EXAMINATION	NATIONAL SENIOR CERTIFICATE
GRADE	12
DATE	NOVEMBER 2025
SUBJECT	PHYSICAL SCIENCES
PAPER	2
MARK TOTAL	150
DURATION (HOURS)	3
NUMBER OF PAGES	22

SOUTH AFRICAN COMPREHENSIVE ASSESSMENT INSTITUTE

SUID-AFRIKAANSE KOMPREHENSIEWE ASSESSERINGSINSTITUUT

INSTRUCTIONS AND INFORMATION

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

2. Start each question on a **NEW** page in the answer book.

3. Number the questions correctly according to the numbering system used in this question paper.

4. Leave **ONE** line between two sub-questions, for example between **QUESTION 2.1** and **QUESTION 2.2**.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. Show **ALL** the formulae and substitutions in **ALL** calculations.

8. Round off your final numerical answers to a minimum of **TWO** decimal places.

9. Give brief motivations, discussions, *et cetera,* where required.

10. You are advised to use the **ATTACHED DATA SHEETS**.

11. Write neatly and legibly, in **BLUE** ink only.

QUESTION 1

Various 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 numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 The condensed formula of an organic compound is given below:

$$CH_3C(CH_3)_2CCCH_2CH_3$$

Which ONE of the following is the correct IUPAC name of this compound?

A 5,5-dimethylhex-3-ene

B 5,5-dimethylhex-3-yne

C 2,2-dimethylhex-3-ene

D 2,2-dimethylhex-3-yne (2)

1.2 Which ONE of the following combinations best describes the intermolecular forces in ASCENDING (lowest to highest) order of the vapour pressure?

A London dispersion forces; Dipole-dipole forces; Hydrogen bonding

B Dipole-dipole forces; London dispersion forces; Hydrogen bonding

C Dipole-dipole forces; Hydrogen bonding; London dispersion forces

D Hydrogen bonding; Dipole-dipole forces; London dispersion forces (2)

1.3 Consider the reaction represented below:

$$CH_3CH_2CH_2CH_2CH_3 \rightarrow CH_3CHCH_2 + P$$

Which ONE of the following CORRECTLY gives the type of reaction that takes place and the IUPAC name of the product **P**?

	TYPE OF REACTION	PRODUCT P
A	Elimination	Ethane
B	Elimination	Ethene
C	Addition	Ethane
D	Addition	Ethene

(2)

1.4 Consider the reaction between copper granules and 150 cm^3 nitric acid solution, with a concentration 3 $mol \cdot dm^{-3}$, represented by the balanced equation below:

$$Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$$

Which of the following statements will increase the initial rate of this reaction, if the concentration of the nitric acid solution remains constant?

i) Use a copper rod, with the same mass as the granules.
ii) Heat the reaction vessel.
iii) Increase the volume of the nitric acid solution to 300 cm^3.

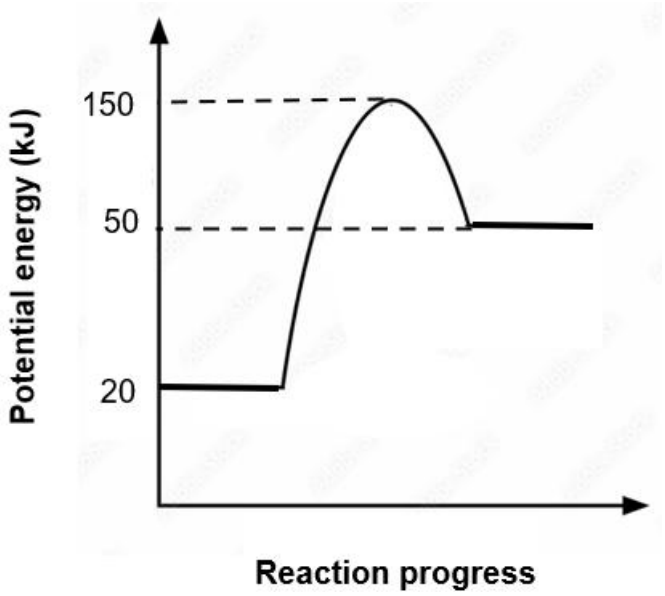
A i

B ii

C i, ii and iii

D ii and iii only (2)

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



Which ONE of the following statements about the REVERSE reaction is correct?

A The activation energy for the reaction is **+100 kJ.**

B The activation energy for the reaction is **+130 kJ.**

C The enthalpy change (ΔH) for the reaction is **+30 kJ.**

D The enthalpy change (ΔH) for the reaction is **-100 kJ.** (2)

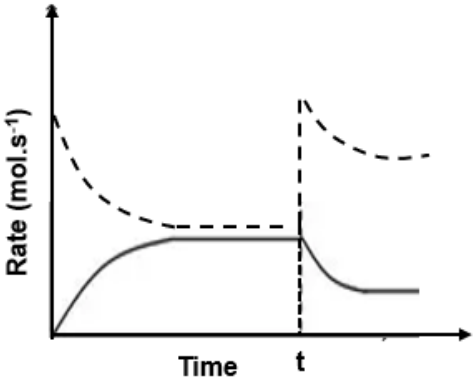
1.6 Initially a certain amount of **X**(g) was placed in an empty container. The hypothetical reaction reaches equilibrium in a closed container according to the following balanced reaction:

$$\mathbf{X_{(g)} \rightleftharpoons 2Y_{(g)} \quad ; \quad \Delta H < 0}$$

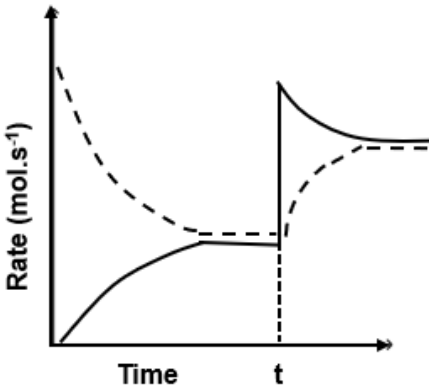
At time **t**, the temperature is increased.

Which graph below best illustrates the resulting changes in the rates of the forward and reverse reaction after the temperature is increased?

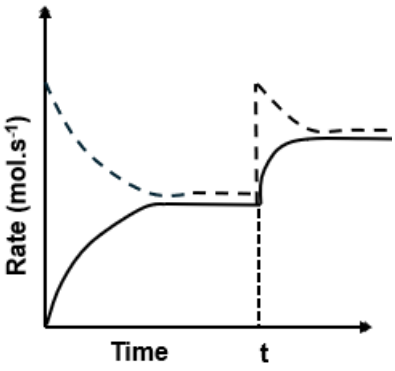
A.



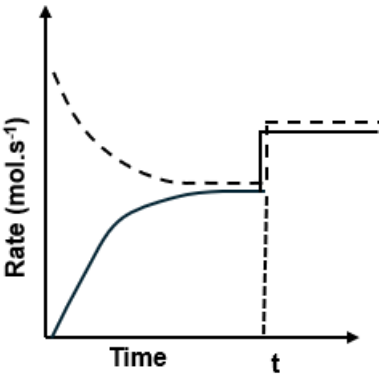
B.



C.



D.



(2)

1.7 According to Lowry-Brønsted theory an acid is a substance that ...

A accepts a proton (H^+) in a chemical reaction.

B reacts with metals to produce hydrogen gas (H_2).

C increases the hydroxide ion (OH^-) concentration in water.

D donates a proton (H^+) in a chemical reaction. (2)

1.8 Consider the following salts:

(i) Sodium chloride (NaCℓ)
(ii) Ammonium chloride ($NH_4C\ell$)
(iii) Sodium acetate (CH_3COONa)

Which of the following correctly identifies the effect of each salt on the pH of its aqueous solution?

	NaCℓ	**$NH_4C\ell$**	**CH_3COONa**
A	Acidic	Neutral	Basic
B	Basic	Acidic	Neutral
C	Neutral	Acidic	Basic
D	Neutral	Basic	Acidic

(2)

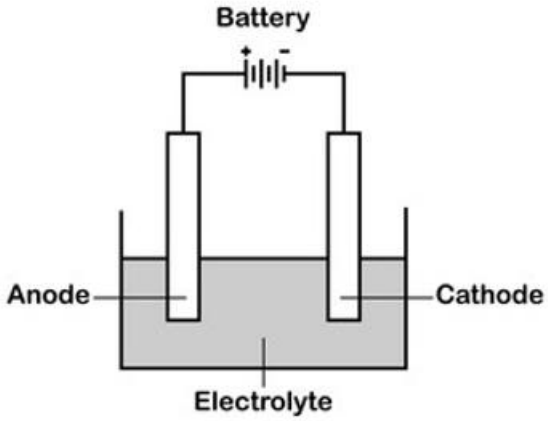
1.9 Consider the cell notation of the galvanic cell below:

$$\mathbf{Zn_{(s)} \mid Zn^{2+}_{(aq)} \parallel C\ell_{2\,(g)} \mid C\ell^{-}_{(aq)} \mid Pt_{(s)}}$$

Which ONE of the following statements regarding this cell is CORRECT?

A Chlorine is reduced, zinc is oxidised and the reaction is spontaneous.
B Zinc is reduced, chlorine is oxidised, and the reaction is non-spontaneous.
C Both chlorine and zinc are reduced, and the reaction is spontaneous.
D Chlorine is oxidised, zinc is reduced, and the reaction is spontaneous. (2)

1.10 The diagram below shows a simplified cell used for the purification of copper.



Which ONE of the following statements is correct?

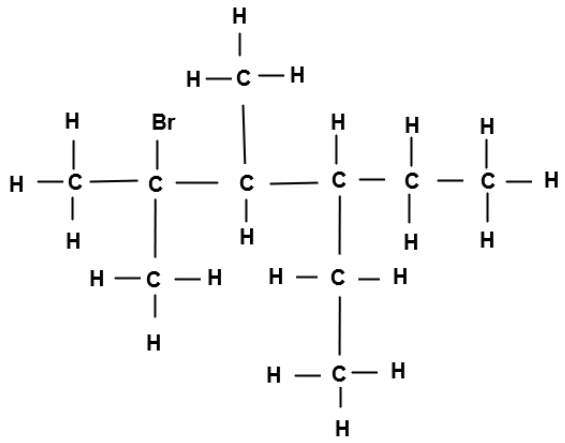
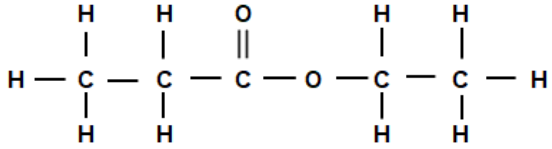
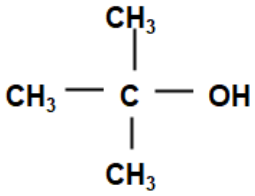
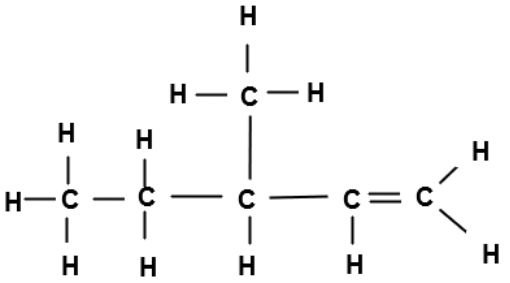
	Pure copper deposited on	Mass of anode
A	Anode	Increase
B	Anode	Decrease
C	Cathode	Decrease
D	Cathode	Increase

(2)

[20]

QUESTION 2 (Start on a new page)

The letters **A** to **H** in the table below represent eight organic compounds:

A		**B**	CH_3CH_2CHO
C		**D**	C_3H_4
E	$CH_3CH(OH)CH_2CH_2CH_3$	**F**	
G		**H**	C_XH_Y

2.1 Write down the LETTER that represents EACH of the following:

2.1.1 An alkyne. (1)

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

2.1.3 A secondary alcohol. (1)

2.2 Write down the:

2.2.1 IUPAC NAME of compound **A**. (4)

2.2.2 The STRUCTURAL FORMULA of the FUNCTIONAL GROUP of compound **B**. (2)

2.2.3 STRUCTURAL FORMULA of compound **E**. (2)

2.2.4 MOLECULAR FORMULA of compound **F**. (1)

2.3 When compound **H** undergoes complete combustion, the following products are formed:

$$2C_XH_{Y\ (\ell)} + 25O_{2\ (g)} \rightarrow 16CO_{2\ (g)} + 18H_2O_{\ (g)}$$

2.3.1 Determine the values of **X** and **Y**. (2)

2.3.2 If 3,42 g of compound **H** is burned in EXCESS oxygen at reaction temperature, calculate the TOTAL VOLUME of gas formed. (6)

[20]

QUESTION 3 (Start on a new page)

The boiling points and melting points of the following organic compounds are investigated and the results are recorded in the table below:

	COMPOUND	BOILING POINT (°C)	MELTING POINT (°C)
A	CH_4	-161,5	-182,5
B	C_4H_{10}	-0,5	-138,3
C	$C_2H_4O_2$	118,1	16,6
D	C_3H_6O	56,05	-94,7
E	C_2H_5OH	78,37	-114,1
F	C_4H_9OH	117,7	-89,5

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

3.2 Refer to compounds **A** and **B**.

3.2.1 Which compound has the higher vapour pressure? (1)

3.2.2 Explain the answer to QUESTION 3.2.1 by referring to the information in the table. (1)

3.3 Refer to compound **C**.

3.3.1 Write down the IUPAC NAME of the TWO FUNCTIONAL isomers of this compound. (2)

3.3.2 Identify the STRONGEST intermolecular force present in EACH of the two isomers named in QUESTION 3.3.1. (2)

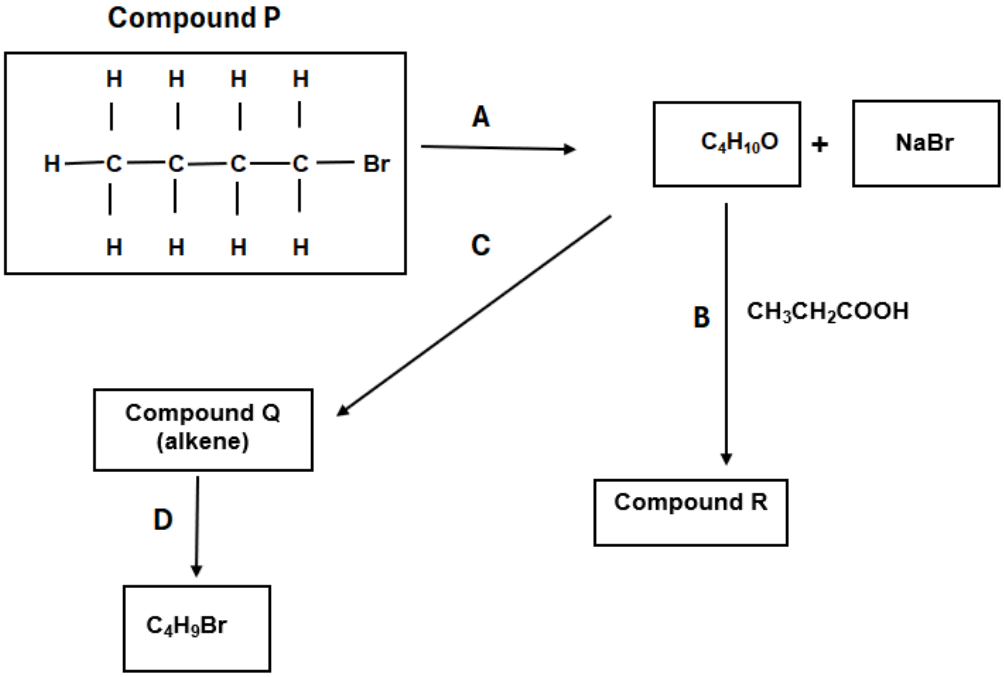
3.4 The melting points of compounds **E** and **F** are compared.

Fully explain the difference in the melting points of these two compounds. (4)

[12]

QUESTION 4 (Start on a new page)

The flow diagram below shows how a haloalkane (compound **P**) can be used to produce other organic compounds. The letters **A to D** represent different **chemical reactions** and the unknown compounds are labelled **Q and R.**



4.1 Write down the type of reaction represented by **B**. (1)

4.2 Write down the STRUCTURAL FORMULA and IUPAC NAME for compound **R**. (3)

4.3 Write down the type of substitution reaction represented by **A**. (1)

4.4 Write down the CONDENSED FORMULA and IUPAC NAME for compound **Q**. (2)

4.5 Write down the type of addition reaction represented by **D**. (1)

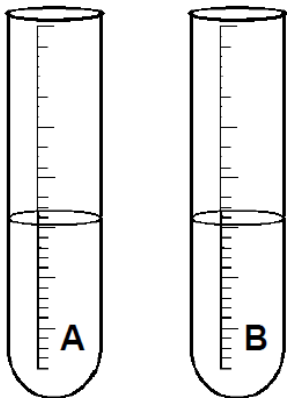
4.6 Consider reaction **C**.

4.6.1 Use STRUCTURAL FORMULAE to write down the balanced chemical equation for this process. (4)

4.6.2 Write down the FORMULA of the catalyst used in the preparation of compound **Q**. (1)

4.6.3 Write down the IUPAC NAME of the chain isomer of compound **Q**. (2)

4.7 Two test tubes, **A** and **B**, contain oct-1-ene and octane respectively. Both are colourless liquids at room temperature. The reaction of the substances with bromine water (Br_2) is investigated.



During the investigation, bromine water is added to both **A** and **B**. The bromine water becomes colourless immediately when added to test tube **A**.

4.7.1 Write down the STRUCTURAL FORMULA and the IUPAC NAME for the ORGANIC PRODUCT that forms in test tube **A**. (4)

4.7.2 Using MOLECULAR formulae, write down the balanced reaction between octane and bromine water, indicating the required conditions for this reaction to take place. (4)

4.7.3 What colour will be observed in **B** after adding the bromine water? (1)

[24]

QUESTION 5 (Start on a new page)

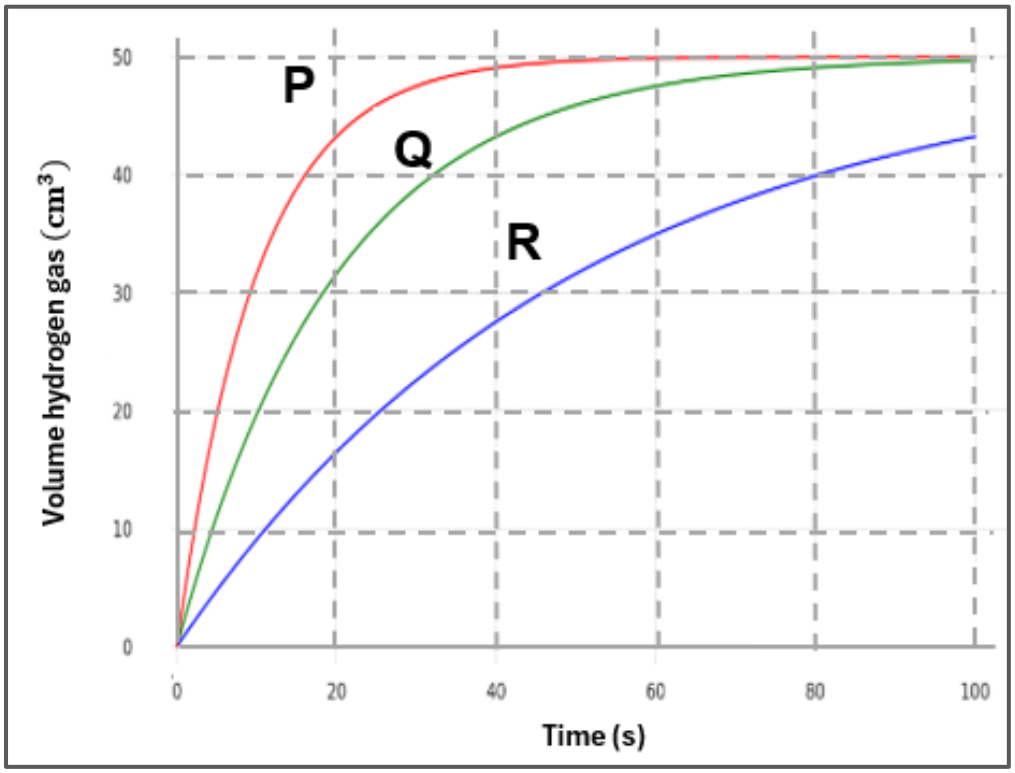
Learners investigate the rate at which 25 cm^3 hydrochloric acid reacts with 2-cm magnesium ribbon to produce hydrogen gas at STP. The learners are provided with three solutions of EXCESS hydrochloric acid with the following concentrations:

Solution A: 0,5 $mol \cdot dm^{-3}$
Solution B: 1,0 $mol \cdot dm^{-3}$
Solution C: 2,0 $mol \cdot dm^{-3}$

The reaction is represented by the following balanced equation:

$$Mg_{(s)} + 2HC\ell_{(aq)} \rightarrow MgC\ell_{2(aq)} + H_{2(g)}$$

The volume of H_2 gas produced, using the three solutions, are represented in the following graphs.



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

5.2 For this investigation, write down:

5.2.1 The independent variable. (1)

5.2.2 The controlled variable. (1)

5.3 Which graph represents the reaction for solution **C**? (1)

5.4 For this investigation, write down the conclusion that can be drawn from the results. (2)

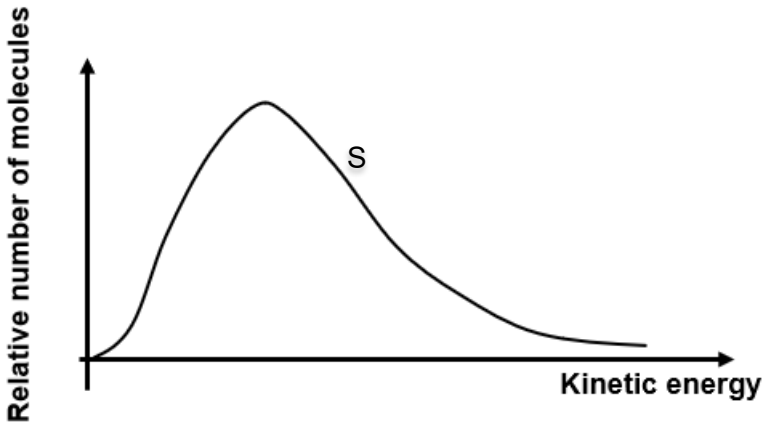
5.5 Use curve **Q** to calculate the mass of the magnesium ribbon which reacted. (4)

5.6 The learners repeat their investigation by using POWDERED magnesium, with the same mass as the 2 cm magnesium ribbon, before adding it to the 1 mol·dm^{-3} HCℓ solution.

5.6.1 How will the gradient of graph **Q** change when the magnesium powder is added to the HCℓ solution? Choose from STEEPER, LESS STEEP or REMAINS THE SAME. (1)

5.6.2 Use the *Collision Theory* to explain the answer to QUESTION 5.6.1. (3)

5.7 Learners use solution **B**, to draw the Maxwell-Boltzman graph at a temperature of 25 °C and label it curve **S**.



Keeping the concentration and volume of the solution constant, they increase the temperature to 45 °C.

Redraw this curve in the ANSWER BOOK. On the same set of axes, sketch the curve that will be obtained at 45°C. Clearly label this as curve **T**. (2)

[17]

QUESTION 6 (Start on a new page)

A chemical reaction is carried out in a sealed container at a temperature of 1 600°C, according to the balanced equation below:

$$\underset{\text{Red Brown}}{Br_{2\,(g)}} \rightleftharpoons \underset{\text{Colourless}}{2Br_{(g)}}$$

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

6.2 When the temperature of the original reaction mixture is decreased, it is observed that the colour of the mixture changes to a deeper red brown.

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

6.2.2 Explain the answer to QUESTION 6.2.1 by referring to Le Chatelier's Principle. (3)

6.3 At equilibrium the pressure of the system is increased by decreasing the volume of the container at constant temperature. How will each of the following be affected? Choose between INCREASES, DECREASES or REMAINS THE SAME.

6.3.1 The value of the equilibrium constant. (1)

6.3.2 The number of Br_2 molecules. (1)

6.4 Explain the answer to QUESTION 6.3.2 by referring to Le Chatelier's Principle. (2)

6.5 Initially 1,077 mol of bromine (Br_2) is sealed in the container. At equilibrium it is found that the concentration of bromine (Br_2) is 0,2074 mol·dm^{-3}.

The K_c value for the reaction at 1 600°C is 1,3 x 10^{-4} at equilibrium.

Calculate the volume of the container. (9)

[19]

QUESTION 7 (Start on a new page)

The following information is given about the ionisation of a solution of phosphoric acid (H_3PO_4) with an initial pH of 1,07.

	K_a value
$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^{-1}$	$7,2 \times 10^{-3}$
$H_2PO_4^{-1} + H_2O \rightleftharpoons H_3O^+ + HPO_4^{-2}$	$6,3 \times 10^{-8}$
$H_2PO_4^{-2} + H_2O \rightleftharpoons H_3O^+ + HPO_4^{-3}$	$4,5 \times 10^{-13}$

7.1 Is phosphoric acid a WEAK or a STRONG acid? (1)

7.2 Fully explain the answer to QUESTION 7.1. (2)

7.3 Calculate the concentration of the hydronium ions in the initial phosphoric acid solution. (3)

7.4 Which ion is the conjugate base of $H_2PO_4^{-1}$? (1)

7.5 In a titration, 50 cm^3 of diluted phosphoric acid (H_3PO_4) reacts with 100 cm^3 of a sodium hydroxide solution (NaOH) with a concentration of 0,1 $mol \cdot dm^{-3}$ according to the reaction below:

$$\mathbf{H_3PO_4 + NaOH \rightarrow NaH_2PO_4 + H_2O}$$

The concentration of the acid is unknown.
The EXCESS NaOH is then titrated with a hydrochloric acid solution (HCℓ), with a concentration of 0,1 $mol \cdot dm^{-3}$, and 25 cm^3 of HCℓ is needed to neutralise it.

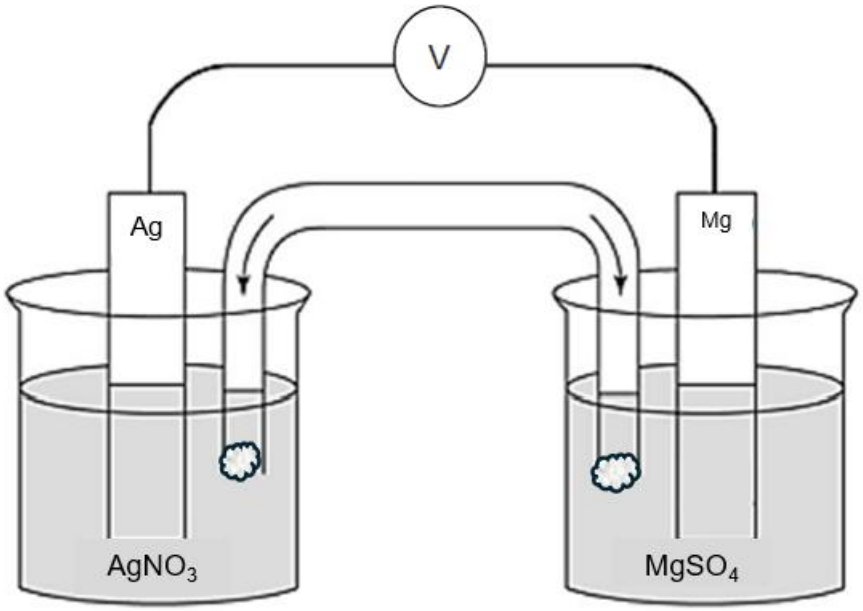
7.5.1 Calculate the concentration of the phosphoric acid (H_3PO_4). (7)

7.5.2 Suggest an indicator that can be used during this titration. (1)

[15]

QUESTION 8 (Start on a new page)

Consider an electrochemical cell that operates as shown in the simplified diagram below using silver and magnesium as electrodes, under standard conditions.



8.1 Is this a GALVANIC or ELECTROLYTIC cell? (1)

8.2 Write down the nett reaction for this cell. (3)

8.3 Calculate the standard emf (E^0 cell) of this electrochemical cell. (4)

The concentration of the silver nitrate ($AgNO_3$) is now decreased.

8.4 How will this decrease in concentration affect the reading of the voltmeter.
Choose between INCREASE, DECREASE or REMAIN THE SAME. (1)

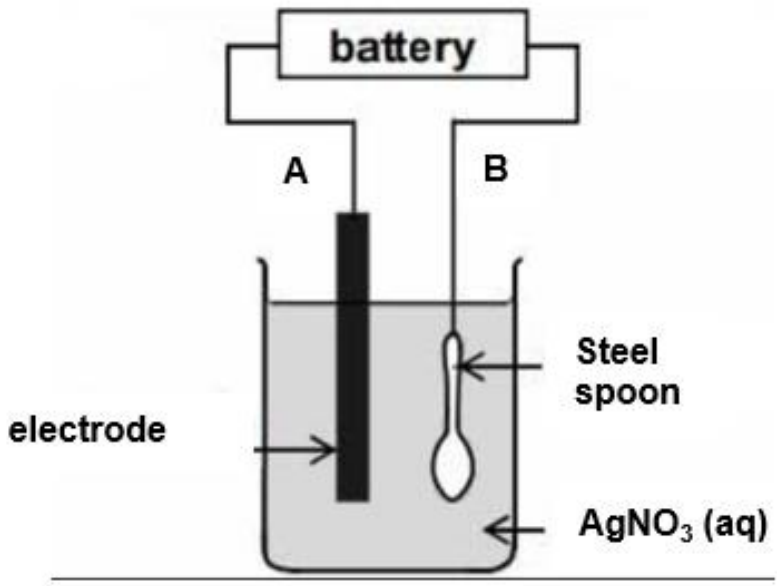
8.5 Refer to the REDUCING AGENT to explain the answer to QUESTION 8.4. (3)

8.6 A 100 cm^3 magnesium sulphate ($MgSO_4$) solution is prepared as the electrolyte for this cell. Calculate the mass of $MgSO_4$ needed to prepare the solution. (3)

[15]

QUESTION 9 (Start on a new page)

The diagram below shows a simplified electrochemical cell used to electroplate steel cutlery with a layer of silver using silver nitrate ($AgNO_3$) solution as the electrolyte.



9.1 Define the term *electrolysis*. (2)

9.2 Is the spoon the ANODE or CATHODE of the cell? (1)

9.3 Describe the movement of Ag^+ ions during the electroplating process. (2)

9.4 Fully explain, by referring to the standard reduction potentials table, what would happen if copper were used as an electrode instead of silver. (3)

[8]

GRAND 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 / *NAME*	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 *Standaard temperatuur*	T^{θ}	273 K
Charge on electron *Lading op 'n electron*	e	$-1{,}6 \times 10^{-19}$ C
Avogrado's constant *Avogadro se 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 $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at 298K	
$E^{\theta}_{cell/sel} = E^{\theta}_{cathode/katode} - E^{\theta}_{anode}$ or $E^{\theta}_{cell/sel} = E^{\theta}_{reduction/reduksie} - E^{\theta}_{oxidaton/oksidasie}$ or $E^{\theta}_{cell/sel} = E^{\theta}_{oxidising\ agent/\ oksideermiddel} - E^{\theta}_{reducing\ agent/\ reduseermiddel}$	

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

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)
2,1 1 H 1																	1 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1.5 22 Ti 48	1.6 23 V 51	1.6 24 Cr 52	1.5 25 Mn 55	1.8 26 Fe 56	1.8 27 Co 59	1.8 28 Ni 59	1.9 29 Cu 63,5	1.6 30 Zn 65	1.6 31 Ga 70	1.8 32 Ge 73	2.0 33 As 75	2.4 34 Se 79	2.8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1.4 40 Zr 91	41 Nb 92	1.8 42 Mo 96	1.9 43 Tc	2.2 44 Ru 101	2.2 45 Rh 103	2.2 46 Pd 106	1.9 47 Ag 108	1.7 48 Cd 112	1.7 49 In 115	1.8 50 Sn 119	1.9 51 Sb 122	2.1 52 Te 128	2.5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1.6 72 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	1.8 81 Tℓ 204	1.8 82 Pb 207	1.9 83 Bi 209	2.0 84 Po	2.5 85 At	86 Rn
0,7 87 Fr	0,9 88 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

KEY/*SLEUTEL*

Atomic number / ***Atoomgetal***

Electronegativity / ***Elektronegatiwiteit*** → 29 / 1,9 / Cu / 63,5 ← **Symbol** / ***Simbool***

Approximate relative atomic mass / ***Benaderde relatiewe atoommassa***

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Half-reaksies*			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
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**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 reducing ability/*Toenemende reduserende vermoë* ↓

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

Half-reactions/*Half-reaksies*	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
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	**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 oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*