basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

FEBRUARY/MARCH 2014/*FEBRUARIE/MAART 2014*

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 21 pages.
Hierdie memorandum bestaan uit 21 bladsye.

Copyright reserved/*Kopiereg voorbehou*

Learning Outcomes and Assessment Standards ***Leeruitkomste en Assesseringstandaarde***		
LO/*LU* 1	**LO/*LU* 2**	**LO/*LU* 3**
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. *Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.*	**AS 12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.*	**AS 12.3.1:** Research, discuss, compare and evaluate scientific and indigenous knowledge systems and knowledge claims by indicating the correlation among them, and explain the acceptance of different claims. *Doen navorsing, bespreek, vergelyk en evalueer wetenskaplike en inheemse kennissisteme en kennisaansprake deur die ooreenkoms aan te dui en verduidelik die aanvaarding van verskillende aansprake.*
AS 12.1.2: Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. *Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.*	**AS 12.2.2** Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. *Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.*	**AS 12.3.2:** Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. *Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.*
AS 12.1.3: Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingsstrategieë om (ongesiene) probleme op te los.*	**AS 12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS 12.3.3:** Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. *Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.*
AS 12.1.4: Communicate and defend scientific arguments with clarity and precision. *Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.*		

Copyright reserved/*Kopiereg voorbehou*

GENERAL GUIDELINES/*ALGEMENE RIGLYNE*

1. CALCULATIONS/*BEREKENINGE*

1.1 **Marks will be awarded for:** correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: *korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*

1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.
Geen punte *sal toegeken word waar 'n* ***verkeerde of ontoepaslike formule gebruik*** *word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Wanneer 'n fout gedurende ***substitusie in 'n korrekte formule*** *begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar* ***geen verdere punte*** *sal toegeken word nie.*

1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark**.
Example:
No K_c expression, correct substitution

$$K_c = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark (\frac{2}{3})$$

Indien ***geen formule*** *gegee is nie, maar* ***al die substitusies is korrek, verloor*** *die kandidaat* ***een punt****.*
Voorbeeld:
Geen K_c-uitdrukking, korrekte substitusie:

$$K_c = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark (\frac{2}{3})$$

1.5 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien 'n poging tot 'n berekening aangewend is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.

1.6 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.

1.7 All calculations, when not specified in the question, must be done to two decimal places.
Alle berekeninge, wanneer nie in die vraag gespesifiseer word nie, moet tot twee desimale plekke gedoen word.

Copyright reserved/*Kopiereg voorbehou*

1.8 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord tot 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

2. UNITS/*EENHEDE*

2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
*Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag**.*

2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.

2.3 Marks are only awarded for an answer and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie. Kandidate sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:
- *Korrekte antwoord + verkeerde eenheid*
- *Verkeerde antwoord + korrekte eenheid*
- *Korrekte antwoord + geen eenheid*

2.4 Separate compound units with a multiplication dot, not a full stop, for example, $mol \cdot dm^{-3}$. Accept $mol.dm^{-3}$ (or mol/dm^3) for marking purposes.
Skei saamgestelde eenhede met 'n vermenigvuldigingsteken en nie 'n punt nie, byvoorbeeld, $mol \cdot dm^{-3}$. Aanvaar $mol.dm^{-3}$ (of mol/dm^3).

3. GENERAL/*ALGEMEEN*

3.1 If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2 When a chemical **FORMULA** is asked, and the **NAME** is given as answer the candidate forfeits the marks. The same rule applies when the **NAME** is asked and the **FORMULA** is given.
*Wanneer 'n chemiese formule gevra word, en die NAAM word as antwoord gegee, sal die kandidaat punte verbeur. Dieselfde reël geld wanneer die **NAAM** gevra word en die **FORMULE** gegee word.*

Copyright reserved/*Kopiereg voorbehou*

3.3 When redox half-reactions are to be written, the correct arrow should be used. If the equation

$$H_2S \rightarrow S + 2\,H^+ + 2e^- \quad (2/2)$$

is the correct answer, the marks must be given as follows:

$H_2S \rightleftharpoons S + 2\,H^+ + 2e^-$ $(1/2)$

$H_2S \leftarrow S + 2\,H^+ + 2e^-$ $(0/2)$

$S + 2H^+ + 2e^- \leftarrow H_2S$ $(2/2)$

$S + 2H^+ + 2e^- \rightleftharpoons H_2S$ $(0/2)$

Wanneer redokshalfreaksies geskryf moet word, moet die korrekte pyltjie gebruik word. Indien die vergelyking

$$H_2S \rightarrow S + 2\,H^+ + 2e^- \quad (2/2)$$

die korrekte antwoord is, sal die volgende punte toegeken word:

$H_2S \rightleftharpoons S + 2\,H^+ + 2e^-$ $(1/2)$

$H_2S \leftarrow S + 2\,H^+ + 2e^-$ $(0/2)$

$S + 2H^+ + 2e^- \leftarrow H_2S$ $(2/2)$

$S + 2H^+ + 2e^- \rightleftharpoons H_2S$ $(0/2)$

3.3 When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, do not accept the following:

- Stating the position of a substance on table 4 only (e.g. Cu is above Mg).
- Using relative reactivity only (e.g. Mg is more reactive than Cu).
- The correct answer would be for instance: Mg is a stronger reducing agent than Cu, and therefore Mg will be able to reduce Cu^{2+} ions to Cu. The answer can also be given in terms of the relative strength as electron acceptors and donors.

Wanneer kandidate 'n verduideliking moet gee oor die relatiewe sterkte van oksideer- en reduseermiddels, is die volgende onaanvaarbaar:

- *Meld slegs die posisie van 'n stof op tabel 4 (bv. Cu is bo Mg).*
- *Gebruik slegs relatiewe reaktiwiteit (bv. Mg is meer reaktief as Cu).*
- *Die korrekte antwoord sal byvoorbeeld wees: Mg is 'n sterker reduseermiddel as Cu en derhalwe sal Mg in staat wees om Cu^{2+}-ione na Cu te reduseer. Die antwoord kan ook in terme van die relatiewe sterkte van elektronakseptors of -donors gegee word.*

3.4 One mark is forfeited when the charge of an ion is omitted per equation.(not for the charge on an electron)
Een punt sal verbeur word wanneer die lading van 'n ioon per vraag weggelaat is.

Copyright reserved/*Kopiereg voorbehou*

3.5 The error carrying principle does not apply to chemical equations or half reactions. For example, if a learner writes the wrong oxidation/reduction half-reaction in the Subquestion and carries the answer over to another Subquestion (balancing of equations or calculation of E^{θ}_{cell}) then the learner must not be credited for this substitution.
Die foutdraendebeginsel geld nie vir chemiese vergelykings of halfreaksies nie. Byvoorbeeld, indien 'n leerder die verkeerde oksidasie/reduksie-halfreaksie vir die subvraag skryf en die antwoord na 'n ander subvraag oordra (balansering van vergelyking of E^{θ}_{sel}) dan word die leerder nie vir die substitusie gekrediteer nie.

3.6 In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks must be deducted if hydrogen atoms are omitted.
In die struktuurformules van 'n organiese molekuul moet alle waterstofatome getoon word. Punte sal afgetrek word vir die weglating van waterstofatome.

3.7 When a structural formula is asked, marks must be deducted if the learner writes the condensed formula.
Wanneer 'n struktuurformule gevra word, sal punte afgetrek word indien die leerder die gekondenseerde formule skryf.

3.8 When an IUPAC name is asked and the candidate omits the hyphen (e.g. instead of pent-1-ene or 1-pentene the candidate writes pent 1 ene or 1 pentene), marks must be forfeited.
Wanneer die IUPAC-naam gevra word en die koppelteken(s) in die naam word uitgelaat (bv. in plaas van pent-1-een of 1 -penteen skryf 'n kandidaat pent 1 een of 1 penteen), sal punte verbeur word.

3.9 When a chemical reaction is asked, marks are awarded for correct reactants, correct products and correct balancing.

If only a reactant(s) followed by an arrow, or only a product(s) preceded by an arrow, is/are written, marks may be awarded for the reactant(s) or product(s). If only a reactant(s) or only a product(s) are written, without an arrow, no marks are awarded for the reactant(s) or product(s).

Examples: $N_2 + 3H_2$ ✓$\rightarrow 2NH_3$ ✓ bal. ✓	
$N_2 + H_2 \rightarrow$✓	1/3
$\rightarrow NH_3$ ✓	1/3
$N_2 + H_2$	0/3
NH_3	0/3

Wanneer 'n chemiese reaksie gevra word, word punte toegeken vir korrekte reaktanse, korrekte produkte en korrekte balansering.

Copyright reserved/*Kopiereg voorbehou*

Indien slegs 'n reaktans(e) gevolg deur 'n pyl, of slegs 'n produk(te) voorafgegaan deur 'n pyl, geskryf word, word punte vir die reaktans(e) of produkte gegee. Indien slegs reaktanse of slegs produk(te) geskryf word sonder 'n pyl, word geen punte gegee nie.

Voorbeelde: $N_2 + 3H_2$ ✓→ NH_3 ✓ bal. ✓

$N_2 + 3H_2 \rightarrow$ ✓	1/3
$\rightarrow NH_3$ ✓	1/3
$N_2 + 3H_2$	0/3
NH_3	0/3

4. POSITIVE MARKING/*POSITIEWE NASIEN*

Positive marking regarding calculations will be followed in the following cases: *Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:*

4.1 **Subquestion to subquestion:** When a certain variable is calculated in one Subquestion (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.
Subvraag na subvraag: *Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en korrek in 3.2 of 3.3 vervang word, word* ***volpunte*** *vir die daaropvolgende subvraag toegeken.*

4.2 **A multi-step question in a subquestion:** If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
'n Vraag met veelvuldige stappe in 'n subvraag: *Indien 'n kandidaat byvoorbeeld, die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

5. NEGATIVE MARKING/*NEGATIEWE NASIEN*

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given to QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 3.1. is based on a calculation, the motivation for the incorrect answer in 3.2 could be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

Copyright reserved/*Kopiereg voorbehou*

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1 Haloalkanes / Alkyl halides ✓
Haloalkane / Alkielhaliede (1)

1.2 Alkynes / *Alkyne* ✓ (1)

1.3 Activation energy / *Aktiveringsenergie* ✓ (1)

1.4 Electroplating / *Elektroplatering* ✓ (1)

1.5 Ostwald (process) / *Ostwald(proses)* ✓ (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 A ✓✓ (2)

2.2 A ✓✓ (2)

2.3 D ✓✓ (2)

2.4 B ✓✓ (2)

2.5 C ✓✓ (2)

2.6 C ✓✓ (2)

2.7 D ✓✓ (2)

2.8 A ✓✓ (2)

2.9 A ✓✓ (2)

2.10 B ✓✓ (2)
[20]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

Copyright reserved/*Kopiereg voorbehou*

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1

3.1.1 C ✓ (1)

3.1.2 F ✓ (1)

3.1.3 D ✓ (1)

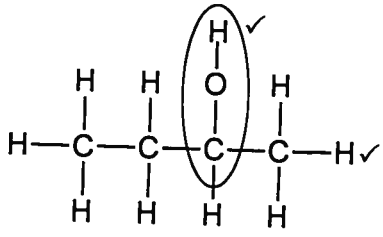
3.1.4 E ✓ (1)

3.2

3.2.1 3-methyl✓cyclohexene ✓
3-metiel✓siklohekseen ✓ (2)

Notes/*Aantekeninge*
IF IUPAC name completely correct but hyphens omitted:/*Indien IUPAC-naam heeltemal korrek, maar koppeltekens uitgelaat:*
3 methylcyclohexene ✓
3 metielsiklohekseen ✓

3.2.2



(2)

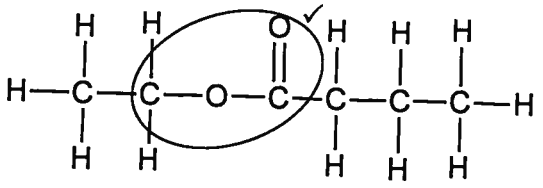
Notes/*Aantekeninge*
Functional group encircled/*Funksionele groep omkring:* ✓
Whole structure correct/*Hele struktuur korrek:* ✓

3.2.3 Esters ✓ (1)

3.3

3.3.1 Esterification / *Verestering / Esterifikasie* ✓ (1)

3.3.2



(2)

Notes/*Aantekeninge*
Functional group: ✓
Whole structure correct: ✓
Funksionele groep: ✓
Hele struktuur korrek: ✓

Notes/*Aantekeninge:*
- Condensed or semi-structural formula: $\frac{1}{2}$
  Gekondenseerde of semistruktuurformule: $\frac{1}{2}$
- Molecular formula/*Molekulêre formule:* $\frac{0}{2}$

3.3.3 Butanoic acid / *Butanoësuur* ✓ (1)

[13]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 4/*VRAAG 4*

4.1 Alkanes / *Alkane* ✓ (1)

4.2 Same molecular formula. / *Dieselfde molekulêre formule.* ✓
Different structural formulae. / *Verskillende struktuurfomules.* ✓ (2)

4.3 B ✓

- **Structure:**
  Less branched./is a less compact molecule./has a larger surface area (over which intermolecular forces act.) ✓
- **Intermolecular forces:**
  Stronger intermolecular forces. ✓
- **Energy:**
  More energy needed to overcome intermolecular forces. ✓

B ✓

- **Struktuur:**
  Minder vertak./het 'n minder kompakte molekuul./het 'n groter oppervlakte (waaroor intermolekulêre kragte werk.) ✓
- **Intermolekulêre kragte**
  Sterker intermolekulêre kragte. ✓
- **Energie:**
  Meer energie benodig om intermolekulêre kragte te oorkom. ✓

OR/*OF*

B ✓

- **Structure:**
  Compound A has more branching./is a less compact molecule./ has a smaller surface area (over which the intermolecular forces act.) ✓
- **Intermolecular forces:**
  Weaker intermolecular forces. ✓
- **Energy:**
  Less energy needed to overcome intermolecular forces. ✓

B ✓

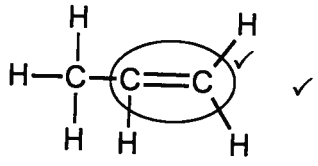
- **Struktuur:**
  ***Isomere** meer vertak./Molekule meer kompak./ Kleiner oppervlaktes (waaroor intermolekulêre kragte werk.)* ✓
- **Intermolekulêre kragte**
  Swakker intermolekulêre kragte. ✓
- **Energie:**
  Die minder energie benodig om intermolekulêre kragte te oorkom. ✓ (4)

4.4

4.4.1 Cracking / *Kraking* ✓
Accept/*Aanvaar:* elimination/*eliminasie* (1)

Copyright reserved/*Kopiereg voorbehou*

4.4.2



✓

Notes/*Aantekeninge*
Functional group/*Funksionele groep:* ✓
Whole structure correct/*Hele struktuur korrek:* ✓

Notes/*Aantekeninge:*
- Condensed or semi-structural formula: ½
  Gekondenseerde of semistruktuurformule: ½
- Molecular formula/*Molekulêre formule:* 0/2

(2)

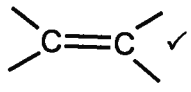
4.4.3 $C_5H_{12} + 8O_2$ ✓ $\rightarrow 5CO_2 + 6H_2O$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore/*Ignoreer* ⇌
- Marking rule 3.9/*Nasienreël 3.9*

(3)
[13]

QUESTION 5/*VRAAG 5*

5.1



✓

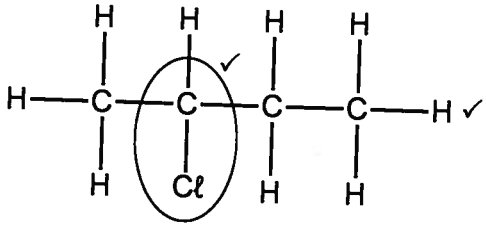
(1)

5.2

5.2.1 Addition / hydrohalogenation ✓
Addisie / hidrohalogenering

(1)

5.2.2



✓ ✓

Functional group: ✓
Whole structure correct: ✓

Funksionele groep: ✓
Hele struktuur korrek: ✓

Notes/*Aantekeninge:*
- Condensed or semi-structural formula: Max. ½
  Gekondenseerde of semistruktuurformule: Maks. ½
- Molecular formula/*Molekulêre formule:* 0/2

(2)

5.3

5.3.1 Substitution / Hydrolysis ✓
Substitusie / Hidrolise

(1)

Copyright reserved/*Kopiereg voorbehou*

5.3.2 Water / H_2O ✓

OR/*OF*
Dilute sodium hydroxide / NaOH(aq) / *Verdunde natriumhidroksied*

OR/*OF*
Dilute potassium hydroxide / KOH(aq) / *Verdunde kaliumhidroksied* (1)

5.4

5.4.1 Secondary (alcohol) / *Sekondêre (alkohol)* ✓ (1)

5.4.2 Elimination / dehydration ✓
Eliminasie / Dehidratering / Dehidrasie (1)

5.4.3 Catalyst / *Katalisator* ✓
Accept/*Aanvaar:* Dehydrating agent / *Dehidreermiddel* (1)

5.5

5.5.1 Elimination / dehydrohalogenation / dehydrochlorination ✓
Eliminasie / Dehidrohalogenering / Dehidrochlorinering (1)

5.5.2 Concentrated strong base / *Gekonsentreerde sterk basis* ✓
OR/*OF* *concentrated/gekonsentreerde NaOH of KOH*
Heat / *Hitte* ✓ (2)

5.5.3 (a) NaOH ✓
(b) NaCℓ ✓
(c) H_2O ✓

OR
(a) KOH
(b) KCℓ
(c) H_2O (3)
[15]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 6/*VRAAG 6*

6.1 Rate of change of concentration (of P). ✓✓
Tempo van verandering in konsentrasie (van P).

OR/*OF*
The change in concentration (of P) ✓
per unit time/per second. ✓
Die verandering in konsentrasie (van P)
per eenheidstyd/per sekonde.

(2)

6.2 10 s ✓
Gradient (of the tangent) at 10 s is greater than that at 30 s. ✓
Gradiënt (van raaklyn) by 10 s is groter as diéby 30 s.

OR/*OF*
10 s
The graph has a steeper slope at 10 s than at 30 s.
Die grafiek het 'n steiler helling by 10 2 as by 30 s.

(2)

6.3 0,27 mol·dm^{-3} ✓

(1)

6.4

OPTION 1/*OPSIE 1*

At t = 0 s:
n = cV ✓
= (0,27)(2) ✓
= 0,54 mol

At t = 10 s
n = cV
= (0,15)(2) ✓
= 0,3 mol

$$\text{Rate/Tempo} = \frac{0,30 - 0,54 \checkmark}{10 - 0 \checkmark}$$
$$= -0,024 \text{ mol·s}^{-1} / 0,024 \text{ mol·s}^{-1} \checkmark$$

OPTION 2/*OPSIE 2*

$$\text{Rate/}\textit{Tempo} = \frac{0,15 - 0,27 \checkmark}{10 - 0 \checkmark}$$
$$= -0,012 \text{ mol·dm}^{-3}\text{·s}^{-1} \checkmark$$

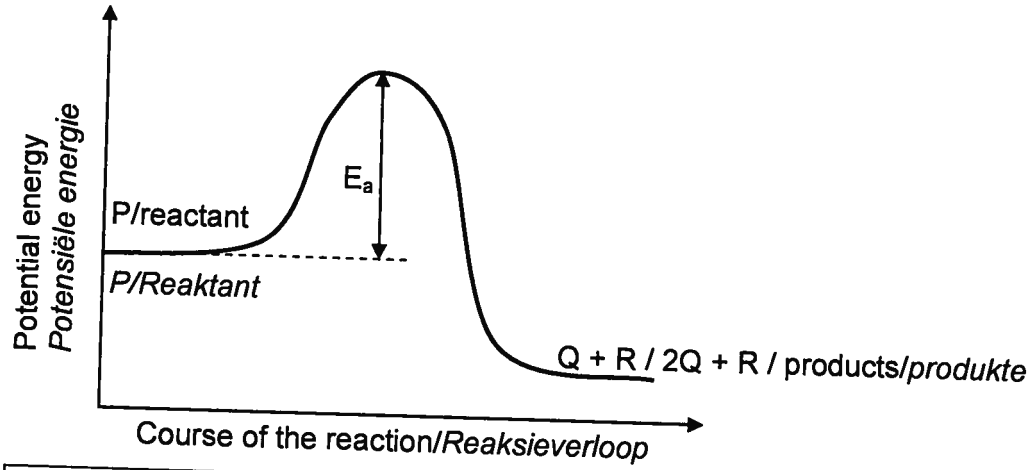
Rate/ *Tempo* = (- 0,012)(2) ✓✓
= -0,024 mol·s^{-1} / 0,024 mol·s^{-1} ✓

Notes/*Aantekeninge:*
Do not penalise for positive answer.
Moenie vir positiewe antwoord penaliseer nie.

(6)

Copyright reserved/*Kopiereg voorbehou*

6.5



Marking criteria/ *Nasienriglyne:*	
Correct shape as shown./*Korrekte vorm soos getoon.*	✓
Reactants and products correctly indicated. *Reaktanse en produkte korrek aangetoon.*	✓
Activation energy indicated as shown. *Aktiveringsenergie aangedui soos getoon.*	✓

Notes/*Aantekeninge:*
If axes not labelled/*Indien asse nie benoem nie*: Max. $\frac{1}{2}$

(3)

6.6 More molecules with sufficient / enough kinetic energy. ✓
More effective collisions per unit time. ✓

Meer molekule met voldoende/genoeg kinetiese energie.
Meer effektiewe botsings per eenheidstyd.

(2)
[16]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 7/*VRAAG 7*

7.1 CO_2 gas is a greenhouse gas ✓
and will contribute to global warming. ✓

CO_2-gas is 'n kweekhuisgas
en sal bydra tot aardverwarming.

(2)

7.2 (The stage in a chemical reaction when the) rate of forward reaction equals the rate of reverse reaction. ✓✓ (2 marks or zero)
(Die stadium in 'n chemiese reaksie wanneer) die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaarste reaksie. ✓✓ (2 punte of nul)

OR/*OF*

(The stage in a chemical reaction when) the concentration of reactants and products remain constant. ✓✓
(Die stadium in 'n chemiese reaksie wanneer) die konsentrasie van reaktanse en produkte konstant bly.

(2)

7.3

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK

Mark allocation/*Puntetoekenning:*

- **USING** ratio/***GEBRUIK*** *verhouding:* $CH_4 : H_2O : CO_2 : H_2 = 1 : 2 : 1 : 4$ ✓
- Equilibrium/*Ewewig:* $n(CH_4)$ = initial/*aanvanklik* – change/*verandering*
  Equilibrium/*Ewewig*: $n(H_2O)$ = initial/*aanvanklik* – change/*verandering* } ✓
- Equilibrium/*Ewewig:* $n(H_2)$ = initial/*aanvanklik* + change/*verandering* ✓
- Divide ALL equilbrium moles 5 dm^3 ✓
  Deel ALLE ewewigsmolle deur 5 dm^3
- Correct K_c expression (formulae in square brackets) ✓
  Korrekte K_c uitdrukking (formules in vierkanthakies)
- *Substitution of concentrations into* K_C expression ✓
  Vervanging van konsentrasies in K_C-uitdrukking
- Final answer/*Finale antwoord*: 0,25 ✓

Copyright reserved/*Kopiereg voorbehou*

OPTION 1/*OPSIE 1*

	CH_4	H_2O	CO_2	H_2
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	1	2	0	0
Change (mol) *Verandering (mol)*	0,3	0,6	0,3	1,2
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,7	1,4 ✓	0,3	1,2 ✓
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	0,14	0,28	0,06	0,24

ratio ✓
verhouding

$$K_C = \frac{[CO_2][H_2]^4}{[CH_4][H_2O]^2} \checkmark$$

$$= \frac{(0,06)(0,24)^4}{(0,14)(0,28)^2} \checkmark$$

$$= 0,02\ (0,018) \checkmark$$

Divide by /*gedeel deur* 5✓

No K_C expression, correct substitution / *Geen K_c uitdrukking*, korrekte substitusie: Max. / *Maks.* 6/7

Wrong K_C expression/*Verkeerde K_c-uitdrukking*: Max. / *Maks.* 4/7

Copyright reserved/*Kopiereg voorbehou*

OPTION 2/*OPSIE 2*

CALCULATIONS USING CONCENTRATIONS
BEREKENINGE WAT KONSENTRASIES GEBRUIK

Mark allocation/*Puntetoekenning*

- Initial concentrations: $[CH_4] = 0,2$ mol·dm^{-3} & $[H_2O] = 0,4$ mol·dm^{-3}
- Equilibrium concentration $[CO_2] = 0,06$ mol·dm^{-3} } ✓
- **USING** ratio/***GEBRUIK*** *verhouding:* $CH_4 : H_2O : CO_2 : H_2 = 1 : 2 : 1 : 4$ ✓
- Equilibrium/*Ewewig:* c(CH_4) = initial/*aanvanklik* – change/*verandering*
  Equilibrium/*Ewewig*: c(H_2O) = initial/*aanvanklik* – change/*verandering* } ✓
- Equilibrium/*Ewewig:* c(H_2) = initial/*aanvanklik* – change/*verandering* ✓
- Correct K_c expression (formulae in square brackets) ✓
  Korrekte K_c uitdrukking (formules in vierkanthakies)
- *Substitution of concentrations into* K_C expression ✓
  Vervanging van konsentrasies in K_C-uitdrukking
- Final answer/*Finale antwoord*: 0,25 ✓

	CH_4	H_2O	CO_2	H_2
Initial concentration (mol·dm^{-3}) *Aanvangskonsentrasie (mol·dm^{-3})*	0,2	0,4	0	0
Change (mol·dm^{-3}) *Verandering* (mol·dm^{-3})	0,06	0,12	0,06	0,24
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	0,14	0,28 ✓	0,06	0,24✓

ratio ✓ *verhouding*

$$K_C = \frac{[CO_2][H_2]^4}{[CH_4][H_2O]^2}$$ ✓

Divide by 5 / *Gedeel deur 5* ✓

$$= \frac{(0,06)(0,24)^4}{(0,14)(0,28)^2}$$ ✓

$= 0,02$ (0,018) ✓

No K_C expression, correct substitution / *Geen K_c uitdrukking*, korrekte substitusie: Max. / *Maks.* 6/7

Wrong K_C expression/*Verkeerde K_c-uitdrukking*: Max. / *Maks.* 4/7

(7)

7.4 Exothermic ✓
K_c decreased, thus less products and more reactants. ✓
Therefore reverse reaction is favoured.✓
An increase in temperature favours the endothermic reaction and thus the forward reaction is endothermic.✓

Eksotermies
K_c neem af, dus minder produkte en meer reaktanse.
Dus is die terugwaartse reaksie bevoordeel.
'n Toename in temperatuur bevoordeel die endotermiese reaksie en dus is die voorwaartse reaksie endotermies.

(4)
[15]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 8/*VRAAG 8*

8.1

8.1.1 Chemical energy to electrical energy ✓
Chemiese energie na elektriese energie (1)

8.1.2 $Cu(s) + 2Ag^+(aq)$ ✓$\rightarrow Cu^{2+}(aq) + 2Ag(s)$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore/*Ignoreer* $\rightleftharpoons$
- Marking rule 3.9/*Nasienreël 3.9*

(3)

8.1.3 $Cu(s) \mid \overset{\checkmark}{Cu^{2+}}(aq) \parallel \overset{\checkmark}{Ag^+}(aq) \mid \overset{\checkmark}{Ag}(s)$

OR/*OF*

$Cu(s) \mid Cu^{2+}(1\ mol{\cdot}dm^{-3}) \parallel Ag^+(1\ mol{\cdot}dm^{-3}) \mid Ag(s)$

OR/*OF*

$Cu \mid Cu^{2+} \parallel Ag^+ \mid Ag$

(3)

8.2

OPTION 1/*OPSIE 1*

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$= 0,80$ ✓$- (+0,34)$ ✓
$E^{\theta}_{cell} = 0,46$ V ✓

OPTION 2/*OPSIE 2*

✓ $Cu \rightarrow Cu^{2+} + 2e^-$ $E^{\theta} = -0,34$ ✓
$Ag^+ + e^- \rightarrow Ag$ $E^{\theta} = 0,80$ ✓
$E^{\theta} = 0,46$ V ✓

Notes/*Aantekeninge*
Accept any other correct formula from the data sheet.
Aanvaar enige ander korrekte formule vanaf gegewensblad.

Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions: $^3/_4$
Enige ander formule wat onkonvensionele afkortings gebruik bv. $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings:* $^3/_4$

(4)

8.3 Cu to Ag ✓ (1)

8.4

$$n(Cu) = \frac{m}{M}$$
$$= \frac{3,2}{63,5} \checkmark$$
$$= 0,05 \text{ mol}$$

POSITIVE MARKING FROM QUESTION 8.1.2 FOR MOLE RATIO.
POSITIEWE NASIEN VAN VRAAG 8.1.2 VIR MOLVERHOUDING.

$n(Ag) = 2(0,05) = 0,1$ mol ✓
$m(Ag) = nM$
$= (0,1)(108)$ ✓
$= 10,8$ g ✓

(4)

Copyright reserved/*Kopiereg voorbehou*

8.5

8.5.1 Positive ✓
Cu is a weaker reducing agent (than H_2). ✓
H_2 will be oxidised ✓and standard hydrogen electrode is the anode. /Cu^{2+} is reduced and Cu is the cathode. ✓

Positief
Cu is 'n swakker reduseermiddel (as H_2).
H_2 sal geoksideer word en die standaard waterstofelektrode is die anode. / Cu^{2+} word gereduseer en Cu is die katode. (4)

8.5.2 0,34 V ✓ (1)
[21]

QUESTION 9/*VRAAG 9*

9.1 A ✓ (1)

9.2 Endothermic / *Endotermies* ✓ (1)

9.3
- A gas (chlorine) forms at electrode A. ✓
  'n Gas (chloor) vorm by elektrode A.
- A solid (copper) forms at electrode B. ✓
  'n Vaste stof (koper) vorm by elektrode B.
- The intensity of the blue solution decreases. / Solution becomes colourless. ✓
  Die intensiteit van die blou oplossing neem af. / Oplossing word kleurloos. (3)

9.4 $CuC\ell_2$ ✓→ $Cu(s) + C\ell_2(g)$ ✓ Balancing ✓

Notes/*Aantekeninge*:		
• Reactants ✓ *Reaktanse*	Products ✓ *Produkte*	Balancing ✓ *Balansering*
• Ignore/*Ignoreer* ⇌		
• Marking rule 3.9/*Nasienreël 3.9*		

(3)

9.5 Ions of salt must be free to move. / To conduct electricity. ✓
Ione van die sout moet vry wees om te beweeg./Om elektrisiteit te gelei. (1)
[9]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 10/*VRAAG 10*

10.1 $2H_2(g) + O_2(g)$ ✓ $\rightarrow 2H_2O(\ell)$ ✓ bal ✓

Notes/*Aantekeninge*		
• Reactants ✓ *Reaktanse*	Products ✓ *Produkte*	Balancing ✓ *Balansering*
• Ignore/*Ignoreer* ⇌		
• Marking rule 3.9/*Nasienreël 3.9*		

(3)

10.2 Water is the only product. / *Water is die enigste produk.*✓ (1)

10.3

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$ ✓ $= 0,40$ ✓$- (-0,83)$ ✓ $E^\circ_{cell} = 1,23$ V ✓	Accept any other correct formula from the data sheet. *Aanvaar enige ander korrekte formule vanaf gegewensblad.*
OPTION 2/*OPSIE 2*	Any other formula using unconventional abbreviations, e.g. $E^\circ_{cell} = E^\circ_{OA} - E^\circ_{RA}$ followed by correct substitutions: $\frac{3}{4}$ *Enige ander formule wat onkonvensionele afkortings gebruik bv.* $E^\circ_{sel} = E^\circ_{OM} - E^\circ_{RM}$ *gevolg deur korrekte vervangings:* $\frac{3}{4}$
✓ $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ $E^\theta = 0,83$ ✓ $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ $E^\theta = 0,40$ ✓ $E^\theta = 1,23$ V ✓	

(4)

10.4 **POSITIVE MARKING FROM QUESTION 10.3.**
POSITIEWE NASIEN VAN VRAAG 10.3.

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$Q = I\Delta t$ ✓ $= (1)(3\,600)$ ✓ $= 3\,600$ C $W = VQ$ ✓ $= (1,23)(3600)$ ✓ $= 4\,428$ J ✓	$W = VIt$ ✓✓ $= (1,23)$ ✓ $(1)(3600)$ ✓ $= 4\,428$ J ✓

(5)
[13]

Copyright reserved/*Kopiereg voorbehou*

QUESTION 11/*VRAAG 11*

11.1

11.1.1 $SO_3 + H_2SO_4$ ✓→ $H_2S_2O_7$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore/*Ignoreer* ⇌
- Marking rule 3.9/*Nasienreël 3.9*

(3)

11.1.2 The reaction is (highly) exothermic/ produces toxic fumes / mist. ✓
Die reaksie is (hoogs) eksotermies / vorm giftige dampe /mis. (1)

11.2

11.2.1 Ammonium phosphate / *Ammoniumfosfaat* ✓
Highest percentage phosphorous. / *Hoogste persentasie fosfor.* ✓ (2)

11.2.2
- Excess fertiliser runs into water resources causing contamination of water resources/ eutrophication / higher concentration of nitrates in water / dead zones ✓
  that can result in poor water quality / dying of fish / changing of habitats. ✓
  Oormaat kunsmis loop af in waterbronne en veroorsaak kontaminasie van waterbronne / eutrofikasie / hoër nitraatkonsentrasies in water / dooie sones
  wat tot swak waterkwaliteit / visvrektes / veranderde habitatte kan lei.
- Excess fertiliser in soil leads to eutrophication / change in acidity of soil / dead zones ✓
  that can result in changing of natural growth / habitats. ✓
  Oormaat kunsmis in grond lei tot eutrofikasie / verandering in suurgehalte van grond / dooie sones
  wat tot verandering in natuurlike groei/habitatte kan lei.

Marking guidelines/*Nasienriglyne:*
- Immediate effect of excess fertiliser runoff in water. ✓
  Onmiddellike invloed van oormaat kunsmis wat in water afloop.
- Effect of contaminated water on environment. ✓
  Invloed van besmette water op omgewing.
- Immediate effect if excess fertiliser in soil. ✓
  Onmiddellike invloed van oormaat kunsmis in grond.
- Effect of contaminated soil on environment. ✓
  Invloed van besmette grond op omgewing.

(4)
[10]

TOTAL SECTION B/*TOTAAL AFDELING B:* 125
GRAND TOTAL/*GROOTTOTAAL:* 150

Copyright reserved/*Kopiereg voorbehou*