Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2021

PHYSICAL SCIENCES: CHEMISTRY P2 MARKING GUIDELINE/
FISIESE WETENSKAPPE: CHEMIE V2 NASIENRIGLYN
(EXEMPLAR/*EKSEMPLAAR*)

MARKS/*PUNTE*: 150

This marking guideline consists of 15 pages./
Hierdie nasienriglyn bestaan uit 15 bladsye.

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1 2.1.1 Homologous series ✓
Homoloë reeks (1)

2.1.2 Unsaturated. ✓
Contains a triple bond ✓/multiple bonds
Onversadig
Bevat driedubbelbinding/veelvoudige bindings (2)

2.1.3 C_5H_9 ✓ (1)

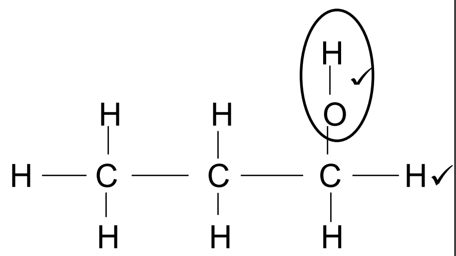
2.1.4 5-ethlyl ✓ -2-methyl ✓ hex-3-yne ✓
OR 5-ethlyl-2-methyl-3-hexyne
5-etiel-2-metielheks-3-yn
OF *5-etiel-2-metiel-3-heksyn*

Marking Criteria/*Nasien-kriteria*

- Hexyne ✓
  heksyn
- Side chains (ethyl and methyl) ✓
- *Syketting (etiel en metiel)*
- Whole name correct ✓
  Volledige naam korrek

(3)

2.2.1



Marking criteria/Nasien-kriteria

- Functional group correct (1/2)
  Funksionele groep korrek (1/2)
- Whole structure correct (2/2)
  Volle struktuur korrek (2/2)

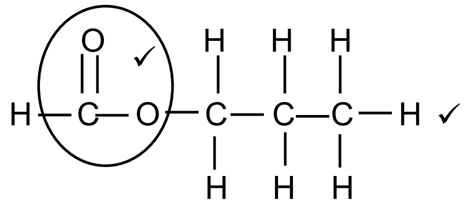
(2)

2.2.2 (Mild) heat ✓ in a water bath ✓
(Matige) hitte in 'n waterbad (2)

2.2.3 Esterification/ Condensation ✓
Esterifikasie/kondensasie (1)

2.2.4 H_2SO_4 ✓ (1)

2.2.5



Marking criteria/*Nasien riglyne*

- Functional group correct (1/2) *Funksionele groep (1/2)*
- Whole structure correct (2/2) *Volle struktuur korrek (2/2)*

(2)

2.3 2.3.1 Compounds with the same molecular formula. ✓ but different structural formula. ✓

Verbindings met dieselfde molekulêre formule maar verskillende struktuurformule. (2)

2.3.2 The C atom bonded to Br is bonded to one other C atom ✓✓ **OR** The C atom bonded to Br is bonded to two hydrogen atoms
Die C atoom wat aan die Br gebind is, is aan een ander C atom gebind

OF

Die C atoom gebind aan die Br is aan twee waterstofatome gebind. (2)

2.3.3 1-bromo-2-methylpropane ✓✓✓
1-bromo-2-metielpropaan

Marking Criteria/*Nasien-kriteria*

- Propane ✓ *Propaan*
- (bromo and methyl) ✓ *(bromo en metiel)*
- Whole name correct ✓ *Volle naam korrek*

(3)
[22]

QUESTION 3/*VRAAG 3*

3.1 The temperature at which the vapour pressure of a liquid equals the atmospheric pressure. ✓✓

Die temperatuur waarteen die dampdruk van 'n vloeistof gelyk is aan die atmosferiese druk. (2)

3.2 A ✓ Compound A has the lowest boiling point. ✓

Verbinding A het die laagste kookpunt. (2)

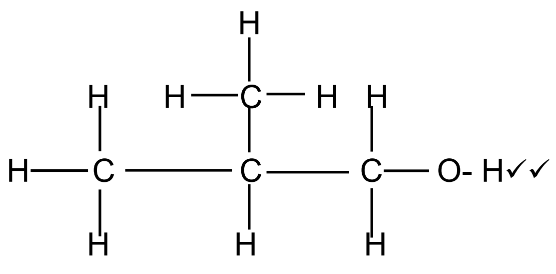
3.3.1 Molar mass/ Molecular size/ Surface area ✓
Molêre massa/ Molekulêre grootte/Oppervlakte (1)

3.3.2 Hydrogen bond ✓
Waterstofbinding (1)

3.4
- The molar mass/Molecular size/ surface area of the compounds increases from top to bottom in the table. ✓
- The compounds have London forces and (Hydrogen bonds) ✓
- The strength of London forces increases with an increase in molar mass/molecular size/surface area. ✓
- More energy is needed to overcome the intermolecular forces ✓

- *Die molêre massa/molekulêre grootte/oppervlakte van die verbinding neem toe van bo na onder in die tabel.*
- *Die verbindings het Londonkragte en (waterstofbindings)*
- *Die sterkte in Londonkragte neem toe met 'n toename in molêre massa/molekulêre grootte/oppervlakte*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom* (4)

3.5.1



Marking criteria/*Nasien kriteria*

- 3 Carbon atoms in longest chain with correct functional group
  3 koolstofatome in die langste ketting en korrekte funksionele groep

(2)

3.5.2 B ✓ It has the same molecular formula ✓
Dit het dieselfde molekulêre formule (2)

3.5.3 Lower than ✓
Laer as. (1)

3.5.4
- 2-methylpropan-1-ol has a smaller surface area than butan-1-ol. ✓
- Both compounds have London forces and (hydrogen bonds) ✓
- 2-methylpropan-1-ol have weaker London forces than butan-1-ol ✓
- Less energy is needed to overcome the intermolecular forces in 2-methylpropan-1-ol ✓

- *2-metielpropan-1-ol het 'n Kleiner oppervlakte as butan-1-ol*
- *Beide verbindings het Londonkragte en (waterstofbinding)*
- *2-metielpropan-1-ol het swakker Londonkragte as butan-1-ol*
- Minder energie word benodig om die intermolekulêrekragte in 2-metielpropan-1-ol te oorkom

OR/*OF*

- Butan-1-ol has a larger surface area than 2-methylpropan-1-ol ✓
- Both compounds have London forces and (hydrogen bonds) ✓
- Butan-1-ol have stronger Londonforces than 2-methylpropan-1-ol ✓
- More energy is needed to overcome the intermolecular forces in butan-1-ol ✓

- *Butan-1ol het 'n groter oppervlakte as 2-metielpropan-1-ol*
- *Beide verbindings het Londonkragte en (waterstofbinding)*
- *Butan-1-ol ol het sterker Londonkragte as 2-metielpropan-1-ol*
- *Meer energie word benodig om die intermolekulêrekragte in butan-1-ol te oorkom* (3)

3.6
- Methanoic acid and propan-1-ol have both Hydrogen bond and (London forces) ✓
- Methanoic acid have two sites for hydrogen bonds while propan-1-ol have only one site for hydrogen bonds. ✓
- Methanoic acid has stronger intermolecular forces than propan-1-ol ✓
- More energy is needed to overcome the intermolecular forces in methanoic acid. ✓

- *Metanoësuur en propan-1-ol het beide waterstofbinding en (Londonkragte)*
- *Metanoësuur het twee plekke vir waterstofbinding terwyl propan-1-ol slegs een plek het vir waterstofbinding*
- *Metanoësuur het sterker intermolekulêrekragte as propan-1-ol*
- *Meer energie word benodig om die intermolekulêrekragte te oorkom metanoësuur*

OR/*OF*

- Methanoic acid and propan-1-ol have both Hydrogen bond and (London forces) ✓
- Methanoic acid have two sites for hydrogen bonds while propan-1-ol have only one site for hydrogen bonds. ✓
- Propan-1-ol has weaker intermolecular forces than methanoic acid ✓
- Less energy is needed to overcome the intermolecular forces in propan-1-ol. ✓

- *Metanoësuur en propan-1-ol het beide waterstofbinding en (Londonkragte)*
- *Metanoësuur het twee plekke vir waterstofbinding terwyl propan-1-ol slegs een plek het vir waterstofbinding*
- *Propan-1-ol het swakker intermolekulêrekragte as metanoësuur*
- *Minder energie word benodig om die intermolekulêrekragte te oorkom in propan-1-ol* (4)

[22]

QUESTION 4/*VRAAG 4*

4.1 Process of breaking down long chain hydrocarbons ✓/alkanes into smaller more useful chains ✓
Proses van opbreek van lang ketting koolwaterstowwe/alkane na kleiner meer bruikbare kettings (2)

4.2 4.2.1 C_4H_{10} ✓✓ (2)

4.2.2 HIGH TEMPERATURE ✓ **OR** HIGH PRESSURE
*HOË TEMPERATUUR **OF** HOË DRUK* (1)

4.3 4.3.1 Substitution ✓
Substitusie (1)

4.3.2 Elimination ✓
Eliminasie (1)

4.4 Hydrogenation ✓
Hidrogenasie (1)

4.5 4.5.1 Br_2/Bromine ✓
Br_2/ Broom (1)

4.5.2 Pt/Ni/Pd/Platinum/Nickel/Palladium ✓
Pt/Ni/Pd / Platinum/Nikkel/ Palladium (1)

4.6 $CH_3CH_2CH_2CHBr$ ✓✓+ KOH $\longrightarrow$ $CH_3CH = CHCH_3$ ✓✓ + KBr + H_2O

Marking criteria/*Nasienkriteria*

- Organic reactant ✓✓
  Organiese reaktant
- Organic product ✓✓
  Organiese produk
- ALL Inorganic reagents correct ✓ (KOH, KBr and H_2O)
  ALLE anorganiese reagense korrek (KOH, KBr en H_2O

(5)
[15]

QUESTION 5/*VRAAG 5*

5.1 Change in concentration (of reactant/products) per unit time ✓✓
Verandering in konsentrasie (van reaktante/produkte) per eenheidstyd

OR/*OF*

Amount/Volume/Mass of reactant/product used/formed per unit time
Hoeveelheid/volume/Massa van reaktante/produkte gebruik/gevorm per eenheidstyd (2)

5.2 RELEASED ✓
VRYGESTEL
ΔH < 0 ✓/Energy of products is less than the energy of reactants/ Reaction exothermic
ΔH < 0/ Energie van produkte is minder as die energie van die reaktante/ Reaksie is eksotermies (2)

5.3 5.3.1 INCREASES ✓
VERHOOG (1)

5.3.2 NO EFFECT ✓
GEEN EFFEK (1)

5.4 5.4.1 After 120 s ✓
Na 120 s (1)

5.4.2 Concentration (of HCℓ) ✓ Surface area (of Zinc) ✓ **OR** temperature
Konsentrasie (van HCℓ) *Oppervlak (van Sink)* ***OF*** *temperatuur* (2)

5.5 5.5.1 Rate / *Tempo* = Δv/Δt= 300 -0✓ /120 – 0 ✓= 2,50 $cm^3 \cdot s^{-1}$ ✓ (3)

5.5.2 $n = V/V_m$ ✓ OR/*OF* $pV = nRT$

$n = \frac{250 \times 10^{-3}}{24}$ ✓ $(101,3\times10^{3})(250\times10^{-6}) = n\,(8,31)(20+273)$✓

n= 0,01 mol H_2 produced/*geproduseer* n = 0,01 mol H_2 produced/*geproduseer*

Mole ratio $HC\ell : H_2$
Mol verhouding 2 : 1

$n(HC\ell) = 2\,n(H_2)$
$n(HC\ell) = 2(0,01)$ ✓
$n(HC\ell) = 0,02$ mol reacted

NOTE/*LET WEL*:

If the above formula was used to calculate the mole of H_2 then award formula mark for m= nM

As die bostaande formule gebruik was om die mol van H_2 te bereken, dan die toekenningsformule- punt vir m=nM

Mole Option/ *Mol Opsie*	**Mass Option/*Massa Opsie***
$n = cV$	$m = nM$
$n = (0,5)(50\times10^{-3})$ ✓	$m = (0,02)(36,5)$ ✓
n = 0,025 mol initially *aanvanklik*	m = 0,73 g reacted *reageer*
n (left) = n (initially) – n (reacted)	$m = cMV$
n (left) = 0,025 – 0,02 ✓	$m = (0,5)(36,5)(50\times10^{-3})$ ✓
n (left) = 0,005 mol	m = 0,9125 g initially
$m = nM$	m(left) = m (i) – m (r)
$m = (0,005)(36,5)$ ✓	m (left) = 0,9125 – 0,73 ✓
m = 0,1825 g ✓	m (left) = 0,1825 g ✓

(7)

5.6 5.6.1 Catalyst ✓ **OR** Increases reaction rate
*Katalisator **OF** Toename in reaksie-tempo* (1)

5.6.2
- Catalyst lowers activation energy/provides an alternative path of lower activation energy ✓
Katalisator verlaag die aktiveringsenergie/ bied 'n alternatiewe pad van laer aktiveringsenergie
- More particles have sufficient Ek OR more particles have Ek>Ea ✓
Meer deeltjies het genoeg Ek OF meer deeltjie het Ek>Ea
- More effective collisions per unit time/Frequency of effective collisions increase ✓✓
Meer effektiewe botsings per eenheidstyd/ Frekwensie van die effektiewe botsings neem toe

(4)
[24]

QUESTION 6/*VRAAG 6*

6.1 Reaction in which products can be converted back to reactants ✓✓ **(2 or 0)**
Reaksie waarin produkte terug na reaktante oorgeskakel word ***(2 of 0)*** (2)

6.2 6.2.1 Decreases ✓
Verlaag (1)

6.2.2 Increases ✓
Verhoog (1)

6.3
- (When the temperature is decreased) the exothermic reaction is favoured ✓
- Forward reaction is favoured ✓
  (Wanner die temperatuur verlaag) word die eksotermiese reaksie bevoordeel
  Voorwaartse reaksie word bevoordeel (2)

6.4 **CALCULATION USING MOLES/*BEREKENINGE DEUR MOL TE GEBRUIK***
<u>Marking guideline/Nasienriglyn</u>

- Formula/*formule* n=m/M
- Substitution of/*Substitusie van* 28 $g\cdot mol^{-1}$
- Use of ratio/*Gebruik van verhouding* $N_2:H_2:NH_3$
- Equilibrium amounts of N_2 and H_2 formed/ *Ewewigshoeveelheid van N_2 en H_2 gevorm*
- Division $n_{equilibrium}$ of N_2, H_2 and NH_3 by 2 / *Deel van n_{ewewig} van N_2, H_2 en NH_3 deur 2*
- Correct Kc expression/*Korrekte Kc uitdrukking*
- Substitution into Kc expression/*substitusie in Kc uitdrukking*
- Final answer/*Finale antwoord*

n = m/M ✓
= 7,84/28 ✓
= 0,28 mol

	N_2 +	$3\ H_2$ ⇆	$2\ NH_3$
n_i (mol)	0,28	0,6	0
Δn (mol)	0,06	0,18	0,12 Ratio ✓/*Verhouding*
n_e (mol)	0,22	0,42 ✓	0,12
c_e ($mol\cdot dm^{-3}$)	0,22/2 =0,11	0,42/2 0,21	0,12/2 Division by 2 ✓/*Deel met 2* 0,06

$Kc = [NH_3]^2/[N_2].[H_2]^3$ ✓

$= 0,06^2/(0,11 \times 0,21^3)$ ✓

= 3,53 ✓

CALCULATION USING CONCENTRATION/*BEREKENIGE DEUR GEBRUIK TE MAAK VAN KONSENTRASIE*

Marking guidelines/ *Nasienriglyne*

- Formula / Formule c=m/MV or c=n/v
- Substitution into*/ Substitutsie in* c=m/MV or c=n/V
- Dividing by 2 for all concentration/ *Deel deur 2 vir alle konsentrasies*
- Use of ratio/ *Gerbuik van verhoudings* $N_2:H_2:NH_3$
- Equilibrium concentrations of*/ Ewewig konsentrasies van* N_2, H_2 and NH_3
- Correct Kc expression/*Korrekte Kc uitdrukking*
- Substitution into Kc expression/ *Substitusie in Kc uitdrukking*
- Final answer /*Finale antwoord*

✓ (Any one/*Enige een*)

c (N_2) = m/MV	c (H_2) = n/V	c (NH_3) = n/V
c (N_2) = 7,84/(28)(2) ✓	c (H_2) = 0,6/2	c (NH_3) = 0,12/2
c (N_2) = 0,14 mol·dm^{-3}	c (H_2) = 0,3 mol·dm^{-3}	c (NH_3) = 0,06 mol·dm^{-3}

(dividing by/*deel van* 2) ✓

	N_2 +	$3H_2$ →	$2NH_3$
c_i	0,14	0,3	0
Δc	-0,03	-0,9	+0,06 ratio ✓/*verhouding*
c_{eq}	0,11	0,21	0,06 ✓

$Kc = [NH_3]^2/[N_2]\cdot[H_2]^3$ ✓

$= 0,06^2/(0,11 \times 0,21^3)$ ✓

= 3,53 ✓ (8)

6.5 As pressure increases percentage yield increases. ✓✓
As die druk toeneem, neem die persentasie opbrengs toe. (2)

6.6 **MOLE OPTION / *MOLOPSIE***

Ratio/*Verhouding* $N_2 : H_2$ 1: 3 $n(H_2) = 3 (0,28)$ ✓ $n(H_2) = 0,84$ mol of H_2 needed only 0,6 mol of H_2 is available	Ratio/*Verhouding* $N_2 : H_2$ 1 : 3 $n(N_2) = 1/3 (0,6)$ $n(N_2) = 0,2$ mol of N_2 needed 0,28 mol of N_2 is available

0,84 *mol van H_2 word benodig* *0,2 mol N_2 word benodig*
Slegs 0,6 mol van H_2 is beskikbaar *0,28 mol N_2 is beskikbaar*
∴ H_2 is the limiting reagent ✓ ∴ H_2 is the limiting reagent
∴H_2 is die beperkende reagens *∴ H_2 is die beperkende reagens*
Theoretical yield/*Teoretiese opbrengs* = 0,6 x 2/3 = 0,4 mol ✓

% Yield/*Opbrengs* = actual yield (*werklike opbrengs)/*theoretical yield(*teoretiese opbrengs)* × 100 %
= 0,12/0,4 x 100 ✓
= 30%
Pressure / *Druk*= 100 (atmospheres/*atmosfeer*) ✓

CONCENTRATION OPTION/*KONSENTRASIE-OPSIE*

• V is constant/*V is konstant* • Concentration ratio $N_2 : H_2$ *Konsentrasie-verhouding 1*: 3 $c(H_2) = 3 (0,14)$ ✓ $c(H_2) = 0,42\ mol·dm^{-3}$ of H_2 required *H_2 benodig* only 0,3 $mol·dm^{-3}$ is available *slegs 0,3* $mol·dm^{-3}$ *is beskikbaar*	Concentration ratio $N_2 : H_2$ *Konsentrasie-verhouding* 1 : 3 $c(N_2) = 1/3 (0,3)$ $c(N_2) = 0,1\ mol·dm^{-3}$ 0,14 $mol·dm^{-3}$ is available *0,14* $mol·dm^{-3}$ *is beskikbaar*

∴ H_2 is the limiting reagent/*is die beperkende reagens* ✓

Theoretical yield/*teoretiese opbrengs* = 0,3×2/3 ✓= 0,2 $mol·dm^{-3}$

% yield/*opbrengs* = actual yield (*werklike opbrengs)*/theoretical yield/*teoretiese opbrengs* ×100 %
% yield/*opbrengs* = 0,06/0,2 ×100 % ✓
% yield/*opbrengs* = 30 %
Pressure/*druk* 100 (atmosphere/*atmosfeer*) ✓ (5)

[21]

QUESTION 7/*VRAAG 7*

7.1 7.1.1 Reaction of a salt with water ✓✓
Reaksie van 'n sout met water (2)

7.1.2 (Excess) Hydroxide/OH^- ions are formed ✓
Hydroxide/ OH^- is basic/alkaline ✓

(Oormaat) Hidroksied/ OH^- ione word gevorm
Hidroksied/ OH^- is basies/alkalies (2)

7.1.3 H_2O ✓ and HCO_3^- ✓ (2)

7.1.4 HCO_3^- can accept a proton (H^+) (to form H_2CO_3) ✓
HCO_3^- can donate a proton (H^+) (to form CO_3^{2-}) ✓

HCO_3^- kan 'n proton (H^+) aanvaar (om H_2CO_3 te vorm)
HCO_3^- kan 'n proton (H^+) skenk (om CO_3^{2-} te vorm) (2)

7.2 7.2.1 Acid is a proton donor ✓✓
Suur is 'n protonskenker (2)

7.2.2 $pH = -\log[H_3O^+]$ ✓
$1 = -\log[H_3O^+]$ ✓
$[H_3O^+] = 0{,}1\ mol{\cdot}dm^{-3}$ ✓
$[X] = 2\,[H_3O^+]$
$[X] = 2(0{,}1)$
$[X] = 0{,}2\ mol{\cdot}dm^{-3}$ ✓ (4)

7.2.3 It is a solution of known concentration ✓✓
Dit is 'n oplossing met bekende konsentrasie. (2)

7.2.4 Bromothymol blue ✓
Acid X is a strong acid.
KOH is a strong base. ✓
There is no hydrolysis of the salt produced, therefore the equivalence point of the titration would be within the range of indicator. ✓

Broomtimolblou
Suur X is 'n sterk suur.
KOH is 'n sterk basis.
Daar is geen hidrolisereaksie van die sout wat vorm, dus sal ekwivalente punt van die titrasie binne die grense van die indikator wees. (3)

7.2.5

$c_1V_1=c_2V_2$ 0,049 x 15 ✓ = c_2 x 90 ✓ c_2 = 8,17 ×10^{-3} mol·dm^{-3}	
$n_{Acid/suur}$ = cV ✓ = 8,17 ×10^{-}x 25×10^{-3} ✓ = 2,04×10^{-4} mol n(KOH) = 2 x 2,04×10^{-4} ✓ = 4,08 x 10^{-4} mol c = n/V = 4,08 x 10^{-4}/ 28,5 x 10^{-3} ✓ = 0,014 mol·dm^{-3} ✓	caVa/cb.Vb = na/nb ✓ 8,17 ×10^{-3} x 25 ✓/ cb.28,5 ✓ = ½ ✓ c_b = 0,014 mol·dm^{-3} ✓

(7)
[26]

TOTAL/*TOTAAL:* 150