education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIORSERTIFIKAAT

GRADE/GRAAD 12

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

JUNE/*JUNIE* 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/PUNTE: 150

This marking guidelines consists of 15 pages.
Hierdie nasienryglyne bestaan uit 15 bladsye.

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QUESTION 1 / VRAAG 1

1.1 B ✓✓

1.2 C ✓✓

1.3 D ✓✓

1.4 A ✓✓

1.5 C ✓✓

1.6 C ✓✓

1.7 B ✓✓

1.8 D ✓✓

1.9 D ✓✓

1.10 D ✓✓ **[20]**

QUESTION 2 / VRAAG 2

2.1.1 C ✓ (1)

2.1.2 A ✓ (1)

2.1.3 D ✓ (1)

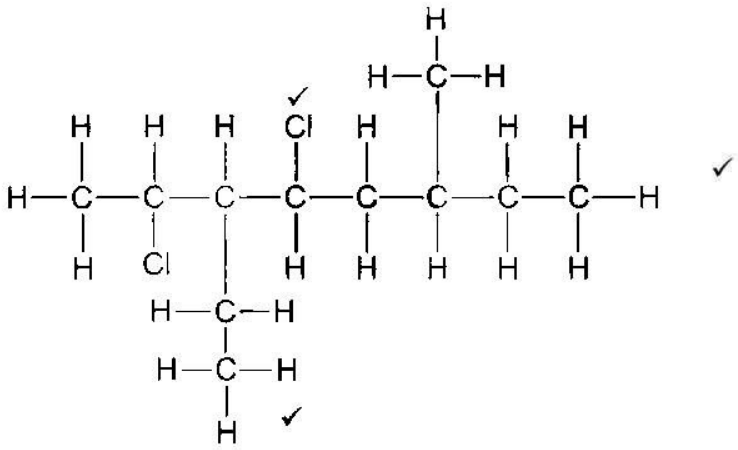
2.2.1 5-ethyl-2-methylhept-3-yne /*5-etiel-2-metielhept-3-yn*

Marking criteria:
- Correct stem i.e. heptyne. ✓
- All substituents (ethyl and methyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam d.i. heptyn.* ✓
- *Alle substituente (etiel en metiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas.* ✓ (3)

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2.2.2



✓ ✓ ✓

Marking criteria/*Nasienkriteria*

- Eight C atoms in longest chain/ *Agt C-atome in langste ketting*✓
- One Cl atom on C2 and one on C4./*Een Cl-atom op C2 en een op C4* ✓
- Ethyl substituent on C3 and methyl substituent on C6./*Etielsubstituent op C3 en metielsubstituent op C6*✓

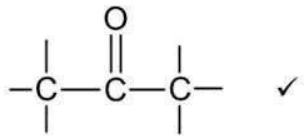
IF/*INDIEN*

H-atom or bond omitted/*H-atoom of binding uitgelaat.* Max/*Maks:* $^{2}/_{3}$

(3)

2.2.3 Aldehyde/*Aldehied* ✓ (1)

2.2.4



✓

(1)

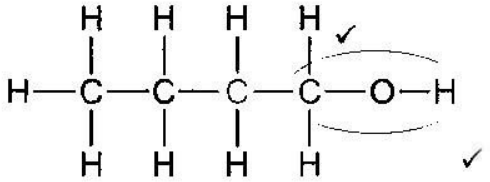
2.3.1

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.*
The underlined phrases must be in the correct context. / *Die onderstreepte frases moet in die korrekte konteks wees.*

Organic compound with the same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain. ✓✓
Organiese verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting, substituente of funksionele groepe op die stamketting (2)

2.3.2



✓

Marking criteria/*Nasienkriteria*

- OH-group on C1 ✓
- *OH-groep op C1*
- Whole structure correct. ✓
- *Hele struktuur korrek*

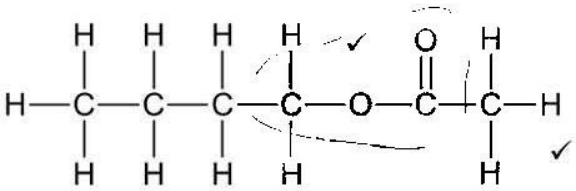
(2)

2.3.3 Secondary alcohol/*Sekondêre alkohol* ✓
The –OH group is (covalently) bonded to a carbon that is bonded to two other C-atoms ✓
Die –OH groep (kovalent) gebind is aan 'n koolstof wat gebind is aan twee ander C-atome (2)

2.4.1 Esterification /Condensation/*Esterifikasie/Kondensasie* ✓ (1)

2.4.2 H_2SO_4/ Sulphuric acid/*Swaelsuur* ✓ (a) (1)

2.4.3



✓ ✓

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

(2)

2.4.4 Butyl ✓ethanoate✓/ *Butieletanoaat* (2)

2.5

Marking criteria / Nasienkriteria:
- Substitute / *Vervang* 72 g·mol^{-1} $n = \frac{m}{M}$ ✓
- Use mole ration/ *gebruik molverhouding*✓
- Substitute number of moles and 22,4 dm^3·mol^{-1} in $n = \frac{V}{V_m}$ ✓
- Substitute / *Vervang* 76% in %yield = $\frac{\text{actual}}{\text{theoretical}}$ ✓
- Final answer / *Finale antwoord*: 53,2 dm^3 ✓

$$n = \frac{m}{M}$$
$$= \frac{45}{72}\checkmark$$
$$= 0{,}625 \text{ mol}$$

$$nCO_2 = 5nC_5H_{12}$$
$$= 5(0{,}625)$$
$$= 3{,}125 \text{ mol} \checkmark$$

$V = nV_m$
$= 3{,}125 \times 22{,}4\checkmark$
$= 70 \text{ dm}^3$

$$76 = \frac{x}{70} \times 100\checkmark$$
$V_{actual/werklik} = 53{,}2 \text{ dm}^3\checkmark$

OR/***OF***

$$76 = \frac{x}{3{,}125} \times 100\checkmark$$
$n_{actual/werklik} = 2{,}375 \text{ mol}$

$V = nV_m$
$= 2{,}375 \times 22{,}4\checkmark$
$= \underline{53{,}2 \text{ dm}^3\checkmark}$

(5)
[28]

QUESTION 3 / VRAAG 3

3.1

Marking criteria/*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 pressure. /*Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk.* ✓✓

IF Temperature is omitted 0/2. (2)

3.2 Flamable/*Vlambaar*✓ (1)

3.3 Use straight chain ✓ primary alcohols ✓
Gebruik reguitketting primêre alkohole (2)

3.4.1 Chain length/number of C-atoms/molecular mass/surface area ✓
Kettinglengte/aantal C-atome/molekulêre massa/oppervlak (1)

3.4.2 Hydroxyl (group)/*Hidroksiel(groep)* ✓ (1)

3.4.3 Ethanol/Etanol ✓ (1)

3.5 C/propan-1-ol/propan-1-ol ✓ **ACCEPT/ANVAAR**: Formula/*formule* (1)

3.6

Marking criteria:
- Compare the structures of the compounds
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:
- *Vergelyk die struktuur van die verbindings*
- Vergelyk die sterkte van intermolekulêre kragte
- *Vergelyk die energie benodig om intermolekulêre kragte te oorkom*

C/$CH_3CH_2CH_2OH$/Propan-1-ol

- **Structure/*Struktuur***
  LONGEST chain length/largest surface area (over which intermolecular forces act ✓
- **Intermolecular forces**
  STRONGEST/MOST intermolecular forces/ *Van der Waals forces/London forces/ dipole-dipole forces* ✓
- **Energy**
  Most/more energy is needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces ✓

OR

A/CH_3OH/methanol

- **Structure**
  Shortest chain length/smallest surface area (over which intermolecular forces act ✓
- **Intermolecular forces**
  Weakest/less intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces ✓
- **Energy**
  Least energy is needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces ✓

OR

From A to C

- **Structure**
  Chain length/ surface area inreases.✓
- **Intermolecular forces**
  The intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces increase. ✓
- **Energy**
  The energy require to overcome the intermolecular forces /Van der Waals forces/London forces/ dipole-dipole forces increases ✓

OR

From C to A

- **Structure**
  Chain length/ surface area decreases.✓
- **Intermolecular forces**
  The intermolecular forces/ Van der Waals forces/London forces/ dipole-dipole forces decrease. ✓
- **Energy**
  The energy require to overcome the intermolecular forces /Van der Waals forces/London forces/ dipole-dipole forces decreases ✓

C/$CH_3CH_2CH_2OH$/Propan-1-ol

- ***Struktuur***
  Langste kettinglente/grootste oppervlak (waaroor intermolekulêre kragte werk) ✓
- ***Intermolekulêre kragte***
  Sterkste/meeste intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte ✓
- ***Energie***
  Meeste energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek. ✓

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OF

C/CH_3OH/Metanol

- ***Struktuur***
  Kortste kettinglente/kleinste oppervlak (waaroor intermolekulêre kragte werk) ✓
- ***Intermolekulêre kragte***
  Swakste/minste intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte ✓
- ***Energie***
  Minste energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek. ✓

OF

Van A tot C

- **Struktuur**
  Kettinglengte/ oppervlakte*(waaroor intermolekulêre kragte werk)* verhoog.✓
- **Intermolekulêre kragte**
  Die intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte verhoog.✓
- **Energie**
- *Die energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek verhoog.* ✓ (3)

OF

Van C tot A

- **Struktuur**
  Kettinglengte/ oppervlakte*(waaroor intermolekulêre kragte werk)* verlaag.✓
- **Intermolekulêre kragte**
  Die intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ dipool-dipoolkragte verlaag.✓
- **Energie**
  Die energie benodig om die intermolekulêre kragte/Van der Waalskragte/ dipool-dipoolkragte te oorkom/breek verlaag. ✓

3.7.1 The two compounds have the same molecular mass/*Die twee verbindings het dieselfde molekulêre massa* (1)

3.7.2

Marking criteria:

- State that carboxylic acids have two sites for hydrogen bonding
- State that alcohols have one site for hydrogen bonding
- Compare the strength of intermolecular forces
- Compare the energy required to overcome intermolecular forces

Nasienkriteria:

- *Benoem die intermolekulêre kragte*
- *Stel dat karboksielsure twee plekke het vir waterstofbindings*
- *Stel dat alkohole een plek het vir waterstofbinding*
- *Vergelyk die sterkte van die IMK's / energie benodig om IMK's te oorkom*
- *Vergelyk die **energie benodig om** intermolekulêre kragte te oorkom*

- Compound **C/** $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol has one site ✓for hydrogen bonding
- Compound **X**/CH_3COOH/ ethanoic acid/carboxylic acid has two/more sites for hydrogen bonding. ✓
- Intermolecular forces in Compound **X**/CH_3COOH/ ethanoic acid / carboxylic acid are stronger than the intermolecular forces in compound **C/** $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol. ✓
- More energy is needed to overcome/break intermolecular forces in compound Compound **X**/CH_3COOH/ ethanoic acid / carboxylic acid than Compound **C/** $CH_3CH_2CH_2OH$/ propan-1-ol/ alcohol ✓

- *Verbinding **C/** $CH_3CH_2CH_2OH$/propan-1-ol/alkohol het een punt vir waterstofbindings en verbinding **X/**CH_3COOH/etanoësuur / karboksielsuur het twee/meer punte vir waterstofbindings.* ✓
- *Intermolekulêre kragte in verbinding **X/**CH_3COOH/ etanoësuur/ karboksielsuur is sterker as die intermolekulêre kragte in verbinding **C/** $CH_3CH_2CH_2OH$/propan-1-ol/alkohol.* ✓
- *Meer energie word benodig om intermolekulêre kragte in verbinding **X/**CH_3COOH/etanoësuur/ karboksielsuur as in verbinding **C/** $CH_3CH_2CH_2OH$/propan-1-ol/alkohol* ✓

(4)
[17]

QUESTION 4/ *VRAAG 4*

4.1.1 Addition/hydrogenation✓
Addisie/hidrogenasie/hidrogenering (1)

4.1.2 Substitution✓
Substitusie (1)

4.1.3 Elimination/dehydration✓
Eliminasie/dehidrasie (1)

4.2.1 Butan-2-ol/2-Butanol✓✓

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

Nasienkriteria
- *Korrekte stam d.i. butanol*
- *IUPAC-naam heeltemal korrek insluitende nommering en koppeltekens.* (2)

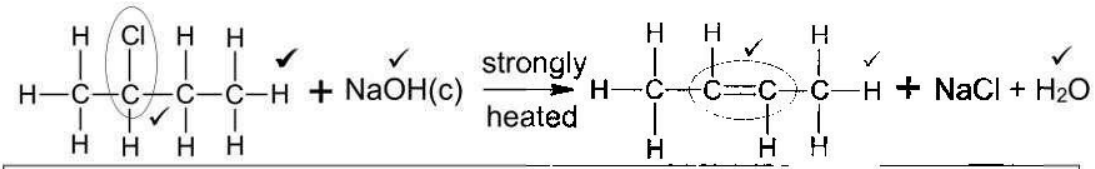
4.2.2 Water/H_2O ✓ (1)

4.2.3 Hydration/*Hidrasie*. ✓ (1)

4.3.1 Saturated/*Versadig* ✓
Compounds in which there are no multiple bonds between C atoms in their hydrocarbon chains. ✓
Verbindings waarin daar geen meervoudige bindings tussen C-atome in hul koolwaterstofkettings is nie (2)

4.3.2 Heat/UV light/hf/ *Hitte/UV lig/hf* ✓ (1)

4.4



Marking Criteria/*Nasienriglyne*
- Chlorine on the second C for 2-chlorobutane✓
  Chloor atoom op die tweede C-atoom vir 2-chlorobutaan
- Whole structural formula correct ✓
  Hele struktuurformule vir 2-bromobutaan korrek
- NaOH as reactant ✓
  NaOH as 'n reaktant
- Water(H_2O) as part of the products✓
  Water (H_2O) as deel van die produkte
- The functional group on the second carbon for but-2-ene✓
  Die funksionele groep op die tweede koolstof atoom vir but-2-een
- Whole structural formula correct ✓
  Hele struktuur korrek (6)

NOTE/LET WEL
- Penalise only once for the use of condensed structural formulae or molecular formulae
- *Penaliseer slegs een keer vir die gebruik van gekondenseerde struktuurformules of molekulêre formule*

4.5 No water (H_2O)✓ and a non-reactive solvent/dissolve in ethanol✓
Geen water (H_2O) en onreaktiewe oplosmiddel/ los op in etanol (2)
[17]

QUESTION 5/ *VRAAG 5*

5.1.1 $n(O_2) = \frac{m}{M}$✓
$= \frac{36,8}{32}$✓
$= 1,15$ mol✓

Marking criteria/*Nasienriglyne*
- Formula /*Formule*
- Substitute 32 in formula / *Vervang 32 in formule*
- Answer / *Antwoord*

(3)

5.1.2 **POSITIVE MARKING FROM QUESTION 5.1.1**
$n(PbS) = \frac{2}{3}n(O_2)$
$n(PbS) = \frac{2}{3}(1,15)$✓
$= 0,7666$ mol
$n = \frac{m}{M}$
$0,7666 = \frac{m}{239}$✓
$m = 183,23$ g ✓

Marking criteria/*Nasienriglyne*
- Mol ratio/ *mol verhouding*
- Substitute 239 in formula / *Vervang 239 in formule*
- Answer / *Antwoord*

(3)

5.1.3 **POSITIVE MARKING FROM QUESTION 5.1.2**
$\%Purity = \frac{183,23}{800} \times 100$✓
$= 22,9\%$ ✓
(2)

5.2.1 H_2O ✓ (1)

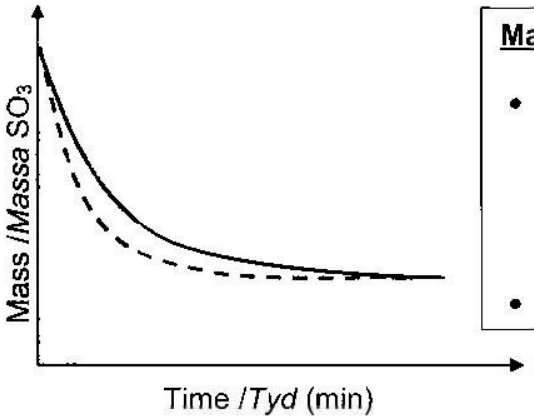
5.2.2 2(min) ✓ (1)

5.2.3 The reaction stopped/The reaction reached completion/The limiting reactant has been used up.✓
Die reaksie het gestop/Die reaksie het voltooing bereik/ Die beperkende reaktant is opgebruik (1)

5.2.4 The change in concentration ✓of reactants or products per unit time✓
/Die verandering in konsentrasie ✓van reaktante of produkte per eenheid tyd✓. (2)

5.2.5 $$\text{Rate} = -\frac{\Delta m}{\Delta t}$$
$$= -(\frac{25 - 50✓}{2(60)✓})$$
$$= 0{,}2083\ (g \cdot s^{-1})✓$$
(3)

5.2.6



Marking criteria/*Nasienriglyne*

- Both curves start at the same point and have the same endpoint/ *Beide kurwes begin by dieselfde punt en het dieselfde eindpunt* ✓
- Steeper gradient / *steiler helling*✓

(2)

5.2.7
- Increase in temperature increases the average kinetic energy/molecules move faster. ✓
  Toename in temperatuur verhoog die gemiddelde kinetiese energie/molekule beweeg vinniger.
- More molecules have enough/sufficient kinetic energy/More molecules have $E_k \geq E_a$. ✓
  Meer molekule het genoeg/voldoende kinetiese energie/Meer molekule het $E_k \geq E_a$.
- More effective collisions per unit time/second. /Frequency of effective collisions increases. ✓
  Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.

(3)
[21]

QUESTION 6 / *VRAAG 6*

6.1.1 Close system is isolated from its surroundings./ *'n Geslote sisteem is geïsoleer van die omgewing*✓ (1)

6.1.2
- From green to yellow./ *Van groen na geel*✓
- When concentration is increased the reaction that decreases the concentration is favoured / *Wanneer konsentrasie verhoog sal die reaksie wat die konsentrasie verlaag bevoordeel word.* ✓
- [NO] increases/the reverse reaction is favoured/ *[NO] verhoog/die terugwaartse reaksie word bevoordeel.* ✓
- [NOCℓ] will increase / *[NOCℓ] sal toeneem*✓ (4)

6.1.3 **Marking criteria/*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.*

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. / *Wanneer die ewewig in 'n geslote sisteem versteur word, stel die sisteem 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel.* ✓✓ (2)

6.1.4
- DECREASED / *VERLAAG.* ✓
- The concentration of $C\ell_2$ inceases. / *Die konsentrasie van $C\ell_2$ verhoog.* ✓
- The forward reaction is favoured.*Die voorwaartse reaksie is bevoordeel*✓
- The reaction that forms the most/greatest number of moles was favoured, thus the pressure was decreased. /*Die reaksie wat die meeste/grootste aantal mol vorm was bevoordeel.*✓ (4)

6.2.1 Exothermic / *Eksotermies* ✓ (1)

6.2.2
- From the graph, we can see that an increase in temperature decreases the yield of ammonia/ *Vanaf die grafiek kan afgelei word dat 'n toename in temperatuur die hoeveelheid ammoniak laat toeneem.* ✓
- An increase in temperature favours the endothermixc reaction/ *'n toename in temperatuur sal die endotermiese reaksie bevoordeel.* ✓
- Increase in temperature favours the reverse reaction/*Verhoging in temperatuur bevoordeel die terugwaarste reaksie.* ✓
- Thus, the forward reaction is exothermic / *die voorwaartse reaksie is eksotermies.* ✓ (4)

6.2.3 50 % ✓ (1)

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6.3 **Marking criteria / Nasienkriteria:**

a. Substitute 4 in $nCuCl_4^{2-}{}_{initial}$ and 2,2 in $nCu(H_2O)_6^{2+}{}_{final}$ in table ✓
Vervang 4 in $nCuCl_4^{2-}{}_{aanvanklik}$ en 2,2 in $nCu(H_2O)_6^{2+}{}_{finaal}$ in tabel
b. Use mol ratio / *Gebruik mol verhouding* : 1:4:1 ✓
c. n Equilibrium/ n Ewewig = nReactants / $nReaktante_{initial/begin}$ + nReactants / $nReaktante_{reacted/\ reageer}$ ✓
d. n Equilibrium/ *n Ewewig* = n Reactants $_{initial/begin}$ - n Reactants $_{reacted/\ reageer}$ ✓
e. Divide by the volume (2)/ *Deel deur die volume (2)* ✓
f. Correct Kc expression / *Korrekte Kc uitdrukking* ✓
g. Correct substitute into Kc expression / *Korrekte invervanging in K_c – uitdrukking* ✓
h. Final answer / Finale antwoord (0,00218) ✓

	$Cu(H_2O)_6^{2+}(aq)$	$4Cl^-(aq)$	$CuCl_4^{2-}(aq)$
Initial mol Aanvanklike mol	0	0	4
Change in mol Verandering in mol	+2,2 ✓(a)	+8,8	-2,2
Equilibrium mol Ewewigs mol	2,2	8,8	1,8
Equilibrium concentration Ewewigskonstante	1,1 ✓(c)	4,4	0,9 ✓(d)

Ratio ✓(b)

✓Divide by 2 (e)

$$K_c = \frac{[CuCl_4^{2-}]}{[Cu(H_2O)_6^{2+}][Cl^-]^4} \checkmark (f)$$

$$= \frac{(0,9)}{(1,1)(4,4)^4} \checkmark \ (g)$$

$$= 0,00218 \checkmark \ (h)$$

NB: If the chemical equation has been reversed in the table, award **7/8** marks, no mark for the answer.

(8)
[25]

QUESTION 7 / *VRAAG 7*

7.1 An Acid is a proton donor (H^+ -ion donor) /*'n Suur is 'n protonskenker (H^+ -ioon-skenker).* ✓✓ (2)

7.2.1 A substance that can act as either acid or base. ✓✓
'n Stof wat as óf 'n suur óf 'n basis kan reageer (2)

7.2.2 HSO_3^- ✓ (1)

7.2.3 H_2SO_3, HSO_3^- ✓and/*en* H_2O, H_3O^+ ✓ (2)

ACCEPT: If arrows on the equation were used.
AANVAAR: *Indien pyle op die vergelyking gebruik is*

7.3 Bromothymol blue / *Broomtimolblou* ✓
- Is most suitable for a solution with a pH = 7/ *Mees geskik vir oplossing wat 'n pH =7 het.* ✓
- Reaction of a strong acid and a strong base/The equivalence pont is equal to pH 7/ *Reaksie van 'n sterk suur en 'n sterk basis/Die ekwivalente punt is gelyk aan 'n pH van 7*✓ (3)

7.4.1 n(NaOH) = cV
= (1,2)(0,2)✓
= 0,24 mol ✓ (2)

POSITIVE MARKING FROM QUESTION 7.4.1
POSITIEWE NASIEN VAN VRAAG 7.4.1

7.4.2

Marking criteria / Nasienkriteria:

a) Formula c= $\frac{n}{V}$ ✓
b) Substitute 0,85 and 0,02367 in correct formula / Vervang 0,85 en 0,02367 in regte formule✓
c) Mol ratio n (Na_2CO_3) : n (HNO_3) 1:2 ✓
d) V (HNO_3) in 0,05 dm^3 to 0,2 dm^3✓
e) $n_{initial}$ (HNO_3) - n_{excess} (HNO_3) ✓✓
f) Substitude 56 in correct formula ✓
g) %purity = $\frac{4,426464}{13}$ x 100% ✓
h) Final answer (34,0 – 34,5) ✓

n (Na_2CO_3) = cV✓ (a)
= (0,85) (0,02367) ✓(b)
= 0,0201195 mol

n(HNO_3) = 2n(Na_2CO_3)
=0,0201195 x 2✓ (c)
= 0,040239 mol in 50cm^3

$\frac{C_aV_a}{C_bV_b} = \frac{n_a}{n_b}$

$\frac{C_a \times 50}{(0,85)(23,67)} = \frac{2}{1}$ ✓(a ✓(b ✓(c)

=0,80478 mol·dm^{-3}

n(HNO_3)=cV
=0,80478x0,05
=0,040239 mol

Therefore (4 × 0,040239 mol) = 0,160956 mol in 200 cm^3 ✓ (d)

$n_{used}(HNO_3) = n_{inital}(HNO_3) - n_{excess}(HNO_3)$
$n_{used}(HNO_3) = 0,24 - 0,160956$ ✓✓ (e)
$n_{used}(HNO_3) = 0,079$ mol

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

$$0,079044 = \frac{m}{56}$$ ✓ (f)

$$m = 4,426464 \text{ g}$$

$$\%\text{purity/suiwerheid} = \frac{4,426464}{13} \times 100$$ ✓ (g)

$$= 34,05\%$$ ✓ (h)

(9)
[21]

GRAND TOTAL/*GROOTTOTAAL* [150]