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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 2022

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 19 pages.
*Hierdie nasienriglyne bestaan uit 19 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

- 2.1
- 2.1.1 C & D ✓ (1)
- 2.1.2 Functional/*Funksionele* ✓ (1)
- 2.1.3 C_nH_{2n-2} ✓ (1)
- 2.1.4 Hydroxyl (group)/*Hidroksiel(groep)* ✓ (1)
- 2.2
- 2.2.1 4-bromo-3,3-dimethylhexane/*4-bromo-3,3-dimetielheksaan* ✓✓✓

Marking criteria:

- Correct stem i.e. hexane. ✓
- All substituents (bromo and dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam d.i. heksaan.* ✓
- *Alle substituenten (bromo en dimetiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

(3)

- 2.2.2 4,4-dimethylpent-2-yne/4,4-dimethyl-2-pentyne ✓✓
 4,4-dimetielpent-2-yn/4,4-dimetiel-2-pentyn

Marking criteria/Nasienkriteria:

- Correct stem and substituents: dimethyl and pentyne ✓
Korrekte stam en substituent: dimetiel en pentyn
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓
IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.

(2)

- 2.2.3 Butanal/Butanaal ✓✓

Marking criteria/Nasienkriteria:

- Correct functional group: -al /
Korrekte funksionele groep: -aal ✓
- IUPAC name correct/IUPAC-naam korrek ✓

(2)

2.3

- 2.3.1 Esterification/condensation ✓
Esterifikasie/verestering/kondensasie

(1)

- 2.3.2 $M(C_3H_6O) = 58 \text{ g} \cdot \text{mol}^{-1}$

molecular mass of molecular formula

molecular mass empirical formula

$$= \frac{116}{58} = 2$$

Compound S = $C_6H_{12}O_2$ ✓

$C_2H_4O_2$ ✓✓

Marking criteria/Nasienkriteria:

- $C_6H_{12}O_2$ ✓
- $C_2H_4O_2$ ✓✓
- If only correct answer given ✓✓✓
Indien slegs korrekte antwoord gegee

NOTE/LET WEL

- Condensed or structural formula/Gekondenseerde of struktuurformule:
 Max./Maks. $\frac{2}{3}$

(3)

[15]

QUESTION 3/VRAAG 3

3.1.1 Ketone/Ketoon ✓ (1)

3.1.2 Functional group/homologous series ✓
Funksionele groep/homoloë reeks (1)

3.1.3

Marking criteria:

- Compare structures. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓
- State the difference in melting point. ✓

Nasienkriteria:

- Vergelyk strukture. ✓
- Vergelyk die sterkte van intermolekulêre kragte. ✓
- Vergelyk die energie benodig om intermolekulêre kragte te oorkom. ✓
- Noem die verskil in smeltpunte. ✓

Pentan-2-one/C

- **Structure:**
Longer chain length/less branched/less compact/less spherical/larger surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
Stronger/more intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
More energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓
- Higher melting point. ✓

NOTEIF higher boiling point - Max. $\frac{3}{4}$

OR

3-methylbutanone/D

- **Structure:**
Shorter chain length/more branched/more compact more spherical/smaller surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
Weaker/less intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
Less energy needed to overcome or break intermolecular forces/Van der Waals force/dipole-dipole forces. ✓
- Lower melting point. ✓

NOTEIF lower boiling point - Max. $\frac{3}{4}$

Pentan-2-oon/C

- **Struktuur:**
Langer kettinglengte/minder vertak/minder kompak/minder sferies/groter oppervlak (waaroor intermolekulêre kragte werk). ✓
- **Intermolekulêre kragte:**
Sterker/meer intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte. ✓
- Meer energie benodig om intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte te oorkom/breek. ✓
- Hoër smeltpunt. ✓

LET WEL**INDIEN** hoër kookpunt - Maks. $\frac{3}{4}$ **OF****3-metielbutanoon/D**

- **Struktuur:**
Korter kettinglengte/meer vertak/meer kompak/meer sferies/kleiner oppervlak (waaroor intermolekulêre kragte werk). ✓
- **Intermolekulêre kragte:**
Swakker/minder intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte. ✓
- **Energie:**
Minder energie benodig om intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte te oorkom/breek. ✓
- Laer smeltpunt. ✓

LET WEL**INDIEN** laer kookpunt - Maks. $\frac{3}{4}$

(4)

3.2.1

Marking criteria/Nasienkriteria

If any one of the underlined key words phrases in the **correct context** (vapour pressure) is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde of frases in die **korrekte konteks** (dampdruk) uitgelaat is, trek 1 punt af.

The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓

Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. ✓✓

(2)

3.2.2

Marking criteria/Nasienkriteria:

- Dependent and independent variables correctly identified. ✓
Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.
- Correct relationship between dependent and independent variables stated. ✓
Korrekte verwantskap tussen die afhanklike en onafhanklike veranderlikes gestel.

Vapour pressure decreases with increase in number of C atoms/chain length. ✓✓

Dampdruk neem af met toename in aantal C-atome/kettinglengte.

OR/OF

Vapour pressure increases with decrease in number of C atoms/chain length.

Dampdruk neem toe met afname in aantal C-atome/kettinglengte.

(2)

3.2.3 Hexan-1-ol/1-Hexanol
✓✓✓
Heksan-1-ol/1-Heksanol

Marking criteria/Nasienkriteria

- Correct chain length i.e. hex ✓
Korrekte kettinglengte d.i. heks
- **IF** hexanol/**INDIEN** heksanol
Max/Maks: $\frac{2}{3}$
- Whole name correct./Volledige naam korrek. $\frac{3}{3}$

(3)

3.2.4 Increases/Toeneem ✓

(1)

[14]**QUESTION 4/VRAAG 4**

4.1 Tertiary/Tersiêre ✓

The halogen/bromine/functional group (-X) is bonded to a C atom that is bonded to three other C atoms/ a tertiary C atom. ✓

Die halogeen/broom/funksionele groep (-X) is gebind aan 'n C-atoom wat aan drie ander C-atome gebind is/ 'n tersiêre C-atoom.

OR/OF

The functional group ($\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{X/Br} \end{array}$) is bonded to three other C atoms.

$$\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{X/Br} \end{array}$$

Die funksionele groep ($\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{X/Br} \end{array}$) is gebind aan drie ander C-atome.

$$\begin{array}{c} | \\ -\text{C}- \\ | \\ \text{X/Br} \end{array}$$

(2)

4.2.1 Concentrated strong base ✓

OR

Concentrated NaOH/KOH/LiOH/sodium hydroxide/ potassium hydroxide/ lithium hydroxide

OR

Strong base/NaOH/KOH/LiOH/sodium hydroxide/ potassium hydroxide/lithium hydroxide in ethanol.

Gekonsentreerde sterk basis

OF

Gekonsentreerde NaOH /KOH/ LiOH /natriumhidroksied/ kaliumhidroksied/ litiumhidroksied

OF

Sterk basis/NaOH /KOH/ LiOH / natriumhidroksied/kaliumhidroksied/litiumhidroksied in etanol

(1)

4.2.2 Elimination/dehydrohalogenation/dehydrobromination ✓

Eliminasie/dehidrohalogenering/dehidrohalogenasie/dehidrobrominasie/ dehidrobromonering

(1)

4.2.3

Marking criteria:

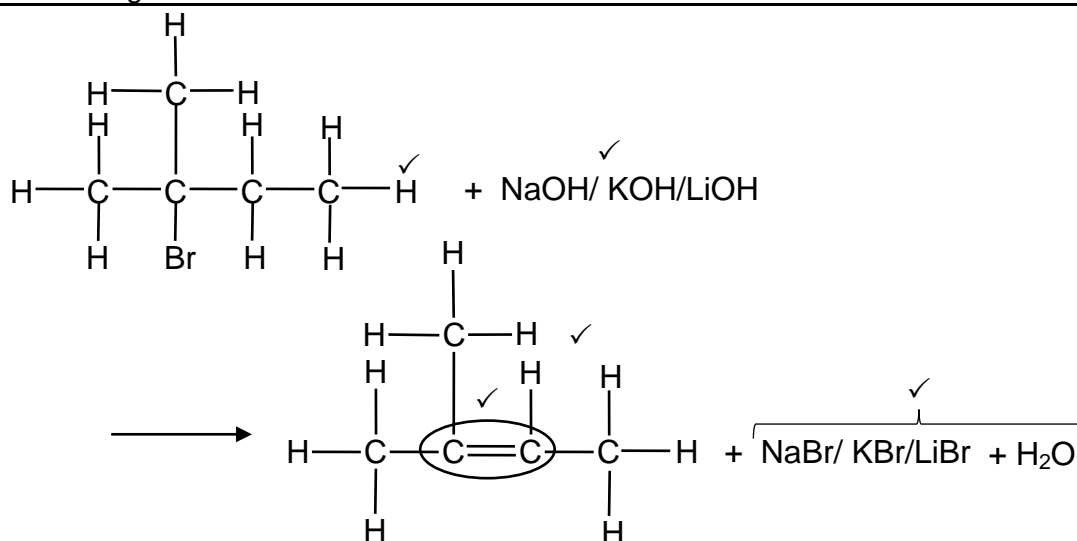
- Whole structural formula correct for compound A. ✓
- React (2-bromo-2-methylbutane) with NaOH/KOH/LiOH. ✓
- Functional group of alkene correct. ✓
- Whole structural formula of alkene correct. ✓
- NaBr/KBr/LiBr + H₂O ✓

Nasienkriteria:

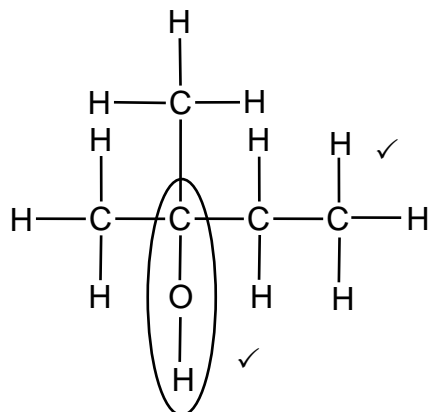
- Hele struktuurformule vir verbinding A korrek. ✓
- Reageer (2-bromo-2-metielbutaan) met NaOH/KOH/LiOH. ✓
- Funksionele groep van alkeen korrek. ✓
- Hele struktuurformule van alkeen korrek. ✓
- NaBr/KBr/LiBr + H₂O ✓

IF/INDIEN

- Any error e.g. omission of H atoms, condensed or semi structural formula/Enige fout bv. weglating van H-atome, gekondenseerde of semi-struktuurformule: Max./Maks. 3/5
- Any additional reactants or products /Enige addisionele reaktanse of produkte: Max./Maks. 4/5
- Molecular formulae used:/Molekulêre formule gebruik: Max./Maks. 2/5
- No or incorrect inorganic reactants or products:/ Geen of verkeerde anorganiese reaktanse of produkte: Max./Maks. 3/5
- Marking rule 6.3.10/Nasienreël 6.3.10



4.3.1

**Marking criteria/Nasienkriteria:**

- Functional group correct ✓
Funksionele groep korrek
- Whole structure correct ✓
Hele struktuur korrek

(2)

- 4.3.2 Water/H₂O ✓ (1)
- 4.3.3 Hydration/Hidrasie ✓ (1)
- 4.4.1 Substitution/Hydrolysis/Substitusie/Hidrolise ✓ (1)
- 4.4.2 Dilute strong base ✓
OR: Dilute NaOH/KOH/LiOH/sodium hydroxide/potassium hydroxide/lithium hydroxide
OR: NaOH(aq)/KOH(aq)/LiOH(aq)
OR: (Add) water/H₂O
 Verdunde sterk basis
OF: Verdunde NaOH/KOH/LiOH/natriumhidroksied/ kaliumhidroksied/ litiumhidroksied
OF: NaOH(aq)/KOH(aq)/LiOH(aq)
OF: (Voeg) water/H₂O (by) (1)

[15]**QUESTION 5/VRAAG 5**

- 5.1 B ✓
 • The catalyst provides an alternative route of lower activation energy. ✓
 • More molecules have enough/sufficient (kinetic) energy./More molecules have (kinetic) energy equal to or higher than the activation energy. ✓
 • More effective collisions per unit time./Higher frequency of effective collisions. ✓
 • Die katalisator verskaf 'n alternatiewe roete van laer aktiveringsenergie.
 • Meer molekule het genoeg/voldoende (kinetiese) energie./Meer molekule het (kinetiese) energie gelyk aan of groter hoër as die aktiveringsenergie.
 • Meer effektiewe botsings per eenheidtyd./Hoër frekwensie van effektiewe botsings. (4)
- 5.2 Y ✓✓ (2)
- 5.3
 5.3.1 560 (cm³) / 0,56 dm³ ✓✓ (2)

5.3.2 POSITIVE MARKING FROM QUESTION 5.3.1.

POSITIEWE NASIEN VANAF VRAAG 5.3.1.

<p>Marking criteria:</p> <p>(a) Substitute <u>24 000 and 560/24 and 0,56</u> $\text{in } n = \frac{V}{V_m} \checkmark$</p> <p>(b) USE mol ratio: $n(\text{H}_2\text{O}) : n(\text{O}_2) = 2 : 1 \checkmark$</p> <p>(c) Substitute <u>18 and $n(\text{H}_2\text{O})$</u> in $m = nM \checkmark$</p> <p>(d) Final answer: 0,83 g \checkmark Range: 0,72 to 0,9 g</p>	<p>Nasienkriteria:</p> <p>(a) Vervang <u>24 000 en 560/24 en 0,56</u> $\text{in } n = \frac{V}{V_m} \checkmark$</p> <p>(b) GEBRUIK molverhouding: $n(\text{H}_2\text{O}) : n(\text{O}_2) = 2 : 1 \checkmark$</p> <p>(c) Vervang <u>18 en $n(\text{H}_2\text{O})$</u> in $m = nM \checkmark$</p> <p>(d) Finale antwoord: 0,83 g \checkmark Gebied: 0,72 tot 0,9 g</p>
<p>OPTION 1/OPSIE 1</p> $n(\text{O}_2) = \frac{V}{V_m}$ $= \frac{560}{24\,000} \checkmark \text{(a)}$ $= 0,023 \text{ mol (0,0233)}$ <p style="text-align: center;">↓</p> $n(\text{H}_2\text{O}) = 2n(\text{O}_2)$ $n(\text{H}_2\text{O}) = 2(0,023) \checkmark \text{(b)}$ $= 0,046 \text{ mol (0,0467)}$ <p style="text-align: center;">↓</p> $m = nM \checkmark \text{(c)}$ $= 0,046 \times 18$ $= 0,83 \text{ g} \checkmark \text{(d)}$	<p>OPTION 2/OPSIE 2</p> $\left. \begin{array}{l} 1 \text{ mol} \dots\dots 24\,000 \text{ cm}^3 \\ x \text{ mol} \dots\dots 560 \text{ cm}^3 \end{array} \right\} \checkmark \text{(a)}$ $x = 0,023 \text{ mol (0,0233)}$ <p style="text-align: center;">↓</p> $n(\text{H}_2\text{O}) = 2n(\text{O}_2)$ $n(\text{H}_2\text{O}) = 2(0,023) \checkmark \text{(b)}$ $= 0,046 \text{ mol (0,0467)}$ <p style="text-align: center;">↓</p> $m = nM \checkmark \text{(c)}$ $= 0,0466 \times 18$ $= 0,83 \text{ g} \checkmark \text{(d)}$

(4)

5.4

5.4.1 0 (g·s⁻¹) / zero / nul \checkmark

(1)

5.4.2 Greater than/Groter as \checkmark

(1)

5.4.3

<p>Marking criteria</p> <p>a) Substitute 0,9 g in $\frac{m}{M}$ ✓</p> <p>b) Substitute 32 in $\frac{m}{M}$ ✓</p> <p>c) USE mol /rate ratio: $n(\text{H}_2\text{O}_2) : n(\text{O}_2) = 2 : 1$ ✓</p> <p>d) Substitute $2,1 \times 10^{-3}$ and $n(\text{H}_2\text{O}_2)$ in rate formula ✓ OR: Substitute rate O_2 ($1,05 \times 10^{-3}$) and $n(\text{O}_2)$ in rate formula OR: Substitute rate O_2 ($0,0336 \text{ g}\cdot\text{s}^{-1}$) in rate formula</p> <p>e) Final correct answer: 26,67 (s) ✓ Range: 26,67 to 28,57 (s)</p>	<p>Nasienkriteria:</p> <p>a) Vervang 0,9 g in $\frac{m}{M}$ ✓</p> <p>b) Vervang 32 in $\frac{m}{M}$ ✓</p> <p>c) GEBRUIK mol-/tempoverhouding: $n(\text{H}_2\text{O}_2) : n(\text{O}_2) = 2 : 1$ ✓</p> <p>d) Vervang $2,1 \times 10^{-3}$ en $n(\text{H}_2\text{O}_2)$ in tempoformule ✓ OF: Vervang tempo O_2 ($1,05 \times 10^{-3}$) en $n(\text{O}_2)$ in tempoformule OF: Vervang tempo O_2 ($0,0336 \text{ g}\cdot\text{s}^{-1}$) in tempoformule</p> <p>e) Finale korrekte antwoord: 26,67 (s) ✓ Gebied: 26,67 tot 28,57 (s)</p>
<p>OPTION 1/OPSIE 1</p> $n(\text{O}_2) = \frac{m}{M}$ $= \frac{0,9}{32} \checkmark \text{(a)}$ $= 0,028 \text{ mol (0,0281)}$ $n(\text{H}_2\text{O}_2) = 2n(\text{O}_2)$ $= 2(0,028) \checkmark \text{(c)}$ $= 0,056$ $\text{rate/tempo} = \frac{\Delta n}{\Delta t}$ $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t} \checkmark \text{(d)}$ $\Delta t = 26,67 \text{ (s)} \checkmark \text{(e)}$	<p>OPTION 2/OPSIE 2</p> <p>1 mol 32 g ✓(b)</p> <p>x mol 0,9 g ✓(a)</p> $x = 0,0275 \text{ mol}$ $n(\text{H}_2\text{O}_2) = 2n(\text{O}_2)$ $= 2(0,0275) \checkmark \text{(c)}$ $= 0,056 \text{ mol}$ $\text{rate/tempo} = \frac{\Delta n}{\Delta t}$ $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t} \checkmark \text{(d)}$ $\Delta t = 26,67 \text{ (s)} \checkmark \text{(e)}$
<p>OPTION 3/OPSIE 3</p> $n(\text{O}_2) = \frac{m}{M}$ $= \frac{0,9}{32} \checkmark \text{(a)}$ $= 0,028 \text{ mol (0,0281)}$ $\text{Rate}(\text{O}_2) = \frac{1}{2} \text{ rate}(\text{H}_2\text{O}_2)$ $= \frac{1}{2} (2,1 \times 10^{-3}) \checkmark \text{(c)}$ $= 1,05 \times 10^{-3}$ $\text{rate/tempo} = \frac{\Delta n}{\Delta t}$ $1,05 \times 10^{-3} = \frac{0,028}{\Delta t} \checkmark \text{(d)}$ $\Delta t = 26,67 \text{ (s)} \checkmark \text{(e)}$	<p>OPTION 4/OPSIE 4</p> $\text{rate H}_2\text{O}_2 = 2,1 \times 10^{-3} \text{ mol}\cdot\text{s}^{-1}$ $\text{Rate}(\text{O}_2) = \frac{1}{2} \text{ rate}(\text{H}_2\text{O}_2)$ $= \frac{1}{2} (2,1 \times 10^{-3}) \checkmark \text{(c)}$ $= 1,05 \times 10^{-3}$ <p>In one second:</p> $n(\text{O}_2) = \frac{m}{M}$ $1,05 \times 10^{-3} = \frac{m}{32} \checkmark \text{(b)}$ $m(\text{O}_2) = 0,0336 \text{ g}$ $\text{rate} = 0,0336 \text{ g}\cdot\text{s}^{-1}$ $\text{rate} = \frac{\Delta m}{\Delta t} \checkmark \text{(a)}$ $0,0336 = \frac{0,9 - 0}{\Delta t} \checkmark \text{(d)}$ $\Delta t = 26,79 \text{ (s)} \checkmark \text{(e)}$

(5)
[19]

QUESTION 6/VRAAG 6

6.1

Marking criteria/Nasienkriteria

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

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

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk.

(2)

6.2

$$K_c = \frac{[\text{CS}_2]}{[\text{S}]^2} \quad \checkmark$$

$$9,4 = \frac{0,5}{[\text{S}]^2} \quad \checkmark$$

$$[\text{S}] = 0,23 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

NOTE/LET WEL

- Wrong K_c expression/Verkeerde K_c -uitdrukking: Max./Maks. $\frac{2}{4}$
- No K_c expression but correct substitution/Geen K_c -uitdrukking but korrekte vervanging: Max./Maks. $\frac{3}{4}$

(4)

6.3

Increases/Neem toe ✓

(1)

6.4

- Increasing/doubling the volume will decrease the pressure. ✓
- The reaction that produces a greater number of moles/amount of gas (1 mole gas to 2 moles gas) is favoured. ✓
- Reverse reaction is favoured. ✓
- Verhoging/verdubbeling van volume sal die druk verlaag.
- Die reaksie wat 'n groter aantal mol/hoeveelheid gas (1 mol gas na 2 mol gas) lewer word bevoordeel.
- Terugwaartse reaksie word bevoordeel.

(3)

6.5 **POSITIVE MARKING FROM 6.2./POSITIEWE NASIEN VAN VRAAG 6.2.****CALCULATIONS USING CONCENTRATION****BEREKENINGE WAT KONSENTRASIE GEBRUIK****Marking criteria:**

- (a) Initial concentration is halved. ✓
 (b) Change in $[CS_2]$ and $[S]$ **USING** ratio: $S : CS_2 = 2 : 1$ ✓
 (c) Equilibrium $[S] = \text{initial } [S] + \text{change in } [S]$ ✓
 (d) Equilibrium $[CS_2] = \text{initial } [CS_2] - \text{change in } [CS_2]$ ✓
 (e) **CORRECT** final answer. ✓

Nasienkriteria:

- (a) Aanvanklike konsentrasie is gehalveer. ✓
 (b) Verandering in $[CS_2]$ en $[S]$ deur **GEBRUIK** van verhouding $S : CS_2 = 2 : 1$ ✓
 (c) Ewewig $[S] = \text{aanvanklike } [S] + \text{verandering in } [S]$ ✓
 (d) Ewewig $[CS_2] = \text{aanvanklike } [CS_2] - \text{verandering in } [CS_2]$ ✓
 (e) **KORREKTE** finale antwoord. ✓

OPTION 1/OPSIE 1

	S	CS_2	
Initial concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Aanvangskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$0,23 \times \frac{1}{2}$ $= 0,115$	$0,5 \times \frac{1}{2}$ $= 0,25$	✓(a)
Change in concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Verandering in konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$2x$	x	✓(b)
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$0,115 + 2x$	$0,25 - x$	
	✓(c)	✓(d)	

$$K_c = \frac{[CS_2]}{[S]^2}$$

$$9,4 = \frac{0,25 - x}{(0,115 + 2x)^2} \quad \checkmark(e)$$

Wrong K_c expressionVerkeerde K_c - uitdrukking. Max./Maks. $\frac{4}{5}$

CALCULATIONS USING NUMBER OF MOLES**BEREKENINGE WAT GETAL MOL GEBRUIK****Marking criteria:**

- (a) $n(\text{initial}) = c(\text{initial}) \times 2$. ✓
 (b) Change in $n(\text{S})$ and $n(\text{CS}_2)$ **USING** ratio: $\text{S} : \text{CS}_2 = 2 : 1$ ✓
 (c) Equilibrium $n(\text{S}) = \text{initial } n(\text{S}) + \text{change in } n(\text{S})$ ✓
 (d) Equilibrium $n(\text{CS}_2) = \text{initial } n(\text{CS}_2) - \text{change in } n(\text{CS}_2)$ ✓
 (e) **CORRECT** final answer. ✓

Nasienkriteria:

- (a) $n(\text{aanvanklik}) = c(\text{aanvanklik}) \times 2$ ✓
 (b) Verandering in $n(\text{S})$ en $n(\text{CS}_2)$ deur **GEBRUIK** van verhouding: $\text{S} : \text{CS}_2 = 2 : 1$ ✓
 (c) Ewewig $n(\text{S}) = \text{aanvanklike } n(\text{S}) + \text{verandering in } n(\text{S})$ ✓
 (d) Ewewig $n(\text{CS}_2) = \text{aanvanklike } n(\text{CS}_2) - \text{verandering in } n(\text{CS}_2)$ ✓
 (e) **KORREKTE** finale antwoord. ✓

OPTION 2/OPSIE 2

	S	CS ₂	
Initial quantity (mol) Aanvangshoeveelheid (mol)	0,46	1	✓(a)
Change (mol) Verandering (mol)	8x	4x	✓(b)
Quantity at equilibrium (mol)/ Hoeveelheid by ewewig (mol)	0,46 + 8x	1 - 4x	✓(c) ✓(d)
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{0,46 + 8x}{4}$	$\frac{1 - 4x}{4}$	

$$K_c = \frac{[\text{CS}_2]}{[\text{S}]^2}$$

$$9,4 = \frac{\frac{1 - 4x}{4}}{\left(\frac{0,46 + 8x}{4}\right)^2} \quad \checkmark(e)$$

Wrong K_c expressionVerkeerde K_c -uitdrukking: Max./Maks. $\frac{4}{5}$

(5)

6.6

- 6.6.1 (Chemical) equilibrium / Rate of the forward and reverse reactions are equal. / Concentrations of reactants and products are constant. ✓
 (Chemiese) ewewig / Tempo van voorwaartse en terugwaartse reaksie dieselfde./Konsentrasies van reaktante en produkte is konstant. (1)

- 6.6.2 Increase in the amount/concentration of S/reactant **OR** S was added. ✓
 Toename in die hoeveelheid/konsentrasie S/reaktans **OF** S is bygevoeg. (1)

- 6.6.3 Decrease in temperature/Verlaging in temperatuur ✓ (1)

- 6.6.4
- The rates of the forward and reverse reactions decrease. ✓
 - The reverse reaction is favoured / faster than the forward reaction.
- OR**
- The forward reaction decreases more. ✓
- A decrease in temperature favours the exothermic reaction. ✓
 - *Die voorwaartse en terugwaartse reaksietempo neem af.*
 - *Die terugwaartse reaksie word bevoordeel/is vinniger as die voorwaartse reaksie.*
- OF**
- Die voorwaartse reaksie neem meer af.*
- *'n Verlaging in die temperatuur bevoordeel die eksotermiese reaksie.*

(3)
[21]

QUESTION 7/VRAAG 7

7.1

- 7.1.1 (An acid is a) proton donor/ H^+ (ion) donor. ✓✓ (2 or 0)
(*'n Suur is 'n*) protonskenker/ H^+ (-ioon) skenker. (2 of 0) (2)

- 7.1.2 (Weak acids) ionise/dissociate incompletely/partially (in water)/have a low K_a value. ✓
(*Swak sure*) ioniseer/dissosieer onvolledig/gedeeltlik (in water)/het 'n lae K_a -waarde. (1)

- 7.1.3 H_2O ✓ and CH_3COO^- ✓ (2)

7.2

- 7.2.1 $n(NaOH) = cV$ ✓
 $n = \frac{(0,167)(0,300)}{1000}$ ✓
 $\therefore n(NaOH) = 0,05 \text{ mol}$ ✓ ($5 \times 10^{-2} \text{ mol}$) (3)

7.2.2

<p>Marking criteria:</p> <p>a) Any formula: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+]$ / $\text{pOH} = -\log[\text{OH}^-]$ / $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>b) Substitute 11,4 in $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>c) Substitute calculated $[\text{H}_3\text{O}^+]$ in $[\text{H}_3\text{O}^+][\text{OH}^-] / 2,6$ in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>d) Final answer: $2,51 \times 10^{-3} \text{ mol}\cdot\text{dm}^{-3}$ ✓ $(0,003 \text{ mol}\cdot\text{dm}^{-3})$</p>	<p>Nasienkriteria:</p> <p>a) Enige formule: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+]$ / $\text{pOH} = -\log[\text{OH}^-]$ / $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>b) Vervang 11,4 in $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>c) Vervang berekende $[\text{H}_3\text{O}^+]$ in $[\text{H}_3\text{O}^+][\text{OH}^-] / 2,6$ in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>d) Finale antwoord: $2,51 \times 10^{-3} \text{ mol}\cdot\text{dm}^{-3}$ ✓ $(0,003 \text{ mol}\cdot\text{dm}^{-3})$</p>
<p>OPTION 1/OPSIE 1</p> <p>$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $11,4 \checkmark \text{ (b)} = -\log[\text{H}_3\text{O}^+]$ OR/OF $[\text{H}_3\text{O}^+] = 10^{-11,4}$ Any one/Enige een ✓ (a) $[\text{H}_3\text{O}^+] = 3,98 \times 10^{-12}$</p> <p>$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ $\checkmark \text{ (c)}$ $(3,98 \times 10^{-12})[\text{OH}^-] = 1 \times 10^{-14}$ $[\text{OH}^-] = 2,51 \times 10^{-3} \text{ mol}\cdot\text{dm}^{-3} \checkmark \text{ (d)}$ (0,003)</p> <p>OPTION 2/OPSIE 2</p> <p>$\text{pH} + \text{pOH} = 14$ $11,4 + \text{pOH} = 14 \checkmark \text{ (b)}$ Any one/Enige een ✓ (a) $\text{pOH} = 2,6$</p> <p>$\text{pOH} = -\log[\text{OH}^-] \checkmark$ $2,6 \checkmark \text{ (c)} = -\log[\text{OH}^-]$ $[\text{OH}^-] = 2,51 \times 10^{-3} \text{ mol}\cdot\text{dm}^{-3} \checkmark \text{ (d)}$ (0,003)</p>	

(4)

7.2.3 POSITIVE MARKING FROM QUESTION 7.2.1. AND 7.2.2.

POSITIEWE NASIEN VANAF VRAAG 7.2.1. EN 7.2.2.**Marking criteria:**

- a) Substitute $[\text{NaOH}] = 0,00251 \text{ mol} \cdot \text{dm}^{-3}$ (answer from Q7.2.2) and 0,8 in $c = \frac{n}{V}$ ✓
- b) Subtract: $n(\text{NaOH})_{\text{initial}}$ (from Q7.2.1) – $n(\text{NaOH})_{\text{mixture}}$ ✓✓
- c) Use of ratio: $n(\text{OH}^-) = n(\text{CH}_3\text{COOH})$ ✓
- d) Substitute 0,5 and $\Delta n(\text{CH}_3\text{COOH})$ [calculated by subtraction] into $c = \frac{n}{V}$ ✓
- e) Final correct answer: $0,096 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Range: 0,095 to $0,1 \text{ mol} \cdot \text{dm}^{-3}$

Nasienkriteria:

- a) Vervang $[\text{NaOH}] = 0,00251 \text{ mol} \cdot \text{dm}^{-3}$ (antwoord van Q7.2.2) en 0,8 in $c = \frac{n}{V}$ ✓
- b) Trek af: $n(\text{NaOH})_{\text{aanvanklik}}$ (vanaf Q7.2.1) – $n(\text{NaOH})_{\text{mengsel}}$ ✓✓
- c) Gebruik verhouding: $n(\text{OH}^-) = n(\text{CH}_3\text{COOH})$ ✓
- d) Vervang 0,5 en $\Delta n(\text{CH}_3\text{COOH})$ [bereken deur aftrekking] in $c = \frac{n}{V}$ ✓
- e) Finale korrekte antwoord: $0,096 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Gebied: 0,095 tot $0,1 \text{ mol} \cdot \text{dm}^{-3}$

$$n(\text{NaOH})_{\text{mixture}} = cV$$

$$= 0,00251 \times 0,8 \text{ ✓(a)}$$

$$= 0,002 \text{ mol (0,0024)}$$

$$n(\text{NaOH})_{\text{reacted}} = 0,05 - 0,002 \text{ ✓✓(b)}$$

$$= 0,048 \text{ mol (0,0476)}$$

$$n(\text{NaOH})_{\text{reacted}} = n(\text{CH}_3\text{COOH})_{\text{used}}$$

$$= 0,048 \text{ mol ✓(c)}$$

$$[\text{CH}_3\text{COOH}] = \frac{n}{V}$$

$$= \frac{0,048}{0,5} \text{ ✓(d)}$$

$$= 0,096 \text{ mol} \cdot \text{dm}^{-3} \text{ ✓(e)}$$

$$(0,0952)$$

NOTE/LET WEL**IF/INDIEN:**

- $\frac{c_a V_a}{c_b V_b} = \frac{1}{1}$ Max./Maks. $1/6$
- Answer from Q7.2.1 substituted in $c = \frac{n}{V}$ to obtain an answer of $0,01 \text{ mol} \cdot \text{dm}^{-3}$.
Antwoord van Q7.2.1 vervang in $c = \frac{n}{V}$ om $0,01 \text{ mol} \cdot \text{dm}^{-3}$ as antwoord te kry.
Max./Maks. $1/6$

(6)
[18]

QUESTION 8/VRAAG 8

8.1

8.1.1 Zn/zinc/sink ✓

(1)

8.1.2

MnO_4^- is a stronger oxidising agent ✓ than $\text{Zn}^{2+}/\text{Zn}(\text{II})$ ions ✓ and will oxidise Zn ✓ (to $\text{Zn}^{2+}/\text{Zn}(\text{II})$ ions).

MnO_4^- is 'n sterker oksideermiddel as $\text{Zn}^{2+}/\text{Zn}(\text{II})$ -ione en sal Zn oksideer (na $\text{Zn}^{2+}/\text{Zn}(\text{II})$ -ione).

OR/OF

$\text{Zn}^{2+}/\text{Zn}(\text{II})$ ion is a weaker oxidising agent ✓ than MnO_4^- ✓ and therefore MnO_4^- will be reduced ✓ (to $\text{Mn}^{2+}/\text{Mn}(\text{II})$ ions).

$\text{Zn}^{2+}/\text{Zn}(\text{II})$ ione is 'n swakker oksideermiddel as MnO_4^- en dus word MnO_4^- gereduseer (to $\text{Mn}^{2+}/\text{Mn}(\text{II})$ -ione).

(3)

8.2

8.2.1 Provides path for movement of ions. / Completes the circuit. / Ensures electrical neutrality in the cell. / Restore charge balance. ✓

Verskaf pad vir beweging van ione. / Voltooi die stroombaan. / Verseker elektriese neutraliteit in die sel. / Herstel balans van lading.

(1)

8.2.2 Mn to/na Ni ✓✓

(2)

8.2.3

OPTION 1/OPTION 1

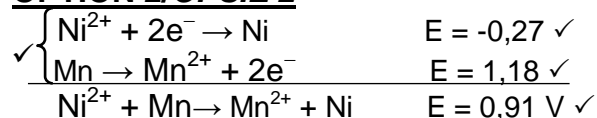
$$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$$

$$= -0,27 \checkmark - (-1,18) \checkmark$$

$$= 0,91 \text{ V} \checkmark$$

NOTE/LET WEL

- Accept any other correct formula from the data sheet. /Aanvaar enige ander korrekte formule vanaf gewensblad.
- Any other formula using unconventional abbreviations, e.g. $E_{\text{cell}}^{\theta} = E_{\text{OA}}^{\theta} - E_{\text{RA}}^{\theta}$ followed by correct substitutions: /Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E_{\text{sel}}^{\theta} = E_{\text{OM}}^{\theta} - E_{\text{RM}}^{\theta}$ gevolg deur korrekte vervangings $3/4$

OPTION 2/OPSIE 2

(4)

8.2.4 $\text{Ni}^{2+} + \text{Mn} \checkmark \rightarrow \text{Mn}^{2+} + \text{Ni} \checkmark$ Bal. ✓**Marking criteria/Nasienkriteria:**

- Reactants ✓ Products ✓ Balancing ✓
- Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/Ignoreer ⇌ and phases/en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(3)

8.2.5 Increase/Toeneem ✓

(1)

[15]

QUESTION 9/VRAAG 9**9.1 ANY ONE:**

- The chemical process in which electrical energy is converted to chemical energy. ✓✓ (2 or 0)
- The use of electrical energy to produce a chemical change.
- The process during which an electric current passes through a solution / molten ionic compound.

ENIGE EEN:

- Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie. (2 of 0)
- Die gebruik van elektriese energie om 'n chemiese verandering te veroorsaak.
- Die proses waar 'n elektriese stroom deur 'n oplossing / gesmelte ioniese verbinding beweeg.

(2)

9.2.1 $\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Cr}$ ✓✓**Marking criteria/Nasienkriteria:**

- $\text{Cr} \leftarrow \text{Cr}^{3+}(\text{aq}) + 3\text{e}^-$ ($\frac{2}{2}$)
 $\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{Cr}$ ($\frac{1}{2}$)
 $\text{Cr} \rightleftharpoons \text{Cr}^{3+}(\text{aq}) + 3\text{e}^-$ ($\frac{0}{2}$)
 $\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \leftarrow \text{Cr}$ ($\frac{0}{2}$)
- Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.
- If charge (+) omitted on Cr^{3+} /Indien lading (+) weggelaat op Cr^{3+} :
 Example/Voorbeeld: $\text{Cr}^3(\text{aq}) + 3\text{e}^- \rightarrow \text{Cr}$ Max./Maks: $\frac{1}{2}$

(2)

9.2.2 $q = I\Delta t$ ✓

$$= (2,5)(10 \times 60 \times 60) \checkmark$$

$$= 9 \times 10^4 \text{ C } \checkmark \quad (90\,000 \text{ C})$$

(3)

9.2.3 POSITIVE MARKING FROM QUESTION 9.2.2.

POSITIEWE NASIEN VANAF VRAAG 9.2.2.

<p>Marking criteria:</p> <p>a) Substitute $1,6 \times 10^{-19} \text{ C}$ in $n = \frac{Q}{e}$ ✓</p> <p>b) $N(\text{Cr}) = n(\text{electrons})$ divide by 3 ✓</p> <p>c) $n(\text{Cr}) = N(\text{Cr})$ divided by N_A ✓</p> <p>d) Substitution of 52 into $n = \frac{m}{M}$ ✓</p> <p>e) $m(\text{Cr}) + 2,2$ ✓</p> <p>f) Final answer: 18,32 (g) ✓ Range: 18,32 to 18,40 (g)</p>	<p>Nasienkriteria:</p> <p>a) Vervang $1,6 \times 10^{-19} \text{ C}$ in $n = \frac{Q}{e}$ ✓</p> <p>b) $N(\text{Cr}) = n(\text{elektrone})$ gedeel deur 3 ✓</p> <p>c) $n(\text{Cr}) = N(\text{Cr})$ gedeel deur N_A ✓</p> <p>d) Vervang 52 in $n = \frac{m}{M}$ ✓</p> <p>e) $m(\text{Cr}) + 2,2$ ✓</p> <p>f) Finale antwoord: 18,32 (g) ✓ Gebied: 18,32 tot 18,40 (g)</p>
<p>OPTION 1/OPSIE 1</p> $n = \frac{Q}{e} / \frac{Q}{q_e}$ $= \frac{9 \times 10^4}{1,6 \times 10^{-19}} \checkmark (\text{a})$ $= 5,63 \times 10^{23} \text{ electrons}$ $N(\text{Cr atoms}) = \frac{5,63 \times 10^{23}}{3} \checkmark (\text{b})$ $= 1,88 \times 10^{23}$ $n(\text{Cr}) = \frac{N}{N_A}$ $= \frac{1,88 \times 10^{23}}{6,02 \times 10^{23}} \checkmark (\text{c})$ $= 0,31 \text{ mol}$ $n(\text{Cr}) = \frac{m}{M}$ $m(\text{Cr}) = 0,31 \times 52 \checkmark (\text{d})$ $= 16,12 \text{ g}$ $m(\text{X}) = 16,12 + 2,2 \checkmark (\text{e})$ $= 18,32 \text{ (g)} \checkmark (\text{f})$	<p>OPTION 2/OPSIE 2</p> $n(\text{Cr}) = \frac{9 \times 10^4}{3 \times 96\,500} \checkmark \checkmark (\text{a \& c})$ $\checkmark (\text{b})$ $= 0,31 \text{ mol}$ \downarrow $m(\text{Cr}) = 0,31 \times 52 \checkmark (\text{d})$ $= 16,12 \text{ g}$ \downarrow $m(\text{X}) = 16,12 + 2,2 \checkmark (\text{e})$ $= 18,32 \text{ (g)} \checkmark (\text{f})$

(6)
[13]

TOTAL/TOTAAL: 150