DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN ONDERWYS
REPUBLIEK VAN SUID-AFRIKA

SENIOR CERTIFICATE EXAMINATION - 2005
SENIORSERTIFIKAAT-EKSAMEN - 2005

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

HIGHER GRADE
HOËR GRAAD

FEBRUARY/MARCH 2005
FEBRUARIE/MAART 2005

304-1/2

PHYSICAL SCIENCE HG: Paper 2
Chemistry

304 1 2 HG

Marks: 200
Punte : 200

2 Hours
2 Ure

This question paper consists of 15 pages and a data sheet of 4 pages.
Hierdie vraestel bestaan uit 15 bladsye en 'n datablad van 4 bladsye.

X05

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.

PLAAS DIE VOLTOOIDE ANTWOORDBLAD BINNE DIE VOORSTE OMSLAG VAN JOU ANTWOORDEBOEK, INDIEN 'N AFSONDERLIKE ANTWOORDBLAD GEBRUIK IS.

VOORBEELD:

VRAAG: Die simbool van 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.

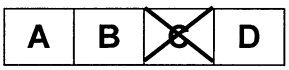
PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE:

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

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

ANSWER:



1.1 Die kookpunte van helium en argon is onderskeidelik –269°C en –186°C. Hierdie verskil in kookpunt kan toegeskryf word aan sterker …

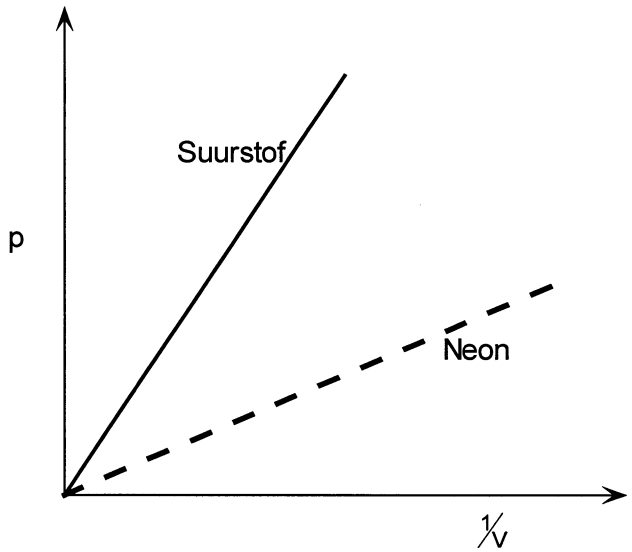
A ioniese bindings tussen argon-atome.

B kovalente bindings tussen helium-atome.

C waterstofbindings tussen helium-atome.

D Van der Waalskragte tussen argon-atome. (4)

1.2 'n Eksperiment is uitgevoer met aparte monsters suurstof- en neongas. Die volgende grafieke van druk (p) teenoor die resiprook van die volume ($\frac{1}{V}$) is in elke geval verkry:



Indien dieselfde aantal mol gas gebruik is in elke eksperiment, watter EEN van die volgende stellings rakende die temperatuur van die gasse is WAAR?

A Die temperatuur van beide gasse was dieselfde.

B Die temperatuur van die neon was laer as dié van die suurstofgas.

C Die temperatuur van die neon was hoër as dié van die suurstofgas.

D Geen gevolgtrekkings rakende die temperatuur kan vanaf die grafiek gemaak word nie. (4)

1.3 Die reaksie wat plaasvind wanneer H_2S-gas deur 'n oplossing van yster(III)chloried geborrel word, is:

$$2Fe^{3+}(aq) + H_2S(g) \rightarrow 2Fe^{2+}(aq) + S(s) + 2H^+(aq)$$

Watter EEN van die volgende stellings omtrent hierdie reaksie is **NIE** korrek nie?

A 'n Geel neerslag vorm.

B Die Fe^{3+}-ione word gereduseer.

C Die pH van die oplossing neem toe.

D Die H_2S tree as 'n reduseermiddel op. (4)

1.1 The boiling points of helium and argon are –269°C and –186°C respectively. This difference in boiling point is due to the presence of stronger ...

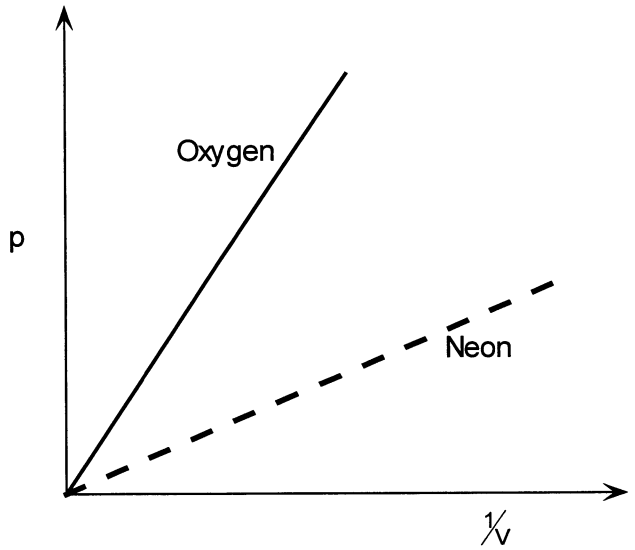
A ionic bonds between argon atoms.

B covalent bonds between helium atoms.

C hydrogen bonds between helium atoms.

D Van der Waals forces between argon atoms. (4)

1.2 An experiment was done with separate samples of oxygen and neon gas. The following graphs of pressure (p) versus the reciprocal of the volume ($\frac{1}{V}$) were obtained in each case:



If the same number of moles of gas were used in each experiment, which ONE of the following statements concerning the temperature of the gases is TRUE?

A The temperature of both gases was the same.

B The temperature of the neon was lower than that of the oxygen gas.

C The temperature of the neon was higher than that of the oxygen gas.

D No deductions about the temperature can be made from the graph. (4)

1.3 The reaction that occurs when H_2S gas is bubbled through an iron (III) chloride solution is:

$$2Fe^{3+}(aq) + H_2S(g) \rightarrow 2Fe^{2+}(aq) + S(s) + 2H^+(aq)$$

Which ONE of the following statements about this reaction is **NOT** correct?

A A yellow precipitate forms.

B The Fe^{3+} ions are reduced.

C The pH of the solution increases.

D The H_2S acts as a reducing agent. (4)

1.4 'n Onbekende soutoplossing word by 'n oplossing van silwernitraat en by 'n oplossing van swawelsuur gevoeg. Wit neerslae vorm in beide gevalle. Die onbekende soutoplossing is waarskynlik ...

A bariumchloried.

B loodnitraat.

C koper(II)chloried.

D bariumnitraat. (4)

1.5 In watter EEN van die volgende industriële prosesse word stikstofoksied (NO) op 'n stadium gedurende die proses gevorm?

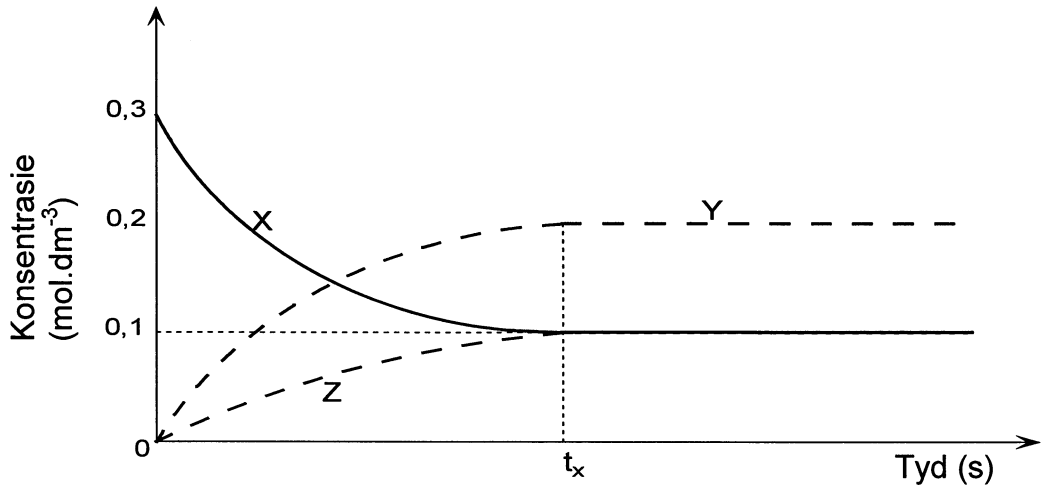
A Fraksionele distillasie van lug

B Haber-proses

C Ostwald-proses

D Kontakproses (4)

1.6 'n Gas X word geplaas in 'n verseëlde houer by t = 0 s. Die gas ontbind in gasse Y en Z. 'n Chemiese ewewig tussen die drie gasse word by t = t_x bereik. Die onderstaande grafiek van konsentrasie teenoor tyd dui die veranderings aan wat gedurende die reaksie plaasvind:



Die vergelyking van hierdie reaksie is:

A $3X \rightleftharpoons 2Y + Z$

B $X \rightleftharpoons Y + Z$

C $X \rightleftharpoons 2Y + Z$

D $2X \rightleftharpoons 2Y + Z$ (4)

1.4 An unknown salt solution is added to a solution of silver nitrate and to a solution of sulphuric acid. A white precipitate forms in each case.The unknown salt solution is probably …

A barium chloride.

B lead nitrate.

C copper (II) chloride.

D barium nitrate. (4)

1.5 In which ONE of the following industrial processes is nitrogen oxide (NO) formed at some stage in the process?

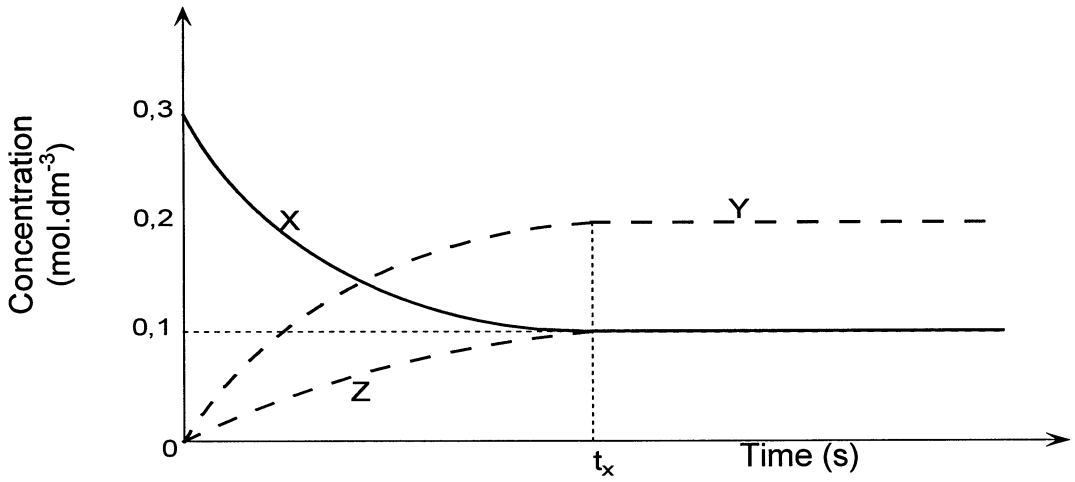
A Fractional distillation of air

B Haber process

C Ostwald process

D Contact process (4)

1.6 A gas X is placed in a sealed container at t = 0 s. The gas decomposes into gases Y and Z. A chemical equilibrium between the three gases is reached at t = t_x. The following graph of concentration versus time shows the changes that occurred during the reaction:



The equation for this reaction is:

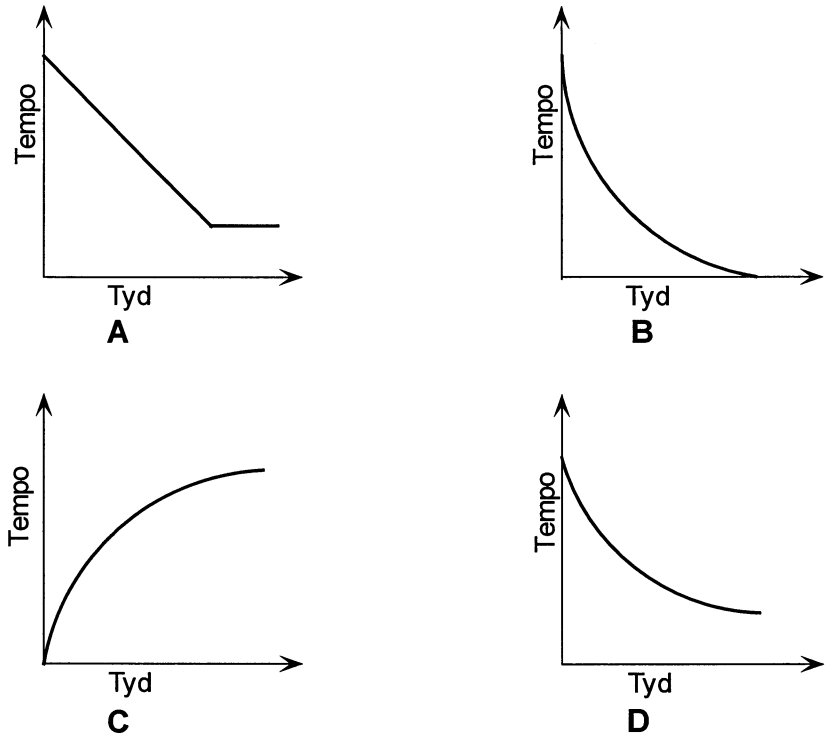
A $3X \rightleftharpoons 2Y + Z$

B $X \rightleftharpoons Y + Z$

C $X \rightleftharpoons 2Y + Z$

D $2X \rightleftharpoons 2Y + Z$ (4)

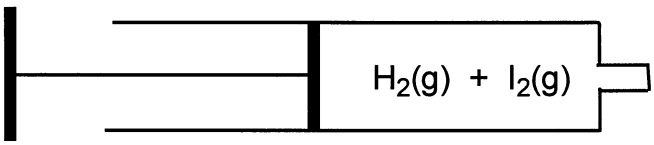
1.7 Watter EEN van die volgende grafieke van reaksietempo teenoor tyd is kenmerkend van 'n reaksie tussen 'n oormaat soutsuur en 'n monster magnesiumpoeier?



(4)

1.8 'n Mengsel van $H_2(g)$ en $I_2(g)$ word in 'n gasspuit verseël. Die mengsel word dan toegelaat om ewewig te bereik by 'n konstante temperatuur volgens die vergelyking:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

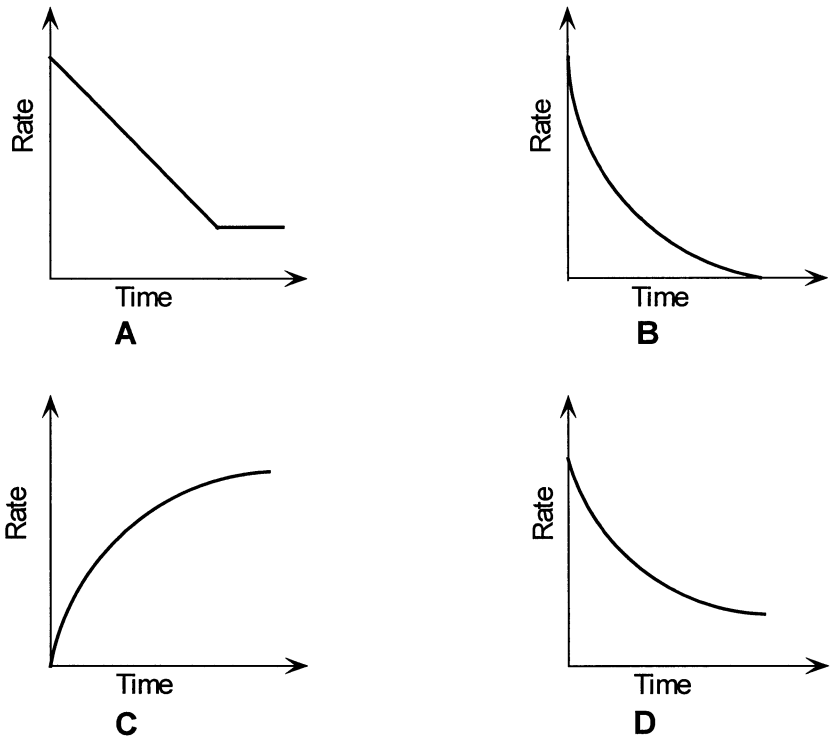


Wat sal gebeur met die **konsentrasie** en **opbrengs** van HI, as die suier ingedruk word terwyl die temperatuur konstant bly?

	[HI]	Opbrengs HI
A	Neem toe	Neem af
B	Neem af	Bly dieselfde
C	Neem af	Neem toe
D	Neem toe	Bly dieselfde

(4)

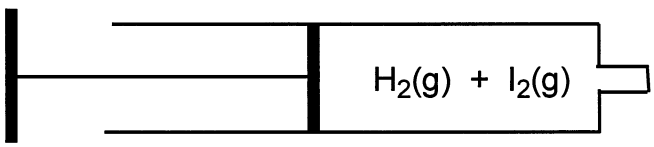
1.7 Which ONE of the following graphs of rate of reaction versus time is typical of a reaction between an excess of hydrochloric acid and a sample of powdered magnesium?



(4)

1.8 A mixture of $H_2(g)$ and $I_2(g)$ is sealed in a gas syringe.
The mixture is then allowed to reach equilibrium at a constant temperature according to the equation:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$



What will happen to the **concentration** and **yield** of HI if the piston is moved inwards while the temperature remains constant?

	[HI]	**Yield of HI**
A	Increases	Decreases
B	Decreases	Stays the same
C	Decreases	Increases
D	Increases	Stays the same

(4)

1.9 Verdunde salpetersuur word geleidelik gevoeg by 'n fles gedistilleerde water by 25°C.
Hoe beïnvloed dit die waterstofioon-konsentrasie $[H^+]$ en die ionisasie-konstante (K_w) van water?

	$[H^+]$	K_w
A	Neem toe	Neem toe
B	Neem toe	Neem af
C	Neem toe	Bly dieselfde
D	Bly dieselfde	Bly dieselfde

(4)

1.10 Beskou die volgende omkeerbare reaksie:

$$HPO_4^{2-}(aq) + H_2O(\ell) \rightleftharpoons H_2PO_4^-(aq) + OH^-(aq)$$

Die verbindings HPO_4^{2-} en OH^- kan in hierdie reaksie beskryf word as ...

A 'n gekonjugeerde suur-basispaar.

B Lowry-Brönsted-basisse.

C Lowry-Brönsted-sure.

D poliprotiese sure. (4)

1.11 Watter EEN van die volgende vergelykings is die beste verklaring van waarom 'n kopersulfaat-oplossing **nie** in 'n aluminium-houer **gestoor behoort te word nie**?

A $2A\ell^{3+} + 3Cu \rightarrow 3Cu^{2+} + 2A\ell$

B $A\ell^{3+} + Cu^{2+} \rightarrow A\ell^{2+} + Cu^{3+}$

C $2A\ell + 3Cu^{2+} \rightarrow 2A\ell^{3+} + 3Cu$

D $A\ell^{3+} + Cu^{+} \rightarrow A\ell^{2+} + Cu^{2+}$ (4)

1.12 Die selnotasie van 'n elektrochemiese sel is:

$$Mg(s) \mid Mg^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$$

Die emk van die sel onder standaardtoestande is 2,71 V. Toe 'n leerder egter die sel opstel vind hy/sy dat die emk slegs 1,20 V is. Watter EEN van die volgende faktore het heel waarskynlik sy/haar resultate beïnvloed?

A Die volume van die $Cu^{2+}(aq)$-oplossing.

B Die konsentrasie van die $Cu^{2+}(aq)$-oplossing.

C Die grootte van die koper-elektrode.

D Die konsentrasie van die oplossing in die soutbrug. (4)

1.9 Dilute nitric acid is gradually added to a flask of distilled water at 25°C. How does this affect the hydrogen ion concentration $[H^+]$ and the ionisation constant (K_w) of water?

	$[H^+]$	K_w
A	Increases	Increases
B	Increases	Decreases
C	Increases	Stays the same
D	Stays the same	Stays the same

(4)

1.10 Consider the following reversible reaction:

$$HPO_4^{2-}(aq) + H_2O(\ell) \rightleftharpoons H_2PO_4^-(aq) + OH^-(aq)$$

The compounds HPO_4^{2-} and OH^- in this reaction can be described as ...

A a conjugate acid-base pair.

B Lowry-Brönsted bases.

C Lowry-Brönsted acids.

D polyprotic acids. (4)

1.11 Which ONE of the following equations best explains why a solution of copper sulphate **should not be stored** in an aluminium container?

A $2A\ell^{3+} + 3Cu \rightarrow 3Cu^{2+} + 2A\ell$

B $A\ell^{3+} + Cu^{2+} \rightarrow A\ell^{2+} + Cu^{3+}$

C $2A\ell + 3Cu^{2+} \rightarrow 2A\ell^{3+} + 3Cu$

D $A\ell^{3+} + Cu^{+} \rightarrow A\ell^{2+} + Cu^{2+}$ (4)

1.12 The cell notation of an electrochemical cell is:

$$Mg(s) \mid Mg^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$$

The emf of the cell under standard conditions is 2,71 V. However, when a learner set up this cell, he/she found that the emf was only 1,20 V. Which ONE of the following factors most probably affected his/her results?

A The volume of the $Cu^{2+}(aq)$ solution.

B The concentration of the $Cu^{2+}(aq)$ solution.

C The size of the copper electrode.

D The concentration of the solution in the salt bridge. (4)

1.13 Die halfreaksies wat plaasvind in 'n sekere hipotetiese elektrochemiese sel is:

$X^{2+} + 2e^- \rightleftharpoons X$ $\quad E^\circ = +0,80$ V

$Y^+ + e^- \rightleftharpoons Y$ $\quad E^\circ = -0,76$ V

Watter EEN van die volgende tree op as die reduseermiddel?

A X^{2+}

B Y^+

C X

D Y (4)

1.14 Watter EEN van die volgende verbindings het die molekulêre formule $C_2H_4O_2$?

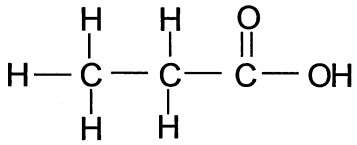
A Metanoësuur

B Etanol

C Etielmetanoaat

D Etanoësuur (4)

1.15 Beskou die onderstaande verbinding:



Hierdie verbinding kan berei word deur die oksidasie van 'n …

A ester.

B alkeen.

C alkohol.

D alkaan. (4)

[60]

1.13 The half-reactions taking place in a certain hypothetical electrochemical cell are:

$X^{2+} + 2e^- \rightleftharpoons X$ $\quad E^\circ = +0,80$ V

$Y^+ + e^- \rightleftharpoons Y$ $\quad E^\circ = -0,76$ V

Which ONE of the following acts as the reducing agent?

A X^{2+}

B Y^+

C X

D Y (4)

1.14 Which ONE of the following compounds has the molecular formula $C_2H_4O_2$?

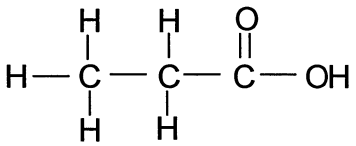
A Methanoic acid

B Ethanol

C Ethyl methanoate

D Ethanoic acid (4)

1.15 Consider the compound below:



This compound can be prepared by the oxidation of an …

A ester.

B alkene.

C alcohol.

D alkane. (4)

[60]

BEANTWOORD VRAAG 2 – 10 IN DIE ANTWOORDEBOEK.

INSTRUKSIES

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

VRAAG 2

2.1 Beskou die volgende lys chemiese stowwe:

A. $KNO_3(s)$ B. $CO_2(s)$ C. C(s)

D. $H_2O(\ell)$ E. Cu(s)

Kies uit die bostaande lys 'n stof wat:
(Skryf slegs die letter neer wat die stof verteenwoordig.)

2.1.1 Allotrope het (2)

2.1.2 Van der Waalskragte tussen die deeltjies het (2)

2.1.3 'n Vaste stof is wat in 'n polêre vloeistof kan oplos (2)

2.1.4 Metaalbinding tussen die atome het (2)

2.1.5 By kamertemperatuur kan sublimeer (sublimasie kan ondergaan) (2)

2.2 Verduidelik waarom 'n ware gas afwyk van ideale gasgedrag by lae temperature. (3)

2.3 5,60 g van 'n diatomiese gas beslaan 'n volume van $3,00 \times 10^{-3}$ m^3 by 'n temperatuur van 25°C en 'n druk van 165 kPa.

2.3.1 Bereken die molêre formulemassa van die gas. (6)

2.3.2 Gee die naam of formule van die gas. (2)
[21]

ANSWER QUESTIONS 2 – 10 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a new page in your 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 Consider the following list of chemical substances:

A. $KNO_3(s)$ B. $CO_2(s)$ C. C(s)

D. $H_2O(\ell)$ E. Cu(s)

Select from the above list a substance which:
(Write only the letter representing the substance.)

2.1.1 Has allotropes (2)

2.1.2 Has Van der Waals forces between its particles (2)

2.1.3 Is a solid that can dissolve in a polar liquid (2)

2.1.4 Has metallic bonding between its atoms (2)

2.1.5 Can sublime at room temperature (undergoes sublimation) (2)

2.2 Explain why a real gas deviates from ideal gas behaviour at low temperatures. (3)

2.3 5,60 g of a diatomic gas occupies a volume of $3,00 \times 10^{-3}$ m^3 at a temperature of 25°C and a pressure of 165 kPa.

2.3.1 Calculate the molar formula mass of the gas. (6)

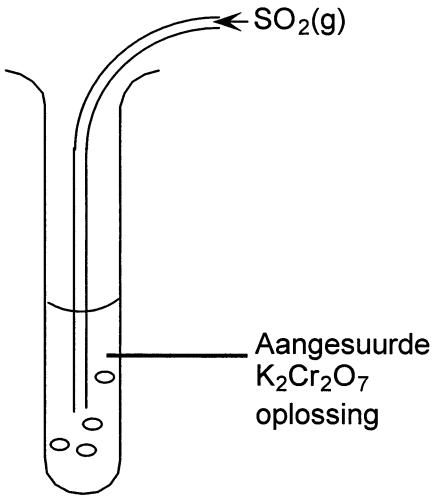
2.3.2 Give the name or formula of the gas. (2)
[21]

VRAAG 3 (BEGIN OP 'N NUWE BLADSY)

Swaweldioksiedgas word in die laboratorium berei deur die reaksie tussen natriumsulfiet en verdunde soutsuur.

3.1 Skryf die gebalanseerde chemiese vergelyking van hierdie reaksie neer. (3)

Die swaweldioksiedgas word geborrel deur 'n aangesuurde oplossing van kaliumdichromaat. Die oplossing verkleur groen.



3.2 Skryf die formule van die ioon wat verantwoordelik is vir die groen kleur neer. (2)

3.3 Gebruik die Tabel van Standaard Reduksiepotensiale om die gebalanseerde vergelyking van hierdie reaksie neer te skryf. Hierdie vergelyking kan in ioniese vorm gelaat word. (6)

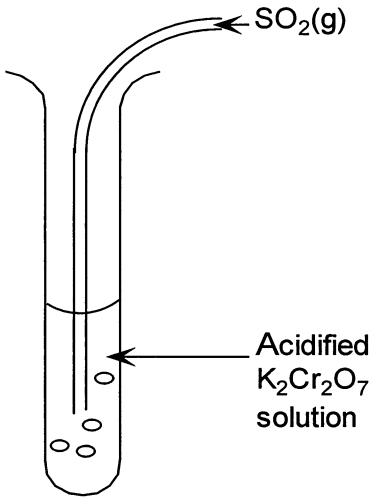
3.4 Identifiseer die oksideermiddel in hierdie reaksie. (2)
[13]

QUESTION 3 (START ON A NEW PAGE)

Sulphur dioxide gas is produced in the laboratory, through the reaction between sodium sulphite and dilute hydrochloric acid.

3.1 Write the balanced chemical equation for this reaction. (3)

The sulphur dioxide gas is bubbled through an acidified solution of potassium dichromate. The solution changes green in colour.



3.2 Write the formula of the ion responsible for the green colour. (2)

3.3 Use the Table of Standard Reduction Potentials to write down the balanced equation for this reaction. This equation can be left in ionic form. (6)

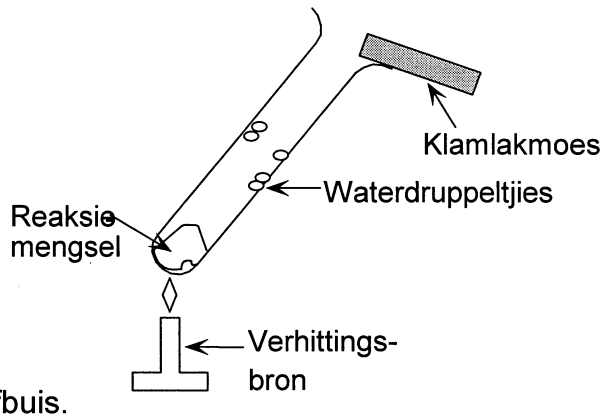
3.4 Identify the oxidising agent in this reaction. (2)
[13]

VRAAG 4 (BEGIN OP 'N NUWE BLADSY)

4.1 Gelyke hoeveelhede ammoniumchloried-kristalle en 'n kalsiumverbinding word gemeng en in 'n proefbuis geplaas.

Die proefbuis word dan verhit en 'n klam lakmoespapiertjie word by die mond van die proefbuis gehou.

Na 'n paar sekondes word 'n sterk reuk waargeneem en druppeltjies water vorm teen die kante van die proefbuis.



4.1.1 Skryf die **NAAM** van die kalsiumverbinding neer. (2)

4.1.2 Skryf die kleur van die lakmoespapiertjie na afloop van die reaksie neer. (1)

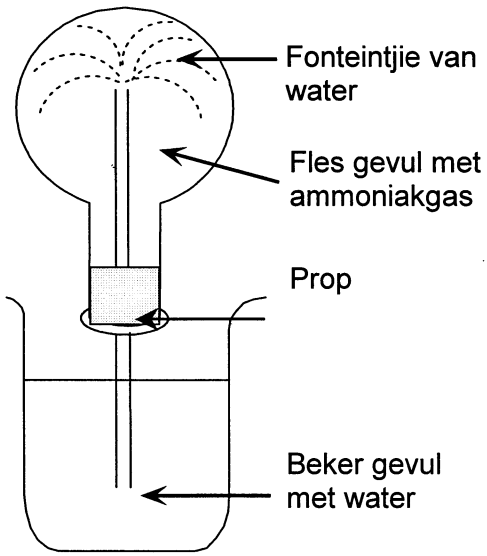
4.1.3 Skryf die **NAAM** van die produk neer wat verantwoordelik is vir die kleurverandering in VRAAG 4.1.2. (2)

4.1.4 Verduidelik, met behulp van 'n gebalanseerde vergelyking, waarom waterdruppels teen die kante van die proefbuis vorm. (4)

4.2 'n Rondebolfles word gevul met ammoniakgas.
Die fles word verseël met 'n prop waarin 'n glasbuis is.

Die fles word nou omgekeer en geplaas oor 'n beker water soos in die skets aangedui.

Daar word waargeneem dat water in die buis opstyg en 'n fontein vorm binne-in die fles.



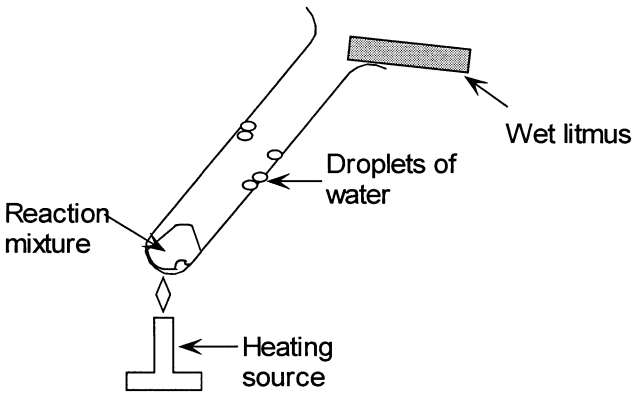
Verduidelik waarom water in die buis opstyg tot binne-in die fles. (4)
[13]

QUESTION 4 (START ON A NEW PAGE)

4.1 Equal quantities of ammonium chloride crystals and a calcium compound are mixed together and placed in a test tube.

The test tube is then heated and a piece of wet litmus paper is placed at the mouth of the test tube.

After a few seconds, a strong smell is noticed and small droplets of water form on the sides of the test tube.



4.1.1 Write the **NAME** of the calcium compound. (2)

4.1.2 Write the colour of the litmus paper after the reaction took place. (1)

4.1.3 Write the **NAME** of the product responsible for the colour change in QUESTION 4.1.2. (2)

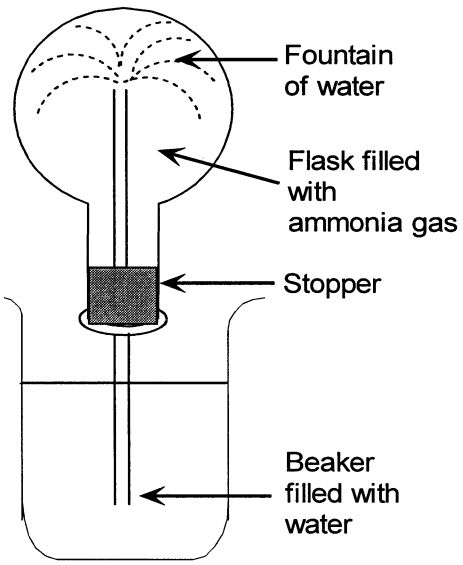
4.1.4 Explain, with the aid of a balanced equation, why water droplets form on the side of the test tube. (4)

4.2 A round bottomed flask is filled with ammonia gas.

The flask is sealed with a stopper which has a glass tube through it.

The flask is then inverted and placed over a beaker of water as shown in the sketch.

It is observed that water rises up in the tube and forms a fountain in the flask.



Explain why the water rises up the tube into the flask. (4)
[13]

VRAAG 5 (BEGIN OP 'N NUWE BLADSY)

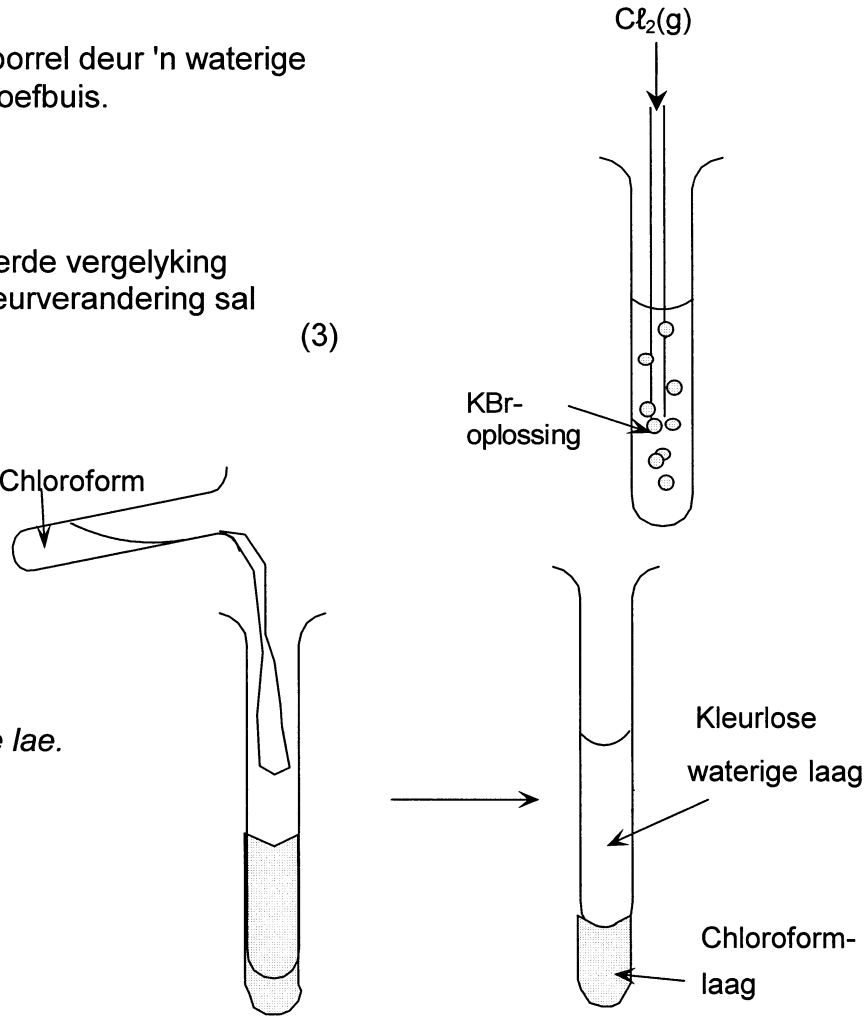
Chloorgas word in 'n skoollaboratorium berei deur gebruik te maak van kaliumpermanganaat en soutsuur.

5.1 Skryf die gebalanseerde vergelyking van hierdie reaksie neer. (4)
(Die vergelyking kan in ioniese vorm sonder toeskouer-ione gelaat word.)

5.2 Chloorgas ($C\ell_2$) word geborrel deur 'n waterige oplossing van KBr in 'n proefbuis.

Die oplossing verkleur.

5.2.1 Skryf 'n gebalanseerde vergelyking neer wat hierdie kleurverandering sal verduidelik. (3)



'n Hoeveelheid chloroform word nou by die proefbuis gevoeg.

Die proefbuis word versigtig geskud.

Die oplossing skei in twee lae.

Die waterige laag word kleurloos, terwyl die chloroform-laag verkleur.

5.2.2 Gee die **FORMULE** van die opgeloste stof in die waterige laag (boonste laag). (2)

5.2.3 Gee die **FORMULE** van die opgeloste stof in die chloroformlaag (onderste laag). (2)

5.3 'n Leerder besluit om chloor deur 'n ander metode te berei.
Sy voeg 'n hoeveelheid MnO_2 by 'n 1 mol.dm^{-3} $HC\ell$-oplossing in 'n proefbuis. Geen reaksie vind plaas nie. Gebruik die Tabel van Standaard Reduksie-potensiale en verduidelik waarom sy nie suksesvol is om chloor op hierdie manier te berei nie. (4)
[15]

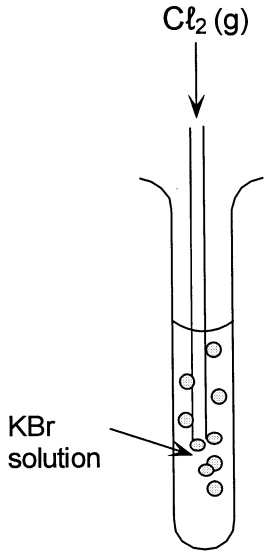
QUESTION 5 (START ON A NEW PAGE)

Chlorine gas is prepared in the school laboratory by using potassium permanganate and hydrochloric acid.

5.1 Write a balanced equation for this reaction. (4)
(The equation may be in ionic form without spectator ions.)

5.2 *Chlorine gas ($C\ell_2$) is bubbled through an aqueous solution of KBr in a test tube.*

The solution changes colour.



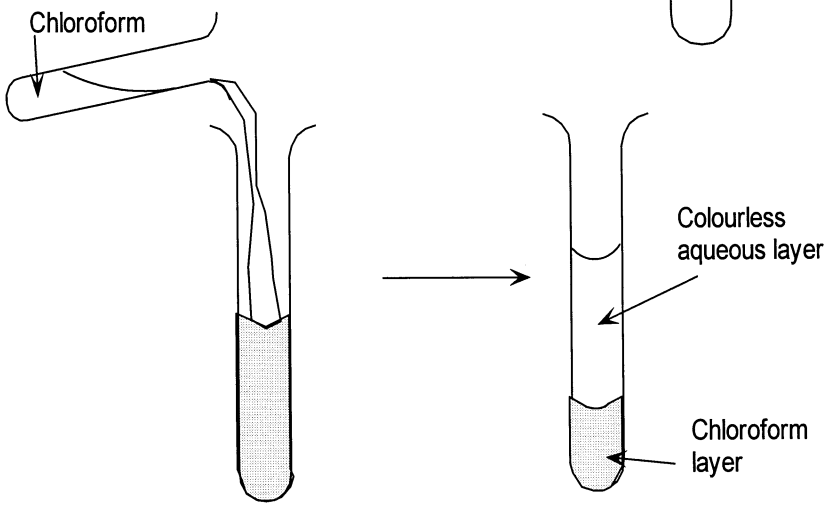
5.2.1 Write a balanced equation that will explain this colour change. (3)

Some chloroform is then added to this test tube.

The test tube is carefully shaken.

The solution separates into two layers.

The aqueous layer becomes colourless, while the chloroform layer takes on a colour.



5.2.2 Give the **FORMULA** of the solute (dissolved substance) in the aqueous layer (top layer). (2)

5.2.3 Give the **FORMULA** of the solute (dissolved substance) in the chloroform layer (bottom layer). (2)

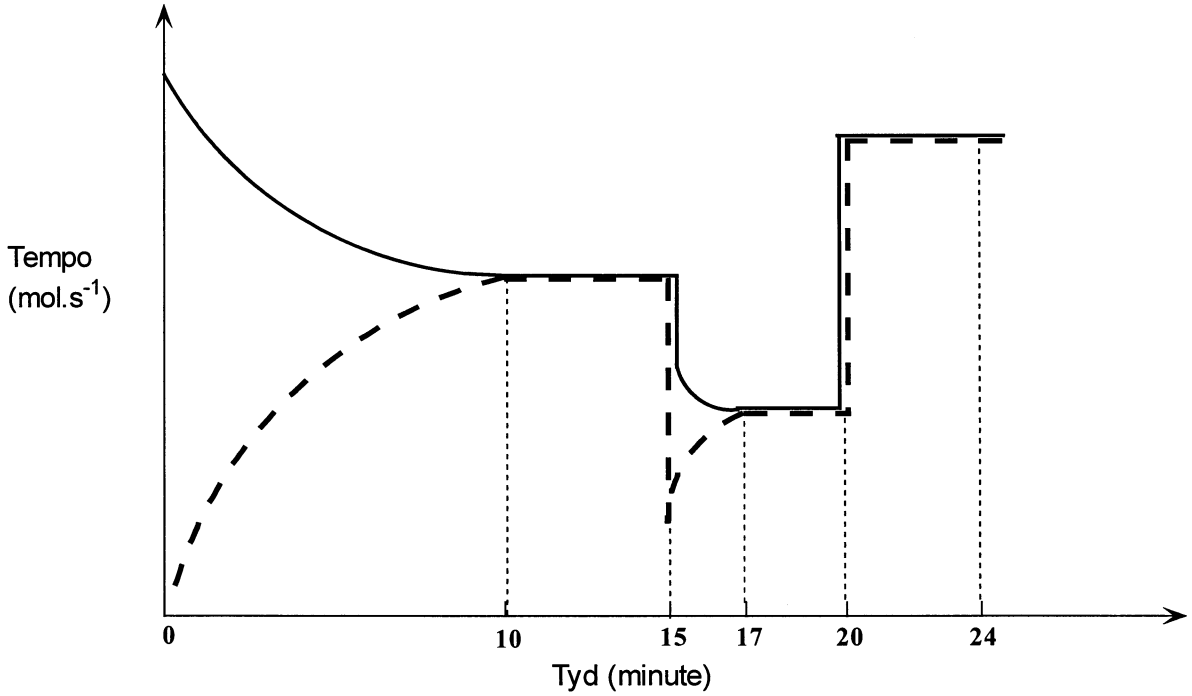
5.3 A learner decides to prepare chlorine using another method.
She takes some MnO_2 and adds it to a 1 mol.dm^{-3} $HC\ell$ solution in a test tube.
No reaction takes place. Use the Table of Standard Reduction Potentials and explain why she was not successful in preparing chlorine in this way. (4)
[15]

VRAAG 6 (BEGIN OP 'N NUWE BLADSY)

Stikstof- en suurstofgas reageer in 'n verseëlde houer volgens die volgende vergelyking:

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

Nadat die reaksie ewewig bereik het, word sekere veranderings aangebring.
Die onderstaande grafiek van reaksietempo teenoor tyd illustreer hierdie situasie.



6.1 Skryf die vergelyking neer van die reaksie wat voorgestel word deur die gebroke lyn (- -) op hierdie grafiek. (2)

6.2 Wat word voorgestel deur die gedeelte van die grafiek tussen die 10de en 15de minuut? Verduidelik jou antwoord. (3)

6.3 'n Temperatuurverandering vind plaas by t = 15 minute.

6.3.1 Was die temperatuur verhoog of verlaag by t = 15 minute? (1)

6.3.2 Verduidelik of die voorwaartse reaksie eksotermies of endotermies is. (3)

6.3.3 Watter uitwerking het hierdie temperatuurverandering op die ewewigskonstante (Kc)?
(Skryf slegs NEEM TOE, NEEM AF of GEEN UITWERKING neer.) (2)

6.4 'n Drukverandering word bewerkstellig by t = 20 minute.

6.4.1 Is die druk verhoog of verlaag? (1)

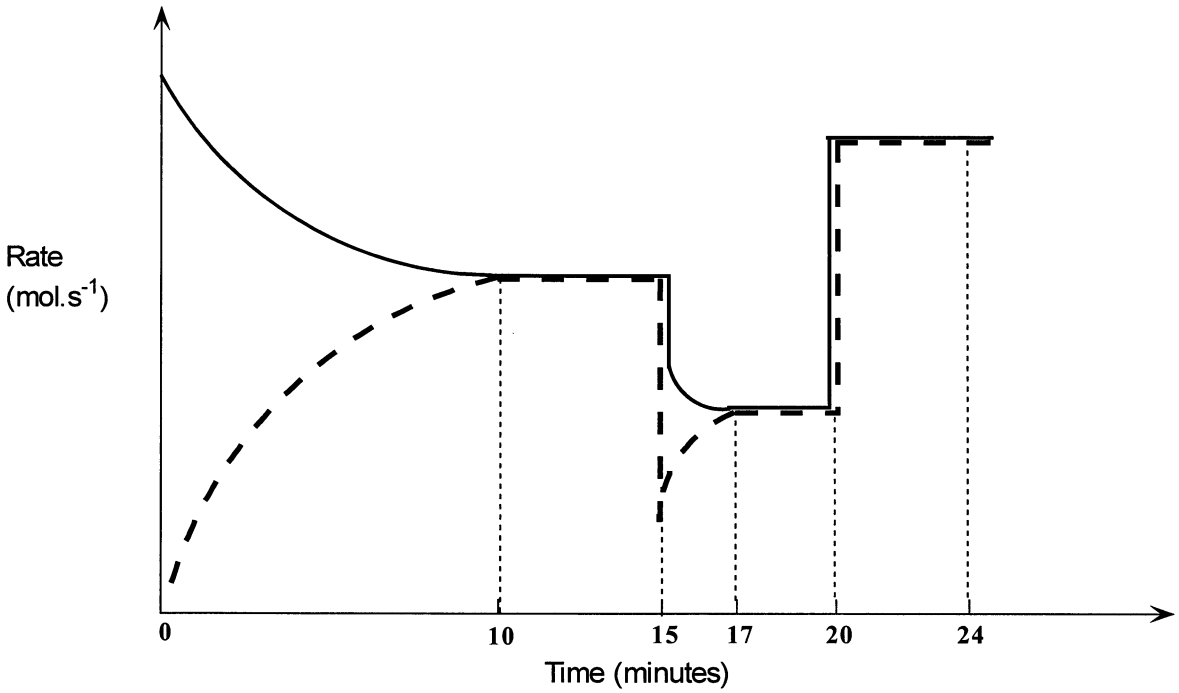
6.4.2 Verduidelik hoe hierdie verandering in druk die hoeveelheid van elke gas by ewewig beïnvloed. (3)
[15]

QUESTION 6 (START ON A NEW PAGE)

Nitrogen and oxygen gases react in a sealed container according to the following equation:

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

After the reaction reaches equilibrium, certain changes are made. The following graph of rate of reaction versus time illustrates the situation.



6.1 Write the equation of the reaction represented by the dashed line (- -) on this graph. (2)

6.2 What is represented by the section of the graph between the 10th and 15th minute? Explain your answer. (3)

6.3 A temperature change takes place at t = 15 minutes.

6.3.1 Was the temperature increased or decreased at t = 15 minutes? (1)

6.3.2 Explain whether the forward reaction is exothermic or endothermic. (3)

6.3.3 What effect does this temperature change have on the equilibrium constant (Kc)?
(Write only INCREASES, DECREASES or NO EFFECT.) (2)

6.4 A pressure change is introduced at t = 20 minutes.

6.4.1 Was the pressure increased or decreased? (1)

6.4.2 Explain how this change in pressure affects the amounts of each gas at equilibrium. (3)
[15]

VRAAG 7 (BEGIN OP 'N NUWE BLADSY)

Beskou die hipotetiese reaksie wat plaasvind tussen gasse A_2 en B in 'n geslote houer:

$$\underset{\text{kleurloos}}{A_2(g)} + \underset{\text{kleurloos}}{2B(g)} \rightleftharpoons \underset{\text{donker rooi}}{2AB(g)} \qquad \Delta H > 0$$

X mol van gas A_2 en 2,0 mol van gas B word verseël in 'n 1,0 dm^3-houer.
Na 'n paar minute word ewewig ingestel en die kleur van die inhoud van die houer verander na 'n ligte rooi kleur.

7.1 By ewewig word daar gevind dat 0,40 mol van gas AB in die houer teenwoordig is. Die waarde van K_c is 0,50.
Bepaal X, die hoeveelheid (in mol) van gas A_2 wat **oorspronklik** in die houer verseël is. (8)

7.2 'n Groter aantal mol van B word by die houer gevoeg. Sal die waarde van K_c **GROTER AS, KLEINER AS** of **GELYK AAN** 0,50 wees? (2)

7.3 Die houer en die inhoud daarvan word nou verhit. Watter uitwerking sal dit hê op die kleur van die inhoud van die houer? (2)
[12]

VRAAG 8 (BEGIN OP 'N NUWE BLADSY)

8.1 Agt gram (8,0 g) natriumhidroksied word opgelos in 350 cm^3 gedistilleerde water. 15 cm^3 van hierdie oplossing neutraliseer 20 cm^3 van 'n swawelsuur-oplossing.

Die gebalanseerde vergelyking van hierdie reaksie is:

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(\ell)$$

Bereken die konsentrasie van die swawelsuur-oplossing. (7)

8.2 'n Omgewingsramp bedreig die dorpie Bafanaville. Daar was 'n groot storting van gekonsentreerde soutsuur ($HC\ell$) in die dorp se enigste opgaardam.
Die pH van die water het verlaag na 4.

8.2.1 Verduidelik, met behulp van 'n chemiese vergelyking, waarom die pH van die water verlaag het. (4)

Die Munisipaliteit besluit om hoeveelhede natriumkarbonaat (Na_2CO_3) by die dam se water te voeg in die hoop dat die pH sal herstel tot 'n waarde naby aan 7.

8.2.2 Bereken die massa natriumkarbonaat (Na_2CO_3) wat benodig word om elke 1 dm^3 van die suur damwater te neutraliseer. (9)

8.2.3 Benewens neutralisasie, watter ander uitwerking sal die byvoeging van die Na_2CO_3 hê op die water in die dam? (2)
[22]

QUESTION 7 (START ON A NEW PAGE)

Consider the hypothetical reaction that takes place between gases A_2 and B in a closed container:

$$\underset{\text{colourless}}{A_2(g)} + \underset{\text{colourless}}{2B(g)} \rightleftharpoons \underset{\text{dark red}}{2AB(g)} \qquad \Delta H > 0$$

X mol of gas A_2 and 2,0 mol of gas B are sealed in a 1,0 dm^3 container. After a few minutes equilibrium is established and the contents of the container turns light red.

7.1 At equilibrium it is found that 0,40 mol of gas AB is present in the container. The value of K_c is 0,50.
Determine X, the quantity (in mol) of gas A_2 that was **originally** sealed in the container. (8)

7.2 More moles of B are added to the container. Will the value of K_c be **GREATER THAN**, **LESS THAN** or **EQUAL** to 0,50? (2)

7.3 The container and its contents are now heated. What effect will this have on the colour of the contents of the container? (2)
[12]

QUESTION 8 (START ON A NEW PAGE)

8.1 Eight grams (8,0 g) of sodium hydroxide are dissolved in 350 cm^3 of distilled water. 15 cm^3 of this solution neutralises 20 cm^3 of a sulphuric acid solution.

The balanced equation for this reaction is:

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(\ell)$$

Calculate the concentration of the sulphuric acid solution. (7)

8.2 An environmental disaster threatens the small town of Bafanaville. There has been a large spillage of concentrated hydrochloric acid (HCℓ) into the town's only water storage dam.
The pH of the water has decreased to 4.

8.2.1 Explain, with the aid of a chemical equation, why the pH of the dam water decreased. (4)

The Municipality decides to add quantities of soda ash (Na_2CO_3) to the water of the dam, hoping that the pH will be restored to a value close to 7.

8.2.2 Calculate the mass of soda ash (Na_2CO_3) required to neutralise each 1 dm^3 of the acidified dam water. (9)

8.2.3 Besides neutralisation, what other effect will the addition of the Na_2CO_3 have on the water in the dam? (2)
[22]

VRAAG 9 (BEGIN OP 'N NUWE BLADSY)

9.1 'n Standaard elektrochemiese sel word opgestel deur van die volgende halfreaksies gebruik te maak:

$$Ce^{3+} + 3e^- \rightarrow Ce \qquad E^o = -2,30\ V$$

$$Pd^{2+} + 2e^- \rightarrow Pd \qquad E^o = +0,99\ V$$

9.1.1 Skryf die oksidasie-halfreaksie van hierdie sel neer. (2)

9.1.2 Skryf die gebalanseerde vergelyking neer van die netto totale selreaksie. (3)

9.1.3 Bereken die emk van hierdie sel. (4)

9.2 Metale A, B en C kan slegs divalente ione (ione met 'n valensie van 2) vorm.

Metaal A kan B^{2+}-ione uit oplossings daarvan verplaas.

Metaal C kan A^{2+}-ione uit oplossings daarvan verplaas.

9.2.1 Watter EEN van die drie ione is die sterkste oksideermiddel? (2)

9.2.2 Watter TWEE van die metale sal jy gebruik om 'n standaard elektrochemiese sel op te stel wat die hoogste potensiaalverskil sal hê? (2)
[13]

QUESTION 9 (START ON A NEW PAGE)

9.1 A standard electrochemical cell is set up using the following half-reactions:

$$Ce^{3+} + 3e^- \rightarrow Ce \qquad E^\circ = -2{,}30\ V$$

$$Pd^{2+} + 2e^- \rightarrow Pd \qquad E^\circ = +0{,}99\ V$$

9.1.1 Write the oxidation half-reaction for this cell. (2)

9.1.2 Write the balanced equation for the nett overall cell reaction. (3)

9.1.3 Calculate the emf of this cell. (4)

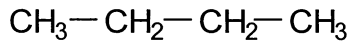
9.2 Metals A, B and C form only divalent ions (ions with a valency of 2).
Metal A can displace B^{2+} ions from its aqueous solutions.
Metal C can displace A^{2+} ions from its aqueous solutions.

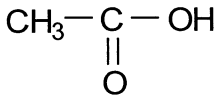
9.2.1 Which ONE of the three ions is the strongest oxidising agent? (2)

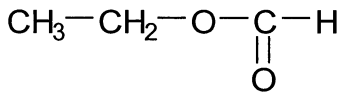
9.2.2 Which TWO of the metals would you use to construct a standard electrochemical cell with the highest potential difference? (2)
[13]

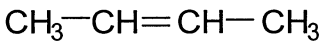
VRAAG 10 (BEGIN OP 'N NUWE BLADSY)

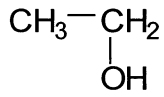
10.1 Beskou die volgende lys organiese verbindings:

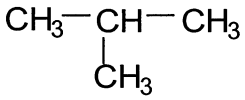
A: 

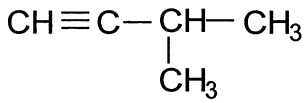
B: 

C: 

D: 

E: 

F: 

G: 

10.1.1 Deur van STRUKTUURFORMULES gebruik te maak, skryf 'n vergelyking neer vir die bereiding van 'n ester. Kies die reaktanse uit die bostaande lys. (4)

10.1.2 Skryf die letters neer van TWEE verbindings in die lys wat isomere is van mekaar. (2)

10.1.3 Skryf die IUPAC-naam van verbinding C neer. (2)

10.1.4 Skryf die IUPAC-naam van verbinding D neer. (2)

10.2 'n Bottel wyn, wat etanol bevat, word oopgemaak en vir 'n paar dae laat staan. Na 'n tyd begin dit suur word en ruik soos asyn. 'n Chemiese reaksie het plaasgevind.

10.2.1 Is hierdie 'n ADDISIE-, OKSIDASIE-, SUUR-BASIS- of ESTERIFIKASIE-reaksie? (2)

10.2.2 Gee die IUPAC-naam en STRUKTUURFORMULE van die produk wat verantwoordelik is vir die reuk. (4)
[16]

TOTAAL: 200

QUESTION 10 (START ON A NEW PAGE)

10.1 Consider the following list of organic compounds:

A: $CH_3-CH_2-CH_2-CH_3$

B: $CH_3-\underset{\underset{O}{\|}}{C}-OH$

C: $CH_3-CH_2-O-\underset{\underset{O}{\|}}{C}-H$

D: $CH_3-CH=CH-CH_3$

E: $CH_3-\underset{\underset{OH}{|}}{CH_2}$

F: $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$

G: $CH\equiv C-\underset{\underset{CH_3}{|}}{CH}-CH_3$

10.1.1 Using STRUCTURAL FORMULAE, write an equation for the preparation of an ester. Choose the reactants from the above list. (4)

10.1.2 Write the letters representing TWO compounds in this list that are isomers of each other. (2)

10.1.3 Write the IUPAC name of compound C. (2)

10.1.4 Write the IUPAC name of compound D. (2)

10.2 A bottle of wine, which contains ethanol, is opened and left to stand for a few days. After a while it begins to turn sour, and to smell like vinegar. A chemical reaction has taken place.

10.2.1 Is this reaction an ADDITION, OXIDATION, ACID-BASE or ESTERIFICATION reaction? (2)

10.2.2 Give the IUPAC name and STRUCTURAL FORMULA of the product responsible for the smell. (4)

[16]

TOTAL: 200

SENIOR SERTIFIKAAT-EKSAMEN - MAART 2005

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)

TABEL 1: FISIESE KONSTANTE
TABLE 1: PHYSICAL CONSTANTS

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

TABEL 2: FORMULES
TABLE 2: FORMULAE

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

SENIOR CERTIFICATE EXAMINATION - MARCH 2005

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SENIORSERTIFIKAAT-EKSAMEN

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Molêre gasvolume by STD Molar gas volume at STP	V_m	22,4 $dm^3.mol^{-1}$
Standaardtemperatuur Standard temperature	T^θ	273 K

TABEL 2: FORMULES

TABLE 2: FORMULAE

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

SENIORSERTIFIKAAT-EKSAMEN - MAART 2005

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TALE 3: THE PERIODIC TABLE OF ELEMENTS

SLEUTEL / KEY

Atoomgetal
Atomic number

Elektronegatiwiteit
Electronegativity

Simbool
Symbol

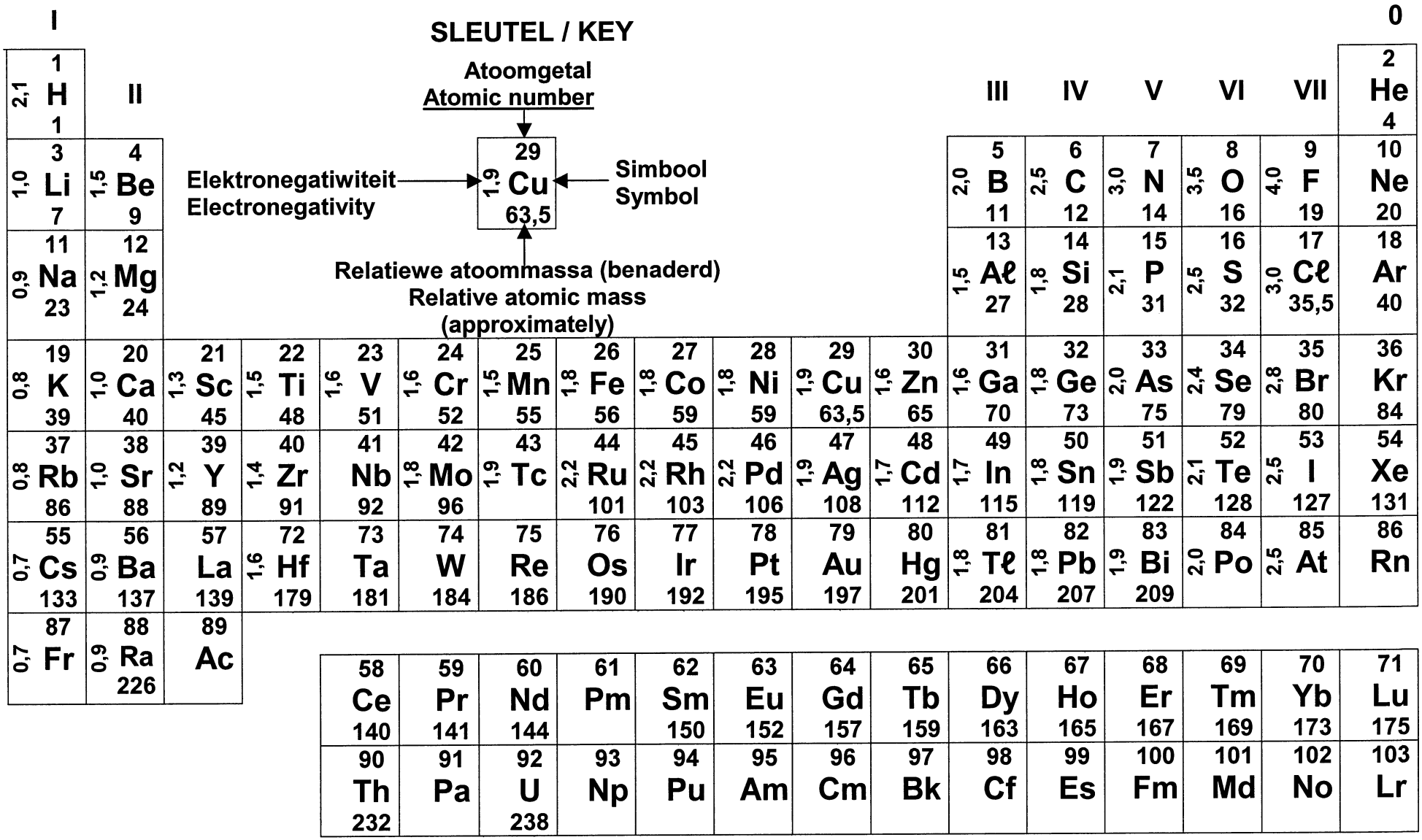
Relatiewe atoommassa (benaderd)
Relative atomic mass
(approximately)

I	II	III	IV	V	VI	VII	0
2,1 H 1							He 4
1,0 Li 7	1,5 Be 9	2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	Ne 20
0,9 Na 23	1,2 Mg 24	1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101
0,7 Cs 133	0,9 Ba 137	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190
0,7 Fr	0,9 Ra 226	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

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 3: THE PERIODIC TABLE OF ELEMENTS



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

Increasing oxidising ability / Toenemende oksideervermoë ↑

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
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2\,H_2O$	+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
$2H^+ + 2e^- \rightleftharpoons H_2$	**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 reducing ability / Toenemende reduseervermoë ↓

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

Increasing oxidising ability / Toenemende oksideervermoë ↑

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
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2\ H_2O$	+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 reducing ability / Toenemende reduseervermoë ↓

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

Increasing oxidising ability / Toenemende oksideervermoë ↓

Halfreaksie / Half-reaction	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

↑ Increasing reducing ability / Toenemende reduseervermoë

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

Increasing oxidising ability / Toenemende oksideervermoë ↓

↑ Increasing reducing ability / Toenemende reduseervermoë

Halfreaksie / Half-reaction	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
$\mathbf{2H^+ + 2e^- \rightleftharpoons H_2}$	**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