KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL STANDARDISED ASSESSMENT

GRADE 12

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

SEPTEMBER 2026

MARKS: 150

TIME: 3 HOURS

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

INSTRUCTIONS AND INFORMATION

1. Write your name 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 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

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.10) on the answer sheet.

1.1 Which ONE of the compounds below is an aldehyde?

A CH_3COCH_3

B CH_3CH_2COOH

C $CH_3CH_2CH_2OH$

D CH_3CH_2CHO (2)

1.2 Which ONE of the following compounds is a tertiary alcohol?

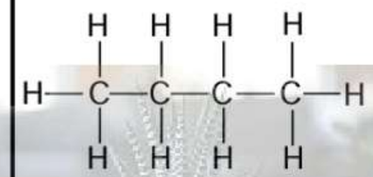
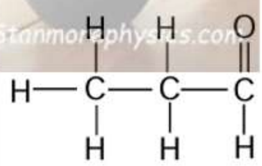
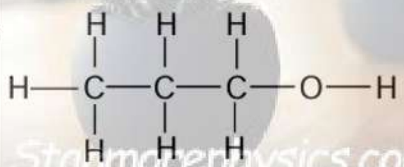
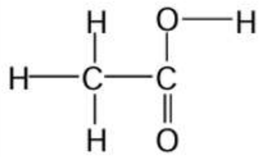
A 3-methylhexan-1-ol

B 2-methylhexan-3-ol

C 2-methylhexan-2-ol

D 3-methylhexan-2-ol (2)

1.3 Which ONE of the following compounds has the LOWEST vapour pressure under the same conditions?

A		B	
C		D	

(2)

1.4 A compound $CH_3(CH_2)_5CH_3$ undergoes the following reaction:

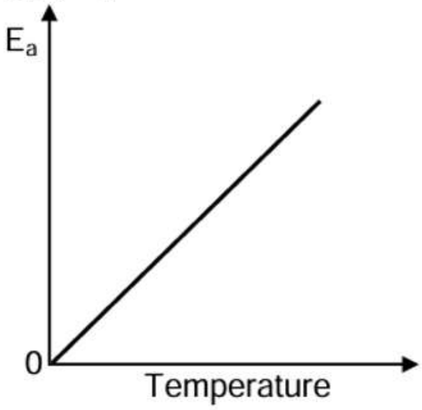
$$CH_3(CH_2)_5CH_3 \rightarrow \mathbf{R} + CH_3(CH_2)_2CH_3$$

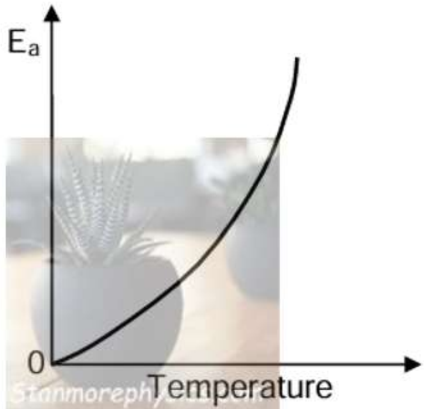
Which ONE of the following combinations CORRECTLY describes the type of reaction and the IUPAC name of compound **R**?

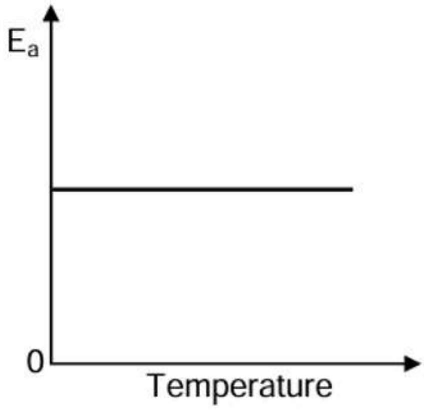
	TYPE OF REACTION	IUPAC NAME
A	Elimination	Propane
B	Addition	Propene
C	Cracking	Propane
D	Cracking	Propene

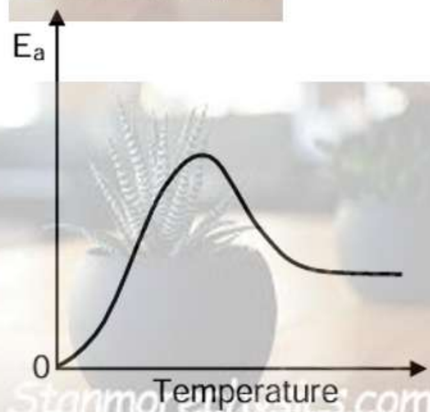
(2)

1.5 Which ONE of the following graphs shows the relationship between activation energy (Ea) of a reaction and temperature?

A


B


C


D


(2)

1.6 A reaction reaches equilibrium at 25 °C in a flask according to the following balanced equation:

$$Co(H_2O)_6^{2+}(aq) + 4C\ell^-(aq) \rightleftharpoons CoC\ell_4^{2-}(aq) + 6H_2O(\ell) \quad \Delta H > 0$$

Pink blue

Which ONE of the following will change the colour of the mixture from pink to blue?

A Adding $NH_4C\ell(aq)$

B Adding water

C Adding NaOH(aq)

D Cooling the flask (2)

1.7 Dilute nitric acid is added to distilled water at 25 °C.
How will this affect the hydronium ion concentration $[H_3O^+]$ and the ionisation constant (K_w) of water at 25 °C?

	$[H_3O^+]$	K_w
A	Decreases	Increases
B	Increases	Remains the same
C	Remains the same	Increases
D	Increases	decreases

(2)

1.8 In a galvanic (voltaic) cell, electrons move from the ...

A anode to the cathode in the external circuit.

B cathode to the anode in the external circuit.

C anode to the cathode through the salt bridge.

D cathode to the anode through the salt bridge. (2)

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

A $Br_2\,(aq) + 2C\ell^-\,(aq) \rightarrow 2Br^-\,(aq) + C\ell_2\,(g)$

B $2Fe^{3+}\,(aq) + 2I^-\,(aq) \rightarrow 2Fe^{2+}\,(aq) + I_2\,(g)$

C $Ni^{2+}\,(aq) + H_2\,(g) \rightarrow Ni\,(s) + 2H^+\,(aq)$

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

1.10 A concentrated sodium chloride solution ($NaC\ell$) undergoes electrolysis in an electrolytic cell. The product(s) formed at the cathode is/are:

A H_2 and OH^-

B O_2 and H^+

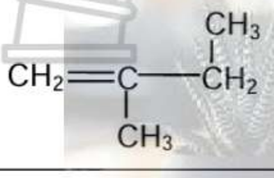
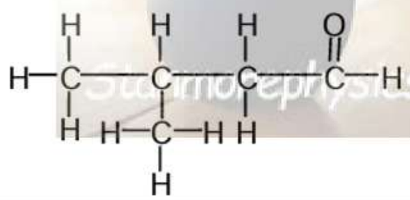
C Na

D $C\ell_2$ (2)

[20]

QUESTION 2 (Start on a new page)

The letters A to F in the table below represent six organic compounds.

A	$CH\equiv C-CH_2-CH_2-CH_3$	**B**	$CH_3CH_2CH_2\underset{\underset{OH}{\vert}}{C}HCH_3$
C		**D**	Pentanoic acid
E		**F**	$CH_3-CH_2-O-\overset{\overset{O}{\Vert}}{C}-CH_2-CH_3$

2.1 Write down the letter(s) that represent(s) each of the following:

2.1.1 A compound with a hydroxyl group. (1)

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

2.1.3 TWO compounds that have the same molecular formula but different functional groups. (2)

2.2 Write down:

2.2.1 The IUPAC name of compound C. (2)

2.2.2 The homologous series to which compound E belongs. (1)

2.2.3 The structural formula of a SINGLE-BRANCHED chain isomer of compound D. (3)

2.3 A group of campers on a mountain uses a portable gas stove fuelled by butane (C_4H_{10}). The temperature and pressure on the mountain are 20°C and 90 kPa, respectively. downloaded from Stanmorephysics
Butane gas is burnt in EXCESS oxygen according to the following unbalanced chemical equation:

$$C_4H_{10}\,(g) + O_2\,(g) \rightarrow CO_2\,(g) + H_2O\,(g)$$

2.3.1 Write down the NAME of the reaction taking place. (1)

2.3.2 Balance the chemical equation above. (2)

2.3.3 Calculate the volume of butane gas that will be required to produce 5 dm³ of carbon dioxide gas at 20 °C and 90 kPa. (3)

[16]

QUESTION 3 (Start on a new page)

Learners investigate factors that influence the boiling points of organic compounds. The boiling points of some organic compounds obtained are shown in the table below.

	COMPOUND	MOLECULAR MASS ($g.mol^{-1}$)	BOILING POINT (°C)
A	Propane	44	-42
B	Butane	58	-0,5
C	Pentane	72	36
D	2-methylbutane	72	28
E	Ethanal	44	**X**
F	Ethanol	46	78

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

3.2 Consider compounds A, B, and C.

3.2.1 To which homologous series do compounds A, B, and C belong? (1)

3.2.2 Explain the difference in Boiling points between compounds A, B, and C by referring to the relative strength of Intermolecular forces. (3)

3.2.3 Which ONE of the compounds A, B, and C has the LOWEST vapour pressure? Give a reason for your answer. (2)

3.3 Compounds C and D have the same molecular formula but different structural formulae.

3.3.1 Distinguish between a *molecular formula* and a *structural formula*. (2)

3.3.2 What TYPE of Isomers are compounds C and D?
Choose from POSITIONAL, CHAIN, or FUNCTIONAL GROUP. (1)

3.3.3 Referring to their structural formulae, give a reason why compound C has a higher boiling point than compound D. (1)

3.4 The boiling point of compound A is – 42 °C while that of compound E is **X**.

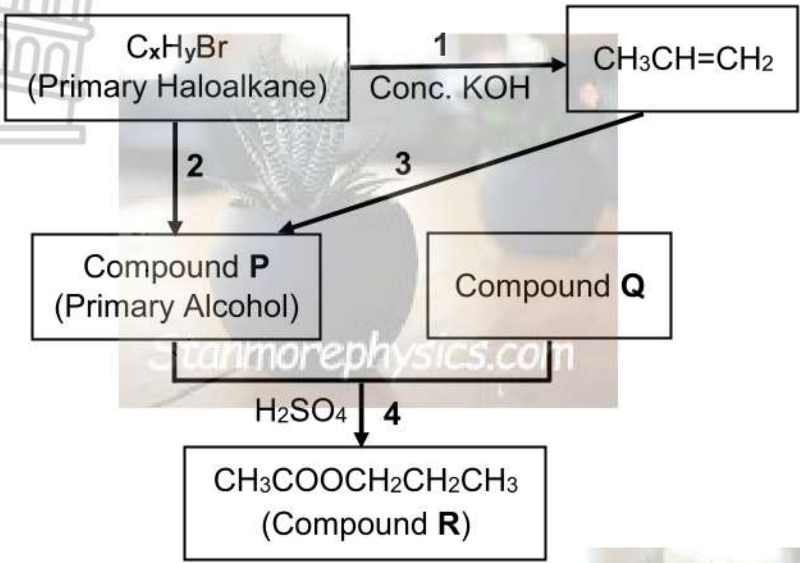
3.4.1 Write down the condensed structural formula of compound E. (1)

3.4.2 How does the boiling point of compound E compare to the boiling point of compound A?
Write down HIGHER THAN, LOWER THAN, or EQUAL TO. (1)

3.4.3 Fully explain your answer in 3.4.2. (3)
[17]

QUESTION 4 (Start on a new page)

Study the flow diagram below.
1, 2, 3, and **4** represent Chemical reactions.



4.1 Define the term *Primary haloalkane*. (2)

4.2 For Reaction **1**, write down:

4.2.1 The TYPE of reaction taking place. (1)

4.2.2 In addition to using concentrated alcoholic KOH, what other condition is necessary for this reaction? (1)

4.2.3 The values of **x** and **y** in C_xH_yBr. (2)

4.2.4 Formulae of INORGANIC products formed. (2)

4.3 Reaction **3** is an addition reaction.

4.3.1 What TYPE of Addition reaction is reaction **3**? (1)

4.3.2 Write down the IUPAC name of Compound **P**. (1)

4.3.3 Is compound **P** the MAJOR or MINOR product of reaction **3**? (1)

4.4 In reaction **4,** compound **P** reacts with compound **Q** in the presence of concentrated Sulphuric acid (H_2SO_4) to form compound **R**.

4.4.1 To which homologous series does compound **Q** belong? (1)

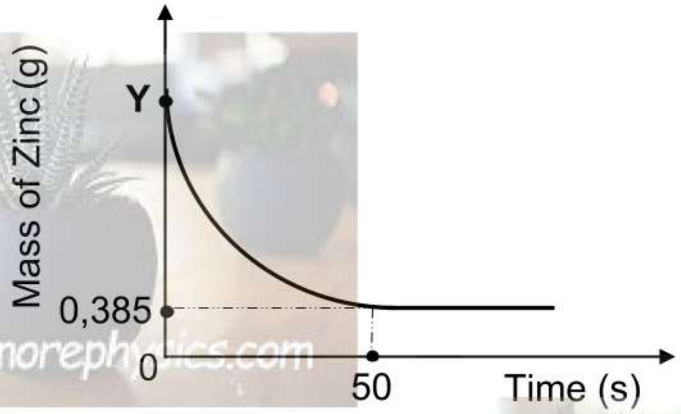
4.4.2 Write down the balanced chemical equation, using structural formulae, for reaction **4**. (4)
[16]

QUESTION 5 (Start on a new page)

An unknown mass of Zinc granules is added to a dilute hydrochloric acid solution in a conical flask at room temperature.
The balanced chemical equation of the reaction taking place is:

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

The graph below shows the change in mass of the zinc granule as they react with the acid.



The temperature of the reaction mixture increases as the reaction progresses.

5.1 Is the reaction above EXOTHERMIC or ENDOTHERMIC? Give a reason. (2)

5.2 Why is the graph horizontal after 50 seconds? (1)

5.3 Define *reaction rate*. (2)

5.4 How will the rate of this reaction be affected if POWDERED Zinc was used instead of Zinc granules?
Write down INCREASES, DECREASES, or REMAINS THE SAME. (1)

5.5 Use the Collision theory to explain your answer in Question 5.4. (3)

The volume of Hydrogen gas collected after 50 seconds is 0,168 dm^3. Take the molar volume of gas at room temperature as 24 $dm^3.mol^{-1}$.

5.6 Calculate the value of **Y** shown on the graph. (6)

5.7 Calculate the rate at which Zinc reacts in $g.s^{-1}$. (3)

[18]

QUESTION 6 (Start on a new page)

During the contact process, Sulphur dioxide (SO_2) reacts with Oxygen (O_2) to form Sulphur trioxide (SO_3) according to the following balanced chemical equation:

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

Initially, **X** mol $SO_2(g)$ and 6 mol $O_2(g)$ are sealed in a 2 dm^3 container, and the system is allowed to reach its first equilibrium at 450 °C.
It is found that the concentration of O_2 at this equilibrium is 1,5 $mol.dm^{-3}$.

6.1 Explain why chemical equilibrium is considered *dynamic*. (2)

6.2 The pressure of the system is increased by decreasing the volume of the container, while the temperature is kept constant.

6.2.1 Which reaction will be favoured as a result of the pressure increase? Write FORWARD or REVERSE. Give a reason. (2)

6.2.2 How will the Kc value be affected by the increase in pressure? Write INCREASES, DECREASES, or REMAINS THE SAME. (1)

6.3 A new equilibrium is reached at the same temperature of 450 °C. The second equilibrium concentrations are as follows:

$[SO_2]$ = 1,7888 $mol.dm^{-1}$; $[O_2]$ = 1,2 $mol.dm^{-1}$ and $[SO_3]$ = 2,4 $mol.dm^{-1}$.

Calculate the number of moles of SO_2, **X**, that was initially placed in the container. (9)

6.4 When the temperature is decreased, the equilibrium constant (K_c) increases.

6.4.1 State *Le Chatelier's principle*. (2)

6.4.2 Is the forward reaction EXOTHERMIC or ENDOTHERMIC? Explain your answer in terms of Le Chatelier's principle. (3)

[19]

QUESTION 7 (Start on a new page)

A laboratory assistant prepares a solution by dissolving 10,26 g of an unknown Group II metal hydroxide, **M**$(OH)_2$, and making the solution up to 600 cm^3 in a volumetric flask. During an experiment, 37,5 cm^3 of this standard solution is mixed with 22,5 cm^3 HCl solution of concentration 0,4 $mol.dm^{-3}$. The balanced chemical equation is as follows:

$$\mathbf{M}(OH)_2\,(aq) + 2HCl(aq) \rightarrow \mathbf{M}Cl_2(aq) + 2H_2O(l)$$

7.1 Define an *Arrhenius base*. (2)

7.2 Give a reason why HCl is classified as a strong acid. (1)

7.3 Calculate the number of moles of HCl. (3)

7.4 The resulting solution at the end of the reaction has a pH of 1,602.

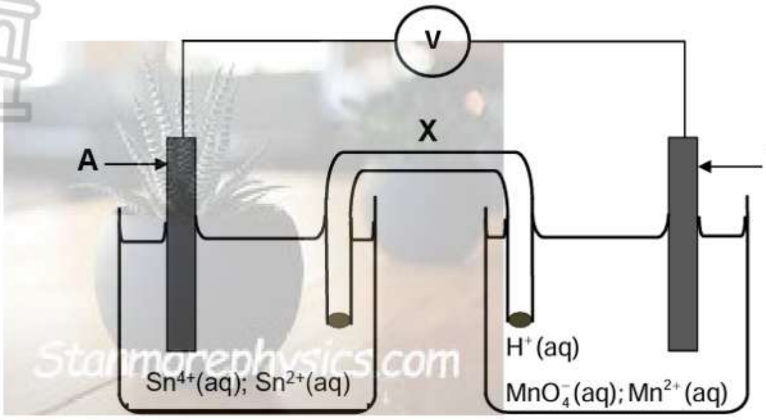
7.4.1 Which reactant, **M**$(OH)_2$ or HCl, was the limiting reagent? Give a reason for your answer. (2)

7.4.2 Use calculations to identify metal **M**. (9)

[17]

QUESTION 8 (Start on a new page)

The diagram below shows a Galvanic cell that operates under standard conditions. **A** and **B** are Carbon rods.



8.1 State the energy conversion taking place in this cell. (1)

8.2 Write down ONE function of component **X**. (1)

8.3 Which electrode, **A** or **B**, is the Cathode? (1)

8.4 For this cell, write down:

8.4.1 The formula of the reducing agent. (1)

8.4.2 The reduction half-reaction. (2)

8.4.3 The cell notation. (3)

8.5 Calculate the cell potential of the above cell. (4)

8.6 The concentration of Sn^{4+} ions is increased.
How will this change affect the following? Write down INCREASES, DECREASES, or REMAINS THE SAME.

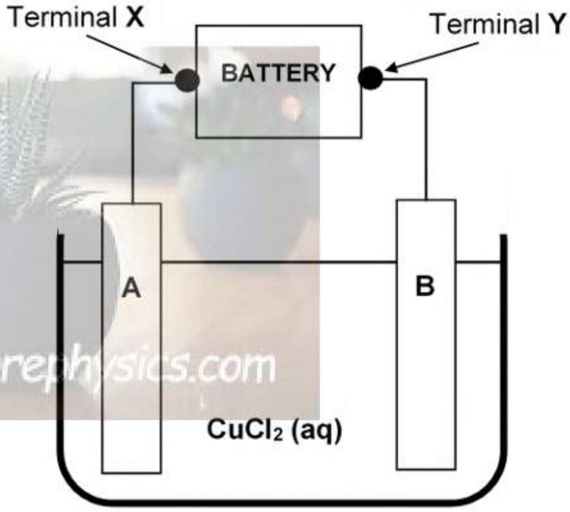
8.6.1 The size of electrode A. (1)

8.6.2 The voltmeter reading. (2)

[16]

QUESTION 9 (Start on a new page)

Copper chloride solution ($CuCl_2(aq)$) is used as an electrolyte in the copper purification process as shown in the diagram below.



9.1 Define the term *Electrolysis*. (2)

9.2 Is the reaction taking place in this cell EXOTHERMIC or ENDOTHERMIC? (1)

9.3 It is observed that the mass of electrode **B** decreases while the cell is in operation.

9.3.1 Which terminal, **X** or **Y**, is the negative terminal of the battery? (1)

9.3.2 Which electrode is pure copper? Write down **A** or **B**. (1)

9.3.3 Write down the half-reaction taking place at electrode **A**. (2)

9.4 One major change is now made to this cell: The two electrodes, **A** and **B**, are replaced with two CARBON rods.

9.4.1 How will the concentration of copper ions in the electrolyte be affected while the cell is in operation?
Write down INCREASES, DECREASES, or REMAINS THE SAME. (1)

9.4.2 Write down the NAME or FORMULA of the gas that will be formed at the Anode. (1)

9.4.3 Write down a half-reaction to support your answer in question 9.4.2. (2)

[11]

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*

$n = \dfrac{m}{M}$	$n = \dfrac{N}{N_A}$
$c = \dfrac{n}{V}$ or/*of* $c = \dfrac{m}{MV}$	$n = \dfrac{V}{V_m}$
$\dfrac{c_a V_a}{c_b V_b} = \dfrac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ 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* $E^{\theta}_{cell} = E^{\theta}_{oxidising agent} - E^{\theta}_{reducing agent} \,/\, E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	
$I = \dfrac{Q}{\Delta t}$	$n = \dfrac{Q}{e}$ where n is the number of electrons/ *waar n die aantal elektrone is*

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
$Cl_2(g) + 2e^-$	⇌	$2Cl^-$	+ 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
$Al^{3+} + 3e^-$	⇌	Al	− 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

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

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

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

FINAL

KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL STANDARDISED ASSESSMENTS

GRADE 12

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

MARKING GUIDELINES

SEPTEMBER 2026

MARKS: 150

These marking guidelines consist of 9 pages.

QUESTION 1

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

QUESTION 2

2.1.1 B ✓ (1)

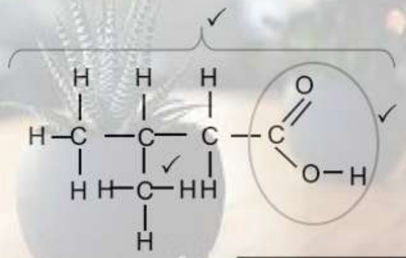
2.1.2 A ✓ (1)

2.1.3 D and F ✓✓ (2 or 0) (2)

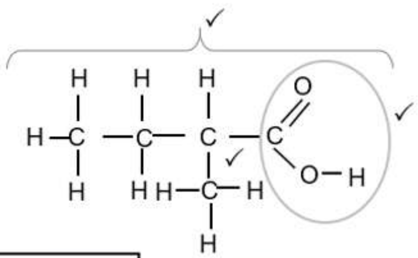
2.2.1 2-methylbut-1-ene ✓ ✓ (2)

2.2.2 Aldehyde ✓ (1)

2.2.3



Or



(3)

Marking criteria

- Functional group: ✓
- Side chain (methyl) on carbon 2 or 3: ✓
- Whole structure correct: ✓

2.3.1 Combustion ✓ Accept oxidation (1)

2.3.2 $\underline{2C_4H_{10} + 13O_2}$ ✓ → $\underline{8CO_2 + 10H_2O}$ ✓ (2)

2.3.3 $\frac{V_{(C_4H_{10})}}{V_{(CO_2)}} = \frac{n_{(C_4H_{10})}}{n_{(CO_2)}}$ ✓

Positive marking from 2.3.2 (for applying the ratio correctly)

$\frac{V_{(C_4H_{10})}}{5} = \frac{2}{8}$ ✓

$V_{(C_4H_{10})} = 1,25\ dm^3$ ✓ (3)

[16]

QUESTION 3

3.1 The temperature at which the vapour pressure is equal to the atmospheric pressure. ✓✓ (2 or 0) (2)

3.2.1 Alkanes ✓ (1)

3.2.2
- A, B, and C have London forces ✓ between their molecules.
- As the molecular mass/Chain length/surface area increases from A to C, so does the strength of the intermolecular forces. ✓
- The energy needed to overcome the intermolecular forces is the highest in C and lowest in A. ✓ (3)

3.2.3 C. ✓
It has the highest Boiling point ✓ as compared to A and B. (2)

3.3.1 Molecular formula shows the actual number of each type of atom in a molecule. ✓ downloaded fromStanmorephysics
Structural formula shows how the atoms are arranged and bonded to one another in a molecule. ✓ (2)

3.3.2 Chain ✓ (isomer) (1)

3.3.3 Compound C has a greater surface area ✓
(Accept: Compound C has the longer chain length) (1)

3.4.1 CH_3CHO ✓ (1)

3.4.2 Higher than. ✓ (1)

3.4.3
- Compound E has Dipole forces ✓ between its molecules while A has London forces only.
- Dipole forces in compound E are stronger than the London forces in compound A. ✓
- More energy is required to overcome the intermolecular forces in compound E than in compound A. ✓ (3)

[17]

QUESTION 4

4.1 A haloalkane in which the carbon bonded to the halogen is directly bonded to one other carbon atom. ✓✓ (2)

4.2.1 Elimination ✓ or dehydrohalogenation. (1)

4.2.2 Heat under reflux. /strong heat✓ (1)

4.2.3 x = 3 ✓
y = 7 ✓ (2)

4.2.4 KBr ✓ and H_2O ✓ (2)

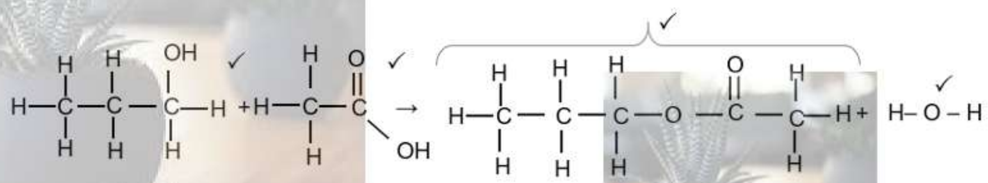
4.3.1 Hydration ✓ (1)

4.3.2 Propan-1-ol ✓/ 1-Propanol (1)

4.3.3 Minor. ✓ (1)

4.4.1 Carboxylic acid. ✓ (1)

4.4.2



(4)

Marking criteria

- Propan-1-ol formula correct: ✓
- Ethanoic acid formula correct: ✓
- Propyl ethanoate formula correct: ✓
- Water formula correct: ✓

[16]

QUESTION 5

5.1 Exothermic. ✓
Energy is released as heat. ✓ (2)

5.2 The reaction has reached completion/HCl has been completely used up. ✓ (1)

5.3 The change in the concentration of reactants or products per unit time. ✓✓ (2)

5.4 Increases. ✓ (1)

5.5
- Increase in surface area ✓
- The number of reactive sites increases/ More particles of zinc are exposed). ✓ (3)
- More effective collisions occur per unit time. ✓

5.6 **Number of moles of H_2 formed:**

$n = \frac{V}{V_m} = \frac{0,168}{24}$ ✓ $= 0, 007$ mol

Number of moles of Zn used during the reaction

Ratio H_2: Zn => 1:1

$n_{Zn} = n_{H_2} = 0, 007$ mol ✓

Mass of Zn that reacted:

m = n.M ✓ = 0, 007 x 65 ✓ = 0, 455 g

Initial mass of Zn:

m = 0, 385 +✓ 0, 455 = 0, 84

Y = 0, 84 ✓ (grams)

OR

Mol of Zn

$n = \frac{m}{M} = \frac{00,385}{65}$ ✓ = 0, 00592 mol

initial mol of Zn

n = 0,007 + 0, 00592

= 0,013 mol

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

$0,013 = = \frac{m}{65}$

m = 0,845g (6)

5.7 Positive marking from 5.6

Reaction rate $= -\frac{\Delta m}{\Delta t} = -\frac{0,385 - 0,84 ✓}{50-0 ✓}$ (3)

Reaction rate = 0,0091 $g.s^{-1}$ ✓

[18]

QUESTION 6

6.1 The forward and reverse reactions continue to occur ✓✓ (simultaneously at equal rates, resulting in no net change in the concentrations of the reactants and products). downloaded from Stanmorephysics (2)

6.2.1 Forward. ✓
An increase in pressure favours the reaction that proceeds towards fewer moles. ✓ (2)

6.2.2 Remains the same. ✓ (1)

6.3 **Marking criteria**

- Correct Kc expression. ✓
- Substituting 2nd equilibrium concentrations in Kc expression. ✓
- Number of moles of O_2 at 1st equilibrium. ✓
- Ratio $n(SO_2):n(O_2):n(SO_3)$ = 2:1:2 correct: ✓
- All number of moles at equilibrium are correct, with SO_2 moles' expression given in terms of **X**: ✓
- Dividing all equilibrium moles by 2: ✓
- Correct substitution of 1st equilibrium concentrations in K_c expression: ✓
- Substitute the calculated K_c value.✓
- Correct value of **X**: (X=10 mol) ✓

$K_c = \frac{[SO_3]^2}{[SO_2]^2.[O_2]}$ ✓ $= \frac{(2,4)^2}{(1,7888)^2.(1,2)}$ ✓ = 1,5

	SO_2 (g)	O_2 (g)	SO_3 (g)	
Ratio	2	1	2	
Initial n (mol)	**X**	6	-	
Change (mol)	6	3	6	*Ratio* ✓
Equilibrium (mol)	**X – 6**	3 ✓	6	*All Equil. n correct* ✓
$c = \frac{n}{V}$ (mol.dm⁻³)	$\frac{X-6}{2}$	1,5	$\frac{6}{2} = 3$	*Divide all by 2* ✓

$K_c = \frac{[SO_3]^2}{[SO_2]^2.[O_2]}$ So; 1,5 ✓ $= \frac{3^2}{\left(\frac{X-6}{2}\right)^2 \times 1,5}$ ✓; therefore X = 10 ✓

(9)

6.4.1 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2)

6.4.2
- Exothermic.✓
- A decrease in temperature favours the Exothermic reaction. ✓
- When Kc increases, the forward reaction is favoured/ More SO_3 is formed. ✓ (3)

[19]

QUESTION 7

7.1 A substance that produces hydroxide ions (OH^-) in aqueous solution/water ✓✓ (2)

7.2 It ionises completely in water ✓. (1)

7.3 $n = cv$ ✓

$= 0,4 \times 0,0225$ ✓

$n = 0,009$ mol ✓ (3)

7.4.1 $M(OH)_2$. ✓

The solution is acidic ✓ (pH < 7) (2)

7.4.2 Positive marking from 7.3

Marking criteria

- pH formula. ✓
- Substitution in pH formula to calculate $[H_3O^+]$. ✓
- Number of moles of HCl in the mixture. ✓
- Number of moles of HCl that reacted: $n_{initial} - n_{in\ excess}$. ✓
- Correct mole ratio: HCl: **M**$(OH)_2$ to determine moles of **M**$(OH)_2$. ✓
- Multiply by 16 to get the number of moles of $M(OH)_2$ in 600cm^3: ✓
- Substitution into formula m = nM to calculate the molar mass of **M**$(OH)_2$: ✓
- Calculate the relative atomic mass of **M**. ✓
- Identify that **M** is Barium. ✓

$pH = -\log[H_3O^+]$ ✓

$1,602$ ✓ $= -\log[H_3O^+]$

$[H_3O^+] = 0,025$ mol.dm^{-3}.

$n = cv = 0,025 \times (0,0375 + 0,0225)$ ✓ $= 0,0015$ mol

Reacted HCl: $n = 0,009 - 0,0015$ ✓ $= 0,0075$ mol.

Ratio: HCl:**M**$(OH)_2$ is 2:1

Number of moles of **M**$(OH)_2$ in 37,5 cm^3: $n = ½\ 0,0075$ ✓ $= 0,00375$ mol.

Number of moles of **M**$(OH)_2$ in 600cm^3: $n = 0,00375 \times 16$ ✓ $= \underline{0,06\ mol}$.

Molar mass of **M**$(OH)_2$:

$m = nM$

$10,26 = 0,06 \times Mr$ ✓

$Mr = 171$ g.mol^{-1}.

Relative atomic mass of M:

M + (16x2) + (1x2) = 171

M = 137 g.mol^{-1} ✓

M is Barium (Ba) ✓

$c = \frac{n}{V} = \frac{0,06}{0,6}$; $c = 0,1$ mol·dm^{-3}

$c = \frac{m}{M_rV}$; $0,1 = \frac{10,26}{M_r(0,6)}$ ✓

$Mr = 171$ g.mol^{-1}.

Relative atomic mass of M:

M + (16x2) + (1x2) = 171

M = 137 g·mol^{-1} ✓

M is Barium (Ba) ✓ (9)

[17]

QUESTION 8

8.1	Chemical energy to Electrical energy. ✓	(1)
8.2	To maintain the neutrality of solutions. / To complete the circuit. } Any one ✓	(1)
8.3	B ✓	(1)
8.4.1	Sn^{2+} ✓	(1)
8.4.2	$MnO_4^- + 8H^+ + 5e^-$ ✓ → $Mn^{2+} + 4H_2O$ ✓	(2)
8.4.3	$\underset{✓}{\underline{C(s) \mid Sn^{2+}(aq), Sn^{4+}(aq)}} \parallel \underset{✓}{\underline{MnO_4^-(aq); H^+(aq)}}, \underset{✓}{\underline{Mn^{2+}(aq) \mid C(s)}}$ (**Deduct 1 mark** if H_2O is shown in the cell notation)	(3)
8.5	$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ $= (+1,51)$ ✓ $- (0,15)$ ✓ $= 1.36\ V$ ✓	(4)
8.6.1	Remains the same. ✓	(1)
8.6.2	Decreases. ✓✓	(2)
		[16]

QUESTION 9

9.1	The chemical process in which electrical energy is converted to chemical energy. ✓✓	(2)
9.2	Endothermic. ✓	(1)
9.3.1	X ✓	(1)
9.3.2	A ✓ Accept B	(1)
9.3.3	$Cu^{2+}(aq) + 2e^-$ ✓ → $Cu(s)$ ✓	(2)
9.4.1	Decreases. ✓	(1)
9.4.2	Chlorine (gas) / Cl_2 ✓	(1)
9.4.3	$2Cl^-$ ✓ → $\underline{Cl_2(g) + 2e^-}$ ✓	(2)
		[11]

TOTAL: 150