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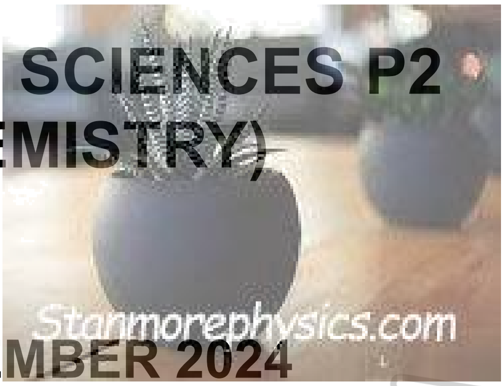
education

Department of
Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES P2
(CHEMISTRY)



SEPTEMBER 2024

MARKS: 150

TIME: 3 HOURS

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

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INSTRUCTIONS AND INFORMATION

1. Write your name and other applicable information in the appropriate spaces on the ANSWER BOOK.

2. The question paper consists of 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 3.1 and QUESTION 3.2.

6. You may use a non-programmable pocket calculator.

7. You may use appropriate mathematical instruments.

8. Show ALL formulae and substitutions in ALL calculations.

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

10. Give brief motivations, discussions, etc. 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. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in your ANSWER BOOK, for example, 1.11 E.

1.1 The condensed structural formula of an organic molecule is given as:

$$CH_3CH(CH_3)CH_2CH_3$$

The molecule is …

A unsaturated.

B saturated.

C a straight alkane.

D a straight alkene. (2)

1.2 Consider the organic structure below:

$$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-O-CH_3$$

The IUPAC name of its FUNCTIONAL ISOMER is …

A methyl ethanoate.

B propanoic acid.

C ethyl methanoate.

D ethanoic acid. (2)

1.3 Consider the following organic molecule:

$$CH(CH_3)_2CH_2CH(CH_3)CH_3$$

The correct IUPAC name is …

A 1,1,4-trimethylbutane.

B 2-methyl-3,3-dimethylbutane.

C 2,4-dimethylpentane.

D 2,2,4-trimethylpentane. (2)

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1.4 While a chemical reaction takes place, the rate of the reaction …

A remains the same.

B decreases because the concentration of products decreases.

C increases because the concentration of reactants increases.

D decreases because the concentration of reactants decreases. (2)

1.5 Consider the following **hypothetical** reaction:

$$A_2 + B \rightleftharpoons A_2B \qquad \Delta H < 0$$

The activation energy (E_A) for this reaction is 100 kJ·mol^{-1}.

For the reverse reaction …

A E_A is equal to 100 kJ·mol^{-1}.

B E_A is greater than 100 kJ·mol^{-1}.

C E_A is less than 100 kJ·mol^{-1}.

D E_A and ΔH are equal. (2)

1.6 Write down the conjugate base of $HC\ell O_4$.

A $HClO_3^-$

B $HClO_4^-$

C ClO_4^-

D $H_2C\ell O_4$ (2)

1.7 A solution of sodium hydroxide …

A turns bromothymol blue to yellow.

B is acidic.

C turns phenolphthalein to colourless.

D is basic. (2)

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

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

Which ONE of the following is an oxidising agent?

A $C\ell^-$

B Mg^{2+}

C H^+

D H_2 (2)

1.9 In a galvanic cell the salt bridge …

A is responsible for the charge balance to be maintained in the cell.

B allows for the movement of electrons from one half-cell to the other.

C allows the mixing of the two solutions from different half-cells.

D is not necessary for the optimal functioning of the cell. (2)

1.10 What is the energy conversion in an electrolytic cell?

A Electrical to chemical

B Chemical to electrical

C Electrical to mechanical

D Chemical to mechanical (2)

[20]

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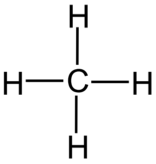
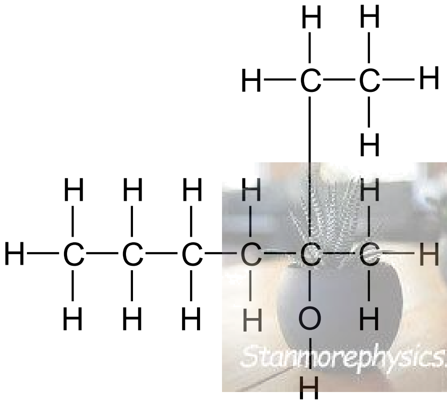
QUESTION 2 (Start on a new page.)

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

A		**B**	Propyl ethanoate
C		**D**	Propanal
E	3,3-difloro-2-methylpentane		

2.1 Write down the letter(s) representing:

2.1.1 A compound with the general formula C_nH_{2n+2} (1)

2.1.2 A haloalkane (1)

2.1.3 A functional isomer of a ketone (1)

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

2.2.1 The type of alcohol it is, and give a reason for the answer. (2)

2.2.2 IUPAC name (3)

2.2.3 Name of its functional group (1)

2.3 For compound **B,** write down the:

2.3.1 Structural formulae of the TWO organic compounds it is formed from (4)

2.3.2 Structural formula of the functional group of its functional isomer (1)

2.4 Write down the structural formula of Compound **E.** (3)

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2.5 Compound **A** undergoes complete combustion according to the following balanced equation:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

During the combustion, 2,75 kg of carbon dioxide is formed. Calculate the mass of CH_4 needed for this reaction. (5)

[22]

QUESTION 3 (Start on a new page.)

The boiling points of four organic compounds at a specific pressure are compared.

COMPOUND		**BOILING POINT (°C)**
A	Pentane	36
B	2-methylbutane	28
C	2,2-dimethylpropane	10
D	Pentanal	103
E	Butanoic acid	…

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

3.2 Consider compounds **A** to **C**.

3.2.1 Fully explain the trend in boiling points from compound **A** to **C**. (4)

3.2.2 Which compound will have the highest vapour pressure? (1)

3.2.3 Explain your answer to QUESTION 3.2.2. (1)

3.3 Compounds **D** and **E** are compared. Is the boiling point of compound **E** GREATER THAN, SMALLER THAN or EQUAL TO 103°C? Fully explain the answer. (4)

3.4 Is the comparison in QUESTION 3.3 fair? (1)

3.5 Explain the answer to QUESTION 3.4. (1)

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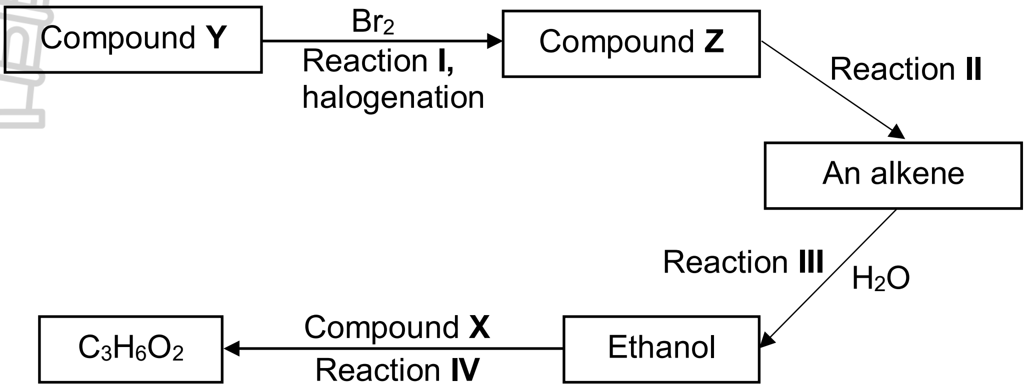
QUESTION 4 (Start on a new page.)

The flow diagram below shows the steps in the preparation of an alcohol from compound **Y,** which is a SATURATED HYDROCARBON.



4.1 Explain the term *halogenation*. (2)

4.2 For **reaction I**, write down:

4.2.1 ONE reaction condition (1)

4.2.2 The formula of the inorganic product (1)

4.3 For **reaction II**, write down the balanced equation using CONDENSED STRUCTURAL FORMULAE. (5)

4.4 Write down the name of **reaction III.** (1)

In **reaction IV**, $C_3H_6O_2$ is formed when ethanol reacts with compound **X**.

4.5 Write down the IUPAC name of compound **X**. (2)

4.6 Write down the name of **reaction IV.** (1)

4.7 Using STRUCTURAL FORMULAE, write down the balanced equation for this reaction. (4)
[17]

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QUESTION 5 (Start on a new page.)

Grade 12 learners use a reaction of $CaCO_3$ with EXCESS HCℓ to investigate the relationship between concentration and rate of reaction. The balanced equation for the reaction is:

$$CaCO_3(s) + 2HC\ell(aq) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$

They conduct the experiment twice, each with a different concentration of HCℓ. A decrease in the mass of the flask and the content is represented in the table below.

EXPERIMENT	**TIME(s)**	0	30	60	90	120	150	180
1	Mass of flask and contents (g)	270	268,4	267,4	266,75	266,3	266	266
2	Mass of flask and contents (g)	270	269	268,4	268,1	268	268	268

5.1 Write down the name of the apparatus used for measuring the mass. (1)

5.2 Write down the NAME of the limiting reagent. (1)

5.3 Define the term *rate of reaction*. (2)

5.4 For **experiment 1**, calculate the rate of reaction in mol·s^{-1} in the first 30 s. (5)

5.5 In which experiment did the learner use a higher concentration of HCℓ? (1)

5.6 Use the collision theory to explain the answer to QUESTION 5.5. (3)
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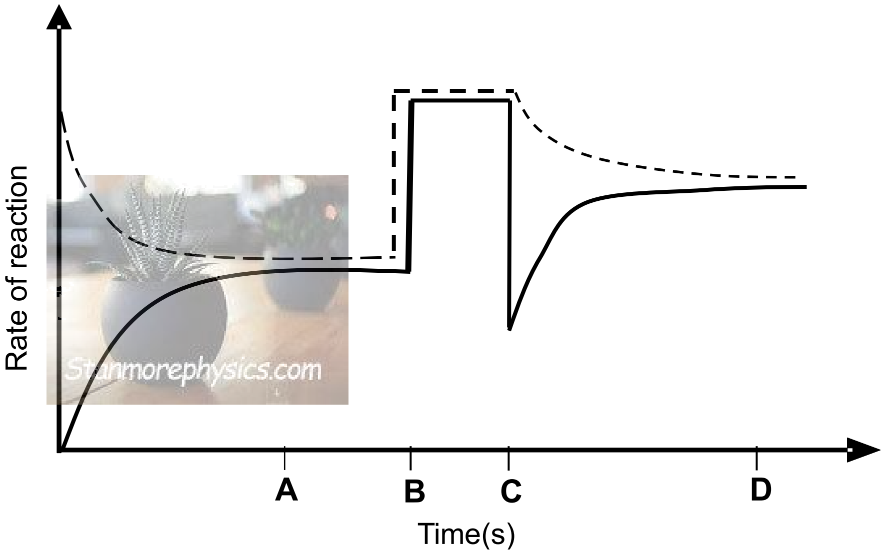
QUESTION 6 (Start on a new page.)

6.1 Ammonia gas is produced by pouring nitrogen gas and hydrogen gas in an empty container and allowed to react in a closed container according to the following balanced equation:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The graph of the rate of forward and reverse reactions is indicated below.



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

6.1.2 Identify the change made at time **B**. (2)

6.1.3 There was a temperature change at time **C,** while the pressure was kept constant.

(a) How did the temperature change? Write down only INCREASED or DECREASED. (1)

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

(c) Use Le Chatelier's principle to explain the answer to QUESTION 6.1.3 (b). (2)

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6.2 The decomposition reaction of nitrosyl chloride (NOCℓ) is represented below:

$$2NOCℓ(g) \rightleftharpoons 2NO(g) + Cℓ_2(g)$$

At a temperature of 50°C, 4 mol of NOCℓ is placed in a 2 dm^3 container. At equilibrium, it was found that 0,9 $mol·dm^{-3}$ of NO was formed.

6.2.1 Define the term *reversible reaction*. (1)

6.2.2 Calculate the value of K_C at 50°C. (7)
[16]

QUESTION 7 (Start on a new page.)

7.1 According to the balanced equation below, A dilute solution of HCℓ is used in titration against an ammonia solution.

$$HCℓ(aq) + NH_3(aq) \rightarrow NH_4Cℓ(aq)$$

7.1.1 Define the term *hydrolysis*. (2)

7.1.2 Will the final solution be ACIDIC or BASIC? (1)

7.1.3 Write down a balanced chemical equation that explains the answer to QUESTION 7.1.2. (3)

7.2 For the above titration, 25 cm^3 of a 0,1 $mol·dm^{-3}$ NH_3 solution is titrated against 40 cm^3 HCℓ solution.

7.2.1 Is HCℓ a STRONG or a WEAK acid? (1)

7.2.2 Explain the answer to QUESTION 7.2.1. (2)

7.2.3 Write down the name of the indicator that is most suitable for this reaction. (1)

7.2.4 Explain your choice of indicator. (2)

7.2.5 Calculate the number of moles of NH_3 in 25 cm^3 of the ammonia. (3)

7.2.6 Calculate the pH of the final solution if the concentration of the original HCℓ was 0,1 $mol·dm^{-3}$. (8)
[23]

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QUESTION 8 (Start on a new page.)

The following balanced chemical equation represents a reaction taking place when a galvanic cell is in operation under STANDARD CONDITIONS. The initial reading on the voltmeter is 0,14V.

$$6C\ell^-(aq) + 2Au^{3+}(aq) \rightarrow 3C\ell_2(g) + 2Au(s)$$

8.1 Write down TWO standard conditions under which it operates. (2)

8.2 For this cell, write down the:

8.2.1 Name or formula of the electrolyte that can be used in the salt bridge (2)

8.2.2 Reducing agent (1)

8.2.3 Cell notation (3)

8.3 Calculate the standard reduction potential of Au. (4)
[12]

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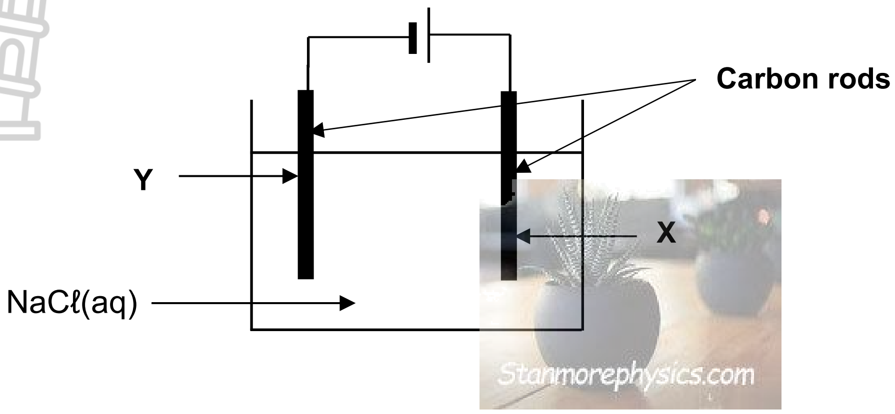
QUESTION 9 (Start on a new page.)

The simplified diagram below represents the electrolysis of a concentrated sodium chloride solution.



The balanced equation for the reaction taking place in the above cell is:

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

9.1 Define the term *electrolysis*. (2)

9.2 Which electrode is the anode? Write down only **X** or **Y**. (1)

9.3 Write down the half-reaction that takes place at:

9.3.1 Electrode **X** (2)

9.3.2 Electrode **Y** (2)

9.4 A current of 0,5 A is applied over a period of 5 hours. Calculate the volume of chlorine gas at STP that is formed during this time. (6)
[13]

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*

NAME / *NAAM*	SYMBOL / *SIMBOOL*	VALUE / *WAARDE*
Standard pressure *Standaarddruk*	p^θ	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by 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-konstante	N_A	$6,02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ *OR/OF* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1x10^{-14}$ *at/by 298 K*	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ *OR* $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ *OR* $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{redusing\ agent}$	$E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ *OF* $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ *OF* $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$
$I = \frac{Q}{\Delta t}$	$n = \frac{Q}{q_e}$ where n is the number of electrons waar n die aantal elektrone is

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number
Atoomgetal

29 1,9 Cu 63,5

Electronegativity / *Elektronegatiwiteit* → 1,9

Symbol / *Simbool* → Cu

Approximate relative atomic mass / *Benaderde relatiewe atoommassa* → 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

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 oxidising ability / *Toenemende oksiderende vermoë* ↑

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
$\mathbf{2H^+ + 2e^-}$	**⇌**	$\mathbf{H_2(g)}$	**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
$Pt^{2+} + 2\,e^-$	⇌	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
$H_2O_2 + 2H^+ +2\,e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

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PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/*GRAAD* 12

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

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SEPTEMBER 2024

MARKS/*PUNTE*: 150

MARKING GUIDELINES/*NASIENRIGLYNE*

These marking guidelines consist of 14 pages.
Hierdie nasienriglyne bestaan uit 14 bladsye.

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QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

1.8 C ✓✓ (2)

1.9 A ✓✓ (2)

1.10 A ✓✓ (2)
[20]

QUESTION 2/*VRAAG 2*

2.1.1 A ✓ (1)

2.1.2 E ✓ (1)

2.1.3 D ✓ (1)

2.2.1 Tertiary (alcohol) / *Tersiêre (alkohol)* ✓
The carbon atom bonded to the hydroxyl group is bonded to three other carbon atoms. ✓
Die koolstofatoom wat aan die hidroksielgroep gebind is, is aan drie ander koolstofatome gebind. (2)

2.2.2 3-methylheptan-3-ol / *metielheptaan-3-ol*

Marking criteria/*Nasienkriteria:*

- Correct stem of alcohol, i.e. heptanol. ✓
- Substituent correctly identified, i.e. methyl. ✓
- IUPAC name completely correct including numbering and hyphens. ✓

- *Korrekte stam van alkohol, d.i. heptanol.*
- *Substituent korrek geïdentifiseer, d.i. metiel.*
- *IUPAC-naam heeltemal korrek, insluitend nommering en koppeltekens.*

(3)

2.2.3 Hydroxyl (group) / *Hydroksiel (groep)* ✓ (1)

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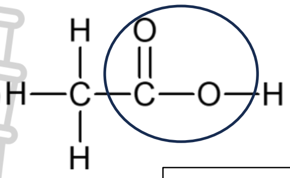
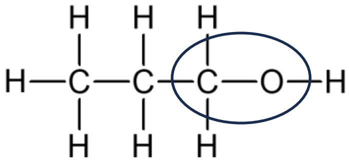
2.3.1





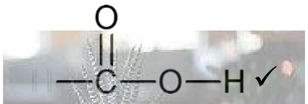
Marking criteria/Nasienkriteria*:*

- Correct functional group of carboxylic acid. ✓
- Whole structure of carboxylic acid correct. ✓
- Correct functional group of alcohol. ✓
- Whole structure of alcohol correct. ✓

- *Korrekte funksionele groep karboksielsuur.*
- *Hele struktuur van karboksielsuur korrek.*
- *Korrekte funksionele groep alkohol.*
- *Hele struktuur van alkohol korrek.*

(4)

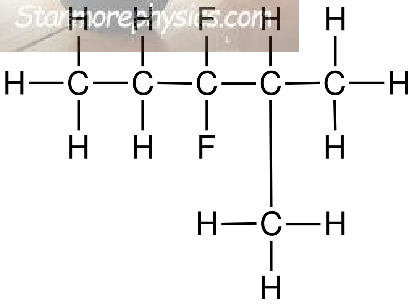
2.3.2



$-\overset{\displaystyle O}{\overset{\|}{C}}-O-H$ ✓

(1)

2.4



Marking criteria/Nasienkriteria*:*

- Methyl substituent on second C atom. ✓
- Two fluorine atoms on third C atom. ✓
- Whole structure correct. ✓

- *Metielsubstituent op tweede C-atoom.*
- *Twee fluooratome op derde C-atoom.*
- *Hele struktuur korrek.*

(3)

2.5 $n(CO_2) = \frac{m}{M}$ ✓(a)

$= \frac{2750}{44}$ ✓(b)

$= 62{,}5$ mol

$n(CH_4) = n(CO_2)$ ✓ (c)

$= 62{,}5$ mol

Marking criteria/Nasienkriteria*:*

(a) Formula/*Formule* $n = \frac{m}{M}$ ✓

(b) Substitute/*Vervanging* $M = 44\ g\cdot mol^{-1}$ in $n = \frac{m}{M}$ ✓

(c) Use mole ratio/*Gebruik molverhouding:*
$n(CH_4) = n(CO_2)$ ✓

(d) Substitute/*Vervanging* $M = 16\ g\cdot mol^{-1}$ in $n = \frac{m}{M}$ ✓

(e) Correct final answer/*Korrekte finale antwoord*:
1 000 g OR 1 kg ✓

$m(CH_4) = n(CH_4) \times M\ (CH_4)$

$= 62{,}5 \times 16$ ✓ (d)

$=1000g/\ 1kg$ ✓ (e)

(5)

[22]

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QUESTION 3/*VRAAG 3*

3.1 **Marking criteria/*Nasienkriteria*:**

> If any of the underlined key phrases in the correct context is omitted, deduct 1 mark.
> *Indien enige van die onderstreepte sleutelfrases in die korrekte konteks weggelaat word, trek 1 punt af.*

The temperature at which the vapour pressure of a liquid is equal to the atmospheric pressure.✓✓
Die temperatuur waarby die dampdruk van 'n vloeistof gelyk is aan die atmosferiese druk. (2)

3.2.1 **FROM A TO C**

- Increase branching/smaller surface area/more compact ✓
- Weaker intermolecular forces ✓
- Less energy needed to break the intermolecular forces ✓
- Boiling point decreases ✓

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VANAF A TOT C

- *Vergroot vertakking/kleiner oppervlakte/meer kompak*
- *Swakker intermolekulêre kragte*
- *Minder energie benodig om die intermolekulêre kragte te breek*
- *Kookpunt neem af* (4)

3.2.2 C/2,2-dimethylpropane / *dimetielpropaan* ✓ (1)

3.2.3 Lowest boing point / *Laagste kookpunt* ✓ (1)

3.3 Greater than (103 °C) ✓

- Between compound D/pentanal molecules are dipole-dipole forces✓ (and London forces) and between compound E/butanoic acid are hydrogen bonds✓ (dipole-dipole and London forces).
- Dipole-dipole forces are weaker than hydrogen bonds. ✓
  OR
  Intermolecular forces between compound D/pentanal molecules are weaker than those between compound E/butanoic acid molecules.
  OR
  Less energy is needed to break the intermolecular forces between pentanal molecules.

Groter as (103 °C)

- *Tussen verbinding D/pentanale molekules is dipool-dipoolkragte (en Londen-kragte) en tussen verbinding E/butaansuur is waterstofbindings (dipool-dipool en Londen-kragte).*
- *Dipool-dipoolkragte is swakker as waterstofbindings.*
  OF

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Intermolekulêre kragte tussen verbinding D/pentanale molekules is swakker as dié tussen verbinding E/butaansuurmolekules.
OF
Minder energie benodig om die intermolekulêre kragte tussen pentanale molekules te breek. (4)

3.4 Yes/*Ja* ✓ (1)

3.5 Comparable molecular masses AND only functional group (homologous series) changed/only 1 independent variable ✓

Vergelykbare molekulêre massas EN enigste funksionele groep (homoloë reeks) verander/slegs 1 onafhanklike veranderlike. (1)

[14]

QUESTION 4/*VRAAG 4*

4.1 A reaction of a halogen with a compound. ✓✓
'n Reaksie van 'n halogeen met 'n verbinding. (2)

4.2.1 Heat/Sunlight/UV light / *Hitte/Sonlig/UV-lig* ✓ (1)

4.2.2 HBr ✓ (1)

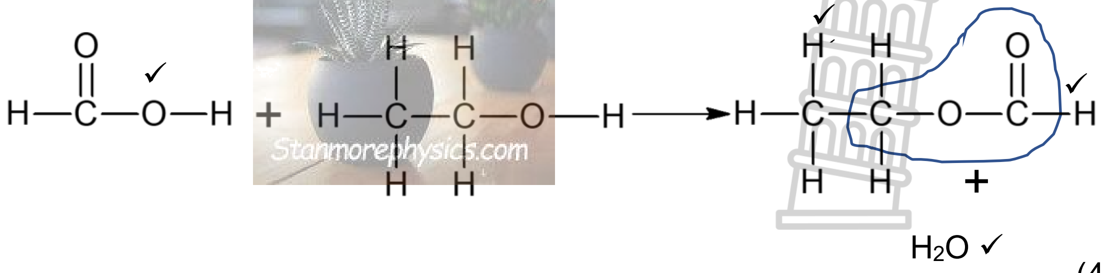
4.3 CH_3CH_2Br ✓ + NaOH/ ✓ → CH_2CH_2 ✓ + NaBr/ ✓ + H_2O ✓
KOH/LiOH KBr/LiBr (5)

4.4 Addition/Hydration / *Addisie/Hidrasie* ✓ (1)

4.5 Methanoic acid / *Metanoësuur* ✓✓ (2)

4.6 Esterification/Condensation / *Verestering/Kondensasie* ✓ (1)

4.7



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(4)

[17]

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QUESTION 5/*VRAAG 5*

5.1 Mass meter/Scale / *Massameter/Skaal* ✓ (1)

5.2 Calcium carbonate / *Kalsiumkarbonaat* ✓ (1)

5.3
- Change in concentration/mass/amount/volume ✓ of reactants/products per unit time. ✓
- Concentration/amount/mass/volume of reactants used/products formed per unit time.
- Rate of change in concentration/amount/mass/volume. **(2 or 0)**

- *Verandering in konsentrasie/massa/hoeveelheid/volume van reaktante/ produkte per tydseenheid.*
- *Konsentrasie/hoeveelheid/massa/volume van reaktante gebruik/produkte gevorm per tydseenheid.*
- *Tempo van verandering in konsentrasie/hoeveelheid/massa/volume.* (2)

5.4 **Marking criteria/*Nasienriglyne:***

- Mass of CO_2 formed/*Massa van CO_2 gevorm*: 270-268,4 or/*of* 1,6g ✓
- Substituting/*Vervanging* 44 in $n = \frac{m}{M}$ ✓
- Substitute number of moles of CO_2 in the rate formula ✓
  Vervang die aantal mol CO2 in die tempoformule
- Substitute time in the rate formula / *Vervang tyd in die tempoformule* ✓
- Correct final answer/*Korrekte finale antwoord* ✓
- Range/*Gebied*: 0,001 to 0,0013 $mol \cdot s^{-1}$

$$n(CO_2) = \frac{m}{M}$$

$$= \frac{1,6 \checkmark (a)}{44 \checkmark (b)}$$

$$= 0,03636 \text{ mol}$$

$$\text{Rate/}\textit{Tempo} = \left(\frac{\triangle n}{\triangle t}\right)$$

$$= \left(\frac{0,03636-0}{30-0}\right) \begin{matrix} \checkmark (c) \\ \checkmark (d) \end{matrix}$$

$$= 1,21 \times 10^{-3} \ (mol \cdot s^{-1}) \checkmark (e)$$

(5)

5.5 Experiment 1 /*Eksperiment 1* ✓ (1)

5.6
- High concentration results in more particles per unit volume ✓
- More effective collisions per unit time/frequency of effective collisions increases ✓
- Higher rate of reaction ✓/Higher rate of formation of CO_2.

- *Hoë konsentrasie lei tot meer deeltjies per eenheid volume*
- *Meer effektiewe botsings per tydseenheid/frekwensie van effektiewe botsings neem toe*
- *Hoër reaksietempo/Hoër tempo van vorming van CO_2.* (3)

[13]

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QUESTION 6/*VRAAG 6*

6.1.1 Rate of forward reaction is equal to rate of reverse reaction. ✓✓
Tempo van voorwaartse reaksie is gelyk aan tempo van terugwaartse reaksie. (2)

6.1.2 Addition of a catalyst / *Addisie van 'n katalisator* ✓✓ (2)

6.1.3 (a) Decreased / *Toeneem* ✓ (1)

(b) Exothermic / *Eksotermies* ✓ (1)

(c)
- Decrease in temperature favours an exothermic reaction . ✓
- The forward reaction is favoured ✓/rate of forward reaction decreased less than that of the reverse reaction.

- *Verlaging in temperatuur bevoordeel 'n eksotermiese reaksie.*
- *Die voorwaartse reaksie word bevoordeel/tempo van voorwaartse reaksie het minder afgeneem as dié van die terugwaartse reaksie* (2)

6.2.1 When the products can be converted back to reactants ✓
Wanneer die produkte terug na reaktante omgeskakel kan word (1)

6.2.2 **CALCULATIONS USING NUMBER OF MOLES/**

Mark allocation:

(a) USING ratio NOCℓ : NO : $C\ell_2$= 2:2:1✓
(b) Change in number of moles of NO = equilibrium moles of NO
Equilibrium number moles of $C\ell_2$ = change in moles of $C\ell_2$
(c) Equilibrium moles NOCℓ = initial moles NOCℓ – change moles of NOCℓ ✓
(d) Dividing equilibrium moles NOCℓ and $C\ell_2$ by 2 AND mutiplying equilibrium concentration NO by 2 ✓
(e) Correct K_c expression (<u>formulae in square brackets</u>) ✓ } ✓
(f) Correct substitution of concentrations into K_c correct expression ✓
(g) Final answer : 0,33 ✓

BEREKENINGE MET GEBRUIK VAN AANTAL MOL

Puntetoekenning:

(a) GEBRUIK verhouding NOCℓ : NO : $C\ell_2$= 2:2:1
(b) Verandering in aantal mol NO = ewewigsmol NO
Ekwilibriumgetal mol $C\ell_2$ = verandering in mol $C\ell_2$
(c) Ekwilibrium mol NOCℓ = aanvanklike mol NOCℓ – verander mol van NOCℓ
(d) Deel ewewigsmol NOCℓ en $C\ell_2$ deur 2 EN vermenigvuldig ewewigkonsentrasie NO met 2
(e) Korrekte K_c-uitdrukking (<u>formules tussen vierkantige hakies</u>)
(f) Korrekte vervanging van konsentrasies in K_c korrekte uitdrukking
(g) Finale antwoord : 0,33

	NOCℓ	**NO**	**$C\ell_2$**	
Initial quantity (mol) *Aanvanklike hoeveelheid (mol)*	4	0	0	
Change *Verander* (mol)	1,8	1,8	0,9	Ratio ✓ (a) *Verhouding*
Quantity at equilibrium (mol) *Hoeveelheid by ewewig (mol)*	2,2 ✓ (c)	1,8	0,9	✓(b)
Equilibrium concentration (mol·dm^{-3}) *Ekwilibriumkonsentrasie (mol·dm-^{3})*	1,1	0,9	0,45	✓(d) ÷ & x 2

$$Kc = \frac{[NO]^2[Cl_2]}{[NOCl]^2} \checkmark \text{ (e)}$$

$$Kc = \frac{(0,9)^2(0,45)}{1,1} \checkmark\text{(f)}$$

$$Kc = 0,33 \checkmark\text{(g)}$$

Wrong K_c expression / *Verkeerde K_c uitdrukking*	Max/*Maks:* $^4/_7$
No K_c expression followed by correct substitutions / *Geen K_c-uitdrukking gevolg deur korrekte vervangings*	Max/*Maks*: $^6/_7$

(7)

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CALCULATIONS USING CONCENTRATIONS
Mark allocation:
(a) Initial concentration of NOCℓ = initial moles of NOCℓ ÷ 2 ✓
(b) USING ratio NOCℓ : NO: $C\ell_2$ = 2:2:1✓
(c) Change in concentration of NO = equilibrium concentration of NO
Equilibrium concentration of $C\ell_2$ = change in concentration of $C\ell_2$ } ✓
(d) Equilibrium concentration of NOCℓ = initial concentration of NOCℓ – change in concentration of NOCℓ ✓
(e) Correct K_c expression (formulae in square brackets) ✓
(f) Correct substitution of concentrations into K_c expression ✓
(g) Final answer : 0,33 ✓

BEREKENINGE DEUR KONSENTRASIES
Puntetoekenning:
(a) Aanvanklike konsentrasie van NOCℓ = aanvanklike mol NOCℓ ÷ 2
(b) GEBRUIK verhouding NOCℓ : NO: $C\ell_2$ = 2:2:1
(c) Verandering in konsentrasie van NO = ewewigskonsentrasie van NO
Ekwilibriumkonsentrasie van $C\ell_2$ = verandering in konsentrasie van $C\ell_2$
(d) Ekwilibriumkonsentrasie van NOCℓ = aanvanklike konsentrasie NOC – verandering in konsentrasie van NOCℓ
(e) Korrekte K_c-uitdrukking (formules tussen vierkantige hakies)
(f) Korrekte vervanging van konsentrasies in K_c uitdrukking
(g) Finale antwoord: 0,33

	NOCℓ	**NO**	**$C\ell_2$**
Initial concentration ($mol\cdot dm^{-3}$l) *Aanvanklike konsentrasie ($mol\cdot dm^{-3}$l)*	2 ✓ (a)	0	0
Change concentration ($mol\cdot dm^{-3}$) *Verander konsentrasie ($mol\cdot dm^{-3}$)*	0,9	✓(c) 0,9	0,45
Equilibrium concentration ($mol\cdot dm^{-3}$) *Ekwilibriumkonsentrasie ($mol\cdot dm^{-3}$)*	1,1✓ (d)	0,9	0,45

Ratio ✓ (b)
Verhouding

$$Kc = \frac{[NO]^2[Cl_2]}{[NOCl]^2} \ ✓ \text{ (e)}$$

$$Kc = \frac{(0,9)^2(0,45)}{1,1} \ ✓\text{(f)}$$

$$Kc = 0,33 \ ✓\text{(g)}$$

Wrong K_c expression / *Verkeerde K_c uitdrukking*	Max/*Maks:* $^4/_7$
No K_c expression followed by correct substitutions / *Geen K_c-uitdrukking gevolg deur korrekte vervangings*	Max/*Maks*: $^6/_7$

(7)
[16]

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QUESTION 7/*VRAAG 7*

7.1.1 The reaction of salt with water ✓✓
Die reaksie van soutwater met water (2)

7.1.2 Acidic/*Suur* ✓ (1)

7.1.3 $NH_4^+(aq) + H_2O(\ell)$ ✓ $\rightarrow NH_3 + H_3O^+(aq)$ ✓✓
OR / *OF*
$NH_4^+(aq) + 2H_2O(\ell)$ ✓ $\rightarrow NH_4OH + H_3O^+(aq)$ ✓✓ (3)

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7.2.1 Strong (acid) / *Sterk (suur)*✓ (1)

7.2.2 Ionises/dissociate completely in water✓to form a high concentration of H_3O^+ ions. ✓
Ioneer/dissosieer heeltemal in water om 'n hoë konsentrasie van H_3O^+ ione te vorm. (2)

7.2.3 Methyl orange / *Metiel oranje* ✓ (1)

7.2.4 Titration of strong acid ✓ and weak base ✓
Titrasie van sterk suur en swak basis (2)

7.2.5

<u>Marking criteria/*Nasienriglyne:*</u>

- Formula / *Formule* $c = \frac{n}{V}$ ✓
- Substitute / *Vervang* 0,1 AND / *EN* 25 x 10^{-3} in n = cV ✓
- Final answer/*Finale antwoord:* 0,0025 mol ✓

$c = \frac{n}{V}$ ✓
$n = 0,1 \times 25 \times 10^{-3}$ ✓
$n = 2,5 \times 10^{-3}$ mol✓ / 0,0025 mol (ACCEPT/*AANVAAR*: 0,003 mol) (3)

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7.2.6 **Marking criteria/*Nasienriglyne:***

(a) Ratio / *Verhouding* $n(HCℓ) = n(NH_3)$ ✓
(b) Formula / *Formule* $c = \frac{n}{V}$ / $pH = -\log[H_3O^+]$ ✓
(c) Substituting $n(NH_3)$ and volume of $0{,}04\,dm^3$ / *Vervang $n(NH_3)$ en volume van $0{,}04\,dm^3$*
(d) Subtraction / *Aftrekking*: $c(HCℓ)_{initial} - c(HCℓ)_{used}$ ✓✓
(e) $c(H_3O^+) = c(HCℓ)$ ✓
(f) Substituting / *Vervanging* $c(H_3O^+)$ in $pH = -\log[H_3O^+]$ ✓
(g) Final answer / *Finale antwoord* = 1,43 ✓

$n(HCℓ) = n(NH_3)$ ✓(a)
$= 2{,}5 \times 10^{-3}$

$c(HCℓ) = \frac{n}{V}$

$= \frac{2{,}5 \times 10^{-3}}{0{,}04}$ ✓(c)

$= 0{,}0625\ mol{\cdot}dm^{-3}$

$c(HCℓ)$ excess/*oormaat* $= 0{,}1 - 0{,}0625$ ✓✓(d)
$= 0{,}0375\ mol{\cdot}dm^{-3}$

$c(H_3O^+) = c(HCℓ)$ ✓(e)
$= 0{,}0375$

$pH = -\log[H_3O^+]$
$= -\log(0{,}0375)$ ✓(f)
$= 1{,}43$ ✓(g)

ANY/*ENIGE* 1 ✓(b)

(8)
[23]

QUESTION 8/*VRAAG 8*

8.1 Concentration / *Konsentrasie* = 1 mol·dm^{-3} ✓
Temperature / *Temperatuur* = 25 °C ✓ (2)

8.2.1 Potassium nitrate/KNO_3/Any soluble salt ✓✓
Kaliumnitraat/KNO_3/Enige oplosbare sout (2)

8.2.2 $C\ell^-$ ✓ (1)

8.2.3 $Pt(s) \mid C\ell^-(aq) \mid C\ell_2(g)$ ✓$\overset{✓}{\parallel}$ $Au^{3+}(aq) \mid Au(s)$ ✓ (3)

8.3 **OPTION/*OPSIE* 1**

$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓
$0{,}14 = E^\theta_{reduction}$ ✓ $- 1{,}36$ ✓
$E^\theta_{reduction} = 1{,}5$ V ✓

$E^\theta_{sel} = E^\theta_{redukusie} - E^\theta_{oksidasie}$ ✓
$0{,}14 = E^\theta_{reduksie}$ ✓ $- 1{,}36$ ✓
$E^\theta_{reduksie} = 1{,}5$ V ✓

Notes/*Aantekeninge:*
Accept any other correct formula from the data sheet.
Aanvaar enige ander korrekte formule uit die datablad.

Any other formula using unconventional abbreviations, e.g. ~~$E^\theta_{cell} = E^\theta_{OA} - E^\theta_{R}$~~, followed by correct substitutions: $^3/_4$
Enige ander formule wat onkonvensionele afkortings gebruik, bv. ~~$E^\theta_{cell} = E^\theta_{OA} - E^\theta_{R}$~~ *gevolg deur korrekte vervangings:* $^3/_4$

OPTION/*OPSIE* 2

✓ $\left\{ \begin{array}{l} Au^{3+} + 3e^- \rightarrow Au \\ \underline{2C\ell^- \rightarrow C\ell_2 + 2e^-} \end{array} \right.$
$6\,C\ell^- + 2Au^{3+} \rightarrow 3C\ell_2 + 2Au$

$E^\theta = 1{,}5$ V ✓
$E^\theta = \underline{-1{,}36\ (V)}$ ✓
$E^\theta = 0{,}14$ (V) ✓ (4)

[12]

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QUESTION 9/*VRAAG 9*

9.1 The chemical process in which electrical energy is converted to chemical energy/ use of electrical energy to produce a chemical reaction. ✓✓

Die chemiese proses waarin elektriese energie na chemiese energie omgeskakel word/gebruik van elektriese energie om 'n chemiese reaksie te produseer. (2)

9.2 X ✓ (1)

9.3.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓

Marking criteria/*Nasienkriteria:*

- $2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ $\frac{1}{2}$ $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $\frac{0}{2}$
  $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ $\frac{0}{2}$ $C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $\frac{2}{2}$
- Ignore if charge omitted on electron/*Ignoreer as lading op electron weggelaat is*
- If charge (-) omitted on $C\ell^-$/*Indien lading (+) weggelaat is op $C\ell^-$:*
  Max./*Maks:* $\frac{1}{2}$
  Example/*Voorbeeld*: $2C\ell \rightarrow C\ell_2 + 2e^-$

(2)

9.3.2 $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ ✓✓

Marking criteria/*Nasienkriteria:*

- $2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ $\frac{1}{2}$ $H_2 + 2OH^- \rightleftharpoons 2H_2O + 2e^-$ $\frac{0}{2}$
  $H_2 + 2OH^- \leftarrow 2H_2O + 2e^-$ $^{2}/_{2}$ $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ $^{0}/_{2}$
- Ignore if charge omitted on electron / *Ignoreer as lading op elektron weggelaat is*
- If charge (-) omitted on OH^-
  Indien lading (-) op OH^- weggelaat is   Max./*Maks:* $\frac{1}{2}$
  Example / *Voorbeeld*: $2H_2O + 2e^- \rightarrow H_2 + 2OH$

(2)

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9.4

Marking criteria/*Nasienriglyne:*

(a) Substitute / *Vervang* 0,5 x 18 000 ✓
(b) Dividing charge by / *Deel lading deur* 1,6 x 10^{-19} ✓
(c) Dividing number of electrons by Avogadro's constant. ✓
Deel die aantal elektrone deur Avogadro se konstante.
(d) Using ratio / *Gebruik verhouding* n(Cℓ) : n(e^-) = 1:2 ✓
(e) Substituting / *Vervanging* n($C\ell_2$) and / *en* 22,4 in $n = \frac{V}{V_m}$ ✓
(f) Final answer / *Finale antwoord* 1,04 dm^3 ✓

$Q = I\triangle t$
$= 0{,}5 \times 18\ 000$ ✓(a)
$= 9\ 000$ C

$n = \frac{Q}{q_e}$

$n = \frac{9\ 000}{1{,}6 \times 10^{-19}}$ ✓ (b)

$= 5{,}625 \times 10^{22}$ electrons / *elektrone*

n(electrons) $= \frac{5{,}625 \times 10^{22}}{6{,}02 \times 10^{23}}$ ✓ (c)
$= 0{,}093$ mol

$n(C\ell_2) = \frac{1}{2}n(e^-)$
$= 0{,}093 \div 2$ ✓(d)
$= 0{,}0465$ mol

$n = \frac{V}{V_m}$

$V = 0{,}0465 \times 22{,}4$ ✓(e)
$= 1{,}04\ dm^3$ ✓(f)

(6)
[13]

TOTAL/*TOTAAL*: 150