basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 16 pages./
Hierdie nasienriglyne bestaan uit 16 bladsye.

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1 E ✓ (1)

2.1.2 F ✓ (1)

2.1.3 C ✓ (1)

2.1.4 H ✓ (1)

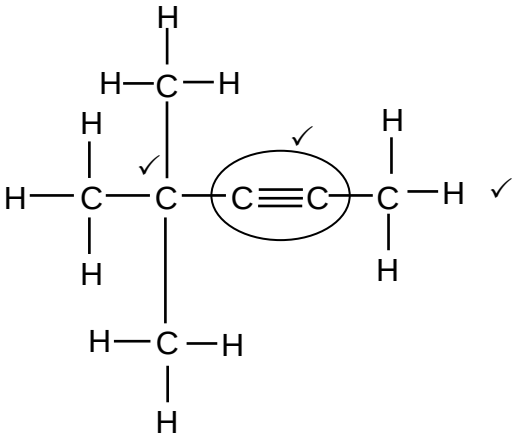
2.2

2.2.1 2-bromo-2,4,5-trimethylhexane/*2-broom-2,4,5-trimetielheksaan*

Marking criteria*:*	***Nasienkriteria:***
• Correct stem i.e. hexane. ✓ • All substituents (bromo and trimethyl) correctly identified. ✓ • IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓	• *Korrekte stam d.i. heksaan.* ✓ • *Alle substituente (bromo and trimetiel) korrek geïdentifiseer.* ✓ • *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓

(3)

2.2.2



Marking criteria/*Nasienkriteria:*
- Five C atoms in longest chain + triple bond. ✓
  Vyf C-atome in langste ketting + drievoudige binding.
- Two methyl substituents. ✓
  Twee metielsubstituente.
- Whole structure correct.
  Hele struktuur korrek. ✓

IF/*INDIEN*
- More than one functional group/wrong functional group:
  Meer as een funksionele groep/foutiewe funksionele groep: 0/3
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:* Max/*Maks.*: 2/3

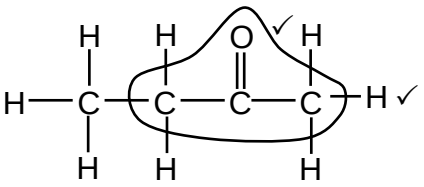
(3)

2.3

2.3.1 Aldehyde/*Aldehied* ✓ (1)

2.3.2 Formyl/*Formiel* ✓ (1)

2.3.3



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

IF/*INDIEN*
- More than one functional group/wrong functional group:
  Meer as een funksionele groep/foutiewe funksionele groep: 0/2
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:* Max/*Maks.*: 1/2

(2)

2.4

2.4.1 Methyl✓propane✓/2-methylpropane/*Metielpropaan/2-metielpropaan* (2)

2.4.2 $2C_4H_{10} + 13O_2$ ✓ $\rightarrow 8CO_2 + 10H_2O$ ✓ Bal. ✓

Ignore phases./*Ignoreer fases.*

Marking criteria/*Nasienkriteria:*
- Reactants ✓ Products ✓ Balancing: ✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*

IF: Structural formula for C_4H_{10} Max. 2/3
INDIEN: Structural formula for C_4H_{10} Max. 2/3

(3)

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QUESTION 3/*VRAAG 3*

3.1

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.*

The temperature at which the vapour pressure of a substance equals atmospheric/external pressure. ✓✓
Die temperatuur waar die dampdruk van 'n stof gelyk is aan atmosferiese/ eksterne druk. (2)

3.2

3.2.1 Increases/*Neem toe* ✓ (1)

3.2.2 **From A to C:**

- Increase in molecular mass/size/chain length/surface area/number of C atoms. ✓
- Strength of the intermolecular forces increases/More sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

OR
From C to A:

- Decrease in molecular mass/size/chain length/surface area/number of C atoms. ✓
- Strength of the intermolecular forces decreases/Less sites for London forces. ✓
- Less energy is needed to overcome/break intermolecular forces. ✓

Van A na C:

- *Verhoging in molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak/aantal C-atome.* ✓
- *Sterkte van die intermolekulêre kragte verhoog./Meer punte vir Londonkragte.* ✓
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* ✓

OF
Van C na A:

- *Verlaging in molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak/aantal C-atome.* ✓
- *Sterkte van die intermolekulêre kragte verlaag./Minder punte vir Londonkragte.* ✓
- *Minder energie benodig om intermolekulêre kragte te oorkom/breek.* ✓ (3)

3.3 No / *Nee* ✓
More than one independent variable./Molar mass and chain length (surface area) are changing. ✓
Meer as een onafhanklike veranderlike./Molêre massa (reaksie-oppervlak) en kettinglengte verander. (2)

3.4

3.4.1 Functional group/homologous series/type of intermolecular forces/type of compound ✓ (1)
Funksionele groep/homoloë reeks/soort intermolekulêre kragte/tipe verbinding

3.4.2 Dipole-dipole forces/*Dipool-dipoolkragte* ✓ (1)

3.5 D / methylbutane / *metielbutaan* ✓

Lower boiling point/Weaker intermolecular forces ✓
Laer kookpunt/Swakker intermolekulêre kragte (2)
[**12**]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Dehydrohalogenation/elimination/dehydrobromination ✓
Dehidrohalogenering/eliminasie/dehidrobrominering (1)

4.1.2 2-methylbut-2-ene / 2-methyl-2-butene ✓✓
2-metielbut-2-een / 2-metiel-2-buteen ✓✓ (2)

Marking criteria/*Nasienkriteria*
Methylbutene/*metielbuteen* ✓
IUPAC name correct/*IUPAC-naam korrek* ✓

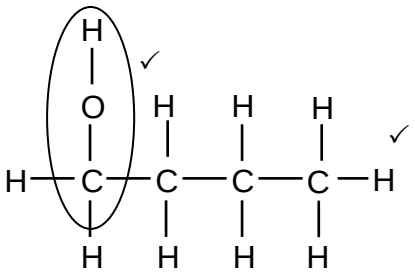
IF/*INDIEN*
Any error, e.g. hyphens omitted and/or incorrect sequence/*Enige fout, bv. koppeltekens weggelaat en/of verkeerde volgorde:* Max/*Maks:* ½

4.1.3 Water/H_2O ✓ (1)

4.1.4 Heat/*Hitte* ✓
(Concentrated) sulphuric acid/catalyst ✓
(Gekonsentreerde) swawelsuur/katalisator (2)

ACCEPT/*AANVAAR*:
High temperature/
Hoë temperatuur

4.1.5



✓ ✓ (2)

Marking criteria/*Nasienkriteria*
- Whole structure correct/*Hele struktuur korrek:* 2/2
- Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*: ½

IF/*INDIEN*
More than one functional group/*Meer as een funksionele groep* 0/2

4.2

4.2.1 Catalyst/Lowers the activation energy./Increases the rate of the reaction. ✓
Katalisator/Verlaag die aktiveringsenergie./Laat reaksietempo toeneem. (1)

4.2.2 The bromine water/Br_2/solution decolourises. ✓
Die broomwater/Br_2/oplossing ontkleur.

OR/*OF*
Bromine water/Br_2/solution changes from brown/reddish to colourless.
Broomwater/Br_2/oplossing verander van bruin/rooi na kleurloos. (1)

4.2.3 Addition/halogenation/bromination ✓ (1)
Addisie/halogenering/brominering

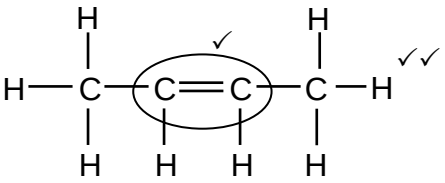
4.2.4 C_2H_6 ✓✓✓ (**3 or/*of* 0**) **OR/*OF*** C_4H_{10} **OR/*OF*** C_6H_{14}

IF structural/condensed formulae: **(2 or 0)**
INDIEN *struktuurformules/gekondenseerde formules gebruik:* ***(2 of 0)*** (3)

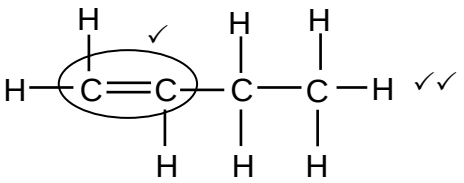
4.2.5

Marking criteria	***Nasienkriteria***
• Correct functional group i.e. double bond. ✓ • Correct number of C atoms in relation to answer in Q4.2.4. ✓ • Whole structure correct. ✓ **IF** condensed/molecular formulae used: Max. $^2/_3$	• *Korrekte funksionele groep d.i. dubbelbinding*. ✓ • *Korrekte aantal C-atome na aanleiding van antwoord in V4.2.4.* ✓ • *Hele struktuur korrek*. ✓ ***INDIEN*** *gekondenseerde/molekulêre formules gebruik: Maks.* $^2/_3$

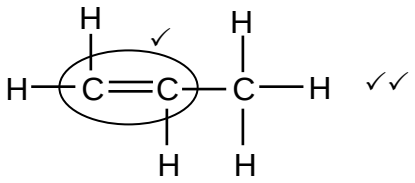
IF C_2H_6 in QUESTION 4.2.4/*INDIEN C_2H_6 in VRAAG 4.2.4*:



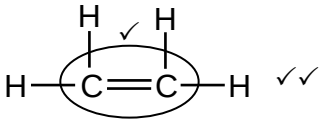
OR/*OF*



IF C_4H_{10} in QUESTION 4.2.4/
INDIEN C_4H_{10} in VRAAG 4.2.4:



IF C_6H_{14} in QUESTION 4.2.4:
INDIEN C_6H_{14} in VRAAG 4.2.4:



(3)
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QUESTION 5/*VRAAG 5*

5.1

NOTE/*LET WEL*
Give the mark for per unit time only if in context of reaction rate.
Gee die punt vir per eenheidtyd slegs indien in konteks met reaksietempo.

ANY ONE:

- Change in concentration ✓ of products/reactants per (unit) time. ✓
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
- Rate of change in concentration/amount/number of moles/volume/ mass.✓✓ **(2 or 0)**

ENIGE EEN:

- *Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.*
- *Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.*
- *Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.*
- *Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/ volume/massa.* ***(2 of 0)*** (2)

5.2

- Surface area / state of division / particle size (of $MgCO_3$) ✓
- Concentration (of HCℓ) ✓

- *Reaksieoppervlak/toestand van verdeeldheid/deeltjie-grootte (van* $MgCO_3$)
- *Konsentrasie (van HCℓ*) (2)

5.3

- At a higher temperature particles move faster/have a higher kinetic energy. ✓
- More molecules have enough/sufficient kinetic energy for an effective collision. ✓
  OR More molecules have kinetic energy/E_k equal to or greater than the activation energy.
- More effective collisions per unit time/second. ✓
  OR Frequency of effective collisions increases.
- Reaction rate increases. ✓

- *By 'n hoër temperatuur beweeg die deeltjies vinniger/het die deeltjies hoër kinetiese energie.* ✓
- *Meer molekule het genoeg/voldoende kinetiese energie/*E_k *vir 'n effektiewe botsing.* ✓
  ***OF** Meer molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.*
- *Meer effektiewe botsings per eenheidtyd/sekonde.* ✓
  ***OF** Frekwensie van effektiewe botsings verhoog.*
- *Reaksietempo neem toe.* ✓ (4)

5.4.1

Marking criteria	***Nasienkriteria***
• Formula: $n = \frac{m}{M}$ ✓	• *Formule:* $n = \frac{m}{M}$ ✓
• Substitution of 84 g·mol^{-1} in $n = \frac{m}{M}$ ✓	• *Vervanging van 84 g·mol^{-1} in* $n = \frac{m}{M}$ ✓
• Use mole ratio: $n(MgCO_3)_{used} = n(CO_2)_{produced}$ ✓	• *Gebruik molverhouding*: $n(MgCO_3)_{gebruik} = n(CO_2)_{berei}$ ✓
• Substitution of 44 g·mol^{-1} in $n = \frac{m}{M}$ **or** to calculate rate in mol·min^{-1}. ✓	• *Vervanging van 44 g·mol^{-1} in* $n = \frac{m}{M}$ ***of*** *om tempo te bereken in mol·min^{-1}.* ✓
• Correct substitution of 0,5 in rate equation. ✓	• *Korrekte vervanging van 0,5 in tempovergelyking*. ✓
• Final answer*:* 5,238 to 5,28 min ✓	• *Finale antwoord: 5,238 tot 5,28 min* ✓

$n(MgCO_3) = \frac{m}{M}$ ✓

$= \frac{5}{84}$ ✓

$= 0,06$ mol (0,0595 mol)

$n(CO_2)_{produced/gevorm} = n(MgCO_3)$ ✓ $= 0,06$ mol

$n(CO_2) = \frac{m}{M}$

$0,06 = \frac{m}{44}$ ✓

$m(CO_2) = 2,64$ g

Ave rate/*gem tempo* $= \frac{\Delta m(CO_2)}{\Delta t}$

$0,5$ ✓$= \frac{2,64}{\Delta t}$

$\Delta t = 5,28$ min ✓

Ave rate/*gem tempo* in mol·min^{-1}:

$\frac{0,5}{44}$ ✓$= 0,0114$ mol·min^{-1}

Ave rate/*gem tempo* $= \frac{\Delta n(CO_2)}{\Delta t}$

$0,0114 = \frac{0,06}{\Delta t}$

$\Delta t = 5,28$ min ✓

(6)

5.4.2 **POSITIVE MARKING FROM QUESTION 5.4.1.**
POSITIEWE NASIEN VANAF VRAAG 5.4.1.

Marking criteria	***Nasienkriteria***
• Substitution of $n(CO_2)$ AND 1,5 dm^3 in $n = \frac{V}{V_m}$. ✓	• *Vervanging van* $n(CO_2)$ EN 1,5 dm^3 in $n = \frac{V}{V_m}$. ✓
• Final answer*:*	• *Finale antwoord:*
• \25 to 25,21 dm^3·mol^{-1}✓	25 dm^3 *tot* 25,21 dm^3·mol^{-1} ✓

$n = \frac{V}{V_m}$

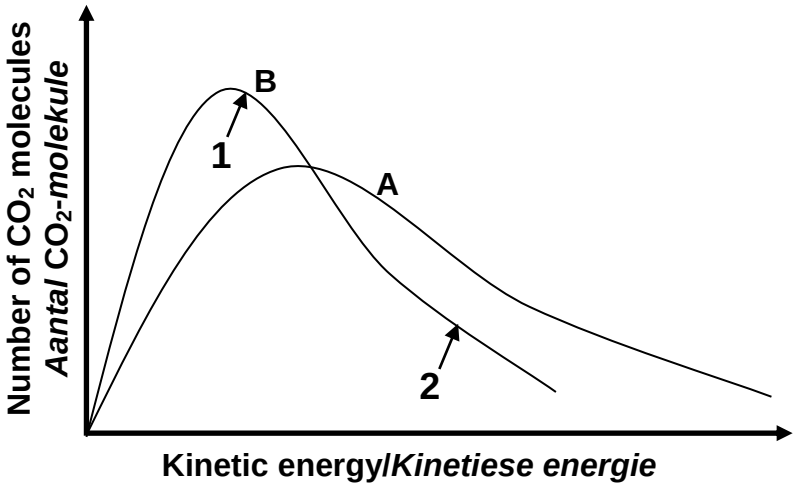
$0,06 = \frac{1,5}{V_m}$ ✓

$V_m =$ 25 dm^3·mol^{-1} ✓ (25,21 dm^3·mol^{-1})

ACCEPT/*AANVAAR*: 25 dm^3

(2)

5.5



Marking criteria/*Nasienkriteria*		
1	Curve **B** has a higher peak to the left of curve **A**. *Kurwe **B** het hoër piek aan die linkerkant van kurwe **A**.*	✓
2	Curve **B** is below curve **A** beyond the peak of curve **A**./*Kurwe **B** is onder kurwe **A** na die piek van kurwe **A**.*	✓
If BOTH graphs not labelled (**A** and **B**): no marks *Indien BEIDE grafieke nie benoem nie (**A** en **B**): geen punte*		

(2)
[18]

QUESTION 6/*VRAAG 6*

6.1.1 2 (mol·dm^{-3}) ✓ (1)

6.1.2

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)

6.1.3 Cooled/*Afgekoel* ✓ (1)

6.1.4
- A decrease in temperature favours the exothermic reaction./An increase in temperature favours the endothermic reaction. ✓
- The forward reaction is favoured./HI concentration increases./Equilibrium (position) shifts to the right. ✓
- The forward reaction is exothermic./Reverse reaction is endothermic. ✓

- *Afname in temperatuur bevoordeel die eksotermiese reaksie./Toename in temperatuur bevoordeel die endotermiese reaksie.* ✓
- *Die voorwaartse reaksie word bevoordeel./ HI-konsentrasie neem toe./Die ewewigs(posisie) skuif na regs.* ✓
- *Voorwaatse reaksie is eksotermies./Die terugwaartse reaksie is endotermies.* ✓ (3)

6.2

6.2.1 Products can be converted back to reactants. ✓
OR
Both forward and reverse reactions can take place.
OR
A reaction which can take place in both directions.

Produkte kan omgeskakel word na reaktanse. ✓
OF
Beide voor-en terugwaartse reaksies kan plaasvind.
OF
'n Reaksie wat in beide rigtings kan plaasvind. (1)

6.2.2

Marking criteria	***Nasienkriteria:***
a) $\Delta n(N_2O_4) = n(N_2O_4)_{eq} - n(N_2O_4)_{ini}$. ✓	(a) $\Delta n(N_2O_4) = n(N_2O_4)_{ewe} - n(N_2O_4)_{aanv}$.✓
b) USING ratio: $n(NO_2) : n(N_2O_4) = 2 : 1$ ✓	(b) *GEBRUIK verhouding:* $n(NO_2) : n(N_2O_4) = 2 : 1$ ✓
c) $n(NO_2)_{eq} = n(NO_2)_{ini} - \Delta n(NO_2)$ ✓	(c) $n(NO_2)_{ewe} = n(NO_2)_{aanv} - \Delta n(NO_2)$ ✓
d) Divide BOTH by 1 dm^3 ✓	(d) *Deel BEIDE deur* 1 dm^3 ✓
e) Correct K_c expression (formulae in square brackets). ✓	(e) *Korrekte K_c uitdrukking (formules in vierkantige hakies).* ✓

	NO_2	N_2O_4
Initial amount (moles) *Aanvangshoeveelheid (mol)*	x	0
Change in amount (moles) *Verandering in hoeveelheid (*mol)	1,62	0,81 (a) ✓
Equilibrium amount (moles) *Ewewigshoeveelheid (mol)*	x – 1,62 (c) ✓	0,81
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	x – 1,62	0,81

ratio ✓ *verhouding*

$$K_c = \frac{[N_2O_4]}{[NO_2]^2} \checkmark \text{ (e)}$$

$$= \frac{(0{,}81)}{(x-1{,}62)^2}$$

Wrong or no K_c expression/*Verkeerde of geen K_c-uitdrukking*: Max./*Maks.* $\frac{4}{5}$

(5)

6.2.3 **POSITIVE MARKING FROM QUESTION 6.2.2**
POSITIEWE NASIEN VAN VRAAG 6.2.2.

Marking criteria	***Nasienkriteria:***
a) Add 0,79 mol to $n(N_2O_4)_{ini}$. ✓ b) USING ratio: $n(NO_2) : n(N_2O_4) = 2 : 1$ to calculate $\Delta n(N_2O_4)$ as 0,6 mol. ✓ c) $n(NO_2)_{eq} = n(NO_2)_{ini} + \Delta n(NO_2)$ $n(N_2O_4)_{eq} = n(N_2O_4)_{ini} - \Delta n(N_2O_4)$ ✓ d) Substitution of concentrations into correct K_c expression. ✓ e) Equating K_c expresssion from Q6.1.3 and Q6.2.3. ✓ f) Final answer: 12,42 ✓ (Range: 11,27 – 12,42)	*(a) Voeg 0,79 mol by $n(N_2O_4)_{aanv}$.* ✓ *(b) GEBRUIK verhouding:* *$n(NO_2) : n(N_2O_4) = 2 : 1$* *om $\Delta n(N_2O_4)$ as 0,6 mol te bereken.* ✓ *(c) $n(NO_2)_{ewe} = n(NO_2)_{aanv} + \Delta n(NO_2)$* *$n(N_2O_4)_{ewe} = n(N_2O_4)_{aanv} - \Delta n(N_2O_4)$* ✓ *(d) Vervanging van konsentrasies in korrekte K_c-uitdrukking.* *(e) Stel K_c-uitdrukking van Q6.1.3 en Q6.2.3 gelyk aan mekaar.* ✓ *(f) Finale antwoord: 12,42* ✓ *(Gebied: 11,27 – 12,42)*

	NO_2	N_2O_4
Initial amount (moles) *Aanvangs hoeveelheid (mol)*	x – 1,62	0,81 + 0,79 ✓ = 1,6
Change in amount (moles) *Verandering in hoeveelheid (*mol)	1,2	0,6 ✓
Equilibrium amount (moles) *Ewewigshoeveelheid (*mol)	x – 1,62 +1,2	1 ✓(c)
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	x – 0,42	1

$$K_c = \frac{[N_2O_4]}{[NO_2]^2}$$

$$\frac{(0,81)}{(x-1,62)^2} \overset{(e)}{=} \frac{1}{(x-0,42)^2}$$ ✓(d)

x = 12,42 (mol) ✓(f)

Wrong K_c expression/*Verkeerde K_c- uitdrukking*: Max./*Maks.* $^4/_6$
No K_c expression/*Geen K_c- uitdrukking*: $^6/_6$

(6)
[19]

QUESTION 7/VRAAG 7

7.1
7.1.1 An acid is a proton (H^+ ion) donor. ✓✓
'n Suur is 'n protondonor/skenker of H^+-ioon donor/skenker. (2)

7.1.2 HY ✓
For the SAME acid concentration:
Lower pH / higher H^+ or H_3O^+ concentration / more ionised. ✓
Vir DIESELFDE suurkonsentrasie:
Laer pH / hoër H^+/H_3O^+ konsentrasie / meer geïoniseer. (2)

7.1.3 Lower than./*Laer as* ✓
$K_a < 1$ / HX ionises incompletely. / HX has a small K_a value. / HX is a weak acid. ✓
$K_a < 1$ / *HX ioniseer onvolledig. / HX het 'n klein K_a-waarde. / HX is 'n swak suur.* (2)

7.2

7.2.1 pH = $-\log[H_3O^+]$ **OR/*OF*** $[H_3O^+] = 10^{-pH}$ ✓
2 ✓ = $-\log[H_3O^+]$
$[H_3O^+]$ = 0,01 mol·dm^{-3} ✓ (1 x 10^{-2} mol·dm^{-3}) (3)

7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.1.**
POSITIEWE NASIEN VAN VRAAG 7.2.1.

Marking criteria for OPTION 1*:*	***Nasienkriteria vir OPSIE 1:***
• Substitute c(HCℓ)$_{excess}$ and 0,35 dm^3 to calculate n(HCℓ)$_{excess}$.✓ • Substitute to calculate n(HCℓ)$_{initial}$ ✓ • n(HCℓ)$_{react}$ = n(HCℓ)$_{ini}$ – n(HCℓ)$_{excess}$.✓✓ • Use ratio: n(NaOH) = n(HCℓ) ✓ • Substitute 0,15 dm^3 in c = $\frac{n}{V}$. ✓ • Final answer: 0,02 mol·dm^{-3} ✓ **or** 0,0167 mol·dm^{-3} **or** 0,017 mol·dm^{-3}	• *Vervang c(HCℓ)$_{oormaat}$ en 0,35 dm^3 om n(HCℓ)$_{oormaat}$ te bereken.*✓ • *Vervang om n(HCℓ)$_{aanv}$ te bereken.* ✓ • *n(HCℓ)$_{rea}$ = n(HCℓ)$_{aanv}$ – (HCℓ)$_{oormaat}$*✓✓ • *Gebruik verhouding: n(NaOH) = n(HCℓ)* ✓ • *Vervang 0,15 dm^3 in c = $\frac{n}{V}$.* ✓ • *Finale antwoord*: 0,02 mol·dm^{-3} ✓ ***of** 0,0167 mol·dm^{-3} **of** 0,017 mol·dm^{-3}*

OPTION 1/*OPSIE 1*

n(HCℓ)$_{excess/oormaat}$ = cV
= 0,01 x 0,35 ✓
= 3,5 x 10^{-3} mol

n(HCℓ)$_{initial/aanv}$ = cV
= 0,03 x 0,2 ✓
= 0,006 mol

n(HCℓ)$_{reacted/reageer}$ = 0,006 – 3,5 x 10^{-3} ✓✓
= 0,0025 mol

n(NaOH)$_{reacted/reageer}$ = n(HCℓ)$_{reacted/reageer}$ = 0,0025 mol ✓

c(NaOH) = $\frac{n}{V}$
= $\frac{0,0025}{0,15}$ ✓
= 0,02 mol·dm^{-3} ✓ (0,0167 mol·dm^{-3} **or/*of*** 0,017 mol·dm^{-3})

OPTION 2/*OPSIE 2*	**Marking criteria**
Concentration ratio in final solution: *Konsentrasie verhouding in finale oplossing:* $HC\ell : H_3O^+ = 1 : 1$ ✓ Thus/dus $[HC\ell] = 0,01$ mol·dm^{-3} ✓✓ $[HC\ell]_{react} = [HC\ell]_{initial} - [HC\ell]_{excess}$ $= \underline{0,03 - 0,01}$ ✓✓ $= 0,02$ mol·dm^{-3} Concentration ratio in final solution: *Konsentrasie verhouding in oorspronklike oplossing:* $HC\ell : NaOH = 1 : 1$ ✓ $[NaOH] = 0,02$ mol·dm^{-3} ✓	• Ratio $HC\ell : H_3O^+ = 1 : 1$ ✓ • $c(HC\ell)_{excess} = 0,01$ (mol·dm^{-3}) ✓✓ • $n(HC\ell)_{react} = n(HC\ell)_{ini} - (HC\ell)_{excess}$.✓✓ • Use ratio: $n(NaOH) = n(HC\ell)$ ✓ • Final answer: 0,02 mol·dm^{-3} ✓ ***Nasienkriteria*** • *Verhouding $HC\ell : H_3O^+ = 1 : 1$* ✓ • *$c(HC\ell)_{oormaat} = 0,01$ (mol·dm^{-3})* ✓✓ • *$n(HC\ell)_{reag} = n(HC\ell)_{aanv} - (HC\ell)_{oormaat}$.✓✓* • *Gebruik verhouding:* *$n(NaOH) = n(HC\ell)$* ✓ • *Finale antwoord: 0,02 mol·dm^{-3}* ✓
OPTION 3/*OPSIE 3*	**Marking criteria**
$\frac{c_1V_1}{c_2V_2} = \frac{n_1}{n_2}$ $\frac{c_1(200)}{(0,01)(350)}$ ✓ $= \frac{1}{1}$ ✓ $c_1 = 0,0175$ mol·dm^{-3} $c(HC\ell)_{react} = c(HC\ell)_{ini} - c(HC\ell)_{excess}$ $= \underline{0,03 - 0,0175}$ ✓✓ $= 0,0125$ mol·dm^{-3} $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ $\frac{(0,0125)(200)}{c_b(150)}$ ✓ $= \frac{1}{1}$ ✓ $c(NaOH) = 0,0167$ mol·dm^{-3} ✓ (0,0167 mol·dm^{-3} **or/*of*** 0,017 mol·dm^{-3})	• Substitute 350 cm^3 in $\frac{c_1V_1}{c_2V_2} = \frac{n_1}{n_2}$ ✓ • Ratio of $HC\ell : H_3O^+ = 1 : 1$ ✓ • $n(HC\ell)_{react} = n(HC\ell)_{ini} - (HC\ell)_{excess}$.✓✓ • Use ratio: $n(NaOH) = n(HC\ell)$ ✓ • Substitute 150 cm^3 in $\frac{c_1V_1}{c_2V_2} = \frac{n_1}{n_2}$ ✓ • Final answer: 0,02 mol·dm^{-3} ✓ **or** 0,0167 mol·dm^{-3} **or** 0,017 mol·dm^{-3} ***Nasienkriteria*** • *Vervang 350 cm^3 in $\frac{c_1V_1}{c_2V_2} = \frac{n_1}{n_2}$* ✓ • *Verhouding $HC\ell : H_3O^+ = 1 : 1$* ✓ • *$n(HC\ell)_{reag} = n(HC\ell)_{aanv} - (HC\ell)_{oormaat}$.✓✓* • *Gebruik verhouding:* *$n(NaOH) = n(HC\ell)$* ✓ • *Vervang 150 cm^3 in $\frac{c_1V_1}{c_2V_2} = \frac{n_1}{n_2}$* ✓ • *Finale antwoord: 0,02 mol·dm^{-3}* ✓ ***of** 0,0167 mol·dm^{-3}* ***of** 0,017 mol·dm^{-3}*

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QUESTION 8/*VRAAG 8*

8.1

8.1.1 Temperature/*Temperatuur*: 25 °C/298 K ✓
Pressure/*Druk*: 101,3 kPa/1 atmosphere ✓
Concentration/*Konsentrasie*: 1 mol·dm^{-3} ✓ (3)

8.1.2

OPTION 1/*OPSIE 1*

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓
2,89 ✓= $E^{\theta}_{reduction}$ – (-1,66) ✓
$E^{\theta}_{reduction}$ = 1,23 (V) ✓

X is O_2/oxygen/*suurstof* ✓

[X marked independently/
X onafhanklik nagesien]

Notes/*Aantekeninge*

- 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:* $^{4}/_{5}$

OPTION 2/*OPSIE 2*

$O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O$ ✓ E^{θ} = +1,23 V ✓
$A\ell(s) \rightarrow A\ell^{3+}(aq) + 3e^-$ E^{θ} = +1,66 V ✓
$4A\ell(s) + 3O_2(g) + 12H^+ \rightarrow 4A\ell^{3+}(aq) + 6H_2O$ E^{θ} = +2,89 (V) ✓

X is O_2/oxygen/*suurstof* ✓

[X marked independently/*X onafhanklik nagesien*] (5)

8.1.3 $A\ell$ ✓ (1)

8.1.4 $O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O$ ✓✓

Ignore phases./*Ignoreer fases*.

Marking criteria/*Nasienkriteria:*

- $2H_2O \leftarrow O_2(g) + 4H^+ + 4e^-$ ($^{2}/_{2}$) $O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$ ($^{1}/_{2}$)
  $O_2(g) + 4H^+ + 4e^- \leftarrow 2H_2O$ ($^{0}/_{2}$) $2H_2O \rightleftharpoons O_2(g) + 4H^+ + 4e^-$ ($^{0}/_{2}$)
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on H^+/ *Indien lading (+) weggelaat op* H^+: Max./*Maks:* $^{1}/_{2}$
  Example/*Voorbeeld:* $O_2(g) + 4H + 4e^- \rightarrow 2H_2O$ ✓

(2)

8.1.5 $A\ell(s) \mid A\ell^{3+}(aq) \parallel O_2(g) \mid H^+(aq) \mid H_2O(\ell) \mid Pt(s)$ ✓ ✓

OR/*OF*
$A\ell(s) \mid A\ell^{3+}(aq) \parallel O_2(g) \mid H^+(aq) \mid H_2O(\ell) \mid C(s)$

OR/*OF*
$A\ell \mid A\ell^{3+} \parallel O_2 \mid H^+ \mid H_2O \mid Pt$ (3)

8.2 Copper/*Koper* ✓

- Cu is a weaker reducing agent than Ni ✓and will not reduce Ni^{2+} (to Ni). / Cu will not be oxidised (to Cu^{2+}).✓
- Zn is a stronger reducing agent than Ni ✓and will reduce Ni^{2+} (to Ni). / Zn will be oxidised (to Zn^{2+}).

- *Cu is 'n swakker reduseermiddel as Ni en sal nie Ni^{2+} (na Ni) reduseer nie. / Cu sal nie geoksideer word nie na (Cu^{2+}).*
- *Zn is 'n sterker reduseermiddel as Ni en sal Ni^{2+} (na Ni) reduseer. / Zn sal geoksideer word (na Zn^{2+}).*

NOTE/LET WEL:
The mark for 'reduce' can be awarded at any ONE of the two comparisons.
Die punt vir 'reduseer' kan toegeken word by ENIGEEN van die twee vergelykings.

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QUESTION 9/*VRAAG 9*

9.1 **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.*

ANY ONE/*ENIGE EEN:*

- The chemical process in which electrical energy is converted to chemical energy. ✓✓
- The use of electrical energy to produce a chemical change.
- Decomposition of an ionic compound by means of electrical energy.
- The process during which an electric current passes through a solution/ionic liquid/molten ionic compound.

- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie. ✓✓*
- *Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.*
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.*
- *Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.*

(2)

9.2
9.2.1 X ✓ (1)

9.2.2 $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ ✓✓

Ignore phases/*Ignoreer fases*

Marking criteria/*Nasienkriteria:*
- $H_2(g) + 2OH^-(aq) \leftarrow 2H_2O(\ell) + 2e^-$ ($^2/_2$) $2H_2O(\ell) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$ ($^1/_2$)
  $H_2(g) + 2OH^-(aq) \rightleftharpoons 2H_2O(\ell) + 2e^-$ ($^0/_2$) $2H_2O(\ell) + 2e^- \leftarrow H_2(g) + 2OH^-(aq)$ ($^0/_2$)
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on OH^- /*Indien lading (-) weggelaat op* OH^-:
  Example/*Voorbeeld:* $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH(aq)$ ✓ Max./*Maks:* $^1/_2$

(2)

9.2.3 X to/*na* Y ✓ (1)

9.2.4 $2H_2O(\ell) + 2C\ell^-(aq)$ ✓ $\rightarrow C\ell_2(g) + H_2(g) + 2OH^-(aq)$ ✓ Bal ✓

OR/*OF*
$2H_2O(\ell) + 2NaC\ell(aq) \rightarrow C\ell_2(g) + H_2(g) + 2NaOH(aq)$

Ignore phases/*Ignoreer fases*

Marking criteria/*Nasienkriteria:*
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing: ✓ *Balansering*
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*

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9.3 Increases / *Toeneem* ✓ (1)

9.4 Solution becomes basic / alkaline **OR** NaOH / OH^- (ions) form ✓
Oplossing word basies / alkalies ***OF*** *NaOH / OH^-(-ione) vorm* (1)

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TOTAL/*TOTAAL*: 150