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)

2023

MARKING GUIDELINES/*NASIENRIGLYNE*

Stanmorephysics

MARKS/*PUNTE*: 150

DBE CE | DBE IMs | Approved: Umalusi Moderators

30/5/23 | 30/5/23 | 30/5/23

These marking guidelines consist of 20 pages.
Hierdie nasienriglyne bestaan uit 20 bladsye.

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QUESTION/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 D ✓✓ (2)

1.3 B ✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 B ✓✓ (2)

1.7 C ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION/*VRAAG 2*

2.1 Compounds with one or more multiple bonds between C atoms in the hydrocarbon chain. ✓✓ (2 or 0)
Verbindings met een of meer meervoudige bindings tussen C-atome in die koolwaterstofkettings. (2 of 0)
OR/*OF*
A hydrocarbon with two or more bonds between the C-atoms.
'n Koolwaterstof met twee of meer bindings tussen die C-atome.
OR/*OF*
Hydrocarbons containing not only single bonds between C atoms.
Koolwaterstowwe wat nie slegs enkelbindings tussen die C-atome bevat nie.
ACCEPT/*AANVAAR:*
Compounds with one or more double/triple bonds between C atoms in the hydrocarbon chain.
Verbindings met een of meer dubbel/trippelbindings tussen C-atome in die koolwaterstofkettings. (2)

2.2.1 D ✓ (1)

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2.2.2 2,4-dimethylhexane ✓✓✓
2,4-dimetielheksaan

Marking criteria:
- Correct stem i.e. hexane. ✓
- Substituents (dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

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

(3)

2.2.3 Propan-2-ol /2-propanol ✓✓

Marking criteria:
- Correct stem i.e. propanol. ✓
- IUPAC name completely correct including numbering and hyphens. ✓

Nasienkriteria:
- *Korrekte stam d.i. propanol.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering en koppeltekens.* ✓

(2)

2.2.4 hept-1-ene/1-heptene ✓✓
hept-1-een/1-hepteen

Marking criteria:
- Correct stem i.e. heptene. ✓
- IUPAC name completely correct including numbering and hyphens. ✓

Nasienkriteria:
- *Korrekte stam d.i. hepteen.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering en koppeltekens.* ✓

(2)

2.2.5

Marking criteria/*Nasienkriteria*
- Correct molecular formula: C_8H_{18} ✓
  Korrekte molekulêre formula: C_8H_{18}
- Correct molecular formula of inorganic reactant and products. ✓
  Korrekte molekulêre formule vir die anorganiese reaktant en produkte.
- Balancing/*Balansering* ✓

$2C_8H_{18}$ ✓ + $25O_2 \rightarrow 16CO_2 + 18H_2O$ ✓ Bal ✓

Notes/*Aantekeninge:*
- Ignore double arrows and phases./*Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*
- If condensed structural formulae used:/*Indien gekondenseerde struktuurformules gebruik:* Max/*Maks.* 2/3

(3)

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2.3.1

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.*

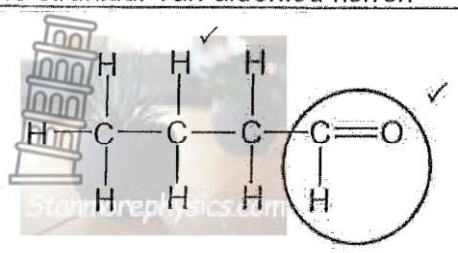
Compounds with the same molecular formula but different functional groups/homologous series. ✓✓
Verbindings met dieselfde molekulêre formule maar verskillende funksionele groepe/homoloë reekse.

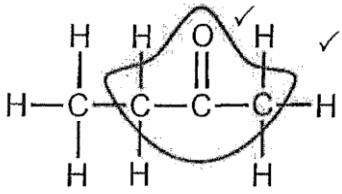
(2)

2.3.2

Marking criteria/*Nasienkriteria:*

- Functional group for aldehyde correct ✓ *Funksionele groep van aldehied korrek*
- Whole structure of aldehyde correct ✓ *Hele struktuur van aldehied korrek*
- Functional group for ketone correct ✓ *Funksionele groep van ketoon korrek*
- Whole structure of ketone correct ✓ *Hele struktuur van ketoon korrek*





(4)

2.4

Marking criteria

- Calculate the mass/percentage of oxygen. ✓
- Substitute correct mass and molar mass for both C and H into $n = \frac{m}{M}$. ✓
- Substitute correct mass and molar mass for O into $n = \frac{m}{M}$. ✓
- Simplify ratio. (Accept correct empirical formula if no ratio is given.) ✓
- Correct molecular formula. ✓✓

Nasienkriteria:

- *Bereken die massa/persentasie suurstof.* ✓
- *Vervang korrekte massa en molêre massa vir beide C en H in* $n = \frac{m}{M}$. ✓
- *Vervang korrekte massa en molêre massa vir O in* $n = \frac{m}{M}$. ✓
- *Vereenvoudig verhouding.* (Aanvaar korrekte empiriese formule indien geen verhouding nie) ✓
- *Korrekte molekulêre formule.* ✓✓

OPTION 1/*OPSIE 1*

	C	H	O
Mass / *Massa*	1,09	0,18	2 – (1,09 + 0,18) ✓ = 0,73
Moles /*mol*	$n = \frac{m}{M}$ $= \frac{1,09}{12}$ = 0,0908	$n = \frac{m}{M}$ $= \frac{0,18}{1}$ ✓ = 0,18	$n = \frac{m}{M}$ $= \frac{0,73}{16}$ ✓ = 0,046
Simplest ratio *Eenvoudigste verhouding*	2	4	1 ✓
Empirical formula *Empiriese formule*	C_2H_4O		

$M(C_2H_4O) \times n = 88\ (g \cdot mol^{-1})$

$44n = 88$

$n = 2$

Molecular formula of compound **X**/
Molekulêre formule van verbinding **X**: $C_4H_8O_2$ ✓✓

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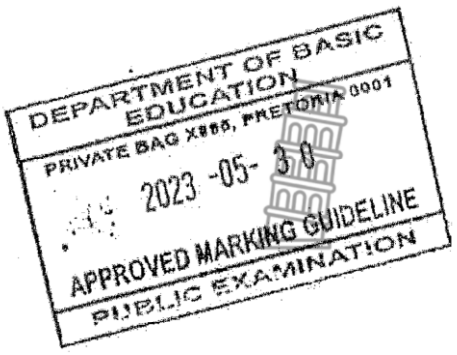
OPTION 2/*OPTION 2*

	C	H	O
Percentage/Persentasie	54,5	9	36,5 ✓
Moles /*mol*	$n = \frac{m}{M}$ $= \frac{54,5}{12}$ $= 4,5417$	$n = \frac{m}{M}$ $= \frac{9}{1}$ ✓ $= 9$	$n = \frac{m}{M}$ $= \frac{36,5}{16}$ ✓ $= 2,28$
Simplest ratio *Eenvoudigste verhouding*	2	4	1 ✓
Empirical formula *Empiriese formule*	C_2H_4O		

$M(C_2H_4O) \times n = 88\ (g \cdot mol^{-1})$
$44n = 88$
$n = 2$

Molecular formula of compound **X**/
Molekulêre formule van verbinding **X**: $C_4H_8O_2$ ✓✓ (6)

[25]



QUESTION/*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 compound) equals atmospheric pressure. ✓✓
Die temperatuur waarby die dampdruk (van 'n verbinding) gelyk is aan die atmosferiese druk. (2)

3.2

Marking criteria/*Nasienkriteria*
- Compare compounds in terms of branches/chain lengths/surface area. ✓ *Vergelyk verbindings in terme van vertakkings/kettinglengte/oppervlakarea.*
- Compare strengths of IMF's/*Vergelyk sterkte van IMK'e.*✓
- Compare energy/*Vergelyk energie* ✓

Butan-1-ol ✓
- Has a longer chain length./is less branched./has a larger surface area/ contact area. ✓
- Strength of the intermolecular forces is greater./There are more sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Het 'n langer kettinglengte./is minder vertak./het 'n groter kontakoppervlak/reaksieoppervlak.* ✓
- *Sterkte van die intermolekulêre kragte verhoog./Daar is meer plekke vir Londonkragte.* ✓
- *Meer energie word benodig om die intermolekulêre kragte te oorkom/breek.* ✓

OR/*OF*
- 2-methylpropan-1-ol has a shorter chain length./is more branched./ has a smaller surface area/contact area.
- Strength of the intermolecular forces is weaker./There are fewer sites for London forces.
- Lesser energy is needed to overcome/break intermolecular forces.

- *2-metielpropan-1-ol het 'n korter kettinglengte./is meer vertak./het 'n kleiner kontakoppervlak/reaksieoppervlak.*
- *Sterkte van die intermolekulêre kragte is swakker./Daar is minder plekke vir Londonkragte.*
- *Minder energie word benodig om intermolekulêre kragte te oorkom/breek.* (4)

3.3 Boiling point/*Kookpunt* ✓ (1)

3.4

3.4.1 S ✓ (1)

3.4.2 P ✓ (1)

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3.4.3 R ✓ (1)

3.5 Propanoic acid/P has the strongest intermolecular forces. ✓
OR
Two sites for hydrogen bonding (which is stronger than other intermolecular forces).
OR
Most energy needed to separate the chains.

Propanoësuur/P het die sterkste intermolekulêre kragte.
OF
Twee plekke vir waterstofbindings (wat sterker is as die ander intermolekulêre kragte).
OF
Meeste energie benodig om kettings te skei. (1)
[11]

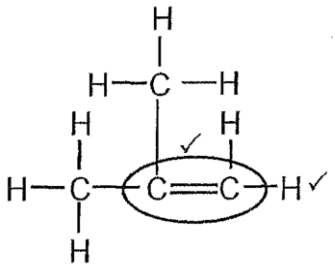
QUESTION/*VRAAG 4*

4.1
4.1.1 Halogenation/Bromination ✓
Halogenering/Brominering (1)

4.1.2 The bromine water/Br_2/solution decolourises./Brown colour disappears. ✓
Die broomwater/Br_2/oplossing ontkleur./Bruin kleur verdwyn.

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

4.1.3



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

(2)

4.1.4 2-chloro-2-methyl✓propane✓ /*2-chloro-2-metielpropaan*

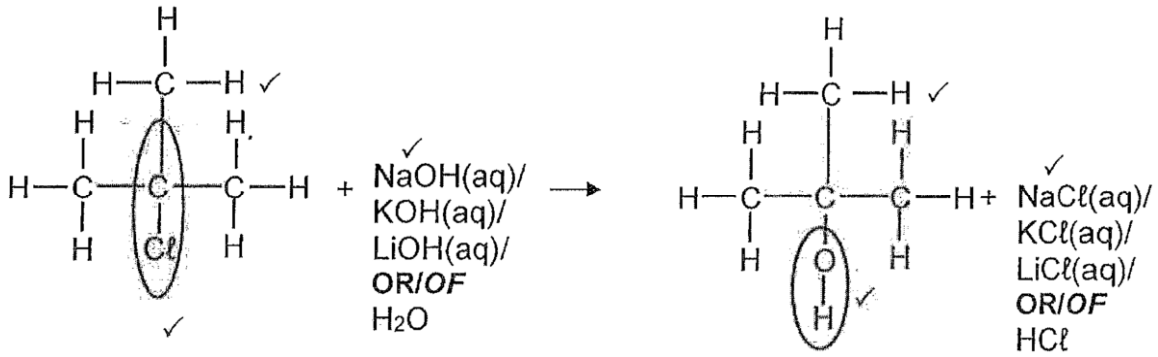
ACCEPT/*AANVAAR*:
2-chloromethylpropane / 2-*chlorometielpropaan* (2)



4.1.5

Marking criteria:
- Cℓ atom on second C atom on compound R ✓
- Whole structure of compound R correct ✓
- React compound R with NaOH(aq)/ KOH(aq)/LiOH(aq) **OR** H_2O ✓
- OH-group replaces Cℓ atom at the same position. ✓
- Whole structure of alcohol correct. ✓
- NaCℓ(aq)/KCℓ(aq)/LiCℓ(aq) **OR** HCℓ(aq) ✓
  (must correspond to the inorganic reactant used)

Nasienkriteria:
- *Cℓ-atoom op tweede C-atoom van verbinding R* ✓
- *Hele struktuur van verbinding R korrek* ✓
- *Reageer verbinding R met NaOH(aq)/ KOH(aq)/LiOH(aq)* ***OF*** *H_2O* ✓
- *OH-groep vervang Cℓ-atoom by dieselfde posisie.* ✓
- *Hele struktuur van alkohol korrek.* ✓
- *NaCℓ(aq)/KCℓ(aq)/LiCℓ(aq)* ***OF*** *HCℓ(aq)* ✓
  (moet ooreenstem met die anorganiese reaktans gebruik)



Notes/*Aantekeninge:*
- Ignore/*Ignoreer* ⇌
- Accept all inorganic reagents as condensed./*Aanvaar alle anorganiese reagense as gekondenseerd.*
- Accept coefficients that are multiples.
  Aanvaar koëffisiënte wat veelvoude is.
- Any additional reactants and/or products
  Enige addisionele reaktanse en/of produkte: Max./*Maks.* $^5/_6$
- Incorrect balancing/*Verkeerde balansering*: Max./*Maks.* $^5/_6$
- Molecular formulae/*Molekulêre formule*: Max./*Maks.* $^3/_6$
- Condensed formulae/*Gekondenseerde formule:* Max./*Maks.* $^4/_6$

Accept/*Aanvaar*:
-OH as condensed / *-OH as gekondenseerd*

Condensed formulae/*Gekondenseerde formule:*

$CH_3C(CH_3)C\ell CH_3$ ✓ + NaOH(aq)/ KOH(aq)/ LiOH(aq)/ **OR/*OF*** H_2O ✓ → $CH_3C(CH_3)OHCH_3$ ✓ + NaCℓ(aq)/ KCℓ(aq)/ LiCℓ(aq)/ **OR/*OF*** HCℓ ✓

(6)

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4.1.6 2-methyl✓propan-2-ol✓/2-methyl-2-propanol
2-metielpropan-2-ol/2-metiel-2-propanol
ACCEPT/AANVAAR:
Methylpropan-2-ol/ *Metielpropan-2-ol* (2)

4.1.7 Dehydration/*Dehidrasie/Dehidratering* ✓ (1)

4.2.1 Esterfication/Condensation ✓
Verestering/Esterfikasie/Kondensasie (1)

4.2.2 Butyl✓propanoate ✓
Butielpropanoaat (2)
[18]

QUESTION/*VRAAG 5*

5.1 Initial concentration is 0 (of NO_2)./Concentration increases./
Curve starts at 0. ✓
Beginkonsentrasie is 0 (van NO_2)./Konsentrasie verhoog./Kurwe begin by 0.

OR/*OF*
Curve B has an initial concentration and is the reactant as its concentration decreases.
Kurwe B het 'n beginkonsentrasie en is die reaktant aangesien sy konsentrasie afneem. (1)

5.2 True/*Waar* ✓
n mol of N_2O_5 forms 2n mol of NO_2 per unit time. ✓
n mol N_2O_5 vorm 2n mol NO_2 per eenheidstyd.

OR/*OF*
Gradient of graph for NO_2 is twice the gradient of graph for N_2O_5.
Gradiënt van grafiek vir NO_2 is twee keer die gradiënt van grafiek vir N_2O_5.
NOTE/*LET WEL*:
If gradients calculated correctly award mark.
Indien gradiënte korrek bereken word punt toegeken. (2)

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5.3.1

Marking criteria/*Nasienkriteria:*

- Formula: $c = \frac{m}{MV}$ / $n(NO_2) = cV$ / $n(NO_2) = \frac{m}{M}$ ✓
- Substitute change in concentration. ✓
  Vervang verandering in konsentrasie .
- Substitute M (46) and V (2)./*Vervang M (46) en V (2).* ✓
- Final correct answer/ *Finale korrekte antwoord:* 1,84 g ✓

OPTION 1/*OPSIE 1*

$c(NO_2) = \frac{m}{MV}$ ✓

200×10^{-4} ✓ $= \frac{m}{(46)(2)}$ ✓

$m = 1,84$ g ✓

OPTION 2/*OPSIE 2*

$n(NO_2) = cV$ ✓

$= (200 \times 10^{-4})$ ✓ x 2

$= 4 \times 10^{-2}$ mol

✓ either/ *enige een*

$n(NO_2) = \frac{m}{M}$

$4 \times 10^{-2} = \frac{m}{46}$

✓ both/ *beide*

$m = 1,84$ g ✓

(4)

5.3.2

Marking criteria/*Nasienkriteria:*

- Substitute the change in concentration into rate formula. ✓
  Vervang verandering in konsentrasie in tempo formule.
- Substitute time into the rate formula./ *Vervang tyd in tempo formule.* ✓
- Use mol ratio/*Gebruik molverhouding:* rate/*tempo*(O_2) = ½ rate/*tempo*(N_2O_5)/ rate/*tempo*(O_2) = ¼ rate/*tempo*(NO_2) ✓
- Final correct answer/*Finale korrekte antwoord:* 1×10^{-5} $(mol \cdot dm^{-3} \cdot s^{-1})$ ✓

NOTE/LET WEL

If concentration is converted to moles, final moles per s $(mol \cdot s^{-1})$ must be converted back to concentration $(mol \cdot dm^{-3} \cdot s^{-1})$. i.e. there must be multiplication and division by 2.

If one of these is omitted: Max. $^2/_4$

Indien konsentrasie omgeskakel is na mol, moet die finale mol per s $(mol \cdot s^{-1})$ omgeskakel word na konsentrasie $(mol \cdot dm^{-3} \cdot s^{-1})$ d.w.s daar moet vermenigvuldig en gedeel word deur 2. Indien een van hierdie uitgelaat word: Maks. $^2/_4$

OPTION 1/*OPSIE 1*

Ave rate/*gem tempo* $= -\frac{\Delta c(N_2O_5)}{\Delta t}$

$= -\frac{(60 \times 10^{-4} - 200 \times 10^{-4})}{700 (- 0)}$ ✓

$= 2 \times 10^{-5}$ $(mol \cdot dm^{-3} \cdot s^{-1})$

$rate(O_2) = ½\ rate(N_2O_5) = ½(2 \times 10^{-5})$ ✓

$= 1 \times 10^{-5}$ $(mol \cdot dm^{-3} \cdot s^{-1})$ ✓

OPTION 2/*OPSIE 2*

Ave rate/*gem tempo* $= \frac{\Delta c(NO_2)}{\Delta t}$

$= \frac{(280 \times 10^{-4} (- 0))}{700 (- 0)}$ ✓

$= 4 \times 10^{-5}$ $(mol \cdot dm^{-3} \cdot s^{-1})$

$rate(O_2) = ¼\ rate(NO_2) = ¼(4 \times 10^{-5})$ ✓

$= 1 \times 10^{-5}$ $(mol \cdot dm^{-3} \cdot s^{-1})$ ✓

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OPTION 3/*OPSIE 3*

$\Delta c(O_2) = \frac{1}{2}\Delta c(N_2O_5)$ **OR/*OF*** $\Delta c(O_2) = \frac{1}{4}\Delta c(NO_2)$

$= \frac{1}{2}(60 \times 10^{-4} - 200 \times 10^{-4})$ ✓ $= \frac{1}{4}(280 \times 10^{-4}$ ✓$(-0))$

$= \frac{1}{2}(140 \times 10^{-4})$ $= 7 \times 10^{-3}\ mol{\cdot}dm^{-3}$

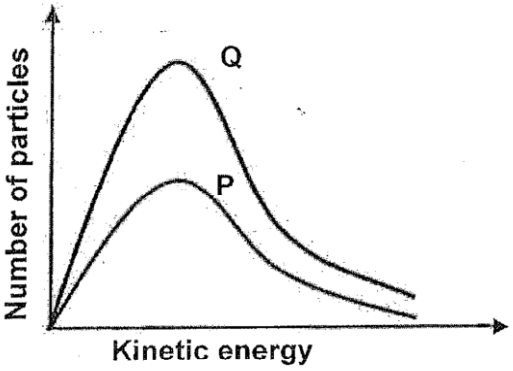
$= 7 \times 10^{-3}\ mol{\cdot}dm^{-3}$ $= 7 \times 10^{-3}\ mol{\cdot}dm^{-3}$

$$\text{Ave rate/}gem\ tempo = \frac{\Delta c(O_2)}{\Delta t}$$

$$= \frac{\left(7 \times 10^{-3}\right)}{700\ (-0)} \checkmark$$

$= 1 \times 10^{-5}\ (mol{\cdot}dm^{-3}{\cdot}s^{-1})$ ✓ (4)

5.4
5.4.1



Marking criteria/*Nasienkriteria*

- Curve Q must be above the given curve P and have the same shape as the given curve P and the peaks have to correspond. ✓
  Kurwe Q moet bo die gegewe kurwe P wees en moet dieselfde vorm hê as die gegewe kurwe P en die maksimums moet ooreenstem
- Starts at origin and not crossing curve P. ✓
  Begin by oorsprong en nie kruis met kurwe P nie.

(2)

5.4.2 Higher than/*Hoër as* ✓

- When the concentration of N_2O_5 is higher there are more N_2O_5 particles per unit volume. ✓
- More effective collisions per unit time/second. ✓
  OR
  Higher frequency of effective collisions.

- *'n Hoër konsentrasie van* N_2O_5 *bevat meer* N_2O_5*-deeltjies per eenheidsvolume*. ✓
- *Meer effektiewe botsings per eenheidstyd/sekonde*. ✓
  OF
  Hoër frekwensie van effektiewe botsings.

(3)
[16]

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QUESTION/*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

6.2.1 $n[H_2(g)] = 0,11$ (mol) ✓ (1)

6.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(HI)_{used/gebruik} = 2n(I_2)$ $= 2(0,11)$ $n(HI)_{eq} = 1 - 0,22$ $= 0,78$ (mol) ✓	$K_c = \frac{[H_2][I_2]}{[HI]^2}$ $0,02 = \frac{(0,11)(0,11)}{[HI]^2}$ $[HI] = 0,78$ mol·dm^{-3} $n(HI) = 0,78$ (mol) ✓

(1)

6.3

6.3.1 Endothermic/*Endotermies* ✓ (1)

6.3.2 K_c increased:

- The concentration of the product/$H_2(g)$ and $I_2(g)$ is increased. ✓
  OR: The concentration of the reactant/HI decreases.
- The increase in temperature favoures the forward reaction. ✓
- (According to Le Chatelier's principle) an increase in temperature favours the endothermic reaction. ✓

K_c het verhoog:

- *Die konsentrasie van die produkte/$H_2(g)$ en $I_2(g)$* verhoog. ✓
  OF: Die *konsentrasie van die reaktanse/HI verlaag.*
- *'n Toename in temperatuur bevoordeel die voorwaartse reaksie.* ✓
- *(Volgens Le Chatelier se beginsel) sal 'n toename in temperatuur die endotermiese reaksie bevoordeel.* ✓

(3)

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6.3.3

POSITIVE MARKING FROM Q6.2/*POSITIEWE NASIEN VANAF V6.2*	
Marking criteria:	***Nasienkriteria:***
(a) Correct K_c expression (formulae in square brackets). ✓	*(a) Korrekte K_c uitdrukking (formules in vierkantige hakies).* ✓
(b) Substitution of 0,09 in Kc expression. ✓	*(b) Vervang 0,09 in Kc uitdrukking.* ✓
(c) Correct initial moles from 6.2.1 and 6.2.2. ✓	*(c) Aanvanklike mol korrek vanaf 6.2.1 en 6.2.2.* ✓
(d) USING ratio: $nHI(g) : 2nI_2(g) = 1:2$ ✓	*(d) GEBRUIK verhouding: $nHI(g) : 2nI_2(g) = 1:2$* ✓
(e) Substitution of concentrations into correct K_c expression. ✓	*(e) Vervang konsentrasies in korrekte K_c uitdrukking.* ✓
(f) Subtraction $[HI]_{ini} - \Delta[HI]$ ✓	*(f) Verskil: $[HI]_{aanv} - \Delta[HI]$* ✓
(g) Substitution of 128 in m = nM. ✓	*(g) Vervang 128 in m = nM.* ✓
(h) Final answer: 80,64 g ✓ (range: 79,36 - 80,64 g)	*(h) Finale antwoord*: 80,64 g ✓ *(gebied*: 79,36 - 80,64 g)

OPTION 1/*OPSIE 1*

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$ ✓ (a)

✓ (c) (0,11 and/*en* 0,78 from 6.2.1 and/*en* 6.2.2)

(b) ✓
$$0,09 = \frac{(0,11 + x)(0,11 + x)}{(0,78 - 2x)^2}$$ ✓(e) ✓(d)

$x = 0,0775$

$[HI]_{equilibrium/ewewig} = [HI]_{ini/aanv} - \Delta[HI]$
$= \underline{0,78 - 2(0,0775)}$ ✓(f)
$= 0,63\ mol{\cdot}dm^{-3}$ (0,625)

$n(HI) = cV$
$= (0,63)(1)$
$= 0,63$ mol (0,625)

$m(HI) = nM$
$= (0,63)(128)$ ✓ (g)
$= 80,64$ g ✓ (h)

OR/*OF*
$m(HI) = cVM$
$= (0,63)(1)(128)$ ✓ (g)
$= 80,64$ g ✓ (h)

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OPTION 2/*OPSIE 2*

	HI	I_2	H_2	
Initial quantity (mol) *Aanvanklike hoeveelheid (mol)*	0,78	0,11	0,11	✓ (c)
Change (mol) *Verandering (mol)*	2x	x	x	Ratio 1:2 ✓ (d)
Quantity at equilibrium (mol) *Hoeveelheid by ewewig (mol)*	0,78 - 2x	0,11 + x	0,11 + x	
Equilibrium concentration *Ewewigskonsentrasie* ($mol \cdot dm^{-3}$)	$\frac{0,78 - 2x}{1}$	$\frac{0,11+ x}{1}$	$\frac{0,11+ x}{1}$	

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$ ✓(a)

(b) ✓
$$0,09 = \frac{(0,11 + x)(0,11 + x)}{(0,78 - 2x)^2}$$ ✓(e)

$x = 0,0775$

(f)
$[HI]_{equilibrium/ewewig} = \frac{0,78 - 2(0,0775)}{}$ ✓
$= 0,63 \text{ mol} \cdot dm^{-3}$ (0,625)

$n(HI) = cV$
$= (0,63)(1)$
$= 0,63$ mol (0,625 mol)

$m(HI) = nM$
$= (0,63)(128)$ ✓(g)
$= 80,64$ g ✓(h)

OR/OF
$m(HI) = cVM$
$= (0,63)(1)(128)$ ✓ (g)
$= 80,64$ g ✓ (h)

(8)
[16]

QUESTION/*VRAAG 7*

7.1

7.1.1 **ANY ONE**:

- A substance whose aqueous solution contains ions. ✓✓ **(2 or 0)**
- Substance that dissolves in water to give a solution that conducts electricity.
- A substance that forms ions in water/forms ions when molten.

ENIGE EEN:

- *'n Stof waarvan die oplossing ione bevat.* ✓✓ ***(2 of 0)***
- *'n Stof wat in water oplos om 'n oplossing te vorm wat elektrisiteit gelei.*
- *'n Stof wat ione vorm in water/ione vorm wanneer gesmelt.*

(2)

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7.1.2 A ✓
H_2SO_4 is diprotic./Donates more than one mole of H^+ ions per mole of acid ✓ (and both acids are of the same concentration)./H_2SO_4 has a higher K_a value.
H_2SO_4 is diproties./Skenk meer as een mol H^+ ione per mol suur (en beide sure het dieselfde konsentrasie)/ H_2SO_4 het 'n hoër K_a-waarde.

OR/*OF*
It ionises to produce more than one mole of protons/H^+ ions for each mole of H_2SO_4./H_2SO_4 has a higher K_a value.
Dit ioniseer om meer as een mol protone/ H^+-ione vir elke mol H_2SO_4 te vorm./H_2SO_4 het 'n hoër K_a-waarde. (2)

7.1.3 B ✓
Stronger acid/ionises completely ✓(and both acids are of the same concentration)./HNO_3 has a higher K_a value.
Sterker suur/ioniseer volledig (en beide sure het dieselfde konsentrasie)./ HNO_3 het 'n hoër K_a-waarde.

OR/*OF*
C/CH_3COOH is a weaker acid/ionises incompletely.
C/CH_3COOH is 'n swak suur/ioniseer onvolledig. (2)

7.2
7.2.1

Marking criteria/*Nasienkriteria:*
- Substitute/*Vervang* 0,04 mol·dm^{-3} and 25 x 10^{-3} dm^3 (25 cm^3) and 19,5 x 10^{-3} dm^3 (19,5 cm^3). ✓
- USE mol ratio:/*GEBRUIK molverhouding:* $n(Na_2CO_3) : n(HCl) = 1 : 2$ ✓
- Final answer/*Finale antwoord:* 0,10 to/*tot* 0,103 mol·dm^{-3} ✓

OPTION 1/*OPSIE 1*

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$$

$$\frac{c_a(19,5)}{(0,04)(25)} = \frac{2}{1}$$ ✓ ✓

c_a = 0,10 mol·dm^{-3} ✓ (0,103)

OPTION 2/*OPSIE 2*

$n(Na_2CO_3) = cV$
$= 0,04 \times 0,025$
$= 0,001$ mol
$n(HCl) = 2n(Na_2CO_3)$
$= 0,002$ mol ✓

$$[HCl] = \frac{n}{V}$$
$$= \frac{0,002}{0,0195}$$
= 0,10 mol·dm^{-3} ✓ (0,103) ✓

(3)

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7.2.2 Greater than/*Groter as* ✓

The few drops of water will dilute the HCl, ✓therefore greater volume of acid will be needed to neutralise the base.
'n Paar druppels water sal die HCl verdun, daarom sal 'n groter volume suur benodig word om die basis te neutraliseer. (2)

7.2.3

POSITIVE MARKING FROM Q7.2.1/*POSITIEWE NASIEN VANAF V7.2.1*

Marking criteria:

(a) Substitute 0,1 mol·dm^{-3} & 18,7 x 10^{-3} dm^3 (18,7 cm^3). ✓
(b) Use mole ratio: 1:1 ✓
(c) Calculate n(NH_3) / m(NH_3) in 250 cm^3: Substitute 0,25 dm^3 (250 cm^3) ✓
(d) Substitute 0,022 dm^3 (22 cm^3). ✓
(e) Substitute 0,02 dm^3 (20 cm^3) to calculate mole/mass in initial solution. ✓
(f) Use 17 g·mol^{-1} in $n = \frac{m}{M}$. ✓
(g) Final answer: 18,06 g ✓
Range: 17 to 19,13 g

Nasienkriteria:

(a) *Vervang 0,1 mol·dm^{-3} & 18,7 x 10^{-3} dm^3 (18,7 cm^3).* ✓
(b) *Gebruik molverhouding: 1:1* ✓
(c) *Bereken n(NH_3) / m(NH_3) in 250 cm^3: Vervang 0,25 dm^3 (250 cm^3).* ✓
(d) *Vervang 0,022 dm^3 (22 cm^3).* ✓
(e) *Vervang 0,02 dm^3 (20 cm^3) om mol/massa van oorspronklike oplossing te bereken.* ✓
(f) *Gebruik 17 g·mol^{-1} in* $n = \frac{m}{M}$. ✓
(g) *Finale antwoord:* 18,06 g ✓
Gebied: 17 *tot* 19,13 g

OPTION 1/*OPSIE 1*

$n(HC\ell) = cV$
$= \frac{(0,1)(18,7 \times 10^{-3})}{}$ ✓ (a)
$= 1,87 \times 10^{-3}$ mol

$n(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$
$= 1,87 \times 10^{-3}$ mol ✓(b)

$n(NH_3)$ in 22 cm^3 = 1,87 x 10^{-3} mol

$n(NH_3)$ in 250 cm^3 $= \frac{(1,87 \times 10^{-3})(250)}{22}$ ✓(c) ✓(d)
$= 0,021$ mol
$(2,13 \times 10^{-2})$

$n(NH_3)$ in initial 20 cm^3 = 0,021 mol

$n = \frac{m}{M}$

$0,021 = \frac{m}{17}$ ✓ (f)

m(NH_3) = 0,357 g in 20 cm^3

m(NH_3) $= \frac{(0,357)(1000)}{20}$ ✓(e)
= 17,85 g ✓(g) (18,06)

OPTION 2/*OPSIE 2*

$n(HC\ell) = cV$
$= \frac{(0,1)(18,7 \times 10^{-3})}{}$ ✓(a)
$= 1,87 \times 10^{-3}$ mol

$(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$
$= 1,87 \times 10^{-3}$ mol ✓(b)

$n(NH_3)$ in 22 cm^3 = 1,87 x 10^{-3} mol

$n = \frac{m}{M}$

$1,87 \times 10^{-3} = \frac{m}{17}$ ✓(f)

m(NH_3) = 3,72 x 10^{-3} g in 22 cm^3

m(NH_3) in 250 cm^3 $= \frac{(3,72 \times 10^{-3})(250)}{22}$ ✓(c) ✓(d)
$= 0,361$ g

m(NH_3) in initial 20 cm^3 = 0,361 g

m(NH_3) in 1 000 cm^3 $= \frac{(0,361)(1000)}{20}$ ✓(e)
= 18,06 g ✓(g)

(7)

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OPTION 3/*OPSIE 3*

$\frac{c_bV_b}{c_aV_a} = \frac{n_b}{n_a}$

$\frac{c_b(22)}{(0,1)(18,7)}$ ✓(d) $= \frac{1}{1}$ ✓ (b)
(a)

$c_1 = 0,085\ mol\cdot dm^{-3}$

$[NH_3]$ in 22 $cm^3 = 0,085\ mol\cdot dm^{-3}$

$[NH_3]$ in 250 $cm^3 = 0,085\ mol\cdot dm^{-3}$

$c_1V_1 = c_2V_2$

$c_1(0,02)$ ✓ $= \frac{(0,085)(0,25)}{(e)}$ ✓ (c)

$c_1 = 1,06\ mol\cdot dm^{-3}$

$m = cVM$ (f)
$= (1,06)(1)(17$✓$)$
$= 18,06$ g ✓(g)

OPTION 4/*OPSIE 4*

$n(HC\ell) = cV$
$= \frac{(0,1)(18,7 \times 10^{-3})}{}$ ✓ (a)
$= 1,87 \times 10^{-3}$ mol

$(NH_3)_{reacted/reageer} = n(HC\ell)_{reacted/reageer}$
$= 1,87 \times 10^{-3}$ mol ✓(b)

$n(NH_3)$ in 22 $cm^3 = 1,87 \times 10^{-3}$ mol

$n(NH_3)$ in 250 $cm^3 = \frac{(1,87 \times 10^{-3})(250)}{22}$ ✓(c) ✓(d)
$= 0,021$ mol

$c(20\ cm^3) = c(1\ dm^3)$
$\frac{n_1}{V_1} = \frac{n_2}{V_2}$

$n(NH_3)$ in 1 000 $cm^3 = \frac{0,021 \times 1000}{20}$ ✓ (e)
$= 1,06$ mol

$n = \frac{m}{M}$

$1,06 = \frac{m}{17}$ ✓(f)

$m(NH_3) = 18,06$ g ✓(g)

7.2.4 Less than 7/*Minder as 7* ✓

$NH_4^+(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons NH_3(aq) + H_3O^+(aq)$ ✓

Notes/*Aantekeninge*:
- Ignore single arrow/*Ignoreer* enkelpyl: →

(3)
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QUESTION/*VRAAG 8*

8.1
- Pressure: 1 atmosphere /101,3 kPa /1,01 x 10^5 Pa ✓
  Druk: 1 atmosfeer /101,3 kPa /1,01 x 10^5 Pa
- Temperature/*Temperatuur*: 25 °C /298 K ✓
- Concentration of electrolytes: 1 $mol\cdot dm^{-3}$ ✓
  Konsentrasie van elektroliete: 1 $mol\cdot dm^{-3}$

(3)

8.2 To maintain electrical neutrality/To complete the circuit/To allow movement of ions between electrolytes ✓
Om elektriese neutraliteit te verseker/Om die stroombaan te voltooi/Laat ione toe om tussen elektroliete te beweeg

(1)

Stanmorephysics.com

8.3

OPTION 1/*OPTION 1*

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓

$1{,}20$ ✓ $= E^{\theta}_{cathode} - 0$ ✓

$E^{\theta}_{cathode} = 1{,}20$ (V) ✓

X is Pt/platinum ✓

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:* Max./*Maks.* $\frac{4}{5}$

OPTION 2/*OPSIE 2*

✓
$X^{2+} + 2e^- \rightarrow X$ $\quad E^{\theta} = 1{,}20$ V ✓

$H_2 \rightarrow 2H^+ + 2e^-$ $\quad E^{\theta} = 0{,}00$ V ✓

$H_2 + X^{2+} \rightarrow X + 2H^+$ $\quad E^{\theta} = 1{,}20$ V ✓

X is Pt/Platinum ✓

(5)

8.4 $H_2(g) \rightarrow 2H^+(aq) + 2e^-$ ✓✓

Marking criteria/*Nasienkriteria:*

- $2H^+(aq) + 2e^- \leftarrow H_2(g)$ $(\frac{2}{2})$ $\quad H_2(g) \rightleftharpoons 2H^+(aq) + 2e^-$ $(\frac{1}{2})$

  $H_2(g) \leftarrow 2H^+(aq) + 2e^-$ $(\frac{0}{2})$ $\quad 2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$ $(\frac{0}{2})$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on H^+/*Indien lading (+) weggelaat op* H^+:

  Example/*Voorbeeld:* $H_2(g) \rightarrow 2H(aq) + 2e^-$ Max./*Maks.* $\frac{1}{2}$

(2)

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8.5 H^+, X^{2+} (Pt^{2+}), Au^{3+} ✓

- H_2 loses/donates electrons to both Au and X/Pt. ✓
  OR
  H_2 is the anode/is oxidised in both cells.
  Therefore H^+ is the weakest oxidising agent.
- The reduction potential of $X|X^{2+}$ is 1,2 V and that of $Au|Au^{3+}$ is 1,5 V. ✓
  OR
  The reduction potential of $X|X^{2+}$ is smaller than that of $Au|Au^{3+}$.
  OR
  According to the Table of Standard Reduction Potentials Au^{3+} is stronger oxidation agent than Pt^{2+}.
  OR
  The cell containing Au produces a higher emf than cell containing X.
- *H_2 verloor/skenk elektrone aan beide Au en X/Pt.* ✓
  OF
  H_2 is die anode/word geoksideer in beide selle.
  Daarom is H^+ die swakste oksideermiddel
- *Die reduksiepotensiaal van $X|X^{2+}$ is 1,2 V en die van $Au|Au^{3+}$ is 1,5 V.* ✓
  OF
  Die reduksiepotensiaal van $X|X^{2+}$ is kleiner as dié van $Au|Au^{3+}$.
  OF
  Volgens *die Tabel van Standaardreduksiepotensiale is Au^{3+} 'n sterker oksideermiddel as* Pt^{2+}
  OF
  Die sel wat Au bevat het 'n hoër emk as die sel wat X bevat. (3)

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QUESTION/*VRAAG 9*

9.1 A cell in which electrical energy is converted into chemical energy. ✓✓ (2 or 0)
'n Sel waar elektriese energie na chemiese energie omgeskakel word. (2 of 0) (2)

9.2 R ✓
Oxidation takes place./R loses electrons./R decreases in mass. ✓
Oksidasie vind plaas./R verloor elektrone./R se massa sal afneem. (2)

9.3

9.3.1 $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ ✓✓
Ignore phases/*Ignoreer fases*

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

(2)

9.3.2 Zinc/Zn/*Sink* ✓ (1)

9.4 Zn^{2+} ions are reduced/[Zn^{2+}] decreases. ✓
Zn^{2+} ions must be replaced by oxidation of the Zn electrode. ✓
Zn^{2+} ione word gereduseer/[Zn^{2+}] neem af.
Zn^{2+} ione moet vervang word deur oksidasie van Zn-elektrode. (2)
[9]

TOTAL/*TOTAAL:* **150**

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