Western Cape Government

Education

FOR YOU

PHYSICAL SCIENCES
PAPER 2

GRADE 12

MNED PLC CLUSTER PAPER
SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

This paper consists of 15 pages and 4 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name in the space below and submit the Examination Paper with your Answer Book.

   NAME & SURNAME: ________________________________

   GRADE: ______

2. This question paper consists of 9 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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions etc. where required.
12. Write neatly and legibly.

QUESTION 1 (MULTIPLE-CHOICE)

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) on your ANSWER BOOK.

1.1 Which ONE of the following compounds is NOT a chain isomer of 2- fluorohexane?

A 2-fluoro-2-methylpentane

B 2-fluoro-3-methylpentane

C 2-fluoro-2,3-dimethylbutane

D 3- fluorohexane (2)

1.2 Which ONE of the following compounds will have the lowest melting point?

A propan-1-ol

B propanoic acid

C propane

D propanal (2)

1.3 Which ONE of the following equations represents a cracking process?

A $CH_2 = CH_2 + HBr \rightarrow CH_2BrCH_3$

B $CH_3(CH_2)_5CH = CH_2 + H_2 \rightarrow CH_3(CH_2)_6CH_3$

C $CH_3(CH_2)_6CH_3 \rightarrow CH_3(CH_2)_4CH_3 + CH_2 = CH_2$

D $CH_3(CH_2)_7OH \rightarrow CH_3(CH_2)_5CH = CH_2 + H_2O$ (2)

1.4 Which ONE of the following will RAPIDLY decolourise bromine water?

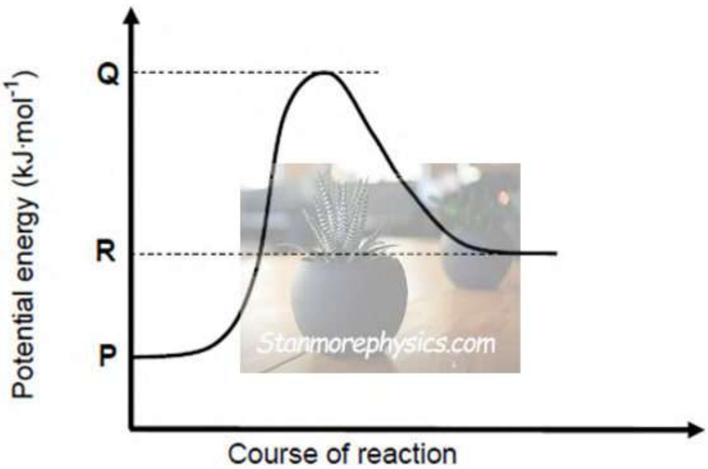
A $CH_3CH_2CH_3$

B CH_3CHCH_2

C CH_3COOCH_3

D CH_3CH_2COOH (2)

1.5 Consider the potential energy graph for a reaction shown below:



The activation energy for the reverse reaction in terms of **P**, **Q** and **R** is:

A Q - P

B Q - R

C R - Q

D P - Q (2)

1.6 A hypothetical reaction reaches equilibrium at 10 °C in a closed container according to the following balanced equation:

$$A(g) + B(g) \rightleftharpoons AB(g) \qquad \Delta H < 0$$

The temperature is now increased to 25 °C. Which ONE of the following is correct as the reaction approaches a new equilibrium?

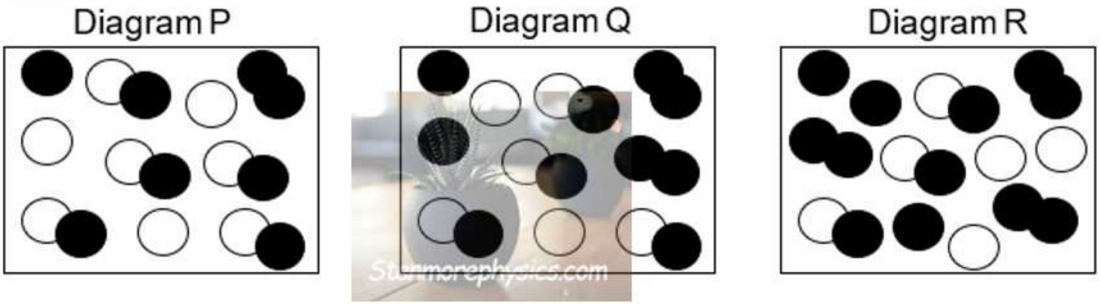
	REACTION RATE OF REVERSE REACTION	YIELD OF PRODUCTS
A	Increases	Remains the same
B	Increases	Increases
C	Increases	Decreases
D	Decreases	Decreases

(2)

1.7 Diagrams **P**, **Q** and **R** represent different reaction mixtures of the following hypothetical reaction that is at equilibrium in a closed container at a certain temperature.

$$X(g) + Y_2(g) \rightleftharpoons XY(g) + Y(g) \qquad \Delta H > 0$$

KEY: X: ○ Y: ●



If at equilibrium $K_c = 2$, which diagram(s) correctly represent(s) the mixture at equilibrium?

A P only

B Q only

C R only

D P, R and Q (2)

1.8 Which of the following is not a conjugate acid-base pair?

A HCl and Cl^-

B HCO_3^- and H_2CO_3

C HSO_4^- and H_2SO_4

D OH^- and H_3O^+ (2)

1.9 The cell notation of a galvanic cell is given as:

$$Ni(s)|Ni^{2+}(aq)\ (1\ mol.dm^{-3},\ 298K)\ ||Ag^{+}(aq)\ (1\ mol.dm^{-3},\ 298K)\ |Ag(s)$$

A bulb connected across the two electrodes initially glows brightly. After some time the brightness of the bulb decreases. This is because the …

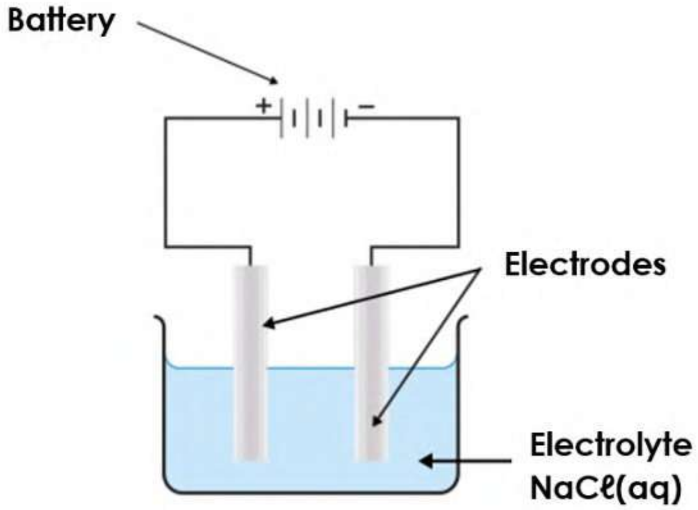
A concentration of Ag^{+} decreases.

B concentration of Ni^{2+} decreases.

C Ag electrode is used up.

D Ni electrode is used up. (2)

1.10 Which of the following occurs at the cathode during the electrolysis of aqueous sodium chloride (NaCℓ)?



A Chlorine gas is produced.

B Sodium metal is deposited.

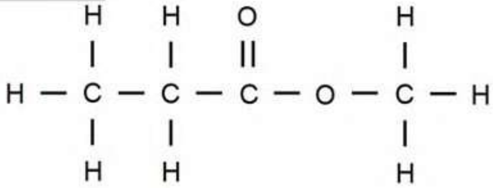
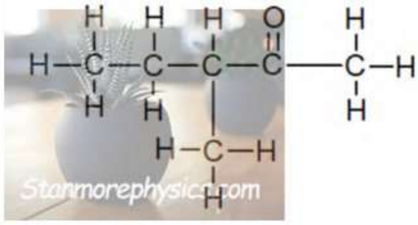
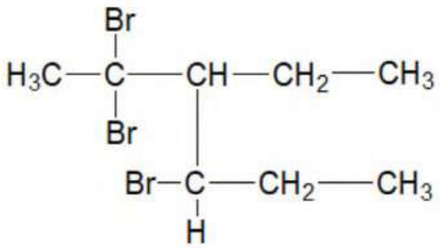
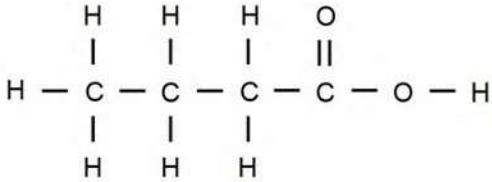
C Hydrogen gas is produced.

D Oxygen gas is produced. (2)

[20]

QUESTION 2 (Start on a new page)

Letters **A** to **H** in the table below represent eight organic compounds of different *homologous series*.

A	C_9H_{18}	**B**	Pentanal
C	$CH_3CHOHCH_2CH_3$	**D**	$CHCC(CH_3)_2(CH_2)_3CH_3$
E		**F**	
G		**H**	

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

2.2 Write down the letter(s) for:

2.2.1 A ketone (1)

2.2.2 TWO compounds that are FUNCTIONAL ISOMERS of each other. (1)

2.2.3 A compound with the general formula C_nH_{2n-2}. (1)

2.2.4 A compound containing the carboxyl group. (1)

2.3 Give the STRUCTURAL formula of a POSITIONAL ISOMER of compound **C**. (2)

2.4 Write down the IUPAC name of:

2.4.1 Compound **F** (2)

2.4.2 Compound **G** (3)

2.5 Give the STRUCTURAL formula of compound **B**. (2)

2.6 Using MOLECULAR formulae, write down the balanced equation for the complete combustion of compound **A**. (3)

[18]

QUESTION 3 (Start on a new page)

A learner investigates the relationship between the compounds **W**, **X**, **Y**, **Z**, and their boiling points. The results obtained were recorded as shown in the table below:

	COMPOUND	BOILING POINT (°C)
W	Ethanol	79
X	Propan-1-ol	98
Y	Butan-1-ol	117
Z	Pentan-1-ol	138

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

3.2 Write down the NAME of the functional group of the compounds **W** to **Z.** (1)

3.3 For this investigation write down the:

3.3.1 Dependent variable (1)

3.3.2 Independent variable (1)

3.3.3 Conclusion that could be drawn from the above results. (2)

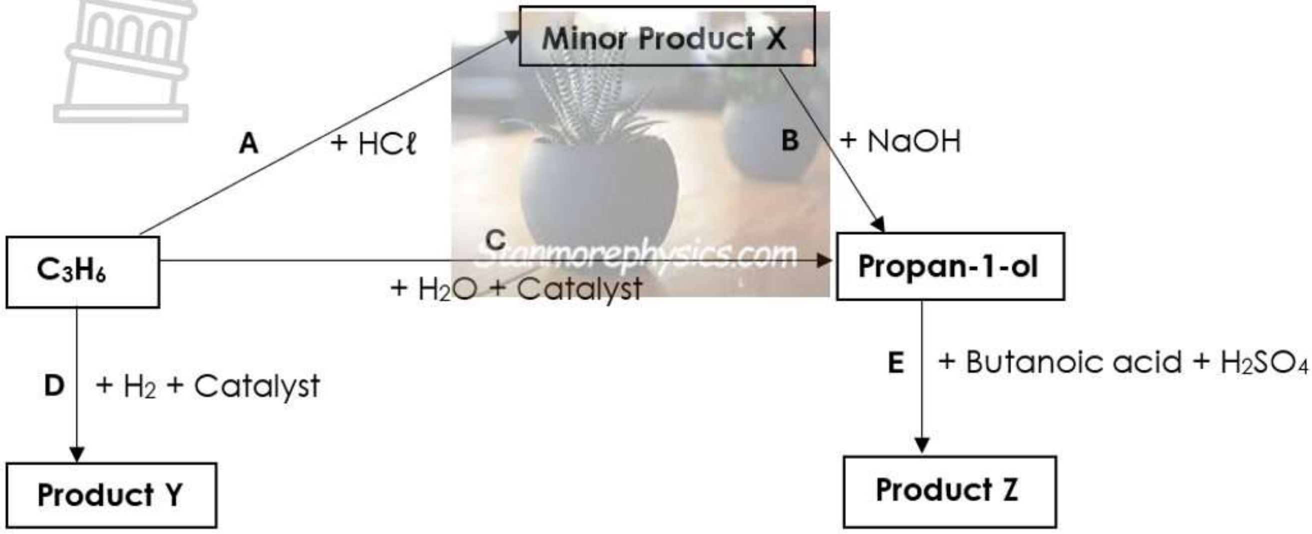
3.4 Which one of the compounds **W** or **X** has a higher vapour pressure? Give a reason for your answer. (2)

3.5 Use the information in the table to explain the difference in boiling points of compounds **Y** and **Z**. (3)

[12]

QUESTION 4 (Start on a new page)

Unsaturated organic compounds are often used in the production of other organic compounds. **Propene (C_3H_6)** is used as a reactant to produce various other organic compounds as shown in the diagram below. Study the diagram and answer the questions that follow.



4.1 In reaction **A**, the addition of hydrochloric acid produces a minor product **X**.

4.1.1 Identify the type of addition reaction that takes place. (1)

4.1.2 Draw the STRUCTURAL formula of the minor product **X** that forms in the reaction and write down the IUPAC name. (3)

4.1.3 State the reaction condition for reaction **A**. (1)

4.2 In reaction **B**, the minor product **X** is added to water and there is an addition of a dilute strong base at room temperature.

4.2.1 Identify the type of reaction that takes place. (1)

4.2.2 Explain what will happen when a concentrated strong base is added instead of a dilute strong base. (1)

4.2.3 Is the alcohol formed in reaction **B** a PRIMARY, SECONDARY or TERTIARY alcohol? Motivate your answer. (2)

4.2.4 How would an increase in temperature affect the amount of propan-1-ol produced? Only write INCREASE, DECREASE or REMAIN THE SAME. (1)

4.3 Reaction **C**, produces propan-1-ol and a *positional isomer* of propan-1-ol.

4.3.1 Define the term *positional isomer*. (2)

4.3.2 Write down the chemical formula or name of the catalyst used in reaction **C.** (1)

4.4 Write the IUPAC name of product **Y** formed in reaction **D**. (2)

4.5 Reaction **E** is commonly used in the food industry.

4.5.1 Name the type of reaction represented. (1)

4.5.2 Write down the IUPAC name of the organic product **Z**. (2)

4.5.3 State the function of H_2SO_4 in the reaction. (1)

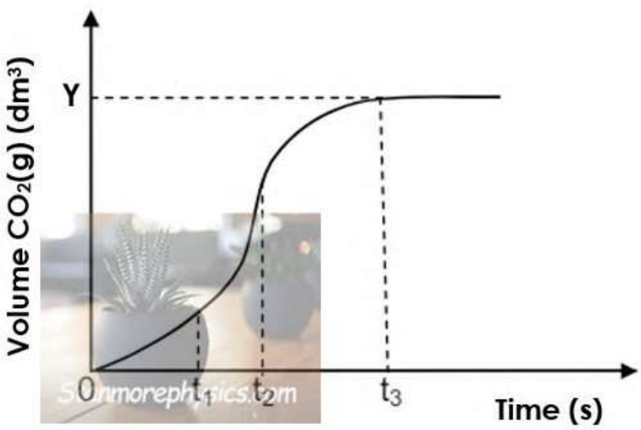
[19]

QUESTION 5 (Start on a new page)

The reaction of 10 g of a PURE sample of magnesium carbonate, $MgCO_3$, with EXCESS hydrochloric acid, HCℓ, of concentration 1,0 mol·dm^{-3}, is used to investigate the rate of a reaction. The balanced equation for the reaction is:

$$MgCO_3(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2O(\ell) + CO_2(g)$$

The volume of CO_2(g) produced is measured at regular intervals. A sketch graph representing the total volume of carbon dioxide gas produced as a function of time is shown below.



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

5.2 Give a reason why the gradient of the graph decreases between t_2 and t_3. (1)

5.3 Changes in the graph between t_1 and t_2 are due to temperature changes within the reaction mixture.

5.3.1 Is the reaction EXOTHERMIC or ENDOTHERMIC? (1)

5.3.2 Explain the answer in QUESTION 5.3.1 by referring to the graph. (3)

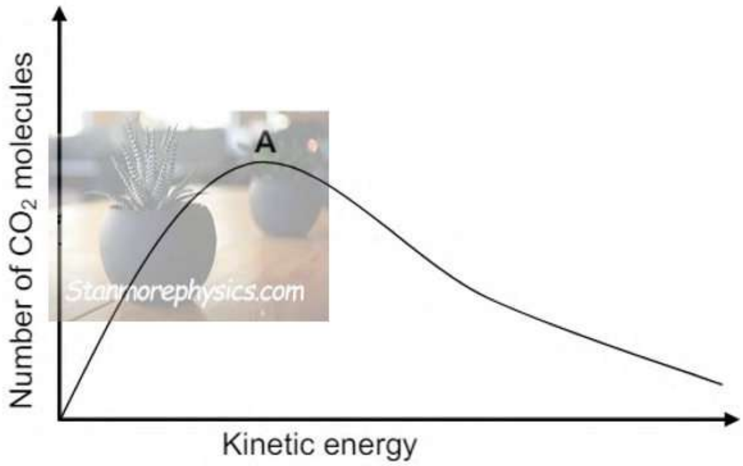
5.4 Calculate the value of **Y** on the graph assuming that the gas is collected at 25 °C. Take the molar gas volume at 25 °C as 24 dm^3. (4)

5.5 Calculate the reaction rate (in $dm^3.s^{-1}$) if the reaction takes 15 s to completion. (3)

5.6 How will the reaction rate change if 10 g of an IMPURE sample of $MgCO_3$ reacts with the same $HC\ell$ solution?
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

5.7 Use the collision theory to explain the answer to QUESTION 5.6. (2)

5.8 The graph below represents the Maxwell-Boltzmann distribution curve for CO_2(g) at 25 °C.



Redraw the graph above in the ANSWER BOOK. Clearly label the curve as **A**.
On the same set of axes, sketch the curve that will be obtained for the CO_2(g) at 35 °C. Label this curve as **B**. (2)

[19]

QUESTION 6 (Start on a new page)

6.1 The thermal decomposition of calcium carbonate ($CaCO_3$) that takes place in a closed container can be represented by the following equation:

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

Equilibrium is reached at 700 °C.

6.1.1 State *Le Chatelier's principle* in words. (2)

6.1.2 It is found that the value of K_c increases when the container is heated to 900°C. Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Use *Le Chatelier's principle* to explain your answer. (4)

6.2 The following reaction is investigated in a laboratory:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H < 0$$

Initially 3,45 mol of $SO_2(g)$ and an unknown mass, **X**, of $O_2(g)$ are sealed in a 3 dm^3 flask and allowed to reach equilibrium at a certain temperature.

At equilibrium it is found that the concentration of $SO_3(g)$ present in the flask is 0,65 $mol \cdot dm^{-3}$.

6.2.1 Calculate the mass of $O_2(g)$ initially present in the flask if the equilibrium constant (K_c) at this temperature is 1,52. (9)

6.2.2 The volume of the container is now decreased to 1 dm^3 while the temperature is kept constant. How will each of the following be affected? Write down only INCREASES, DECREASES or REMAINS THE SAME.

6.2.2.1 The value of K_c. (1)

6.2.2.2 The number of moles of $O_2(g)$ present in the equilibrium mixture. (1)

[17]

QUESTION 7 (Start on a new page)

150 g of impure barium hydroxide is dissolved in 2 dm^3 of water. 2 dm^3 of a hydrochloric acid solution, with a concentration of 0,75 $mol.dm^{-3}$, is then added to the barium hydroxide solution. A scientist measures the pH of the solution after the addition of the hydrochloric acid solution and finds the combined solution to have a pH of 12. The reaction between barium hydroxide and hydrochloric acid is represented below:

$$Ba(OH)_2(aq) \ + \ 2HC\ell(aq) \ \rightarrow \ BaC\ell_2(aq) \ + \ 2H_2O(\ell)$$

7.1 Define an acid in terms of *Lowry-Brønsted*. (2)

7.2 Calculate the concentration of hydroxide ions present in the solution after the hydrochloric acid solution was added. (5)

7.3 Calculate the *percentage purity* of the sample of barium hydroxide. (7)

7.4 Suggest an indicator that would be appropriate to use to indicate the endpoint during a titration between barium hydroxide and hydrochloric acid. Choose from *methyl orange*, *bromothymol blue* or *phenolphthalein*. (1)

7.5 Explain your answer to QUESTION 7.4 by referring to the strengths of the acid and base as well as the pH. (3)

[18]

QUESTION 8 (Start on a new page)

The following THREE unknown half-cells under standard conditions are given in the table below. Metal **X** displaces Y^{2+} ions in a YSO_4 solution and metal **Z** displaces X^{2+} ions in a XSO_4 solution.

NUMBER	HALF-CELL	ELECTROLYTE
1	X/X^{2+}	$XSO_4(aq)$
2	Y/Y^{2+}	$YSO_4(aq)$
3	Z/Z^{2+}	$ZSO_4(aq)$

8.1 Define the term *electrolyte*. (2)

Use the information above to answer the following questions:

8.2 Write down TWO conditions needed for these half-cell reactions to function under standard conditions. (2)

8.3 When metal **X** displaces Y^{2+} ions in a YSO_4 solution, will Y^{2+} be *oxidised* or *reduced*? Give a reason for your answer. (2)

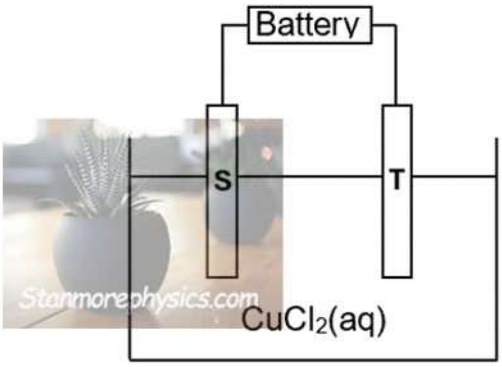
Suppose metals **Mg**, **Cu** and **Ni** replace **X**, **Y** and **Z** respectively and are now used to set up a galvanic cell under standard conditions.

8.4 Identify (from the metals above) a suitable pair of electrodes that will produce an emf of 2,7 V. Show your calculations. (4)

[10]

QUESTION 9 (Start on a new page)

In the electrolytic cell below, two carbon rods are used as electrodes and a concentrated copper(II)chloride solution ($CuC\ell_2$) is used as an *electrolyte*.



When the cell is in operation, a gas is released at electrode **S** while electrode **T** is covered with a brown layer.

9.1 Write down a half reaction to explain the observation made at:

9.1.1 Electrode **S**. (2)

9.1.2 Electrode **T**. (2)

9.2 Which electrode, **S** or **T**, is the cathode? Give a reason for the answer. (2)

9.3 A current of 2,5 A passes through the cell for 5 hours.
Calculate the:

9.3.1 Total charge that flows through the cell during this time. (2)

9.3.2 Increase in mass of the cathode. (5)

9.4 The carbon rods in the above cell are now replaced with COPPER RODS and the cell is allowed to operate for some time.

The following observations are made at electrode **S**:

- No gas is released.
- Its surface appears rough and corroded.

9.4.1 Refer to the RELATIVE STRENGTHS OF REDUCING AGENTS and explain these observations. (3)

9.4.2 This cell can be used for the purification of copper. Which electrode (**S** or **T**) will be replaced with the impure copper during this purification process? (1)

[17]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *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* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}\ /\ E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}\ /\ E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}\ /\ E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	
$I = \frac{Q}{\Delta t}$	$n = \frac{Q}{q_e}$ where n = number of electrons

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

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*: 29
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

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

Increasing strength of oxidising agents /*Toenemende sterkte van oksideermiddels*

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 strength of reducing agents /*Toenemende sterkte van reduseermiddels*

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

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

Increasing strength of oxidising agents /*Toenemende sterkte van oksideermiddels*

Increasing strength of reducing agents /*Toenemende sterkte van reduseermiddels*

Western Cape Government

Education

FOR YOU

PHYSICAL SCIENCES
PAPER 2
MARKING GUIDELINE DRAFT 2

GRADE 12

MNED PLC CLUSTER PAPER
SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

This marking guideline consists of 14 pages

QUESTION 1/ VRAAG 1 (MULTIPLE-CHOICE/ MEERVOUDIGEKEUSE)

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

QUESTION 2/ VRAAG 2

2.1 A series of organic compounds that can be described by the same general formula *OR* A series of organic compounds in which one member differs from the next with a CH_2 group. ✓✓ (2 or 0)

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word *OF* 'n Reeks organiese verbindings waarin een lid van die volgende verskil met 'n CH_2-groep. ✓✓ (2 of 0) (2)

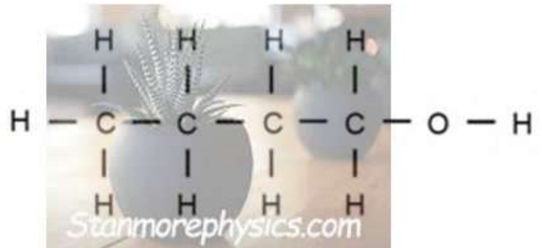
2.2.1 F✓ (1)

2.2.2 E & H✓ (1)

2.2.3 D✓ (1)

2.2.4 H✓ (1)

2.3



Mark allocation/ Puntetoekenning:

-O-H on first carbon/ -O-H op eerste koolstof✓

whole molecule correct/ hele molekule korrek✓ (2)

2.4.1 3-methylpentan-2-one **Marking allocation:** 3-methyl✓pentan-2-one ✓

3-metielpentan-2-oon **Puntetoekenning:** 3-metiel✓pentan-2-oon ✓ (2)

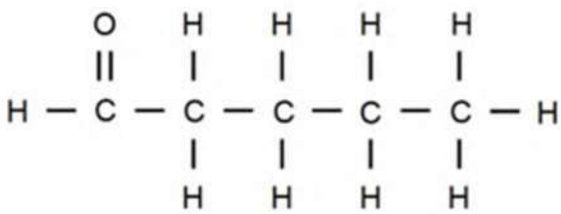
2.4.2 2,2,4-tribromo-3-ethylhexane

Mark allocation:2,2,4-tribromo✓3-ethyl✓ hexane✓

2,2,4-tribromo-3-etielheksaan

Puntetoekenning:2,2,4-tribromo✓3-etiel✓heksaan✓ (3)

2.5



Mark allocation/ Puntetoekenning:

Functional group (formyl group)/Funksionele groep (formielgroep)✓

Whole molecule correct/Hele molekule korrek✓ (2)

2.6 $2C_9H_{18} + 27O_2 \rightarrow 18CO_2 + 18H_2O$

reactants/reaktante ✓ products/produkte ✓ balancing/balansering✓ (3)

[18]

QUESTION 3/ VRAAG 3

3.1 Boiling point is the temperature ✓at which the vapour pressure of a substance is equal to the atmospheric pressure.✓
Kookpunt is die temperatuur✓ waarby die dampdruk van 'n stof gelyk is aan die atmosferiese druk.✓ (2)

3.2 Hydroxyl (group)/Hidroksiel (groep) ✓ (1)

3.3.1 Boiling point/ Kookpunt ✓ (1)

3.3.2 Chain length /molecular mass of the compounds✓
Kettinglengte/molekulêre massa van die verbindings✓ (1)

3.3.3 The increase in the chain length of compounds✓ results in an increase in the boiling point of compounds.✓
Die toename in die kettinglengte van verbindings✓ lei tot 'n toename in die kookpunt van verbindings.✓ (2)

OR

The decrease in the chain length of compounds✓ results in a decrease in the boiling point of compounds.✓
Die afname in die kettinglengte van verbindings✓ lei tot 'n afname in die kookpunt van verbindings.✓

3.4 W✓ Lower boiling point/ Vapour pressure is inversely proportional to the boiling point./ Weaker intermolecular forces✓
W✓ Laer kookpunt/dampdruk is omgekeerd eweredig aan die kookpunt./ Swakker intermolekulêre kragte✓ (2)

3.5 Compound Z/Pentan-1-ol has a longer chain length than compound Y/Butan-1-ol. ✓
The intermolecular forces/London forces of compound Z is stronger than compound Y. ✓
More energy is needed to overcome the intermolecular forces of compound Z than compound Y✓

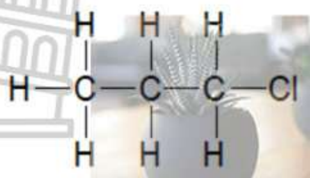
Verbinding Z/Pentan-1-ol se kettinglengte is langer as verbinding Y/Butan-1-ol. ✓
Die intermolekulêre kragte/Londonkragte van verbinding Z is sterker as verbinding Y. ✓
Meer energie is nodig om die intermolekulêre kragte van verbinding Z te oorkom as die van verbinding Y✓ (3)

[12]

QUESTION 4/ VRAAG 4

4.1.1 Hydrohalogenation/ Hydrochlorination✓
Hidrohalogenering/Hidrochlorinering✓ (1)

4.1.2



1-chloropropane/ 1-chloropropaan

<u>Mark allocation/Punte toekenning:</u>
Cℓ on first carbon✓ Whole structural formula correct✓ Correct IUPAC name✓
Cℓ op eerste koolstof✓ Hele struktuurformule korrek✓ Korrekte IUPAC naam✓
Note: Negative marking on naming if the structural formula is incorrect.
Let wel: Negatiewe nasien by benaming as die struktuurformule verkeerd is. (3)

4.1.3 No water present/ Geen water teenwoordig✓ (1)

4.2.1 Substitution/ Substitusie/ Hydrolysis/Hidrolise✓ (1)

4.2.2 The use of a concentrated strong base will <u>result in an elimination reaction</u>✓ thus producing propene and not a substitution reaction as desired.
Die gebruik van 'n gekonsentreerde sterk basis sal <u>lei tot 'n eliminasiereaksie</u>✓ wat dus propeen produseer en nie 'n substitusiereaksie soos verlang nie. (1)

4.2.3 Primary✓
The carbon atom that is bonded to the hydroxyl group is attached to only one other carbon atom✓
Primêre✓
Die koolstofatoom wat aan die hidroksielgroep gebind is, is aan slegs een ander koolstofatoom geheg✓ (2)

4.2.4 Remain the same/ Bly dieselfde✓ (will only increase the rate of the reaction) (1)

4.3.1 <u>Same molecular formula</u>✓, but <u>different positions of the side chain/substituents/functional groups on the parent chain</u>. ✓
<u>Dieselfde molekulêre formule</u>✓, maar <u>verskillende posisies van die syketting/ substituente/funksionele groepe op die moederketting</u>. ✓ (2)

4.3.2 H_3PO_4/Phosphoric acid/Fosforsuur✓ OR/OF H_2SO_4/Sulphuric acid/Swaelsuur (1)

4.4 Propane/ Propaan✓✓ (2)

4.5.1 Esterification/Esterifikasie OR/OF Condensation/Kondensasie✓ (1)

4.5.2 Propyl✓butanoate✓/ Propiel✓butanoaat✓ (2)

4.5.3 Catalyst/ Katalisator ✓ OR/OF Dehydrating agent/Dehidreermiddel (1)

[19]

QUESTION 5/ VRAAG 5

5.1 Change in concentration of products/reactants per unit time. ✓✓ (2 or 0)
Verandering in konsentrasie van produkte/reaktante per tydseenheid.✓✓ (2 of 0) (2)

5.2 Reaction rate decreases / Concentration of HCℓ decreases/ Concentration of reactants decreases / Reactants are used up/ Mass of $MgCO_3$ decreases or is used up. ✓
Reaksietempo neem af / Konsentrasie van HCℓ neem af/ Konsentrasie van reaktante neem af / Reaktante word opgebruik/ Massa $MgCO_3$ neem af of word opgebruik. ✓ (1)

5.3.1 EXOTHERMIC/ EKSOTERMIES✓ (1)

5.3.2 Gradient increases/ becomes steeper/ Curve becomes steeper. ✓
Reaction rate increases/ More (or larger volume) of CO_2 is produced per unit time. ✓
Temperature increases/ Energy is released/ Average kinetic energy of the molecules increases. ✓

Gradiënt neem toe/ word steiler/ Kromme word steiler. ✓
Reaksietempo neem toe/ Meer (of groter volume) CO_2 word per tydseenheid geproduseer. ✓
Temperatuur styg/ Energie word vrygestel/ Gemiddelde kinetiese energie van die molekules neem toe. ✓ (3)

5.4 $n(MgCO_3) = \frac{m}{M}$

$= \frac{10}{84}$ ✓

$= 0{,}119$ mol

$n(CO_2) = n(MgCO_3) = 0{,}119$ mol✓ (use of mole ratio/gebruik molverhouding)

$V(CO_2) = nV_m$

$= (0{,}119)(24)$ ✓

$= 2{,}86 dm^3$ ✓ (Answer range: $2{,}856\ dm^3 - 2{,}880\ dm^3$) (4)

5.5 Rate/Tempo $= \frac{\Delta V}{\Delta t}$ **Positive marking from Q5.4**

$= \frac{2{,}856 - (0)}{15}$ ✓✓ (if/indien (0 - 2,856) max ⅓ /maks ⅓)

$= 0{,}1904\ (dm^3.s^{-1})$ ✓ (3)

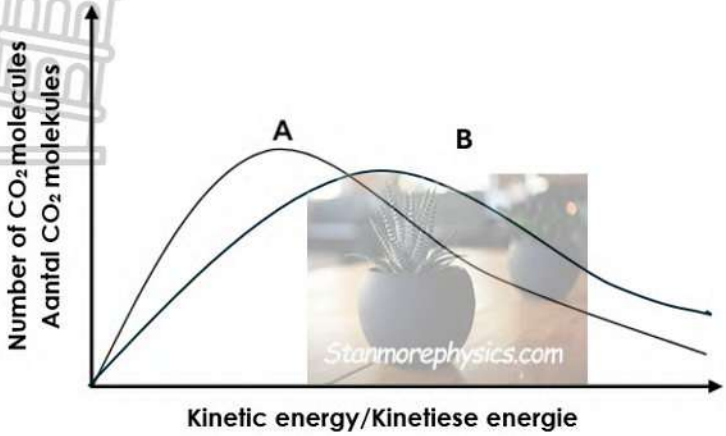
5.6 DECREASES/ VERLAAG ✓ (1)

5.7 Less ($MgCO_3$) particles with correct orientation/ Less exposed surface area.✓
Less effective collisions per unit time/ Lower frequency of effective collisions.✓

Minder ($MgCO_3$) deeltjies met korrekte oriëntasie/ Minder blootgestelde

oppervlakte.✓
Minder effektiewe botsings per tydseenheid/ Laer frekwensie van effektiewe botsings.✓ (2)

5.8



(2)

Marking criteria/Nasienkriteria		
1	Curve B has a lower peak to the right of curve A. Kurwe B het laer piek aan die regterkant van kurwe A.	✓
2	Curve B is above curve A beyond the peak of curve B Kurwe B is bo kurwe A na die piek van kurwe B.	✓
If BOTH graphs not labelled (A and B): no marks Indien BEIDE grafieke nie benoem nie (A en B): geen punte		

[19]

QUESTION 6/ VRAAG 6

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

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance.✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. (2)

6.1.2 Endothermic.✓
According to Le Chatelier's principle an increase in temperature will favour the endothermic reaction.✓

When the temperature was increased the K_c value increased, therefore $[CO_2]$ increased/more product formed, ✓therefore the forward reaction was favoured.✓ Therefore the forward reaction is endothermic.
Endotermies.✓
Volgens Le Chatelier se beginsel sal 'n toename in temperatuur die endotermiese reaksie bevoordeel.✓
Toe die temperatuur verhoog is, the K_c toegeneem, dus het $[CO_2]$ verhoog/produkte vermeeder ✓en dus word die voorwaartse reaksie bevoordeel.✓ Dus is die voorwaartse reaksie endotermies. (4)

6.2.1 **Marking criteria OPTION 1-3/ Nasienkriteria OPSIE 1-3:**

a) Calculate $n(SO_3) = cV = (0,65)(3) = 1,95$ mol
b) Calculate $n(SO_3)_{formed/gevorm} = n_{equilibrium/ewewig} + n_{initial/begin} = 1,95$
c) Use mole ratio 2:1:2
d) $n(O_2)_{initial} = \frac{x}{32}$ (Show substitution of M = 32 g.mol^{-1})
e) Calculate $n(SO_2)_{equilibrium/ewewig}$ & $n(O_2)_{equilibrium/ewewig}$: $n_{initial/begin} - n_{used/gebruik}$
f) Calculate concentration by dividing $n_{equilibrium/ewewig}$ by 3dm^3
g) Correct K_c expression
h) Substitute equilibrium concentrations and K_c value into K_c expression
i) Answer: $x = m(O_2) = 137,94$ g (Answer range: 137,80g - 138,45g)

No K_c expression, correct substitution/ Geen K_c uitdrukking, korrekte substitusie: Max/Maks $\frac{8}{9}$
Wrong K_c expression/ Verkeerde K_c uitdrukking: Max/Maks $\frac{6}{9}$

OPTION/OPSIE 1

	SO_2	O_2	SO_3	
Mole ratio/ Mol verhouding	**2**	**1**	**2**	
Initial mol/ Aanvanklike mol	**3,45**	$\frac{x}{32}$✓	0	
Change in mol/ Verandering in mol	1,95	0,975	1,95✓	*Ratio✓*
Mol at equilibrium/ Mol by ewewig	✓1,5	$\frac{x}{32} - 0,975$	1,95✓	
Concentration at equilibrium/ Konsentrasie by ewewig	0,5	$\frac{x-31,2}{96}$	**0,65**	*Divide by 3✓*

$$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}✓$$

$$1,52 = \frac{(0,65)^2}{(0,5)^2(\frac{x-31,2}{96})}✓$$

(9)

$x = 137,94g$ ✓

OPTION/OPSIE 2

	SO_2	O_2	SO_3	
Mole ratio/ Mol verhouding	**2**	**1**	**2**	
Initial mol/ Aanvanklike mol	**3,45**	y	0	
Change in mol/ Verandering in mol	1,95	0,975	1,95✓	*Ratio*✓
Mol at equilibrium/ Mol by ewewig	✓1,5	y - 0,975	1,95✓	
Concentration at equilibrium/ Konsentrasie by ewewig	0,5	$\frac{y-0,975}{3}$	**0,65**	*Divide by 3*✓

$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ ✓

$1,52 = \frac{(0,65)^2}{(0,5)^2(\frac{y-0,975}{3})}$ ✓

$y = 4,3105\ mol$

$m(O_2) = nM = (4,3105)(32)$ ✓

$x = m(O_2) = 137,94g$ ✓

OPTION/OPSIE 3

	SO_2	O_2	SO_3	
Mole ratio/ Mol verhouding	**2**	**1**	**2**	
Initial mol/ Aanvanklike mol	**3,45**	y	0	
Change in mol/ Verandering in mol	1,95	0,975	1,95✓	*Ratio*✓
Mol at equilibrium/ Mol by ewewig	1,5✓	y - 0,975	1,95✓	
Concentration at equilibrium/ Konsentrasie by ewewig	0,5	$[O_2]$	**0,65**	*Divide by 3*✓

$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$✓

$1,52 = \frac{(0,65)^2}{(0,5)^2[O_2]}$✓

$[O_2] = 1,1118\ mol.dm^{-3}$

$y - 0,975 = (1,1118)(3)$

$y = 4,3105\ mol$

$m(O_2) = nM = (4,3105)(32)$✓

$x = m(O_2) = 137,94g$✓

Marking criteria OPTION 4-5/ Nasienkriteria OPSIE 4-5:

a) Calculate initial concentration by dividing $n_{initial/aanvanklik}$ by $3dm^3$
b) Calculate $c(SO_3)_{formed/gevorm}$ = $c_{initial/begin} + c_{equilibrium/ewewig}$ = 0,65 ($mol.dm^{-3}$)
c) Use mole ratio 2:1:2
d) $c(O_2)_{initial} = \frac{x}{32\times 3}$ (Show substitution of M = 32 $g.mol^{-1}$)
e) Divide by 3 dm^3 to calculate concentration OR Multiply by 3 dm^3 to calculate mass($m(O_2) = cMV$)
f) Calculate $c(SO_2)_{equilibrium/ewewig}$ & $c(O_2)_{equilibrium/ewewig} = c_{initial/begin} - c_{used/gebruik}$
g) Correct K_c expression
h) Substitute equilibrium concentrations and K_c value into K_c expression
i) Answer: x = $m(O_2)$ = 137,94 g (Answer range: 137,80g - 138,45g)

No Kc expression, correct substitution/ Geen Kc uitdrukking, korrekte substitusie: Max/Maks $\frac{8}{9}$
Wrong Kc expression/ Verkeerde Kc uitdrukking: Max/Maks $\frac{6}{9}$

OPTION/OPSIE 4

	SO_2	O_2	SO_3	
Mole ratio/ Mol verhouding	**2**	**1**	**2**	
Initial concentration/ Aanvanklike konsentrasie	✓ $\frac{3,45}{3} = 1,15$	$\frac{x}{32\times 3} = \frac{x}{96}$	0	*M = 32✓ Divide by 3✓*
Change in concentration/ Verandering in konsentrasie	0,65	0,325	0,65 ✓	*Ratio✓*
Concentration at equilibrium/ Konsentrasie by ewewig	0,5✓	$\frac{x}{96} - 0,325$	**0,65**	

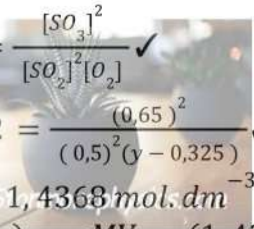
$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ ✓

$1,52 = \frac{(0,65)^2}{(0,5)^2(\frac{x}{96} - 0,325)}$ ✓

$x = m(O_2) = 137,94g$ ✓

OPTION/OPSIE 5

	SO_2	O_2	SO_3	
Mole ratio/ Mol verhouding	**2**	**1**	**2**	
Initial concentration/ Aanvanklike konsentrasie	✓ $\frac{3,45}{3} = 1,15$	y	0	
Change in concentration/ Verandering in konsentrasie	0,65	0,325	0,65✓	*Ratio*✓
Concentration at equilibrium/ Konsentrasie by ewewig	0,5✓	$y - 0,325$	**0,65**	



$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ ✓

$1,52 = \frac{(0,65)^2}{(0,5)^2(y - 0,325)}$ ✓

$y = 1,4368\ mol.dm^{-3}$

$m(O_2) = cMV = (1,4368)(32)(3)$ ✓✓

$m(O_2) = 137,94g$ ✓

6.2.2.1 Remains the same✓
Bly dieselfde✓ (1)

6.2.2.2 Decrease✓
Verminder✓ (1)

[17]

QUESTION 7/ VRAAG 7

7.1 A proton donor. ✓✓ (2 or 0)
'n Proton skenker. ✓✓ (2 of 0) (2)

7.2
$pH = -\log[H_3O^+]$ ✓
12 ✓ $= -\log[H_3O^+]$
$[H_3O^+] = 1 \times 10^{-12}$

$K_w = [H_3O^+][OH^-]$ ✓
$1 \times 10^{-14} = [1 \times 10^{-12}][OH^-]$ ✓
$[OH^-] = 1 \times 10^{-2}\ mol.dm^{-3}$ ✓

Mark allocation/Puntetoekenning:
a)pH formula/ pH formule
b)Substitution into pH formula/ Vervanging in pH formule
c)K_w formula/ K_w formule
d)Substitution into K_w formula/ Vervanging in K_w formule
e)Final answer correct/ Finale antwoord korrek
(5)

7.3 $Ba(OH)_2(aq) + 2HC\ell(aq) \rightarrow BaC\ell_2(aq) + 2H_2O(\ell)$

$n(HC\ell) = cV$
$= (0{,}75)(2)$ ✓
$= 1{,}5\ mol$

$n(Ba(OH)_2)_{reacts} = \frac{1}{2} n(HC\ell)$
$= (0{,}5)(1{,}5)$ ✓
$= 0{,}75\ mol$

$n(Ba(OH)_2)_{excess} = \frac{1}{2} n(OH^-)$
$= \frac{1}{2} cV$
$= (0{,}5)(1 \times 10^{-2})(4)$ ✓ **Positive marking from Q7.2**
$= 0{,}02\ mol$

$n(Ba(OH)_2)_{total} = 0{,}75 + 0{,}02$ ✓
$= 0{,}77\ mol$

$m(Ba(OH)_2) = nM$
$= (0{,}77)(171)$ ✓ $M = (137 + (2 \times 16) + 2) = 171\ g.mol^{-1}$
$= 131{,}67\ g$

$\%purity = \frac{131{,}67}{150} \times 100$ ✓
$= 87{,}78\%$ ✓
(7)

Mark allocation:	**Puntetoekenning:**
a)Calculate $n(HC\ell)$ b)Mole ratio of $Ba(OH)_2$ to $HC\ell$ used c)Calculate $n(Ba(OH)_2)_{excess}$ d)Calculate $n(Ba(OH)_2)_{total}$ e)Substitution of $M = 171\ g.mol^{-1}$ and $n(Ba(OH)_2)_{total}$ into $n = \frac{m}{M}$ f)$m(Ba(OH)_2) \div 150g \times 100$ g)Final answer = 87,78%	a)Bereken $n(HC\ell)$ b)Molverhouding van $Ba(OH)_2$ tot $HC\ell$ gebruik c)Bereken $n(Ba(OH)_2)_{oormaat}$ d)Bereken $n(Ba(OH)_2)_{totaal}$ e)Vervanging van $M = 171\ g.mol^{-1}$ en $n(Ba(OH)_2)_{totaal}$ in $n = \frac{m}{M}$ f)$m(Ba(OH)_2) \div 150g \times 100$ g)Finale antwoord = 87,78%

7.4 Bromothymol blue/ Broomtimolblou ✓ (1)

7.5 Barium hydroxide is a strong base ✓and hydrochloric acid is a strong acid.✓ The salt that is formed is neutral and at the endpoint the pH will be (around) 7. ✓

Bariumhidroksied is 'n sterk basis✓ en soutsuur is 'n sterk suur.✓ Die sout wat gevorm word is neutral en die pH by die eindpunt is (ongeveer) 7.✓ (3)

Negative marking from Q7.2/Negatief merk vanaf V7.2

[18]

QUESTION 8/ VRAAG 8

8.1 A solution/liquid/dissolved substance that conducts electricity ✓through the movement of ions.✓
'n Oplossing/vloeistof/opgeloste stof wat elektrisiteit gelei ✓ deur die beweging van ione. ✓ (2)

8.2 Temperature at 25°C/ 298 K / Temperatuur van 25°C/ 298 K✓
Concentration of 1 $mol.dm^{-3}$ / Konsentrasie van 1 $mol.dm^{-3}$ ✓ (2)

8.3 It is reduced,✓ because Y^{2+} gains/accepts electrons from metal X / It is an oxidising agent / the oxidation number decreases. ✓
Word gereduseer,✓ want Y^{2+} ontvang elektrone vanaf metaal X / Is 'n reduseermiddel / die oksidasie getal verminder ✓ (2)

8.4 **<u>OPTION 1/OPSIE 1</u>**
Mg and/en Cu ✓

$E^o_{cell} = E^o_{cathode} - E^o_{anode}$✓
$E^o_{sel} = E^o_{katode} - E^o_{anode}$
$= (+0,34)$✓ $- (-2,36)$✓
$= 2,7$ V

<u>OPTION 2/OPSIE 2</u>
Mg and/en Cu ✓

$Cu^{2+} + 2e^- \rightarrow Cu \qquad +0,34$ V✓
$Mg \rightarrow Mg^{2+} + 2e^- \qquad -2,36$ V✓
$Cu^{2+} + Mg \rightarrow Cu + Mg^{2+} \qquad +2,70$ V✓ (4)

<u>Notes/Aantekeninge</u>
Accept any other correct formula from the data sheet/ Aanvaar enige ander korrekte formule vanaf gegewensblad.

Any other formula using unconventional abbreviations, e.g. $E^o_{cell} = E^o_{OA} - E^o_{RA}$ followed by correct substitution:/ Enige ander formule wat onkonvensionele afkortings gebruik bv. $E^o_{sel} = E^o_{OM} - E^o_{RM}$ gevolg deur korrekte vervangings:
-1 mark/punt

[10]

QUESTION 9/ VRAAG 9

9.1.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

$2C\ell^- \leftrightharpoons C\ell_2 + 2e^-$	1/2	$C\ell_2 + 2e^- \leftarrow 2C\ell^-$	2/2
$2C\ell^- \leftarrow C\ell_2 + 2e^-$	0/2	$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	0/2

9.1.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

$Cu^{2+} + 2e^- \leftrightharpoons Cu$	1/2	$Cu \leftarrow Cu^{2+} + 2e^-$	2/2
$Cu^{2+} + 2e^- \leftarrow Cu$	0/2	$Cu \rightleftharpoons Cu^{2+} + 2e^-$	0/2

9.2 T ✓
Reduction occurs there / Cu^{2+} is reduced at T / Cu^{2+} is an oxidising agent✓
Reduksie vind daar plaas / Cu^{2+} word geoksideer by T / Cu^{2+} 'n oksideermiddel✓ (2)

9.3.1 $Q = I\Delta t$
$= (2,5)(5 \times 60 \times 60)$✓ OR $(2,5)(18\ 000)$
$= 45\ 000\ C$ $(4,5 \times 10^4\ C)$✓ (2)

9.3.2 $n = \frac{Q}{e}$ OR $n = \frac{Q}{q_e}$

$= \frac{45\ 000}{1,6 \times 10^{-19}}$ ✓ **Positive marking from Q9.3.1**

$= 2,8125 \times 10^{23}$ (electrons)

N(Cu atoms) $= \frac{2,8125 \times 10^{23}}{2}$ ✓

$= 1,40625 \times 10^{23}$

n(Cu) $= \frac{1,40625 \times 10^{23}}{6,02 \times 10^{23}}$ ✓

$= 0,23356$ mol

m(Cu) = nM

$= (0,23356)(63,5)$ ✓

$= 14,83$ g✓ (Answer range: 14,61g -14,83g) (5)

9.4.1 Cu is a stronger reducing agent✓ than $C\ell^-$ ✓ and thus Cu will be oxidised from Cu to Cu^{2+}✓. (no $C\ell_2$ gas formed but Cu will dissolve/break up)
Cu is 'n sterker reduseermiddel ✓ as $C\ell^-$ ✓en sal dus van Cu word geoksideer na Cu^{2+}✓. (3)

9.4.2 S ✓ (1)

TOTAL: 150 **[17]**