantal deeltjies het genoeg energie*
- *Meer effektiewe botsings per eenheidstyd*

OR/*OF*

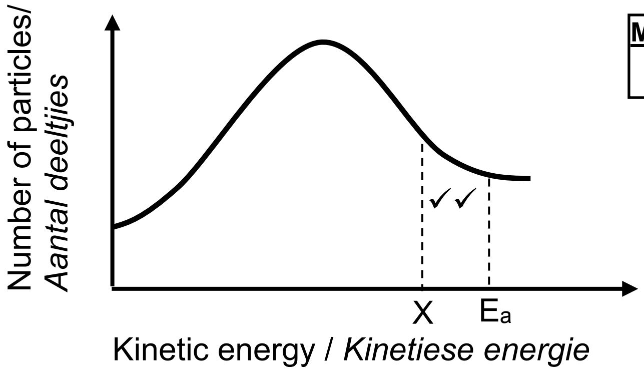
For T_1

- Lower temperature decreases kinetic energy of particles
- Fewer particles have sufficient energy.
- Less effective collision per unit time

Vir T_1

- *Laer temperatuur verlaag die kinetiese energie van die deeltjies*
- *Minder aantal deeltjies het genoeg energie*
- *Minder effektiewe botsings per eenheidstyd* (3)

5.4.3



Marking criteria/*Nasienkriteria*

- $X < E_a$

(2)

5.5

Marking criteria

- Formula n = m/M
- Substitution into n = m/M
- **Using** ratio HCℓ: $Na_2S_2O_3$ 2 : 1
- Substitution into rate equation
- Final answer

Nasienkriteria

- *Formule* n = m/M
- *Vervanging in* n = m/M
- ***Gebruik** van verhouding* HCℓ: $Na_2S_2O_3$ 2 : 1
- *Vervanging in tempo vergelyking*
- *Finale antwoord*

$n = \frac{m}{M}$ ✓

$n = \frac{0,7118}{158}$ ✓

n ($Na_2S_2O_3$) = 4,505 x 10^{-3} mol

n (HCℓ) = 2 (4,505 x 10^{-3}) ✓

n (HCℓ) = 9,01 x 10^{-3} mol

rate/ *tempo* = $-\frac{\Delta n}{\Delta t}$

rate/ *tempo* = $-\frac{0 - 9,01 \times 10^{-3}}{34}$ ✓

rate/ *tempo* = 2,65 x 10^{-4} (mol·s^{-1}) ✓

Accept / *Aanvaar*

rate/ *tempo* = $\frac{\Delta n}{\Delta t}$

rate/*tempo* = $\frac{-9,01 \times 10^{-3}}{34}$ ✓

rate / *tempo* = - 2,65 x 10^{-4} (mol·s^{-1}) ✓

(5)

5.6 REMAINS THE SAME / *BLY DIESELFDE* ✓ (1)

[17]

QUESTION/*VRAAG* 6

6.1.1 (A reaction in which) products can be converted back to its reactants ✓✓ (and vice versa)

(Is 'n reaksie waar) produkte terug na reaktanse, en omgekeerd, omgeskakel kan word. **(2 or/ *of* 0)** (2)

6.1.2 Turns more pink / *Raak meer pienk* ✓ (1)

6.1.3 Turns more blue / *Raak meer blou* ✓ (1)

6.1.4 Exothermic / *Eksotermies* ✓ (1)

6.1.5

- Increase in temperature shifted the equilibrium position left ✓/Reverse reaction is favoured
- Increase in temperature favours the endothermic reaction ✓

- *Toename in temperatuur verskuif die ewewigsposisie na links/ Terugwaartse reaksie word bevoordeel.*
- *Toename in temperatuur bevoordeel 'n endotermiese reaksie.* (2)

6.2

OPTION 1: MOLE CALCULATIONS
OPSIE 1: MOL BEREKENINGE

Marking criteria:

a. Substitution into formula $n = \frac{N}{N_A}$ ✓
b. Using ratio $N_2O_4 : NO_2 = 1 : 2$ ✓
c. $n(NO_2)$ equilibrium = $n_{\text{initial}} + \Delta n$ ✓
d. $n(N_2O_4)$ equilibrium = n initial - Δn ✓
e. Divide **equilibrium** amounts of N_2O_4 and NO_2 by 4 dm^3 ✓
f. Correct K_C expression (formulae in square brackets) ✓
g. Substitution into equilibrium concentration into K_C expression ✓
h. Final answer ✓

Nasienkriteria:

a. *Vervanging in formule* $n = \frac{N}{N_A}$
b. ***Gebruik** verhouding* $N_2O_4 : NO_2 = 1 : 2$ ✓
c. $n(NO_2)$ ewewig = $n_{\text{initial}} + \Delta n$ ✓
*d. Deel **ewewig**hoeveelhede van* N_2O_4 *en* NO_2 *deur 4* dm^3
e. Korrekte K_c*-uitdrukking (formules met vierkanthakies)*
f. Vervanging in ewewigskonsentrasies in K_c*-uitdrukking*
g. *Finale antwoord*

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

$n = \frac{3{,}01 \times 10^{23}}{6{,}02 \times 10^{23}}$ ✓ (a)

n = 0,5 mol

	N_2O_4 (g)	2 NO_2 (g)	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,5	-	
Change (mol) *Verandering (mol)*	0,4	0,8	✓ (b) ratio
Equilibrium (mol) *Ewewig (mol)*	0,1 ✓ (d)	0,8	✓ (c)
Concentration ($mol \cdot dm^{-3}$) *Konsentrasie* ($mol \cdot dm^{-3}$)	0,025	0,2	✓ (e)

$K_c = \dfrac{[NO_2]^2}{[N_2O_4]}$ ✓ (f)	No K_c expression, correct substitution / *Geen K_c-uitdrukking, korrekte, korrekte substitusie.* Max / *Maks 7/8*
$K_c = \dfrac{(0,2)^2}{(0,025)}$ ✓ (g)	Wrong K_c expression/*Verkeerde K_c – uitdrukking.* Max. *Maks. 5/8*
K_c = 1,6 ✓ (h)	

OPTION 2: CONCENTRATION CALCULATIONS/ *OPSIE 2:* KONSENTRASIEBEREKENINGE

Marking criteria

a. Substitution into formula $n = \frac{N}{N_A}$ ✓
b. Using ratio N_2O_4: NO_2 = 1 : 2 ✓
c. $c(NO_2)$ equilibrium = c $_{\text{initial}}$ + Δc ✓
d. $c(N_2O_4)$ equilibrium = c initial – Δc ✓
e. Divide n initial and Δn of N_2O_4 by 4 dm^3 ✓
f. Correct K_C expression (formulae in square brackets) ✓
g. Substitution into equilibrium concentration into K_C expression ✓
h. Final answer ✓

Nasienkriteria:

a. *Vervanging in formule* $n = \frac{N}{N_A}$
b. ***Gebruik*** *verhouding N_2O_4 : NO_2 1 : 2*
c. Ewewig $c(NO_2)$ = *begin c* + Δc
d. Ewewig c (N_2O_4) = begin c – Δc ✓(b)
e. Deel ***aanvangs en verandering*** *hoeveelhede van N_2O_4 en NO_2 deur 4 dm^3* ✓ (e)
f. Korrekte K_c-uitdrukking (formules met vierkanthakies)
g. Vervanging in ewewigskonsentrasies in K_c-uitdrukking
h. Finale antwoord

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

$n = \frac{3{,}01 \times 10^{23}}{6{,}02 \times 10^{23}}$ ✓ (a)

$n = 0{,}5$ mol

	N_2O_4 (g)	2 NO_2 (g)
Initial concentration ($mol \cdot dm^{-3}$) *Aanvangs konsentrasie ($mol \cdot dm^{-3}$)*	0,125	-
Change in concentration ($mol \cdot dm^{-3}$) *Verandering in konsentrasie ($mol \cdot dm^{-3}$)*	0,1	0,2
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewig konsentrasie ($mol \cdot dm^{-3}$)*	0,025✓ (c)	0,2

✓ (d)

$K_c = \frac{[NO_2]^2}{[N_2O_4]}$ ✓ (f)

$K_c = \frac{(0{,}2)^2}{(0{,}025)}$ ✓ (g)

$K_c = 1{,}6$ ✓ (h) (8)

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

[15]

QUESTION/*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 HCℓ and/*en* $Cℓ^-$ ✓✓ **OR/*OF*** H_3O^+ and/*en* H_2O ✓✓ (2)

7.1.3 Solution **I.** ✓

- HCℓ is a stronger acid than CH_3COOH / HCℓ has a higher K_a ✓ (than CH_3COOH)
- HCℓ will produce a higher concentration of H_3O^+ ✓ (than CH_3COOH)

OR

- CH_3COOH is a weaker acid than HCℓ / CH_3COOH has a lower K_a (than HCℓ)
- CH_3COOH will produce a lower concentration of H_3O^+ (than HCℓ)

*Oplossing **I.***

- *HCℓ is 'n sterker suur as CH_3COOH / HCℓ het 'n hoër K_a-waarde as CH_3COOH*
- *HCℓ sal 'n hoër konsentrasie van H_3O^+ produseer as CH_3COOH*

OF

- *CH_3COOH is 'n swakker suur as HCℓ / CH_3COOH het 'n laer K_a-waarde as HCℓ*
- *CH_3COOH sal 'n laer konsentrasie H_3O^+ produseer as HCℓ* (3)

7.2.1

n = cV ✓

= 1 x10 / 1 000 ✓

= 0,01 mol ✓

(3)

7.2.2

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

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
pH = - log $[H_3O^+]$ ✓ 13 ✓ = - log $[H_3O^+]$ $[H_3O^+] = 1 \times 10^{-13}$ mol·dm^{-3} $K_w = [OH^-][H_3O^+] = 1 \times 10^{-14}$ $[OH^-][H_3O^+] = 1 \times 10^{-14}$ $[OH^-](1 \times 10^{-13}) = 1 \times 10^{-14}$ ✓ $[OH^-]$ = 0,1 mol·dm^{-3} [NaOH] = 0,1 mol·dm^{-3}	pOH + pH = 14 ✓ pOH + 13 ✓ = 14 pOH = 1 pOH = - log $[OH^-]$ 1 = - log $[OH^-]$ ✓ $[OH^-]$ = 0,1 mol·dm^{-3} [NaOH] = 0,1 mol·dm^{-3}
$c = \frac{n}{V}$ **OR/*OF*** $0{,}1 = \frac{0{,}01}{V}$ ✓ From 7.2.1 *Vanaf 7.2.1* V = 0,1 (dm^3)✓	$c_1V_1 = c_2V_2$ $\underline{(1)(10) = (0{,}1)V_2}$ ✓ V_2 = 100 cm^3 V = 0,1 (dm^3) ✓

(5)

7.2.3

Marking criteria	**Marking criteria /**
- Formula n = cV✓ - Substitution of acid values into n = cV **AND** **Using** ratio Acid : Base = 1 : 2 ✓ - Substitution of V and c into n = cV for V base reacting ✓ - Subtracting $V_{remaining} = V_{initial} - V_{reacting}$ ✓ - Final answer ✓ ***Nasienkriteria*** - *Formule n = cV* - *Vervanging van suur waardes in formule n = cV* ***EN*** ***Gebruik** verhouding Suur : Basis = 1 : 2* - *Vervanging van V en c in n = cV vir V basis wat reageer* - *Aftrekking* $V_{oorbly} = V_{aanvangs} - V_{reageer}$ - *Finale antwoord*	- Formula $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓ - Substitution LHS $\frac{c_aV_a}{c_bV_b}$ ✓ - Substitution RHS $\frac{n_a}{n_b}$ ✓ - Subtracting $V_{remaining} = V_{initial} - V_{reacting}$ ✓ - Final answer ✓ ***Nasienkriteria*** - *Formule* $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ - *Vervang LK* $\frac{c_aV_a}{c_bV_b}$ - *Vervang RK* $\frac{n_a}{n_b}$ - *Aftrekking* $V_{oorbly} = V_{aanvangs} - V_{reageer}$ - *Finale antwoord*
OPTION 1/*OPSIE 1*	**OPTION 2/OPSIE 2**
n acid reacting = cV✓ = 0,09 x 15/1 000 = $1,35 \times 10^{-3}$ mol n base reacting= 2 x $1,35 \times 10^{-3}$ mol ✓ = $2,7 \times 10^{-3}$ mol n = cV $2,7 \times 10^{-3} = 0,1\ V_{\text{base reacting /basis reageer}}$ ✓ $0,027\ dm^3 = V_{\text{base reacting/ basis reageer}}$	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓ $\frac{(0,09)(15)}{(0,1)V_b}$ ✓ $= \frac{1}{2}$ ✓ $V_b = 27\ cm^3$ $V_b = 0,027\ dm^3$

$V_{remaining/oorbly} = 0,1 - 0,027$ ✓
$= 0,073\ dm^3$ ✓

(5)
[20]

QUESTION/*VRAAG* 8

8.1 Loss of electrons / *Verlies aan elektrone* ✓✓ **(2 or/*of* 0)** (2)

8.2.1 1 $mol\cdot dm^{-3}$ ✓ (1)

8.2.2 Platinum ✓ (1)

8.2.3 Cu ✓ (1)

8.2.4 $O_2 + 4H^+ + 4e^- \rightarrow 2\ H_2O$ ✓✓

Marking criteria / *Nasienkriteria*

- $O_2 + 4H^+ + 4e^- \rightleftharpoons 2\ H_2O$ ½
- $2\ H_2O \leftarrow O_2 + 4H^+ + 4e^-$ 2/2
- $2\ H_2O \rightleftharpoons O_2 + 4H^+ + 4e^-$ 0/2
- $2\ H_2O \rightarrow O_2 + 4H^+ + 4e^-$ 0/2

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

(2)

8.2.5 $2\ Cu + O_2 + 4\ H^+$ ✓ $\rightarrow 2\ Cu^{2+} + 2\ H_2O$ ✓ (✓ bal)

Marking criteria/*Nasienkriteria*

- Reactants/ *Reaktanse*
- Products / *Produkte*
- Balancing / *Balansering*

(3)

8.3.1 $E^{\theta}_{cell} = E^{\theta}_{cathode/reduction/oxidising\ agent} - E^{\theta}_{anode/oxidation/reducing\ agent}$ ✓

$E^{\theta}_{cell} = (1,23)$ ✓ $- (0,34)$ ✓

$E^{\theta}_{cell} = 0,89\ V$ ✓

Notes/*Aantekeninge*

- Any other formula using unconventional abbreviation , e.g. $E^o_{cell} = E^o_{OA} - E^o_{RA}$ followed by the correct substitution : ¾
- *Enige ander formule wat onkonvensionele afkortings gebruik bv.*
- $E^o_{sel} = E^o_{OM} - E^o_{RM}$ *gevolg met korrekte vervangings:* ¾

(4)

8.3.2 Concentration of the reactants decreases ✓
Rate of the forward reaction decreases ✓

Konsentrasie van reaktanse verlaag
Tempo van voortwaartse reaksie verlaag (2)

8.3.3 Equilibrium / *Ewewig* ✓ (1)

[17]

QUESTION/*VRAAG* 9

9.1.1

<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

(It is a cell in which) <u>electrical energy</u> ✓ is converted <u>into chemical energy</u> ✓

(Dit is 'n sel waarin) <u>elektriese energie</u> omgeskakel word <u>na chemiese energie.</u> (2)

9.1.2 $2\ C\ell^- \rightarrow C\ell_2(g) + 2e^-$ ✓✓

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 indien lading weggelaat is op elektron*

9.1.3 H_2 / Hydrogen gas / *Waterstofgas* (1)

9.1.4 H_2O is a <u>stronger oxidising agent</u> than Na^+ ✓
H_2O is reduced to H_2 ✓

H_2O is 'n <u>sterker oksideermiddel</u> as Na^+
H_2O word gereduseer na H_2 (2)

9.2.1 Cathode / *Katode* ✓ (1)

9.2.2 $n_{Cu} = ½ \times 6$ ✓
$= 3$ mol

$m_{Cu} = nM = 3 \times 63,5$✓

$= 190,5$ g
$0,95$ ✓$m_{\text{IMPURE sample}} = 190,5$

$m_{\text{IMPURE sample}} = 200,53$ g ✓

<u>Marking criteria</u>

- Use of ratio of electrons to Cu
- Subst. into n = m/M
- Division by 0,95
- Final answer

<u>Nasienkriteria</u>

- *Gebruik van verhouding van elektrone tot Cu*
- *Vervanging in n = m/M*
- *Deel deur 0,95*
- *Finale antwoord*

(4)
[12]

TOTAL/*TOTAAL*: 150