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

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

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.* $^2/_3$

(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 (— C —) is bonded to three other C atoms.
(with X/Br)
Die funksionele groep (— C —) is gebind aan drie ander C-atome.
(with X/Br)

(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)

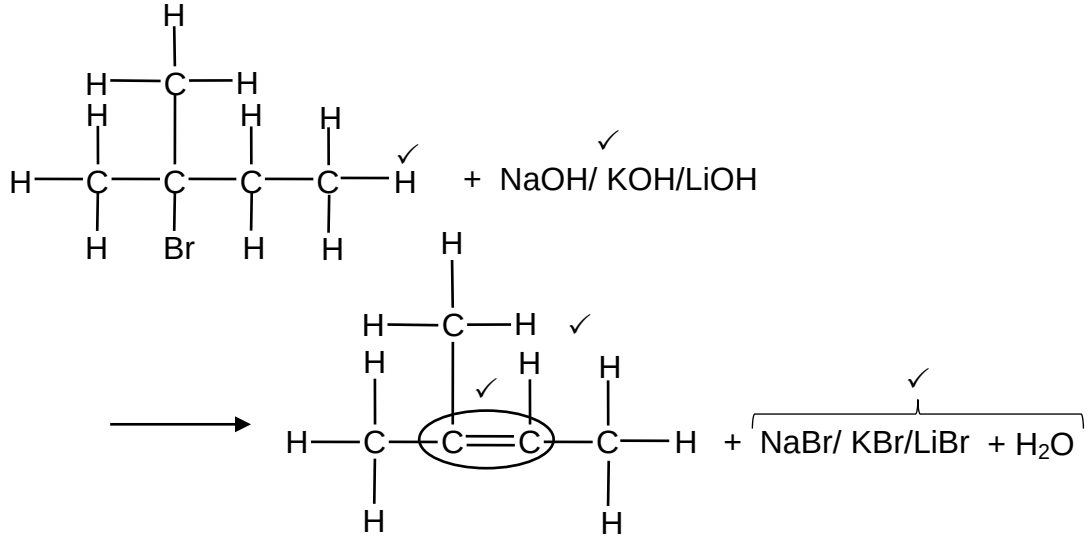
4.2.2 Elimination/dehydrohalogenation/dehydrobromination ✓
Eliminasie/dehidrohalogenering/dehidrohalogenasie/dehidrobrominasie/ dehidrobromonering (1)

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 ✓

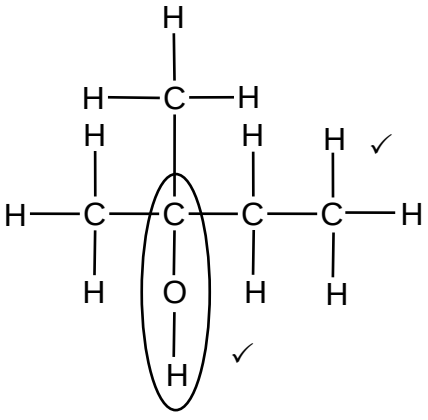
Nasienkriteria:
- *Hele struktuurformule vir verbinding A korrek.* ✓
- *Reageer (2-bromo-2-metielbutaan) met NaOH/KOH/LiOH.* ✓
- *Funksionele groep van alkeen korrek.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *NaBr/KBr/LiBr + H_2O* ✓

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 $n = \frac{V}{V_m}$ ✓ (b) USE mol ratio: $n(H_2O) : n(O_2) = 2 : 1$ ✓ (c) Substitute 18 and $n(H_2O)$ in $m = nM$ ✓ (d) Final answer: 0,83 g ✓ Range: 0,72 to 0,9 g	*(a) Vervang 24 000 en 560/24 en 0,56 in $n = \frac{V}{V_m}$* ✓ *(b) GEBRUIK molverhouding: $n(H_2O) : n(O_2) = 2 : 1$* ✓ *(c) Vervang 18 en $n(H_2O)$ in $m = nM$* ✓ *(d) Finale antwoord: 0,83 g* ✓ *Gebied:* 0,72 *tot 0,9 g*
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(O_2) = \frac{V}{V_m}$ $= \frac{560}{24\,000}$ ✓**(a)** = 0,023 mol (0,0233) ↓ $n(H_2O) = 2n(O_2)$ $n(H_2O) = 2(0,023)$ ✓**(b)** = 0,046 mol (0,0467) ↓ $m = nM$ ✓**(c)** = 0,046 x 18 = 0,83 g ✓**(d)**	1 mol …….24 000 cm^3 x mol …….560 cm^3 ✓**(a)** x = 0,023 mol (0,0233) ↓ $n(H_2O) = 2n(O_2)$ $n(H_2O) = 2(0,023)$ ✓**(b)** = 0,046 mol (0,0467) ↓ $m = nM$ ✓**(c)** = 0,0466 x 18 = 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 $\frac{m}{M}$ ✓ b) Substitute 32 in $\frac{m}{M}$ ✓ c) USE mol /rate ratio: $n(H_2O_2) : n(O_2) = 2 : 1$ ✓ d) Substitute $2,1 \times 10^{-3}$ and $n(H_2O_2)$ in rate formula ✓ **OR:** Substitute rate O_2 ($1,05 \times 10^{-3}$) and $n(O_2)$ in rate formula **OR:** Substitute rate O_2 ($0,0336\ g \cdot s^{-1}$) in rate formula e) Final correct answer: 26,67 (s) ✓ Range: 26,67 to 28,57 (s)	*a) Vervang 0,9 g in* $\frac{m}{M}$ ✓ *b) Vervang 32 in* $\frac{m}{M}$ ✓ *c) GEBRUIK mol-/tempoverhouding:* $n(H_2O_2) : n(O_2) = 2 : 1$ ✓ *d) Vervang* $2,1 \times 10^{-3}$ *en* $n(H_2O_2)$ *in tempoformule* ✓ ***OF:*** *Vervang tempo* O_2 ($1,05 \times 10^{-3}$) *en* $n(O_2)$ *in tempoformule* ***OF:*** *Vervang tempo* O_2 ($0,0336\ g \cdot s^{-1}$) *in tempoformule* *e) Finale korrekte antwoord: 26,67 (s)* ✓ *Gebied: 26,67* tot 28,57 *(s)*
OPTION 1/*OPSIE 1* $n(O_2) = \frac{m}{M}$ $= \frac{0,9}{32}$ ✓**(a)** ✓**(b)** $= 0,028$ mol (0,0281) $n(H_2O_2) = 2n(O_2)$ $= 2(0,028)$ ✓**(c)** $= 0,056$ rate/*tempo* $= \frac{\Delta n}{\Delta t}$ ✓**(d)** $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t}$ $\Delta t = 26,67$ (s) ✓**(e)**	**OPTION 2/*OPSIE 2*** 1 mol ……32 g ✓**(b)** x mol ……0,9 g ✓**(a)** x = 0,0275 mol $n(H_2O_2) = 2n(O_2)$ $= 2(0,0275)$ ✓**(c)** $= 0,056$ mol rate/*tempo* $= \frac{\Delta n}{\Delta t}$ = ✓**(d)** $2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t}$ $\Delta t = 26,67$ (s) ✓**(e)**
OPTION 3/*OPSIE 3* $n(O_2) = \frac{m}{M}$ $= \frac{0,9}{32}$ ✓**(a)** ✓**(b)** $= 0,028$ mol (0,0281) $Rate(O_2) = ½\ rate(H_2O_2)$ $= ½ (2,1 \times 10^{-3})$ ✓**(c)** $= 1,05 \times 10^{-3}$ rate/*tempo* $= \frac{\Delta n}{\Delta t}$ ✓**(d)** $1,05 \times 10^{-3} = \frac{0,028}{\Delta t}$ $\Delta t = 26,67$ (s) ✓**(e)**	**OPTION 4/*OPSIE 4*** rate $H_2O_2 = 2,1 \times 10^{-3}\ mol \cdot s^{-1}$ $Rate(O_2) = ½\ rate(H_2O_2)$ $= ½ (2,1 \times 10^{-3})$ ✓**(c)** $= 1,05 \times 10^{-3}$ In one second: $n(O_2) = \frac{m}{M}$ $1,05 \times 10^{-3} = \frac{m}{32}$ ✓**(b)** $m(O_2) = 0,0336$ g rate = $0,0336\ g \cdot s^{-1}$ rate = $\frac{\Delta m}{\Delta t}$ ✓**(a)** ✓**(d)** $0,0336 = \frac{0,9 - 0}{\Delta t}$ $\Delta t = 26,79$ (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 ($mol \cdot dm^{-3}$) *Aanvangskonsentrasie ($mol \cdot dm^{-3}$)*	0,23 x ½ = 0,115	0,5 x ½ = 0,25	✓**(a)**
Change in concentration ($mol \cdot dm^{-3}$) *Verandering in konsentrasie ($mol \cdot dm^{-3}$)*	2x	x	✓**(b)**
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	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) *Aanvangshoeveelheid (mol)*	0,46	1	✓**(a)**
Change (mol) *Verandering (mol)*	8x	4x	✓**(b)**
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)* ✓**(c)**	0,46 + 8x	1 – 4x	✓**(d)**
Equilibrium concentration ($mol \cdot dm^{-3}$) *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 ✓
$n = \frac{(0,167)(0,300)}{}$ ✓
∴ n(NaOH) = 0,05 mol ✓ (5×10^{-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 ✓ b) Substitute 11,4 in pH = -log[H_3O^+]/ pH + pOH = 14 ✓ c) Substitute calculated [H_3O^+] in [H_3O^+][OH^-] / 2,6 in pOH = -log[OH^-] ✓ 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 ✓ *b) Vervang* 11,4 in pH = - log[H_3O^+]/ pH + pOH = 14 ✓ *c) Vervang berekende* [H_3O^+] in [H_3O^+][OH^-] / 2,6 in pOH = -log[OH^-] ✓ *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^+] = $10^{-11,4}$ — Any one/*Enige een* ✓**(a)**
[H_3O^+] = 3,98 x 10^{-12}

[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)** — Any one/*Enige een* ✓**(a)**
pOH = 2,6

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***
$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓ = - 0,27✓ – (- 1,18)✓ = 0,91 V ✓	• Accept any other correct formula from the data sheet. /*Aanvaar enige ander korrekte formule vanaf gegewensblad.* • 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 = $\frac{Q}{e}$ ✓ b) N(Cr) = n(electrons) divide by 3 ✓ c) n(Cr) = N(Cr) divided by N_A ✓ d) Substitution of 52 into n = $\frac{m}{M}$ ✓ e) m(Cr) + 2,2 ✓ f) Final answer: 18,32 (g) ✓ Range: *18,32 to 18,40* (g)	a) *Vervang 1,6 x 10^{-19} C in n =* $\frac{Q}{e}$ ✓ b) *N(Cr) = n(elektrone) gedeel deur 3* ✓ c) *n(Cr) = N(Cr) gedeel deur N_A* ✓ d) *Vervang 52 in n =* $\frac{m}{M}$ ✓ e) *m(Cr) + 2,2* ✓ f) *Finale antwoord: 18,32 (g)* ✓ *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

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

$m(Cr) = 0,31 \times 52$ ✓**(d)**

$= 16,12$ g

$m(X) = 16,12 + 2,2$ ✓**(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

$m(Cr) = 0,31 \times 52$ ✓**(d)**

$= 16,12$ g

$m(X) = 16,12 + 2,2$ ✓**(e)**

$= 18,32$ (g) ✓**(f)**

(6)
[13]

TOTAL/*TOTAAL*: 150