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# 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)**

**2019**

**MARKING GUIDELINES/NASIEENRIGLYNE**

**MARKS/PUNTE: 150**

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

**QUESTION 1/VRAAG 1**

1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	C ✓✓	(2)
1.4	A ✓✓	(2)
1.5	D ✓✓	(2)
1.6	C ✓✓	(2)
1.7	D ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	A ✓✓	(2)
		<b>[20]</b>



## QUESTION 2/VRAAG 2

2.1 Unsaturated/Onversadig ✓



**ANY ONE/ENIGE EEN:**

- C/It has a triple/multiple bond. ✓  
C/Dit het 'n trippelbinding/meervoudige-binding.
- C/It has a triple/multiple bond between C atoms.  
C/Dit het 'n trippelbinding/meervoudige-binding tussen C-atome.
- C/It does NOT contain the maximum number of H atoms bonded to C atoms.  
C/Dit bevat NIE die maksimum getal H-atome gebind aan C-atome nie.
- Compound C is an alkyne./Verbinding C is 'n alkyn. (2)

2.2

2.2.1 D ✓ (1)

2.2.2 B ✓ (1)

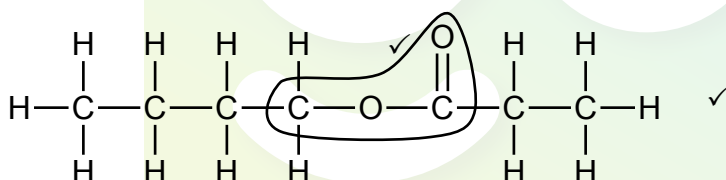
2.2.3 C ✓ (1)

2.2.4 E ✓ (1)

2.3

2.3.1  $\text{—C}\equiv\text{C—}$  ✓ (1)

2.3.2



(2)

### **Marking criteria/Nasienriglyne:**

- Whole structure correct:

Hele struktuur korrek:  $\frac{2}{2}$

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

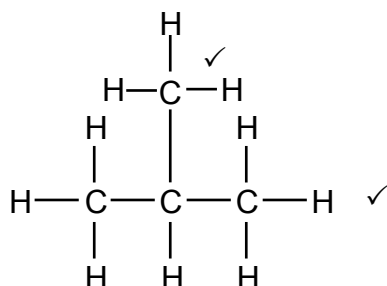
### **IF/INDIEN:**

- More than one functional group/Meer as een funksionele groep:  $\frac{0}{2}$

- If condensed or semi structural formula used:/Indien gekondenseerde of semi-struktuurformule gebruik:

Max/Maks.  $\frac{1}{2}$

2.3.3



**Marking criteria/Nasienriglyne:**

- Three C atoms in longest chain. ✓  
*Drie C-atome in langste ketting.*
- One methyl substituent on C2. ✓  
*Een metielsubstituent op C2.*

**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.:  $\frac{1}{2}$

(2)

2.4

2.4.1 2,3-dibromo-5-methylheptane/2,3-dibromo-5-metielheptaan

**Marking criteria/Nasienriglyne:**

- Correct stem i.e. heptane./Korrekke stam d.i. heptaan. ✓
- All substituents (bromo and methyl) correctly identified./Alle substituenten (bromo en metiel) korrek geïdentifiseer. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas. ✓

(3)

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

**Notes/Aantekeninge:**

- 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.  $\frac{2}{3}$
- Accept coefficients that are multiples./Aanvaar koëffisiënte wat veelvoude is.

(3)

[17]

**QUESTION 3/VRAAG 3**

3.1

3.1.1 Yes/Ja ✓



**ANY ONE/ENIGE EEN:**

- Compounds have the same molecular mass. ✓  
*Verbindings het dieselfde molekulêre massa.*
- Only one independent variable./Slegs een onafhanklike veranderlike.

(2)

3.1.2 Functional group/Homologous series/Type of (organic) compound ✓  
*Funksionele groep/Homoloë reeks/Tipe (organiese) verbinding*

(1)

3.2 A/butane/butaan ✓



Lowest boiling point/weakest intermolecular forces. ✓  
*Laagste kookpunt/swakste intermolekulêre kragte.*

(2)

3.3

**Marking guidelines/Nasienriglyne**

- Type of IMF in A./Tipe IMK in A.
  - BOTH B and C have hydrogen bonding./BEIDE B en C het waterstofbinding.
  - Compare number of sites for hydrogen bonding in B and C./Vergelyk aantal punte vir waterstofbinding in B en C.
  - Compare strength of IMFs./Vergelyk sterkte van IMKe.
  - Compare energy required./Vergelyk energie benodig.
  - Between molecules of butane/compound A are London forces/dispersion forces/induced dipole forces. ✓
  - Molecules of compound B/propan-1-ol have one site for hydrogen bonding. ✓
  - Molecules of compound C/ethanoic acid have two/more sites for hydrogen bonding. ✓
  - Strength of intermolecular forces increases from compound A/butane to compound B/propan-1-ol to compound C/ethanoic acid. ✓
- OR**
- Intermolecular forces in compound A/butane are the weakest and intermolecular forces in compound C/ethanoic acid are the strongest.
- More energy is needed to overcome/break intermolecular forces in compound C than in the other two compounds. ✓
  - Tussen molekule van butaan/verbinding A is Londonkragte/dispersie-kragte/geïnduseerde dipoolkragte. ✓
  - Molekule van verbinding B/propan-1-ol het een punt vir waterstof-bindings. ✓
  - Molekule van verbinding C/etanoësuur het twee punte vir waterstof-bindings. ✓
  - Sterkte van intermolekulêre kragte neem toe van verbinding A/butaan na verbinding B/propan-1-ol na verbinding C/etanoësuur. ✓
- OF**
- Intermolekulêre kragte tussen propaan is die swakste en intermolekulêre kragte in verbinding C is die sterkste.
- Meer energie word benodig om intermolekulêre kragte in verbinding C as in die ander twee bindings te oorkom/breek. ✓

(5)

3.4

Butan-1-ol ✓

⊖

- Longer chain length./Larger molecule./Larger molecular mass./Larger molecular size./Stronger intermolecular forces./Larger surface area. ✓
- Langer kettinglengte./Groter molekuul./Groter molekulêre massa/Groter molekuul./Sterker intermolekulêre kragte./Groter oppervlakte.

(2)

[12]

## QUESTION 4/VRAAG 4

4.1

4.1.1 Addition (polymerisation)/Addisie-(polimerisasie) ✓ (1)

4.1.2 Ethene/eteen ✓ (1)

4.1.3 Polyethene/polythene ✓  
Poli-eteen/politeen (1)

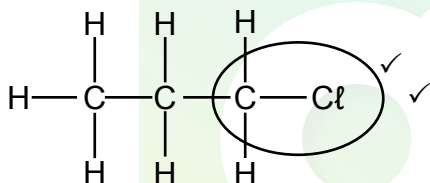
4.2

4.2.1 Dehydration/elimination ✓  
Dehidrasie/dehidratering/eliminasi (1)

4.2.2 Catalyst/dehydrating agent/causes dehydration/removes water molecules ✓  
Katalisator/dehidreermiddel/veroorzaak dehidrasie/verwyder watermolekule (1)

4.2.3 Prop-1-ene/propene/1-propene ✓✓ (2 or 0)  
Prop-1-een/propeen/1-propeen (2 of 0) (2)

4.2.4



### Marking criteria/Nasienriglyne:

- Whole structure correct:

Hele struktuur korrek:  $\frac{2}{2}$

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

### IF/INDIEN:

- More than one functional group/Meer as een funksionele groep:  $\frac{0}{2}$
- If condensed or semi structural formula used:/Indien gekondenseerde of semi-struktuurformule gebruik:

Max/Maks.  $\frac{1}{2}$

4.2.5 Addition/Hydration ✓  
Addisie/Hidrasie/Hidratering (1)

4.2.6 Propan-2-ol/2-propanol ✓✓

### Marking criteria/Nasienriglyne:

- Correct stem and functional group i.e propanol/Korrekte stam en funksionele groep d.i propanol ✓
- Name completely correct/Naam volledig korrek: Propan-2-ol/2-propanol ✓✓

(2)  
[12]



## 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/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)

5.2

5.2.1 Rate of the reaction/Reaksietempo ✓

(1)

5.2.2

### **Criteria for conclusion/Kriteria vir gevolgtrekking:**

Dependent (reaction rate) and independent (concentration ) variables correctly identified./Afhanklike(reaksietempo) en onafhanklike (konsentrasie) veranderlikes korrek geïdentifiseer.

✓

Relationship between the independent and dependent variables correctly stated.  
Verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek genoem.

✓

### **Example/Voorbeeld:**

Reaction rate increases with increase in concentration./Reaction rate is proportional to concentration.

Reaksietempo neem toe met toename in konsentrasie./Reaksietempo is eweredig aan konsentrasie.

### **IF/INDIEN**

DIRECTLY proportional/DIREK eweredig: Max/Maks.:  $\frac{1}{2}$

(2)



5.3

5.3.1 Activation energy/(The boundary line for the) molecules with (adequate) kinetic energy to make effective collisions. ✓  
*Aktiveringsenergie/(Die grenslyn vir die) molekule met (genoeg) kintiese energie vir effektiewe botsings.* (1)

5.3.2 B ✓ (1)

5.3.3

- At a higher temperature particles move faster/have a higher kinetic energy. ✓  
*By 'n hoër temperatuur beweeg die deeltjies vinniger/het die deeltjies hoër kinetiese energie.*
- More molecules have enough/sufficient (kinetic) energy. ✓  
Meer molekule het genoeg/voldoende (kinetiese) energie.  
**OR/OF**  
 More molecules have (kinetic) energy equal to or greater than activation energy.  
*Meer molekule het (kinetiese) energie gelyk aan of groter as aktiveringsenergie.*
- More effective collisions per unit time/second./Increased frequency of effective collisions.  
Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.
- Reaction rate increases. ✓  
Reaksietempo neem toe. (4)

5.4 Curve Y/it was obtained for the reaction where a catalyst was added. ✓  
*Kurwe Y/dit is vir die reaksie waar 'n katalisator bygevoeg is, verkry.*

**OR/OF**

Curve X was obtained for the reaction in the absence of a catalyst.  
*Kurwe X is verkry vir die reaksie sonder 'n katalisator.* (1)

5.5 **Marking guidelines/Nasienriglyne**

- Any formula/*Enige formule*:  $n = \frac{m}{M}$  or/of  $c = \frac{n}{V}$  ✓
- Substitute/*Vervang* 0,1 dm<sup>3</sup> in  $n = cV$  ✓
- Use mole ratio/*Gebruik molverhouding*:  
 $n(S)_{\text{expected/verwag}} = \frac{1}{2}n(HCl)_{\text{used/gebruik}}$  ✓
- Substitution of/*Vervanging van* 32 g·mol<sup>-1</sup> in  $n = \frac{m}{M}$  ✓
- SUBSTITUTE in/*VERVANG in*:  

$$\frac{n(S)_{\text{produced / berei}}}{n(S)_{\text{expected / verwag}}} \times 100 / \frac{m(S)_{\text{produced / berei}}}{m(S)_{\text{expected / verwag}}} \times 100$$
 ✓
- Final answer/*Finale antwoord*: 56,25% to 60% ✓

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$n(\text{HCl})_{\text{used/gebruik}} = cV \checkmark$ $= 0,2 \times 0,1 \checkmark$ $= 0,02 \text{ mol}$	$n(\text{HCl})_{\text{used/gebruik}} = cV \checkmark$ $= 0,2 \times 0,1 \checkmark$ $= 0,02 \text{ mol}$
$n(\text{S})_{\text{expected/verwag}} = \frac{1}{2}n(\text{HCl})_{\text{used/gebruik}}$ $= \frac{1}{2}(0,02) \checkmark$ $= 0,01 \text{ mol}$	$n(\text{S})_{\text{expected/verwag}} = \frac{1}{2}n(\text{HCl})_{\text{used/gebruik}}$ $= \frac{1}{2}(0,02) \checkmark$ $= 0,01 \text{ mol}$
$n(\text{S})_{\text{produced/berei}} = \frac{m}{M}$ $= \frac{0,18}{32} \checkmark$ $= 0,0056 \text{ mol}$	$m(\text{S})_{\text{expected/verwag}} = nM$ $= (0,01)(32) \checkmark$ $= 0,32 \text{ g}$
$\% \text{yield/opbrengs} = \frac{n(\text{S})_{\text{prod/berei}}}{n(\text{S})_{\text{exp/verwag}}} \times 100$ $= \frac{0,0056}{0,01} \times 100 \checkmark$ $= 56,25\% \checkmark$	$\% \text{yield/opbrengs} = \frac{m(\text{S})_{\text{prod/berei}}}{m(\text{S})_{\text{exp/verwag}}} \times 100$ $= \frac{0,18}{0,32} \times 100 \checkmark$ $= 56,25\% \checkmark$

(6)  
[18]

### QUESTION 6/VRAAG 6

- 6.1 Reversible reaction/Both forward and reverse reactions can take place./Products can be converted back to reactants.  $\checkmark$   
*Omkeerbare reaksie/Beide voorwaartse en terugwaartse reaksies kan plaasvind./Produkte kan terugverander word na reaktanse.* (1)
- 6.2 To favour the forward reaction/production of ammonia./To increase the yield of ammonia./Prevent the decomposition of  $\text{NH}_3$ .  $\checkmark$   
*Om die voorwaartse reaksie/produksie van ammoniak te bevoordeel./Om die ammoniak-opbrengs te verhoog./Voorkom die ontbinding van  $\text{NH}_3$ .* (1)
- 6.3 20(%)  $\checkmark$  (1)

6.4

6.4.1 At 500 °C lower yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓  
*Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.*
- An increase in temperature favours the endothermic reaction. ✓  
*'n Toename in temperatuur bevoordeel die endotermiese reaksie.*
- The reverse reaction is favoured. ✓  
*Die terugwaartse reaksie word bevoordeel.*

**OR/OF**

At 350 °C higher yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓  
*Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.*
- A decrease in temperature favours the exothermic reaction. ✓  
*'n Afname in temperatuur bevoordeel die eksotermiese reaksie.*
- The forward reaction is favoured. ✓  
*Die voorwaartse reaksie word bevoordeel.*

(3)

6.4.2 At 350 atm higher yield of ammonia:

- An increase in pressure favours the reaction that produces the lower number of moles/number of molecules/volume of gas. ✓  
*'n Toename in druk bevoordeel die reaksie wat die kleiner aantal mol/aantal molekule/volume gas lewer.*
- The forward reaction is favoured. ✓  
*Die voorwaartse reaksie word bevoordeel.*

**OR/OF**

At 150 atm lower yield of ammonia:

- A decrease in pressure favours the reaction that produces the higher number of moles/number of molecules/volume of gas. ✓  
*'n Afname in druk bevoordeel die reaksie wat die groter aantal mol/aantal molekule/volume gas lewer.*
- Reverse reaction is favoured. ✓  
*Die terugwaartse reaksie word bevoordeel.*

(2)

6.5

6.5.1 1 mol N<sub>2</sub> reacts with 3 mol H<sub>2</sub> to produce 2 mol NH<sub>3</sub>  
∴ 2 mol N<sub>2</sub> reacts with 6 mol H<sub>2</sub> to produce 4 (mol) NH<sub>3</sub> ✓✓ (2 of 0)

1 mol N<sub>2</sub> reageer met 3 mol H<sub>2</sub> om 2 mol NH<sub>3</sub> te lewer  
∴ 2 mol N<sub>2</sub> reageer met 6 mol H<sub>2</sub> om 4 (mol) NH<sub>3</sub> te vorm (2 of 0)

(2)

6.5.2 **POSITIVE MARKING FROM QUESTION 6.5.1.****Marking criteria/Nasienriglyne:**

- Calculate 35% of 4 mol  $\text{NH}_3$  (answer from Q6.5.1). ✓
- Use mol ratio/*Gebruik molverhouding*  $n(\text{N}_2) : n(\text{H}_2) : n(\text{NH}_3) = 1 : 3 : 2$  ✓
- Equilibrium/*Ewewig*  $n(\text{N}_2) = \text{initial/aanvanklike } n(\text{N}_2) - \Delta n(\text{N}_2)$  } ✓  
Equilibrium/*Ewewig*  $n(\text{H}_2) = \text{initial/aanvanklike } n(\text{H}_2) - \Delta n(\text{H}_2)$  }
- Divide by/*Deel deur*  $0,5 \text{ dm}^3$ . ✓
- Correct  $K_c$  expression (*formulae in square brackets*). ✓  
*Korrekte  $K_c$  uitdrukking (formules in vierkantige hakies).*
- Substitution of concentrations into correct  $K_c$  expression. ✓  
*Vervanging van konsentrasies in korrekte  $K_c$ -uitdrukking.*
- Final answer/*Finale antwoord*: 0,002 ✓  
Range/*Gebied*: 0,00155 to 0,002 ( $1,55 \times 10^{-3}$  to  $2 \times 10^{-3}$ )

$$n(\text{NH}_3) = \frac{35}{100} \times 4 \text{ ✓}$$

$$= 1,4 \text{ mol}$$

	$\text{N}_2$	$\text{H}_2$	$\text{NH}_3$
Initial amount (moles) <i>Aanvangs hoeveelheid (mol)</i>	6	6	0
Change in amount (moles) <i>Verandering in hoeveelheid (mol)</i>	0,7	2,1	1,4
Equilibrium amount (moles) <i>hoeveelheid (mol)</i>	5,3	3,9 ✓	1,4
Equilibrium concentration ( $\text{mol} \cdot \text{dm}^{-3}$ ) <i>Ewewigskonsentrasie (<math>\text{mol} \cdot \text{dm}^{-3}</math>)</i>	10,6	7,8	2,8

ratio ✓  
verhoudingDivide by  
 $0,5 \text{ dm}^3$  ✓

$$K_c = \frac{[\text{NH}_3]^2}{[\text{H}_2]^3 [\text{N}_2]} \text{ ✓}$$

$$= \frac{(2,8)^2}{(7,8)^3 (10,6)} \text{ ✓}$$

$$= 0,002 \text{ ✓}$$

No  $K_c$  expression, correct substitution/*Geen  $K_c$ -uitdrukking, korrekte substitusie*: Max./Maks.  $\frac{6}{7}$ Wrong  $K_c$  expression/*Verkeerde  $K_c$ -uitdrukking*:  
Max./Maks.  $\frac{4}{7}$ (7)  
[17]

### QUESTION 7/VRAAG 7

- 7.1 A base forms hydroxide ions ( $\text{OH}^-$ ) in water/aqueous solution. ✓✓  
*'n Basis vorm hidroksiedione ( $\text{OH}^-$ ) in water/waterige oplossing.*

**IF/INDIEN:**

A base ionises to form hydroxide ions ( $\text{OH}^-$ ). ✓

*'n Basis ioniseer om hidroksiedione ( $\text{OH}^-$ ) te vorm.*

Max./Maks.  $\frac{1}{2}$

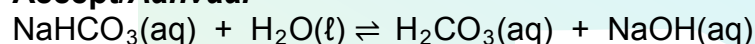
(2)

- 7.2 A strong base ionises/dissociates completely ✓ and a weak base ionises/dissociates incompletely. ✓  
*'n Sterk basis ioniseer/dissosieer volledig en 'n swak basis ioniseer/dissosieer onvolledig.*

(2)

- 7.3  $\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq})$  ✓ Bal. ✓

**Accept/Aanvaar**



**Notes/Aantekeninge:**

- Reactants/Reaktanse ✓ Products/Produkte ✓ Balancing/Balansering ✓
- Ignore single arrow./Ignoreer enkelpyl.
- Marking rule 6.3.10./Nasienreël 6.3.10.
- Ignore phases/Ignoreer fases.

(3)

7.4

- 7.4.1  $\text{pH} = -\log[\text{H}_3\text{O}^+]$  ✓  
 $= -\log(0,2)$  ✓  
 $= 0,70$  ✓ (0,699)

(3)

- 7.4.2 Titration of a weak base and a strong acid. ✓  
*Titrasie van 'n swak basis en 'n sterk suur.*

**OR/OF**

The endpoint will be at  $\text{pH} < 7$ ./Die eindpunt sal by 'n  $\text{pH} < 7$ .

(1)

7.4.3

**Marking guidelines/Nasienriglyne:**

- Any formulae/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  $0,2 \text{ mol} \cdot \text{dm}^{-3}$  &  $20 \times 10^{-3} / 0,02 \text{ dm}^3$  or  $20 \text{ cm}^3$ . ✓
- Use mol ratio/Gebruik molverhouding  $n(\text{XHCO}_3) : n(\text{HCl}) = 1 : 1$  ✓
- Substitute/Vervang  $n(\text{XHCO}_3)$  or/of  $c(\text{XHCO}_3)$  AND/EN  $0,4 \text{ g}$ . ✓
- $M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1}$  ✓
- $\text{X} = \text{K}$ /potassium/kalium. ✓

**OPTION 1/OPSIE 1**

$$c(\text{HCl}) = \frac{n}{V} \quad \checkmark$$

$$\therefore 0,2 = \frac{n}{20 \times 10^{-3}} \quad \checkmark$$

$$n(\text{HCl}) = 4 \times 10^{-3} \text{ mol}$$

$$n(\text{XHCO}_3) = n(\text{HCl}) \quad \checkmark$$

$$= 4 \times 10^{-3} \text{ mol}$$

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

$$\therefore 4 \times 10^{-3} = \frac{0,4}{M} \quad \checkmark$$

$$M = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

**OR/OF**

potassium/kalium

$$\begin{array}{l} 1 \text{ mol} \\ M(\text{XHCO}_3) \quad 4 \times 10^{-3} \text{ mol} \rightarrow \\ \rightarrow 0,4 \text{ g} \quad \checkmark \\ M(\text{XHCO}_3) = 100 \text{ g} \cdot \text{mol}^{-1} \end{array}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

**OR/OF**

potassium/kalium

**OPTION 2/OPSIE 2**

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

$$\frac{0,2 \times 20}{c_b \times 100} = \frac{1}{1} \quad \checkmark$$

$$c_b = 0,04 \text{ mol} \cdot \text{dm}^{-3}$$

$$c(\text{XHCO}_3) = \frac{m}{MV}$$

$$\therefore 0,04 = \frac{0,4}{M(0,1)} \quad \checkmark$$

$$M(\text{XHCO}_3) = 100 \text{ g} \cdot \text{mol}^{-1}$$

$$M(\text{XHCO}_3) = M(\text{X}) + 61$$

$$= 100$$

$$\therefore M(\text{X}) = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

$$\text{X} = \text{K} \quad \checkmark$$

**OR/OF**

potassium/kalium

(6)  
[17]

### QUESTION 8/VRAAG 8

- 8.1 It is a conductor of electricity/a solid to connect wires to./Pt is inert or unreactive. ✓  
*Dit is 'n geleier van elektrisiteit/'n vaste stof waaraan drade geskakel kan word./Pt is inert of onreaktief.*

#### OR/OF

$\text{Cl}^-(\text{aq})$  and chlorine gas are not solids and cannot be used as an electrode.  
 *$\text{Cl}^-(\text{aq})$  en chloorgas is nie vaste stowwe nie en kan nie as 'n elektrode gebruik word nie.*

(1)

8.2

- 8.2.1 Chemical (energy) to electrical (energy) ✓  
*Chemiese (energie) na elektriese (energie)*

(1)

- 8.2.2  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$  ✓✓

#### Marking guidelines/Nasienriglyne

- $\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$   $\frac{1}{2}$   $2\text{Cl}^- \rightleftharpoons \text{Cl}_2 + 2\text{e}^-$   $\frac{0}{2}$
- $2\text{Cl}^- \leftarrow \text{Cl}_2 + 2\text{e}^-$   $\frac{2}{2}$   $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$   $\frac{0}{2}$
- Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.
- If charge (-) omitted on  $\text{Cl}^-$ /Indien lading (-) weggelaat op  $2\text{Cl}^-$ :  
 Max./Maks:  $\frac{1}{2}$  Example/Voorbeeld:  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}$  ✓

(2)

- 8.2.3  $\text{Cr}(\text{s}) | \text{Cr}^{3+}(\text{aq}) \parallel \text{Cl}_2(\text{g}) | \text{Cl}^-(\text{aq}) | \text{Pt}(\text{s})$  ✓✓

#### OR/OF

$\text{Cr}(\text{s}) | \text{Cr}^{3+}(1 \text{ mol} \cdot \text{dm}^{-3}) \parallel \text{Cl}_2(\text{g}) | \text{Cl}^-(1 \text{ mol} \cdot \text{dm}^{-3}) | \text{Pt}(\text{s})$

#### Accept/Aanvaar:

$\text{Cr} | \text{Cr}^{3+} \parallel \text{Cl}_2 | \text{Cl}^- | \text{Pt}$

(3)

8.3

#### OPTION 1/OPSIE 1

$$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \checkmark$$

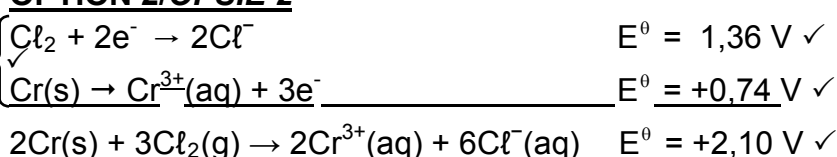
$$= 1,36 \checkmark - (-0,74) \checkmark$$

$$E_{\text{cell}}^{\theta} = 2,10 \text{ V} \checkmark$$

#### 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



(4)

- 8.4 Increases/Verhoog ✓✓

(2)

[13]



### QUESTION 9/VRAAG 9

9.1 Electrolytic/*Elektrolities* ✓ (1)

9.2  $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$  ✓✓

#### Marking guidelines/Nasienriglyne

- $2\text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{H}_2 + 2\text{OH}^-$   $\frac{1}{2}$        $\text{H}_2 + 2\text{OH}^- \rightleftharpoons 2\text{H}_2\text{O} + 2\text{e}^-$   $\frac{0}{2}$   
 $\text{H}_2 + 2\text{OH}^- \leftarrow 2\text{H}_2\text{O} + 2\text{e}^-$   $\frac{2}{2}$        $\text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{e}^-$   $\frac{0}{2}$
- Ignore if charge omitted on electron. / *Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on  $\text{OH}^-$  / *Indien lading (-) weggelaat op  $\text{OH}^-$ :*  
 Max./Maks:  $\frac{1}{2}$       Example/Voorbeeld:  $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}$   
 ✓

(2)

9.3 Chlorine (gas) /  $\text{Cl}_2$  / *Chloor(gas)* ✓ (1)

9.3.2 P ✓ & Y ✓ (2)

9.4 Cathode/*Katode* ✓  
 Reduction takes place here. / *Gains electrons.* ✓  
*Reduksie vind hier plaas. / Wins van elektrone.* (2)

9.5  $\text{CuCl}_2(\text{aq}) \checkmark \rightarrow \text{Cu}(\text{s}) + \text{Cl}_2(\text{g}) \checkmark$  Bal ✓  
**OR/OF**  
 $\text{Cu}^{2+}(\text{aq}) + 2\text{Cl}^- \rightarrow \text{Cu}(\text{s}) + \text{Cl}_2(\text{g})$

#### Notes/Aantekeninge:

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

(3)  
**[11]**

# QUESTION 10/VRAAG 10

10.1

10.1.1 II – IV – III – I ✓

(1)

10.1.2  $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$  ✓ Bal ✓

## Notes/Aantekeninge:

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

(3)

10.1.3 Vanadium pentoxide/Vanadiumpentoksied ✓

(1)

10.1.4  $\text{SO}_3(\text{g}) + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$  ✓ Bal ✓

## Notes/Aantekeninge:

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

(3)

10.1.5 Sulphuric acid will form (white) mists./The reaction is very exothermic/gives off too much heat./Corrosive reaction. ✓  
Swawelsuur sal (wit) mis vorm./Die reaksie is té eksotermies/gee te veel warmte af./Vretende reaksie.

(1)

10.2

## Marking criteria/Nasienriglyne:

- Calculate m(fertiliser)./Bereken m(kunsmis). ✓
- Use ratio/gebruik verhouding:  $\frac{2}{X+3}$  /m(P) =  $\frac{1}{2}$ m(K) ✓
- Use/Gebruik m(K) = 3,33 kg ✓
- Final answer/Finale antwoord: 3 ✓

## OPTION 1/OPSIE 1

$$m(\text{fertiliser}) = \frac{20}{100} \times 50 \checkmark$$

$$= 10 \text{ kg}$$

$$m(\text{K}) = \frac{2}{X+3} \times 10$$

$$\therefore 3,33 \checkmark = \frac{2}{X+3} \times 10$$

$$\therefore X = 3 \checkmark$$

## OPTION 2/OPSIE 2

$$m(\text{K}) = \frac{2}{X+3} \times \frac{20}{100} \times 50 \checkmark = 3,33 \checkmark$$

$$X = 3 \checkmark$$

## OPTION 3/OPSIE 3

$$m(\text{fertiliser}) = \frac{20}{100} \times 50 \checkmark$$

$$= 10 \text{ kg}$$

$$m(\text{P}) = \frac{1}{2}m(\text{K}) \checkmark$$

$$= \frac{1}{2}(3,33) = 1,665 \text{ kg}$$

$$m(\text{X}) = 10 - 3,33 \checkmark - 1,665$$

$$= 5,005$$

$$\text{N} : \text{P} : \text{K} = 5,005 : 1,665 : 3,33$$

$$= 3 : 1 : 2$$

$$\therefore X = 3 \checkmark$$

(4)

[13]

TOTAL/TOTAAL: 150