GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2023

10842

PHYSICAL SCIENCES: CHEMISTRY

(PAPER 2)

TIME: 3 hours

MARKS: 150

PHYSICAL SCIENCES: Paper 2

10842E

X05

19 pages + 4 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.

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

3. Start EACH question (e.g. QUESTION 2 and QUESTION 3) on a NEW page.

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

5. Leave ONE line open between subquestions, e.g. 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, et cetera where required.

12 Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given 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 the ANSWER BOOK, e.g. 1.11 E.

1.1 The EMPIRICAL formula of hexanoic acid is:

A $C_3H_6O_2$

B $C_6H_6O_2$

C $C_6H_{12}O_2$

D C_3H_6O (2)

1.2 Which intermolecular forces are present between molecules of $C_7H_{15}CHO$?

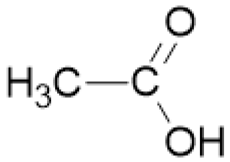
A Only dipole-dipole forces

B Dipole-dipole forces, dispersion (London) forces and hydrogen bonding forces

C Dispersion (London) forces and hydrogen bonding forces

D Dipole-dipole forces and dispersion (London) forces (2)

1.3 The structures of four organic compounds are shown below.

COMPOUND 1	**COMPOUND 2**
	$H_2C=CH_2$
COMPOUND 3	**COMPOUND 4**
$H_3C-CH=CH_2$	$H_3C-CH_2-CH_3$

Which of these compounds will decolourise bromine water FAST?

A 1 and 2

B 2 and 3

C 3 and 4

D 1 and 4 (2)

1.4 Which of the following statements best explains the role of a catalyst?

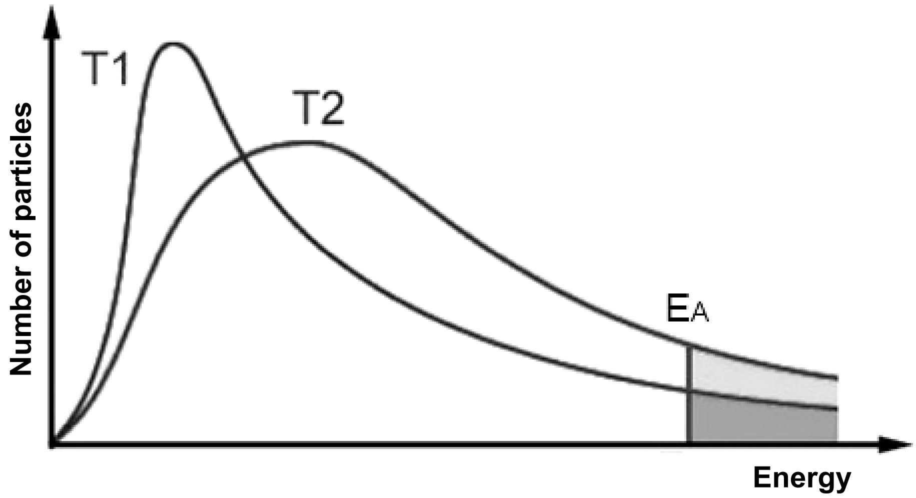
A It lowers the activated complex.

B It increases the concentration of the reactants and therefore increases the rate of the reaction.

C It provides an alternative path with lower activation energy for the reaction.

D It increases the net activation energy. (2)

1.5 The energy distribution curves for a fixed mass of gas at two different temperatures, T1 and T2, are shown below:



Which ONE of the following is the correct interpretation of the curves for the change in temperature from **T1** to **T2**?

	Activation energy	Number of effective collisions
A	Stays the same	Increased
B	Decreased	Decreased
C	Decreased	Increased
D	Stays the same	Decreased

(2)

1.6 Each of the reactions represented below is at equilibrium in a closed container. In which of these reactions will an INCREASE IN PRESSURE (by decreasing the volume) favour the formation of products?

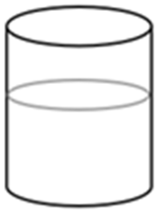
A $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

B $PC\ell_5(g) \rightleftharpoons PC\ell_3(g) + C\ell_2(g)$

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

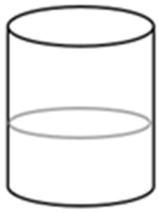
D $NO_2(g) + CO(g) \rightleftharpoons NO(g) + CO_2(g)$ (2)

1.7 Consider beakers **A** and **B** as illustrated below.



200 cm^3 of 0,25 $mol{\cdot}dm^{-3}$ NaOH (aq)

Beaker A



150 cm^3 of 0,1 $mol{\cdot}dm^{-3}$ NaOH (aq)

Beaker B

20 cm^3 of the NaOH(aq) solution in beaker **A** is added to the NaOH(aq) solution in beaker **B**. Which of the following represents the correct calculation for the new concentration of Na^+(aq) ions in beaker **B**?

A $\frac{0,015 + 0,005}{0,17}$

B $\frac{0,015 + 0,05}{0,17}$

C $\frac{0,015 \times 0,005}{0,15}$

D $\frac{0,015 + 0,005}{0,15}$ (2)

1.8 When a galvanic (voltaic) cell delivers current, the purpose of the salt bridge is to …

A allow electrons to move in the cell.

B ensure electrical neutrality in the cell.

C prevent the two solutions from mixing.

D allow electrons to travel from the cathode to the anode. (2)

1.9 Which of the following metals is the strongest reducing agent?

A Ag

B Zn

C Cu

D Aℓ (2)

1.10 Gaseous chlorine ($C\ell_2$), used to disinfect the water in public swimming pools, reacts with water according to the following balanced equation:

$$C\ell_2 + H_2O \rightleftharpoons HOC\ell + HC\ell$$

The addition of chlorine changes the pH of water in swimming pools.

Which of the following substances must be added to public swimming pools periodically to increase the pH?

A $NH_4C\ell$

B Na_2CO_3

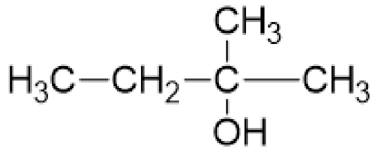
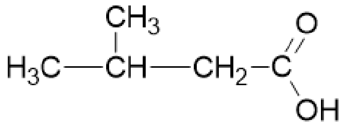
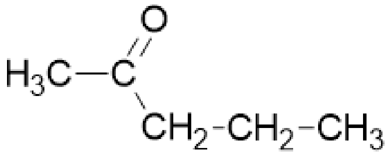
C $KC\ell$

D H_2SO_4 (2)

[20]

QUESTION 2 (Start on a new page.)

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

A		**B**	Pentan-3-one
C	Methyl butanoate	**D**	
E		**F**	$CH_3(CH_2)_3CH_3$

2.1 Consider the organic compound **A**.

2.1.1 Is it a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer. (2)

2.1.2 Write down the IUPAC name for the above-mentioned compound. (2)

2.1.3 The above-mentioned compound undergoes an elimination reaction. Write down the STRUCTURAL FORMULA of the major product that is formed. (2)

2.2 Consider the organic compound **B**.

2.2.1 Define the term *functional isomer.* (2)

Write down the:

2.2.2 Homologous series to which the above-mentioned compound belongs (1)

2.2.3 IUPAC name of its functional isomer (2)

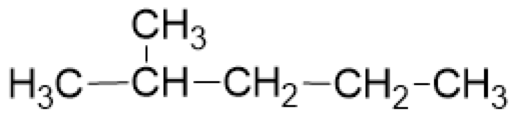
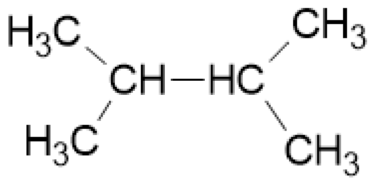
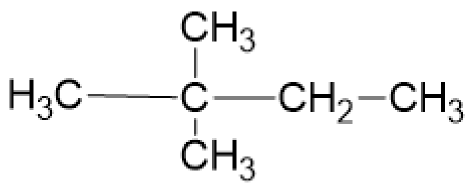
2.2.4 Letter that represents its positional isomer (1)

2.3 Write down the balanced equation using MOLECULAR FORMULAE for the complete combustion of compound **F.** (3)

[15]

QUESTION 3 (Start on a new page.)

Three structural isomers with molecular formula C_6H_{14} are used to investigate the effect of branching on the physical properties of hydrocarbons.

HYDROCARBON	STRUCTURAL FORMULAE
A	
B	
C	

The results obtained for the first TWO investigations are shown in the table below.

HYDROCARBON	INVESTIGATION 1 MELTING POINT (°C)	INVESTIGATION 2 BOILING POINT (°C)
A	-154	60
B	-129	58
C	-100	50

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

3.2 Write down the independent variable for INVESTIGATION 1. (1)

3.3 Explain why these three organic compounds are called structural isomers. (2)

3.4 Write down the type of intermolecular forces present between molecules of these isomers. (1)

3.5 Explain the difference in melting points between molecules **A** and **B**. (4)

For INVESTIGATION 3, the vapour pressure (in mmHg) measured at 25 °C, is shown in the table below:

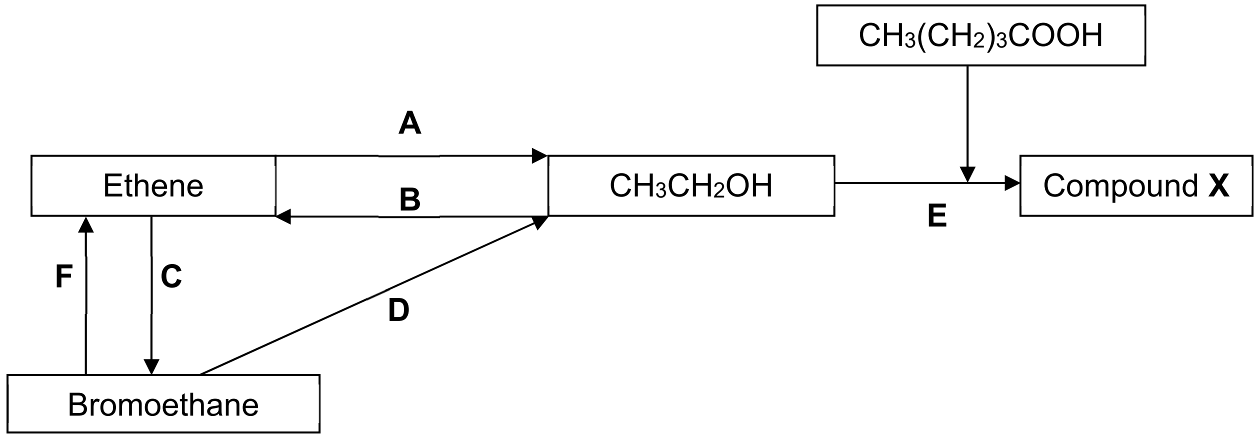
VAPOUR PRESSURE (mmHg)		
235	319	211

3.6 Using the information of INVESTIGATION 2 and INVESTIGATION 3, match the correct vapour pressure with the appropriate molecule **(A – C)**. Write down the letters (A – C) below each other with the corresponding vapour pressure next to each letter. (2)

3.7 Fully explain the answer in QUESTION 3.6. (3)
[15]

QUESTION 4 (Start on a new page.)

The flow diagram below shows how ethene can be used to prepare various organic compounds. The letters **A** to **F** represent different organic reactions.



4.1 Identify the type of reaction represented by:

4.1.1 **B** (1)

4.1.2 **D** (1)

4.2 Write down TWO reaction conditions for reaction **B**. (2)

4.3 For reaction **A**, write down the:

4.3.1 NAME of the inorganic reactant (1)

4.3.2 CHEMICAL FORMULA of the catalyst needed (1)

4.4 For reaction **C**:

4.4.1 Use STRUCTURAL FORMULAE and write down a balanced chemical equation. (3)

4.4.2 Explain why no water should be present during this reaction. (1)

4.5 Reaction **E** represents the conversion of the alcohol into organic compound **X**.

Write down the:

4.5.1 Type of reaction (1)

4.5.2 CHEMICAL FORMULA of the catalyst needed (1)

4.5.3 STRUCTURAL FORMULA of compound **X** (2)

4.5.4 IUPAC name of compound **X** (2)

4.6 Reaction **F** takes place in the presence of warm, concentrated NaOH. Use CONDENSED STRUCTURAL FORMULAE and write down a balanced equation for the reaction. (3)

4.7 Large straight-chained alkanes can be catalytically cracked to produce shorter-chained alkenes and branched alkanes which are more suitable for use in petrol. The reaction below indicates the catalytic cracking of octane.

$$CH_3(CH_2)_6CH_3 \rightarrow CH_2{=}CH_2 + \text{Compound Y}$$

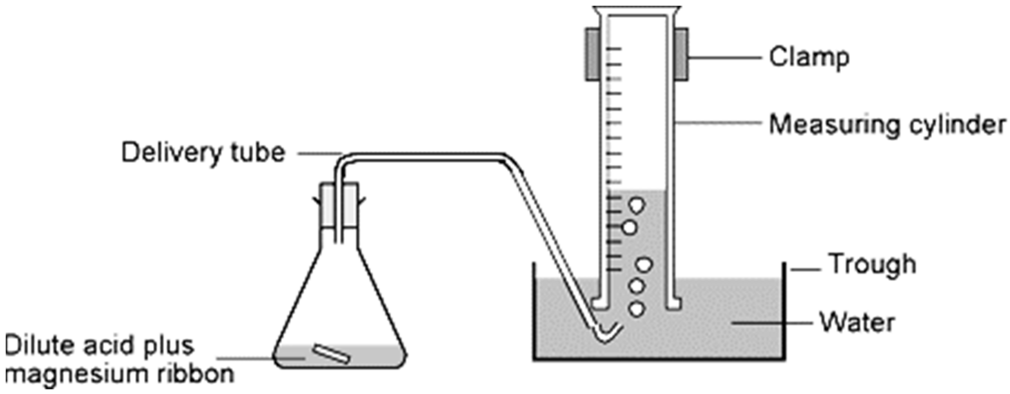
4.7.1 Write down the IUPAC name of compound **Y**. (1)

4.7.2 Briefly explain why shorter-chained alkenes and branched alkanes are more suitable for use in petrol than large straight-chained alkanes. (2)

[22]

QUESTION 5 (Start on a new page.)

The following apparatus was used by a group of learners in an investigation to find out how surface area affects the rate of reaction between excess solid magnesium ribbon and dilute nitric acid with a concentration of 0,05 mol·dm^{-3}.



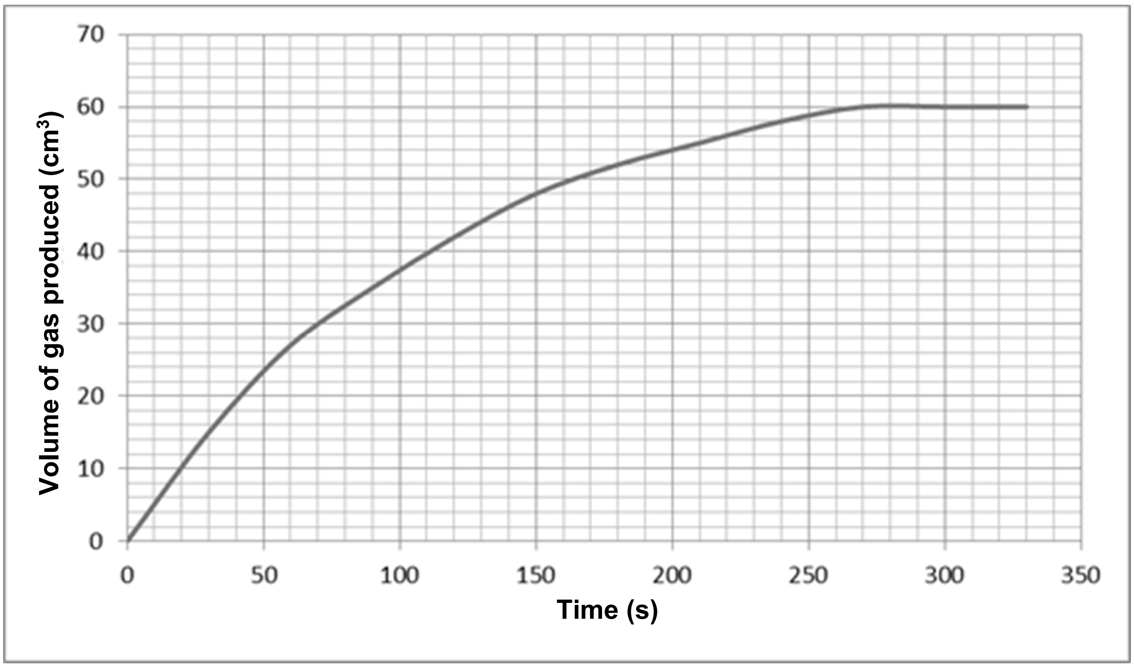
During the reaction, the gas formed is collected in the measuring cylinder. The balanced equation for the reaction is:

$$Mg(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2(g)$$

The summary of their investigation is tabulated below.

EXPERIMENT	MASS OF MAGNESIUM (g)	STATE OF DIVISION
I	2	Ribbon cut into 5 small pieces
II	2	Ribbon as one large piece

The results for experiment **I** are plotted on the graph below.



5.1 Besides the mass and the volume of the reactants, give ONE other variable that must be kept constant during this investigation. (1)

5.2 Write down the dependent variable in this investigation. (1)

5.3 Use the graph to calculate the average rate of the reaction (in $cm^3 \cdot s^{-1}$) between 2 and 2,5 minutes. (3)

5.4 Will the rate of the reaction at 250 s be GREATER THAN, LESS THAN or EQUAL TO the rate calculated in QUESTION 5.3?
Give a reason for the answer. (2)

5.5 Predict how the gradient of the graph for experiment **II** will compare to that of experiment **I**. Write down only INCREASE, DECREASE or STAY THE SAME. (1)

5.6 Calculate the mass of magnesium metal that remains in the conical flask when the reaction has stopped. Assume that the molar volume is 24 $dm^3 \cdot mol^{-1}$ at room temperature. (5)

5.7 Medication used to relieve headaches is available as powders or tablets. Use the collision theory to explain why powders provide faster relief than tablets. (2)
[15]

QUESTION 6 (Start on a new page.)

Hydrogen gas is prepared by the reaction of methane and steam, as shown in the following balanced chemical equation:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206\ kJ$$

The methane (CH_4) and steam (H_2O) are sealed in a 2 dm^3 container to react and are allowed to reach equilibrium at temperature T.

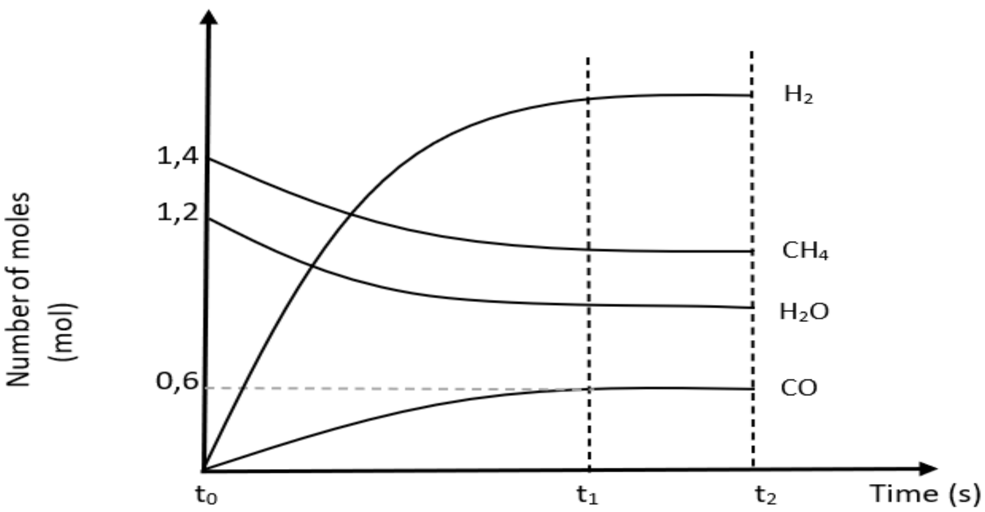
6.1 State *Le Chatelier's Principle*. (2)

6.2 Use Le Chatelier's principle to explain how the following changes will affect the yield of $H_2(g)$:

6.2.1 Adding more CH_4 (3)

6.2.2 A decrease in the volume of the container (3)

The sketch graph below shows the changes in the number of moles of methane, steam and carbon monoxide as the reaction proceeds for the preparation of H_2 gas in a 2 dm^3 container.



6.3 Write down a reason why there is no change in the number of moles of each of the gases between times **t_1** and **t_2**. (1)

6.4 Use the information on the graph and calculate the equilibrium constant, Kc, for this reaction at temperature T. (7)

6.5 The temperature T is **decreased**. How will this change affect the Kc-value for the above reaction? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)

[17]

QUESTION 7 (Start on a new page.)

The balanced equations below represent the ionisation of sulphuric acid in water:

Step 1: $H_2SO_4(\ell) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + HSO_4^-(aq)$

Step 2: $HSO_4^-(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + SO_4^{-2}(aq)$

7.1 Is H_2SO_4 a STRONG or WEAK acid? Give a reason for the answer. (2)

7.2 Write down the FORMULAE of the conjugated acid-base pairs in step 2. (2)

7.3 H_2SO_4 is diprotic. Write down the meaning of the term *diprotic*. (2)

7.4 Write down the FORMULA of the ampholyte in the above reaction. (1)

7.5 An impure sample of potassium hydroxide pellets with a mass of 11,2 g is added to 0,09 mole of sulphuric acid with a volume of 600 cm^3. It reacts according to the balanced chemical equation given below:

$$H_2SO_4(aq) + 2KOH(s) \rightarrow K_2SO_4(aq) + 2H_2O(\ell)$$

7.5.1 Calculate the initial pH of the sulphuric acid used in this reaction. (5)

7.5.2 The percentage purity of the potassium hydroxide pellets used is 80%. Calculate the number of moles of pure potassium hydroxide that react with H_2SO_4. (4)

7.5.3 Determine which reactant is in excess and hence state whether the final solution is ACIDIC, BASIC or NEUTRAL. (3)

[19]

QUESTION 8 (Start on a new page.)

A galvanic cell is set up using a manganese rod, Mn, and an unknown metal **X**. The initial EMF measured under standard conditions is 1,05 V. The electrons flow from manganese to metal **X** in the external circuit.

8.1 Is the reaction that occurs in this cell spontaneous? Write down only YES or NO. Give a reason for the answer. (2)

8.2 Which electrode, **X** or **Mn**, is the anode? (1)

8.3 Use calculations to identify metal **X**. (5)

8.4 For this cell, write down the:

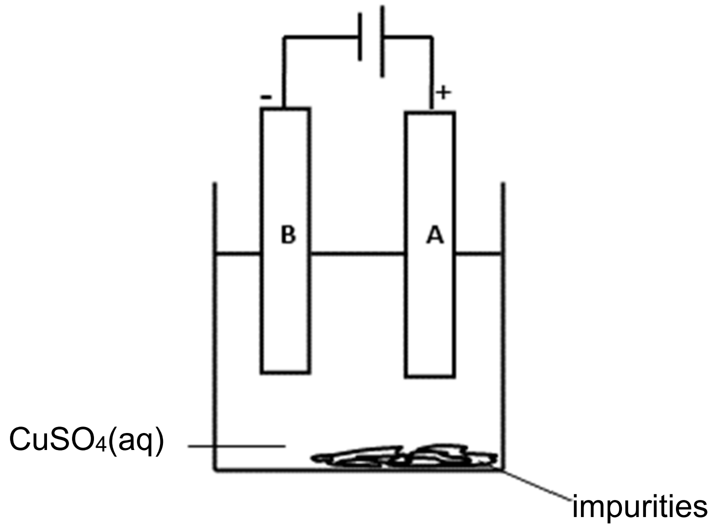
8.4.1 TWO standard conditions (2)

8.4.2 Cell notation (2)

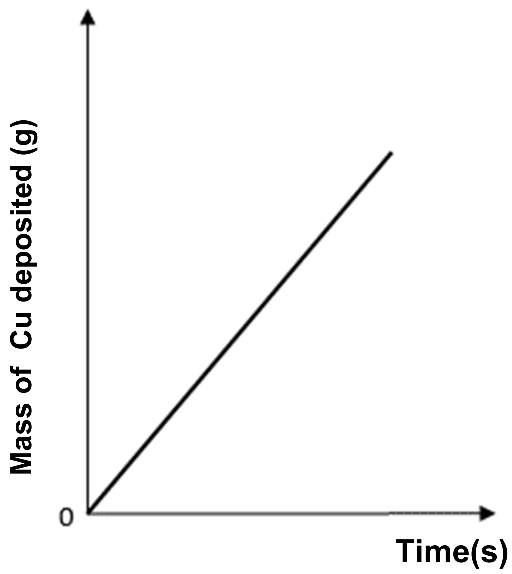
8.4.3 Reduction half reaction (2)
[14]

QUESTION 9 (Start on a new page.)

The diagram below represents the purification of copper ore to pure copper. The cell also contains zinc, silver and platinum impurities.



The graph shows the initial relationship between the mass of Cu deposited versus the time.



9.1 Write down the energy conversion that takes place in this cell. (1)

9.2 At which electrode, **A** or **B**, would pure copper be deposited? (1)

9.3 Write down the half-reaction that takes place at the anode. (2)

9.4 How will the gradient of the graph be affected as the reaction is allowed to proceed until completion? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)

9.5 Refer to the relative strengths of reducing agents to explain why zinc (Zn) will NOT be deposited at the cathode. (3)

9.6 When the current flows for 30 minutes, 15 g of pure copper was deposited at one of the electrodes.

9.6.1 Calculate the number of moles of copper deposited. (3)

9.6.2 Determine the number of moles of electrons that flows through the circuit while 15 g of copper is deposited. (2)

[13]

TOTAL: 150

END

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' number ***Avogadro se nommer***	N_A	$6{,}02 \times 10^{23}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

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

KEY/*SLEUTEL*

Atomic number/ *Atoomgetal*: 29

Electro negativity/ *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

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

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

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

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

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

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