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)

NOVEMBER 2011

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 12 pages.
Hierdie memorandum bestaan uit 12 bladsye.

SECTION A / *AFDELING A*

QUESTION 1 / *VRAAG 1*

1.1 Haloalkane / *Haloalkaan* ✓ (1)

1.2 Hydrocarbons / *Koolwaterstowwe* ✓ (1)

1.3 (Dynamic) equilibrium / (Chemical) equilibrium ✓
(Dinamiese) ewewig / (Chemiese) ewewig ✓ (1)

1.4 Cryolite / *Krioliet* ✓ (1)

1.5 (Cell) capacity / (*Sel)kapasiteit* ✓ (1)
[5]

QUESTION 2 / *VRAAG 2*

2.1 B ✓✓ (2)

2.2 B ✓✓ (2)

2.3 C ✓✓ (2)

2.4 D ✓✓ (2)

2.5 D ✓✓ (2)

2.6 C ✓✓ (2)

2.7 A ✓✓ (2)

2.8 A ✓✓ (2)

2.9 B ✓✓ (2)

2.10 C ✓✓ (2)
[20]

TOTAL SECTION A / *TOTAAL AFDELING*: 25

SECTION B / *AFDELING B*

QUESTION 3 / *VRAAG 3*

3.1
3.1.1 D ✓ (1)

3.1.2 C ✓ (1)

3.2
3.2.1 4-methylpentanal / *4-metielpentanaal* ✓✓ (2)

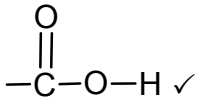
3.2.2 prop-1-yne / *prop-1-yn* ✓✓
Accept / *Aanvaar:*
propyne / *propyn*
1-propyne / *1-propyn* (2)

3.3 H_2O / water ✓

CO_2 / carbon dioxide ✓
CO_2 / *koolstofdioksied* / *koolsuurgas*✓ (2)

3.4
3.4.1 Esters ✓ (1)

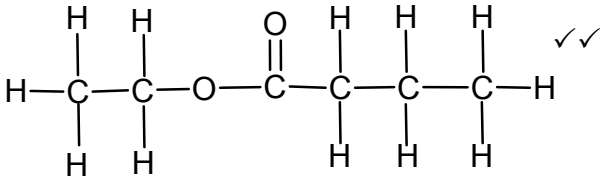
3.4.1



✓ (1)

3.4.3 Butanoic acid / *Butanoësuur* ✓✓ (2)

3.4.4



✓✓ (2)
[14]

QUESTION 4 / *VRAAG 4*

4.1 (Structural) isomers / *(Struktuur)isomere* ✓ (1)

4.2
4.2.1 Boiling point / *Kookpunt* ✓ (1)

4.2.2 Branching / *Vertakking* ✓ (1)

4.2.3 Number of C atoms / *Aantal C-atome* ✓

OR/*OF*
Molecular or molar mass or molecular formula / C_5H_{12} ✓
Molekulêre of molêre massa of molekulêre formule / C_5H_{12} ✓ (1)

4.3 Saturated / *Versadig* ✓
No carbon-carbon double (or triple) bonds. ✓✓
Geen koolstof-koolstofdubbelbindings (of trippelbindings). ✓✓

OR / OF
Saturated / *Versadig* ✓
Only single bonds between C artoms. / *Slegs enkelbindings tussen C-atome.* ✓✓

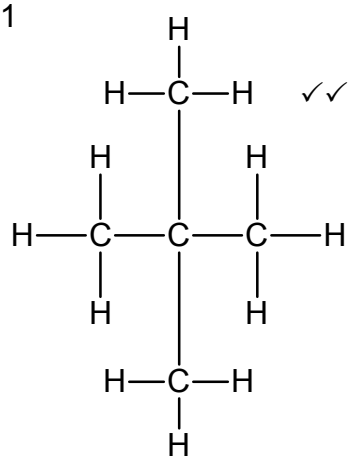
OR / OF
Saturated / *Versadig* ✓
No multiple bonds. / *Geen meervoudige bindings.* ✓✓ (3)

4.4
4.4.1 A ✓ (1)

4.4.2
Pentane / *Pentaan* ✓✓

(2)

4.5.1



(2)

4.5.2
- Most branching / Molecules most compact or spherical / Smallest surface area (over which intermolecular forces act.).✓
- Least / Weakest intermolecular forces. ✓
- Least energy needed to overcome intermolecular forces. ✓

- *Die meeste vertak. / Molekule mees kompak of sferies / Kleinste oppervlakte (waaroor intermolekulêre kragte werk.)* ✓
- *Minste / Swakste intermolekulêre kragte.* ✓
- *Die minste energie benodig om intermolekulêre kragte te oorkom.* ✓ (3)

4.6 C ✓
Lowest boiling point / *Laagste kookpunt* ✓ (2)
[17]

QUESTION 5/*VRAAG 5*

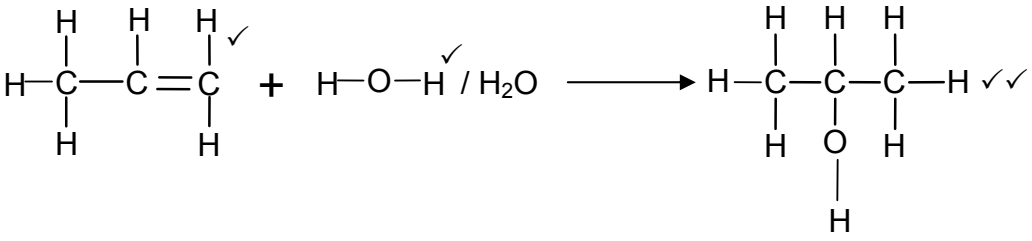
5.1

5.1.1 Addition / hydration ✓
Addisie / hidratering / hidrasie ✓ (1)

5.1.2 Substitution / Hydrolysis ✓
Substitusie / Hidrolise ✓ (1)

5.1.3 Elimination / Dehydrohalogenation / Dehydrobromination ✓
Eliminasie / Dehidrohalogenering / Dehidrobrominering ✓ (1)

5.2



(4)

5.3

Propan-2-ol

Accept / *Aanvaar:*
2-propanol (2)

5.4
- Dilute base ✓
  Verdunde basis ✓
- Mild heat
  Matige hitte ✓

(2)
[11]

QUESTION 6/*VRAAG 6*

6.1 (Gas) syringe / burette / measuring cylinder ✓
(Gas)spuit / buret / maatsilinder ✓ (1)

6.2 24 cm^3 ✓✓ (2)

6.3 Decreases ✓
The gradient of the graph decreases. ✓

Verminder ✓
Die gradiënt van die grafiek neem af. ✓ (2)

6.4 Catalyst / *Katalisator* ✓ (1)

6.5 H_2O / water ✓

CuO / copper(II) oxide ✓
CuO / koper(II)oksied ✓ (2)

6.6 **In terms of lump: / *In terme van soliede stuk:***
Smaller (exposed) surface area / contact area ✓
Less hydrogen peroxide molecules per unit time comes in contact with the catalyst. ✓
Kleiner (blootgestelde) reaksieoppervlakte / kontakoppervlakte. ✓
Minder waterstofperoksied per eenheidstyd kom in kontak met katalisator. ✓

OR/*OF*
In terms of powder: / *In terme van poeier:*
Larger (exposed) surface area / contact area ✓
More hydrogen peroxide molecules per unit time comes in contact with the catalyst. ✓
Groter (blootgestelde) reaksieoppervlakte / kontakarea. ✓
Meer waterstofperoksied per eenheidstyd kom in kontak met katalisator. ✓ (2)

6.7 Decomposition of hydrogen peroxide releases oxygen ✓
that resists the functioning of the bacteria. / oxidises the bacteria. ✓
Ontbinding van waterstofperoksied stel suurstof vry ✓
wat die werking van bakterie teenwerk./ wat bakterieë oksideer. ✓
(2)
[12]

QUESTION 7/*VRAAG 7*

7.1
7.1.1 When the equilibrium in a closed system is disturbed ✓
the system will shift the equilibrium position **OR** re-instate a new equilibrium as to **OR** favour the reaction that will ✓
oppose **OR** cancel **OR** counteract the change **OR** disturbance. ✓

Wanneer die ewewig in 'n geslote sisteem versteur word, ✓
*skuif die sisteem die ewewigsposisie sodanig deur **OF** word 'n nuwe ewewig ingestel* deur OF die reaksie bevoordeel wat ✓
*die effek van die versteuring **OF** verandering teen te werk **OF** te kanselleer.* ✓

OR / *OF*
When a stress / change is placed on a system in equilibrium ✓
The system shifts the equilibrium (position) **OR** re-instate a new equilibrium ✓
so as to remove **OR** cancel **OR** oppose the stress / change. ✓

*Wanneer 'n sisteem in ewewig onderhewig is aan 'n spanning **OF** verandering,* ✓
*skuif die sisteem die ewewig(posisie) sodanig **OF** word 'n nuwe ewewig ingestel* ✓*deur*
*die spanning /verandering te verwyder **OF** teen te werk **OF** te kanselleer.* ✓

OR / OF
When the conditions affecting an equilibrium are changed, ✓
the equilibrium (position) shifts in such a way ✓
as to oppose the change **OR** cancel the change. ✓
Wanneer die toestande wat 'n ewewig beïnvloed, verander word, ✓
sal die ewewig(posisie) sodanig verskuif ✓
*dat die verandering teengewerk word **OF** gekanselleer word.* ✓ (3)

7.1.2 Decreases ✓
When the pressure is increased,
the reverse reaction is favoured. ✓
The reaction that produced the smaller volume/amount of gas is favoured. ✓
OR
4 mol or volumes of gas produces 2 mol or volumes of gas.

Verminder ✓
Wanneer die druk verhoog word,
word die terugwaartse reaksie bevoordeel. ✓
Die reaksie wat 'n kleiner volume / aantal mol vorm, word bevoordeel. ✓
OF
4 mol of volumes gas reageer om 2 mol of volumes gas te vorm. (3)

7.1.3 Products form at faster rate. ✓
Higher yield of products. ✓

Produkte vorm teen 'n vinniger tempo. ✓
Groter opbrengs van produkte. ✓ (2)

7.2
7.2.1 **CALCULATIONS USING NUMBER OF MOLES**
BEREKENINGE WAT AANTAL MOL GEBRUIK

Option 1 / *Opsie 1:*
$n(H_2O)$ at equilibrium / *by ewewig* = 0,2 mol (given)

$n(H_2O)$ formed / *gevorm* = n(CO) formed/*gevorm* = 0,2 (mol)
$n(H_2)$ reacted = (0,2 mol): $n(CO_2)$ reacted = (0,2 mol) } ✓

At equilibrium / *By ewewig*:
$n(H_2)$ = (x – 0,2)/(x – change / *verandering*)
$n(CO_2)$ = 0,1 (mol)/(0,3 – change / *verandering*) } ✓
$n(H_2O) = n(CO)$ = 0,2 (mol) ✓

Equilibrium concentration / *Ewewigskonsentrasies:*

$$c(H_2) = \frac{n}{V} = \frac{x-0,2}{10}$$
$$c(CO_2) = \frac{n}{V} = \frac{0,1}{10}$$
$$c(H_2O) = \frac{n}{V} = \frac{0,2}{10}$$
$$c(CO) = \frac{n}{V} = \frac{0,2}{10}$$
} ✓

$$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]} \checkmark \quad \therefore \quad \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \checkmark = 4 \checkmark$$

$\therefore x = 0,3 \quad \therefore n(H_2) = 0,3$ mol ✓

Option 2/*Opsie 2*

	H_2	CO_2	H_2O	CO
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	x	0,3	0	0
Change (mol) *Verandering (mol)*	- 0,2	-0,2	+ 0,2	+ 0,2
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig(mol)*	x -0,2	0,1 ✓	0,2	0,2✓
Equilibrium concentration ($mol\cdot dm^{-3}$) *Ewewigskonsentrasie ($mol\cdot dm^{-3}$)*	$\frac{x-0,2}{10}$	0,01	0,02	0,02

ratio ✓
verhouding

Divide by 10✓
Deel deur 10

$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ ∴ $\frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)}$ ✓ = 4 ✓ ∴ x = 0,3 ∴ $n(H_2)$ = 0,3 mol ✓

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Option2/*Opsie2*

	H_2	CO_2	H_2O	CO
Initial concentration ($mol\cdot dm^{-3}$) *Aanvangskonsentrasie ($mol\cdot dm^{-3}$)*	$\frac{x}{10}$	0,03	0	0
Change in concentration ($mol\cdot dm^{-3}$) *Verandering in konsentrasie* ($mol\cdot dm^{-3}$)	0,02	0,02	0,02	0,02
Equilibrium concentration ($mol\cdot dm^{-3}$) *Ewewigskonsentrasie ($mol\cdot dm^{-3}$)*	$\frac{x}{10}-0,02$	0,01 ✓	0,02	0,02✓

Divide by 10✓

ratio ✓

$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ ∴ $\frac{(0,02)(0,02)}{(0,x-0,02)(0,01)}$ ✓ = 4 ✓ ∴ x = 0,3 ∴ $n(H_2)$ = 0,3 mol ✓ (8)

7.2.2 Exothermic ✓
A decrease in K_c implies: Lower product concentration / less products **OR**
higher reactant concentration / more reactants. ✓
Reverse reaction favoured. ✓ This means the forward reaction is exothermic.
Eksotermies ✓
'n Afname in K_c beteken: 'n laer produkkonsentrasie / minder produkte **OF**
hoër reaktanskonsentrasie / meer reaktanse. ✓
Terugwaartse reaksie bevoordeel. ✓ *Dus is die voorwaartse reaksie eksotermies.*

OR / *OF*
Exothermic
Decrease in K_c – reverse reaction is favoured. ✓
Increase in temperature favours the endothermic reaction. ✓
∴ Forward reaction is exothermic.
Eksotermies
Afname in K_c – terugwaartse reaksie word bevoordeel✓
Toename in temperatuur bevoordeel die endotermiese reaksie✓
∴ Voorwaartse reaksie *is eksotermies.*

(3)
[19]

QUESTION 8/*VRAAG 8*

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

8.2 Completes the circuit. / *Voltooi die stroombaan*. ✓

OR / *OF*
Maintains electrical neutrality. ✓
Handhaaf elektriese neutraliteit. ✓ (1)

8.3 $Pb \rightarrow Pb^{2+} + 2e^-$ ✓✓ (2)

8.4 Pb to Cu ✓ (1)

8.5 $Pb + Cu^{2+}$ ✓$\rightarrow Pb^{2+} + Cu$ ✓ Balancing ✓ (3)

8.6 Exothermic / *eksotermies* ✓ (1)

8.7 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$= 0,34$ ✓$- (-0,13)$ ✓
$E^{\theta}_{cell} = 0,47$ V ✓ (4)

8.8 Measurements not done at:
Temperature of 25 °C / 298 K ✓✓
Concentration of 1 mol·dm^{-3} ✓✓

Metings nie gedoen by:
Temperatuur van 25 °C / 298 K ✓✓
Konsentrasie van 1 mol·dm^{-3} ✓✓ (4)
[17]

QUESTION 9/*VRAAG 9*

9.1 A substance that forms free (positive and negative) ions when melted or dissolved. ✓✓
'n Stof wat vrye (positiewe en negatiewe) ione vorm wanneer gesmelt of opgelos word.

OR / OF
A liquid / solution / melted substance that conducts electricity through the movement of free ions. ✓✓
A vloeistof / oplossing / gesmelte stof wat elektrisiteit gelei deur die beweging van vry ione. ✓✓ (2)

9.2
9.2.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

9.2.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

9.3 Q ✓
Reduction takes place. ✓
Reduksie vind plaas. ✓ (2)

9.4
9.4.1 Cu is a stronger reducing agent ✓ than the $C\ell^-$ ions. ✓
Cu will be oxidised / loses electrons, ✓
resulting in the plate becoming eroded.

Cu is 'n sterker reduseermiddel ✓as die $C\ell^-$-ione. ✓
Cu sal geöksideer word / elektrone verloor, ✓
wat tot gevolg het dat die plaat verweer.

OR / *OF*
The $C\ell^-$ ion is a weaker reducing agent ✓ than Cu ✓
and will therefore not be oxidised. ✓
Die $C\ell^-$-ioon is 'n swakker reduseermidel ✓as Cu ✓
en sal dus nie geöksideer word nie. (3)

9.4.2 P ✓ (1)
[12]

QUESTION 10/*VRAAG 10*

10.1 Allows only positive ions (cations/Na^+ ions) to migrate to cathode half-cell. ✓
Laat slegs positiewe ione (katione/Na^+-ione) toe om na die katode-halfsel te migreer.✓

OR/*OF*

Prevents chloride ions/$C\ell^-$ ions from migrating to the cathode half-cell.
Verhoed dat chloried-ione/$C\ell^-$-ione na die katode-halfsel migreer. (1)

10.2 Y ✓
Chloride ions are oxidised at Y. ✓
Chloriedione word by Y geöksideer. ✓

OR/ OF
Chloride ions are negative and must be attracted to Y. ✓
Chloriedione is negatief en word deur Y aangetrek. ✓ (2)

10.3
10.31 Hydrogen / H_2 ✓
Waterstof / H_2 ✓ (1)

10.3.2 Chlorine / $C\ell_2$ ✓ (1)
Chloor / $C\ell_2$ ✓

10.3.3 Sodium hydroxide / NaOH ✓ (1)
Natriumhidroksied / NaOH ✓

10.4 $2H_2O + 2C\ell^-$ ✓ $\rightarrow H_2 + 2OH^- + C\ell_2$ ✓ Balancing ✓

OR / *OF*
$2H_2O + 2NaC\ell$ ✓ $\rightarrow H_2 + 2NaOH + C\ell_2$ ✓ Balancing ✓ (3)

10.5 Uses huge amounts of electricity / energy. ✓
Combustion of coal during generation of electricity releases huge amounts of carbon dioxide into atmosphere. ✓

Gebruik groot hoeveelhede elektrisiteit. ✓
Verbranding van steenkool tydens opwekking van elektrisiteit stel groot hoeveelhede koolstofdioksied in die atmosfeer vry. ✓ (2)

[11]

QUESTION 11 / *VRAAG 11*

11.1

11.1.1 Ostwald process / *Ostwaldproses* ✓ (1)

11.1.2 $2NO + O_2$ ✓→ $2NO_2$ ✓ Balancing ✓ (3)

11.2 H_2O / water ✓ (1)

11.3 $4NO_2 + \underline{O_2}$ ✓$+ 2H_2O \rightarrow 4HNO_3$ Balancing ✓ (2)

11.4.

Option 1 / *Opsie 1*	**Option 2 / *Opsie 2***
30% of 50 kg = 15 kg $\frac{3}{9}$ ✓ x 15 ✓ = 5 kg ✓	30% of 50 kg = 15 kg (33,33%)✓of 15 ✓ = 5 kg ✓
Option 3 / *Opsie 3*	
$\frac{3}{9}$ ✓ x 30 ✓= 10% 10% of 50 kg = 5 kg ✓	

(3)

11.5 **ANY ONE / *ENIGE EEN*:**

- Fish / Aquatic life dies. ✓
  Results in loss of income / jobs / food. ✓
  Vis / Waterlewe gaan dood. ✓
  Lei tot verlies aan inkomste / werk / voedsel. ✓
- Leads to poor water quality. ✓
  Not enough drinking water. / Poses health risk. ✓
  Lei tot swak waterkwaliteit. ✓
  Nie genoeg drinkwater nie. / Gesondheidsrisiko. ✓
- Water recreation areas become unattractive / dangerous. ✓
  Lack of income due to decline in tourism. / Less recreation facilities. ✓
  Waterontspanningsareas word onaansienlik/gevaarlik. ✓
  Verlies aan inkomste as gevolg van afname in toerisme. ✓

(2)
[12]

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