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 substituente (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 substituente: 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 ✓
*Esterfikasie/verestering/kondensasie* (1)

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

$$\frac{\text{molecular mass of molecular formula}}{\text{molecular mass empirical formula}} = \frac{116}{58} = 2$$

**Marking criteria/*Nasienkriteria*:**
- $C_6H_{12}O_2$ ✓
- $C_2H_4O_2$ ✓✓
- If only correct answer given ✓✓✓
  *Indien slegs korrekte antwoord gegee*

Compound S = $C_6H_{12}O_2$ ✓
$C_2H_4O_2$ ✓✓

**NOTE/*LET WEL***
- Condensed or structural formula/*Gekondenseerde of struktuurformule*:
  Max./*Maks.* $^2/_3$

(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. ✓

**NOTE**
**IF** higher boiling point - Max. $^{3}/_{4}$

**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.✓

**NOTE**
**IF** lower boiling point - Max. $^{3}/_{4}$

***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.* $^3/_4$

***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.* $^3/_4$ (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*: $^{2}/_{3}$
- Whole name correct./*Volledige naam korrek.* $^{3}/_{3}$

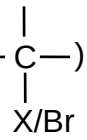
(3)

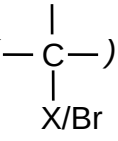
3.2.4 Increases/*Toeneem* ✓ (1)
**[14]**

**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 (  ) is bonded to three other C atoms.

*Die funksionele groep (*  *) is gebind aan drie ander C-atome.*

(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/litium-hidroksied in etanol* (1)

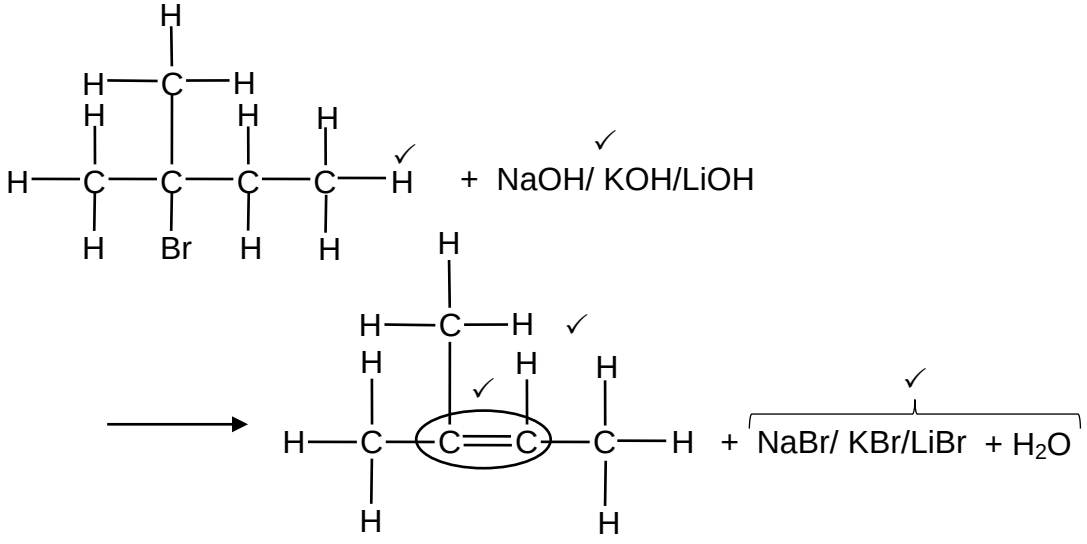
4.2.2 Elimination/dehydrohalogenation/dehydrobromination ✓
*Eliminasie/dehidrohalogenering/dehidrohalogenasie/dehidrobrominasie/ dehidrobromonering* (1)

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 + $H_2O$ ✓

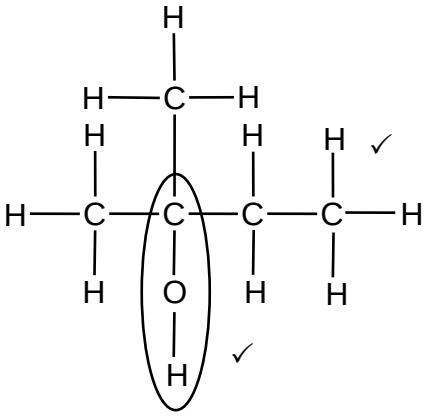
***Nasienkriteria:***
- *Hele struktuurformule vir verbinding A korrek.* ✓
- *Reageer (2-bromo-2-metielbutaan) met NaOH/KOH/LiOH.* ✓
- *Funksionele groep van alkeen korrek.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *NaBr/KBr/LiBr + $H_2O$* ✓

**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:/M*olekulêre 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*




(5)

4.3.1



**Marking criteria/*Nasienkriteria*:**
- Functional group correct ✓
  *Funksionele groep korrek*
- Whole structure correct ✓
  *Hele struktuur korrek*

(2)

4.3.2 Water/$H_2O$ ✓ (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/$H_2O$

*Verdunde sterk basis*
***OF:*** *Verdunde NaOH/KOH/LiOH/natriumhidroksied/ kaliumhidroksied/ litiumhidroksied*
***OF*****:** *NaOH(aq)/KOH(aq)/LiOH(aq)*
***OF:*** *(Voeg) water/$H_2O$ (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 ($cm^3$) / 0,56 $dm^3$ ✓✓ (2)

5.3.2 **POSITIVE MARKING FROM QUESTION 5.3.1.**
***POSITIEWE NASIEN VANAF VRAAG 5.3.1.***

| **Marking criteria:** | ***Nasienkriteria:*** |
|---|---|
| (a) Substitute 24 000 and 560/24 and 0,56 in $n = \frac{V}{V_m}$ ✓<br>(b) USE mol ratio:<br>$n(H_2O) : n(O_2) = 2 : 1$ ✓<br>(c) Substitute 18 and $n(H_2O)$ in $m = nM$ ✓<br>(d) Final answer: 0,83 g ✓<br>Range: 0,72 to 0,9 g | *(a) Vervang 24 000 en 560/24 en 0,56 in $n = \frac{V}{V_m}$* ✓<br>*(b) GEBRUIK molverhouding:*<br>*$n(H_2O) : n(O_2) = 2 : 1$* ✓<br>*(c) Vervang 18 en $n(H_2O)$ in $m = nM$* ✓<br>*(d) Finale antwoord: 0,83 g* ✓<br>*Gebied:* 0,72 *tot 0,9 g* |
| **OPTION 1/*OPSIE 1*** | **OPTION 2/*OPSIE 2*** |
| $n(O_2) = \frac{V}{V_m}$<br>$= \frac{560}{24\,000}$ ✓**(a)**<br>= 0,023 mol (0,0233)<br>↓<br>$n(H_2O) = 2n(O_2)$<br>$n(H_2O) = 2(0,023)$ ✓**(b)**<br>= 0,046 mol (0,0467)<br>↓<br>$m = nM$ ✓**(c)**<br>= 0,046 x 18<br>= 0,83 g ✓**(d)** | 1 mol …….24 000 $cm^3$<br>x mol …….560 $cm^3$ ✓**(a)**<br>x = 0,023 mol (0,0233)<br>↓<br>$n(H_2O) = 2n(O_2)$<br>$n(H_2O) = 2(0,023)$ ✓**(b)**<br>= 0,046 mol (0,0467)<br>↓<br>$m = nM$ ✓**(c)**<br>= 0,0466 x 18<br>= 0,83 g ✓**(d)** |

(4)

5.4

5.4.1 0 ($g \cdot s^{-1}$) / zero / *nul* ✓ (1)

5.4.2 Greater than/*Groter as* ✓ (1)

5.4.3

| **Marking criteria** | ***Nasienkriteria:*** |
|---|---|
| a) Substitute 0,9 g in $\frac{m}{M}$ ✓<br>b) Substitute 32 in $\frac{m}{M}$ ✓<br>c) USE mol /rate ratio:<br>$n(H_2O_2) : n(O_2) = 2 : 1$ ✓<br>d) Substitute $2,1 \times 10^{-3}$ and $n(H_2O_2)$ in rate formula ✓<br>**OR:** Substitute rate $O_2$ ($1,05 \times 10^{-3}$) and $n(O_2)$ in rate formula<br>**OR:** Substitute rate $O_2$ ($0,0336\ g \cdot s^{-1}$) in rate formula<br>e) Final correct answer: 26,67 (s) ✓<br>Range: 26,67 to 28,57 (s) | *a) Vervang 0,9 g in* $\frac{m}{M}$ ✓<br>*b) Vervang 32 in* $\frac{m}{M}$ ✓<br>*c) GEBRUIK mol-/tempoverhouding:*<br>$n(H_2O_2) : n(O_2) = 2 : 1$ ✓<br>*d) Vervang* $2,1 \times 10^{-3}$ *en* $n(H_2O_2)$ *in tempoformule* ✓<br>***OF:*** *Vervang tempo* $O_2$ ($1,05 \times 10^{-3}$) *en* $n(O_2)$ *in tempoformule*<br>***OF:*** *Vervang tempo* $O_2$ ($0,0336\ g \cdot s^{-1}$) *in tempoformule*<br>*e) Finale korrekte antwoord: 26,67 (s)* ✓<br>*Gebied: 26,67* tot 28,57 *(s)* |
| **OPTION 1/*OPSIE 1***<br>$n(O_2) = \frac{m}{M}$<br>$= \frac{0,9}{32}$ ✓**(a)** ✓**(b)**<br>$= 0,028$ mol (0,0281)<br>$n(H_2O_2) = 2n(O_2)$<br>$= 2(0,028)$ ✓**(c)**<br>$= 0,056$<br>rate/*tempo* $= \frac{\Delta n}{\Delta t}$<br>✓**(d)** $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t}$<br>$\Delta t = 26,67$ (s) ✓**(e)** | **OPTION 2/*OPSIE 2***<br>1 mol ……32 g ✓**(b)**<br>x mol ……0,9 g ✓**(a)**<br>x = 0,0275 mol<br>$n(H_2O_2) = 2n(O_2)$<br>$= 2(0,0275)$ ✓**(c)**<br>$= 0,056$ mol<br>rate/*tempo* $= \frac{\Delta n}{\Delta t}$<br>= ✓**(d)** $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t}$<br>$\Delta t = 26,67$ (s) ✓**(e)** |
| **OPTION 3/*OPSIE 3***<br>$n(O_2) = \frac{m}{M}$<br>$= \frac{0,9}{32}$ ✓**(a)** ✓**(b)**<br>$= 0,028$ mol (0,0281)<br>$Rate(O_2) = ½\ rate(H_2O_2)$<br>$= ½ (2,1 \times 10^{-3})$ ✓**(c)**<br>$= 1,05 \times 10^{-3}$<br>rate/*tempo* $= \frac{\Delta n}{\Delta t}$<br>✓**(d)** $1,05 \times 10^{-3} = \frac{0,028}{\Delta t}$<br>$\Delta t = 26,67$ (s) ✓**(e)** | **OPTION 4/*OPSIE 4***<br>rate $H_2O_2 = 2,1 \times 10^{-3}\ mol \cdot s^{-1}$<br>$Rate(O_2) = ½\ rate(H_2O_2)$<br>$= ½ (2,1 \times 10^{-3})$ ✓**(c)**<br>$= 1,05 \times 10^{-3}$<br>In one second:<br>$n(O_2) = \frac{m}{M}$<br>$1,05 \times 10^{-3} = \frac{m}{32}$ ✓**(b)**<br>$m(O_2) = 0,0336$ g<br>rate = $0,0336\ g \cdot s^{-1}$<br>rate = $\frac{\Delta m}{\Delta t}$ ✓**(a)**<br>✓**(d)** $0,0336 = \frac{0,9 - 0}{\Delta t}$<br>$\Delta t = 26,79$ (s) ✓**(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

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

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

$$[S] = 0,23 \text{ mol·dm}^{-3} \checkmark$$ (4)

**NOTE/*LET WEL***
- Wrong $K_c$ expression/*Verkeerde $K_c$-uitdrukking*: Max./M*aks.* $^2/_4$
- No $K_c$ expression but correct substitution/*Geen $K_c$-uitdrukking but korrekte vervanging: Max/Maks.* $^3/_4$

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] = initial [S] + change in [S] ✓
(d) Equilibrium [$CS_2$] = initial [$CS_2$] - 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] = aanvanklike [S] + verandering in [S]* ✓
*(d) Ewewig [$CS_2$] = aanvanklike [$CS_2$] - verandering in [$CS_2$]* ✓
(e) ***KORREKTE*** *finale antwoord.* ✓

**OPTION 1/*OPSIE 1***

| | S | $CS_2$ | |
|---|---|---|---|
| Initial concentration (mol·dm$^{-3}$)<br>*Aanvangskonsentrasie (mol·dm$^{-3}$)* | 0,23 x ½<br>= 0,115 | 0,5 x ½<br>= 0,25 | ✓**(a)** |
| Change in concentration (mol·dm$^{-3}$)<br>*Verandering in konsentrasie (mol·dm$^{-3}$)* | 2x | x | ✓**(b)** |
| Equilibrium concentration (mol·dm$^{-3}$)<br>*Ewewigskonsentrasie (mol·dm$^{-3}$)* | 0,115 + 2x | 0,25 - x | |
| | ✓**(c)** | ✓**(d)** | |

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

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

Wrong $K_c$ expression
*Verkeerde $K_c$- uitdrukking*: Max./*Maks.* $^4/_5$

**CALCULATIONS USING NUMBER OF MOLES**
***BEREKENINGE WAT GETAL MOL GEBRUIK***
**Marking criteria*:***
(a) n(initial) = c(initial) x 2. ✓
(b) Change in n(S) and n($CS_2$) **USING** ratio*: S* : $CS_2$ = 2 : 1 ✓
(c) Equilibrium n(S) = initial n(S) + change in n(S) ✓
(d) Equilibrium n($CS_2$) = initial n($CS_2$) - change in n($CS_2$) ✓
(e) **CORRECT** final answer. ✓

***Nasienkriteria*:**
*(a) n(aanvanklik) = c(aanvanklik) x 2 ✓*
*(b) Verandering in n(S) en n($CS_2$) deur **GEBRUIK** van verhouding: S : $CS_2$ = 2 : 1 ✓*
*(c) Ewewig n(S) = aanvanklike n(S) + verandering in n(S) ✓*
*(d) Ewewig n($CS_2$) = aanvanklike n($CS_2$) - verandering in n($CS_2$) ✓*
*(e) **KORREKTE** finale antwoord. ✓*

**OPTION 2/*OPSIE 2***

| | S | $CS_2$ | |
|---|---|---|---|
| Initial quantity (mol)<br>*Aanvangshoeveelheid (mol)* | 0,46 | 1 | ✓**(a)** |
| Change (mol)<br>*Verandering (mol)* | 8x | 4x | ✓**(b)** |
| Quantity at equilibrium (mol)/<br>*Hoeveelheid by ewewig (mol)* ✓**(c)** | 0,46 + 8x | 1 – 4x | ✓**(d)** |
| Equilibrium concentration ($mol \cdot dm^{-3}$)<br>*Ewewigskonsentrasie ($mol \cdot dm^{-3}$)* | $\frac{0,46 + 8x}{4}$ | $\frac{1 - 4x}{4}$ | |

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

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

Wrong $K_c$ expression
*Verkeerde $K_c$-uitdrukking*: Max./M*aks.* $^4/_5$

(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 = $\underline{(0,167)(0,300)}$ ✓
∴ n(NaOH) = 0,05 mol ✓ (5 x $10^{-2}$ mol) (3)

7.2.2

| **Marking criteria*:*** | ***Nasienkriteria:*** |
|---|---|
| a) Any formula: pH = -log[$H_3O^+$] / pH = -log[$H^+$] / pOH = -log[$OH^-$] / [$H_3O^+$][$OH^-$] = $10^{-14}$ / pH + pOH = 14 ✓<br>b) Substitute 11,4 in pH = -log[$H_3O^+$]/ pH + pOH = 14 ✓<br>c) Substitute calculated [$H_3O^+$] in [$H_3O^+$][$OH^-$] / 2,6 in pOH = -log[$OH^-$] ✓<br>d) Final answer: 2,51 x $10^{-3}$ mol·dm$^{-3}$ ✓ (0,003 mol·dm$^{-3}$) | *a)* Enige formule: pH = - log[$H_3O^+$] / pH = - log[$H^+$] / pOH = - log[$OH^-$] / [$H_3O^+$][$OH^-$] = $10^{-14}$ / pH + pOH = 14 ✓<br>*b) Vervang* 11,4 in pH = - log[$H_3O^+$]/ pH + pOH = 14 ✓<br>*c) Vervang berekende* [$H_3O^+$] in [$H_3O^+$][$OH^-$] / 2,6 in pOH = -log[$OH^-$] ✓<br>*d) Finale antwoord:* 2,51x $10^{-3}$ mol·dm$^{-3}$ ✓ (0,003 mol·dm$^{-3}$) |

**OPTION 1/*OPSIE 1***

pH = - log[$H_3O^+$]
11,4 ✓**(b)** = - log[$H_3O^+$] **OR/*OF*** [$H_3O^+$] = $10^{-11,4}$
[$H_3O^+$] = 3,98 x $10^{-12}$

Any one/*Enige een* ✓**(a)**

[$H_3O^+$][$OH^-$] = $10^{-14}$
✓**(c)**
(3,98 x $10^{-12}$)[$OH^-$] = 1 x $10^{-14}$
[$OH^-$] = 2,51 x $10^{-3}$ mol·dm$^{-3}$ ✓**(d)** (0,003)

**OPTION 2/*OPSIE 2***

pH + pOH = 14
11,4 + pOH = 14 ✓**(b)**
pOH = 2,6

Any one/*Enige een* ✓**(a)**

pOH = -log[$OH^-$] ✓
2,6 ✓**(c)** = -log[$OH^-$]
[$OH^-$] = 2,51 x $10^{-3}$ mol·dm$^{-3}$ ✓**(d)** (0,003)

(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 [NaOH] = 0,00251 mol·dm$^{-3}$ (answer from Q7.2.2) and 0,8 in $c = \frac{n}{V}$ ✓
b) Subtract: $n(NaOH)_{initial}$ (from Q7.2.1) – $n(NaOH)_{mixture}$ ✓✓
c) Use of ratio: $n(OH^-) = n(CH_3COOH)$ ✓
d) Substitute 0,5 and $\Delta n(CH_3COOH)$[calculated by subtraction] into $c = \frac{n}{V}$ ✓
e) Final correct answer: 0,096 mol·dm$^{-3}$ ✓
Range: 0,095 to 0,1 mol·dm$^{-3}$

***Nasienkriteria:***

a) *Vervang [NaOH] = 0,00251 mol·dm$^{-3}$ (antwoord van Q7.2.2) en 0,8 in* $c = \frac{n}{V}$ ✓
*b) Trek af: $n(NaOH)_{aanvanklik}$ (vanaf Q7.2.1) – $n(NaOH)_{mengsel}$* ✓✓
*c) Gebruik verhouding: $n(OH^-) = n(CH_3COOH)$* ✓
*d) Vervang 0,5 en $\Delta n(CH_3COOH)$ [bereken deur aftrekking] in* $c = \frac{n}{V}$ ✓
e) *Finale korrekte antwoord: 0,096 mol·dm$^{-3}$* ✓
*Gebied: 0,095 tot 0,1 mol·dm$^{-3}$*

$n(NaOH)_{mixture} = cV$
$= 0,00251 \times 0,8$ ✓**(a)**
$= 0,002$ mol (0,0024)

$n(NaOH)_{reacted} = 0,05 - 0,002$ ✓✓**(b)**
$= 0,048$ mol (0,0476)

$n(NaOH)_{reacted} = n(CH_3COOH)_{used}$
$= 0,048$ mol ✓**(c)**

$[CH_3COOH] = \frac{n}{V}$
$= \frac{0,048}{0,5}$ ✓**(d)**
$= 0,096$ mol·dm$^{-3}$ ✓**(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 mol·dm$^{-3}$./
*Antwoord van Q7.2.1 vervang in* $c = \frac{n}{V}$ *om 0,01 mol·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 $Zn^{2+}$/Zn(II) ions ✓ and will oxidise Zn ✓ (to $Zn^{2+}$/Zn(II) ions).

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

**OR/*OF***

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

*$Zn^{2+}$/Zn(II) ione is 'n swakker oksideermiddel as $MnO_4^-$ en dus word $MnO_4^-$ gereduseer (to $Mn^{2+}$/Mn(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*** | **NOTE/*LET WEL*** |
|---|---|
| $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓<br>= - 0,27✓ – (- 1,18)✓<br>= 0,91 V ✓ | • Accept any other correct formula from the data sheet. /*Aanvaar enige ander korrekte formule vanaf gegewensblad.*<br>• Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E°_{sel} = E°_{OM} - E°_{RM}$ gevolg deur korrekte vervangings* $^3/_4$ |

**OPTION 2/*OPSIE 2***

✓ $Ni^{2+} + 2e^- \rightarrow Ni$ E = -0,27 ✓
$Mn \rightarrow Mn^{2+} + 2e^-$ E = 1,18 ✓
$Ni^{2+} + Mn \rightarrow Mn^{2+} + Ni$ E = 0,91 V ✓ (4)

8.2.4 $Ni^{2+}$ + Mn ✓ → $Mn^{2+}$ + Ni ✓ 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 $Cr^{3+}(aq) + 3e^- \rightarrow Cr$ ✓✓

**Marking criteria/*Nasienkriteria:***

- $Cr \leftarrow Cr^{3+}(aq) + 3e^-$ $(2/2)$
  $Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr$ $(1/2)$
  $Cr \rightleftharpoons Cr^{3+}(aq) + 3e^-$ $(0/2)$
  $Cr^{3+}(aq) + 3e^- \leftarrow Cr$ $(0/2)$
- 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:* $Cr^3(aq) + 3e^- \rightarrow Cr$ Max./*Maks:* $1/2$ (2)

9.2.2 $q = I\Delta t$ ✓
$= \underline{(2,5)(10 \times 60 \times 60)}$ ✓
$= 9 \times 10^4$ C ✓ (90 000 C) (3)

9.2.3 **POSITIVE MARKING FROM QUESTION 9.2.2.**
***POSITIEWE NASIEN VANAF VRAAG 9.2.2.***

| **Marking criteria:** | ***Nasienkriteria:*** |
|---|---|
| a) Substitute 1,6 x $10^{-19}$ C in n = $\frac{Q}{e}$ ✓<br>b) N(Cr) = n(electrons) divide by 3 ✓<br>c) n(Cr) = N(Cr) divided by $N_A$ ✓<br>d) Substitution of 52 into n = $\frac{m}{M}$ ✓<br>e) m(Cr) $\underline{+ 2,2}$ ✓<br>f) Final answer*:* 18,32 (g) ✓<br>Range: *18,32 to 18,40* (g) | a) *Vervang 1,6 x $10^{-19}$ C in n =* $\frac{Q}{e}$ ✓<br>b) *N(Cr) = n(elektrone) gedeel deur 3* ✓<br>c) *n(Cr) = N(Cr) gedeel deur $N_A$* ✓<br>d) *Vervang 52 in n =* $\frac{m}{M}$ ✓<br>e) *m(Cr)* $\underline{+ 2,2}$ ✓<br>f) *Finale antwoord: 18,32 (g)* ✓<br>*Gebied: 18,32 tot 18,40 (g)* |

**OPTION 1/*OPSIE 1***

$n = \frac{Q}{e} / \frac{Q}{q_e}$

$= \frac{9 \times 10^4}{1,6 \times 10^{-19}}$ ✓**(a)**

$= 5,63 \times 10^{23}$ electrons

$N(Cr\ atoms) = \frac{5,63 \times 10^{23}}{3}$ ✓**(b)**

$= 1,88 \times 10^{23}$

$n(Cr) = \frac{N}{N_A}$

$= \frac{1,88 \times 10^{23}}{6,02 \times 10^{23}}$ ✓**(c)**

$= 0,31$ mol

$n(Cr) = \frac{m}{M}$

m(Cr) = 0,31 x 52 ✓**(d)**

= 16,12 g

m(X) = 16,12 $\underline{+ 2,2}$ ✓**(e)**

= 18,32 (g) ✓**(f)**

**OPTION 2/*OPSIE 2***

$n(Cr) = \frac{9 \times 10^4}{3 \times 96\,500}$ ✓✓**(a & c)**

✓**(b)**

= 0,31 mol

m(Cr) = 0,31 x 52 ✓**(d)**

= 16,12 g

m(X) = 16,12 $\underline{+ 2,2}$ ✓**(e)**

= 18,32 (g) ✓**(f)**

(6)
**[13]**

**TOTAL/*TOTAAL*: 150**