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

STANDARD GRADE
STANDAARDGRAAD

OCTOBER/NOVEMBER 2004
OKTOBER/NOVEMBER 2004

304-2/2

Marks: 150
Punte : 150

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 SG: Paper 2
Chemistry

304 2 2 SG

10 YEARS OF FREEDOM
south africa 1994 - 2004

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 antwoordboek 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.

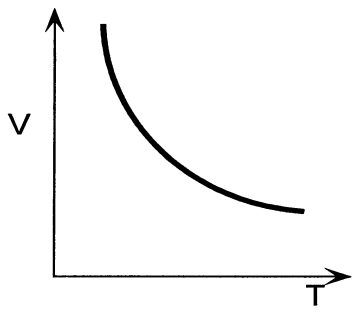
ANSWER:

A	B	C	D

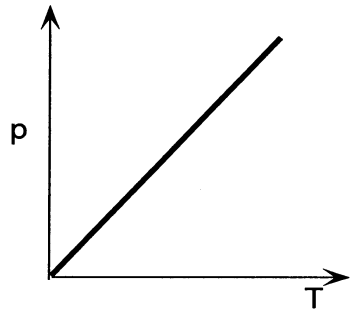
1.1 In grafiet word die atome bymekaar gehou deur ...

A ioniese bindings.
B metaalbindings.
C kovalente bindings.
D waterstofbindings. (3)

1.2 Watter EEN van die volgende grafieke toon 'n korrekte verwantskap vir 'n ideale gas?



A



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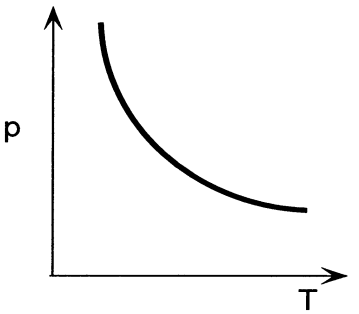
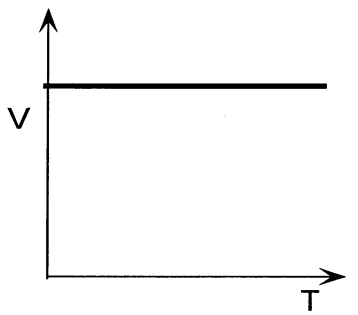


C



D

(3)

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

A Ammoniak en swawelsuur
B Natriumnitraat en ammoniak
C Natriumnitraat en swawelsuur
D Natriumhidroksied en ammoniumnitraat (3)

1.1 In graphite, the atoms are held together by …

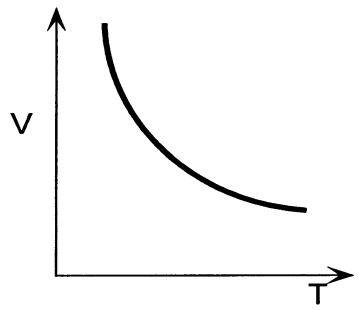
A ionic bonds.

B metallic bonds.

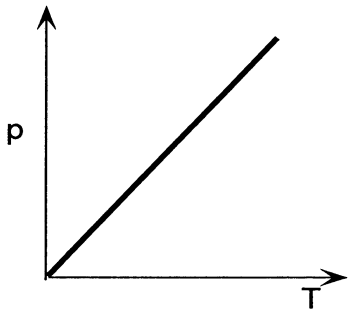
C covalent bonds.

D hydrogen bonds. (3)

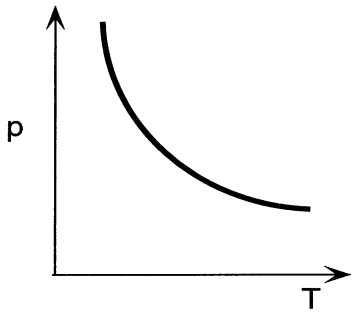
1.2 Which ONE of the following graphs shows a correct relationship for an ideal gas?



A



B



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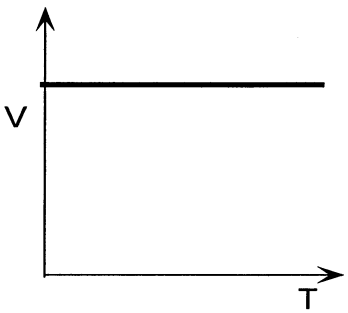


D

(3)

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

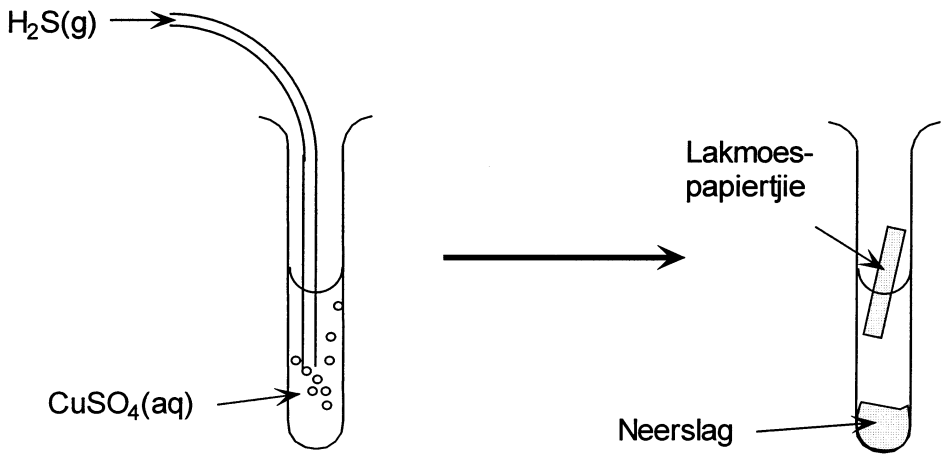
A Ammonia and sulphuric acid

B Sodium nitrate and ammonia

C Sodium nitrate and sulphuric acid

D Sodium hydroxide and ammonium nitrate (3)

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

(3)

1.5 In watter EEN van die volgende reaksies word HCℓ geoksideer?

A $HC\ell + H_2O \rightarrow H_3O^+ + C\ell^-$

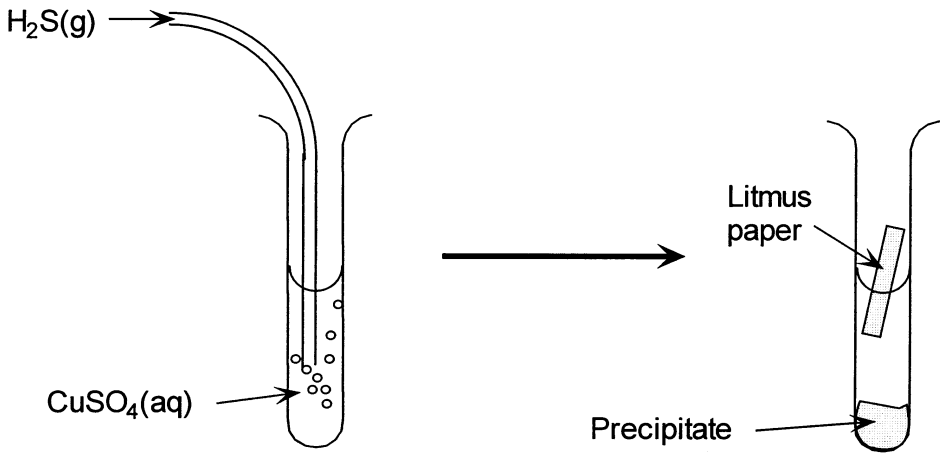
B $CaCO_3 + 2HC\ell \rightarrow CaC\ell_2 + H_2O + CO_2$

C $NH_3 + HC\ell \rightarrow NH_4C\ell$

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

(3)

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

(3)

1.5 In which ONE of the following reactions is $HC\ell$ oxidised?

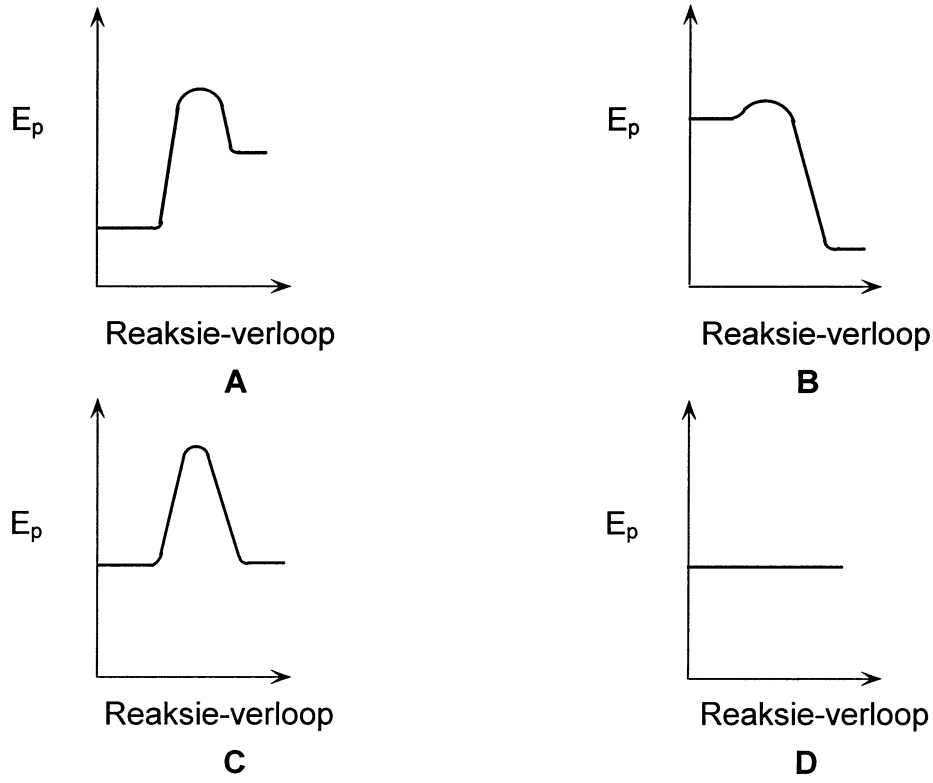
A $HC\ell + H_2O \rightarrow H_3O^+ + C\ell^-$

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

C $NH_3 + HC\ell \rightarrow NH_4C\ell$

D $MnO_2 + 4HC\ell \rightarrow MnC\ell_2 + 2H_2O + C\ell_2$ (3)

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 tydens hierdie reaksie plaasvind?



(3)

1.7 Wanneer 'n chemiese sisteem in dinamiese ewewig verkeer, impliseer dit dat …

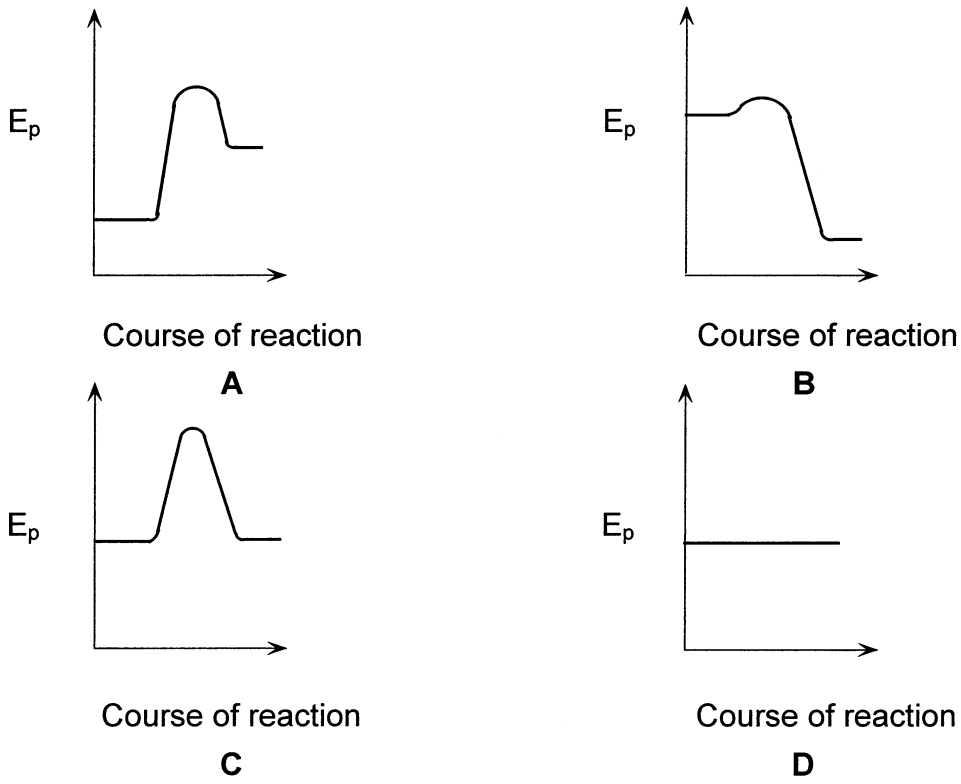
A die reaksie gestop het.

B die massa van die produkte gelyk is aan die massa van die reaktanse.

C die konsentrasie van die produkte gelyk is aan die konsentrasie van die reaktanse.

D die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (3)

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



(3)

1.7 When a chemical system is in a state of dynamic equilibrium, it implies that ...

A the reaction has stopped.

B the mass of the products is equal to the mass of the reactants.

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

D the rate of the forward reaction is equal to the rate of the reverse reaction. (3)

1.8 Beskou die volgende omkeerbare reaksie wat plaasvind wanneer 'n versadigde oplossing van kopersulfaat ($CuSO_4$) berei word:

$$Cu^{2+}(aq) + SO_4^{2-}(aq) \rightleftharpoons CuSO_4(s) \qquad \Delta H < 0$$

Wat kan gedoen word om 'n neerslag van $CuSO_4$ te verkry?

A Verhit die oplossing.

B Voeg kopermetaal as 'n katalisator by.

C Verhoog die druk op die sisteem.

D Voeg gekonsentreerde swawelsuur (H_2SO_4) by. (3)

1.9 'n Gekonjugeerde suur-basispaar in die reaksie

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

is:

A H_3O^+ en H_2O

B H_2SO_4 en H_3O^+

C HSO_4^- en H_3O^+

D HSO_4^- en H_2O (3)

1.10 Watter EEN van die volgende 0,1 $mol.dm^{-3}$-oplossings sal die laagste waterstofioonkonsentrasie [H^+] hê?

A $HC\ell(aq)$

B $KOH(aq)$

C $H_2SO_4(aq)$

D $CH_3COOH(aq)$ (3)

1.8 Consider the following reversible reaction that takes place when a saturated solution of copper sulphate ($CuSO_4$) is prepared:

$$Cu^{2+}(aq) + SO_4^{2-}(aq) \rightleftharpoons CuSO_4(s) \qquad \Delta H < 0$$

What can be done to obtain a precipitate of $CuSO_4$?

A Heat the solution.

B Add copper metal as a catalyst.

C Increase the pressure on the system.

D Add concentrated sulphuric acid (H_2SO_4). (3)

1.9 A conjugate acid-base pair in the reaction

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

is:

A H_3O^+ and H_2O

B H_2SO_4 and H_3O^+

C HSO_4^- and H_3O^+

D HSO_4^- and H_2O (3)

1.10 Which ONE of the following 0,1 $mol.dm^{-3}$ solutions will have the lowest hydrogen ion $[H^+]$ concentration?

A $HC\ell(aq)$

B $KOH(aq)$

C $H_2SO_4(aq)$

D $CH_3COOH(aq)$ (3)

1.11 Beskou die reaksie wat voorgestel word deur die volgende vergelyking:

$$C\ell_2(aq) + 2Br^-(aq) \rightarrow 2C\ell^-(aq) + Br_2(aq)$$

Watter EEN van die volgende stellings rakende hierdie reaksie is WAAR?

A Chloor word geoksideer.

B Die bromied-ioon word gereduseer.

C Chloor is die oksideermiddel.

D Die bromied-ioon is die oksideermiddel. (3)

1.12 Watter EEN van die volgende reaksies is 'n redoksreaksie?

A $2Mg + SO_2 \rightarrow 2MgO + S$

B $H_2S + Pb(CH_3COO)_2 \rightarrow PbS + 2CH_3COOH$

C $H_2S + CuSO_4 \rightarrow CuS + H_2SO_4$

D $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ (3)

1.13 Watter EEN van die volgende stellings rakende 'n standaard sink-koper-elektrochemiese sel is WAAR?

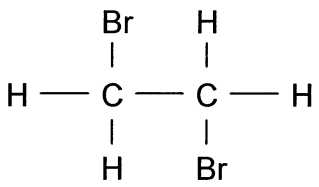
A Die massa van die anode neem toe.

B Die massa van die koper-elektrode neem toe.

C 'n Elektronstroom sal deur die soutbrug vloei.

D Elektrone vloei vanaf die katode na die anode in die eksterne stroombaan. (3)

1.14 Wat is die IUPAC-naam van die onderstaande verbinding?



A 1,2-dibroometaan

B 1,2-dibroometeen

C broometeen

D broometaan (3)

1.11 Consider the reaction represented by the following equation:

$C\ell_2(aq) + 2Br^-(aq) \rightarrow 2C\ell^-(aq) + Br_2(aq)$

Which ONE of the following statements about this reaction is TRUE?

A Chlorine is oxidised.

B The bromide ion is reduced.

C Chlorine is the oxidising agent.

D The bromide ion is the oxidising agent. (3)

1.12 Which ONE of the following reactions is a redox reaction?

A $2Mg + SO_2 \rightarrow 2MgO + S$

B $H_2S + Pb(CH_3COO)_2 \rightarrow PbS + 2CH_3COOH$

C $H_2S + CuSO_4 \rightarrow CuS + H_2SO_4$

D $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ (3)

1.13 Which ONE of the following statements concerning a standard zinc-copper electrochemical cell is TRUE?

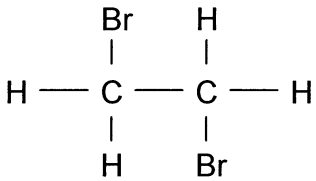
A The mass of the anode increases.

B The mass of the copper electrode increases.

C An electron current will flow through the salt bridge.

D Electrons flow from cathode to anode in the external circuit. (3)

1.14 What is the IUPAC name of the compound below?



A 1,2-dibromoethane

B 1,2-dibromoethene

C bromoethene

D bromoethane (3)

1.15 Beskou die volgende tabel van organiese verbindings met hul onderskeie kookpunte:

VERBINDING	KOOKPUNT (K)
CH_4	109
C_2H_6	184
C_3H_8	231
C_4H_{10}	273

Watter stelling is WAAR?

As in hierdie tabel afgegaan word, is die toename in kookpunt as gevolg van ...

A 'n afname in molekulêre massa.

B 'n toename in die sterkte van die koolstof-koolstofbindings.

C 'n toename in die sterkte van die koolstof-waterstofbindings.

D 'n toename in die sterkte van die intermolekulêre kragte. (3)

[45]

1.15 Consider the following table of organic compounds with their respective boiling points:

COMPOUND	BOILING POINT (K)
CH_4	109
C_2H_6	184
C_3H_8	231
C_4H_{10}	273

Which statement is TRUE?

Moving down this table, the increase in boiling point is due to ...

A a decrease in molecular mass.

B an increase in the strength of the carbon–carbon bonds.

C an increase in the strength of the carbon–hydrogen bonds.

D an increase in the strength of the intermolecular forces. (3)

[45]

BEANTWOORD VRAAG 2 – 8 IN DIE ANTWOORDEBOEK.

INSTRUKSIES

1. Begin elke vraag op 'n nuwe bladsy in jou antwoordeboek.

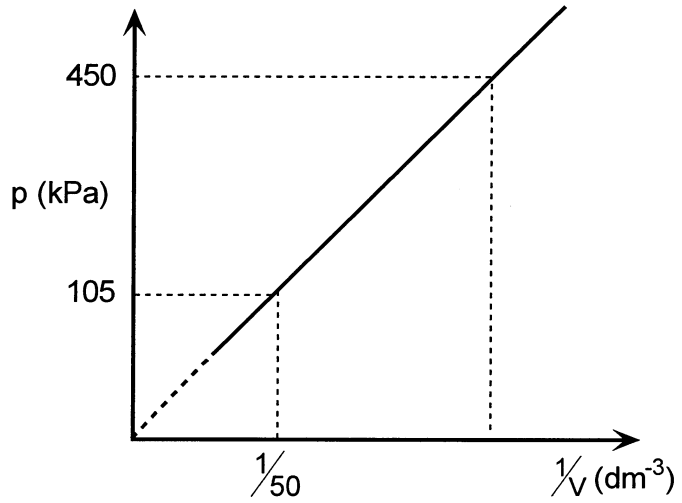
2. Laat 'n reël oop tussen onderafdelings, byvoorbeeld tussen VRAAG 2.1 en 2.2.

3. Verskaf alle formules wat gebruik word en wys jou bewerkings (dit sluit substitusies in).

4. Nommer jou antwoorde soos wat die vrae genommer is.

VRAAG 2

2.1 Die onderstaande grafiek toon die verwantskap tussen die druk (p) en die resiprook van die volume ($\frac{1}{V}$) van 'n ingeslote massa ammoniakgas (NH_3) by kamertemperatuur aan.



2.1.1 Skryf die naam van die wet wat deur die grafiek voorgestel word. (2)

2.1.2 Formuleer (skryf in woorde) die wet genoem in VRAAG 2.1.1. (3)

2.1.3 Bereken die volume NH_3-gas by 'n druk van 450 kPa. (4)

Die eksperiment word herhaal met baie hoë drukwaardes.

2.1.4 Sal die verwantskap tussen p en V dieselfde wees as dié voorgestel deur die grafiek hierbo? (Antwoord **JA** of **NEE**) (1)

2.1.5 Gee 'n rede vir die antwoord op VRAAG 2.1.4. (2)

2.1.6 Noem die intermolekulêre kragte wat in vloeibare ammoniak teenwoordig is. (2)

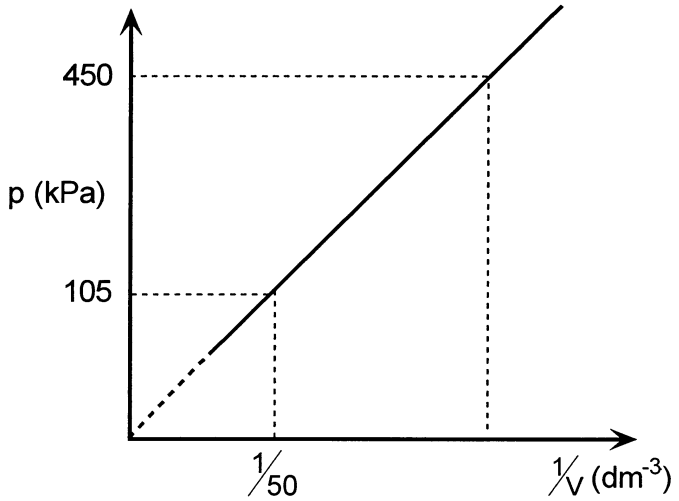
ANSWER QUESTIONS 2 – 8 IN THE ANSWER BOOK.

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 working (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

QUESTION 2

2.1 The graph below indicates the relationship between the pressure (p) and the reciprocal of the volume ($\frac{1}{V}$) of an enclosed mass of ammonia gas (NH_3) at room temperature.



2.1.1 Write the name of the law that the graph illustrates. (2)

2.1.2 State, in words, the law named in QUESTION 2.1.1. (3)

2.1.3 Calculate the volume of NH_3 gas at a pressure of 450 kPa. (4)

The experiment is repeated at very high pressure values.

2.1.4 Will the relationship between p and V be the same as that illustrated by the graph above? (Answer **YES** or **NO**) (1)

2.1.5 Give a reason for the answer to QUESTION 2.1.4. (2)

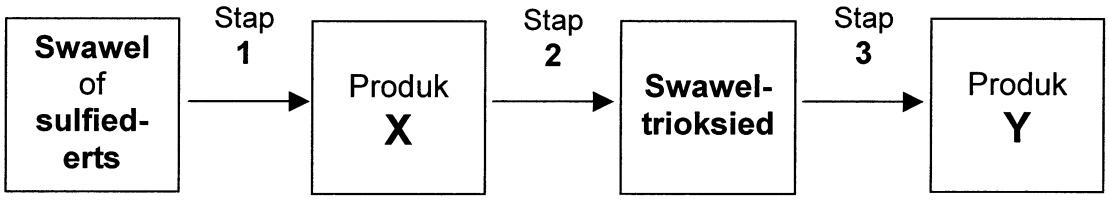
2.1.6 Name the intermolecular forces that exist in liquid ammonia. (2)

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

Bereken die konsentrasie van die **nitraat-ione** in die oplossing. (4)
[18]

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 van Stap 2 in die proses. (3)

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

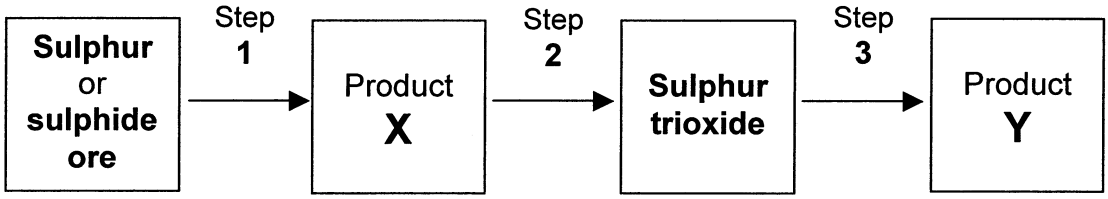
3.2 Skryf 'n gebalanseerde chemiese vergelyking waarin $SO_2(g)$ optree as 'n oksideermiddel met 'n ander verbinding wat swawel bevat. (3)
[12]

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

Calculate the concentration of the **nitrate ions** in the solution. (4)
[18]

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. (3)

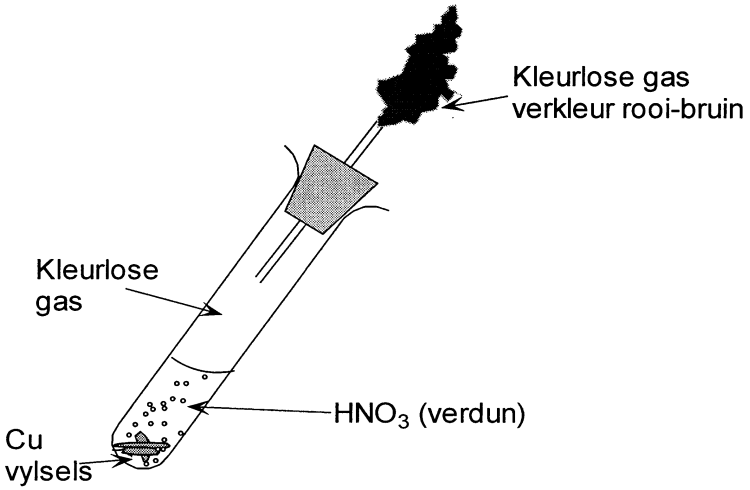
3.1.4 Write the **FORMULA** of **Y**, the final product of the process. (2)

3.2 Write a balanced chemical equation in which $SO_2(g)$ acts as an oxidising agent with another sulphur containing compound. (3)
[12]

VRAAG 4 (Begin op 'n nuwe bladsy)

'n Oormaat verdunde salpetersuur (HNO_3) word gevoeg by kopervylsels (Cu) in 'n proefbuis.

'n Kleurlose gas vorm, wat rooi-bruin verkleur wanneer dit met lug in aanraking kom.



4.1 Maak gebruik van die Tabel van Standaard Reduksiepotensiale en skryf die vergelyking vir die reduksie-halfreaksie wat plaasvind in die proefbuis. (2)

4.2 Skryf die **NAAM** van die kleurlose gas. (2)

4.3 Skryf die gebalanseerde vergelyking vir die vorming van die rooi-bruin gas. (3)

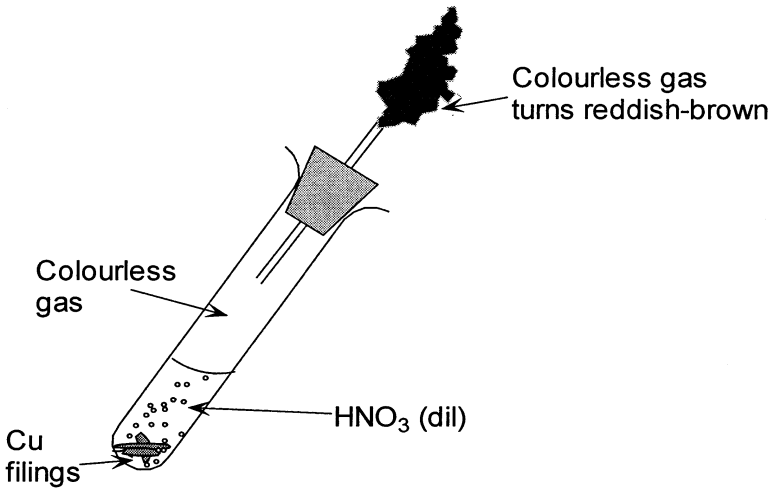
Soos wat die reaksie verloop, verkleur die oplossing in die proefbuis na ligblou.

4.4 Skryf die **FORMULE** van die ioon wat verantwoordelik is vir die ligblou kleur van die oplossing. (2)
[9]

QUESTION 4 (Start on a new page)

An excess of dilute nitric acid (HNO_3) is added to some copper (Cu) filings in a test tube.

A colourless gas is formed, which turns reddish-brown when it comes into contact with air.



4.1 Using the Table of Standard Reduction Potentials, write the equation for the reduction half-reaction that takes place in the test tube. (2)

4.2 Write the **NAME** of the colourless gas. (2)

4.3 Write the balanced equation for the formation of the reddish-brown gas. (3)

As the reaction proceeds, the solution in the test tube turns light blue in colour.

4.4 Write the **FORMULA** of the ion that is responsible for the light blue colour of the solution. (2)
[9]

VRAAG 5 (Begin op 'n nuwe bladsy)

5.1 Sharon voer 'n eksperiment uit om ondersoek in te stel na die faktore wat 'n invloed het op die tempo van chemiese reaksies.

Deur telkens **dieselfde massa** sink te gebruik, herhaal Sharon die eksperiment onder verskillende toestande.

Die volgende tabel is 'n opsomming van die verskillende eksperimentele toestande vir vier van haar eksperimente:

Eksperiment	Konsentrasie HCℓ ($mol.dm^{-3}$)	Temperatuur van HCℓ (°C)	Toestand van Zn
A	2	25	korrels
B	2	15	korrels
C	1	25	korrels
D	2	25	poeier

Vergelyk die tempo's van eksperimente B tot D met die tempo van eksperiment A deur die onderstaande tabel te voltooi.

Dui ook die faktor aan wat verantwoordelik is vir die verandering in die tempo van die reaksie.

Skryf SLEGS die vraagnommer en die korrekte antwoord in jou antwoordeboek.

EKSPERIMENT	**TEMPO (Vinniger, Stadiger, Dieselfde)**	**FAKTOR wat die tempo van die reaksie beïnvloed**
B	Stadiger	5.1.1
C	5.1.2	Konsentrasie HCℓ
D	5.1.3	5.1.4

(8)

QUESTION 5 (Start on a new page)

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

Using the **same mass of** zinc each time, Sharon repeats the experiment under different conditions.

The following table summarises the different experimental conditions for four of her experiments:

Experiment	Concentration of HCℓ ($mol.dm^{-3}$)	Temperature of HCℓ (°C)	State of Zn
A	2	25	granules
B	2	15	granules
C	1	25	granules
D	2	25	powder

Compare the rates of experiments B to D with the rate of experiment A by completing the table below.

Also indicate the factor that is responsible for the change in the rate of reaction.

Write in your answer book ONLY the question number and the correct answer.

EXPERIMENT	**RATE (Faster, Slower, Same)**	**FACTOR affecting the rate of reaction**
B	Slower	5.1.1
C	5.1.2	Concentration of HCℓ
D	5.1.3	5.1.4

(8)

5.2 'n Paar druppels Fe^{3+}-oplossing word gevoeg by 'n verdunde, kleurlose oplossing van kaliumtiosianaat (KCNS). Die volgende ewewig word ingestel:

$$\underset{\text{geel}}{Fe^{3+}(aq)} + \underset{\text{kleurloos}}{CNS^{-}(aq)} \rightleftharpoons \underset{\text{rooi}}{Fe(CNS)^{2+}(aq)} \qquad \Delta H > 0$$

5.2.1 Is die voorwaartse reaksie eksotermies of endotermies? (1)

Die oplossing word nou afgekoel.

5.2.2 Wat sal die kleur van die oplossing nou wees? (2)

5.2.3 Sal die tempo van die terugwaartse reaksie **TOENEEM, AFNEEM** of **DIESELFDE BLY** terwyl die oplossing afgekoel word? (2)

Vir VRAAG 5.2.4 – 5.2.6, skryf slegs **NEEM TOE, NEEM AF** of **BLY DIESELFDE.**

5.2.4 Watter invloed sal die byvoeging van 'n geskikte katalisator hê op die ewewigskonsentrasie van $Fe(CNS)^{2+}$? (2)

5.2.5 Meer CNS^{-} word by die oplossing gevoeg. Hoe sal dit die ewewigskonsentrasie van $Fe(CNS)^{2+}$ beïnvloed? (2)

5.2.6 Die druk op die sisteem word nou verhoog sonder om die temperatuur te verander. Hoe sal dit die ewewigskonsentrasie van Fe^{3+} beïnvloed? (2)
[19]

5.2 A few drops of a Fe^{3+} solution are added to a dilute, colourless solution of potassium thiocyanate (KCNS). The following equilibrium is established:

$$Fe^{3+}(aq) + CNS^{-}(aq) \rightleftharpoons Fe(CNS)^{2+}(aq) \quad \Delta H > 0$$
yellow colourless red

5.2.1 Is the forward reaction exothermic or endothermic? (1)

The solution is now cooled down.

5.2.2 What will be the colour of the solution now? (2)

5.2.3 Will the rate of the reverse reaction **INCREASE**, **DECREASE** or **STAY THE SAME**, as the solution is cooled down? (2)

*For QUESTIONS 5.2.4 – 5.2.6, write only **INCREASES**, **DECREASES** or **STAYS THE SAME**.*

5.2.4 What effect does adding a suitable catalyst have on the equilibrium concentration of $Fe(CNS)^{2+}$? (2)

5.2.5 More CNS^{-} is added to the solution. How will this affect the equilibrium concentration of $Fe(CNS)^{2+}$? (2)

5.2.6 The pressure of the system is now increased without changing the temperature. How will this affect the equilibrium concentration of Fe^{3+}? (2)
[19]

VRAAG 6 (Begin op 'n nuwe bladsy)

'n Leerder gebruik 'n standaard natriumwaterstofkarbonaat ($NaHCO_3$)-oplossing om die konsentrasie van 'n swawelsuur (H_2SO_4)-oplossing te bepaal.

6.1 Skryf die definisie van 'n standaardoplossing. (2)

6.2 Waarom word H_2SO_4 as 'n sterk suur beskou? (2)

6.3 Skryf 'n gebalanseerde vergelyking van die reaksie van H_2SO_4 met water. (3)

Tydens 'n titrasie vind 'n leerder dat 20 cm^3 van 'n 0,2 $mol.dm^{-3}$ natriumwaterstof-karbonaat-oplossing 12 cm^3 van die swawelsuuroplossing neutraliseer.
Die gebalanseerde vergelyking van hierdie reaksie is:

$$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$$

6.4 Hoeveel mol $NaHCO_3$ is teenwoordig in 20 cm^3 van die 0,2 $mol.dm^{-3}$ $NaHCO_3$-oplossing? (3)

6.5 Bepaal die aantal mol H_2SO_4 wat geneutraliseer word deur 20 cm^3 van die 0,2 $mol.dm^{-3}$ $NaHCO_3$-oplossing. (2)

6.6 Bereken die konsentrasie van die H_2SO_4-oplossing. (2)

6.7 Kies die geskikste indikator uit die onderstaande tabel wat gebruik kan word tydens hierdie titrasie.

NAAM VAN INDIKATOR	pH-GEBIED VAN INDIKATOR
Metieloranje	3,1 – 4,4
Broomtimolblou	6,0 – 7,6
Fenolftaleïen	8,3 – 10,0

(2)
[16]

QUESTION 6 (Start on a new page)

A learner uses a standard solution of sodium hydrogen carbonate ($NaHCO_3$) to determine the concentration of a sulphuric acid (H_2SO_4) solution.

6.1 Write the definition of a standard solution. (2)

6.2 Why is H_2SO_4 regarded as a strong acid? (2)

6.3 Write the balanced equation for the reaction of H_2SO_4 with water. (3)

In a titration, the learner finds that 20 cm^3 of a 0,2 $mol.dm^{-3}$ solution of sodium hydrogen carbonate neutralises 12 cm^3 of the sulphuric acid solution.
The balanced equation for this reaction is:

$$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$$

6.4 How many moles of $NaHCO_3$ are present in 20 cm^3 of the 0,2 $mol.dm^{-3}$ $NaHCO_3$ solution? (3)

6.5 Determine the number of moles of H_2SO_4 that are neutralised by 20 cm^3 of the 0,2 $mol.dm^{-3}$ $NaHCO_3$ solution. (2)

6.6 Calculate the concentration of the H_2SO_4 solution. (2)

6.7 From the table below, select the most suitable indicator for use in this titration.

NAME OF INDICATOR	pH RANGE OF INDICATOR
Methyl orange	3,1 – 4,4
Bromothymol blue	6,0 – 7,6
Phenolphthalein	8,3 – 10,0

(2)
[16]

VRAAG 7 (Begin op 'n nuwe bladsy)

7.1 Beskou 'n standaard sink-koper-elektrochemiese sel.

7.1.1 Noem die energie-verandering wat plaasvind binne-in hierdie elektrochemiese sel wanneer dit in werking is. (2)

7.1.2 Skryf die vergelyking van die halfreaksie wat by die katode plaasvind. (2)

7.1.3 Skryf die **FORMULE** van die oksideermiddel. (2)

7.1.4 Noem EEN funksie van die soutbrug. (2)

7.1.5 Skryf die selnotasie (simboliese voorstelling) van hierdie sel. (2)

7.2 Theo wil swaweldioksied (SO_2)-gas in die laboratorium berei. Hy voeg 'n hoeveelheid verdunde swawelsuur by kopervylsels in 'n proefbuis. Ongelukkig vind geen reaksie plaas nie.

7.2.1 Maak gebruik van die Tabel van Standaard Reduksiepotensiale en verduidelik waarom geen reaksie plaasvind nie. (2)

7.2.2 Noem TWEE veranderings wat Theo moet maak sodat die reaksie wel sal plaasvind. (4)

7.3 Watter eienskap van HCℓ word in die laboratoriumbereiding van $C\ell_2$-gas gebruik?
Skryf slegs **OKSIDEERMIDDEL, REDUSEERMIDDEL** of **SUUR**. (2)
[18]

QUESTION 7 (Start on a new page)

7.1 Consider a standard zinc-copper electrochemical cell.

7.1.1 State the energy change taking place in this electrochemical cell when it is in operation. (2)

7.1.2 Write the equation of the half-reaction that takes place at the cathode. (2)

7.1.3 Write the **FORMULA** of the oxidising agent. (2)

7.1.4 State ONE function of the salt bridge. (2)

7.1.5 Write the cell notation (symbolic representation) for this cell. (2)

7.2 Theo wants to prepare sulphur dioxide (SO_2) gas in the laboratory. He adds some dilute sulphuric acid to copper filings in a test tube. Unfortunately, no reaction takes place.

7.2.1 Using the Table of Standard Reduction Potentials, explain why no reaction takes place. (2)

7.2.2 State TWO changes that Theo will have to make in order for this reaction to take place. (4)

7.3 What property of $HC\ell$ is utilised in the laboratory preparation of $C\ell_2$ gas? Write only **OXIDISING AGENT, REDUCING AGENT** or **ACID**. (2)

[18]

VRAAG 8 (Begin op 'n nuwe bladsy)

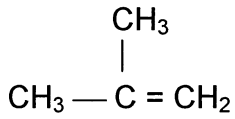
8.1 Voltooi die onderstaande tabel deur SLEGS die vraagnommer en die korrekte antwoord in jou antwoordeboek te skryf.

HOMOLOË REEKS	FUNKSIONELE GROEP
Alkohol	8.1.1
8.1.2	-C ≡ C -

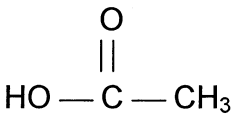
(4)

8.2 Skryf die struktuurformule van metielpropaan. (3)

8.3 Beskou die volgende organiese verbindings A tot E:

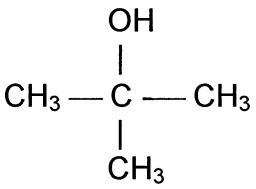


A

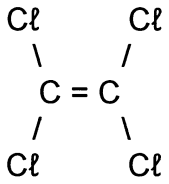


B

C



D



E

Skryf **slegs die letter** van EEN van die bostaande verbindings wat:

8.3.1 In die droogskoonmaakbedryf gebruik word (2)

8.3.2 'n Isomeer van verbinding C is (2)

8.3.3 'n Organiese suur is (2)

[13]

TOTAAL: 150

QUESTION 8 (Start on a new page)

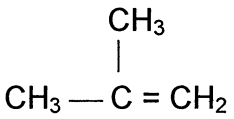
8.1 Complete the table below by writing in your answer book ONLY the question number and the correct answer.

HOMOLOGOUS SERIES	FUNCTIONAL GROUP
Alcohol	8.1.1
8.1.2	-C ≡ C -

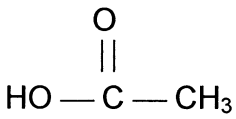
(4)

8.2 Write the structural formula for methylpropane. (3)

8.3 Consider the following organic compounds, A to E:

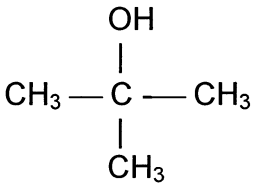


A

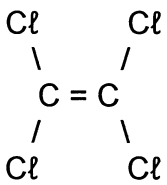


B

C



D



E

Write **only the letter** of ONE of the above compounds that is:

8.3.1 Used in the dry cleaning industry (2)

8.3.2 An isomer of compound C (2)

8.3.3 An organic acid (2)

[13]

TOTAL: 150

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
$n = \frac{m}{M}$	$pH = -\log[\mathrm{H^+}]$
$c = \frac{n}{V}$	$E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$
	$E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}}$
$c = \frac{m}{MV}$	$E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$
	$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$

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

SLEUTEL / KEY

Atoomgetal / Atomic number

Elektronegatiwiteit / Electronegativity → 1,9 Cu ← Simbool / Symbol

63,5 ← Relatiewe atoommassa (benaderd) / Relative atomic mass (approximately)

I	II	III	IV	V	VI	VII	0
2,1 H 1							2 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	10 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	18 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 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
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+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 reducing ability / Toenemende reduseervermoë

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

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
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2\,H_2O$	+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 oxidising ability / Toenemende oksideervermoë ↓

↑ Increasing reducing ability / Toenemende reduseervermoë