



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 2018

MARKING GUIDELINE/NASIENRIGLYN

MARKS/PUNTE: 150

**These marking guidelines consist of 18 pages.
*Hierdie nasienriglyne bestaan uit 18 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1 ANY ONE/ENIGE EEN:

- (Alcohol/ethanol) is flammable/catches fire easily. ✓
(Alkohol/etanol) is vlambaar/slaan maklik aan die brand.
- To heat it evenly./Om dit eweredig te verhit.
- Water bath is used for low heat/low temperature./Waterbad word gebruik vir lae hitte/lae temperatuur.
- Alcohol/ethanol will evaporate too quickly./ (Alkohol/etanol) sal te vinnig verdamp.

Accept/Aanvaar:

(Alcohol/ethanol) is volatile./ (Alkohol/etanol) is vlugtig. (1)

2.2

2.2.1 Esterification/condensation ✓
Verestering/esterifikasie/kondensasie (1)

2.2.2 H_2SO_4 ✓ (1)

2.2.3 Esters ✓ (1)

2.3
$$\frac{M(\text{ester})}{M(\text{C}_4\text{H}_8\text{O})} = \frac{144}{72} = 2$$
$$\therefore 2 \times \text{C}_4\text{H}_8\text{O} = \text{C}_8\text{H}_{16}\text{O}_2 \quad \checkmark$$

Marking guidelines/Nasienriglyne

- If only answer given, award 2 marks on final answer./Indien slegs antwoord gegee, ken 2 punte toe vir finale antwoord.
- If $72 \text{ g}\cdot\text{mol}^{-1}$ calculated without substituting, no mark is awarded./Indien $72 \text{ g}\cdot\text{mol}^{-1}$ bereken is sonder om te vervang word geen punt toegeken nie.

(2)

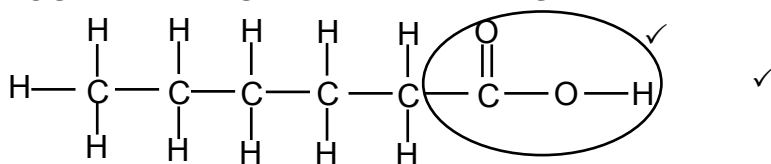
2.4 Ethyl ✓ hexanoate ✓
Etielheksanoaat

Note/Aantekening

Accept any other ethyl ESTER from QUESTION 2.3.
Aanvaar enige ander etiel ESTER vanaf VRAAG 2.3.

(2)

2.5 **POSITIVE MARKING FROM QUESTION 2.4.**
POSITIEWE NASIEN VANAF VRAAG 2.4.



Marking criteria/Nasienriglyne

- Whole structure correct/*Hele struktuur korrek*: $\frac{2}{2}$
- Only functional group correct/*Slegs funksionele groep korrek*: Max/Maks.: $\frac{1}{2}$
- Accept/*Aanvaar* -OH as condensed/*gekondenseerd*.

IF/INDIEN

- More than one functional group/wrong functional group/*Meer as een funksionele groep/foutiewe funksionele groep*: $\frac{0}{2}$
- If condensed structural formulae used/*Indien gekondenseerde struktuur-formules gebruik*: Max/Maks.: $\frac{1}{2}$

(2)
[10]

QUESTION 3/VRAAG 3

3.1 **Marking guidelines/Nasienriglyne**

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 Carboxyl (group)/*karboksiel(groep)* ✓

Accept/Aanvaar

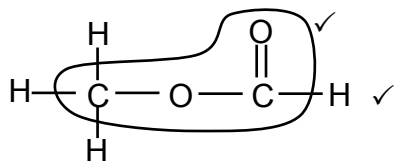
Carboxylic/*Karboksiel*

(1)

3.2.2 Propanoic acid/*propanoësuur* ✓

(1)

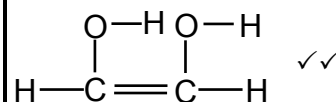
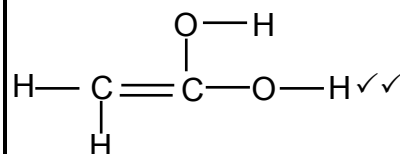
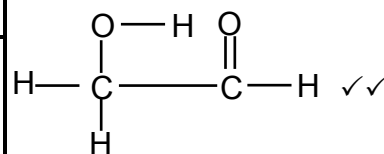
3.2.3

**Marking criteria/Nasienriglyne**

- Whole structure correct:
Hele struktuur korrek: $\frac{2}{2}$
- Only functional group correct:
Slegs funksionele groep korrek: Max/Maks: $\frac{1}{2}$

IF/INDIEN

- More than one functional group/wrong functional group/*Meer as een funksionele groep/foutiewe funksionele groep:* $\frac{0}{2}$
- If condensed structural formulae used/*Indien gekondenseerde struktuur-formules gebruik:* Max/Maks: $\frac{1}{2}$

**ACCEPT/AANVAAR
(2 or/of 0)**

(2)

3.3

A ✓

Lowest boiling point./Shortest chain length. ✓
Laagste kookpunt./Kortste kettinglengte.

(2)

3.4

3.4.1

The same molecular mass/molecular size. ✓
Dieselfde molekulêre massa/molekulêre grootte.

(1)

3.4.2

Primary/Primêre ✓

-OH group is bonded to a C atom bonded to one other C atom. ✓
-OH-groep is gebind aan 'n C-atoom wat aan een ander C-atoom gebind is.

OR/OF

-OH group is bonded to a C atom that has two H atoms.
-OH-groep is gebind aan 'n C-atoom wat twee H-atome bevat.

(2)

3.4.3

Marking guidelines/Nasienriglyne

- BOTH have hydrogen bonding./*BEIDE het waterstofbindings.* ✓
- Compare number of sites for hydrogen bonding./*Vergelyk aantal punte vir waterstofbinding.* ✓
- Compare strength of IMFs./*Vergelyk sterkte van IMKe.* ✓
- Compare energy required./*Vergelyk energie benodig.* ✓

- Both compounds **X** and **B** have (in addition to London forces and dipole-dipole forces) hydrogen bonding./*Beide verbindings X en B het waterstofbindings (behalwe Londonkragte en dipool-dipoolkragte).* ✓
- Compound **X**/CH₃CH₂CH₂OH/propan-1-ol/alcohol has one site for hydrogen bonding and compound **B**/ethanoic acid/carboxylic acid has two/more sites for hydrogen bonding **OR** **B**/ethanoic acid/carboxylic acid has two/more sites for hydrogen bonding. ✓
Verbinding **X**/CH₃CH₂CH₂OH/propan-1-ol/alkohol het een punt vir waterstofbindings en verbinding **B**/etanoësuur/karboksielsuur het twee/meer punte vir waterstofbindings **OF** **B**/etanoësuur/karboksielsuur het twee/meer punte vir waterstofbindings.
- Intermolecular forces in compound **B**/ethanoic acid/carboxylic acid are stronger than intermolecular forces in compound **X**/CH₃CH₂CH₂OH/propan-1-ol/alcohol. ✓
Intermolekulêre kragte in verbinding B/etanoësuur/karboksielsuur is sterker as die intermolekulêre kragte in verbinding X/CH₃CH₂CH₂OH/propan-1-ol/alkohol.
OR/OF
Intermolecular forces in compound X/CH₃CH₂CH₂OH/ propan-1-ol/alcohol are weaker than intermolecular forces in compound **B**/ethanoic acid/carboxylic acid./*Intermolekulêre kragte in verbinding X/CH₃CH₂CH₂OH/propan-1-ol/alkohol is swakker as intermolekulêre kragte in verbinding B/etanoësuur/karboksielsuur.*
- More energy is needed to overcome/break intermolecular forces in compound B/ethanoic acid/carboxylic acid than in compound X/CH₃CH₂CH₂OH/ propan-1-ol/alcohol. ✓
Meer energie word benodig om intermolekulêre kragte in verbinding B/etanoësuur as in verbinding X/CH₃CH₂CH₂OH/ propan-1-ol/alkohol te oorkom/breek.
OR/OF
Less energy is needed to overcome/break intermolecular forces in compound X/CH₃CH₂CH₂OH/propan-1-ol/alcohol than in compound B/ethanoic acid/carboxylic acid.
Minder energie word benodig om intermolekulêre kragte in verbinding X/CH₃CH₂CH₂OH/propan-1-ol/alkohol te oorkom/breek as in verbinding B/etanoësuur/karboksielsuur.

(4)
[15]

QUESTION 4/VRAAG 4

4.1

- 4.1.1 (A series of organic) compounds that can be described by the same general formula/functional group. ✓✓ (2 or 0)
(’n Reeks organiese) verbindings wat deur dieselfde algemene formule/funksionele groep beskryf kan word. (2 of 0)

OR/OF

(A series of organic) compounds in which one member differs from the next by a CH₂ group./(’n Reeks organiese) verbindings waarin een lid van die volgende verskil met ’n CH₂-groep. (2 or/of 0)

(2)

- 4.1.2 Substitution/halogenation/bromination ✓

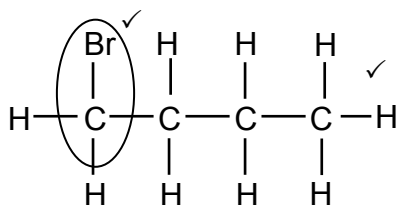
Substitusie/halogenasie/halogenering/brominasie/brominerig

(1)

- 4.1.3 HBr ✓

(1)

4.1.4



Marking criteria/Nasienriglyne

- Br on first C atom/Br op eerste C-atoom: Max/Maks: $\frac{1}{2}$
- Whole structure correct/Hele struktuur korrek: $\frac{2}{2}$

IF/INDIEN:

Br₂ but rest of structure correct/Br₂ maar res van struktuur korrek: $\frac{1}{2}$

(2)

- 4.1.5 C₅H₁₂ + 8O₂ ✓ → 5CO₂ + 6H₂O ✓ Bal ✓

Marking guidelines/Nasienriglyne

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse Produkte Balansering
- 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: $\frac{2}{3}$

(3)

4.1.6

Marking guidelines/Nasienriglyne

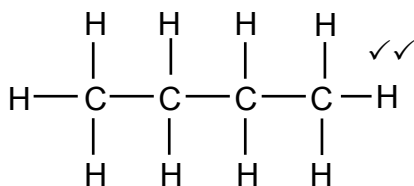
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The (chemical) process in which longer chain hydrocarbons/longer chain alkanes are broken down to shorter/more useful hydrocarbons/molecules/chains/alkanes and alkenes.

Die (chemiese) proses waarin langketting koolwaterstowwe/langketting-alkane afgebreek word in korter/meer bruikbare koolwaterstowwe/molekule/kettings/alkane en alkene.

(2)

4.1.7

**Marking guidelines/Nasienriglyne**

- One or more H atoms omitted/Een of meer H-atome uitgelaat: Max/Maks: $\frac{1}{2}$
- Condensed or semi-structural formula: Gekondenseerde of semi-struktuur-formule: Max/Maks: $\frac{1}{2}$

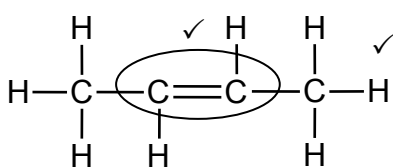
(2)

4.2

4.2.1 Butan-2-ol ✓✓ **OR/OF** 2-butanol ✓✓**IF/INDIEN:**Butanol or/of butan-1-ol $\frac{1}{2}$

(2)

4.2.2

**Marking criteria/Nasienriglyne**

- Only functional group correct/Slegs funksionele groep korrek: Max/Maks: $\frac{1}{2}$
- Whole structure correct: Hele struktuur korrek: $\frac{2}{2}$

(2)

[17]**QUESTION 5/VRAAG 5**

5.1 Temperature/Temperatuur ✓

(1)

5.2

NOTE/LET WELGive 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/ENIGE EEN**

- Change in concentration ✓ of products/reactants per (unit) time. ✓
Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.
- Rate of change in concentration/amount/number of moles/volume/mass.
Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/ volume/massa. ✓✓ **(2 or/of 0)**

(2)

5.3 14 (min) ✓✓

(2)

5.4

5.4.1 Graph/grafiek **B** ✓

ⓐ (Experiment 3) has the highest (acid) concentration/more particles/higher number of moles. ✓

(Eksperiment 3) het die hoogste (suur)konsentrasie/meer deeltjies/groter aantal mol.

(2)

5.4.2 (Graph/grafiek) **C** ✓

ⓐ (Experiment 5) is at highest temperature/more particles with sufficient kinetic energy/HCl is at 35°C ✓

(Eksperiment 5) is by die hoogste temperatuur/meer deeltjies met genoeg kinetiese energie/HCl is by 35°C.

(2)

5.5

5.5.1 Speeds up the reaction./Increases the reaction rate./Provides alternate pathway./Lowers the (net) activation energy. ✓

Versnel die reaksie./Verhoog die reaksietempo./Verskaf alternatiewe roete./Verlaag die (netto) aktiveringsenergie.

(1)

5.5.2 Equal to/Gelyk aan ✓

(1)

5.6

$$\begin{aligned}
 n(\text{Zn}) &= \frac{m}{M} \\
 &= \frac{1,5}{65} \checkmark \\
 &= 0,023 \text{ mol} \\
 \text{rate/tempo} &= -\frac{\Delta n}{\Delta t} \\
 &= -\left(\frac{0 - 0,023}{14 - 0}\right) \checkmark \\
 &= 1,65 \times 10^{-3} \text{ (mol} \cdot \text{min}^{-1})
 \end{aligned}$$

✓

Marking guidelines/Nasienriglyne

- Substitute/vervang 65 g·mol⁻¹ in

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

- Substitute change in mol to calculate rate./Vervang verandering in mol om tempo te bereken. ✓
- Substitute change in time to calculate rate./Vervang verandering in tyd om tempo te bereken. ✓

- Final answer/Finale antwoord:

$$1,65 \times 10^{-3} \text{ mol} \cdot \text{min}^{-1} \checkmark$$

Range/Gebied:

$$1,43 \times 10^{-3} \text{ to/tot } 1,65 \times 10^{-3} \text{ (mol} \cdot \text{min}^{-1})$$

Notes/Aantekeninge

- Ignore if zeros omitted in calculation of reaction rate./Ignoreer indien nulle uitgelaat in berekening van reaksietempo.
- Accept negative answer i.e. $-1,65 \times 10^{-3} \text{ mol} \cdot \text{min}^{-1}$ /Aanvaar negatiewe antwoord d.i. $-1,65 \times 10^{-3} \text{ mol} \cdot \text{min}^{-1}$.

(4)

[15]

QUESTION 6/VRAAG 6

- 6.1 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  Endothermic/Endotermies ✓
- Decrease in temperature favours the exothermic reaction. ✓
Afname in temperatuur bevoordeel die eksotermiese reaksie.
 - The reverse reaction is favoured./Die terugwaartse reaksie word bevoordeel. ✓
OR/OF
Number of moles/amount/concentration of N_2O_4 /colourless gas increases.
Aantal mol/hoeveelheid/konsentrasie van N_2O_4 /kleurlose gas neem toe.
OR/OF
Number of moles/amount of NO_2 /brown gas decreases./Aantal mol/hoeveelheid NO_2 /bruin gas neem af. (3)
- 6.3
- 6.3.1 Increases/Verhoog ✓ (1)
- 6.3.2 Remains the same/Bly dieselfde ✓ (1)
- 6.3.3 Increases/Verhoog ✓ (1)

6.4

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK**Marking guidelines/Nasienriglyne**

- $\Delta n(\text{N}_2\text{O}_4) = 20\%$ of/van $x/0,2x$. ✓
- **USE** ratio/**GEBRUIK** verhouding: $\text{N}_2\text{O}_4 : \text{NO}_2 = 1 : 2$. ✓
- $n(\text{N}_2\text{O}_4)_{\text{eq/ewe}} = n(\text{N}_2\text{O}_4)_{\text{initial/begin}} - \Delta n(\text{N}_2\text{O}_4)$. ✓
 $n(\text{NO}_2)_{\text{eq/ewe}} = n(\text{NO}_2)_{\text{initial/begin}} + \Delta n(\text{NO}_2)$. } ✓
- Divide equilibrium moles by 2 dm^3 /Deel ewewigsmol deur 2 dm^3 . ✓
- Correct K_c expression (formulae in square brackets). ✓
 Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of K_c value/Vervanging van K_c -waarde. ✓
- Substitution of concentrations into correct K_c expression. ✓
 Vervanging van konsentrasies in korrekte K_c -uitdrukking.
- Final answer/Finale antwoord: $1,6 \text{ (mol)}$ ✓

OPTION 1/OPSIE 1

	N_2O_4	NO_2	
Initial amount (moles) <i>Aanvangshoeveelheid (mol)</i>	x	0	
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	$0,2x$ ✓	$0,4x$	ratio ✓ verhouding
Equilibrium amount (moles) <i>hoeveelheid (mol)</i>	$0,8x$	$0,4x$	✓
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$0,4x$	$0,2x$	Divide by 2 dm^3 ✓

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} \checkmark$$

$$0,16 \checkmark = \frac{(0,2x)^2}{(0,4x)} \checkmark$$

$$x = 1,6 \text{ (mol)} \checkmark$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{7}{8}$

Wrong K_c expression/Verkeerde K_c -uitdrukking:
Max./Maks. $\frac{5}{8}$

OPTION 2/OPSIE 2

$$\Delta n(\text{N}_2\text{O}_4) = \frac{20}{100} x \checkmark = 0,2x$$

$$\Delta n(\text{NO}_2) = 2\Delta n(\text{N}_2\text{O}_4) = 0,4x \checkmark$$

$$n(\text{N}_2\text{O}_4)_{\text{eq/ewe}} = x - 0,2x = 0,8x \text{ AND } n(\text{NO}_2)_{\text{eq/ewe}} = 0 + 0,4x \checkmark$$

$$c(\text{N}_2\text{O}_4)_{\text{eq/ewe}} = \frac{0,8x}{2} = 0,4x$$

$$c(\text{NO}_2)_{\text{eq/ewe}} = \frac{0,4x}{2} = 0,2x$$

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} \checkmark$$

$$0,16 \checkmark = \frac{(0,2x)^2}{(0,4x)} \checkmark$$

$$x = 1,6 \text{ (mol)} \checkmark$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{7}{8}$

Wrong K_c expression/Verkeerde K_c -uitdrukking:
Max./Maks. $\frac{5}{8}$

CALCULATIONS USING CONCENTRATION **BEREKENINGE WAT KONSENTRASIE GEBRUIK**

Marking guidelines/Nasienriglyne

- Initial $n(\text{N}_2\text{O}_4)/x$ divide by 2 dm^3 . ✓
Aanvanklike $n(\text{N}_2\text{O}_4)/x$ gedeel deur 2 dm^3 .
- $\Delta c(\text{N}_2\text{O}_4) = 20\%$ of initial concentration/ $0,1x$. ✓
- **USE** ratio/**GEBRUIK** verhouding: $c(\text{N}_2\text{O}_4) : c(\text{NO}_2) = 1 : 2$. ✓
- $c(\text{N}_2\text{O}_4)_{\text{eq/ewe}} = c(\text{N}_2\text{O}_4)_{\text{initial/begin}} - \Delta c(\text{N}_2\text{O}_4)$. } ✓
 $c(\text{NO}_2)_{\text{eq/ewe}} = c(\text{NO}_2)_{\text{initial/begin}} + \Delta c(\text{NO}_2)$. }
- Correct K_c expression (formulae in square brackets). ✓
Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of K_c value/*Vervanging van K_c -waarde.* ✓
- Substitution of concentrations into K_c expression. ✓
Vervanging van konsentrasies in K_c -uitdrukking.
- Final answer/*Finale antwoord:* $1,6 \text{ (mol)}$ ✓

OPTION 3/OPSIE 3

	N_2O_4	NO_2
Initial concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Aanvanklike konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$\frac{x}{2} = 0,5x$	0
Change ($\text{mol} \cdot \text{dm}^{-3}$) <i>Verandering ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$0,1x$ ✓	$0,2x$
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i>	$0,4x$	$0,2x$

Divide by 2 dm^3 ✓ratio ✓
verhouding

✓

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} \quad \checkmark$$

$$0,16 \checkmark = \frac{(0,2x)^2}{0,4x} \quad \checkmark$$

$$x = 1,6 \text{ (mol)} \checkmark$$

No K_c expression, correct substitution/*Geen K_c -uitdrukking, korrekte substitusie:* Max./Maks. $\frac{6}{8}$

Wrong K_c expression/*Verkeerde K_c -uitdrukking:*
Max./Maks. $\frac{5}{8}$

(8)

[16]

QUESTION 7/VRAAG 7

7.1

7.1.1 An acid is a proton donor. ✓✓
'n Suur is 'n protondonor/skenker. (2)

7.1.2 H_2O ✓ (1)

7.1.3 HSO_4^- ✓✓ (2)

7.2

7.2.1 Reaction of a salt with water/ H_2O . ✓✓
Reaksie van 'n sout met water/ H_2O .

Accept/Aanvaar

Reaction of cations or anions with water
Reaksie van katione of anione met water (2)

7.2.2 • $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}_2\text{O}(\ell) \checkmark \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + 2\text{OH}^-(\text{aq}) \checkmark$

OR/OF

$\text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq})$

Accept/Aanvaar:

$\text{CaCO}_3(\text{aq}) + 2\text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq})$

- The formation of $\text{OH}^-(\text{aq})$ neutralises the excess acid. ✓
Die vorming van $\text{OH}^-(\text{aq})$ neutraliseer die oormaat suur.

Marking guidelines/Nasienriglyne

- Reactants ✓ Products ✓
Reaktanse Produkte
- The formation of $\text{OH}^-(\text{aq})$ neutralises the excess acid. ✓
Die vorming van $\text{OH}^-(\text{aq})$ neutraliseer die oormaat suur.
- Ignore single arrows and phases. *Ignoreer enkelpyle en fases.*
- Marking rule 6.3.10/Nasienreël 6.3.10.
- Ignore balancing. *Ignoreer balansering.*

(3)

7.3

7.3.1 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓
 $5 \checkmark = -\log[\text{H}_3\text{O}^+]$
 $[\text{H}_3\text{O}^+] = 1 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3} \checkmark$ (3)

7.3.2 POSITIVE MARKING FROM QUESTION 7.3.1.

POSITIEWE NASIEN VAN VRAAG 7.3.1.**Marking guidelines/Nasienriglyne**

- Any formula/*Enige formule*: $c = \frac{n}{V} / n = \frac{m}{M} / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} / c = \frac{m}{MV}$ ✓
- Substitute/*vervang* $V = 4 \times 10^9 \text{ dm}^3$ ✓
- Calculate $n_a(\text{reacted}) = n_a(\text{initial}) - n_a(\text{final})$ ✓✓
Bereken $n_a(\text{reageer}) = n_a(\text{begin}) - n_a(\text{finaal})$
- Use/*Gebruik* $n(\text{CaO}) : n(\text{H}_3\text{O}^+) = 1:2$ ✓
- Substitution of/*Vervanging van* $56 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Final answer/*Finale antwoord*: $m = 1,08 \times 10^6 \text{ g}$ to/tot $1,09 \times 10^6 \text{ g}$ ✓

IF final answer is negative: **INDIEN** finale antwoord negatief is Max/Maks: $\frac{6}{7}$

OPTION 1/OPSIE 1

$$c(\text{H}_3\text{O}^+)_{\text{ini/aanv.}} = \frac{n}{V} \quad \checkmark$$

$$1 \times 10^{-5} = \frac{n}{4 \times 10^9} \quad \checkmark$$

$$n_a = 4 \times 10^4 \text{ mol}$$

$$\begin{aligned} n(\text{H}_3\text{O}^+)_{\text{react/rea}} &= 4 \times 10^4 - 1,26 \times 10^3 \quad \checkmark \checkmark \\ &= 3,87 \times 10^4 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{CaO}) &= \frac{1}{2}n(\text{H}_3\text{O}^+) \\ &= \frac{1}{2} \times 3,87 \times 10^4 \quad \checkmark \\ &= 1,94 \times 10^4 \text{ mol} \end{aligned}$$

OPTION 2/OPSIE 2

$$c(\text{H}_3\text{O}^+)_{\text{fin}} = \frac{n}{V} \quad \checkmark$$

$$\begin{aligned} &= \frac{1,26 \times 10^3}{4 \times 10^9} \quad \checkmark \\ &= 3,15 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c(\text{H}_3\text{O}^+)_{\text{rea}} &= 1 \times 10^{-5} - 3,15 \times 10^{-7} \quad \checkmark \checkmark \\ &= 9,69 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} n(\text{H}_3\text{O}^+)_{\text{rea}} &= cV \\ &= (9,69 \times 10^{-6})(4 \times 10^9) \\ &= 3,87 \times 10^4 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{CaO}) &= \frac{1}{2}n(\text{H}_3\text{O}^+) \\ &= \frac{1}{2} \times 3,87 \times 10^4 \quad \checkmark \\ &= 1,94 \times 10^4 \text{ mol} \end{aligned}$$

OR/OF

$$\begin{aligned} n(\text{CaO}) &= \frac{m}{M} \\ 1,94 \times 10^4 &= \frac{m}{56} \quad \checkmark \\ \therefore m &= 1,09 \times 10^6 \text{ g} \quad \checkmark \end{aligned}$$

$$\begin{aligned} 1 \text{ mol} &: 56 \text{ g} \quad \checkmark \\ 1,94 \times 10^4 \text{ mol} &: m \\ \therefore m &= 1,09 \times 10^6 \text{ g} \quad \checkmark \end{aligned}$$

OPTION 3/OPSIE 3

$$c(\text{H}_3\text{O}^+)_{\text{fin}} = \frac{n}{V} \quad \checkmark$$

$$\begin{aligned} &= \frac{1,26 \times 10^3}{4 \times 10^9} \quad \checkmark \\ &= 3,15 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c(\text{H}_3\text{O}^+)_{\text{rea}} &= 1 \times 10^{-5} - 3,15 \times 10^{-7} \quad \checkmark \checkmark \\ &= 9,69 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$c(\text{CaO}) = \frac{1}{2}c(\text{H}_3\text{O}^+) \quad \checkmark = 4,845 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3}$$

$$c = \frac{m}{MV} \quad \therefore 4,845 \times 10^{-6} = \frac{m}{56(4 \times 10^9)} \quad \therefore m = 1,09 \times 10^6 \text{ g} \quad \checkmark$$

(7)
[20]

QUESTION 8/VRAAG 8

8.1

8.1.1 Loss of electrons./Verlies aan elektrone. ✓✓ (2 or/of 0) (2)

8.1.2 $\text{Fe} \rightarrow \text{Fe}^{3+} + 3\text{e}^-$ ✓✓

Marking guidelines/Nasienriglyne

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

(2)

8.1.3 Reducing agent/Reduseermiddel ✓

(1)

8.1.4 Fe is a stronger reducing agent ✓ than Cu ✓ and (Fe) will be oxidised ✓ (to Fe^{3+})./Fe is 'n sterker reduseermiddel as Cu en (Fe) sal geoksideer word (na Fe^{3+}).

OR/OF

Cu is a weaker reducing agent ✓ than Fe ✓ and (Cu) will not be oxidised ✓ (to Cu^{2+})./Cu is 'n swakker reduseermiddel as Fe en (Cu) sal nie geoksideer word nie (na Cu^{2+}).

(3)

8.1.5  Zinc/Zn ✓

Stronger reducing agent (than Fe)./Sterker reduseermiddel (as Fe). ✓

OR/OF

Zn will undergo oxidation (before Fe)./Zn sal oksidasie (voor Fe) ondergaan.

OR/OF

Cu is a weaker reducing agent (than Fe)./Cu is 'n swakker reduseermiddel (as Fe).

(2)

8.2

8.2.1 $3\text{Cu}^{2+} + 2\text{Fe} \rightarrow 3\text{Cu} + 2\text{Fe}^{3+}$ ✓ Bal. ✓

Marking guidelines/Nasienriglyne

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

(3)

8.2.2

OPTION 1/OPSIE 1 $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$ $= 0,34 \checkmark - (-0,06) \checkmark$ $= 0,40 \text{ V} \checkmark$	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. $E_{\text{cell}}^{\theta} = E_{\text{OA}}^{\theta} - E_{\text{RA}}^{\theta}$ followed by correct substitutions:/Enige ander formule wat onkonvensionele afkortings gebruik bv. $E_{\text{sel}}^{\theta} = E_{\text{OM}}^{\theta} - E_{\text{RM}}^{\theta}$ gevolg deur korrekte vervangings: $\frac{3}{4}$
OPTION 2/OPSIE 2 $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu} \checkmark$ $\text{Fe} \rightarrow \text{Fe}^{3+} + 3\text{e}^{-} \checkmark$ $3\text{Cu}^{2+} + 2\text{Fe} \rightarrow 3\text{Cu} + 2\text{Fe}^{3+} \checkmark$ $E^{\theta} = 0,34 \text{ V} \checkmark$ $E^{\theta} = 0,06 \text{ V} \checkmark$ $E^{\theta} = +0,40 \text{ V} \checkmark$	

(4)
[17]**QUESTION 9/VRAAG 9**

- 9.1 A cell in which electrical energy is converted to chemical energy. $\checkmark\checkmark$ (2 or 0)
'n Sel waarin elektriese energie omgeskakel word na chemiese energie.
(2 of 0)

OR/OF

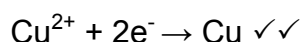
A cell in which electrical energy/electricity is used to obtain a chemical change/reaction. (2 or 0)
'n Sel waarin elektriese energie/elektrisiteit gebruik word om 'n chemiese verandering/reaksie te veroorsaak. (2 of 0)

(2)

- 9.2 Any soluble copper(II) salt e.g./Enige oplosbare koper(II)-sout bv.
 $\text{CuSO}_4/\text{Cu}(\text{NO}_3)_2/\text{CuCl}_2 \checkmark$

(1)

- 9.3 B $\checkmark$

**Marking guidelines/Nasienriglyne**

- $\text{Cu} \leftarrow \text{Cu}^{2+} + 2\text{e}^{-} \quad (\frac{2}{2})$ $\text{Cu} \rightleftharpoons \text{Cu}^{2+} + 2\text{e}^{-} \quad (\frac{0}{2})$
 $\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu} \quad (\frac{1}{2})$ $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^{-} \quad (\frac{0}{2})$
- Ignore if charge on electron is omitted./Ignoreer indien lading op elektron uitgelaat is.
- If a charge of an ion is omitted e.g. $\text{Cu}^2 + 2\text{e}^{-} \rightarrow \text{Cu}$ /Indien lading op ioon uitgelaat is bv. $\text{Cu}^2 + 2\text{e}^{-} \rightarrow \text{Cu}$ Max./Maks: $\frac{1}{2}$

(3)

- 9.4 Platinum/Pt $\checkmark$ **AND/EN** silver/Ag/silwer $\checkmark$

(2)
[8]

QUESTION 10/VRAAG 10

10.1

10.1.1 Haber (process)/Haber(proses) ✓ (1)

10.1.2 Ostwald (process)/Ostwald(proses) ✓ (1)

10.2

10.2.1 Ammonium nitrate/Ammoniumnitraat/ NH_4NO_3 ✓ (1)

10.2.2 Iron/iron oxide/Fe/FeO ✓
Yster/ysteroksied/Fe/FeO (1)

10.3 $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ Bal ✓ (3)

Marking guidelines/Nasienriglyne

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

10.4

Marking guidelines/Nasienriglyne

- Any ONE molar mass correct/Enige EEN molêre massa korrek:
 $80 \text{ g}\cdot\text{mol}^{-1}/164 \text{ g}\cdot\text{mol}^{-1}/74,5 \text{ g}\cdot\text{mol}^{-1}$ ✓
- $m(\text{N}) = 7 \text{ (kg)}$ **OR/OF** $0,14$ ✓
- $m(\text{P}) = 2,27 \text{ (kg)}$ **OR/OF** $0,045$ ✓
- $m(\text{K}) = 9,42 \text{ (kg)}$ **OR/OF** $0,188$ ✓
- Final answer/Finale antwoord: $3 : 1 : 4$ ✓
ACCEPT/AANVAAR: $3,08 : 1 : 4,15$ **OR/OF** $7 : 2,27 : 9,42$

OPTION 1/OPSIE 1

NH_4NO_3 :
 $80 \text{ g} \rightarrow 28 \text{ g N}$
 $20 \text{ kg} \rightarrow \frac{28}{80} \times 20$
 $\therefore m(\text{N}) = 7 \text{ kg}$ ✓
 Na_3PO_4 :
 $164 \text{ g} \rightarrow 31 \text{ g P}$
 $12 \text{ kg} \rightarrow \frac{31}{164} \times 12$
 $\therefore m(\text{P}) = 2,27 \text{ kg}$ ✓
 KCl :
 $74,5 \text{ g} \rightarrow 39 \text{ g K}$
 $18 \text{ kg} \rightarrow \frac{39}{74,5} \times 18$
 $\therefore m(\text{K}) = 9,42 \text{ kg}$ ✓
 $\therefore \text{N} : \text{P} : \text{K}$
 $7 : 2,27 : 9,42$
 $3 : 1 : 4$ ✓

OPTION 2/OPSIE 2

$n(\text{NH}_4\text{NO}_3) = \frac{m}{M}$
 $= \frac{20\,000}{80} = 250 \text{ mol}$
 $n(\text{N}) = 2n(\text{NH}_4\text{NO}_3) = 500 \text{ mol}$
 $m(\text{N}) = 500 \times 14$
 $= 7\,000 \text{ g} = 7 \text{ kg}$ ✓
 $n(\text{Na}_3\text{PO}_4) = \frac{12\,000}{164} = 73,17 \text{ mol}$
 $m(\text{P}) = 73,17 \times 31$
 $= 2\,268 \text{ g} = 2,27 \text{ kg}$ ✓
 $n(\text{KCl}) = \frac{18\,000}{74,5} = 241,61 \text{ mol}$
 $m(\text{K}) = 241,61 \times 39$
 $= 9\,423 \text{ g} = 9,42 \text{ kg}$ ✓
 $\therefore \text{N} : \text{P} : \text{K}$
 $7 : 2,27 : 9,42$
 $3 : 1 : 4$ ✓

<u>OPTION 3/OPSIE 3</u>	<u>OPTION 4/OPSIE 4</u>
$\text{NH}_4\text{NO}_3: \%N = \frac{28}{80} \times 100 = 35\%$ $m(N) = \frac{35}{100} \times 20 = 7 \text{ kg } \checkmark$ $\text{Na}_3\text{PO}_4:$ $\%P = \frac{31}{164} \times 100 = 18,9\%$ $m(N) = \frac{18,9}{100} \times 12 = 2,27 \text{ kg } \checkmark$ $\text{KCl}:$ $\%K = \frac{39}{74,5} \times 100 = 52,34\%$ $m(K) = \frac{52,34}{100} \times 18 = 9,42 \text{ kg } \checkmark$ $\therefore N : P : K = 7 : 2,27 : 9,42$ $= 3 : 1 : 4 \checkmark$	$\text{NH}_4\text{NO}_3:$ $\%N = \frac{28}{80} \times 100 = 35\%$ $\text{Na}_3\text{PO}_4:$ $\%P = \frac{31}{164} \times 100 = 18,9\%$ $\text{KCl}:$ $\%K = \frac{39}{74,5} \times 100 = 52,34\%$ $N: \frac{20}{50} \times 35 = 0,14 \checkmark$ $P: \frac{12}{50} \times 18,9 = 0,045 \checkmark$ $K: \frac{18}{50} \times 52,34 = 0,188 \checkmark$ $N : P : K = 0,14 : 0,045 : 0,188$ $= 3 : 1 : 4 \checkmark$

(5)
[12]**TOTAL/TOTAAL: 150**