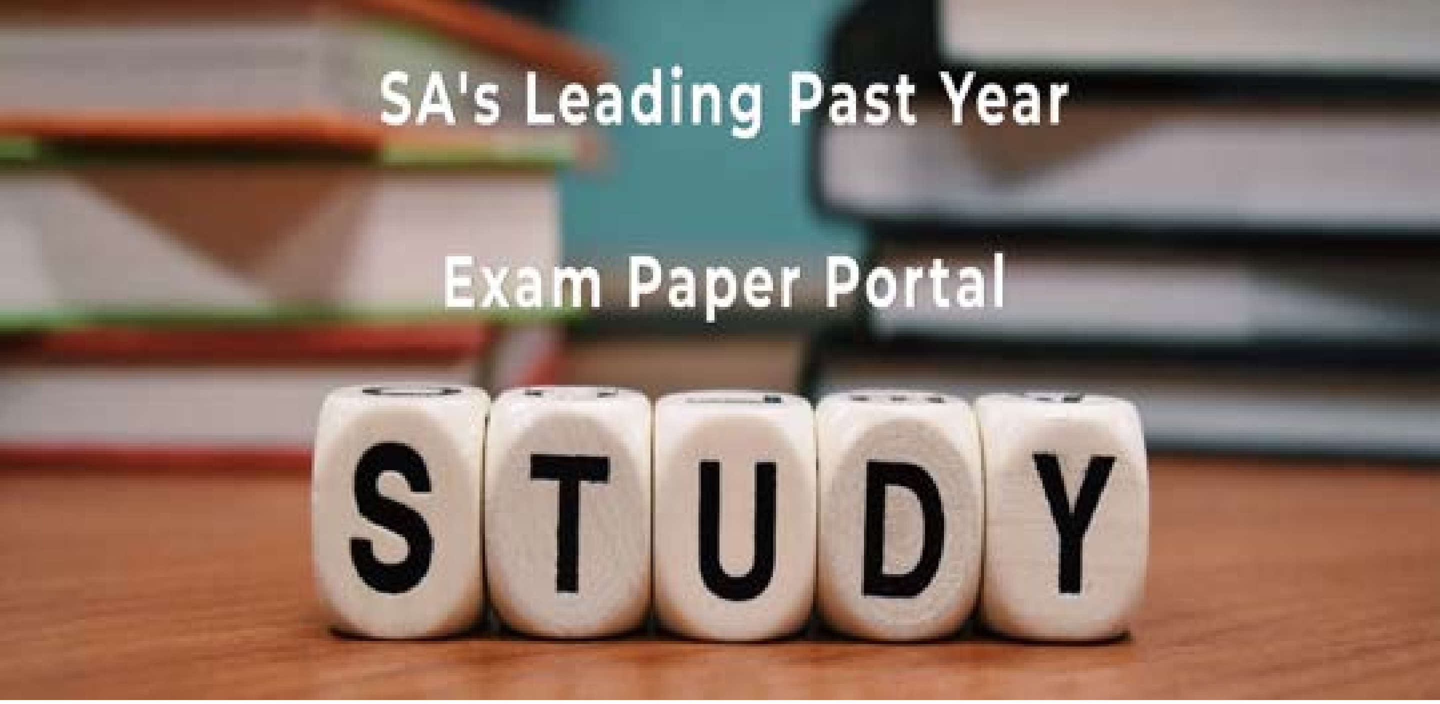
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NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2022

PHYSICAL SCIENCES: CHEMISTRY P2 MARKING GUIDELINE/ *FISIESE WETENSKAPPE: CHEMIE V2 NASIENRIGLYN*

MARKS/*PUNTE*: 150

This marking guideline consists of 13 pages./
Hierdie nasienriglyn bestaan uit 13 bladsye.

QUESTION/*VRAAG 1*

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

QUESTION/*VRAAG 2*

2.1 2.1.1 Alkyne ✓ (1)

2.1.2 Haloalkane ✓ (1)

2.2 2.2.1 E ✓ (1)

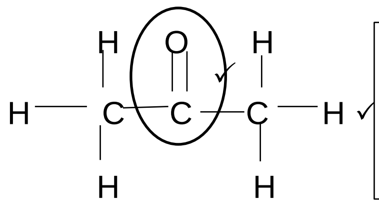
2.2.2 D ✓ (1)

2.3 2.3.1 Compound that contains carbon and hydrogen atoms only. ✓✓ (2 or 0)
Verbinding wat slegs koolstof- en waterstof-atome bevat. (2 of 0) (2)

2.3.2 UNSATURATED ✓ Contains triple bond ✓/multiple bonds (between the C-atoms in die hydrocarbon chain)
ONVERSADIG Bevat 'n drievoudige binding/ meervoudige bindings (tussen C-atome in die koolwaterstofketting) (2)

2.3.3 6-ethyl ✓-2-methyl ✓oct-4-yne ✓ / 6-ethyl-2-methyl-4-octyne
6-etiel-2-metielokt-4-yne / 6-etiel-2-metiel-4-oktyn (3)

2.4

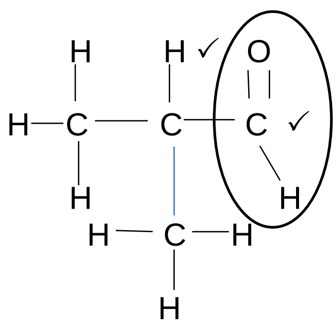


Marking criteria/*Nasienkriteria*:
- Whole structure correct/*Hele struktuur korrek: (2/2)*
- Only functional group correct
  Slegs funksionele groep korrek Max./*Maks. (1/2)*

(2)

2.5 2.5.1 Butanal ✓✓ (2)

2.5.2



Marking criteria/*Nasienriglyne*
- Whole structure correct/*Hele struktuur korrek: (2/2)*
- Only functional group correct
  Slegs funksionele groep korrek Max./*Maks. (1/2)*

(2)

2.6 2.6.1 Combustion ✓/Oxidation
Verbranding / Oksidasie (1)

2.6.2 $2\ C_6H_{14} + 19\ O_2$ ✓ → $12\ CO_2 + 14\ H_2O$ ✓ (✓ Balancing/ *balansering*) (3)

2.6.3 Compound A reacts exothermically with oxygen / releases heat when it reacts with oxygen. ✓
Verbinding A reageer eksotermies met suurstof / hitte word vrygestel wanneer dit met suurstof reageer. (1)

[22]

QUESTION/*VRAAG* 3

3.1 3.1.1 Boiling point is the <u>temperature</u> ✓at which the vapour pressure of a liquid equals the atmospheric pressure. ✓
Kookpunt is die <u>temperatuur</u> waarby die dampdruk van 'n vloeistof gelyk is aan die atmosferiese druk. (2)

3.1.2 Functional group/ ✓Homologous series/ Type of intermolecular forces.
Funksionele groep / Homoloë reeks / Tipe intermolekulêrekragte. (1)

3.1.3 London forces ✓/induced dipole forces/dispersion forces.
Londonkragte/geïnduseerde dipool kragte/verspreidingskragte. (1)

3.1.4 **C** has hydrogen bonds ✓ (in addition to London forces)
B has dipole-dipole forces ✓(in addition to London forces)
Hydrogen bonds are stronger than dipole dipole-forces ✓
More energy is needed to overcome intermolecular forces in **C** ✓

***C** het waterstofbinding (bykomend tot Londonkragte)*
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*
Waterstofbindings is sterker as die dipool-dipoolkragte
*Meer energie word benodig om die intermolekulêrekragte te oorkom in **C***

OR/*OF*

C has hydrogen bonds ✓ (in addition to London forces)
B has dipole-dipole forces ✓(in addition to London forces)
Dipole dipole forces are weaker than hydrogen bonds ✓
Less energy is needed to overcome intermolecular forces in **B** ✓

***C** het waterstofbinding (bykomend tot Londonkragte)*
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*
Dipool-dipool is swakker as die waterstofbindings
*Minder energie word benodig om die intermolekulêrekragte te oorkom in **B*** (4)

3.2 3.2.1 Vapour pressure is the <u>pressure exerted by a vapour</u> ✓ <u>in equilibrium with</u> <u>its liquid in a closed container</u>./ ✓
Dampdruk is die druk <u>uitgeoefen deur 'n damp</u> in <u>ewewig met sy vloeistof in 'n geslote sisteem</u>. (2)

3.2.2 $\mathbf{p_1}$ = 100 (kPa) ✓/101,3 (kPa) / 1 atmosphere / *atmosfeer* (1)

3.2.3 Gas ✓ **A** is above its boiling point / *Bo **A** se kookpunt* ✓ (2)

3.2.4 LOWER THAN/*LAER AS* ✓ (1)

3.2.5 Compound C only reached its boiling point at 117,7 ˚C where its vapour pressure will equal 101,3 kPa. ✓✓
Verbinding C bereik eers sy kookpunt by 117,7 ˚C waar sy dampdruk eers gelyk aan 101,3 kPa gaan wees. (2)

[16]

QUESTION/*VRAAG* 4

4.1 Substitution ✓/Hydrolysis (of haloalkanes)
Substitusie / Hidrolise (van haloalkane) (1)

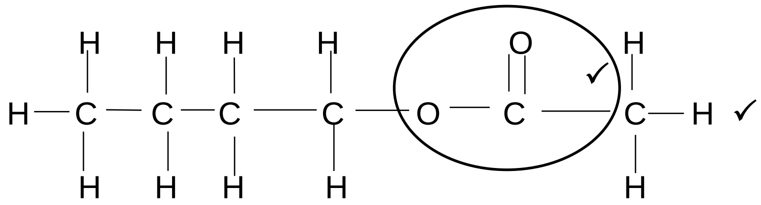
4.2 $CH_3CH_2CH_2CH_2OH$ ✓✓ (2)

4.3 Primary alcohol ✓
The carbon atom that contains the hydroxyl group (-OH) is bonded to one other carbon atom only. ✓
Primêre alkohol
Die koolstof-atoom wat die hidroksielgroep (-OH) bevat is verbind aan slegs een ander koolstof-atoom. (2)

4.4 Esterification/Condensation ✓
Esterifikasie / Kondensasie (1)

4.5 Butyl ethanoate / *Butiel-etanoaat* ✓✓

<u>Marking criteria/*Nasienkriteria*:</u>
- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/
Hele struktuur korrek ✓ *(2/2)*



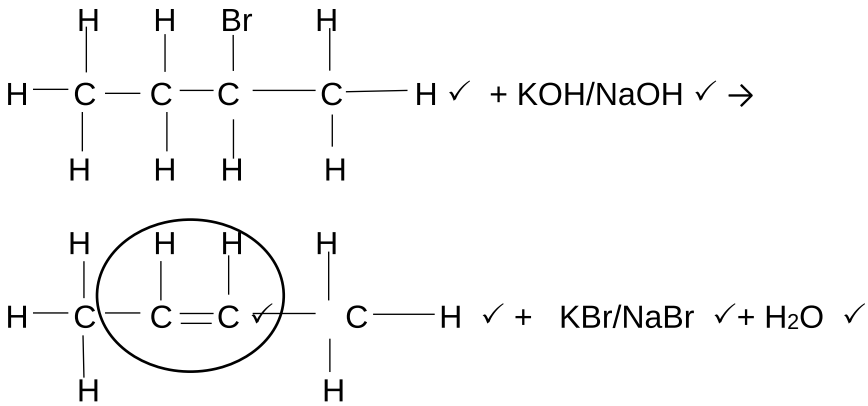
(4)

4.6 Dehydration / *Dehidrasie* ✓ (1)

4.7 (concentrated / *gekonsentreerde*) H_2SO_4 ✓ (1)

4.8 Compounds with <u>same molecular formula</u> ✓ but different positions of the <u>functional group</u> ✓/side chains/substituent on the parent chain./
Verbindings met <u>dieselfde molekulêre formule</u> maar verskillende posisies van die <u>funksionele groep</u>/sykettings/substituent op die stamketting. (2)

4.9



<u>Marking criteria/ *Nasienkriteria*</u>

<u>Reactants / *Reaktanse*</u>

- Organic molecule correct/ *Organiese molecule korrek* ✓
- KOH/NaOH ✓

<u>Products / *Produkte*</u>

- **<u>Organic molecule / *Organiese molekule*</u>**
- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/ *Hele struktuur korrek* ✓ *(2/2)*

<u>Inorganic products / *Anorganiese produkte*</u>

- KBr/NaBr ✓
- H_2O ✓

(6)

[20]

QUESTION 5/*VRAAG 5*

5.1 Change in concentration ✓per unit time. ✓/Amount of product formed/reactant used up per unit time.
Verandering in konsentrasie per eenheid tyd / Hoeveelheid produk gevorm / reaktanse opgebruik per eenheidstyd.

OR/*OF*

Rate of change in concentration **(2 or 0)**
Tempo van verandering in konsentrasie ***(2 of 0)*** (2)

5.2 Concentration ✓ and a catalyst. ✓/
Konsentrasie en 'n katalisator. (2)

5.3 5.3.1 Concentration (of H_2O_2) decreases / *Konsentrasie (van H_2O_2) verlaag* ✓✓ (2)

5.3.2 t = 5 000(s) ✓ (1)

5.3.3 Rate/*tempo* = $-\Delta c/\Delta t$ = - (1,0 – 0) ✓/(0 – 5 000) ✓
= 2×10^{-4} ✓$mol \cdot dm^{-3} \cdot s^{-1}$ (3)

5.3.4 $\Delta c = 0,8\ mol \cdot dm^{-3}$

n (H_2O_2) = cV
= 0,8 x (0,15) ✓
= 0,12 mol

n (H_2O_2) = n (O_2) = 0,12 mol ✓ (Ratio / *verhouding*)

n = V/Vm ✓

0,12 = V/25 000 ✓

V = 3 000 cm^3 ✓/(3 dm^3) (5)

5.4 5.4.1 Decrease / *Verlaag* ✓ (1)

5.4.2 Remains the same / *Bly dieselfde* ✓ (1)

5.5 5.5.1 Minimum energy required for a reaction to take place. ✓✓/
Minimum energie benodig vir 'n reaksie om plaas te vind. (2)

5.5.2 Particles with sufficient kinetic energy to react. ✓/
Deeltjies met genoeg kinetiese energie om te reageer. (1)

5.5.3 E_2 ✓

Calatyst lowers the activation energy ✓
More particles have sufficient kinetic energy to react ✓
More effective collisions per unit time ✓/Frequency of effective collisions increases
'n Katalisator verlaag die aktiveringsenergie.
Meer deeltjies het genoeg kinetiese energie om te reageer
Meer effektiewe botsings per eenheid tyd / Frekwensies van die effektiewe botsings neem toe (4)

[24]

QUESTION 6/*VRAAG 6*

6.1 6.1.1 Reversible ✓ (reaction) / *Omkeerbare (reaksie)* (1)

6.1.2 HIGHER THAN / *HOËR AS* ✓✓ (2)

6.1.3 EQUAL TO / *GELYK AAN* ✓ (1)

6.2 **OPTION 1/ *OPSIE 1* : MOLE OPTION / *MOL OPSIE***
Marking Criteria/ *Nasienkriteria*:

- Divide by 17 to calculate $n(NH_3)_{equilibrium.}$ ✓
  Deel deur 17 om $n(NH_3)_{ewewig}$ te bereken.
- Δn NH_3 ✓
- Use mole ratio N_2:H_2: NH_3 / *Gebruik mol verhouding* N_2:H_2: NH_3 ✓
- n equilibrium / *ewewig* N_2 and/*en* H_2 ✓
- Divide 2 dm^3 all n $_{equilibrium}$ / *Deel deur 2 dm^3 in alle n_{ewewig}* ✓
- Correct K_c expression/*Korrekte K_c uitdrukking.* ✓
- Substitution into K_c expression ✓/*Vervanging in K_c uitdrukking.*
- Final answer / *Finale antwoord* (0,41) ✓

n (NH_3) = m/M = 41,48/17 ✓ = 2,44 mol

	N_2	3 H_2	2 NH_3	
n_i	4,88	6,18	0	
Δn	1,22	3,66	2,44 ✓	**Ratio / *verhouding***
n_e	3,66	2,52 ✓	2,44 ✓	
c_e	1,83	1,26	1,22 ✓	**(Div/by *deel met* 2 dm^3)**

$Kc = [NH_3]^2/[N_2].[H_2]^3$ ✓

$= 1,22^2/1,83 \times 1,26^3$ ✓

$= 0,41$ ✓

OPTION 2: CONCENTRATION / *OPSIE 2: KONSENTRASIE*
Marking criteria/ *Nasienkriteria*:

- Calculate c $(NH_3)_{equilibrium.}$ ✓
  Bereken $c(NH_3)_{ewewig}$
- Δc NH_3 ✓
- c_i N_2 and/*en* H_2 ✓
- Use conc. ratio N_2:H_2: NH_3/*Gebruik gekonsen. verhouding* N_2:H_2: NH_3 ✓
- c equilibrium /*ewewig* N_2 and/*en* H_2 ✓
- Correct K_c expression/*Korrekte* K_c *uitdrukking.* ✓
- Substitution into Kc expression ✓/*Vervanging in* K_c *uitdrukking.*
- Final answer/*Finale antwoord* (0,41) ✓

n (NH_3) = m/M = 41,48/17 = 2,44 mol

c_e (NH_3) = n/V = 2,44/2 ✓ = 1,22 mol·dm^{-3}

c_i (N_2) = n/V = 4,88/2 = 2,44 mol·dm^{-3}

c_i (H_2) = n/V = 6,18/2 = 3,09 mol·dm^{-3}

	N_2	3 H_2	2 NH_3	
c_i	2,44	3,09	0	
Δc	0,61	1,83	1,22 ✓	**Ratio / *verhouding***
c_e	<u>1,83</u>	<u>1,26</u> ✓	1,22 ✓	

$K_c = [NH_3]^2/[N_2].[H_2]^3$ ✓

= $1,22^2/1.83 \times 1,26^3$ ✓

= 0,41 ✓ (8)

6.3 Temperature / *Temperatuur* ✓ (1)

6.4 **A** ✓
At a given temperature the yield of NH_3 is the highest ✓ (in graph **A**)
Increase pressure favours reaction which produces less gas moles ✓
Forward reaction is favoured ✓
By 'n gegewe temperatuur is die opbrengs van NH_3 *die hoogste (in grafiek* ***A****)*
Toename in druk bevoordeel die reaksie wat die minste gas mol produseer
Voorwaartse reaksie word bevoordeel (4)

6.5 6.5.1 Increase / *Toeneem* ✓ (1)

6.5.2 No effect / *Geen effek* ✓ (1)

6.5.3 Decrease/ *Afneem* ✓ (1)
[20]

QUESTION 7/*VRAAG 7*

7.1 7.1.1 An acid is a proton (H^+-ion) donor ✓✓
'n Suur is 'n proton (H^+-ioon) -skenker (2)

7.1.2 H_2O ✓ and / *en* $H_2SO_4^-$ ✓ (2)

7.1.3 H_2O or/*of* HSO_4^- (Any ONE / *Enige EEN* ✓) (1)

7.2 7.2.1 WEAK ACID ✓ Low Ka value/ Ka < 1 ✓
SWAKSUUR Lae Ka-waarde / Ka < 1 (2)

7.2.2 H_2SO_4 ✓ (1)

7.2.3 $pH = -\log[H_3O^+]$ ✓

$3 = -\log[H_3O^+]$ ✓

$[H_3O^+] = 1 \times 10^{-3}\ mol\cdot dm^{-3}$

$[H_2SO_4] = ½ \times 10^{-3}$ ✓

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

Marking criteria/ *Nasienkriteria*
- pH formula / formule
- Substitution / Substitusie
- Ratio / Verhouding
- Final answer / Finale antwoord

7.2.4 $CO_3^{2-} + H_2O$ ✓ → $HCO_3^- + OH^-$ ✓

$Na_2CO_3 + H_2O \rightarrow NaHCO_3 + NaOH$

(Excess) OH^- formed / *(oormaat) OH^- word geproduseer* ✓ (3)

7.3.1 It is a solution of known concentration ✓✓
Dit is 'n oplossing van bekende konsentrasie (2)

7.3.2

OPTION 1 / *OPSIE 1:*	**OPTION 2 / *OPSIE 2:***
n = m/M n = 1,74/58 ✓ = 0,03 mol c = n/V = 0,03 / 0,2 ✓ = 0,15 mol·dm^{-3}	c = m/MV c = 1,74 / (58)(0,2) ✓✓ = 0,15 mol·dm^{-3}
OPTION 3 / *OPSIE 3*:	**OPTION 4 / *OPSIE 4:***
n = cV = (0,15)(0,2) ✓ n = 0,3 mol m = nM = (0,3)(58) ✓ = 1,74 g	m = cMV = (0,15)(58)(0,2) ✓✓ m = 1,74 g

(2)

7.3.3 **Marking guideline / *Nasienriglyn***

- Calculating mole for $Mg(OH)_2$ / *Bereken mol vir* $Mg(OH)_2$
- Calculating the diluted concentration for HCl / *Bereken die verdunde konsentrasie van HCl*
- Calculating the total mole for HCl / *Bereken die totale mol van HCl*
- Calculating the reacted mole for HCl / *Bereken die mol van HCl wat gereageer het*
- Determining the remaining mole for HCl / *Bepaal die mol van HCl wat oorbly*
- Use of formula c = n/V in calculating the concentration of excess ions / *Gebruik formule c = n/V om die konsentrasie van die oormaat ione te bereken*
- Substituting into / *Vervanging in* c = n/V
- Final answer/ *Finale antwoord*

n [$Mg(OH)_2$] = cV
= 0,15 x 0,04 ✓
= 0,006 mol

$c_1V_1 = c_2V_2$
5 x10 = c_2(100) ✓
c_2 = 0,5 mol·dm^{-3}

OR/OF

n = cV
= (10)5 x 10^{-3})
n = 0,05 mol
c = $\frac{n}{V}$
= $\frac{0,05}{0,1}$ ✓
c = 0,5 mol.dm^{-3}

n (HCl) = cV
= 0,5 x 0,05 ✓
= 0,025 mol

n (HCl) reacting = 2 x 0,006 ✓ = 0,012 mol

n (HCl) remaining = 0,025 – 0,012 ✓✓ = 0,013 mol

c (HCl) = n/V ✓= 0,013 / (0,09) ✓ = 0,14 mol·dm^{-3} ✓ (9)

[28]

TOTAL/*TOTAAL*: 150