



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NASIONALE
SENIOR SERTIFIKAAT**

GRAAD 12

PHSC.2

FISIESE WETENSKAPPE: CHEMIE (V2)

FEBRUARIE/MAART 2017

PUNTE: 150

TYD: 3 uur

Hierdie vraestel bestaan uit 16 bladsye en 4 gegewensblaaie.

OGGENDSESSIE



INSTRUKSIES EN INLIGTING

1. Skryf jou eksamennummer en sentrumnummer in die toepaslike ruimtes op die ANTWOORDEBOEK neer.
2. Hierdie vraestel bestaan uit TIEN vrae. Beantwoord AL die vrae in die ANTWOORDEBOEK.
3. Begin ELKE vraag op 'n NUWE bladsy in die ANTWOORDEBOEK.
4. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.
5. Laat EEN reël oop tussen twee subvrae, byvoorbeeld tussen VRAAG 2.1 en VRAAG 2.2.
6. Jy mag 'n nieprogrammeerbare sakrekenaar gebruik.
7. Jy mag toepaslike wiskundige instrumente gebruik.
8. Jy word aangeraai om die aangehegte GEGEWENSBLAAIE te gebruik.
9. Toon ALLE formules en substitusies in ALLE berekeninge.
10. Rond jou finale numeriese antwoorde tot 'n minimum van TWEE desimale plekke af.
11. Gee kort (bondige) motiverings, besprekings, ensovoorts waar nodig.
12. Skryf netjies en leesbaar.



VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie opsies word as moontlike antwoorde op die volgende vrae gegee. Skryf die vraagnommer (1.1–1.10) neer, kies die antwoord en maak 'n kruisie (X) oor die letter (A–D) van jou keuse in die ANTWOORDEBOEK.

VOORBEELD:

1.11

 A B C D

1.1 Watter EEN van die volgende is die produk wat in die Haberproses gevorm word?

A Stikstof

B Ammoniak

C Salpetersuur

D Swawelsuur

(2)

1.2 'n Karbonielgroep is die funksionele groep van ...

A alkohole.

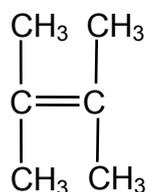
B ketone.

C haloalkane.

D karboksielsure.

(2)

1.3 Beskou die struktuur van 'n organiese verbinding hieronder.



Die IUPAC-naam van hierdie verbinding is ...

A 2,3-dimetielbut-2-een.

B 2,2-dimetielbut-2-een.

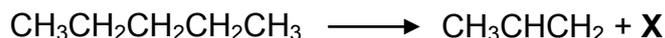
C 1,1,2-trimetielprop-1-een.

D 1,1,2,2-tetrametieleteen.

(2)



1.4 Beskou die reaksie wat hieronder voorgestel word.

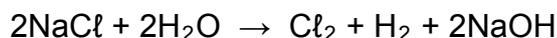


Watter EEN van die volgende dui die tipe reaksie wat plaasvind en die IUPAC-naam van produk **X** KORREK aan?

	Tipe reaksie	Produk X
A	Eliminasie	Etaan
B	Eliminasie	Eteen
C	Addisie	Etaan
D	Addisie	Eteen

(2)

1.5 Beskou die volgende gebalanseerde vergelyking van 'n chemiese reaksie:



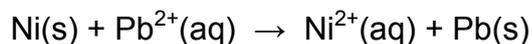
Watter EEN van die volgende stellings oor die reaksie is korrek?

Die reaksie vind plaas in 'n ...

- A galvaniese sel en absorbeer energie.
- B galvaniese sel en stel energie vry.
- C elektrolitiese sel en absorbeer energie.
- D elektrolitiese sel en stel energie vry.

(2)

1.6 Die volgende vergelyking stel die reaksie voor wat in 'n elektrochemiese sel plaasvind:



Die vloei van elektrone deur die eksterne stroombaan van hierdie sel is van ...

- A Pb by die anode na Ni by die katode.
- B Pb by die katode na Ni by die anode.
- C Ni by die katode na Pb by die anode.
- D Ni by die anode na Pb by die katode.

(2)



- 1.7 'n Oplossing het 'n pH = 1. Hierdie oplossing ...
- A bevat geen OH^- -ione nie.
 - B neutraliseer 'n soutsuuroplossing met pH = 1.
 - C bevat 'n hoër konsentrasie H_3O^+ -ione as OH^- -ione.
 - D bevat 'n hoër konsentrasie OH^- -ione as H_3O^+ -ione. (2)

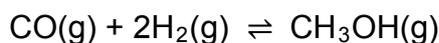
- 1.8 'n Potensiële-energiediagram kan gebruik word om die aktiveringsenergie (E_A) en die reaksiewarmte (ΔH) van 'n reaksie te toon.

Watter EEN van die volgende kombinasies van waardes van E_A en ΔH kan NIE vir enige reaksie verkry word NIE?

	E_A ($\text{kJ}\cdot\text{mol}^{-1}$)	ΔH ($\text{kJ}\cdot\text{mol}^{-1}$)
A	50	-100
B	50	+100
C	100	+50
D	100	-50

(2)

- 1.9 2 mol $\text{CO}(\text{g})$ en 2 mol $\text{H}_2(\text{g})$ word aanvanklik in 'n houer verseël. Die reaksie bereik ewewig volgens die volgende gebalanseerde vergelyking:

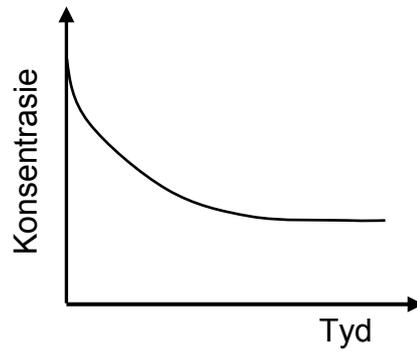


By ewewig sal die hoeveelheid $\text{CH}_3\text{OH}(\text{g})$ in die mengsel ... wees.

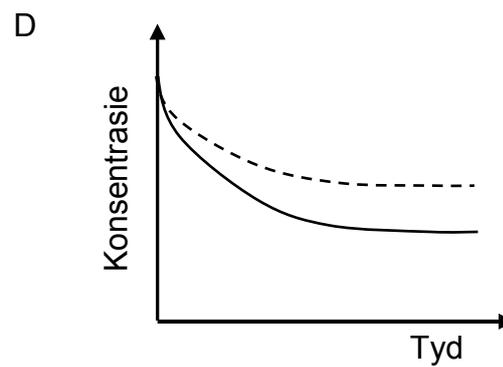
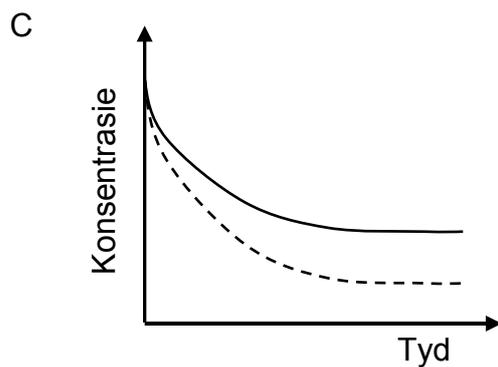
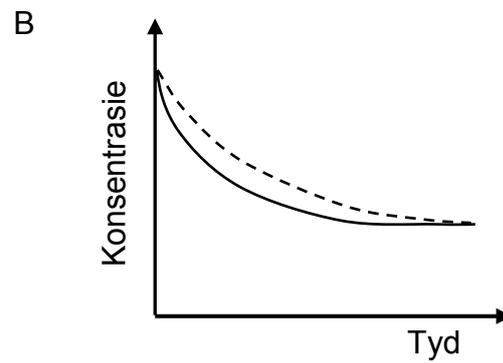
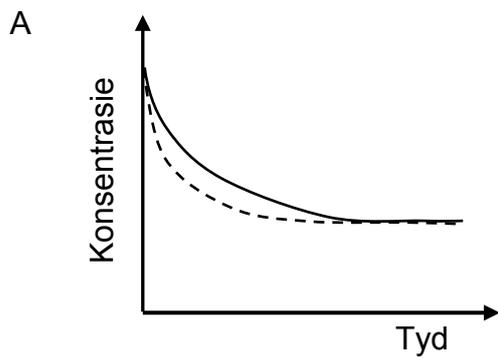
- A 1 mol
- B 2 mol
- C kleiner as 1 mol
- D groter as 1 mol (2)



1.10 Die grafiek hieronder stel die verandering in konsentrasie van 'n reaktans teenoor tyd vir 'n chemiese reaksie voor.



In watter EEN van die volgende grafieke toon die stippellyn die invloed van 'n katalisator op hierdie reaktans?



(2)
[20]



VRAAG 2 (Begin op 'n nuwe bladsy.)

Die letters **A** tot **F** in die tabel hieronder stel ses organiese verbindings voor.

A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	B	$ \begin{array}{c} \text{H} \quad \text{CH}_3 \quad \text{CH}_3 \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}=\text{CH}_2 \\ \quad \\ \text{H} \quad \text{CH}_3 \end{array} $
C	$\text{C}_4\text{H}_8\text{O}$	D	$\text{C}_3\text{H}_8\text{O}$
E	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ & \text{H} & & \end{array} $	F	$ \text{CH}_3\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_2\text{CH}_2\text{CH}_3 $

- 2.1 Skryf die letter neer wat ELK van die volgende voorstel: (1)
- 2.1.1 'n Koolwaterstof (1)
- 2.1.2 'n Alkohol (1)
- 2.1.3 'n Ester (1)
- 2.2 Skryf die IUPAC-naam neer van: (1)
- 2.2.1 Verbinding **A** (1)
- 2.2.2 Verbinding **B** (3)
- 2.3 Verbinding **C** is 'n funksionele isomeer van verbinding **A**. Skryf die struktuurformule van verbinding **C** neer. (2)
- 2.4 Verbinding **D** word as een van die reaktanse gebruik om verbinding **F** te berei. Skryf neer die: (2)
- 2.4.1 Soort reaksie wat plaasvind om verbinding **F** te berei (1)
- 2.4.2 IUPAC-naam van verbinding **D** (2)
- 2.4.3 Struktuurformule van die ander organiese reaktans wat gebruik word (2)
- 2.4.4 IUPAC-naam van verbinding **F** (2)

[16]

VRAAG 3 (Begin op 'n nuwe bladsy.)

Leerders ondersoek faktore wat die kookpunte van alkohole beïnvloed.

Hulle gebruik gelyke volumes van elk van die alkohole en verhit hulle apart in 'n waterbad. Die temperatuur waarby elkeen kook, word gemeet. Die resultate wat verkry is, word in die tabel hieronder getoon.

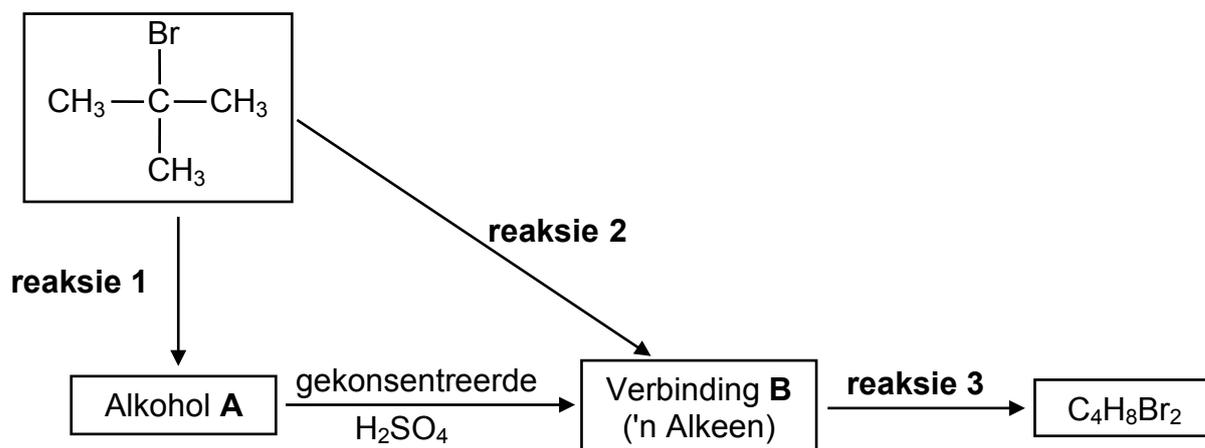
ALKOHOLE	KOOKPUNTE VAN ALKOHOLE (°C)
Butan-1-ol	117,7
Pentan-1-ol	138,5
Heksan-1-ol	157,0

- 3.1 Definieer die term *kookpunt*. (2)
- 3.2 Watter eienskap van alkohole maak dit noodsaaklik dat hulle in 'n waterbad verhit moet word? (1)
- 3.3 Die kookpunte van die alkohole word met mekaar vergelyk.
- 3.3.1 Aan watter strukturele vereistes moet die alkohole voldoen om dit 'n regverdigte vergelyking te maak? (2)
- 3.3.2 Verduidelik die neiging in die kookpunte volledig. (3)
- 3.4 Hoe sal die kookpunt van heksan-1-ol beïnvloed word indien die volume heksan-1-ol wat gebruik word, verdubbel word? Kies uit VERHOOG, VERLAAG of BLY DIESELFDE. (1)
- 3.5 In 'n ander ondersoek vergelyk die leerders die kookpunte van heksan-1-ol en heksanaal.
- 3.5.1 Skryf die onafhanklike veranderlike vir hierdie vergelyking neer. (1)
- 3.5.2 Hulle vind dat die kookpunt van heksan-1-ol hoër as dié van heksanaal is.
- Verduidelik hierdie waarneming volledig. (4)
- [14]**



VRAAG 4 (Begin op 'n nuwe bladsy.)

4.1 Beskou die reaksies wat in die vloedigram hieronder voorgestel word.

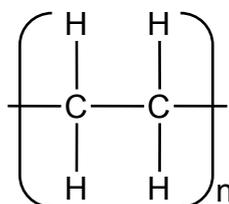


Skryf neer die:

- 4.1.1 Soort reaksie voorgestel deur **reaksie 1** (1)
- 4.1.2 NAAM of FORMULE van die anorganiese reaktans benodig vir **reaksie 1** (1)
- 4.1.3 Soort alkohol (PRIMÊR, SEKONDÊR of TERSIÊR) waarvan alkohol **A** 'n voorbeeld is (1)
- 4.1.4 Soort reaksie wat deur **reaksie 2** voorgestel word (1)
- 4.1.5 IUPAC-naam van verbinding **B** (2)
- 4.1.6 Soort addisiereaksie wat deur **reaksie 3** voorgestel word (1)
- 4.1.7 Gebalanseerde vergelyking vir **reaksie 3** deur struktuurformules te gebruik (4)

4.2 'n Wye reeks sintetiese polimere word berei deur die samevoeging van groot getalle gelyksoortige klein organiese molekule wat in 'n herhalende patroon aan mekaar verbind word.

Polimeer **C** hieronder is 'n voorbeeld van so 'n polimeer.



Polimeer C

Skryf neer:

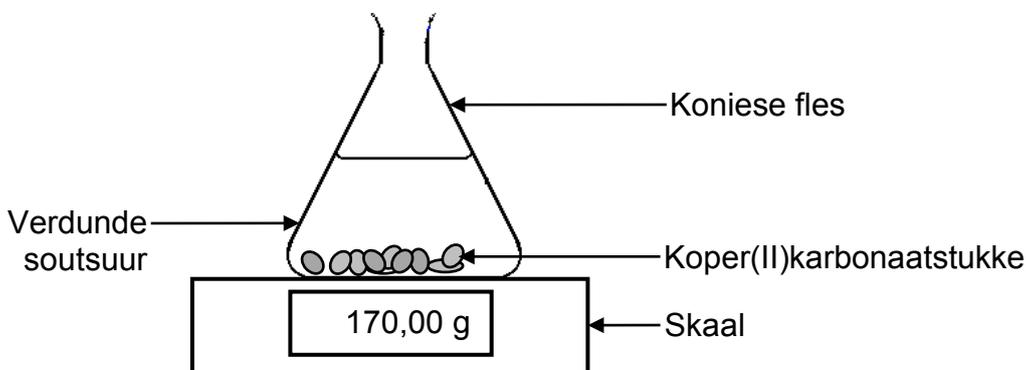
- 4.2.1 EEN woord vir die onderstreepte frase (1)
 - 4.2.2 Die homoloë reeks waaraan die 'klein, organiese molekule' behoort wat gebruik word om polimeer **C** te produseer (1)
 - 4.2.3 Die soort polimerisasie wat plaasvind om polimeer **C** te produseer (1)
- [14]**

VRAAG 5 (Begin op 'n nuwe bladsy.)

Die reaksie van koper(II)karbonaat met oormaat verdunde soutsuur word gebruik om die reaksietempo te ondersoek. Die gebalanseerde vergelyking vir die reaksie is:



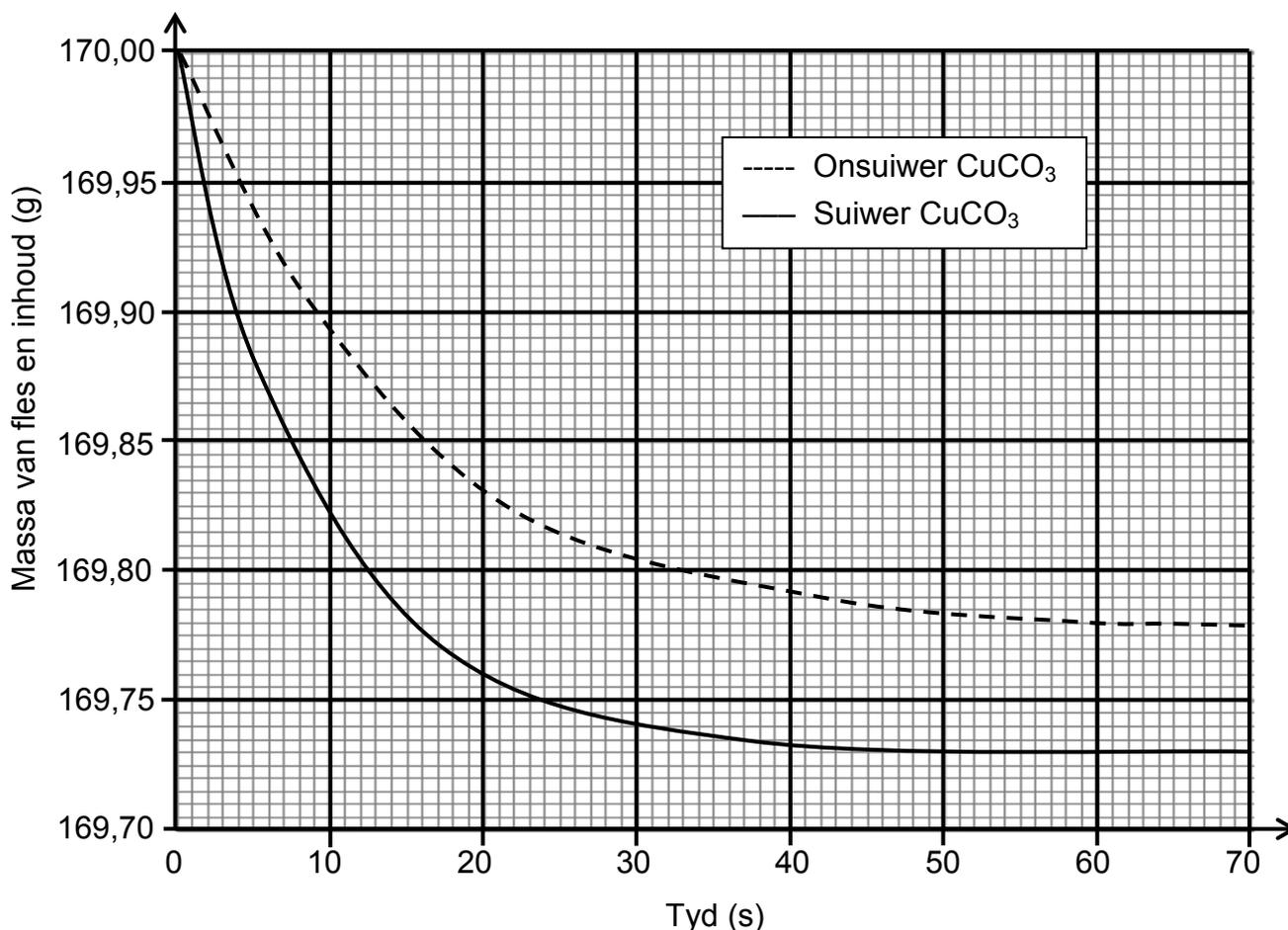
Die apparaat wat gebruik word, word hieronder geïllustreer.



5.1 Noem TWEE maniere waarop die tempo van die reaksie hierbo verhoog kan word. (2)



Monsters van beide SUIWER en ONSUIWER koper(II)karbonaat van GELYKE massa word in die ondersoek gebruik. Die grafieke hieronder is uit die resultate verkry.



5.2 Skryf die reaksietyd neer vir die reaksie van die suiwer CuCO₃ met HCl. (1)

5.3 Aanvaar dat al die gas wat gedurende die twee reaksies gevorm het, uit die fles ontsnap en dat die onsuierhede nie reageer nie.

Bereken die:

5.3.1 Gemiddelde reaksietempo van die suiwer monster in die eerste 20 s (3)

5.3.2 Persentasie suiwerheid van die onsuier monster (4)

5.3.3 Maksimum volume CO₂(g) wat tydens die reaksie van die suiwer monster CuCO₃ geproduseer word indien die reaksie by STANDAARDTOESTANDE plaasvind (3)

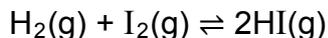
5.4 Skets 'n grafiek van die volume gas geproduseer teenoor tyd vir die reaksie van die suiwer CuCO₃. Dui die reaksietyd op die x-as aan. (2)

[15]



VRAAG 6 (Begin op 'n nuwe bladsy.)

Waterstof en jodium word in 'n 2 dm³-houer verseël. Die reaksie word toegelaat om ewewig te bereik by 700 K volgens die volgende gebalanseerde vergelyking:

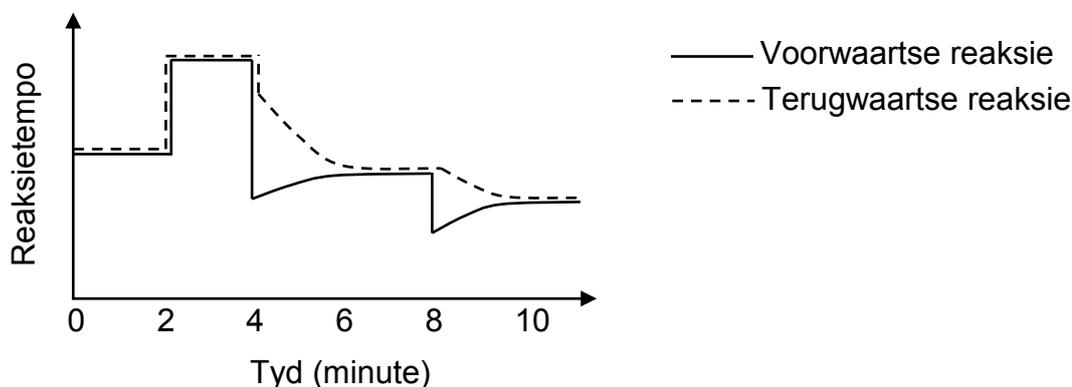


6.1 Gee 'n rede waarom veranderinge in druk geen invloed op die ewewigsposisie sal hê nie. (1)

6.2 By ewewig is 0,028 mol H₂(g) en 0,017 mol I₂(g) in die houer teenwoordig.

Bereken die aanvanklike massa I₂(g), in gram, wat in die houer verseël is, indien K_c vir die reaksie 55,3 by 700 K is. (9)

Die reaksietempo-teenoortydgrafiek hieronder stel verskillende veranderinge voor wat aan die ewewigmengsel gemaak is.



6.3 Wat dui die parallelle lyne in die eerste twee minute aan? (1)

6.4 Noem TWEE moontlike veranderinge wat by t = 2 minute aan die reaksietoestande gemaak kan word. (2)

6.5 Die temperatuur van die ewewigmengsel is by t = 4 minute verander.

6.5.1 Is die voorwaartse reaksie EKSOTERMIES of ENDOTERMIES?

Verduidelik die antwoord volledig. (3)

6.5.2 Hoe sal hierdie verandering die K_c-waarde beïnvloed? Kies uit VERHOOG, VERLAAG of BLY DIESELFDE. (1)

6.6 Watter verandering is by t = 8 minute aan die ewewigmengsel gemaak? (1)

[18]



VRAAG 7 (Begin op 'n nuwe bladsy.)

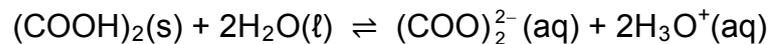
Die K_a -waardes vir twee swak sure, oksaalsuur en koolsuur, is soos volg:

NAAM	FORMULE	K_a
Oksaalsuur	$(\text{COOH})_2$	$5,6 \times 10^{-2}$
Koolsuur	H_2CO_3	$4,3 \times 10^{-7}$

7.1 Definieer die term *swak suur*. (2)

7.2 Watter suur, OKSAALSUUR of KOOLSUUR, is die sterkste? Gee 'n rede vir die antwoord. (2)

7.3 Oksaalsuur ioniseer in water volgens die volgende gebalanseerde vergelyking:



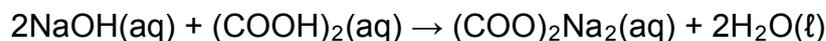
Skryf die FORMULES van die TWEE basisse in hierdie vergelyking neer. (2)

7.4 Leerders berei 2 dm^3 van 'n natriumhidroksiedoplossing met 'n konsentrasie van $0,1 \text{ mol}\cdot\text{dm}^{-3}$.

Bereken die pH van die oplossing. (4)

7.5 Tydens die titrasie van die natriumhidroksiedoplossing in VRAAG 7.4 met verdunde oksaalsuur vind die leerders dat $25,1 \text{ cm}^3$ van die $\text{NaOH}(\text{aq})$ presies $14,2 \text{ cm}^3$ van die $(\text{COOH})_2(\text{aq})$ neutraliseer.

Die gebalanseerde vergelyking vir die reaksie is soos volg:



7.5.1 Bereken die konsentrasie van die oksaalsuuroplossing. (5)

Die volgende indikators is vir die titrasie beskikbaar:

INDIKATOR	pH-GEBIED
A	3,1–4,4
B	6,0–7,6
C	8,3–10,0

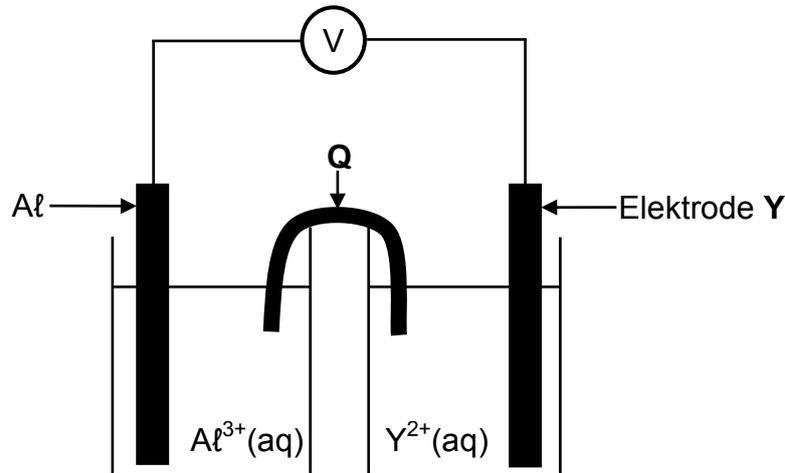
7.5.2 Watter EEN van die indikators hierbo is die geskikste vir hierdie titrasie? Gee 'n rede vir die antwoord. (2)

[17]



VRAAG 8 (Begin op 'n nuwe bladsy.)

In die elektrochemiese sel wat hieronder getoon word, word 'n aluminium-elektrode en 'n ander metaal-elektrode, **Y**, gebruik.



8.1 Skryf neer die:

8.1.1 Naam van komponent **Q** (1)

8.1.2 Soort elektrochemiese sel wat hierbo voorgestel word (1)

Daar word gevind dat die massa van die aluminium-elektrode toeneem terwyl die sel in werking is.

8.2 Hoe sal ELK van die volgende verander terwyl die sel in werking is? Kies uit VERHOOG, VERLAAG of BLY DIESELFDE.

8.2.1 Die konsentrasie van $\text{Al}^{3+}(\text{aq})$ (1)

8.2.2 Die konsentrasie van $\text{Y}^{2+}(\text{aq})$ (1)

8.3 Skryf neer die:

8.3.1 Halfreaksie wat by elektrode **Y** plaasvind (2)

8.3.2 Selnotasie van die sel (3)

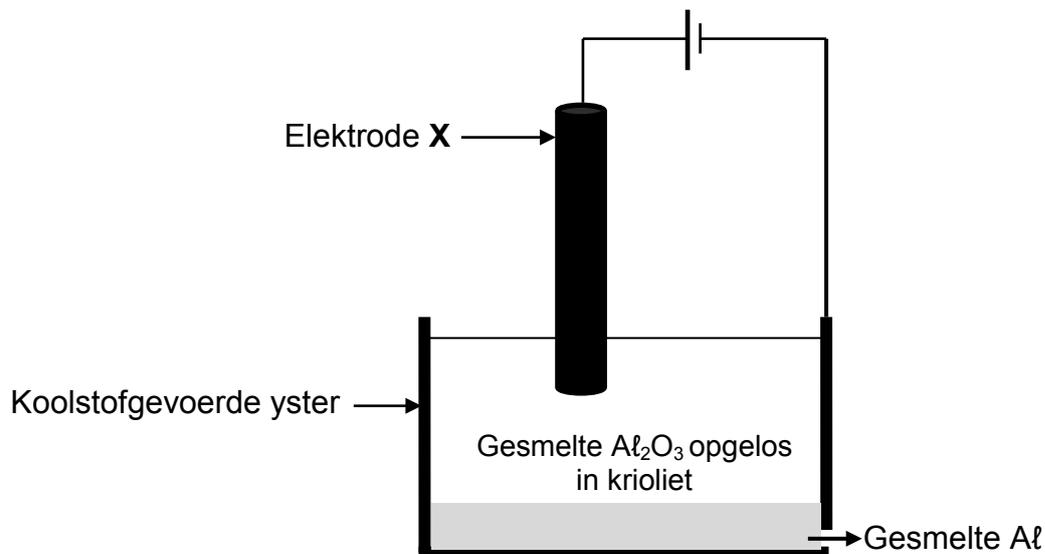
8.4 Die aanvanklike emk van hierdie sel wat onder standaardtoestande gemeet is, is 0,7 V.

Identifiseer metaal **Y** met behulp van 'n berekening. (5)
[14]

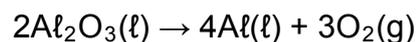


VRAAG 9 (Begin op 'n nuwe bladsy.)

Die vereenvoudigde diagram hieronder toon 'n elektrolitiese sel wat in die industriële ekstrahering van aluminium (Al) uit aluminiumoksied by temperature so hoog as $1\ 000\ ^\circ C$ gebruik word. Elektrode **X** is 'n koolstofstaaf.



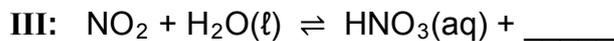
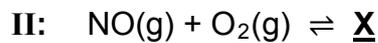
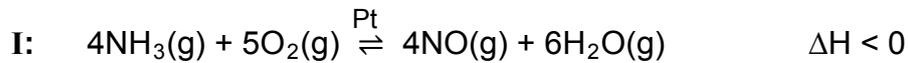
Die selreaksie wat plaasvind, is soos volg:



- 9.1 Skryf die naam van die erts neer wat as bron van aluminiumoksied gebruik word. (1)
- 9.2 Watter halfreaksie (OKSIDASIE of REDUKSIE) vind by elektrode **X** plaas? (1)
- 9.3 Wat is die funksie van die krioliet? (1)
- 9.4 Skryf die reduksiehalfreaksie neer. (2)
- 9.5 Skryf 'n gebalanseerde vergelyking neer wat toon waarom die koolstofstaaf, **X**, gereeld vervang moet word. (3)
- [8]**

VRAAG 10 (Begin op 'n nuwe bladsy.)

10.1 Die reaksies wat hieronder voorgestel word, vind plaas tydens een van die industriële prosesse wat in die kunsmisbedryf gebruik word.



Skryf neer:

10.1.1 Die naam van hierdie industriële proses (1)

10.1.2 Die funksie van Pt in reaksie I (1)

10.1.3 Die NAAM van produk X (1)

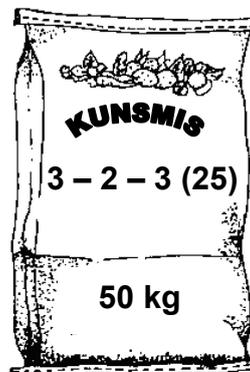
10.1.4 'n Gebalanseerde vergelyking vir reaksie III (2)

10.1.5 TWEE maniere waarop die opbrengs van die NO(g) wat in reaksie I verkry word, verhoog kan word sonder om die hoeveelheid reaktanse en produkte te verander (2)

10.2 NPK-kunsmisstowwe bevat NH_4NO_3 , $(\text{NH}_4)_3\text{PO}_4$ en KCl in verskillende verhoudings.

10.2.1 Wat beteken *NPK*? (1)

10.2.2 Beskou die kunsmis wat hieronder geïllustreer is.



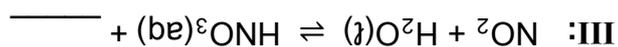
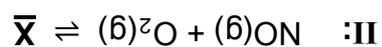
Bereken die massa, in kg, van KCl benodig om hierdie kunsmis te berei. (6)
[14]

TOTAAL: 150



QUESTION 10 (Start on a new page.)

10.1 The reactions represented below take place during one of the industrial processes used in the fertiliser industry.



Write down:

10.1.1 The name of this industrial process (1)

10.1.2 The function of Pt in reaction I (1)

10.1.3 The NAME of product X (1)

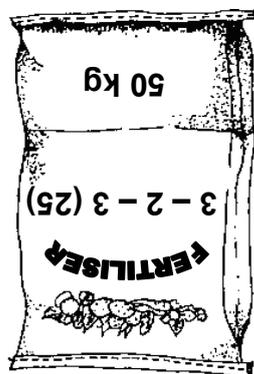
10.1.4 A balanced equation for reaction III (2)

10.1.5 TWO ways in which the yield of the NO(g) obtained in reaction I can be increased without changing the amount of reactants and products (2)

10.2 NPK fertilisers contain NH_4NO_3 , $(\text{NH}_4)_3\text{PO}_4$ and KCl in varying proportions.

10.2.1 What does NPK mean? (1)

10.2.2 Consider the fertiliser illustrated below.



Calculate the mass, in kg, of KCl needed to produce this fertiliser.

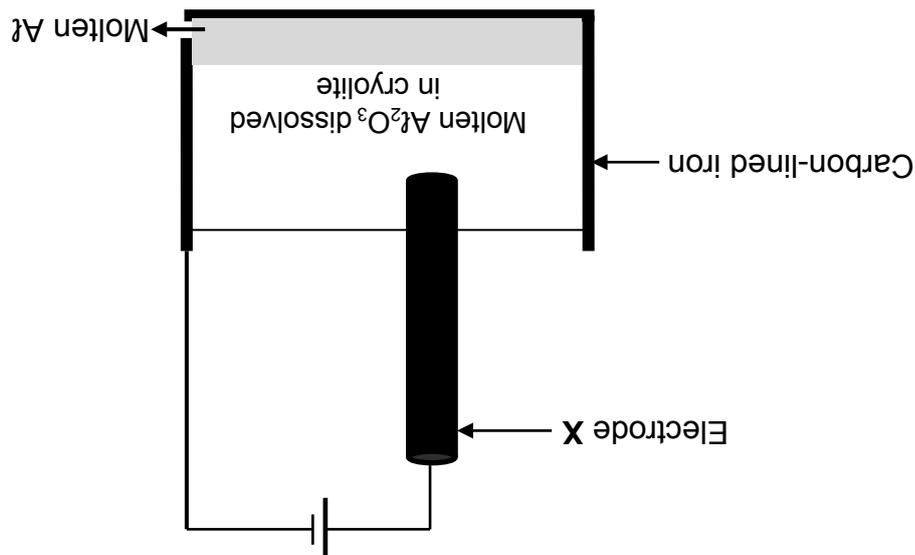
[14]
(6)

TOTAL: 150



QUESTION 9 (Start on a new page.)

The simplified diagram below shows an electrolytic cell used in the industrial extraction of aluminium (Al) from aluminium oxide at temperatures as high as 1 000 °C. Electrode X is a carbon rod.



The cell reaction that takes place is as follows:



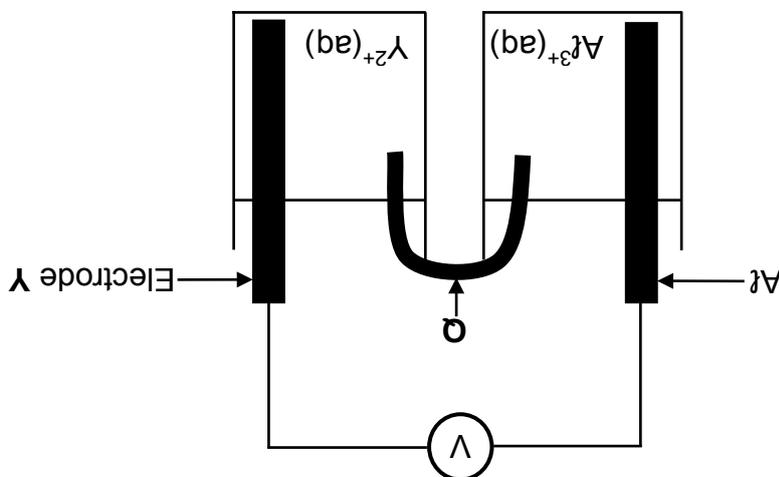
- 9.1 Write down the name of the ore used as source of aluminium oxide. (1)
- 9.2 Which half-reaction (OXIDATION or REDUCTION) takes place at electrode X? (1)
- 9.3 What is the function of the cryolite? (1)
- 9.4 Write down the reduction half-reaction. (2)
- 9.5 Write down a balanced equation that shows why the carbon rod, X, must be replaced regularly. (3)

[8]



QUESTION 8 (Start on a new page.)

In the electrochemical cell shown below an aluminium electrode and another metal electrode, Y, are used.



8.1 Write down the:

8.1.1 Name of component Q (1)

8.1.2 Type of electrochemical cell represented above (1)

It is found that the mass of the aluminium electrode increases whilst the cell is functioning.

8.2 How will EACH of the following change while the cell is functioning? Choose from INCREASES, DECREASES or REMAINS THE SAME.

8.2.1 The concentration of $Al^{3+}(aq)$ (1)

8.2.2 The concentration of $Y^{2+}(aq)$ (1)

8.3 Write down the:

8.3.1 Half-reaction that takes place at electrode Y (2)

8.3.2 Cell notation of the cell (3)

8.4 The initial emf of this cell measured under standard conditions is 0,7 V.

Identify metal Y by means of a calculation.

(5)
[14]



QUESTION 7 (Start on a new page.)

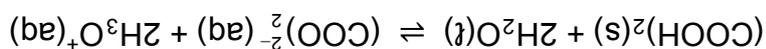
The K_a values for two weak acids, oxalic acid and carbonic acid, are as follows:

NAME	FORMULA	K_a
Oxalic acid	$(\text{COOH})_2$	$5,6 \times 10^{-2}$
Carbonic acid	H_2CO_3	$4,3 \times 10^{-7}$

7.1 Define the term *weak acid*. (2)

7.2 Which acid, OXALIC ACID or CARBONIC ACID, is stronger? Give a reason for the answer. (2)

7.3 Oxalic acid ionises in water according to the following balanced equation:



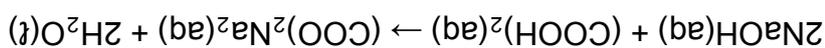
(2) Write down the FORMULAE of the TWO bases in this equation.

7.4 Learners prepare 2 dm^3 of a sodium hydroxide solution of concentration $0,1 \text{ mol} \cdot \text{dm}^{-3}$.

(4) Calculate the pH of the solution.

7.5 During a titration of the sodium hydroxide solution in QUESTION 7.4 with dilute oxalic acid, the learners find that $25,1 \text{ cm}^3$ of the $\text{NaOH}(\text{aq})$ neutralises exactly $14,2 \text{ cm}^3$ of the $(\text{COOH})_2(\text{aq})$.

The balanced equation for the reaction is as follows:



(5) 7.5.1 Calculate the concentration of the oxalic acid solution.

The following indicators are available for the titration:

INDICATOR	pH RANGE
A	3,1–4,4
B	6,0–7,6
C	8,3–10,0

7.5.2 Which ONE of the indicators above is most suitable for this titration? Give a reason for the answer.

(2)
[17]



QUESTION 6 (Start on a new page.)

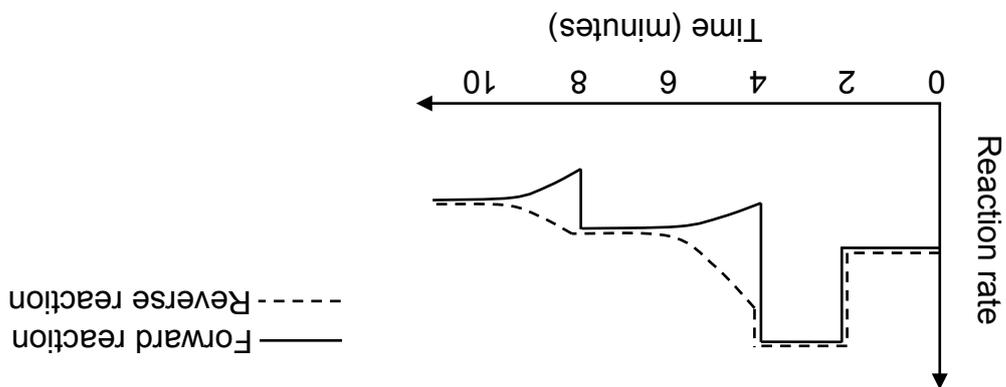
Hydrogen and iodine are sealed in a 2 dm³ container. The reaction is allowed to reach equilibrium at 700 K according to the following balanced equation:



6.1 Give a reason why changes in pressure will have no effect on the equilibrium position. (1)

6.2 At equilibrium, 0,028 mol H₂(g) and 0,017 mol I₂(g) are present in the container. Calculate the initial mass of I₂(g), in grams, that was sealed in the container, if K_c for the reaction is 55,3 at 700 K. (9)

The reaction rate versus time graph below represents different changes made to the equilibrium mixture.



6.3 What do the parallel lines in the first two minutes indicate? (1)

6.4 State TWO possible changes that could be made to the reaction conditions at t = 2 minutes. (2)

6.5 The temperature of the equilibrium mixture was changed at t = 4 minutes. (2)

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

Fully explain the answer. (3)

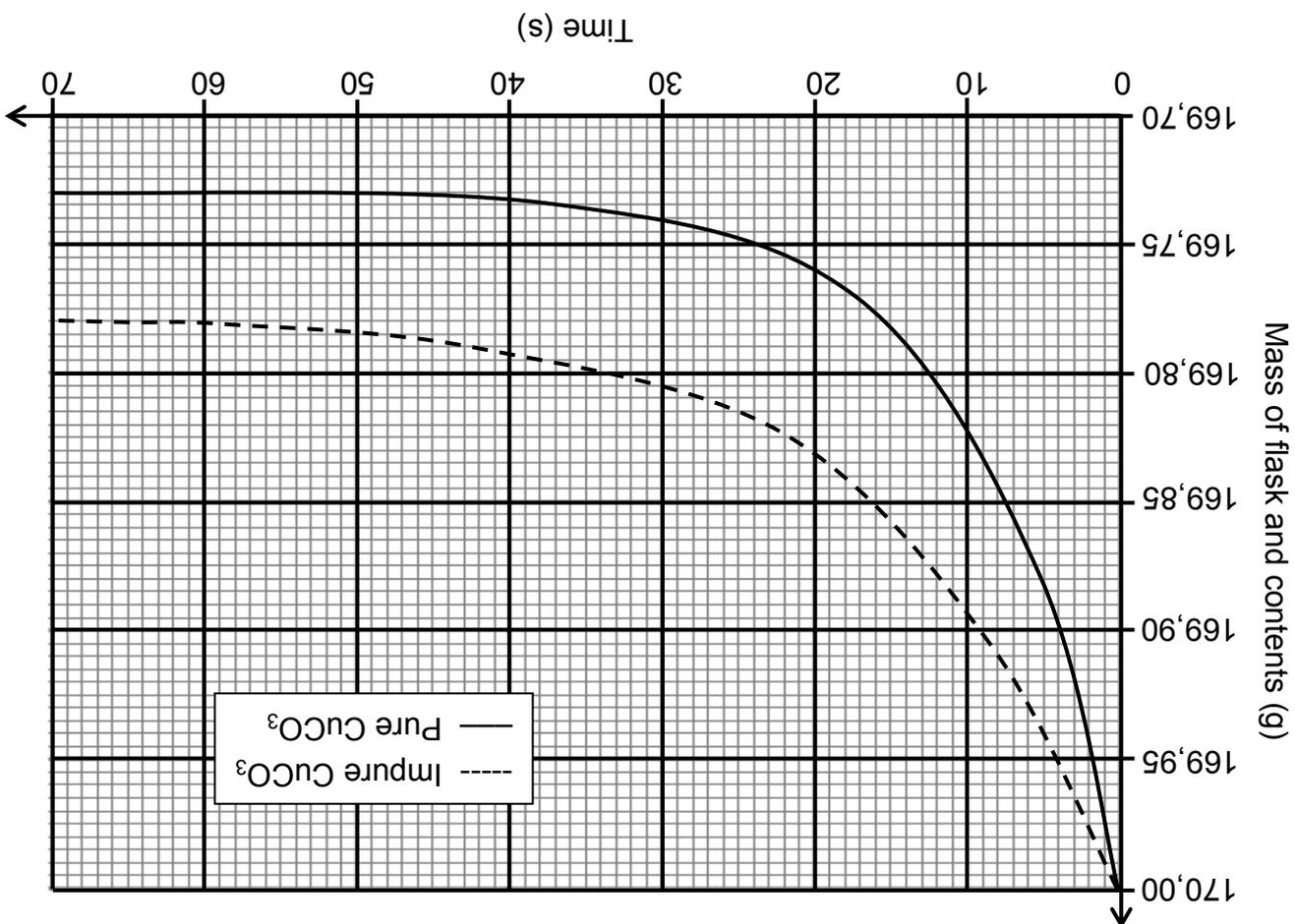
6.5.2 How will this change influence the K_c value? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

6.6 What change was made to the equilibrium mixture at t = 8 minutes? (1)

[18]



During the investigation, samples of both PURE and IMPURE copper(II) carbonate of EQUAL mass are used. The graphs below are obtained from the results.



5.2 Write down the reaction time for the reaction of the pure CuCO_3 with HCl . (1)

5.3 Assume that all the gas formed during the two reactions escape from the flask and that the impurities do not react. Calculate the:

5.3.1 Average rate of the reaction of the pure sample over the first 20 s (3)

5.3.2 Percentage purity of the impure sample (4)

5.3.3 Maximum volume of CO_2 (g) produced during the reaction of the pure sample of CuCO_3 if the reaction takes place at STANDARD CONDITIONS (3)

5.4 Sketch a graph of the volume of gas produced versus time for the reaction of the pure CuCO_3 . Indicate the reaction time on the x-axis. (2)

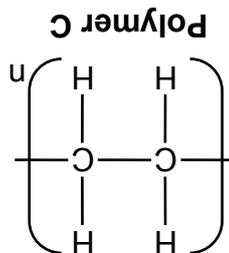
[15]



4.2

A wide range of synthetic polymers are produced by combining large numbers of similar small organic molecules bonded to each other in a repeating pattern.

Polymer **C** below is an example of such a polymer.



Write down:

4.2.1 ONE word for the underlined phrase (1)

4.2.2 The homologous series to which the 'small organic molecules' used to produce polymer **C** belong (1)

4.2.3 The type of polymerisation which takes place to produce polymer **C** (1)

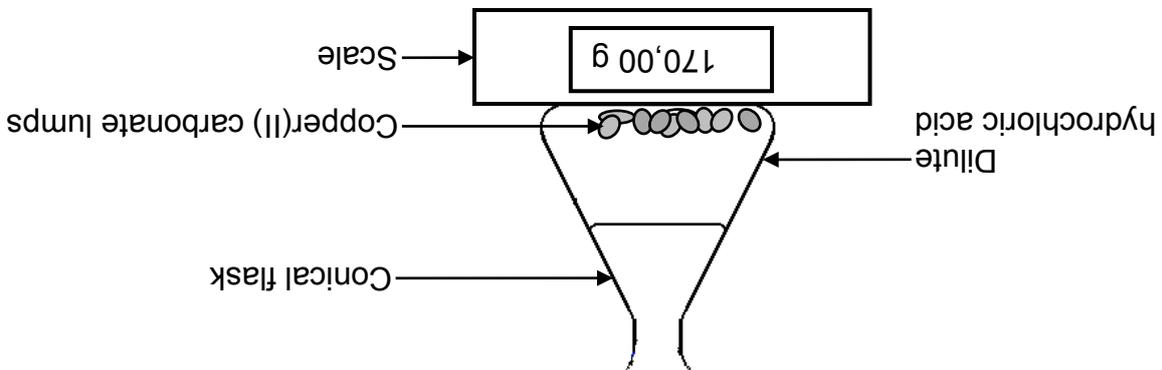
[14]

QUESTION 5 (Start on a new page.)

The reaction of copper(II) carbonate with excess dilute hydrochloric acid is used to investigate the rate of reaction. The balanced equation for the reaction is:



The apparatus used is illustrated below.

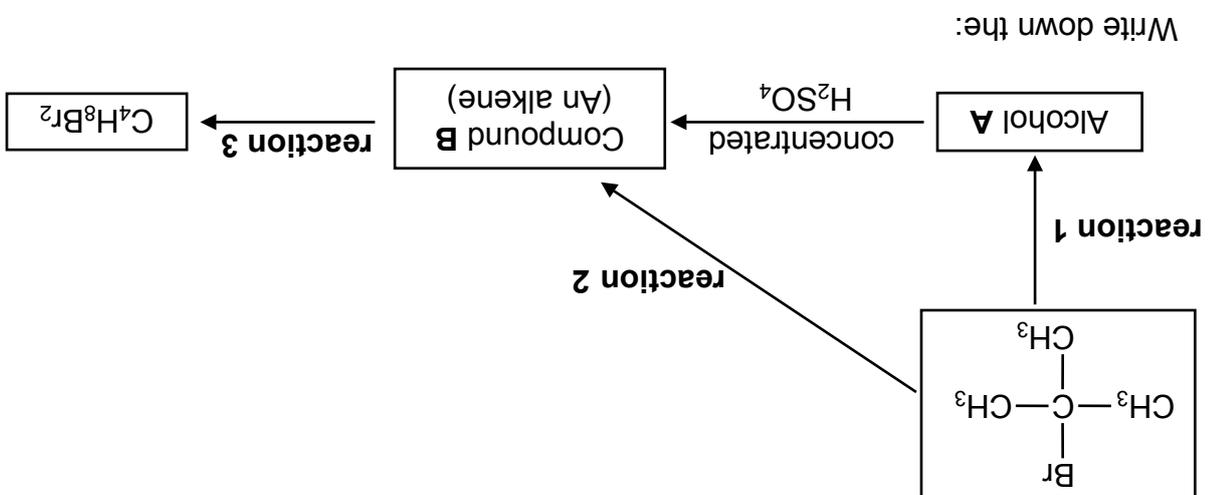


5.1 State TWO ways in which the rate of the reaction above can be increased. (2)



QUESTION 4 (Start on a new page.)

4.1 Consider the reactions represented in the flow diagram below.



- 4.1.1 Type of reaction represented by **reaction 1** (1)
- 4.1.2 NAME or FORMULA of the inorganic reactant needed for **reaction 1** (1)
- 4.1.3 Type of alcohol (PRIMARY, SECONDARY or TERTIARY) of which alcohol **A** is an example (1)
- 4.1.4 Type of reaction represented by **reaction 2** (1)
- 4.1.5 IUPAC name of compound **B** (2)
- 4.1.6 Type of addition reaction represented by **reaction 3** (1)
- 4.1.7 Balanced equation for **reaction 3** using structural formulae (4)





QUESTION 3 (Start on a new page.)

Learners investigate factors which influence the boiling points of alcohols.

They use equal volumes of each of the alcohols and heat them separately in a water bath. The temperature at which each boils is measured. The results obtained are shown in the table below.

ALCOHOLS	BOILING POINTS OF ALCOHOLS (°C)
Hexan-1-ol	157,0
Pentan-1-ol	138,5
Butan-1-ol	117,7

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

3.2 What property of alcohols requires them to be heated in a water bath? (1)

3.3 The boiling points of the alcohols are compared with each other.

3.3.1 What structural requirements must the alcohols meet to make it a fair comparison? (2)

3.3.2 Fully explain the trend in the boiling points. (3)

3.4 How will the boiling point of hexan-1-ol be affected if the volume of hexan-1-ol used is doubled? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

3.5 In another investigation the learners compare the boiling points of hexan-1-ol and hexanal.

3.5.1 Write down the independent variable for this comparison. (1)

3.5.2 They find that the boiling point of hexan-1-ol is higher than that of hexanal.

Fully explain this observation.

[14]
(4)

QUESTION 2 (Start on a new page.)

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

A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	B	$ \begin{array}{c} \text{H} & & \text{H} & & \text{CH}_3 \\ & & & & \\ \text{H}-\text{C} & - & \text{C} & - & \text{C} \\ & & & & \\ \text{H} & & \text{CH}_3 & & \text{CH}_2 \\ & & & & // \\ & & & & \text{CH}_2 \end{array} $
C	$\text{C}_4\text{H}_8\text{O}$	D	$\text{C}_3\text{H}_8\text{O}$
E	$ \begin{array}{ccccccc} & & \text{H} & & & & \\ & & & & & & \\ & & \text{O} & & & & \\ & & & & & & \\ \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ & & & & & & & & & & \\ \text{H} & & \text{H} \end{array} $	F	$ \begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2 \\ \\ \text{O} \\ \\ \text{C} \\ \\ \text{O} \\ \\ \text{CH}_2\text{CH}_2\text{CH}_3 \end{array} $

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

2.1.1 A hydrocarbon

2.1.2 An alcohol

2.1.3 An ester

2.2 Write down the IUPAC name of:

2.2.1 Compound **A**

2.2.2 Compound **B**

2.3 Compound **C** is a functional isomer of compound **A**. Write down the structural formula of compound **C**.

2.4 Compound **D** is used as one of the reactants to prepare compound **F**. Write down the:

2.4.1 Type of reaction which takes place to prepare compound **F**

2.4.2 IUPAC name of compound **D**

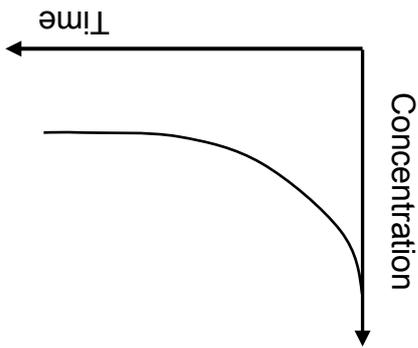
2.4.3 Structural formula of the other organic reactant used

2.4.4 IUPAC name of compound **F**

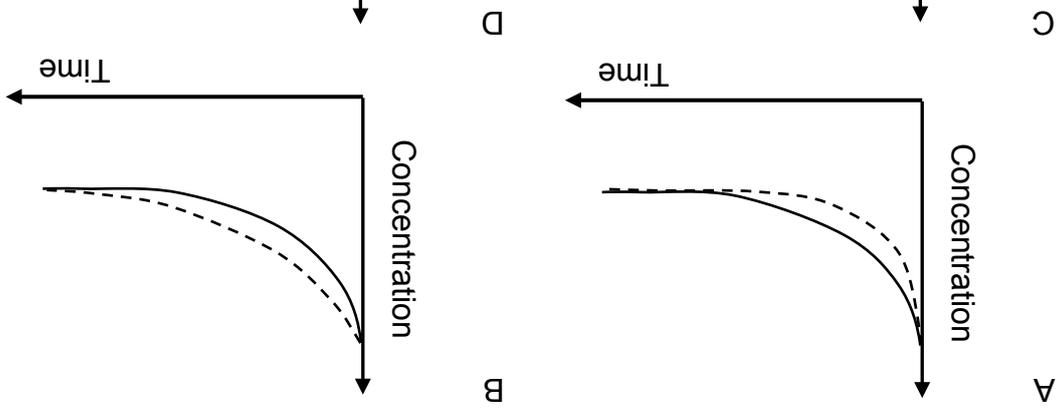
[16]



1.10 The graph below represents the change in concentration of a reactant against time for a chemical reaction.



In which ONE of the following graphs does the dotted line show the effect of a catalyst on this reactant?



[20]
(2)



1.7 A solution has a pH = 1. This solution ...

- A contains no OH⁻ ions.
 B neutralises a hydrochloric acid solution of pH = 1.
 C contains a higher concentration of H₃O⁺ ions than OH⁻ ions.
 D contains a higher concentration of OH⁻ ions than H₃O⁺ ions.

(2)

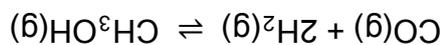
1.8 A potential energy diagram can be used to show the activation energy (E_A) and the heat of reaction (ΔH) of a reaction.

Which ONE of the following combinations of values of E_A and ΔH CANNOT be obtained for any reaction?

	E _A (kJ·mol ⁻¹)	ΔH (kJ·mol ⁻¹)
A	50	-100
B	50	+100
C	100	+50
D	100	-50

(2)

1.9 Initially, 2 mol CO(g) and 2 mol H₂(g) are sealed in a container. The reaction reaches equilibrium according to the following balanced equation:



At equilibrium the amount of CH₃OH(g) in the mixture will be ...

- A 1 mol.
 B 2 mol.
 C less than 1 mol.
 D greater than 1 mol.

(2)



1.4

Consider the reaction represented below.

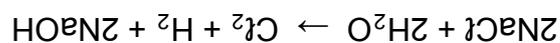


Which ONE of the following CORRECTLY gives the type of reaction that takes place and the IUPAC name of product X?

	Type of reaction	Product X
A	Elimination	Ethane
B	Elimination	Ethene
C	Addition	Ethane
D	Addition	Ethene

1.5

Consider the following balanced equation of a chemical reaction:



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

The reaction takes place in a/an ...

A galvanic cell and absorbs energy.

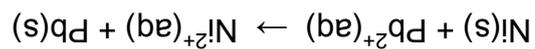
B galvanic cell and releases energy.

C electrolytic cell and absorbs energy.

D electrolytic cell and releases energy.

1.6

The following equation represents the reaction taking place in an electrochemical cell:



The flow of electrons through the external circuit of this cell is from ...

A Pb at the anode to Ni at the cathode.

B Pb at the cathode to Ni at the anode.

C Ni at the cathode to Pb at the anode.

D Ni at the anode to Pb at the cathode.

(2)



QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:	1.11	A	B	C	B
-----------------	------	---	---	---	--------------

1.1 Which ONE of the following is the product formed in the Haber process?

A Nitrogen

B Ammonia

C Nitric acid

D Sulphuric acid

(2)

1.2 A carbonyl group is the functional group of ...

A alcohols.

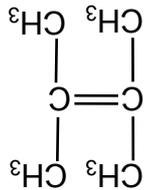
B ketones.

C haloalkanes.

D carboxylic acids.

(2)

1.3 Consider the structure of an organic compound below.



The IUPAC name of this compound is ...

A 2,3-dimethylbut-2-ene.

B 2,2-dimethylbut-2-ene.

C 1,1,2-trimethylprop-1-ene.

D 1,1,2,2-tetramethylethene.

(2)



INSTRUCTIONS AND INFORMATION

1. Write your examination number and centre number in the appropriate spaces on the 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 two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.





MORNING SESSION

This question paper consists of 16 pages and 4 data sheets.

TIME: 3 hours

MARKS: 150

PHSC.2
PHYSICAL SCIENCES: CHEMISTRY (P2)
FEBRUARY/MARCH 2017

GRADE 12

NATIONAL
SENIOR CERTIFICATE

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

basic education

