

MARKING GUIDELINES / NASIENRIGLYNE

EXAMINATION EKSAMEN	NATIONAL SENIOR CERTIFICATE NASIONALE SENIOR SERTIFIKAAT
GRADE / GRAAD	12
DATE / DATUM	MAY/JUNE 2026 / MEI/JUNIE 2026
SUBJECT / VAK	PHYSICAL SCIENCES / FISIESE WETENSKAPPE
PAPER / VRAESTEL	2
MARK TOTAL / PUNTETOTAAL	150
DURATION (HOURS) / TYDSDUUR (UUR)	3
NUMBER OF PAGES / AANTAL BLADSYE	14



SOUTH AFRICAN COMPREHENSIVE ASSESSMENT INSTITUTE
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QUESTION / VRAAG 1

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

[20]

QUESTION / VRAAG 2

- 2.1
- | | | |
|-------|------|-----|
| 2.1.1 | D ✓ | (1) |
| 2.1.2 | G ✓ | (1) |
| 2.1.3 | A ✓✓ | (2) |
- 2.2
- | | | |
|-------|-----------------|-----|
| 2.2.1 | Ester ✓✓ | |
| | <i>Ester</i> ✓✓ | (2) |
- 2.2.2 2-bromo-3,3-difluoro-2-methylbutane
- | | | |
|----------------|---------------------|-----------------------|
| ✓ | ✓ | ✓ |
| <u>2-bromo</u> | <u>3,3-difluoro</u> | <u>2-methylbutane</u> |
- (3)
- 2.2.3 $R - C \equiv C - R'$ ✓
- (1)



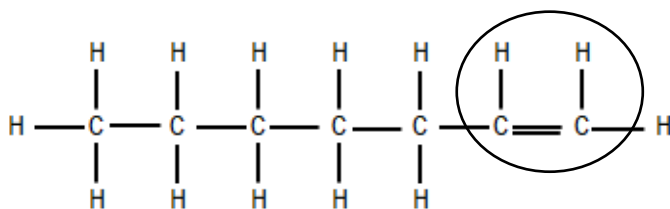
2.3

2.3.1 Carbonyl (group) ✓

Karboniel (groep) ✓

(1)

2.3.2



Marking guidelines /

Nasienriglyne:

✓ Double bond (C₁) /

Dubbelbinding (C₁)

✓ Whole structure correct /

Volledige struktuur is korrek

(2)

2.4 CH₂BrCHBr(CH₂)₄CH₃ ✓ **OR / OF** CH₂BrCHBrCH₂CH₂CH₂CH₂CH₃ ✓

(2)

2.5 Primary ✓

The C-atom that the -OH group is bonded to is attached to only one other C-atom. ✓

Primêre ✓

Die C-atoom waaraan die -OH-groep gebind is, is slegs aan een ander C-atoom gebind. ✓

(2)

2.6 $2\text{C}_4\text{H}_{10}(\text{g}) + 13\text{O}_2(\text{g}) \rightarrow 8\text{CO}_2(\text{g}) + 10\text{H}_2\text{O}(\text{g})$.

✓ Reactants / *Reaktante*

✓ Products / *Produkke*

✓ Balanced / *Balansering*

(3)

[20]



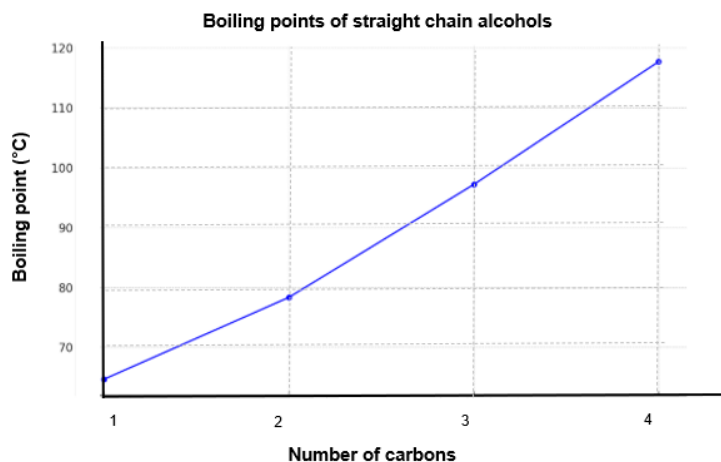
QUESTION / VRAAG 3

- 3.1 The temperature at which the vapour pressure equals atmospheric pressure. ✓✓

Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk. ✓✓

(2)

3.2



Marking guidelines / Nasienriglyne:

- ✓ Axes named correctly / *Asse korrek benoem*
- ✓ Points plotted correctly / *Punte korrek geplaas*
- ✓ Line of best fit / *Lyn van beste passing*

(3)

- 3.3 As the length of carbon chain increases, ✓ the boiling point increases. ✓

Indien die lengte van die koolstofketting toeneem, ✓ neem die kookpunt toe. ✓

(2)

3.4

- 3.4.1 -89°C ✓✓

(2)

- 3.4.2
- Both ethanol (B) and propan-2-ol has hydrogen bonds. ✓
 - Propan-2-ol has a greater molar mass/surface area than ethanol (B), making the IMF of propan-2-ol stronger. ✓
 - More energy required to overcome the IMF in propan-2-ol, ✓ hence higher melting point.

- *Beide etanol (B) en propan-2-ol besit waterstofbindings.* ✓
- *Propan-2-ol het 'n groter massa/kontak-oppervlak as etanol, dus is die intermolekulêre kragte sterker in propan-2-ol.* ✓
- *Meer energie benodig om intermolekulêre kragte in propan-2-ol te oorkom, ✓ dus 'n hoër smeltpunt.*

(3)

[12]



QUESTION / VRAAG 4

4.1 Hydrohalogenation ✓

Hidrohalogenering ✓

(1)

4.2 2-chlorohexane

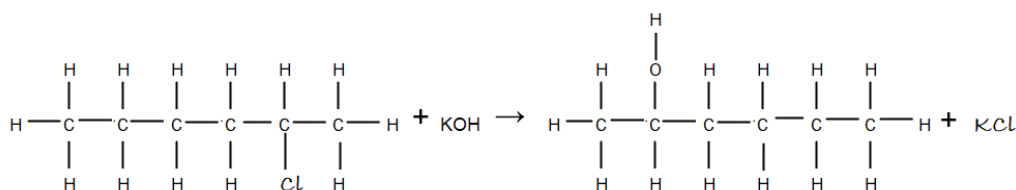
✓ ✓

2-chloroheksaan

(2)

4.3

4.3.1



Marking guidelines / Nasienriglyne:

- ✓ 2-chlorohexane / 2-chloroheksaan
- ✓ + KOH
- ✓ hexan-2-ol / heksan-2-ol
- ✓ + KCl

(4)

4.3.2 Diluted strong base dissolved in ethanol. ✓

Moderate heat ✓

Verdunde sterk basis opgelos in etanol. ✓

Matig verhit ✓

(2)

4.4 Dehydrohalogenation ✓

Dehidrohalogenering ✓

(1)

4.5

4.5.1 Compounds with the same molecular formula, ✓ but different structural formula. ✓

Organiese molekule met dieselfde molekulêre formule, ✓ maar verskillende struktuurformules. ✓

(2)

4.5.2 Positional (isomers) ✓

Posisie (isomere) ✓

(1)



4.6

4.6.1 Estrification **OR** condensation ✓

Estrifikasie OF kondensasie ✓

(1)

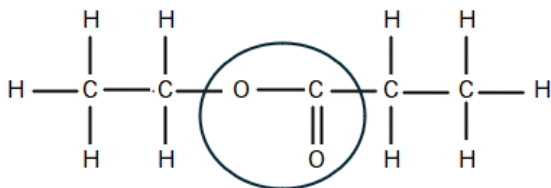
4.6.2 H_2SO_4 ✓

(1)

4.6.3 Water ✓

(1)

4.6.4 Ethyl propanoate / *Etielpropanoaat* ✓



Marking guidelines / Nasienriglyne:

- ✓ Functional group / *Funksionele groep*
- ✓ Balance of structure / *Res van die struktuur*
- ✓ Name / *Naam*

(3)

4.6.5 Pentanoic acid ✓

Pentanoësuur ✓

(1)

[20]



QUESTION / VRAAG 5

5.1 The change in concentration of reactants or products per unit time. ✓✓

OR The change in mass of reactants or products per unit time.

OR The change in volume of reactants or products per unit time.

OR The change in moles of reactants or products per unit time.

Die verandering in konsentrasie van reaktante of produkte per eenheidstyd. ✓✓

OF Die verandering in massa van die reaktante of produkte per eenheidstyd.

OF Die verandering in volume van die reaktante of produkte per eenheidstyd.

OF Die verandering in aantal mol van die reaktante of produkte per eenheidstyd. (2)

5.2 Calcium carbonate (CaCO_3) ✓

At 60–80s there is still CaCO_3 in the container, as the mass remains constant. ✓

Calciumkarbonaat (CaCO_3) ✓

Tussen 60–80 s is daar nog CaCO_3 in die houer oor, want massa bly konstant. ✓ (2)

5.3 Rate of reaction = $\frac{\Delta \text{mass}}{\Delta \text{time}}$

$$-1,07 \checkmark = \frac{54-X \checkmark}{30-0 \checkmark}$$

$$X = 86,1 \text{ g} \checkmark$$

(4)

5.4 0 dm^3 (zero) ✓

(1)

5.5 • A decrease in the concentration of the reactants/ HCl . ✓

• decrease the number of molecules per unit volume. ✓

• Less effective collisions per unit time occur. ✓

• Rate of reaction decreases.

• 'n Afname in die konsentrasie van die reaktante/ HCl . ✓

• afname in die aantal molekule per volume eenheid. ✓

• Minder effektiewe botsings per tydseenheid vind plaas. ✓

• Reaksietempo neem af.

(3)

5.6

5.6.1 Remain the same ✓

Bly dieselfde ✓

(1)

5.6.2 Increase ✓

Toename ✓

(1)

[14]



QUESTION / VRAAG 6

6.1

- 6.1.1 Dynamic chemical equilibrium is when the rate of the forward reaction equals the rate of the reverse reaction. ✓✓

Dit is 'n dinamiese ewewig wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. ✓✓ (2)

- 6.1.2 Colour changes from yellow to orange/more orange. ✓✓

Kleur verander van geel na oranje/meer oranje. ✓✓ (2)

- 6.1.3 Dichromate (ion)/ $\text{Cr}_2\text{O}_7^{2-}$ ✓

Dichromaam (ioon)/ CrO_7^{2-} ✓ (1)

- 6.1.4 Exothermic ✓

Eksotermies ✓ (1)

6.2

- 6.2.1 When the equilibrium in a closed system is disturbed, ✓ the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓

Wanneer die ewewig in 'n geslote sisteem versteur word, ✓ stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel. ✓ (2)

- 6.2.2 $\text{N}_{2(g)}$ added/Concentration N_2 increased. ✓

$\text{N}_{2(g)}$ word bygevoeg/Die konsentrasie van N_2 neem toe. ✓✓ (1)

- 6.2.3 Increase ✓

Toeneem ✓ (1)

- 6.2.4
- According to Le Chatelier's Principle the system will favour the reaction with less moles to decrease the pressure. ✓
 - The system will therefore favour the forward reaction. ✓
 - Producing more NH_3 and less H_2 and N_2 . ✓

- Volgens Le Chatelier se Beginsel sal die sisteem die reaksie bevoordeel wat minder mol vorm om die druk te verlaag. ✓
 - Die sisteem bevoordeel dus die voorwaartse reaksie. ✓
 - Vorm meer NH_3 en minder H_2 en N_2 . ✓
- (3)



6.2.5

	H ₂	N ₂	NH ₃
Ratio	3	1	2
Initial (mol)	x	4,5 ✓	0
Change (mol)	9	3	6
Equilibrium (mol)	$x - 9$	1,5 ✓	6
Concentration at equilibrium (dm ³ .mol ⁻¹)	$\frac{x - 9}{0,5}$	3	12

$$n_{N_2} = \frac{m}{M}$$

$$n_{N_2} = \frac{126}{28} = 4,5 \text{ mol}$$

$$c_{N_2} = \frac{n}{V}$$

$$3 = \frac{n}{0,5}$$

$$n = 1,5 \text{ mol}$$

$$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]} \quad \checkmark$$

$$0,22 = \frac{(12)^2}{\left(\frac{x-9}{0,5}\right)^3 (3)} \quad \checkmark$$

$$\left(\frac{x-9}{0,5}\right)^3 = \frac{144}{0,66}$$

$$\left(\frac{x-9}{0,5}\right) = 6,020134 \dots \quad (6,02)$$

$$x = 12,01006 \dots \quad \checkmark \quad (12,01)$$

$$n_{H_2} = \frac{m}{M}$$

$$m_{H_2} = 12,01006 \dots \times 2$$

$$m_{H_2} = 24,02 \text{ g} \quad \checkmark \quad (24,02 \text{ g})$$

OR / OF

Marking guidelines / Nasienriglyne:

✓ $n_i(N_2) = 4,5 \text{ mol}$

✓ $n_f(N_2) = 1,5$

✓ Use ratio for change in mol / *Gebruik ratio vir verandering in aantal mol*

✓ Calculate / *Bereken* : $[] \div 0,5$

✓ K_c expression / *Uitdrukking*

✓ Substitution into / *Substitueer in* : K_c

✓ Value / *Waarde* $x = 12,01006$. (number of moles)

✓ Answer / *Antwoord* $m = 24,02 \text{ g}$

(8)



Using concentrations:

	H ₂	N ₂	NH ₃	
Ratio	3	1	2	
Initial (c)	x	9 ✓	0	
Change (c)	18	6 ✓	12	✓
Equilibrium (c)	$x - 18$	3	12	✓

$$c_{N_2} = \frac{m}{MV}$$

$$= \frac{126}{(28)(0,5)}$$

$$= 9 \text{ mol} \cdot \text{dm}^{-3}$$

$$\Delta c_{N_2} = 6 \text{ mol} \cdot \text{dm}^{-3}$$

$$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]} \quad \checkmark$$

$$0,22 \checkmark = \frac{(12)^2}{(x-18)^3(3)} \quad \checkmark$$

$$(x - 18)^3 = 218,181818 \dots$$

$$x = 24,55 \text{ mol} \cdot \text{dm}^{-3}$$

$$c_{H_2} = \frac{m}{MV}$$

$$24 = \frac{m}{2 \times 0,5}$$

$$m_{H_2} = 24 \text{ g} \quad \checkmark$$

Marking guidelines / Nasienriglyne:

✓ $c_i(N_2) = 9 \text{ mol} \cdot \text{dm}^{-3}$

✓ $c_{\text{change}}(N_2) = 6 \text{ mol} \cdot \text{dm}^{-3}$

✓ Use ratio for change in concentration / *Gebruik ratio vir verandering in aantal mol*

✓ Calculate equilibrium c / *Bereken ewewig c*

✓ Kc expression / *uitdrukking*

✓ Substitution into Kc (LS)

✓ Substitution into Kc (RS)

✓ Answer / *Antwoord* $m = 24,55 \text{ g}$

(8)

[21]



QUESTION / VRAAG 7

7.1

7.1.1 An acid is a substance that produces hydrogen ions (H^+)/ hydronium ions (H_3O^+) when it dissolves in water. ✓✓

'n Suur is 'n stof wat waterstof-ione (H^+)/hidroniumione (H_3O^+) vorm wanneer dit in water oplos. ✓✓

(2)

7.1.2 Strong acid ✓

Sterk suur ✓

(1)

7.1.3 A strong acid ionises completely in water ✓ and forms a high concentration of H^+ ions. ✓

OR

A strong acid ionises completely in water ✓ as indicated by the large K_a value. ✓

Sterk sure ioniseer volledig in water ✓ om 'n hoë konsentrasie H_3O^+ -ione te vorm. ✓

OF

Sterk sure ioniseer volledig in water ✓ soos hoë K_a aan toon. ✓

(2)

7.1.4 SO_4^{2-} (accept/aanvaar HSO_4^-) ✓

(1)

7.2

7.2.1 The reaction of a salt with water. ✓✓

Die reaksie van 'n sout met water. ✓✓

(2)

7.2.2 $CH_3COO^-(aq) + H_2O(l) \rightleftharpoons CH_3COOH(aq) + OH^-(aq)$

✓(reactants / *reaktant*) ✓(products / *produk*) ✓(balanced / *balanseer*)

(3)

7.3

7.3.1 $n_{H_2SO_4} : n_{H^+} = 1 : 2$ ✓ (Use of ratio / *Gebruik van ratio*)

$pH = -\log [H_3O^+]$ ✓

$0,65 = -\log [H_3O^+]$

$10^{-0,65} = [H_3O^+]$

$[H_3O^+] = 0,2239 \text{ mol} \cdot \text{dm}^{-3}$

$\therefore [H_2SO_4] = \frac{1}{2} \times 0,224$ (allocate mark here if ratio not shown separately)

(*allokeer punt hier indien ratio nie apart gewys word nie*)

$= 0,112 \text{ mol} \cdot \text{dm}^{-3}$ ✓ (0,11)

(4)



$$7.3.2 \quad c_{\text{H}_2\text{SO}_4(\text{initial})} = \frac{n}{V} \checkmark$$

$$0,25 = \frac{n}{0,024} \checkmark$$

$$n = 6 \times 10^{-3} \text{ mol}$$

$$n_{\text{H}_2\text{SO}_4(\text{excess})} = 0,112 \times \left(\frac{X+24}{1000} \right) \checkmark$$

$$\begin{aligned} n_{\text{H}_2\text{SO}_4(\text{reacted})} &= 6 \times 10^{-3} - 0,112 \times \left(\frac{X+24}{1000} \right) \checkmark \\ &= 3,312 \times 10^{-3} - 1,12 \times 10^{-4} X \end{aligned}$$

$$\begin{aligned} n_{\text{NaOH}(\text{initial})} &= (0,15) \left(\frac{X}{1000} \right) \text{ mol } \checkmark \\ &= 1,5 \times 10^{-4} X \end{aligned}$$

$$n_{\text{H}_2\text{SO}_4(\text{reacted})} : n_{\text{NaOH}(\text{reacted})} = 1 : 2 \checkmark$$

$$\begin{aligned} 2(3,312 \times 10^{-3} - 1,12 \times 10^{-4} X) &= 1,5 \times 10^{-4} X \checkmark \\ X &= 1,771 \times 10 \text{ cm}^3 \quad (17,71 \text{ cm}^3) \checkmark \end{aligned}$$

(8)

[23]



QUESTION / VRAAG 8

8.1 $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$
 $0,78 \checkmark = 0,34 - E_{\text{anode}}^{\theta} \checkmark$
 $E_{\text{anode}}^{\theta} = -0,44 \text{ V} \checkmark$

Anode is iron / *Anode is yster* (Fe^{2+})

Metal A is iron / *Metaal A is yster* $\checkmark$

(4)

- 8.2
- According to Le Chatelier's principle, if the product concentration is increased, $\checkmark$
 - the reaction will favour the reverse reaction. $\checkmark$
 - Thereby lowering the cell potential. $\checkmark$
 - *Volgens Le Chaterlier se beginsel sal, indien die konsentrasie van die produk toeneem, $\checkmark$*
 - *die terugwaartse reaksie bevoordeel word. $\checkmark$*
 - *Dus verlaag die selpotensiaal. $\checkmark$*

(3)

- 8.3 Reaction would be spontaneous. $\checkmark$
 $E_{\text{cell}}^{\theta} > 0 \checkmark$

Die reaksie is spontaan. $\checkmark$

$E_{\text{cell}}^{\theta} > 0 \checkmark$

(2)

[9]



QUESTION / VRAAG 9

9.1 Electrical (energy) to chemical (energy) ✓ (must name BOTH)
Elektriese (energie) na chemiese (energie) ✓ (moet beide noem) (1)

9.2 Electrolyte ✓
 Elektroliet ✓ (1)

9.3 P ✓ (1)

9.4 Any two of the following / Enige twee van die volgende:
 Gold / Goud ✓
 Silver / Silwer ✓
 Platinum
 Tin
 Lead / Lood (2)

9.5 $Q = I \times t$
 $= 2 \times (8 \times 3600) \checkmark$
 $= 57\,600 \text{ C}$

number (e^-) = $\frac{57600}{1,6 \times 10^{-19}} \checkmark$
 $= 3,6 \times 10^{23} e^-$

$n = \frac{N}{N_A}$
 $= \frac{3,6 \times 10^{23}}{6,02 \times 10^{23}} \checkmark$
 $= 0,598 \text{ mol}$

2 mol e^- deposits: 1 mol Cu
 $\therefore n(\text{Cu}) = \frac{0,598}{2} \checkmark$
 $= 0,299 \text{ mol Cu}$

$n = \frac{m}{M}$
 $m = 0,299 \times 63,5 \checkmark = 18,987 \text{ g} \checkmark$

Marking guidelines / Nasienriglyne:

✓ 8×3600 (28 800s)

✓ $\frac{57600}{1,6 \times 10^{-19}}$

✓ $\frac{3,6 \times 10^{23}}{6,02 \times 10^{23}}$

✓ USE of ratio / GEBRUIK van ratio 2 : 1
 $\frac{0,598}{2}$

✓ $= 0,299 \times 63,5$

✓ Answer / Antwoord

(6)

[11]

GRAND TOTAL / GROOTTOTAAL: [150]