



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)**

SEPTEMBER 2017

MEMORANDUM

MARKS/PUNTE: 150

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

QUESTION 1/VRAAG 1

- | | | |
|------|------|-------------|
| 1.1 | C ✓✓ | (2) |
| 1.2 | C ✓✓ | (2) |
| 1.3 | B ✓✓ | (2) |
| 1.4 | D ✓✓ | (2) |
| 1.5 | D ✓✓ | (2) |
| 1.6 | A ✓✓ | (2) |
| 1.7 | B ✓✓ | (2) |
| 1.8 | B ✓✓ | (2) |
| 1.9 | C ✓✓ | (2) |
| 1.10 | D ✓✓ | (2) |
| | | [20] |

QUESTION 2/VRAAG 2

2.1.1 2,3-dimethylpent-2-ene (2,3-dimethyl-2-pentene) //
2,3-dimetielpent-2-een (2,3-dimetiel-2-penteen) (2)

2.1.2 3-bromo-4-ethylhexane //
3-bromo-4-etielheksaan / 3-broom-4-etielheksaan (2)

2.1.3
$$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C} \equiv \text{C}-\text{C}-\text{H} \\ | \\ \text{H} \end{array}$$
 (0 if functional group correct, but structure incorrect.)
(0 as die funksionele groep korrek is maar die struktuur verkeerd is.) (1)

2.2 Isomer are organic compounds/molecules with the same molecular formula but different structural formulas.
Isomere is organiese verbindings/molekules met dieselfde molekulêre formule maar verskillende struktuurformules (2)

2.3 B (hexanoic acid) //
B (heksanoësuur) (1)

2.4
$$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{H} \\ | \quad | \quad \text{O} \\ \text{H} \quad | \quad || \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$

Notes/Aantekeninge
Functional group: ✓
Whole structure correct: ✓

*Funksionele groep: ✓
Hele struktuur korrek: ✓*

(2)

Notes/Aantekeninge:

- Condensed or semi structural formula: /Gekondenseerde of semistruktuurformule: $\frac{1}{2}$
- All bonds shown, one or more H atoms omitted: Max. $\frac{1}{2}$
Alle bindings aangetoon, een of meer H-atome uitgelaat: Maks. $\frac{1}{2}$
- Wrong number of bonds e.g. C atoms not forming 4 bonds: $\frac{0}{2}$
Verkeerde aantal bindings bv. C-atome vorm nie 4 bindings nie: $\frac{0}{2}$

[10]

QUESTION 3/VRAAG 3

- 3.1 It is the temperature✓ where the vapour pressure equals the pressure of the (surrounding) atmosphere ✓//
Dit is die temperatuur✓ waar die dampdruk gelyk is aan die (omliggende) atmosferiese druk ✓ (2)
- 3.2.1 Different homologous series ✓/ type of bonds/ functional groups.
Verskillende homologe reekse✓/ soort verbindings/ funksionele groepe (1)
- 3.2.2 Boiling points✓ //
Kookpunte✓ (1)
- 3.2.3 Molecular mass✓ //
Molekulêre massa✓ (1)
- 3.3 A has hydrogen bonds ✓ //
A het waterstofbindings✓ (1)
- 3.4 There is hydrogen bonding (and London forces) in the alcohol / B✓
but dipole-dipole force (and London forces) in the ester / C. ✓
Hydrogen bonds are stronger than dipole-dipole forces.✓
More energy is needed to overcome the stronger intermolecular forces ✓ in the alcohol / B and therefore the boiling point is higher.
OR There are dipole-dipole forces between the ester molecules ✓
and hydrogen bonding between the alcohol molecules. ✓
Dipole-dipole forces are weaker than hydrogen bonding. ✓
Less energy needed to overcome the intermolecular forces between the molecules of the ester✓ therefore boiling point of ester is lower.
- Daar is waterstofbindings (en Londonkragte) in die alkohol / B✓maar dipool-dipoolkragte (en Londonkragte) tussen die estermolekules / C✓.
Waterstofbindings is sterker as dipool-dipoolkragte✓.
Meer energie word dus benodig om die sterker intermolekulêre kragte ✓ in alkohol / B te oorkom en daarom is die kookpunt hoër.
Die teenoorgestelde verduideliking vir die laer kookpunt van esters teenoor die alkohol is ook aanvaarbaar.* (4)
- 3.5.1 Chain isomerism✓ //
Kettingisomere✓ (1)
- 3.5.2 Higher than✓ //
Hoër as✓ (1)

[12]

QUESTION 4/VRAAG 4

4.1.1 A functional group is a bond or atom or a group of atoms ✓ which determines the chemical properties of a group of (organic) compounds ✓ // 'n Funksionele groep is 'n binding of 'n atoom of groep atome ✓ wat die (fisiese en) chemiese eienskappe van 'n groep (organiese) verbindings bepaal. ✓ (2)

4.1.2 $\begin{array}{c} \text{O} \\ || \\ -\text{C}- \end{array}$ ✓ (1)

4.2.1 $\begin{array}{c} \text{H} & \text{H} & \text{H} \\ | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{Cl} \\ | & | & | \\ \text{H} & \text{H} & \text{H} \end{array} \checkmark + \text{KOH/NaOH} \checkmark \rightarrow \begin{array}{c} \text{H} & & \text{H} \\ | & & | \\ \text{H}-\text{C}-\text{C}=\text{C} \\ | & | & | \\ \text{H} & \text{H} & \text{H} \end{array} \checkmark + \text{KCl/NaCl} \checkmark + \text{H}_2\text{O} \checkmark$ (5)

4.2.2 Elimination ✓ (dehydrohalogenation) // Eliminasië ✓ (dehidrohalogenering) (1)

4.2.3 Concentrated strong base (dissolved in ethanol) ✓ and (strong) heating ✓ // Gekonsentreerde sterk basis (opgelos in etanol) ✓ en (sterk) verhitting ✓ (2)

4.2.4 Propan-1-ol / 1-propanol ✓ (1)

4.2.5 Primary alcohol ✓ // primêre alkohol ✓ (1)

4.2.6 $\begin{array}{c} \text{H} & & \text{H} \\ | & & | \\ \text{H}-\text{C}-\text{C}=\text{C} \\ | & | & | \\ \text{H} & \text{H} & \text{H} \end{array} + \text{HBr} \rightarrow \begin{array}{c} \text{H} & \text{Br} & \text{H} \\ | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & | \\ \text{H} & \text{H} & \text{H} \end{array}$ (Hydrogen and bromine at the correct carbon atoms // waterstof en broom op die korrekte koolstowwe) (2)

4.2.7 Addition reaction ✓ // hydrohalogenation ✓ addisiereaksie ✓ // hidrohalogenering / hidrohalogenasie ✓ (1)

4.2.8 A pleasant smell will form ✓ // 'n aangename reuk sal vorm ✓. (1)

4.2.9 Esters ✓ (1)

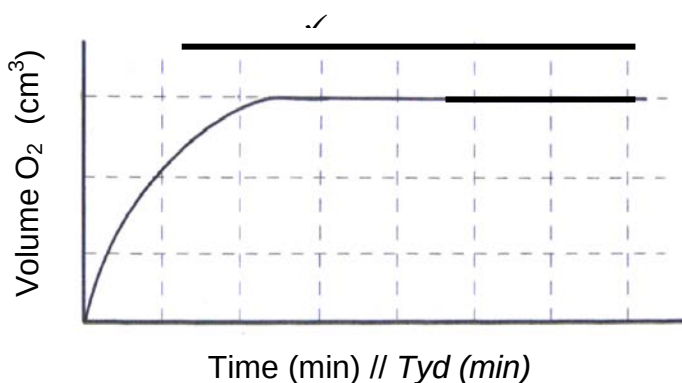
4.2.10 $\begin{array}{c} \text{O} & & \text{I} \\ || & & | \\ -\text{C}-\text{O}-\text{C}- \\ & & | \end{array}$ ✓ (1)

[19]

QUESTION 5/VRAAG 5

- 5.1 A catalyst is a chemical substance which increases the rate of a reaction ✓ without undergoing a permanent change itself ✓ //
'n Katalisator is 'n chemiese stof wat die tempo van 'n chemiese reaksie verhoog ✓ sonder om self 'n permanente verandering te ondergaan. ✓
OR/OF
A catalyst increases the rate of a reaction by providing an alternative route ✓ with lower activation energy. ✓ //
'n Katalisator verhoog die tempo van 'n reaksie deur 'n alternatiewe roete ✓ van laer aktiveringsenergie ✓ te verskaf. (2)

5.2.1



- Line A: smaller gradient, same volume ✓
Lyn A: kleiner gradiënt, dieselfde volume ✓ (1)

- 5.2.2 Line B: More products ✓ higher rate ✓ / steeper gradient, greater volume.
Lyn B: Meer produkte ✓ hoër tempo ✓ / steiler gradiënt, groter volume (2)

- 5.3 1 g ✓ (1)

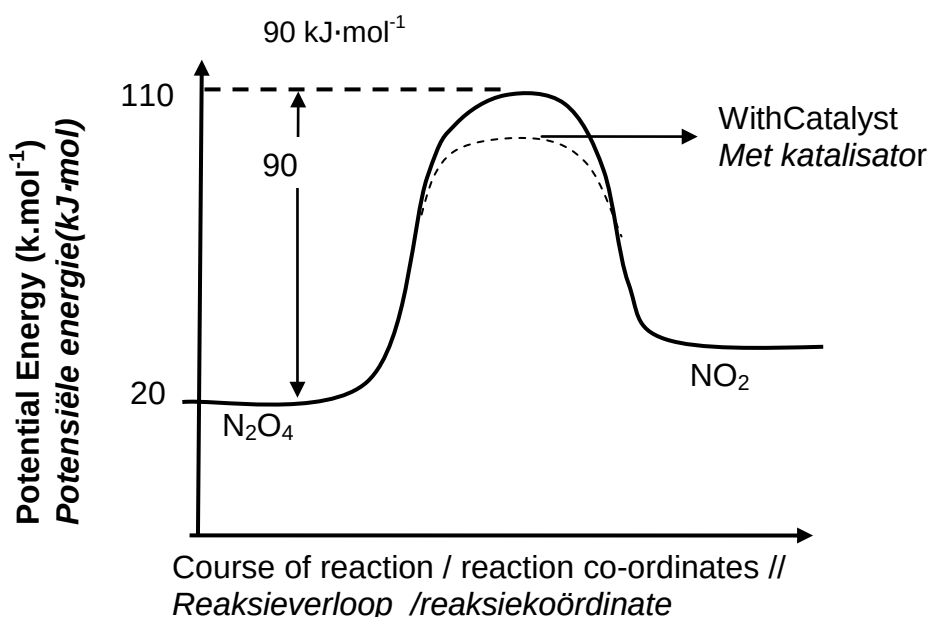
- 5.4 Reaction rate is the change in the concentration of the reactants or products ✓ per unit time. ✓ / amount of products formed or reactants used up per unit time //
Reaksietempo is die verandering in die konsentrasie van die reaktante of produkte ✓ per tydseenheid ✓ / hoeveelheid reaktante verbruik of produkte gevorm per tydseenheid. (2)

- 5.5 The minimum kinetic energy / activation energy is lowered ✓ therefore there are more effective collisions per unit time ✓ //
Die minimum kinetiese energie / aktiveringsenergie te word verlaag. ✓ en dus is daar meer effektiewe botsings per tydseenheid ✓ (2)

[10]

QUESTION 6/VRAAG 6

6.1.1



1 mark each: shape of graph, both 20 and 110 correctly indicated, activation energy correctly indicated (Teaching note: x-axis label NOT time)

1 punt elk: vorm van grafiek, 20 en 110 korrek aangedui, aktiveringsenergie korrek aangedui.

(3)

6.1.2 See dotted line on graph. ✓ // Sien stippellyn op grafiek. ✓

(1)

6.1.3 Forward ✓ //
Voorwaarts ✓

(1)

6.1.4 (The temperature increases) According to Le Chatelier's principle, the reaction that will lower the temperature of the reaction is favoured, ✓ thus the endothermic reaction ✓. The forward reaction is endothermic ✓ and therefore the forward reaction will be favoured.

(Die temperatuur neem toe.) Volgens Le Chatelier se Beginsel sal die sisteem die reaksie bevoordeel wat die temperatuur van die reaksie verlaag, ✓ d.w.s. die endotermiese reaksie. ✓

Die voorwaartse reaksie is endotermies ✓ en dus word die voorwaartse reaksie bevoordeel

(3)

6.2 Exothermic ✓
When temperature decreases, K_c decreases,
reverse reaction is favoured ✓

When temperature decreases, exothermic reaction is favoured, ✓
therefore the reverse reaction is exothermic. //

Eksotermies ✓

As temperatuur afneem verminder K_c , die terugwaartse reaksie word bevoordeel. ✓

As temperatuur verlaag word die eksotermiese reaksie bevoordeel ✓
dus is die terugwaartse reaksie eksotermies.

(3)

6.3.1 CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT AANTAL MOL GEBRUIK

Option 1 / Opsie 1:

$n(\text{H}_2\text{O})$ at equilibrium / *by ewewig* = 0,2 mol (given)

$n(\text{H}_2\text{O})$ formed / *gevorm* = $n(\text{CO})$ formed/*gevorm* = 0,2 (mol)
 $n(\text{H}_2)$ reacted = (0,2 mol): $n(\text{CO}_2)$ reacted = (0,2 mol) } ✓

At equilibrium / *By ewewig*:
 $n(\text{H}_2) = (x - 0,2)/(x - \text{change} / \text{verandering})$
 $n(\text{CO}_2) = 0,1 \text{ (mol)}/(0,3 - \text{change} / \text{verandering})$ } ✓
 $n(\text{H}_2\text{O}) = n(\text{CO}) = 0,2 \text{ (mol)}$ ✓

Equilibrium concentration / *Ewewigskonsentrasies*:

$$\left. \begin{aligned} c(\text{H}_2) &= \frac{n}{V} = \frac{x-0,2}{10} \\ c(\text{CO}_2) &= \frac{n}{V} = \frac{0,1}{10} \\ c(\text{H}_2\text{O}) &= \frac{n}{V} = \frac{0,2}{10} \\ c(\text{CO}) &= \frac{n}{V} = \frac{0,2}{10} \end{aligned} \right\} \checkmark$$

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \checkmark \quad \therefore \frac{(0,02)(0,02)\checkmark}{\left(\frac{x-0,2}{10}\right)(0,01)\checkmark} = 4 \checkmark$$

$$\therefore x = 0,3 \quad \therefore n(\text{H}_2) = 0,3 \text{ mol } \checkmark$$

Option 2/Opsie 2

	H ₂	CO ₂	H ₂ O	CO
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	x	0,3	0	0
Change (mol) <i>Verandering (mol)</i>	-0,2	-0,2	+0,2	+0,2
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig(mol)</i>	x-0,2	0,1 ✓	0,2	0,2 ✓
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x-0,2}{10}$	0,01	0,02	0,02

ratio✓

÷
10✓

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \quad \checkmark \quad \therefore \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \checkmark = 4 \quad \checkmark$$

$$\therefore x = 0,3 \quad \therefore n(\text{H}_2) = 0,3 \text{ mol } \checkmark$$

**CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK**

	H ₂	CO ₂	H ₂ O	CO
Initial concentration (mol·dm ⁻³) <i>Aanvangskonsentrasie (mol·dm⁻³)</i>	$\frac{x}{10}$	0,03	0	0
Change in concentration (mol·dm ⁻³) <i>Verandering in konsentrasie (mol·dm⁻³)</i>	0,02	0,02	0,02	0,02
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x}{10} - 0,02$	0,01 ✓	0,02	0,02 ✓

÷10✓

ratio✓

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \quad \checkmark \quad \therefore \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \checkmark = 4 \quad \checkmark$$

$$\therefore x = 0,3 \quad \therefore n(\text{H}_2) = 0,3 \text{ mol } \checkmark$$

(9)

6.3.2 Remains the same ✓//
Bly dieselfde ✓

(1)

QUESTION 7/VRAAG 7

7.1.1 An acid is a proton donor ✓
a base is a proton acceptor ✓//
'n Suur is 'n protonskenker ✓
'n basis is 'n protonontvanger ✓ (2)

7.1.2 Ampholyte /amphiprotic substance ✓//
Amfoliet /amfiprotiese stof ✓ (1)

7.1.3 B ✓✓ (2)

7.1.4 HCO_3^- ✓ (1)

7.1.5 It can donate two protons ✓//
dit kan twee protone skenk ✓ (1)

7.2.1 $M(\text{CaCO}_3) = 40 + 12 + 3(16) = 100 \text{ g} \cdot \text{mol}^{-1}$

$$n = \frac{m}{M} \checkmark = \frac{0,8}{100} \checkmark = 0,008 \text{ mol } \checkmark \quad \text{CaCO}_3 \text{ has reacted //}$$

CaCO₃ het gereageer

2 mol HCl reacts with// reageer met 1 mol CaCO_3 ✓

$\therefore 2(0,008) = 0,016 \text{ mol } \checkmark$ HCl reacted with // reageer met 1 mol CaCO_3 (5)

7.2.2 Initial // Aanvanklik: moles HCl: $n = cV \checkmark = 0,5 \times 0,06 \checkmark = 0,03 \text{ mol } \checkmark$

HCl left // oor = $0,03 - 0,016 = 0,014 \text{ mol } \checkmark$

(HCl is a strong acid and ionises completely thus $n(\text{H}^+) = 0,014 \text{ mol}$ //
HCl is 'n sterk suur en ioniseer volledig.: $\text{mol H}^+ = 0,014 \text{ mol}$)

$$c = \frac{n}{V} = \frac{0,014}{0,06} \checkmark = 0,23 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$\text{pH} = -\log [\text{H}^+] \checkmark = -\log (0,23) \checkmark = 0,64 \checkmark$ (9)

[21]

QUESTION 8/VRAAG 8

8.1 $\text{Ni} / \text{Ni}^{2+} (1\text{mol}\cdot\text{dm}^{-3}) // \text{Cu}^{2+} / \text{Cu} (1\text{mol}\cdot\text{dm}^{-3})$ (3)

8.2 negative //
negatief (1)

8.3 Cu // copper //
koper (1)

8.4 $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$
 $E_{\text{cell}}^{\theta} = 0,34 - (-0,27) = 0,61 \text{ V}$
 $E_{\text{cell}}^{\theta} > 0,5 \text{ V}$ the bulb should light up //
 die gloeilamp behoort te brand (6)
[11]

QUESTION 9/VRAAG 9

9.1 Y (1)

9.2 Hydrogen gas (accept bubbles/gas) //
Waterstofgas (aanvaar borrels / gas) (1)

9.3 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ ✓✓

Marking criteria // Nasienriglyne

$2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2 + 2\text{OH}^-$ (1/2)

$2\text{H}_2\text{O} + 2\text{e}^- \leftarrow \text{H}_2 + 2\text{OH}^-$ (2/2)

$\text{H}_2 + 2\text{OH}^- \rightleftharpoons 2\text{H}_2\text{O} + 2\text{e}^-$ (0/2)

$\text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{e}^-$ (0/2)

(2)

9.4 Cathode //
Katode (1)

9.5 Y to / na X (1)

9.6 Chloride ions //
chloriedione (1)

9.7 $2\text{H}_2\text{O} + 2\text{NaCl} \rightarrow \text{H}_2 + 2\text{NaOH} + \text{Cl}_2$ Bal
 Except / aanvaar $2\text{H}_2\text{O} + 2\text{Cl}^- \rightarrow \text{H}_2 + 2\text{OH}^- + \text{Cl}_2$ Bal (3)

[10]

QUESTION 10/VRAAG 10

10.1.1 Mass ratio of N:K:P is 3:2:1 ✓//
Massaverhoudingsamestelling van N:P:K is 3:2:1 ✓ (1)

10.1.2 Percentage of fertiliser (N,P and K) present ✓//
persentasie kunsmis (N, P en K) teenwoordig. ✓ (1)

10.2.1 $\% N = \frac{3}{6} \times 28 = 14\%$ ✓ (3)

10.2.2

OPTION 1/OPSIE 1 22% of 20 kg = 4,4 kg $\frac{4}{9} \times 4,4 = 1,96$ kg ✓	OPTION 2/OPSIE 2 $\frac{4}{9} \times 22 = 9,78\%$ $9,78\% \times 4,4 = 1,96$ kg ✓
OPTION 3/OPSIE 3 22% of 20 kg = 4,4 kg 44,44% of 4,4 = 1,96 kg ✓	

(3)

10.3 $2 \text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ ✓ (Bal)✓ (ignore / ignoreer ⇌) (3)

10.4 Contact process ✓//
Kontakproses ✓ (1)

10.5 Necessary for root development ✓//
Nodig vir ontwikkeling van wortels, ✓ (1)

10.6 Eutrofication ✓//
Eutrofikasie ✓ (1)

10.7 An excess of fertilizer washed into/landed up in the pond, causing increased algae growth ✓//
'n Oormaat van die kunsmis kon in die visdam beland het en alge groei aangehelp het. ✓ (1)

10.8 Fishes die, may cause illness(any relevant result)✓
//Omgewing begin stink en kan siektes veroorsaak.(Enige geldige gevolg wat op mense van toepassing is)✓ (1)
[16]

TOTAL/TOTAAL: 150