DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN ONDERWYS
REPUBLIEK VAN SUID-AFRIKA

SENIOR CERTIFICATE EXAMINATION - 2004
SENIORSERTIFIKAAT-EKSAMEN - 2004

PHYSICAL SCIENCE P2 : CHEMISTRY
NATUUR- EN SKEIKUNDE V2 : CHEMIE

HIGHER GRADE
HOËR GRAAD

OCTOBER/NOVEMBER 2004
OKTOBER/NOVEMBER 2004

304-1/2

Marks: 200
Punte : 200

2 Hours
2 Ure

This question paper consists of 16 pages and a data sheet of 4 pages.
Hierdie vraestel bestaan uit 16 bladsye en 'n gegewensblad van 4 bladsye.

PHYSICAL SCIENCE HG: Paper 2
Chemistry

304 1 2 HG

ALGEMENE INSTRUKSIES

1. Skryf jou **eksamennommer** (en **sentrumnommer** indien van toepassing) in die aangewese spasies op die antwoordeboek.
2. Beantwoord **AL** die vrae.
3. Nie-programmeerbare sakrekenaars mag gebruik word.
4. Toepaslike wiskundige instrumente mag gebruik word.
5. 'n Gegewensblad is vir jou gebruik aangeheg.
6. Punte kan verbeur word indien instruksies nie gevolg word nie.

VRAAG 1

INSTRUKSIES

1. Beantwoord hierdie vraag op die spesiaal gedrukte **ANTWOORDBLAD.** *[LET WEL: Die antwoordblad kan óf 'n afsonderlike blad wees wat as deel van die vraestel verskaf word, óf dit kan as deel van die antwoordeboek gedruk word.]*
   Skryf jou **EKSAMENNOMMER** (en **sentrumnommer** indien van toepassing) in die aangewese spasies, indien 'n afsonderlike antwoordblad verskaf word.

2. Vier moontlike antwoorde, voorgestel deur A, B, C en D, word by elke vraag voorsien. Elke vraag het slegs EEN korrekte antwoord. Kies slegs die antwoord wat na jou mening die regte of die beste een is, en merk die toepaslike blokkie op die antwoordblad met 'n kruis.

3. Moenie enige ander merke op die antwoordblad maak nie. Enige berekenings of skryfwerk wat nodig mag wees wanneer hierdie vraag beantwoord word, moet in die antwoordeboek gedoen word en duidelik met 'n skuins streep oor die bladsy deurgehaal word.

4. Indien meer as een blokkie gemerk is, sal geen punte vir die antwoord toegeken word nie.

VOORBEELD

VRAAG: Die simbool vir die SI-eenheid van tyd is ...

A t.
B h.
C s.
D m.

ANTWOORD:

A	B	~~C~~	D

GENERAL INSTRUCTIONS

1. Write your **examination number** (and **centre number** if applicable) in the appropriate spaces on the answer book.
2. Answer **ALL** the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. Marks may be forfeited if instructions are not followed.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the specially printed **ANSWER SHEET.** *[NOTE: The answer sheet may be either a separate sheet provided as part of your question paper, or printed as part of the answer book.]*
   Write your **EXAMINATION NUMBER** (and **centre number** if applicable) in the appropriate spaces if a separate answer sheet is used.

2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on the answer sheet with a cross.

3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.

4. If more than one block is marked, no marks will be awarded for that answer.

EXAMPLE

QUESTION: The symbol for the SI unit of time is ...

A t.
B h.
C s.
D m.

ANSWER:

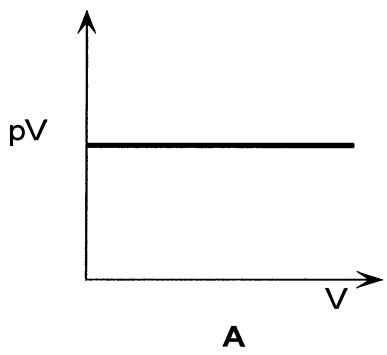
A	B	C	D

1.1 'n Vaste stof **X** los op in xileen en 'n vaste stof **Y** los op in water. **X** en **Y** is waarskynlik onderskeidelik ...

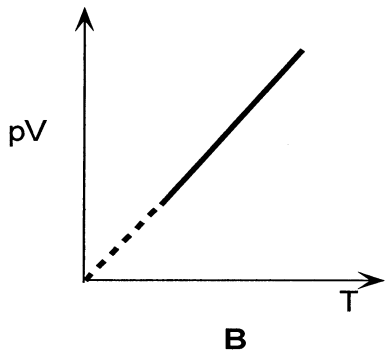
	X	**Y**
A	natriumchloried	natriumnitraat
B	natriumnitraat	jodium
C	grafiet	natriumchloried
D	jodium	kopersulfaat

(4)

1.2 Die verwantskap tussen p, V and T, vir 1 mol van 'n ingeslote gas, is ondersoek en die resultate grafies voorgestel soos hieronder aangedui. In watter EEN van die grafieke stel die helling van die lyn die universele gas-konstante (R) voor?



A



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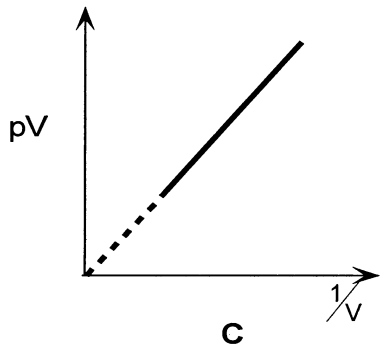

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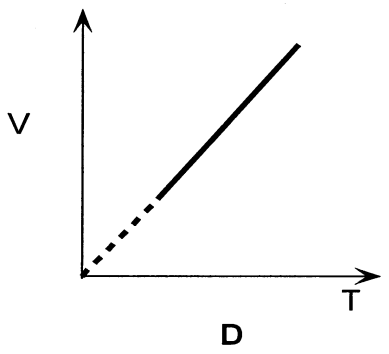


D

(4)

1.3 Watter EEN van die volgende pare verbindings kan gebruik word om waterstofnitraat (HNO_3) in die laboratorium te berei?

A Natriumnitraat en ammoniak

B Natriumhidroksied en ammoniumnitraat

C Natriumnitraat en swawelsuur

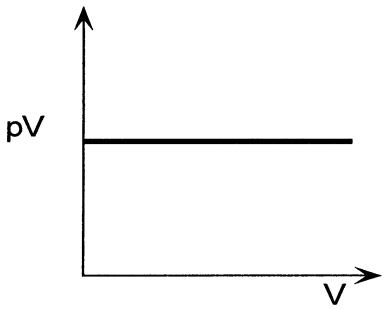
D Ammoniak en swawelsuur (4)

1.1 A solid **X** dissolves in xylene, and a solid **Y** dissolves in water. **X** and **Y** could respectively be …

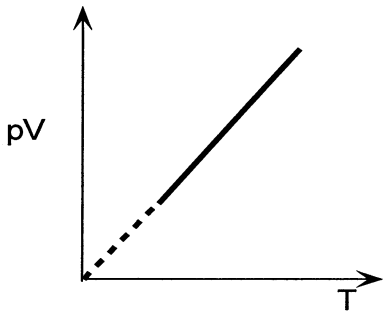
	X	**Y**
A	sodium chloride	sodium nitrate
B	sodium nitrate	iodine
C	graphite	sodium chloride
D	iodine	copper sulphate

(4)

1.2 The relationship between p, V and T, for 1 mol of an enclosed gas, was investigated and the results are plotted below.
In which ONE of the graphs does the gradient of the line represent the universal gas constant (R)?



A



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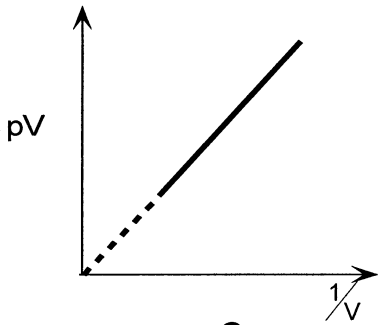

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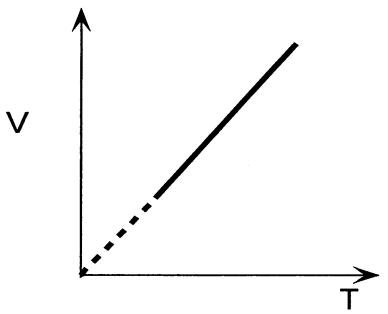


D

(4)

1.3 Which ONE of the following pairs of compounds could be used to prepare hydrogen nitrate (HNO_3) in the laboratory?

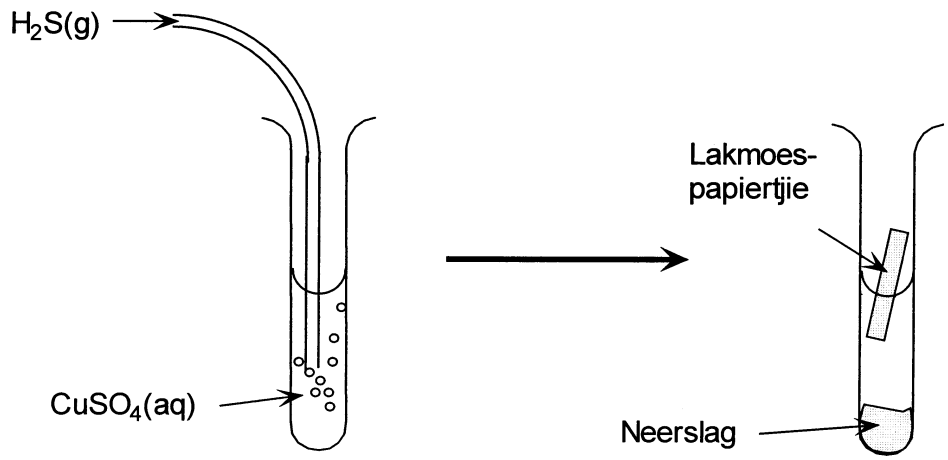
A Sodium nitrate and ammonia

B Sodium hydroxide and ammonium nitrate

C Sodium nitrate and sulphuric acid

D Ammonia and sulphuric acid (4)

1.4 Waterstofsulfiedgas word deur 'n kopersulfaat-oplossing geborrel.
'n Neerslag vorm en die oplossing word toegelaat om vir 'n tyd te staan.
'n Lakmoes-papiertjie word nou in die proefbuis geplaas.
(Lakmoes is blou in basis en rooi in suur.)



Watter EEN van die volgende is WAAR?

	Kleur van neerslag	Kleur van lakmoes in proefbuis
A	Swart	Rooi
B	Swart	Blou
C	Wit	Rooi
D	Wit	Blou

(4)

1.5 Watter een van die volgende vergelykings stel die **INDUSTRIËLE** bereiding van chloorgas voor?

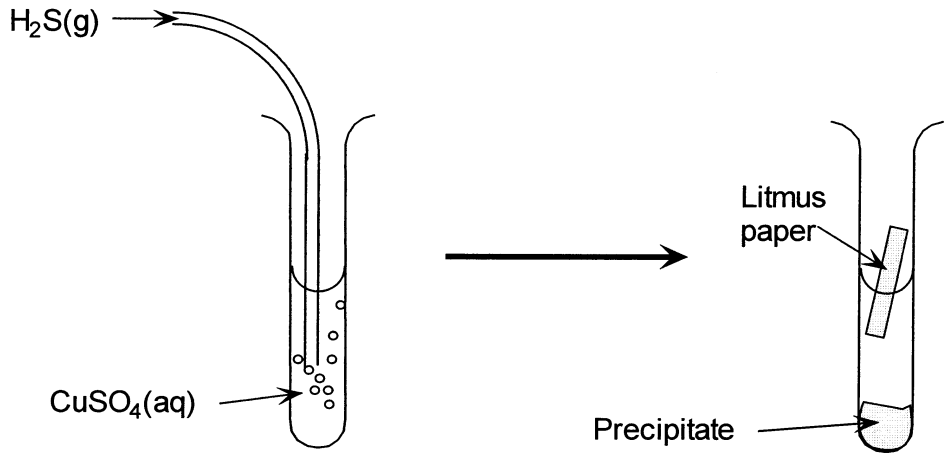
A $MnO_2 + 4HC\ell \rightarrow MnC\ell_2 + 2H_2O + C\ell_2$

B $2NaC\ell + 2H_2O \rightarrow C\ell_2 + H_2 + 2NaOH$

C $2KMnO_4 + 16HC\ell \rightarrow 2KC\ell + 2MnC\ell_2 + 8H_2O + 5C\ell_2$

D $Ca(OC\ell)_2 + 4HC\ell \rightarrow CaC\ell_2 + 2H_2O + 2C\ell_2$ (4)

1.4 Hydrogen sulphide gas is bubbled through a solution of copper sulphate. A precipitate is formed and the solution is allowed to stand for some time. A piece of litmus paper is then added to the test tube. (Litmus is blue in base and red in acid.)



Which ONE of the following is TRUE?

	Colour of precipitate	Colour of litmus in test tube
A	Black	Red
B	Black	Blue
C	White	Red
D	White	Blue

(4)

1.5 Which ONE of the following equations represents the **INDUSTRIAL** preparation of chlorine gas?

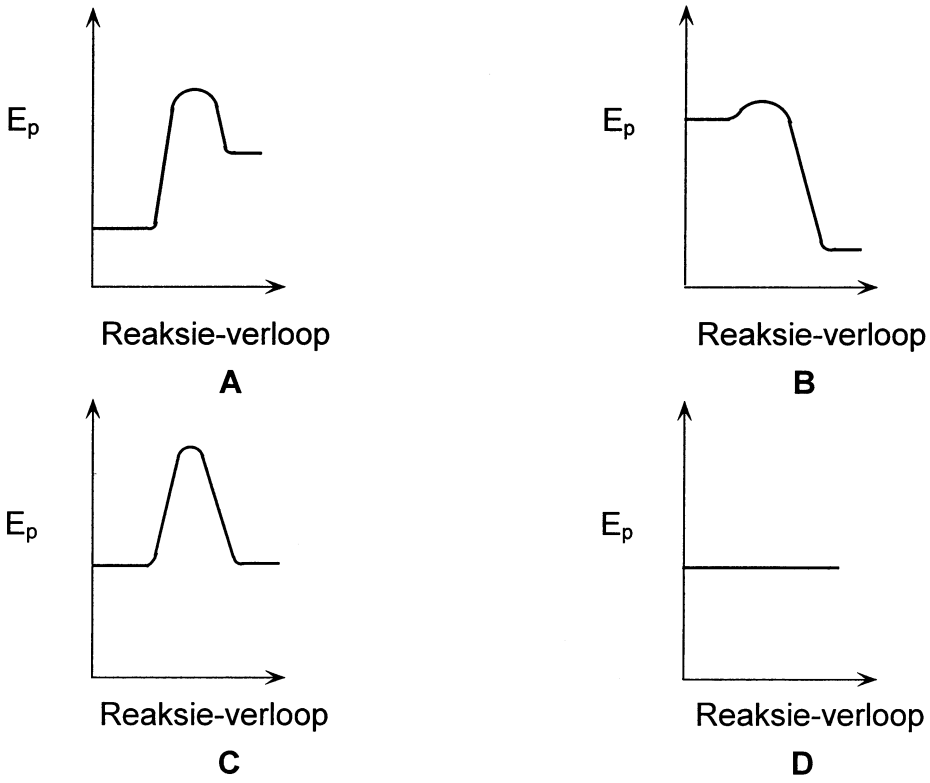
A $MnO_2 + 4HC\ell \rightarrow MnC\ell_2 + 2H_2O + C\ell_2$

B $2NaC\ell + 2H_2O \rightarrow C\ell_2 + H_2 + 2NaOH$

C $2KMnO_4 + 16HC\ell \rightarrow 2KC\ell + 2MnC\ell_2 + 8H_2O + 5C\ell_2$

D $Ca(OC\ell)_2 + 4HC\ell \rightarrow CaC\ell_2 + 2H_2O + 2C\ell_2$ (4)

1.6 Fosfor ontvlam spontaan en stel groot hoeveelhede energie vry. Watter EEN van die grafieke hieronder is die beste voorstelling van die energieveranderings wat plaasvind tydens hierdie reaksie?



(4)

1.7 Die volgende hipotetiese reaksie word toegelaat om ewewig te bereik in 'n geslote houer by 'n temperatuur van 285 °C.

$$A(g) + 2B(g) \rightleftharpoons 3C(s) \qquad \Delta H < 0$$

Oorweeg die volgende stellings aangaande veranderings wat aan hierdie sisteem gemaak word:

I. Die waarde van K_c sal toeneem indien 'n hoeveelheid C uit die houer verwyder word.

II. 'n Toename in temperatuur sal die tempo van beide die voorwaartse en die terugwaartse reaksies verhoog.

III. Die opbrengs van C sal toeneem indien die sisteem afgekoel word.

Watter van die bostaande stellings is WAAR?

A Slegs I

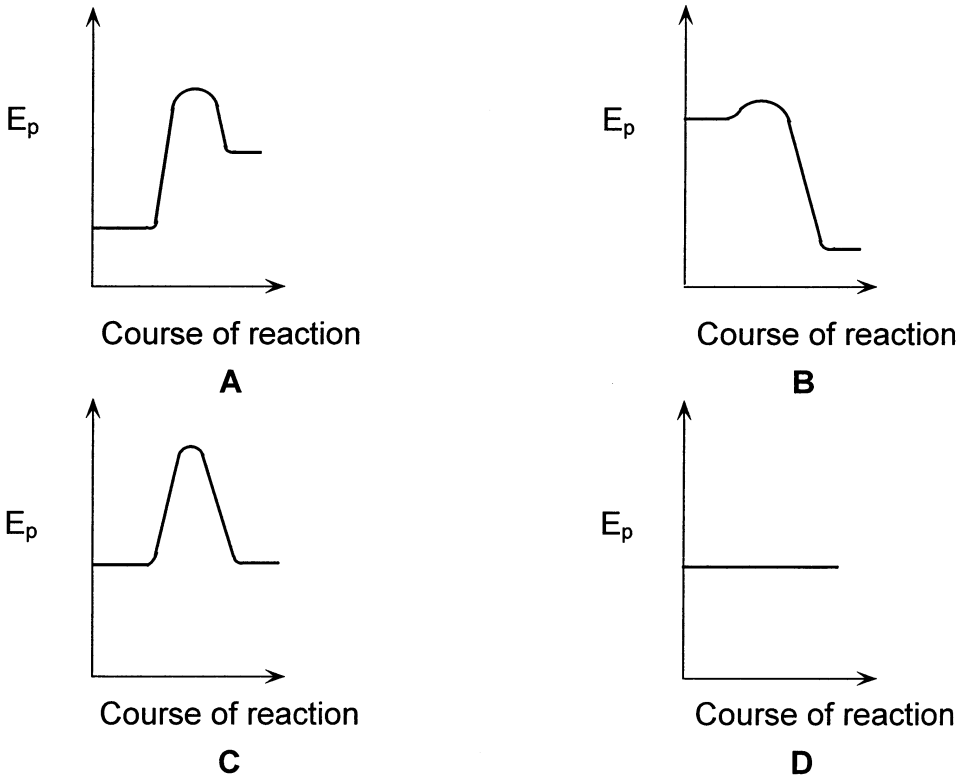
B Slegs I en II

C Slegs II

D Slegs II en III

(4)

1.6 Phosphorous ignites spontaneously to release large amounts of energy. Which ONE of the graphs below is the best representation of the energy changes taking place during this reaction?



(4)

1.7 The following hypothetical reaction is allowed to reach equilibrium in a closed container at 285 °C.

$$A(g) + 2B(g) \rightleftharpoons 3C(s) \qquad \Delta H < 0$$

Consider the following statements about changes made to this system:

I. Removal of some C from the container will result in an increase in the K_c value.

II. An increase in temperature will increase the rate of both the forward and reverse reactions.

III. Cooling the system will increase the yield of C.

Which of the above statement(s) is/are TRUE?

A I only

B I and II only

C II only

D II and III only

(4)

1.8 Beskou die onderstaande chemiese reaksie by ewewig in 'n geslote sisteem:

$$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$$

'n Katalisator word by konstante temperatuur by die sisteem gevoeg. Wat sal die effek hiervan op onderskeidelik die K_c-waarde en die CO_2-opbrengs wees?

	K_c	CO_2-OPBRENGS
A	Toeneem	Afneem
B	Bly dieselfde	Bly dieselfde
C	Bly dieselfde	Toeneem
D	Afneem	Toeneem

(4)

1.9 Die Lowry-Bronsted-basisse tydens die reaksie

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

is:

A H_2O en H_3O^+

B H_2SO_4 en H_3O^+

C HSO_4^- en H_3O^+

D H_2O en HSO_4^- (4)

1.10 'n Leerder berei 0,2 mol.dm^{-3}-oplossings van H_2SO_4, HNO_3, CH_3COOH en NH_4OH. Indien die vier oplossings met mekaar vergelyk word, watter EEN van die volgende stellings is korrek?

A Die CH_3COOH-oplossing het die hoogste $[H^+]$.

B Die NH_4OH-oplossing het die laagste pH.

C Die HNO_3-oplossing het die laagste $[H^+]$.

D Die H_2SO_4-oplossing het die laagste pH. (4)

1.8 Consider the following chemical reaction at equilibrium in a closed system:

$$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$$

A catalyst is added to the system at constant temperature. What effect will this have on the K_c value and on the yield of CO_2 respectively?

	K_c	YIELD OF CO_2
A	Increases	Decreases
B	Stays the same	Stays the same
C	Stays the same	Increases
D	Decreases	Increases

(4)

1.9 In the reaction

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

the Lowry-Bronsted bases are:

A H_2O and H_3O^+

B H_2SO_4 and H_3O^+

C HSO_4^- and H_3O^+

D H_2O and HSO_4^- (4)

1.10 A learner prepares 0,2 mol.dm^{-3} solutions of H_2SO_4, HNO_3, CH_3COOH and NH_4OH. When comparing these four solutions, which ONE of the following statements is correct?

A The CH_3COOH solution has the highest $[H^+]$.

B The NH_4OH solution has the lowest pH.

C The HNO_3 solution has the lowest $[H^+]$.

D The H_2SO_4 solution has the lowest pH. (4)

1.11 Watter EEN van die volgende oplossings sal onder standaardtoestande **NIE** 'n spontane redoksreaksie met H_2O_2 ondergaan **NIE**?

A $Au(NO_3)_3(aq)$

B $FeC\ell_2(aq)$

C $ZnBr_2(aq)$

D $CaF_2(aq)$ (4)

1.12 Beskou die volgende twee hipotetiese vergelykings wat die halfreaksies van 'n elektrochemiese sel voorstel.

$$P + 2e^- \rightleftharpoons P^{2-} \qquad E^o = +2,50\ V$$

$$Q^+ + e^- \rightleftharpoons Q \qquad E^o = -1,50\ V$$

Watter EEN van die stellings is WAAR wanneer die sel 'n elektriese stroom lewer?

A Die massa van P sal toeneem.

B P^{2-} het 'n groter geneigdheid as Q om elektrone te verloor.

C Q^+ sal die produk wees wat deur oksidasie gevorm word.

D Elektrone sal vanaf P na Q in die geleidingsdrade van die eksterne stroombaan vloei. (4)

1.13 Die volgende vergelyking stel 'n omkeerbare reaksie voor:

$$Fe^{2+}(aq) + Cu^+(aq) \rightleftharpoons Fe^{3+}(aq) + Cu(s)$$

Die twee reduseermiddels in hierdie reaksie is:

A Fe^{2+} en Fe^{3+}

B Cu^+ en Cu

C Fe^{2+} en Cu

D Fe^{3+} en Cu^+ (4)

1.11 Which ONE of the following solutions will, under standard conditions, **not** undergo a spontaneous redox reaction with H_2O_2?

A $Au(NO_3)_3(aq)$

B $FeC\ell_2(aq)$

C $ZnBr_2(aq)$

D $CaF_2(aq)$ (4)

1.12 Consider the following two hypothetical equations that represent the half-reactions of an electrochemical cell.

$$P + 2e^- \rightleftharpoons P^{2-} \qquad E^o = +2{,}50\ V$$

$$Q^+ + e^- \rightleftharpoons Q \qquad E^o = -1{,}50\ V$$

Which ONE of the statements is TRUE when the cell is delivering an electric current?

A The mass of P will increase.

B P^{2-} will have a greater tendency than Q to lose electrons.

C Q^+ will be the product formed by oxidation.

D Electrons will flow from P to Q in the conducting wire of the external circuit. (4)

1.13 The following equation represents a reversible reaction:

$$Fe^{2+}(aq) + Cu^+(aq) \rightleftharpoons Fe^{3+}(aq) + Cu(s)$$

The two reducing agents in this reaction are:

A Fe^{2+} and Fe^{3+}

B Cu^+ and Cu

C Fe^{2+} and Cu

D Fe^{3+} and Cu^+ (4)

1.14 Sonneblomolie ondergaan hidrogenering tydens die vervaardigingsproses van margarien. Gedurende hierdie proses sal die ...

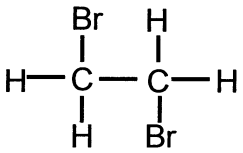
A getal dubbelbindings afneem.

B koolstofkettings toeneem in lengte.

C aantal enkelbindings afneem.

D verbinding minder versadig word. (4)

1.15 Beskou die onderstaande verbinding:



Hierdie verbinding is die produk van die reaksie van ...

A eteen met waterstofbromied.

B eteen met broom.

C etaan met waterstofbromied.

D metaan met broommetaan. (4)

[60]

1.14 Sunflower oil undergoes hydrogenation during the manufacturing process of margarine. During this process the...

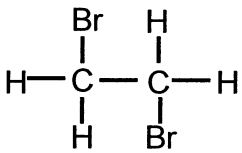
A number of double bonds decreases.

B carbon chains increase in length.

C number of single bonds decreases.

D compound becomes less saturated. (4)

1.15 Consider the compound below:



This compound is the product of the reaction of ...

A ethene with hydrogen bromide.

B ethene with bromine.

C ethane with hydrogen bromide.

D methane with bromomethane. (4)

[60]

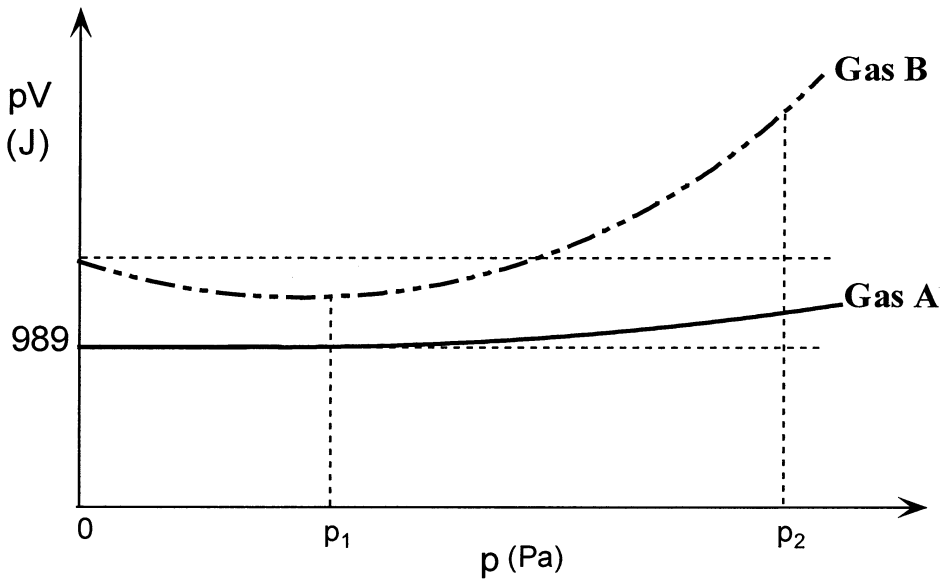
BEANTWOORD VRAAG 2 – 9 IN DIE ANTWOORDEBOEK.

INSTRUKSIES

1. Begin elke vraag op 'n nuwe bladsy in die antwoordeboek.
2. Laat 'n reël oop tussen onderafdelings, byvoorbeeld tussen VRAAG 2.1 en 2.2.
3. Verskaf alle formules wat gebruik word en toon jou bewerkings (dit sluit substitusies in).
4. Nommer jou antwoorde op dieselfde wyse as wat die vrae genommer is.

VRAAG 2

2.1 Vir twee verskillende ingeslote gasse, A en B, is die verwantskap tussen die druk (p) en die volume (V) eksperimenteel bepaal by dieselfde konstante temperatuur. Die inligting verkry is gebruik om pV-waardes vir elke gas te bereken waarna dit grafies voorgestel is, soos aangetoon in die onderstaande grafieke.



2.1.1 Druk die wiskundige verwantskap tussen die druk (p) en die volume (V) van gas A in simbole uit, vir die drukgebied tussen 0 Pa en p_1. (2)

2.1.2 Bewys dat die SI-eenheid van pV die joule is. (2)

2.1.3 Watter gas, butaan of helium, stel heel waarskynlik gas A voor? (1)

2.1.4 Indien 0,4 mol van gas A gebruik is, bereken die temperatuur waarby hierdie eksperiment uitgevoer is. (4)

2.1.5 Verduidelik waarom gas B afwyk van ideale gas-gedrag by druk p_1. (2)

2.1.6 Verduidelik waarom gas B afwyk van ideale gas-gedrag by druk p_2. (2)

2.1.7 Gee 'n rede waarom die pV-afsnit van die twee gasse verskil. (2)

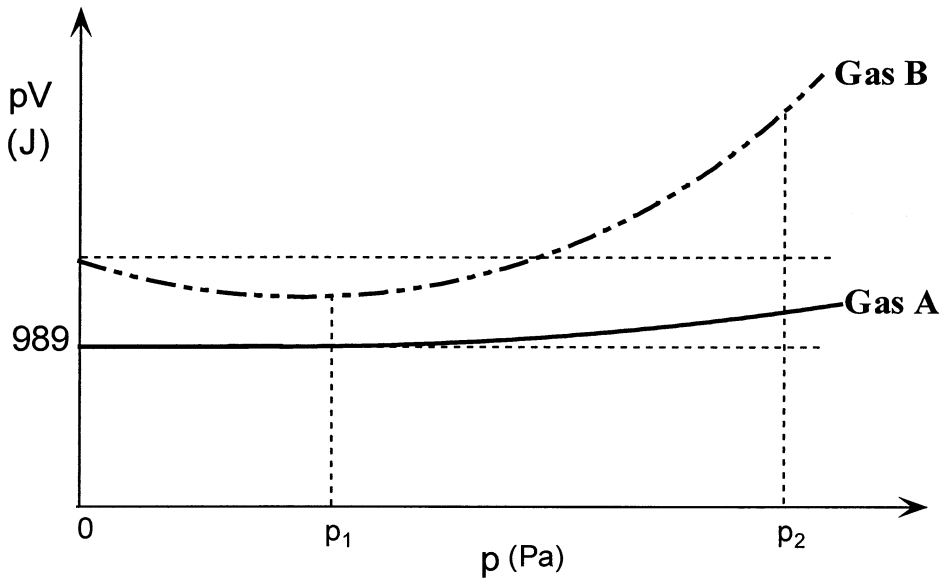
ANSWER QUESTIONS 2 – 9 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a new page in the answer book.
2. Leave one line between subsections, for example between QUESTIONS 2.1 and 2.2.
3. Give all formulae used and show your workings (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

QUESTION 2

2.1 For two different enclosed gases, A and B, the relationship between pressure (p) and volume (V), was determined experimentally at the same constant temperature. The data obtained was used to calculate pV values for each gas, which were then plotted to obtain the graph below.



2.1.1 State, in symbols, the mathematical relationship between the pressure (p) and the volume (V) of gas A, for the pressure range 0 Pa to p_1. (2)

2.1.2 Prove that the SI unit for pV is the joule. (2)

2.1.3 Which gas, butane or helium, is most likely to represent gas A? (1)

2.1.4 If 0,4 moles of the gas A was used, calculate the temperature at which the experiment was conducted. (4)

2.1.5 Explain why gas B deviates from ideal gas behaviour at pressure p_1. (2)

2.1.6 Explain why gas B deviates from ideal gas behaviour at pressure p_2. (2)

2.1.7 Give a reason why the pV intercept is different for the two gases. (2)

2.2 Tien gram (10 g) $Ca(NO_3)_2$ los volledig in 500 cm^3 water op om 'n homogene oplossing te vorm.

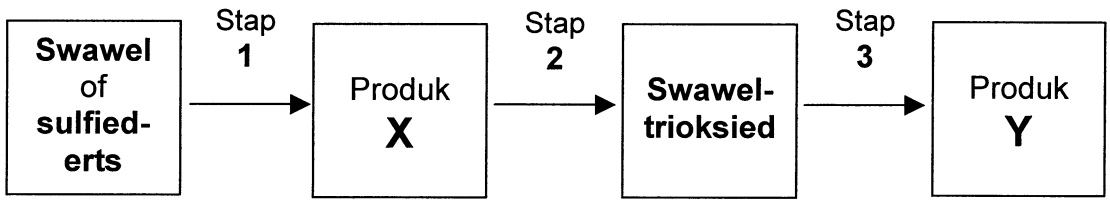
2.2.1 Bereken die konsentrasie van die **nitraat-ione** in die oplossing. (4)

$Ca(NO_3)_2$ los nie in xileen op nie.

2.2.2 Verduidelik waarom $Ca(NO_3)_2$ nie in xileen oplos nie. (3)
[22]

VRAAG 3 (BEGIN OP 'N NUWE BLADSY)

3.1 Die onderstaande diagram is 'n vereenvoudigde vloeidiagram van die Kontak-proses. Elke stap in die proses verteenwoordig 'n chemiese reaksie.



3.1.1 Skryf die **NAAM** van produk **X**. (2)

3.1.2 Produk **X** moet eers gedroog word voordat Stap 2 'n aanvang kan neem. Indien die water nie verwyder word nie, sal 'n verdere reaksie plaasvind. Skryf die **NAAM** van die produk van hierdie (ongewenste) reaksie. (2)

3.1.3 Skryf die gebalanseerde vergelyking vir Stap 2 van die proses. (2)

3.1.4 Skryf die **FORMULE** van **Y,** die finale produk van die proses. (2)

3.2 Skryf 'n gebalanseerde chemiese vergelyking waarin $SO_2(g)$ optree as 'n oksideermiddel met 'n ander verbinding wat swawel bevat. (3)
[11]

2.2 Ten grams (10 g) of $Ca(NO_3)_2$ dissolves completely in 500 cm^3 of water to produce a homogeneous solution.

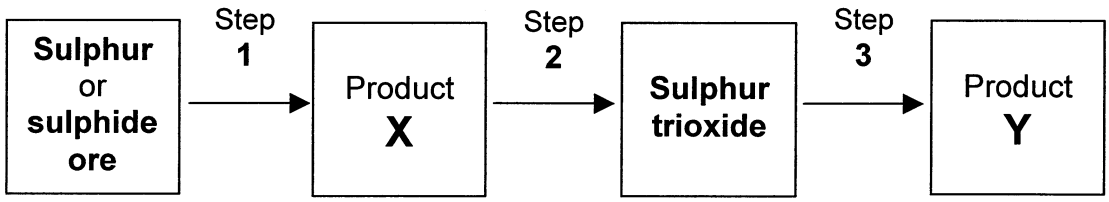
2.2.1 Calculate the concentration of **nitrate ions** in the solution. (4)

$Ca(NO_3)_2$ does not dissolve in xylene.

2.2.2 Explain why $Ca(NO_3)_2$ does not dissolve in xylene. (3)
[22]

QUESTION 3 (START ON A NEW PAGE)

3.1 Below is a simplified flow diagram for the Contact process. Each step in the process represents a chemical reaction.



3.1.1 Write the **NAME** of product **X**. (2)

3.1.2 Product **X** must be dried before Step 2 commences. If the water is not removed, a further reaction will take place. Write the **NAME** of the product of this (undesired) reaction. (2)

3.1.3 Write the balanced equation for Step 2 of the process. (2)

3.1.4 Write the **FORMULA** of **Y,** the final product of the process. (2)

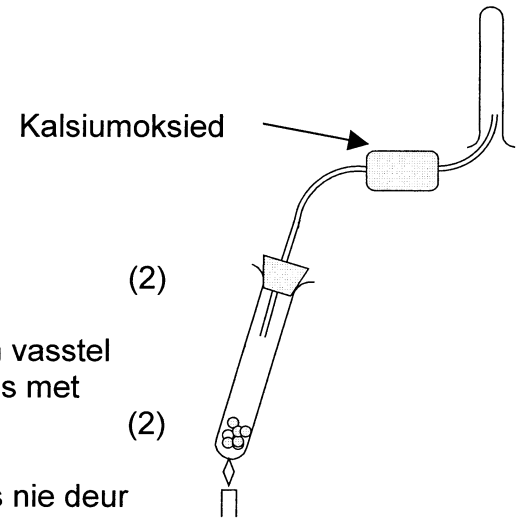
3.2 Write a balanced chemical equation in which $SO_2(g)$ acts as an oxidising agent with another sulphur containing compound. (3)
[11]

VRAAG 4 (BEGIN OP 'N NUWE BLADSY)

4.1 Ammoniak is 'n gas wat in 'n skoollaboratorium berei kan word.

4.1.1 Skryf 'n gebalanseerde vergelyking vir die laboratoriumbereiding van ammoniakgas. (4)

Die ammoniakgas word deur watervrye kalsiumoksied gelei en opgevang in 'n omgekeerde proefbuis soos aangedui in die diagram.



4.1.2 Noem die produk wat deur die kalsiumoksied verwyder word. (2)

4.1.3 Beskryf hoe jy eksperimenteel kan vasstel wanneer die omgekeerde proefbuis met ammoniakgas gevul is. (2)

4.1.4 Verduidelik waarom ammoniakgas nie deur die opwaartse verplasing van lug opgevang kan word nie. (2)

4.2 'n Paar druppels fenolftaleïen word in 'n beker gevul met gedistilleerde water gevoeg en die oplossing is kleurloos. Ammoniakgas word nou deur die oplossing geborrel totdat dit pienk verkleur.

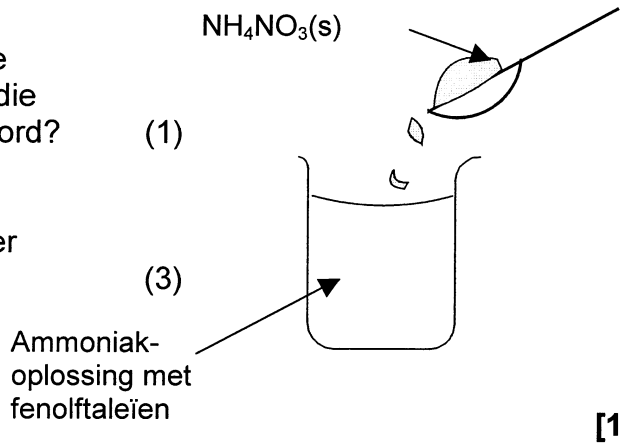
4.2.1 Hoe word die pH van die gedistilleerde water beïnvloed deur die byvoeging van ammoniak?
(Skryf slegs NEEM TOE, NEEM AF of BLY DIESELFDE) (2)

4.2.2 Skryf die gebalanseerde vergelyking van die reaksie van ammoniak met water. (3)

'n Hoeveelheid ammoniumnitraat word nou by die oplossing in die beker gevoeg.

4.2.3 Watter verandering word in die beker waargeneem wanneer die ammoniumnitraat bygevoeg word? (1)

4.2.4 Verduidelik die antwoord op VRAAG 4.2.3 deur Le Chatelier se beginsel te gebruik. (3)



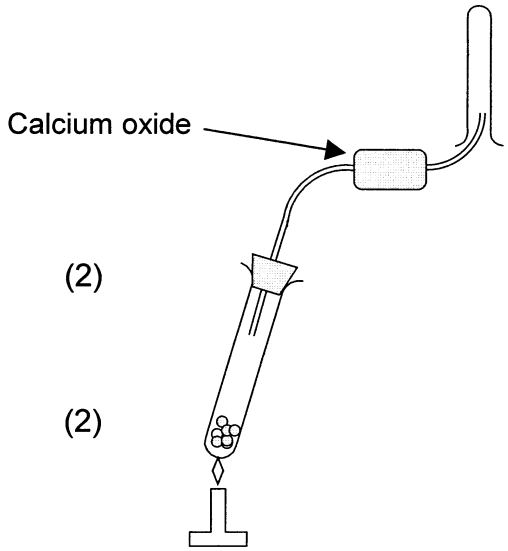
[19]

QUESTION 4 (START ON A NEW PAGE)

4.1 Ammonia is a gas that can be prepared in the school laboratory.

4.1.1 Write a balanced equation for the laboratory preparation of ammonia gas. (4)

The ammonia gas is passed through anhydrous calcium oxide and collected in an inverted test tube as shown in the diagram.



4.1.2 Name the product that is removed by the calcium oxide. (2)

4.1.3 Describe how you can establish experimentally when the inverted test tube is full of ammonia gas. (2)

4.1.4 Explain why ammonia gas cannot be collected by the upward displacement of air. (2)

4.2 A few drops of phenolphthalein are added to a beaker filled with distilled water and the solution is colourless. Ammonia gas is now bubbled through the solution until it turns pink.

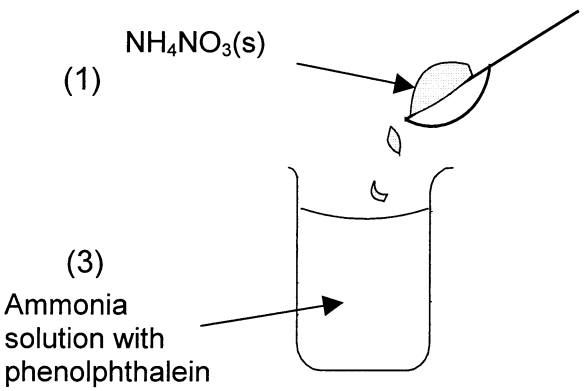
4.2.1 How is the pH of the distilled water affected by the addition of ammonia? (Write only INCREASES, DECREASES or STAYS THE SAME) (2)

4.2.2 Write the balanced equation for the reaction of ammonia with water. (3)

Some ammonium nitrate is now added to the solution in the beaker.

4.2.3 What change will be observed in the beaker when the ammonium nitrate is added? (1)

4.2.4 Use Le Chatelier's principle to explain the answer to QUESTION 4.2.3. (3)



[19]

VRAAG 5 (BEGIN OP 'N NUWE BLADSY)

Chloorwater word gevoeg by 'n proefbuis wat 'n kleurlose oplossing van 'n kaliumsout bevat. Die oplossing verkleur bruin.
Wanneer chloroform bygevoeg en die proefbuis versigtig geskud word, verkleur die chloroformlaag pers.

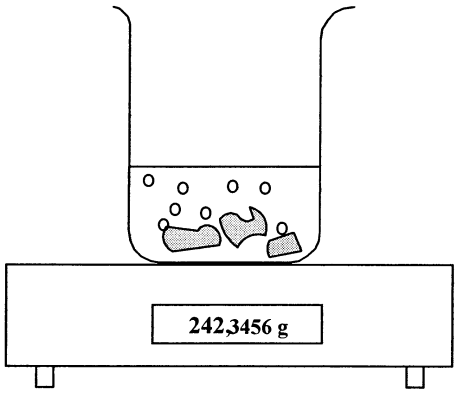
5.1 Skryf die **FORMULE** van die kaliumsout. (2)

5.2 Skryf die gebalanseerde chemiese vergelyking van die reaksie wat plaasgevind het toe die chloorwater bygevoeg is. (3)
[5]

VRAAG 6 (BEGIN OP 'N NUWE BLADSY)

6.1 Sharon voer 'n eksperiment uit om die verskillende faktore wat die tempo van 'n chemiese reaksie beïnvloed, te ondersoek.

Sy plaas 'n monster kalsiumkarbonaat in 'n beker. Daarna word die beker op 'n sensitiewe skaal geplaas en 'n **oormaat** soutsuur (HCℓ) word bygevoeg.



Sharon herhaal die eksperiment 'n aantal kere onder verskillende toestande, telkens met **dieselfde volume HCℓ in oormaat**.

Die volgende tabel is 'n opsomming van die verskillende eksperimentele toestande van vier van haar eksperimente (genommer 1 – 4).

Eksperiment Nommer	Massa $CaCO_3$(g)	Konsentrasie HCℓ ($mol.dm^{-3}$)	Temperatuur van HCℓ (°C)	Toestand van $CaCO_3$(s)
1	10	2	25	korrels
2	10	2	15	korrels
3	20	2	25	korrels
4	10	2	25	poeier

Tydens elke eksperiment word die massa van die beker en sy inhoud elke minuut genoteer.

QUESTION 5 (START ON A NEW PAGE)

Chlorine water is added to a test tube which contains a colourless solution of a potassium salt. The solution turns brown in colour.
When chloroform is added and the test tube carefully shaken, the chloroform layer turns purple in colour.

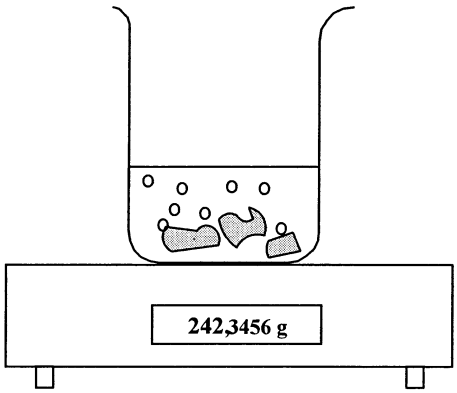
5.1 Write the **FORMULA** of the potassium salt. (2)

5.2 Write a balanced chemical equation for the reaction that took place when the chlorine water was added. (3)
[5]

QUESTION 6 (START ON A NEW PAGE)

6.1 Sharon conducts an experiment to investigate the various factors that influence the rate of chemical reactions.

She places a sample of calcium carbonate in a beaker. The beaker is placed on a sensitive balance and an **excess** of hydrochloric acid (HCℓ) is added.



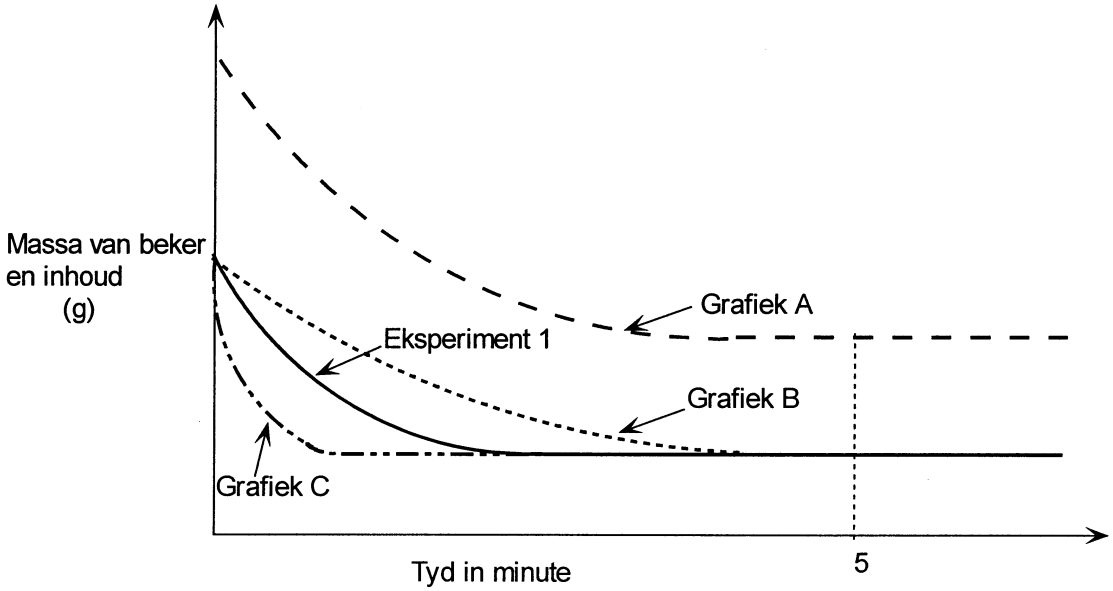
Sharon repeats the experiment a number of times under different conditions, always with the **same volume of HCℓ in excess**.

The following table summarises the different experimental conditions of four of her experiments (numbered 1- 4).

Experiment Number	Mass of $CaCO_3$(g)	Concentration of HCℓ ($mol.dm^{-3}$)	Temperature of HCℓ (°C)	State of $CaCO_3$(s)
1	10	2	25	granules
2	10	2	15	granules
3	20	2	25	granules
4	10	2	25	powder

During each experiment the mass of the beaker and its contents is recorded every minute.

Die onderstaande grafieke toon die veranderinge in die massa van die beker en sy inhoud gedurende die reaksie as 'n funksie van tyd, vir die vier eksperimente.



6.1.1 Gee 'n rede waarom die massa afneem tydens die verloop van elk van die reaksies. (2)

6.1.2 Waarom is al die grafieke reguit lyne na vyf minute? (2)

6.1.3 Watter EEN van die grafieke A, B of C, verteenwoordig die resultate van:

(a) Eksperiment 2 (2)
(b) Eksperiment 3 (2)
(c) Eksperiment 4 (2)

6.2 Sewe (7,0) mol stikstofgas (N_2) en 2,0 mol suurstofgas (O_2) word in 'n leë houer met 'n volume van 2 dm^3 geplaas. Die houer word verseël en die volgende ewewig word ingestel:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

Die K_c-waarde van hierdie reaksie is $4,8 \times 10^{-31}$ by 25 °C.

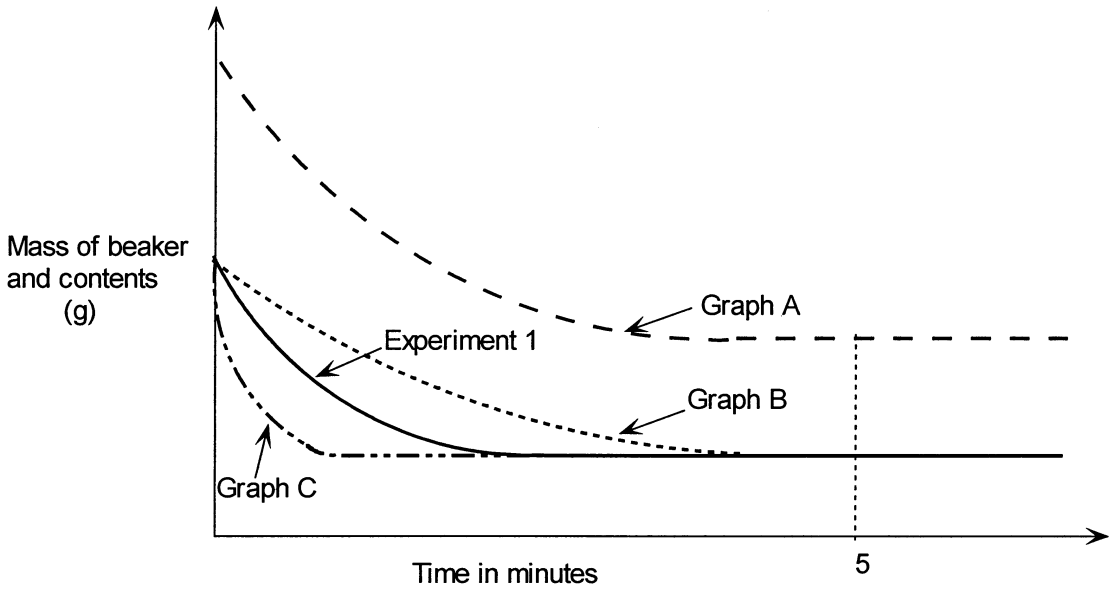
6.2.1 Watter inligting verskaf hierdie waarde van die K_c in verband met die hoeveelheid NO(g) in die ewewigsmengsel by 25 °C? (2)

Die fles word verhit en die sisteem bereik 'n nuwe ewewig by 2 500 °C. By hierdie temperatuur word gevind dat daar 0,4 mol NO(g) teenwoordig is.

6.2.2 Bepaal die K_c-waarde by hierdie temperatuur. (8)

6.2.3 Maak van Le Chatelier se beginsel gebruik en verduidelik waarom die voorwaartse reaksie endotermies is. (4)
[24]

The graphs below indicate the changes in mass of the beaker and its contents during the reaction, as a function of time, for the four experiments:



6.1.1 Give a reason for the decrease in mass as each reaction progresses. (2)

6.1.2 Why are all the graphs straight lines after five minutes? (2)

6.1.3 Which ONE of the graphs A, B or C, represents the results of:

(a) Experiment 2 (2)
(b) Experiment 3 (2)
(c) Experiment 4 (2)

6.2 Seven (7,0) moles of nitrogen gas (N_2) and 2,0 moles of oxygen gas (O_2) are placed in an empty container of volume 2 dm^3. The container is sealed and the following equilibrium is established:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

The K_c value for this reaction at 25 °C is $4,8 \times 10^{-31}$.

6.2.1 What information does this value of K_c indicate with regards to the amount of NO(g) in the equilibrium mixture at 25 °C? (2)

The container is heated and the system reaches a new equilibrium at 2 500 °C. At this temperature it is found that there are 0,4 moles of NO(g) present.

6.2.2 Determine the K_c value at this temperature. (8)

6.2.3 Making use of Le Chatelier's principle, explain why the forward reaction is endothermic. (4)

[24]

VRAAG 7 (BEGIN OP 'N NUWE BLADSY)

7.1 Definieer 'n **sterk suur.** (2)

7.2 Skryf 'n vergelyking om die hidrolise van natriumkarbonaat aan te toon. (3)

7.3 'n Monoprotiese suur het 'n konsentrasie van 0,01 mol.dm^{-3} en 'n pH van 3.

7.3.1 Bereken die waterstofioon-konsentrasie in hierdie oplossing. (2)

7.3.2 Is die sterkte van hierdie suur vergelykbaar met (soortgelyk aan) die sterkte van HCℓ? (Antwoord **JA** of **NEE**) (1)

7.3.3 Gee 'n rede vir die antwoord op VRAAG 7.3.2. (2)

7.4 'n Leerder voeg 'n monster kalsiumkarbonaat by 50,0 cm^3 soutsuur met 'n konsentrasie van 1,0 mol.dm^{-3}. Die soutsuur is in oormaat.

Die gebalanseerde vergelyking van die reaksie wat plaasvind is:

$$CaCO_3 + 2HC\ell \rightarrow CaC\ell_2 + CO_2 + H_2O$$

Die oormaat HCℓ word nou geneutraliseer deur 28,0 cm^3 van 'n 0,5 mol.dm^{-3} - natriumhidroksied-oplossing.

Die gebalanseerde vergelyking van hierdie reaksie is:

$$HC\ell + NaOH \rightarrow NaC\ell + H_2O$$

Bepaal die massa kalsiumkarbonaat in hierdie monster. (10)
[20]

QUESTION 7 (START ON A NEW PAGE)

7.1 Define a **strong acid.** (2)

7.2 Write an equation to show the hydrolysis of sodium carbonate. (3)

7.3 A monoprotic acid has a concentration of 0,01 mol.dm^{-3} and a pH of 3.

7.3.1 Calculate the concentration of the hydrogen ions in this solution. (2)

7.3.2 Is this acid comparable (similar) in strength to HCℓ?
(Answer **YES** or **NO**) (1)

7.3.3 Give a reason for the answer to QUESTION 7.3.2. (2)

7.4 A learner adds a sample of calcium carbonate to 50,0 cm^3 of hydrochloric acid of concentration 1,0 mol.dm^{-3}. The hydrochloric acid is in excess.

The balanced equation for the reaction that takes place is:

$$CaCO_3 + 2HC\ell \rightarrow CaC\ell_2 + CO_2 + H_2O$$

The excess HCℓ is now neutralised by 28,0 cm^3 of a 0,5 mol.dm^{-3} sodium hydroxide solution.

The balanced equation for this reaction is:

$$HC\ell + NaOH \rightarrow NaC\ell + H_2O$$

Calculate the mass of calcium carbonate in this sample. (10)
[20]

VRAAG 8 (BEGIN OP 'N NUWE BLADSY)

8.1 Wanneer 'n oplossing van kaliumdichromaat ($K_2Cr_2O_7$) by oksaalsuur ($H_2C_2O_4$) gevoeg word, verkleur die oplossing van oranje na groen.

8.1.1 Skryf die vergelyking van die halfreaksie wat hierdie verandering in kleur verduidelik. (2)

8.1.2 Die halfreaksie van oksaalsuur word nie gevind in die Tabel van Standaard Reduksiepotensiale (Tabel 4) nie, maar word hieronder aangedui:

$$2CO_2 + 2H^+ + 2e^- \rightleftharpoons H_2C_2O_4 \qquad E^\circ = -0,49\ V$$

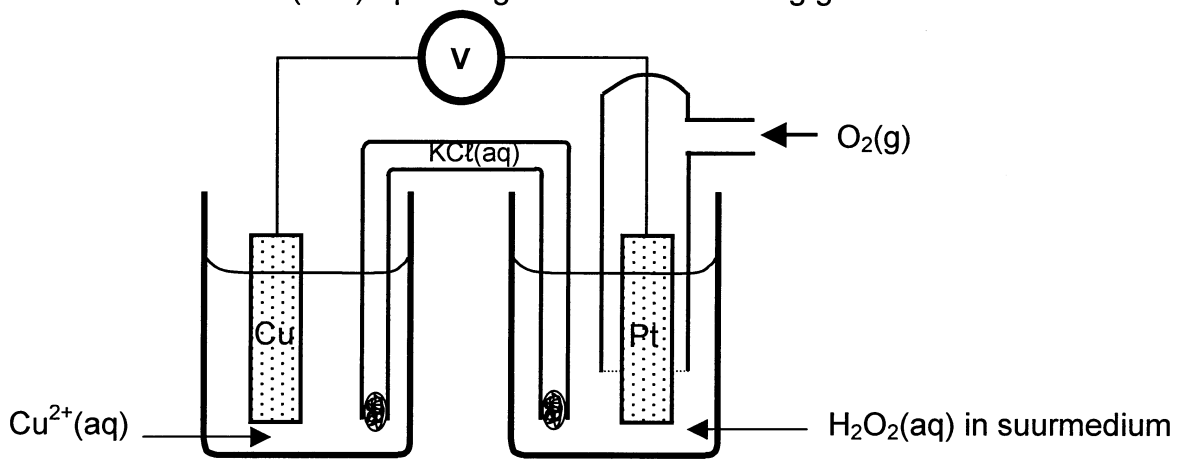
Maak gebruik van hierdie inligting en Tabel 4 om te verduidelik waarom die reaksie tussen oksaalsuur en kaliumdichromaat spontaan is. Verwys na die relatiewe sterkte van die oksideer- en reduseermiddels in jou antwoord. (4)

8.1.3 Skryf 'n gebalanseerde vergelyking van die reaksie tussen oksaalsuur en kaliumdichromaat. Dui die gebalanseerde halfreaksies duidelik aan. Laat die antwoord in ioonvorm sonder toeskouer-ione. (5)

8.2 'n Leerder stel 'n standaard-elektrochemiese sel op deur van die volgende halfselle gebruik te maak:

$$Pt, O_2(g), H^+(aq) | H_2O_2(aq) \quad \text{en} \quad Cu^{2+}(aq) | Cu(s)$$

'n Kaliumchloried (KCℓ)-oplossing word in die soutbrug gebruik.



8.2.1 Watter elektrode is die katode? (1)

8.2.2 Skryf die oksidasie-halfreaksie. (2)

8.2.3 Skryf die reduksie-halfreaksie. (2)

8.2.4 Bereken die emk van hierdie sel. (4)

8.2.5 Die konsentrasie van watter ioon sal in die $O_2|H_2O_2$-halfsel toeneem terwyl die sel in werking is? (Kies uit: K^+, $Cℓ^-$ of H^+) (2)

[22]

QUESTION 8 (START ON A NEW PAGE)

8.1 When a solution of potassium dichromate ($K_2Cr_2O_7$) is added to oxalic acid ($H_2C_2O_4$), the solution changes colour from orange to green.

8.1.1 Write the equation of the half-reaction that explains this colour change. (2)

8.1.2 The half-reaction for oxalic acid is not found in the Table of Standard Reduction Potentials (Table 4), but is indicated below:

$$2CO_2 + 2H^+ + 2e^- \rightleftharpoons H_2C_2O_4 \qquad E^\circ = -0{,}49\ V$$

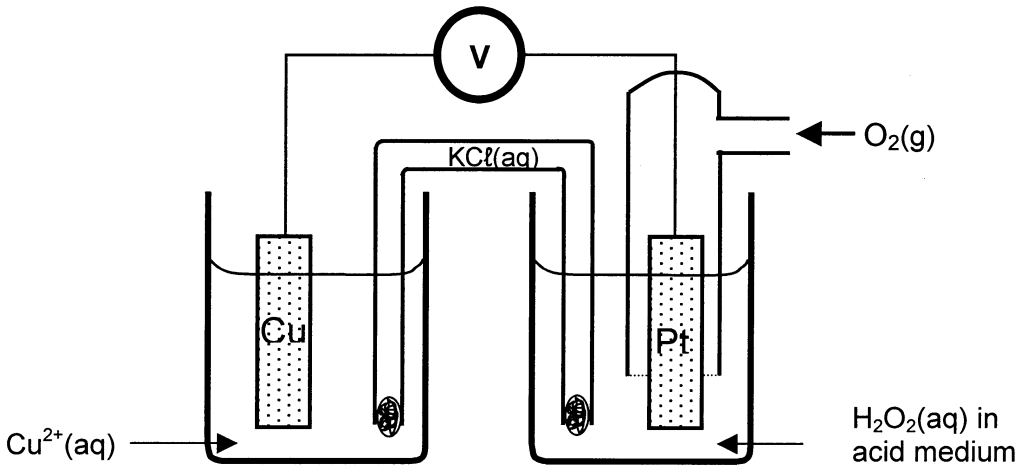
Use this information and Table 4 to explain why the reaction between oxalic acid and potassium dichromate is spontaneous. Refer to the relative strengths of the oxidising and reducing agents in your answer. (4)

8.1.3 Write a balanced equation for the reaction between oxalic acid and potassium dichromate, clearly indicating the balanced half-reactions. Leave the answer in ionic form without spectator ions. (5)

8.2 A learner sets up a standard electrochemical cell using the following half-cells:

$$Pt,\ O_2(g),\ H^+(aq)|\ H_2O_2(aq) \quad \text{and} \quad Cu^{2+}(aq)|Cu(s)$$

Potassium chloride (KCℓ) solution is used in the salt bridge.



8.2.1 Which electrode is the cathode? (1)

8.2.2 Write the oxidation half-reaction. (2)

8.2.3 Write the reduction half-reaction. (2)

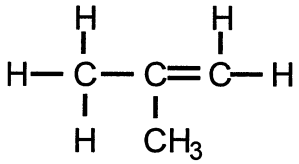
8.2.4 Calculate the emf of this cell. (4)

8.2.5 The concentration of which ion will increase in the $O_2|H_2O_2$ half-cell while the cell is in operation? (Choose from: K^+, $Cℓ^-$, or H^+) (2)

[22]

VRAAG 9 (BEGIN OP 'N NUWE BLADSY)

9.1 Vir die volgende verbinding, skryf:

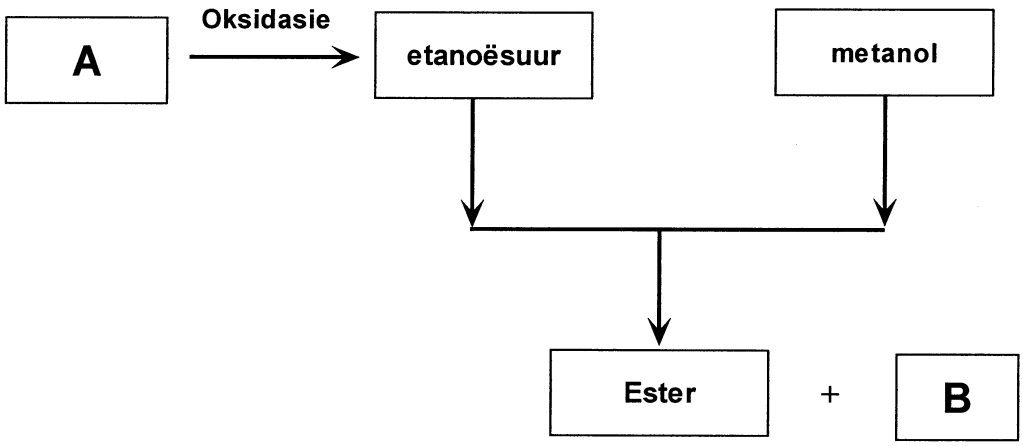


9.1.1 Die IUPAC-naam (2)

9.1.2 Die struktuurformules van twee isomere daarvan (4)

9.2 Die gas in 'n oksiasetileenblaasvlam brand in 'n oormaat suurstof. Skryf 'n gebalanseerde vergelyking van die reaksie wat plaasvind. (3)

9.3 Beskou die onderstaande vloeidiagram van 'n chemiese proses wat tot die vorming van 'n ester lei:



9.3.1. Etanoësuur word verkry deur die oksidasie van verbinding A. Skryf die **NAAM** van verbinding A. (2)

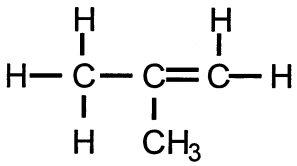
9.3.2. Skryf die **NAAM** van verbinding B. (2)

9.3.3 Gee die IUPAC-naam en STRUKTUURFORMULE van die ester wat gevorm word. (4)
[17]

TOTAAL: 200

QUESTION 9 (START ON A NEW PAGE)

9.1 For the following compound write:

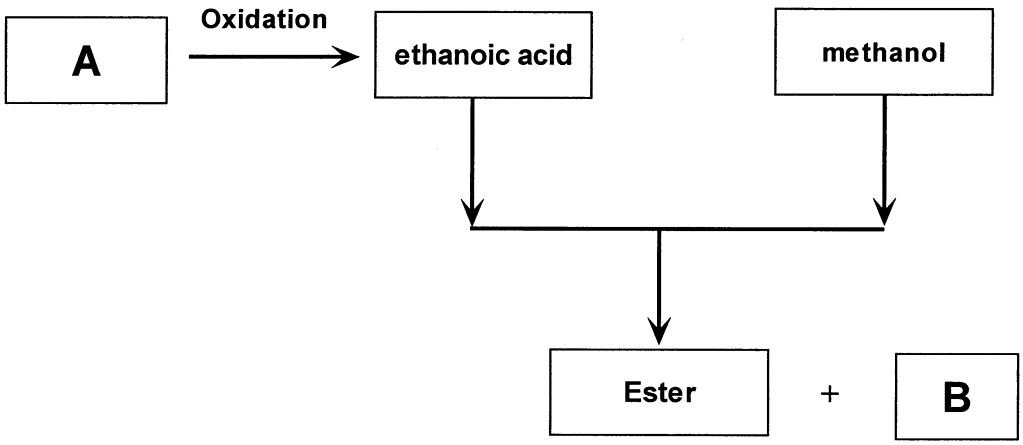


9.1.1 Its IUPAC name (2)

9.1.2 The structural formulae of two of its isomers (4)

9.2 The gas in an oxy-acetylene blowtorch burns in an excess of oxygen. Write a balanced equation for the reaction taking place. (3)

9.3 Consider the following flow-diagram of a chemical process that leads to the formation of an ester:



9.3.1. Ethanoic acid is obtained through the oxidation of compound A. Write the **NAME** of compound A. (2)

9.3.2. Write the **NAME** of compound B. (2)

9.3.3. Give the IUPAC name and STRUCTURAL FORMULA of the ester formed. (4)
[17]

TOTAL: 200

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

DATA FOR PHYSICAL SCIENCE
PAPER 2 (CHEMISTRY)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTES

Avogadro-konstante Avogadro's constant	N_A of/or L	$6{,}02 \times 10^{23}$ mol^{-1}
Molêre gaskonstante Molar gas constant	R	8,31 J.K^{-1}.mol^{-1}
Standaarddruk Standard pressure	p^θ	$1{,}013 \times 10^5$ Pa
Molêre gasvolume by STD Molar gas volume at STP	V_m	22,4 dm^3.mol^{-1}
Standaardtemperatuur Standard temperature	T^θ	273 K

TABLE 2: FORMULAE
TABEL 2: FORMULES

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$
$pV = nRT$	$K_w = [\mathrm{H}^+][\mathrm{OH}^-] = 10^{-14}$ by/at 298 K
$n = \frac{m}{M}$	$pH = -\log[\mathrm{H}^+]$
$c = \frac{n}{V}$	$E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$
	$E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}}$
$c = \frac{m}{MV}$	$E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$
	$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$

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

KEY/SLEUTEL

Atoomgetal
Atomic number

Elektronegatiwiteit
Electronegativity

29
1,9 Cu
63,5

Simbool
Symbol

Relatiewe atoommassa (benaderd)
Relative atomic mass
(approximately)

I	II	III	IV	V	VI	VII	0
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

Halfreaksie / Half-reaction	E° /volt
$F_2 + 2e^- \rightleftharpoons 2F^-$	+2,87
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
$Au^{3+} + 3e^- \rightleftharpoons Au$	+1,42
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	+1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,21
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1,09
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	+0,96
$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0,80
$Hg^{2+} + 2e^- \rightleftharpoons Hg$	+0,79
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S$	+0,14
$\mathbf{2H^+ + 2e^- \rightleftharpoons H_2}$	**0,00**
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0,04
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0,25
$Co^{2+} + 2e^- \rightleftharpoons Co$	-0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0,40
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0,76
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0,83
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1,18
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	-1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2,37
$Na^+ + e^- \rightleftharpoons Na$	-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 oksideervermoë ↑

Increasing reducing ability / Toenemende reduseervermoë ↓

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

Increasing oxidising ability / Toenemende oksideervermoë ↓

Increasing reducing ability / Toenemende reduseervermoë ↑

Half-reaction / Halfreaksie	E° /volt
$Li^+ + e^- \rightleftharpoons Li$	-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
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	-2,37
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	-1,66
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	-1,18
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	-0,83
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	-0,76
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	-0,74
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	-0,44
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	-0,40
$Co^{2+} + 2e^- \rightleftharpoons Co$	-0,28
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	-0,25
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	-0,14
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	-0,13
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	-0,04
$2H^+ + 2e^- \rightleftharpoons H_2$	**0,00**
$S + 2H^+ + 2e^- \rightleftharpoons H_2S$	+0,14
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0,15
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0,16
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+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
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0,54
$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0,68
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0,77
$Hg^{2+} + 2e^- \rightleftharpoons Hg$	+0,79
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0,80
$Ag^+ + e^- \rightleftharpoons Ag$	+0,80
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$	+0,96
$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1,09
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+1,20
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1,21
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1,33
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$	+1,36
$Au^{3+} + 3e^- \rightleftharpoons Au$	+1,42
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1,51
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$F_2 + 2e^- \rightleftharpoons 2F^-$	+2,87