education

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NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

SEPTEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 17 pages, 4 data sheets and a graph paper.

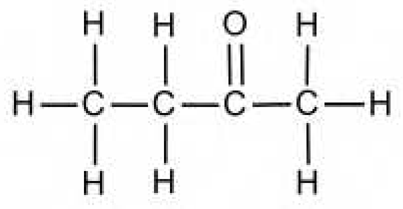
INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on your ANSWER BOOK.
2. This question paper consists of TEN 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 the two 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. 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, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. 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 D.

1.1 The structural formula of an organic compound given below represents …



A an alcohol

B an aldehyde

C a ketone

D an ester (2)

1.2 Consider the following organic compounds below;

propanal propane propanol

Arrange the above compounds in order, starting with the one with the lowest boiling point:

A propanol, propane, propanal

B propanol, propanal, propane

C propane, propanal, propanol

D propane, propanol, propanal (2)

1.3 Which ONE of the following alkanes is likely to produce 1 mole carbon dioxide and 2 moles of water when 1 mole of the alkane is burned in excess oxygen?

A Methane

B Ethane

C Propane

D Butane (2)

1.4 Which ONE of the following statements is CORRECT about an exothermic reaction?

A The products have higher enthalpy than the reactants.

B The reactants release heat and therefore have higher enthalpy.

C The heat of reaction is positive as the products have higher energy.

D The reactants absorb heat and therefore the reaction container would feel cold. (2)

1.5 A lump of magnesium is placed into a beaker containing 50 cm^3 of 0,4 $mol{\cdot}dm^{-3}$sulphuric acid at a temperature of 25 °C.

Which ONE of the following factors will DECREASE the initial rate of reaction?

A Using 100 cm^3 of 0,4 $mol{\cdot}dm^{-3}$ sulphuric acid

B Decreasing temperature of the mixture

C Addition of a positive catalyst

D Using 50 cm^3 of 0,6 $mol{\cdot}dm^{-3}$of sulphuric acid (2)

1.6 When powdered lime is added into an acidic solution, the pH of the solution changes from 4 to 6.

What is the corresponding change in the hydrogen ion concentration?

A Increases by a factor of 2

B Decreases by a factor of 2

C Increases by a factor of 100

D Decreases by a factor of 100 (2)

1.7 Which ONE of the following statements is TRUE for a reversible chemical reaction which has attained a dynamic equilibrium?

A The rate of forward reaction is equal to the rate of reverse reaction.

B The rate of forward reaction and the rate of reverse reaction remain constant.

C The concentration of the products is equal to the concentration of the reactants.

D Le Chatelier's principle may no longer be applied when the dynamic equilibrium has been attained. (2)

1.8 Consider the following acid-base reaction below.

$$H_2O(\ell) + SO_3^{2-}(aq) \rightleftharpoons HSO_3^-(aq) + OH^-(aq)$$

Which ONE is a pair of bases according to the Lowry-Brønsted theory of acids and bases?

A OH^- and HSO_3^-

B H_2O and HSO_3^-

C SO_3^{2-} and OH^-

D SO_3^{2-} and HSO_3^- (2)

1.9 The standard zinc half-cell is given below.

$$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$$

Which ONE of the following is TRUE about this half-cell?

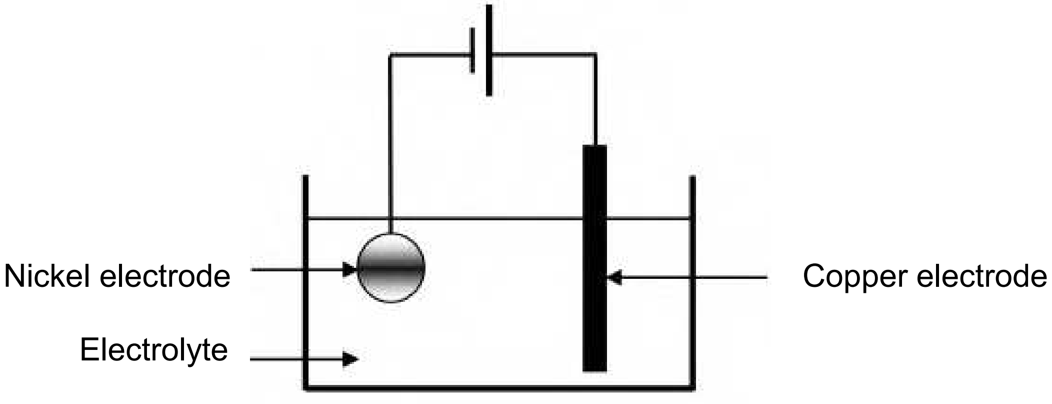
A Zn is always a cathode.

B Zn will not be oxidised spontaneously.

C Zn is the anode when the half-cell is connected to the hydrogen half-cell.

D Zn does not lose electrons as easily as hydrogen does. (2)

1.10. The simplified diagram below represents an electrolytic cell used to electroplate a nickel (Ni) coin with copper (Cu).



Which ONE of the following reactions takes place at the anode?

A $Ni^{2+} + 2e^- \rightarrow Ni$

B $Ni \rightarrow Ni^{2+} + 2e^-$

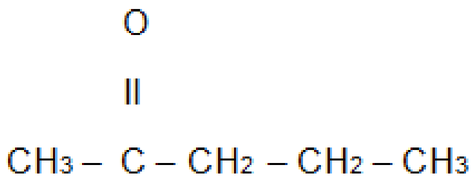
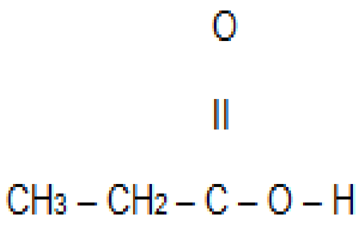
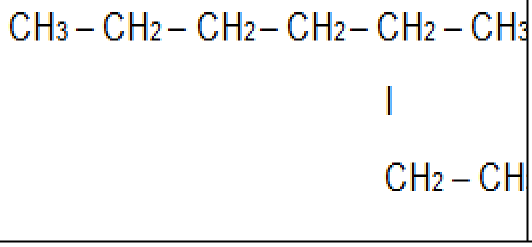
C $Cu^{2+} + 2e^- \rightarrow Cu$

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

[20]

QUESTION 2: (Start on a new page.)

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

A	 $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_3$	**B**	Propan -2-ol
C	2-Methylpropan-1-ol	**D**	 $CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - O - H$
E	 $CH_3 - CH_2 - CH_2 - CH_2 - \underset{\underset{CH_2 - CH}{\|}}{CH_2} - CH_3$	**F**	2-Methylbutanal
G	$CH_2 = CH_2$		

2.1 Write down the IUPAC name of compound **E**. (3)

2.2 Compounds **A** and **F** are isomers:

2.2.1 Define the term *isomer*. (2)

2.2.2 What type of isomers is compound **A** and **F**? (1)

2.2.3 Write down the homologous series to which compound **F** belongs? (1)

2.3 Compound **B** is an alcohol.

2.3.1 Is compound **B** a primary, secondary or tertiary alcohol? (1)

2.3.2 Explain the answer in QUESTION 2.3.1. (2)

2.4. Write down the STRUCTURAL FORMULA of compound **C**. (2)

2.5 For compound **D,** write down:

2.5.1 The NAME of the functional group. (1)

2.5.2 The IUPAC name. (2)

2.6. Compound **G** undergoes hydrogenation reaction.

Write down the:

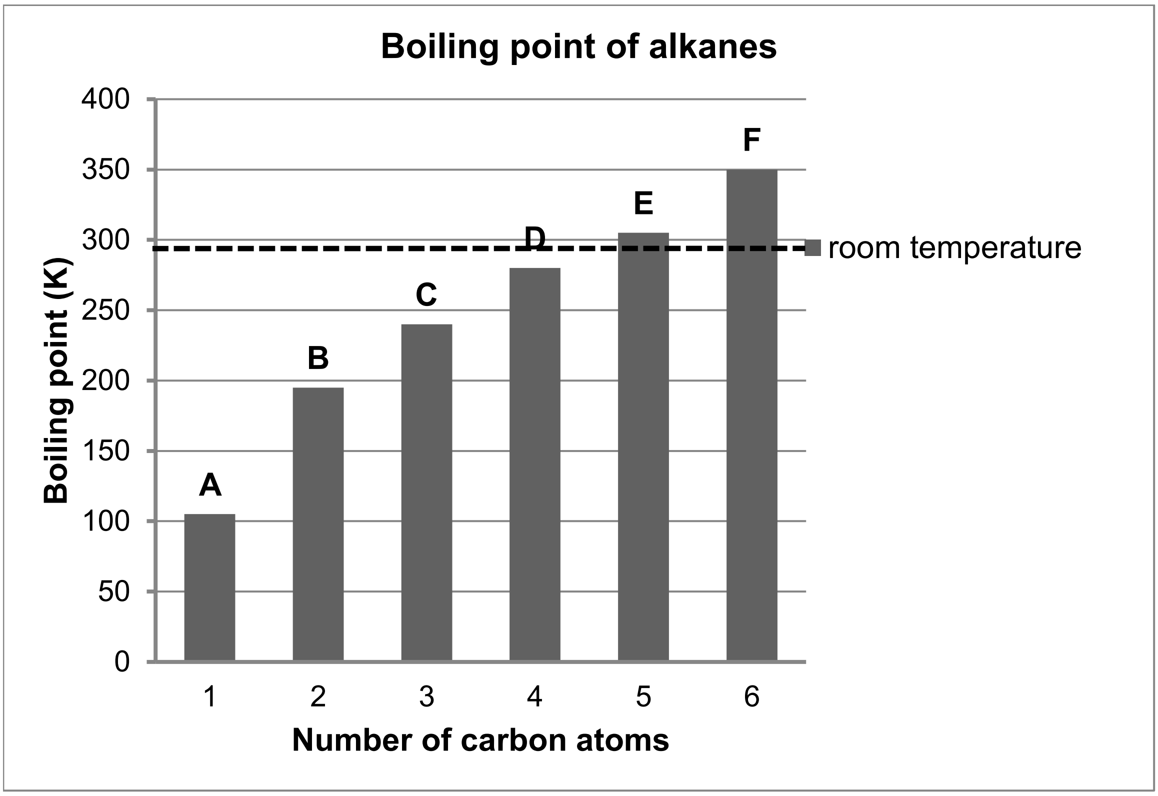
2.6.1 General formula of the homologous series of which compound **G** belongs. (1)

2.6.2 CONDENSED STRUCTURAL FORMULA of the product formed in this reaction. (1)

[17]

QUESTION 3: (Start on a new page.)

During a practical investigation the boiling points of the first six straight chain ALKANES were determined, and the following graph was obtained from the tabulated results.



3.1 Are alkanes SATURATED or UNSATURATED compounds? Explain the answer. (2)

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

3.3 Write down the:

3.3.1 Controlled variable for the investigation. (1)

3.3.2 IUPAC name of the alkane that is liquid at room temperature. (1)

3.3.3 Type of intermolecular force that exists in the compound mentioned in QUESTION 3.3.2. (2)

3.3.4 Structural formula of the CHAIN ISOMER of the alkane with 4 carbon atoms. (1)

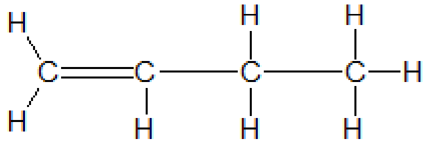
3.4 What is the trend of boiling point from compound **A** to **F**? Fully explain the trend. (4)

3.5 Will the vapour pressure of the chain isomers of compound **D** be HIGHER THAN, LOWER THAN or EQUAL TO that of compound **D**. (2)
[15]

QUESTION 4: (Start on a new page.)

4.1 Alkenes undergo addition reactions. Reaction **I** and **II** given below represent the equations of incomplete addition reactions. Compound **P** and **Q** are organic products.

Reaction I



+ H_2O → Compound **P** **(Major product)**

Reaction II

2-methylpent-1-ene + HCℓ → Compound **Q** **(Major product)**

4.1.1 Write down the TYPE of addition reaction represented in:

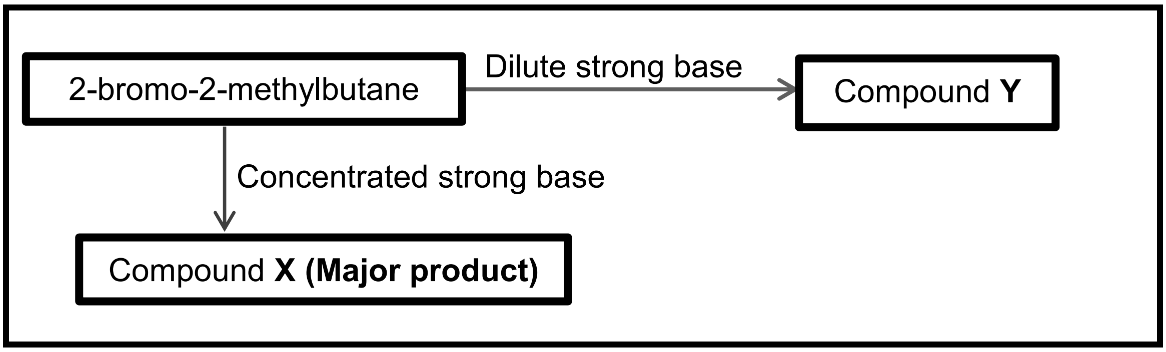
(a) Reaction I (1)

(b) Reaction II (1)

4.1.2 Structural formula of compound **P**. (2)

4.1.3 IUPAC name of compound **Q**. (2)

4.2 Halo-alkanes can either undergo ELIMINATION or SUBSTITUTION in the presence of a strong base. Study the flow diagram below which represents two different reactions



Write down the

4.2.1 TYPE of reaction will take place when 2-bromo-2-methylbutane is heated in the presence of diluted strong base?

Choose either ELIMINATION or SUBSTITUTION (1)

4.2.2 NAME or FORMULA of the strong base. (1)

4.2.3 Balanced chemical equation for the reaction using STRUCTURAL FORMULAE that takes place when 2-bromo-2-methyl butane reacts with concentrated strong base. (4)

4.2.4 IUPAC name of the compound **Y** (2)

4.3 An ester is formed when ethanoic acid and methanol is heated in the presence of a catalyst.

Write down the:

4.3.1 NAME or FORMULA of the catalyst used. (1)

4.3.2 Balanced chemical equation for the reaction using STRUCTURAL FORMULAE. (5)
[20]

QUESTION 5: (Start on a new page.)

A group of students investigate the rate of reaction using a reaction between magnesium and hydrochloric acid at constant temperature.

The balanced chemical equation for the reaction is:

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

In one of the experiments they added 0,24 g of pure magnesium ribbon to an EXCESS of dilute hydrochloric acid and the following results were recorded.

Time (seconds)	**Volume of H_2 gas evolved (cm^3)**
0	0
20	90
40	140
60	172
80	195
100	210
120	224
140	224

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

5.2 Use the GRAPH PAPER provided to draw a graph of volume of H_2 gas produced versus time. (4)

5.3 Use the graph to calculate the average rate of reaction in (cm^3. s^{-1}) during the time interval 50 s to 90 s. (3)

5.4 Give a reason why the gradient of the graph decreases as the reaction proceeds. (1)

5.5 The experiment was repeated using 0,24 g of pure magnesium powder instead of magnesium ribbon.

5.5.1 Calculate the mass of hydrogen gas produced at the end of the reaction. (4)

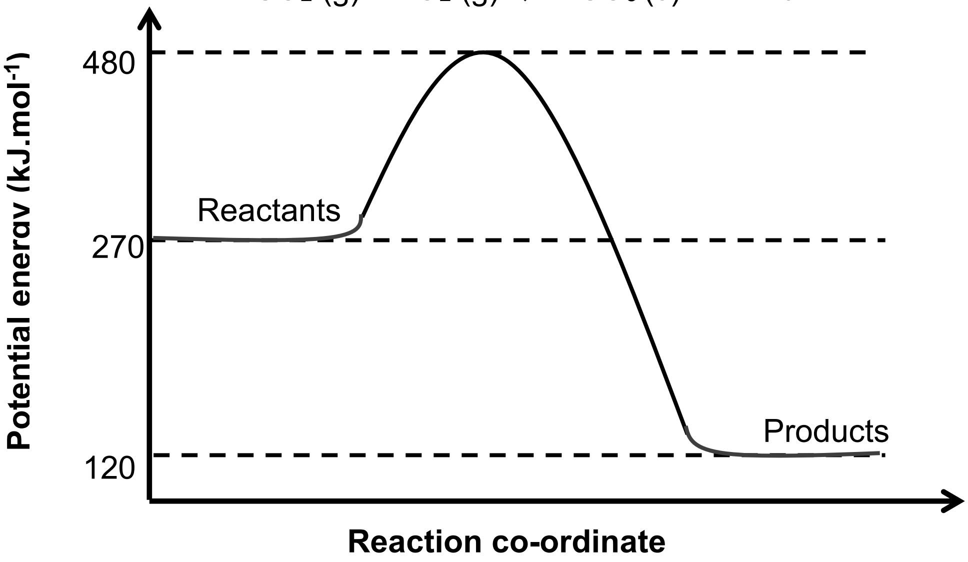
5.5.2 How will the rate of reaction be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME? (1)

[15]

QUESTION 6: (Start on a new page.)

6.1 The energy diagram below shows changes in the potential energy for the reaction between sulphur dioxide and oxygen.

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



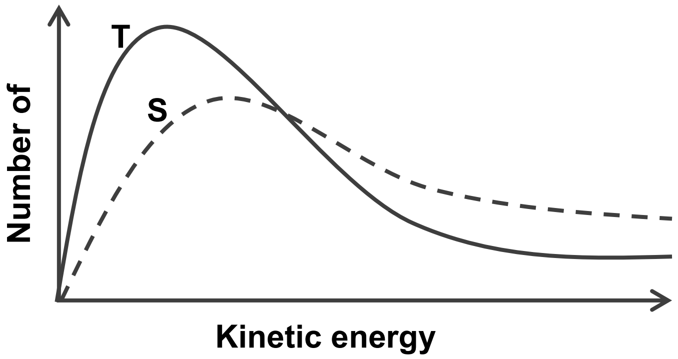
6.1.1 Define the term *activation energy*. (2)

6.1.2 Calculate the activation energy for the reverse reaction. (1)

6.1.3 After a while, a catalyst is introduced in the container.

Copy the above diagram in your ANSWER BOOK and use a dotted line to indicate how a positive catalyst affects the activation energy for the forward reaction. (2)

6.2 The two energy distribution curves below, **T** and **S** represent a gas at different temperatures.



6.2.1 Which ONE of the curves (**T** or **S**) represents the gas at a higher temperature? (1)

6.2.2 Use the COLLISION THEORY and the information on the graph to explain how temperature affects the rate of a reaction. (3)

[9]

QUESTION 7: (Start on a new page.)

When heated hydrogen sulphide gas decomposes according to the following reversible reaction.

$$2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$$

7.1 A 3,4 g sample of H_2S (g) is introduced into an empty rigid container of volume 1,25 dm^3. The sealed container is heated to 483 K, and 0,037 mol of S_2 (g) is present at equilibrium.

7.1.1 Define *Le Chatelier's principle*. (2)

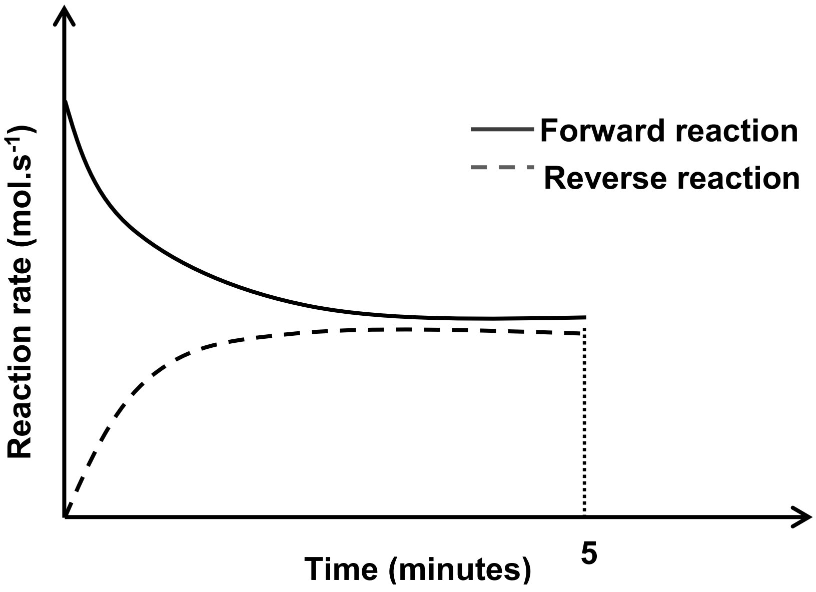
7.1.2 Calculate the equilibrium constant K_c, for the decomposition reaction at 483 K. (8)

7.2 The equilibrium constant, K_c for this reaction is increased by increasing the temperature.

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

7.2.2 Use Le Chatelier's principle to fully explain the answer in QUESTION 7.2.1. (2)

The sketch graph below was obtained for the equilibrium mixture for the first 5 minutes.



7.2.3 Redraw the graph above in your ANSWER BOOK. On the same set of axes complete the graph showing the effect of the temperature on the reaction rate at the 5th minute. (2)

[15]

QUESTION 8: (Start on a new page.)

Carbonic acid (H_2CO_3) ionises according to the following equation:

$$H_2CO_3(aq) + H_2O(\ell) \rightarrow H_3O^+(aq) + HCO_3^-(aq)$$

8.1 *Is carbonic acid, $H_2CO_3(aq)$, a strong acid* or *a weak acid?*

Give a reason for the answer (2)

Two beakers **A** and **B** contain the acid and a strong base respectively.

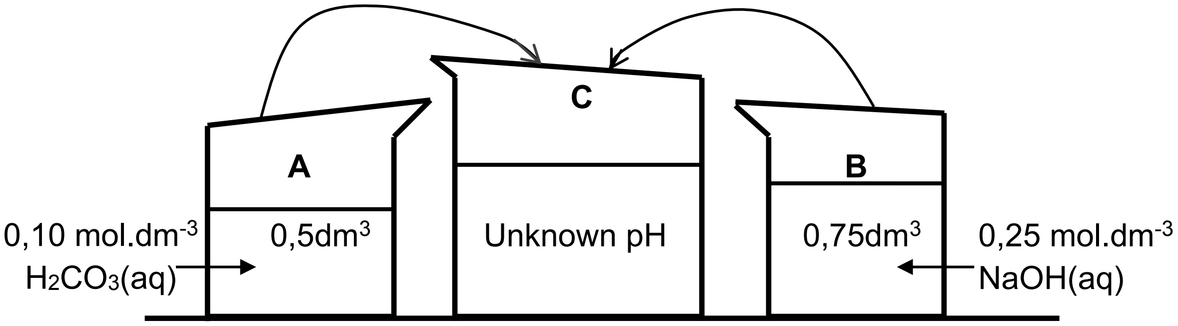
Beaker **A**: 0,5 dm^3 of carbonic acid, $H_2CO_3(aq)$ of concentration 0,10 mol.dm^{-3}

Beaker **B**: 0,75 dm^3 of sodium hydroxide, NaOH(aq) of concentration 0,25 mol.dm^{-3}

When a 0,10 mol·dm^{-3} solution of H_2CO_3 is prepared, it is found that the concentration of $HCO_3^-(aq)$ ions is 0,012 mol.dm^{-3} at 25 °C.

8.2 Calculate the number of moles of $H_3O^+(aq)$ ions present in H_2CO_3 solution in beaker **A.** (3)

The contents of beakers **A** and **B** are added together in beaker **C**. The solution in beaker **C** has an unknown pH.



The balanced equation for the reaction is:

$$H_2CO_3(aq) + NaOH(aq) \rightarrow NaHCO_3(aq) + H_2O(\ell)$$

8.3 Calculate the:

8.3.1 Number of moles of hydroxide (OH^-) ions in beaker **B**. (3)

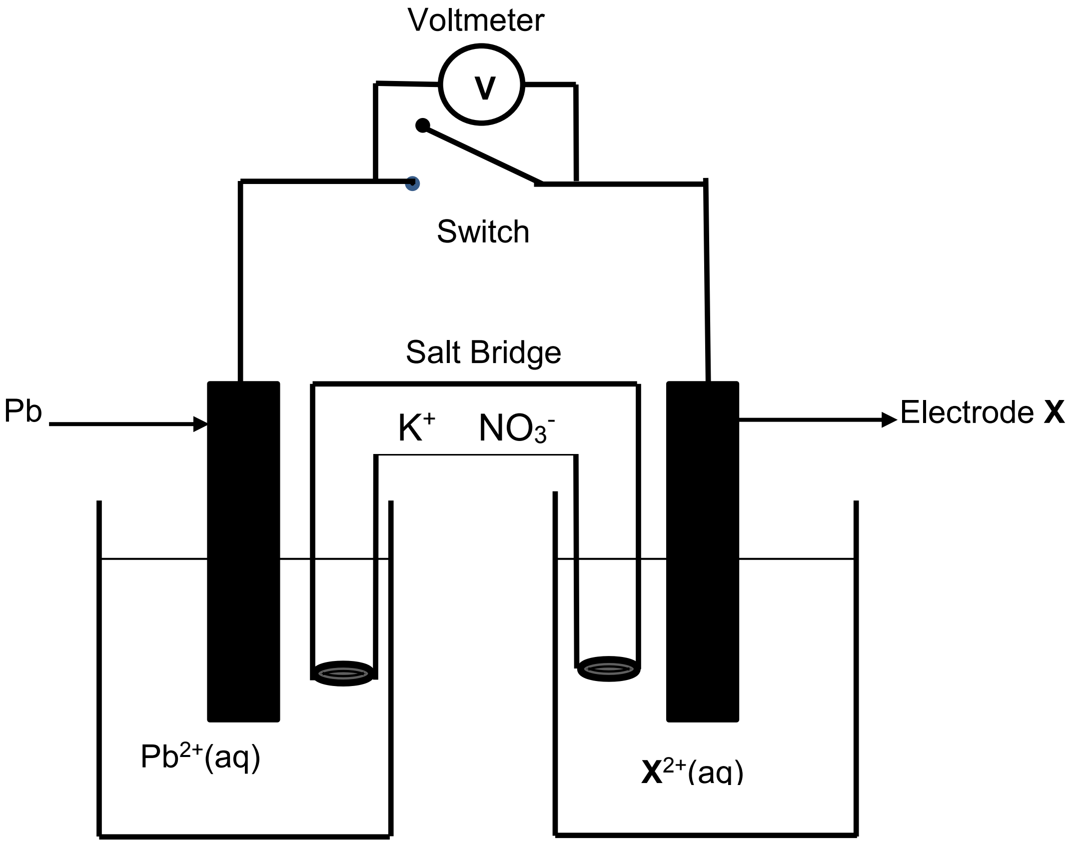
8.3.2 pH of the solution at the completion of the reaction in beaker **C**. (7)

[15]

QUESTION 9: (Start on a new page.)

A standard electrochemical cell is set up using a standard lead half-cell and X|X^{2+} half -cell as shown in the diagram below. A voltmeter connected across the cell, initially registers 0,47 V.

9.1 Define the term *oxidising agent* in terms of ELECTRON TRANSFER. (2)



When the cell is in operation, electrons flow through the Pb electrode towards the **X** electrode in the external circuit.

9.2 Write down the equation for the half reaction that occurs at the cathode. (2)

9.3 Use the STANDARD ELECTRODE POTENTIAL TABLE to identify metal **X**. (5)

9.4 Write down the cell notation of the above cell. (3)

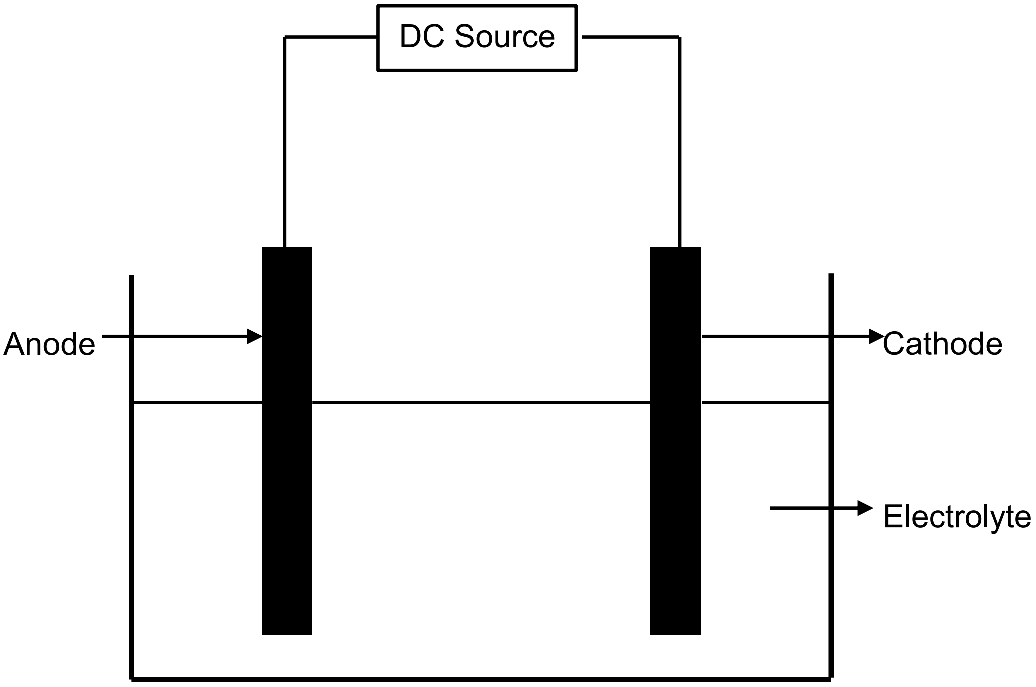
During an experiment, a student set up the electrochemical cell as shown above. After the experiment is over, a student left the switch closed. On the next day, the student opens the switch and takes the voltmeter reading.

9.5 What will be the possible voltmeter reading? Choose from LESS THAN 0,47 V, EQUAL TO 0,47 V or MORE THAN 0,47 V.

Explain your answer by referring to the concentrations of the electrolytes (3)
[15]

QUESTION 10(Start on a new page.)

Copper metal can be purified by electrolysis, using the electrochemical shown below.



10.1 Define the term *electrolysis.* (2)

10.2 Write down the CHEMICAL NAME or FORMULA of the electrolyte. (1)

10.3 On which electrode will copper be formed? Write down only ANODE or CATHODE. Support your answer by writing down the relevant half reaction. (3)

10.4 The solid impurities which form during the electrolysis contain silver.

Refer to the relative strength of reducing agents to explain why silver metal does not react with the electrolyte mentioned in QUESTION 10.2. (3)

[9]

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* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE1

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

29
1,9 Cu
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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

↓ Increasing reducing ability/*Toenemende reduserende vermoë*

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

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

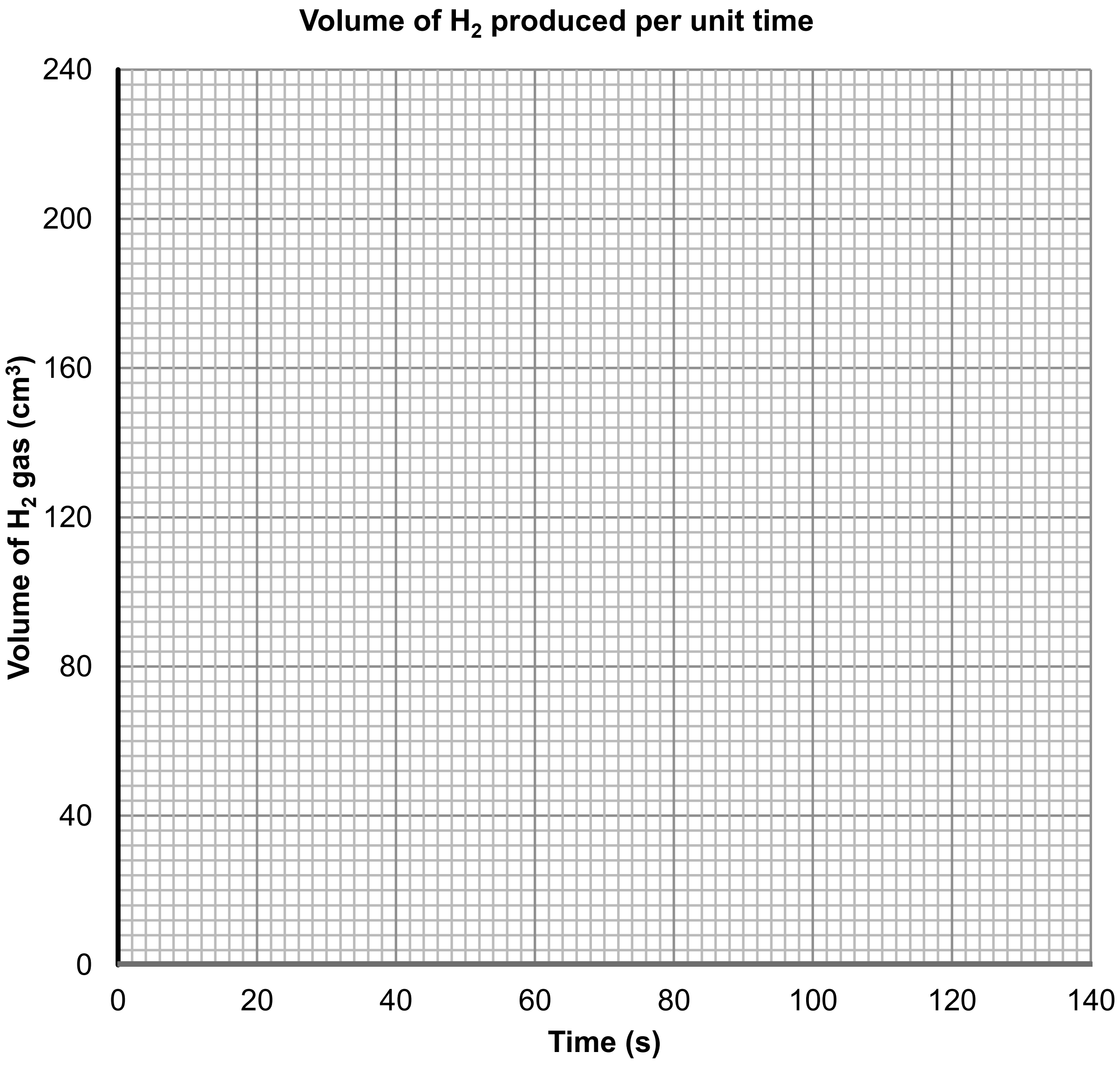
Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

NAME OF THE LEARNER:	

ANSWER SHEET (N.B. Staple the graph paper inside the answer book)

QUESTION 5.2



education
Lefapha la Thuto la Bokone Bophirima
Noordwes Departement van Onderwys
North West Department of Education
NORTH WEST PROVINCE

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

PHYSICAL SCIENCE: CHEMISTRY (P2)
FISIESE WETENSKAP: CHEMIE (V2)

SEPTEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 17 pages including the cognitive grid.
Hierdie nasienriglyne bestaan uit 17 bladsye insluitend die kognitiewe tabel.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1 3–methyl✓heptane ✓✓/*3-metiel✓heptaan* ✓✓

Marking criteria

- Correct stem i.e. <u>heptane.</u>✓
- Substituent (methyl)correctly identified.✓
- IUPAC name correct including numering and hyphen. ✓

Nasienriglyne

- *Korrekte stam bv heptaan.*✓
- *Sytak (metiel) korrek geïdentifiseer.*✓
- *IUPAC naam heeltemal korrek insluitende volgorde en koppelteken.* ✓

(3)

2.2

2.2.1 Organic compounds having <u>same molecular formula</u> ✓but <u>different structural formula</u>✓/*Organiese verbindings met <u>dieselfde molekulêre formule</u>✓ maar <u>verskillende struktuurformules</u>* ✓. (2)

2.2.2 Functional isomer✓ /*Funksionele isomere* ✓ (1)

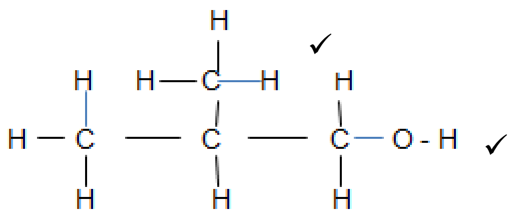
2.2.3 Aldehyde✓/*Aldehied* ✓ (1)

2.3

2.3.1 Secondary✓/*Sekondêre* ✓ (1)

2.3.2 The carbon bonded to the hydroxyl group/-OH is bonded to two other carbon atoms✓✓/*Die koolstof gebind aan die hidroksielgroep/OH⁻ is gebind aan twee ander koolstofatome* ✓✓ (2)

2.4



Marking criteria

- -OH on the first carbon ✓
- Whole structure correct ✓

Nasienriglyne

- -OH op die eerste koolstof ✓
- Hele struktuur korrek ✓

(2)

2.5.

2.5.1 Carboxyl group✓/*Karboksielgroep* ✓ (1)

2.5.2 Propanoic acid✓✓/*Propanoësuur* ✓✓ (2)

2.6

2.6.1 C_nH_{2n} ✓ (1)

2.6.2 CH_3CH_3 ✓ (1)

[17]

QUESTION 3/*VRAAG 3*:

3.1 Saturated✓/*Versadig*✓

No multiple bond/ single bonds **only** ✓between carbon atoms in their hydrocarbon chain
*Geen meervoudige bindings/**slegs** enkel bindings ✓ tussen die koolstofatome in die koolwaterstofketting.* (2)

Marking criteria
If one of the underlined key phrases in the **correct context** is omitted deduct 1 mark
Nasienkriteria
*Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

3.2 Temperature at which vapour pressure is equal to the atmospheric pressure✓✓
Temperatuur waarby die dampdruk gelyk is aan die atmosferiese druk ✓✓ (2)

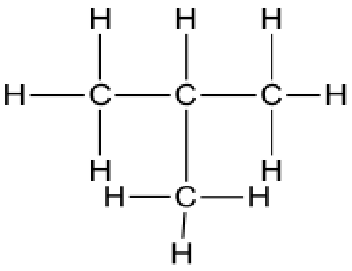
3.3

3.3.1 Homologous series✓/*Homoloë reeks*✓ (1)

3.3.2 Pentane/Hexane✓/*Pentaan/Heksaan*✓ (1)

3.3.3 London force/induced dipole force✓/*Londonkragte/geïnduseerde dipoolkragte*✓ (1)

3.3.4



✓✓ (2)

3.4 Increases✓/*Verhoog*✓ (1)

- **Structure:**
  The chain length/molecular mass increases from compound A to F✓
- **Intermolecular forces:**
  The strength of the London force increase ✓
- **Energy:**
  More energy needed to break the intermolecular forces from A to F✓
- ***Struktuur:***
  Die kettinglengte/molekulêre massa neem toe van verbinding A tot F✓
- ***Intermolekulêre kragte:***
  Die sterkte van die Londonkragte neem toe ✓
- ***Energie:***
  Meer energie word benodig om die intermolekulêrekragte van A na F te onderbreek. ✓ (4)

3.5 Higher than✓✓/*Hoër as*✓✓ (2)
[15]

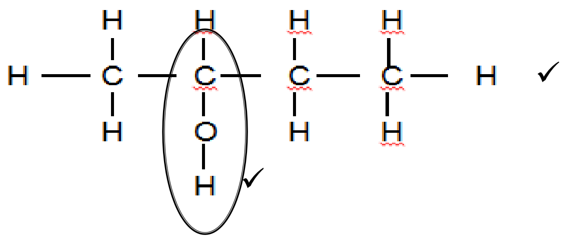
QUESTION 4/*VRAAG 4*:

4.1

4.1.1 a) Hydration✓/*Hidrasie* ✓ (1)

b) Hydrohalogenation✓/*Hidrohalogenering* ✓ (1)

4.1.2



(2)

Marking criteria:
- Four carbon atoms in longest chain✓
- Hydroxyl group on C_2✓

Nasienkriteria:
- *Vier koolstowwe in die langste ketting*✓
- *Hydroksielgroep op C_2*✓

4.1.3 2–chloro–2–methyl✓pentane✓/*2–chloro–2–metiel*✓*pentaan*✓ (2)

4.2

4.2.1 Substitution✓/*Substitusie*✓ (1)

4.2.2 NaOH/KOH/LiOH✓ (1)

4.2.3

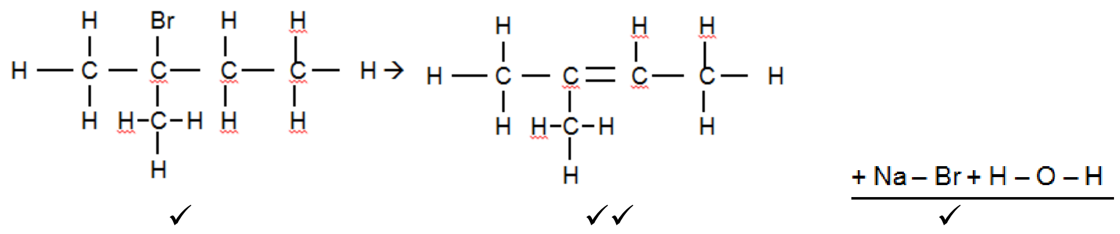
Note:
- For QUESTIONS 4.2.3 & 4.3.2, penalise only once for the use of condensed formulae or molecular formulae

Aantekeninge:
- *Vir VRAE 4.2.3 & 4.3.2, penaliseer slegs een keer vir die gebruik van gekondenseerde of molekulêre formules*

Marking criteria:
- Correct structural formula for 2-bromo-2-methylbutane✓
- Correct structural formula for 2-methylbut-2-ene✓
- Correct functional group(double bond between carbon atoms) ✓for 2-methylbut-2-ene
- Correct formula for NaBr & H_2O✓

Nasienkriteria:
- *Korrekte struktuurformule vir 2-bromo-2-metielbutaan*✓
- *Korrekte struktuurformele vir 2-metielbut-2-een*✓
- *Korrekte funksionele groep(dubbelbinding tussen koolstofatome)* ✓*vir 2-metielbut-2-een*
- *Korrekte formule vir NaBr & H_2O* ✓

4.2.3



(4)

4.2.4 2–methylbutan–2–ol✓✓/*2-metielbutan-2-ol* ✓✓ (2)

4.3.1.(Concentrated)Sulphuric acid/H_2SO_4✓/*(gekonsentreerde)Swawelsuur/* H_2SO_4 ✓ (1)

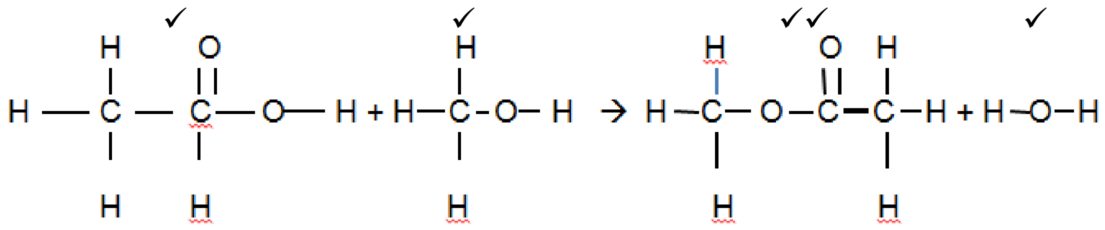
4.3.2 **Marking criteria:**

- Correct structural formula for ethanoic acid✓
- Correct structural formula for methanol✓
- Correct functional group (ester) ✓& correct structural formula methyl ethanoate✓
- Correct formula for H_2O✓

Nasiekriteria:

- *Korrekte struktuurformule vir etanoësuur*
- *Korrekte struktuurformule vir metanol*
- *Korrekte funksionele groep (ester)* ✓& *korrekte struktuurformule metieletanoaat*
- *Korrekte formule vir* H_2O

4.3.2.



(5)
[20]

QUESTION 5/*VRAAG* 5:

5.1. **ANY ONE:**

- Change in concentration ✓of products/reactants per unit time✓
- Change in amount/number of mole/volume/mass ✓of products/reactants per unit time✓
- Amount/number of mole/volume/mass of products formed/reactants used✓ per unit time✓
- Rate of change in concentration/amount of moles/number of moles/volume/mass✓✓(**2 or 0**)

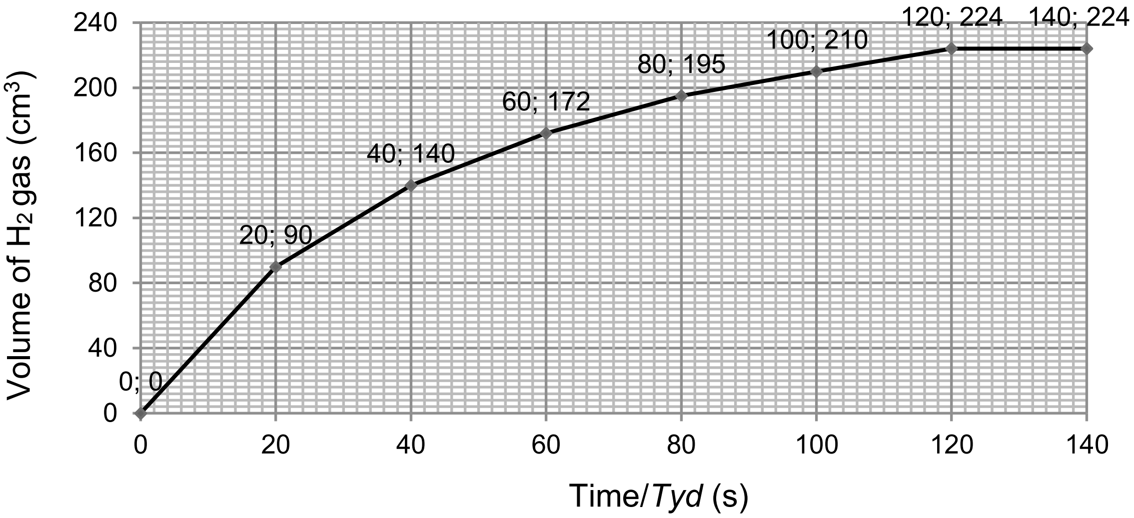
ENIGE EEN:

- *Verandering in konsentrasie ✓van produkte/reaktante per tydseenheid✓*
- *Verandering in hoeveelheidl/aantal mol/volume/massa ✓van die produkte/reaktante per tydseenheid ✓*
- *Hoeveelheidl/aantal mol/volume/massa produkte gevorm/reaktante opgebruik ✓per tydseenheid ✓*
- *Tempo van verandering in konsentrasie/aantal mol/hoeveelheid mol/volume/massa ✓✓(**2 or 0**)*

(2)

NOTE:
Give the mark for per unit time only if in correct context of reaction rate.
LET WEL:
Gee 'n punt vir per tydseenheid slegs as dit in die korrekte konteks vir reaksietempo gebruik is.

5.2.



Marking criteria/*Nasiekriteria*:	Marks/*Punte*
Plotting all the points correctly *Alle punte korrek geplot*	✓✓
Shape *Vorm van die grafiek*	✓✓
NOTE If four points plotted correctly give one mark. ***Aantekening*** *Indien vier punte korrek geplot is, gee een punt.*	

(4)

5.3 Rate of reaction $= \frac{\Delta v}{\Delta t} = \frac{202-156 ✓}{90-50 ✓} = 1{,}15\ cm^3.s^{-1}$ ✓ (3)

5.4. Reactants are used up/concentration of HCl decreased ✓
Reaktante is opgebruik/konsentrasie van HCl het afgeneem ✓ (1)

5.5

Marking criteria:

- Substituting 24 g.mol^{-1}✓ & 2 g.mol^{-1}✓ in the correct formula
- Using the ratios Mg : H_2 = 1 : 1✓
- Final answer✓

Nasienkriteria:

- *Vervang 24 g·mol^{-1} ✓& 2 g·mol^{-1} in die korrekte formule*
- *Gebruik die verhouding vir Mg : H_2 = 1:1*
- *Finale antwoord*

5.5.1 $n\ (Mg) = \frac{m}{M}$

$n\ (Mg) = \frac{0{,}24}{24 ✓} = 0{,}01$ mol

Mg : H_2 = 1 : 1; n (H_2) = 0,01 mol✓

$n\ (H_2) = \frac{m}{M}$

$0{,}01 = \frac{m}{2}$✓ m = 0,02 g✓ (4)

5.5.2 Increase/*Toeneem*✓ (1)

[15]

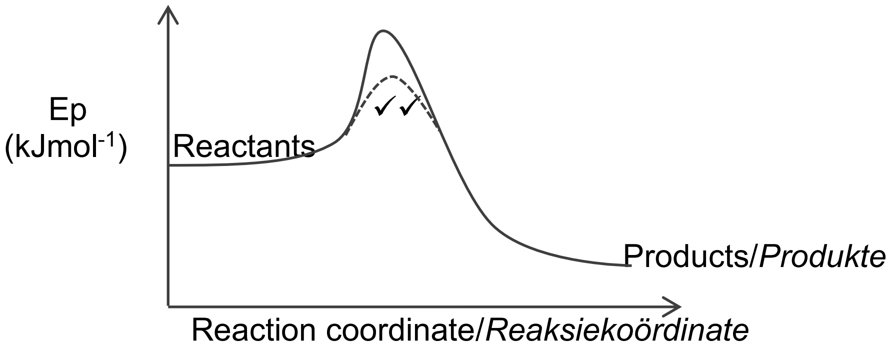
QUESTION 6/*VRAAG 6*:

6.1

6.1.1 Minimum energy needed for a reaction to take place✓✓
Minimum energie benodig vir 'n reaksie om plaas te vind ✓✓ (2)

6.1.2 $E_a = 480 - 120, = 360(\text{kJ·mol}^{-1})$ ✓ (1)

6.1.3



(2)

6.2.1 S ✓ (1)

6.2.2

- An increase temperature increases average kinetic energy of the particles✓
- More effective collision per unit time✓
- Rate of reaction will increase✓
- *'n Toename in temperatuur verhoog die gemiddelde kinetiese energie van die deeltjies*✓
- *Meer effektiewe botsings per tydseenheid*✓
- *Reaksietempo sal toeneem*✓

OR/*OF*

- A decrease temperature decreases the average kinetic energy of the particles✓
- Lesser effective collision per unit time✓
- Rate of reaction will decrease✓
- *'n Afname in temperatuur verlaag die gemiddelde kinetiese energie van die deeltjies*✓
- *Minder effektiewe botsings per tydseenheid*✓
- *Reaksietempo sal afneem*✓

(3)
[9]

QUESTION 7/*VRAAG* 7:

7.1.1 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.✓✓*Wanneer die* ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel, deur die reaksie wat die versteuring teenwerk te bevoordeel.✓✓(**2 or 0**) (2)

7.1.2

CALCULATIONS USING NUMBER OF MOLES
BEREKNENINGE WAT GETAL MOL GERBUIK

Marking criteria:

a) Calculating initial n(H_2S) substitute 34✓ in the formula n=n/M
b) Change in n (S_2) = equilibrium n(S_2) - initial n(S_2) ✓
c) Using ratio: H_2S : H_2 : S_2 = 2: 2: 1✓
d) Equilibrium n(H_2) = intial n(H_2) + change n(H_2)
   Equilibrium n(H_2S) = intial n(H_2S) - change n(H_2S) ✓
e) Divide equilibrium amounts H_2S and H_2 and S_2 by 1,25 dm^3✓
f) Correct Kc expression in square brackets✓
g) Substitution of equilibrium concentrations into Kc expressions✓
h) Final answer. 0,24✓

Nasienkriteria:

a) Bereken die aanvanklike n(H_2S) vervang 34✓ in formule n=m/M
b) Verandering in n(S_2) = ewewig n(S_2) – aanvanklike n(S_2) ✓
c) Gebruik die verhouding: H_2S : H_2 : S_2 = 2: 2: 1✓
d) Ewewig n(H_2) = aanvanklik n(H_2) + verandering in n(H_2)
   Ewewig n(H_2S) = aanvanklik n(H_2S) – verandering in n(H_2S) ✓
e) Deel ewewigswaardes van H_2S en H_2 en S_2 by 1,25 dm^3✓
f) Korrekte Kc uitdrukking in vierkantige hakkies✓
g) Substitusie van ewewiskonsentrasies in die Kc uitdrukking✓
h) Finale antwoord: 0,24✓

OPTION 1/OPSIE 1

mol	H_2S	H_2	S_2
Initial/ *Aanvanklik*	n= $\frac{3,4}{34✓}$ = 0,1	0	0
Change / *Verandering*	0.074	0,074	0,037✓ ratio✓
Equilibrium/ *Ewewig*	0,026	0,074✓	0,037
Concentration/ *Konsentrasie*	$\frac{0.026}{1,25}$= 0,0208	$\frac{0,074}{1,25}$= 0,0592	$\frac{0,037}{1,25}$ = 0,0296 divide by 1,25✓

$$Kc = \frac{[H_2] \cdot [S_2]}{[H_2S]^2} ✓$$

$$= \frac{(0,0592)^2 \times (0,0296)}{(0,0208)^2} ✓$$

$$= 0,24 ✓$$

CALCULATIONS USING CONCENTRATIONS
BEREKNENINGE WAT KONSENTRASIE GERBUIK

Marking criteria:

a) Calculating initial n(H_2S) substitute 34✓ in the formula n=m/M
b) Divide initial amounts H_2S by 1,25 dm^3✓
c) Change in c (S_2) = equilibrium c(S_2) - initial c(S_2) ✓
d) Using ratio: $H_2S : H_2 : S_2$ = 2:2:1✓
e) Equilibrium c(H_2) = intial c(H_2) + change c(H_2)
   Equilibrium c(H_2S) = intial c(H_2S) - change c(H_2S) ✓
f) Correct Kc expression in square brackets✓
g) Substitution of equilibrium concentrations into Kc expressions✓
h) Final answer. 0,24✓

Nasienkriteria:

a) Bereken die aanvanklike n(H_2S) ✓vervang 34 in die formule n=m/M
b) Deel ewewigswaardes van H2S by 1,25 dm^3✓
c) Verandering in n(S_2) = ewewig n(S_2) – aanvanklike n(S_2) ✓
d) Gebruik die verhouding: $H_2S : H_2 : S_2$ = 2:2:1✓
e) Ewewig c(H_2) = aanvanklik c(H_2) + verandering in c(H_2)
   Equilibrium c(H_2S) = intial c(H_2S) – verandering in c(H_2S) ✓
f) Korrekte Kc uitdrukking in vierkantige hakkies✓
g) Substitusie van ewewiskonsentrasies in die Kc uitdrukking✓
h) Finale antwoord: 0,24✓

OPTION 2/*OPSIE 2*

Concentration/*Konsentrasie*	H_2S	H_2	S_2
Initial/ *Aanvanklik*	n= $\frac{3,4}{34✓}$ = 0,1/1.25✓= 0,08	0	0
Change in concentrations *Verandering in konsentrasie*	0.0592	0,0592	0,0296✓ ratio✓
Equilibrium concentrations *Ewewigskonsentrasies*	0,0208	0,059✓	0,0296

$$Kc = \frac{[H_2]^2 \cdot [S_2]}{[H_2S]^2} ✓$$

$$= \frac{(0,0592)^2 \times (0,0296)}{(0,0208)^2} ✓$$

$$= 0,24 ✓$$

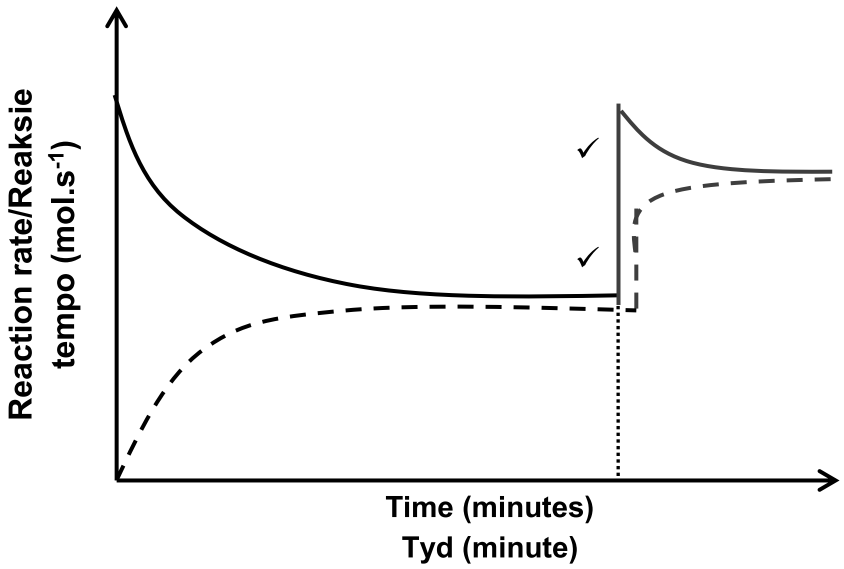
(8)

7.2

7.2.1 Endothermic✓/*Endotermies* ✓ (1)

7.2.2 Increase in temperature increases Kc value, and then the forward reaction is favoured✓. Increase in temperature favours endothermic reaction✓
'n Verhoging in temperatuur verhoog die Kc waarde, die voorwaartse reaksie is bevoordeel. ✓ *'n Verhoging in temperatuur bevoordeel die endotermiese reaksie*✓ (2)

7.2.3



Marking criteria:
- Both lines are up✓
- Solid line is longer than dotted line✓

Nasienkriteria:
- *Beide lyne gaan op* ✓
- *Soliede lyn is langer as stippellyn* ✓

2)
[15]

QUESTION 8/*VRAAG 8*:

8.1 Weak acid ✓ It <u>ionises incompletely/does not ionise completely in water</u>✓ (to form a low concentration of H_3O^+)/
Swak suur✓ Dit <u>ioniseer onvolledig/ioniseer nie volledig in water nie</u>✓(om 'n lae konsentrasie H_3O^+ ione te vorm) (2)

8.2 $[H_3O^+] = [HCO_3^-] = 0,012\ mol.dm^{-3}$✓
n = cV
= 0,012 x 0,5 ✓
n = 0.006 mol ✓

<u>Marking Criteria:</u>

- Ratio $[H_3O^+] = [HCO_3^-]$✓
- Substitution✓ on c = n/V
- Answer✓

<u>Nasienriglyne:</u>

- *Verhouding $[H_3O^+] = [HCO_3^-]$✓*
- *Substitusie✓in c = n/V*
- *Antwoord✓*

(3)

8.3

8.3.1.

<u>Marking criteria:</u>

- Formula c = n/V✓
- Substitution✓
- Using ratio 1(OH^-) : 1(NaOH) correctly ✓

<u>Nasienriglyne:</u>

- *Formule c = n/V✓*
- *Substitusie✓*
- *Gebruik verhouding 1(OH^-) : 1(NaOH) korrek ✓*

n $_{(NaOH)}$ = cV✓
n $_{(NaOH)}$ = 0,25 x 0,75✓
= 0,1875 mol
Therefore n(OH^-) = 0,1875 mol ✓ (3)

8.3.2 **<u>Positive marking from 8.2 & 8.3.1/ *Positiewe merk vanaf 8.2 & 8.3.1*</u>**

<u>Marking criteria:</u>

- Using ratio 1 (OH^-) : 1 (HCO_3^-) correctly✓(0,006 mol of acid neutralises 0,006 mol of base)
- n(OH^-) in excess 0,1875 - 0,006✓ = 0,1815mol
- Substitution ✓on c = n/v
- $[H_3O^+] = 10^{-14}/0,102$ ✓
- pH = -log $[H_3O^+]$ ✓
- Substitution on formula✓
- Final answer✓

<u>Nasienriglyne:</u>

- *Gebruik verhouding 1(OH^-) : 1(HCO_3^-) korrek ✓(0,006 mol suur neutraliseer 0,006 mol basis)*
- *n(OH^-) in oormaat 0,1875- 0,006✓= 0,1815mol*
- *Substitusie ✓on c = n/v*
- *$[H_3O^+]= 10^{-14}/0,102$ ✓*
- *pH = -log $[H_3O^+]$ ✓*
- *Substitusie in formule✓*
- *Finale antwoord✓*

OPTION 1/*OPSIE 1*

0,006 mol of acid neutralises 0,006 mol of base ✓/*0,006 mol suur neutraliseer 0,006 mol basis* ✓
$n(OH^-)$ in excess/*in oormaat* 0,1875- 0,006✓= 0,1815 mol
$[OH^-] = n/V = 0{,}1815/(0{,}5+0{,}75)$ ✓
$= 0{,}1452\ mol.dm^{-3}$
$K_w = [H_3O^+][OH^-] = 1x10^{-14}$,
therefore/*dus* $[H_3O^+] = 10^{-14}/0{,}1452$ ✓
$= 6{,}89x10^{-14}$
$pH = -log[H_3O^+]$ ✓
$pH = -log(6{,}89x10^{-14})$✓
pH = 13,16✓

OPTION 2/*OPSIE 2*

0,006 mol of acid neutralises 0,006 mol of base ✓/*0,006 mol suur neutraliseer 0,006 mol basis* ✓
$n(OH^-)$ in excess/*oormaat* 0,1875 - 0,006✓ = 0,1815 mol
$[OH^-] = n/V = 0{,}1815/(0{,}5 + 0{,}75)$ ✓
$= 0{,}1452\ mol.dm^{-3}$
$pOH = -log[OH^-]$✓
$= -log(0{,}1452)$ ✓
= 0.84
pH = 14 - pOH
pH = 14 - 0,84✓
pH = 13,16✓ (7)

[15]

QUESTION 9/*VRAAG 9*:

9.1 Substance which accepts electron/ electron acceptors✓✓/ *Stof wat elektrone opneem/ontvang*✓✓ (2)

9.2 $X^{2+} + 2e^- \rightarrow X$✓✓ (2)

9.3 $E^\ominus_{cell} = E^\ominus_{reduction} - E^\ominus_{oxidation}$✓
$0{,}47$✓ $= E^\ominus_{cathode} - (-0.13)$ ✓
$E^\ominus_{cathode} = 0{,}34$ v✓
Metal/*Metaal* **X** = Cu/Copper✓/ Koper✓ (5)

NOTE:

- Accept any other correct formula from the data sheet.
- Any other formula using unconventional abbreviations, e.g. $E^\ominus_{cell} = E^\ominus_{OA} - E^\ominus_{RA}$ followed by correct substitutions: ¾

LET WEL:

- *Aanvaar enige ander korrekte formule vanaf gegewensblad.*
- *Any other formula using unconventional abbreviations, e.g. $E^\ominus_{cell} = E^\ominus_{OA} - E^\ominus_{RA}$ followed by correct substitutions: ¾*

9.4 $Pb(s)|Pb^{2+}(aq)$✓ ||✓ $Cu^{2+}(aq)|Cu\ (s)$✓ (3)

Marking criteria/*Nasienriglyne*:

- Oxidation/*Oksidasie* ✓ Double line/*Dubbellyn*(||)✓
  Reduction/*Reduksie*✓
- Ignore the phases/*Ignoreer fases*

9.5 Less than 0.47 V✓/*Minder as 0.47 V*✓
As the reaction proceeds/*Soos die reaksie voortgaan*

- $[Pb^{2+}]$ increases and $[Cu^{2+}]$ decreases✓/*$[Pb^{2+}]$ verhoog en $[Cu^{2+}]$ verlaag*✓
- reverse reaction is favoured✓/*terugwaartse reaksie is bevoordeel*✓ (3)

[15]

QUESTION 10/*VRAAG 10*:

10.1 **ANY ONE: (2 or 0)**

- Process in which electrical energy is converted to chemical energy✓✓
- Process in which electric current flows through an electrolyte✓✓

***ENIGE EEN*: (2 or 0)**

- *Proses waar elektriese stroom deur 'n elektroliet vloei*✓✓
- *Proses waar elektriese energie omgeskakel word in chemiese energie*✓✓ (2)

10.2 Copper Sulphate/$CuSO_4$✓ **Accept** : Copper ions/Cu^{2+}
Kopersulfaat/ $CuSO_4$✓***Aanvaar:*** *Koperione/Cu^{2+}* (1)

10.3 Cathode/*Katode*✓

$Cu^{2+} + 2e^- \rightarrow Cu$✓✓ (3)

10.4 Ag(s) is a weaker reducing agent ✓than Cu(s) ✓and will therefore not be able to reduce $cu^{2+}(aq)$ to Cu(s) ✓/*Ag(s) is 'n swakker reduseermiddel*✓ *as Cu(s)* ✓ *en sal dus nie Cu^{2+} na Cu reduseer nie.*✓

OR/*OF*

Cu(s) is a stronger reducing agent ✓than Ag(s) ✓and will therefore not be able to reduce $cu^{2+}(aq)$ to Cu(s) ✓/ *Cu(s) is 'n sterker reduseermiddel* ✓ *as Ag(s)* ✓ *en sal dus nie Cu^{2+} na Cu reduseer nie.*✓ (3)
[9]

TOTAL/*TOTAAL*: 150