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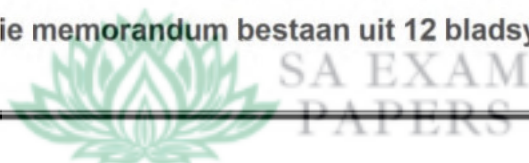
GRADE 12

**PHYSICAL SCIENCES: CHEMISTRY P2
SEPTEMBER 2023
MARKING GUIDELINES**

MARKS/PUNTE: 150

This memorandum consists of 12 pages.

Hierdie memorandum bestaan uit 12 bladsye.



QUESTION 1 / VRAAG 1

1.1 D ✓✓

1.2 C ✓✓

1.3 D ✓✓

1.4 B ✓✓

1.5 C ✓✓

1.6 D ✓✓

1.7 A ✓✓

1.8 B ✓✓

1.9 A ✓✓

1.10 D ✓✓

[20]**QUESTION 2 / VRAAG 2**

2.1 Organic compounds that consist of hydrogen and carbon only. ✓
Organiese verbindings wat slegs uit waterstof en koolstof bestaan. (1)

2.2.1 2,4-dimethylhex-1-ene/2,4-dimetiëlheks-1-een

Marking criteria:

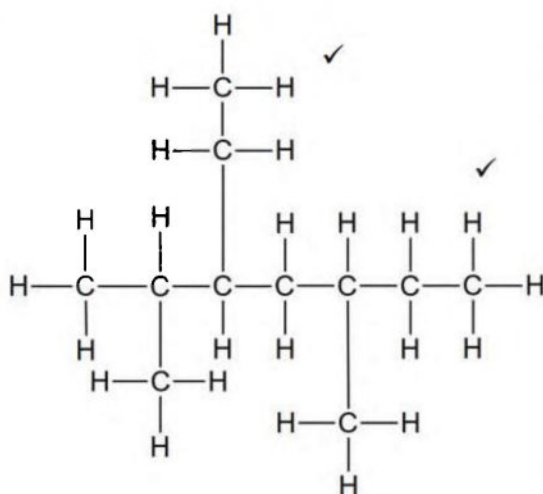
- Correct stem i.e. hexene. ✓
- Dimethyl ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- Korrekte stam d.i. hekseen. ✓
- Dimetiël ✓
- IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekeens en kommas. ✓ (3)

2.2.2 C_nH_{2n} ✓ (1)

2.2.3

**Marking criteria / Nasienriglyne**

- Seven C atoms in longest chain (only single bonds between C-atoms / Sewe C-atome in langste ketting (slegs enkel bindings tussen C-atome) ✓
- Two methyl and one ethyl substituents / Twee metiel en een etiel-substituente. ✓
- Whole structure correct / Hele struktuur korrek ✓

(3)

2.2.4 Bromine (water)/Broom(water)/Br₂ ✓

(1)

2.3.1 Aldehyde/Aldehyd ✓

(1)

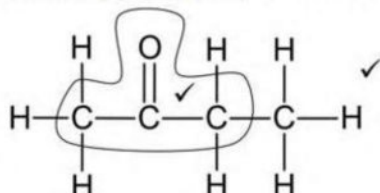
2.3.2 Formyl groep/Formielgroep ✓

(1)

2.3.3 2-methyl ✓ butanal ✓ / 2-metielbutanaal

(2)

2.3.4

**Marking criteria / Nasienriglyne**

- Only functional group correct / Slegs funksionele groep korrek ✓
- Whole structure correct / Hele struktuur korrek

(2)

2.4.1 2-methyl ✓ -pentan-2-ol ✓ / 2-metielpentan-2-ol

(2)

2.4.2 Tertiary (alcohol)/Tersiêre (alkohol) ✓

The C-atom bonded to the hydroxyl/-OH is bonded to three other C-atoms. ✓
 Die C-atoom wat aan die hidroksiell/-OH gebind is, is aan drie ander C-atome gebind.

(2)

[19]

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 solid and liquid phases of a substance are at equilibrium. ✓✓

Die temperatuur waarby die vaste- en vloeistoffases van 'n stof in ewewig is.

(2)

3.2.1 Chain length / number of C-atoms / Molecular mass ✓
Kettinglengte / getal C-atome/ molekulêre massa (1)

3.2.2 • **Structure:**
Compound B has a larger surface area/longer chain length/more C atoms/larger molecular mass than compound A. ✓
 • **Intermolecular forces:**
Intermolecular forces in compound B are stronger than those in compound A. ✓
 • **Energy**
More energy needed to overcome intermolecular forces in compound B than in compound A. ✓
 • **Struktuur:**
Verbinding B het 'n groter oppervlakte/longer kettinglengte/meer C-atome/groter molekulêre massa as verbinding A.
 • **Intermolekulêre kragte:**
Intermolekulêre kragte in verbinding B is sterker as in verbinding A.
 • **Energie:**
Meer energie word benodig om intermolekulêre kragte in verbinding B te oorkom as in verbinding A. (3)

3.3 D/Butan-1-ol ✓
 D has the highest boiling point/ D het die hoogste kookpunt ✓ (2)

3.4.1 Molecular mass/number of Carbon and Hydrogen atoms/Molekulêre massa/aantal Koolstof en Waterstof atome ✓ (1)

3.4.2 • In C/ butanal/aldehydes: dipole-dipole forces ✓ (in addition to London forces/dispersion forces/induced dipole forces).
 • In D/butan-1-ol: Hydrogen bonding. ✓ (in addition to London forces/dispersion forces/induced dipole forces).
 • Intermolecular forces in C/butanal are weaker ✓ than in D/butan-1-ol OR dipole-dipole forces are weaker than hydrogen bonds OR intermolecular forces in D/butan-1-ol are stronger than in C/butanal.
 • More energy needed to overcome/break intermolecular forces in D. ✓
 • In C/butanal/aldehydie: dipool-dipoolkragte (tesame met Londonkragte/dispersiekragte/geïnduseerde dipoolkragte).
 • In D/butan-1-ol: Waterstofbinding. (tesame met Londonkragte/dispersiekragte/geïnduseerde dipoolkragte).
 • Intermolekulêre kragte in C/butanaal/aldehyd is swakker as in D/butan-1-ol/alkohol
 • Intermolekulêre kragte in D/butan-1-ol sterker as in C/butanaal OF dipool-dipoolkragte is swakker as waterstofbindings.
 • Meer energie benodig om intermolekulêre kragte te oorkom/breek in D. (4)

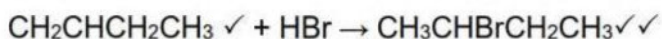
[13]

QUESTION 4/ VRAAG 4

- 4.1.1 Hydrohalogenation/Hydrobromination✓
Hidrohalogenasie/Hidrohalogenering/Hidrobrominasie (1)
- 4.1.2 Hydrogenation/Hidrogenering/Hidrogenasie✓ (1)
- 4.1.3 Hydration/Hidrasie✓ (1)
- 4.2.1 Substitution/Hydrolysis✓
Substitusie/Hidrolise (1)
- 4.2.2 Dilute strong base/NaOH/KOH/LiOH✓ and mildly heated✓
Verdunde sterk basis/ NaOH/KOH/LiOH en matig verhit (2)
- 4.2.3 NaBr/Sodium bromide/Natriumbromied✓ (1)
- 4.3 Pt/Pd/Ni✓ (1)

4.4 **Marking criteria/Nasienriglyne**

- Correct condensed structural formula for but-1-ene ✓
Korrekte gekondenseerde struktuurformule van but-1-ene
- Compound X: Bromine atom on correct carbon✓ and whole condensed structural formula correct ✓
Verbinding X: Broom atoom op korrekte C-atoom en die hele gekondenseerde struktuurformule korrek.

**NOTE/LET WEL**

- Penalise only once for the use of structural formulae or molecular formulae
- *Penaliseer slegs een keer vir die gebruik van struktuurformules of molekulêre formules* (3)

- 4.5 Alcohol/Alkohol ✓ (1)
- 4.6.1 Esterification/Esterifikasie ✓ (1)
- 4.6.2 Butyl ✓ methanoate✓/Butieletanoaat (2)
- [15]**

QUESTION 5/ VRAAG 5

5.1

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.

ANY ONE

- The change in concentration ✓ of reactants or products per unit time ✓
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
- Rate of change in concentration/amount of moles/number of moles/volume/mass. ✓✓ (2 or 0)

ENIGE EEN

- Die verandering in konsentrasie ✓ van reaktante of produkte per eenheid tyd. ✓
- Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.
- Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.
- Tempo van verandering in konsentrasie/ hoeveelheid mol/getal mol/ volume/massa. ✓ (2 of 0) (2)

5.2 To make sure that only the $H_2(g)$ /gases escapes./Om seker te maak dat slegs $H_2(g)$ /gasse kan ontsnap. ✓ (1)

5.3.1 Graph/Grafiek **B** ✓ (1)

5.3.2

Marking criteria/Nasienriglyne

- Calculate change in $m(\text{Zn})$ or $n(\text{Zn})$ ✓
Bereken verandering in $m(\text{Zn})$ of $n(\text{Zn})$
- Substitute/Vervang $65 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M}$ ✓
- Use mol ratio/Gebruik molverhouding: $n(\text{Zn}) = 2n(\text{HCl})$ ✓
- Final answer/Finale antwoord (0,2 mol) ✓

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$\Delta \text{Zn} = 7 - 0,5 \checkmark$ $= 6,5 \text{ g}$ $n(\text{Zn}_{\text{used/gebruik}}) = \frac{m}{M}$ $= \frac{6,5}{65} \checkmark$ $= 0,1 \text{ mol Zn}$ $n(\text{HCl}) = 2n(\text{Zn}) \checkmark$ $= 2(0,1) \checkmark$ $= 0,2 \text{ mol} \checkmark$	$n(\text{Zn}_{3s}) = \frac{m}{M} = \frac{7}{65} \checkmark = 0,108 \text{ mol Zn}$ $n(\text{Zn}_{12s}) = \frac{0,5}{65}$ $= 0,0077 \text{ mol Zn}$ $\Delta n(\text{Zn}) = 0,108 - 0,0077 \checkmark$ $= 0,1 \text{ mol Zn}$ $n(\text{HCl}) = 2n(\text{Zn}) \checkmark$ $= 2(0,1) \checkmark$ $= 0,2 \text{ mol} \checkmark$

(4)

5.4

Marking criteria/Nasienriglyne

- Substitute/Vervang $2,5 \times 10^{-4}$ in ave rate/gem. $\text{Tempo} = \frac{\Delta n}{\Delta t} \checkmark$
- Substitute/Vervang 12×60 (720 s) in ave rate/gem. $\text{Tempo} = \frac{\Delta n}{\Delta t} \checkmark$
- Use mol ratio/Gebruik molverhouding: $n(\text{Zn}) = 2n(\text{H}_2)$ ✓
- Substitute/Vervang $65 \text{ g} \cdot \text{mol}^{-1}$ in $n = \frac{m}{M} \checkmark$
- Final answer/Finale antwoord: 10,08 g ✓

$$\begin{aligned} \text{ave rate/gem. tempo} &= -\frac{\Delta n}{\Delta t} \\ \therefore 2,5 \times 10^{-4} \checkmark &= -\frac{\Delta n}{720 - (0) \checkmark} \\ \Delta n &= -0,18 \text{ mol} \\ 0 - n_i &= -0,18 \end{aligned}$$

$$n(\text{Zn}) = n(\text{H}_2) = 0,18 \text{ mol} \checkmark$$

$$\begin{aligned} n(\text{Zn}) &= 0,18 \times 65 \checkmark \\ &= 11,7 \text{ g} \checkmark \end{aligned}$$

(5)

5.5.1 Temperature was decreased/ Temperatuur was verlaag ✓

(1)

- 5.5.2 • Decrease in temperature decreases the average kinetic energy/molecules move slower. ✓
Afname in temperatuur verlaag die gemiddelde kinetiese energie/molekule beweeg stadiger.
- Less molecules have enough/sufficient kinetic energy/Less molecules have $E_k \geq E_a$. ✓
Minder molekule het genoeg/voldoende kinetiese energie/Minder molekule het $E_k \geq E_a$.
- Less effective collisions per unit time/second. /Frequency of effective collisions decreases. ✓
Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.
- Reaction rate decreases /Reaksietempo neem af ✓

(4)

[18]

QUESTION 6 / VRAAG 6

- 6.1 When the rate of the forward reaction equals the rate of the reverse reaction. ✓✓
Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie. (2)
- 6.2.1 Reamaine the same / Bly dieselfde ✓ (1)
- 6.2.2 Reamaine the same / Bly dieselfde ✓ (1)
- 6.3 Endothermic / Endotermies ✓
- A increase in temperature favour the endothermic reaction ✓
'n Verhoging in temperatuur bevoordeel die endotermiese reaksie
 - The forward reaction was favoured ✓
Die voorwaartse reaksie is bevoordeel.
 - The forward reaction is endothermic /Die voorwaartse reaksie is endotermies. (3)
- 6.4 Reamaine the same / Bly dieselfde ✓ (1)

6.5.1 **Marking criteria / Nasienkriteria:**

- a. Subsitute 32 in formula $n = \frac{m}{M}$ ✓
Vervang 32 in formule $n = \frac{m}{M}$
- b. Substitute 0,334 in $nS(s)_{\text{initial}}$ and 0,253 in $nS(s)_{\text{final}}$ in table ✓
Vervang 0,334 in $nS(s)_{\text{aanvanklik}}$ en 0,253 in $nS(s)_{\text{finale}}$ in tabel
- c. Use mol ratio / Gebruik mol verhouding : 1:1:1 ✓
- d. n Equilibrium/ n Ewewig = $n\text{Reactants} / n\text{Reaktante}_{\text{initial/begin}} - n\text{Reactants} / n\text{Reaktante}_{\text{reacted/ reageer}}$ ✓
- e. n Equilibrium/ n Ewewig = $n \text{SO}_2_{\text{initial/begin}} + n \text{SO}_2_{\text{reacted/ reageer}}$ ✓
- f. Divide by the volume (0,5)/ Deel deur die volume (0,5) ✓
- g. Correct K_c expression / Korrekte K_c uitdrukking ✓
- h. Correct substitute into K_c expression / Korrekte invervanging in K_c – uitdrukking ✓
- i. Final answer / Finale antwoord (0,37) ✓

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

$$= \frac{10,7}{32} \checkmark (a)$$

$$= 0,334 \text{ mol}$$

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

$$= \frac{8,1}{32}$$

$$= 0,253 \text{ mol}$$

	S(s)	O ₂ (g)	SO ₂ (g)
Initial mol Aanvanklike mol	0,334	0,3	0
Change in mol Verandering in mol $\checkmark (b)$	-0,081	-0,081	+0,081
Equilibrium mol Ewewigs mol	0,253	0,219 $\checkmark (d)$	0,081 $\checkmark (e)$
Equilibrium concentration Ewewigskonstante		0,438	0,162

Ratio $\checkmark (c)$ Divided by/deel
 deur 0,5 $\checkmark (f)$

$$K_c = \frac{[\text{SO}_2]}{[\text{O}_2]} \checkmark (g)$$

$$= \frac{0,162}{0,438} \checkmark (h)$$

$$= 0,36986 \checkmark (i)$$

$$= 0,37$$

(9)

6.5.2

$$K_c = \frac{1}{0,37}$$

$$= 2,704 \checkmark \checkmark$$

(2)

[19]

QUESTION 7 / VRAAG 7

7.1.1 Hydrogen sulphate ion/*Waterstofsulfaatioon*/ HSO_4^- ✓, K_a value is the highest /
Ka waarde is die hoogste ✓ (2)

7.1.2 SO_4^{2-} ✓ and/en CN^- ✓ (2)

7.2.1 The point where the indicator changes colour. ✓✓
Die punt waar die indicator kleur verander. (2)

7.2.2 $c_i V_i = c_f V_f$
 $(0,63)(0,05) = c_f(1)$ ✓
 $c_f = 0,0315 \text{ mol} \cdot \text{dm}^{-3}$ ✓ (3)

POSITIVE MARKING FROM QUESTION 7.2.2

7.2.3 **Marking criteria / Nasienkriteria:**

- Use of formula ($n = c \times v$) and ($m = n \times M$) ✓
- Substitute answer in 7.2.2 concentration $n_{\text{NaOH}} = c \times v$ ✓
Vervang antwoord in 7.2.2 as konsentrasie in $n_{\text{NaOH}} = c \times V$
- Ratio / *Verhouding* $n(\text{NaOH}) : 2 : 1$ ✓
- Substitute / *Vervang* $90 \text{ g} \cdot \text{mol}^{-1}$ in $m(\text{C}_2\text{H}_2\text{O}_4) = n \times M$ ✓
- Divide $m(\text{C}_2\text{H}_2\text{O}_4)$ by given mass / *Deel $m(\text{C}_2\text{H}_2\text{O}_4)$ deur gegewe massa* ✓
- Answer / *Antwoord* (22,68%) ✓

$$\begin{aligned} n(\text{NaOH}) &= cV \\ &= (0,0315)(0,04) \text{ ✓ (b)} \\ &= 1,26 \times 10^{-3} \text{ mol} \end{aligned} \quad \swarrow \text{ ✓ (a)}$$

$$\begin{aligned} n(\text{C}_2\text{H}_2\text{O}_4) &= \frac{1}{2}n(\text{NaOH}) \\ &= \frac{1}{2}(1,26 \times 10^{-3}) \\ &= 6,3 \times 10^{-4} \text{ mol} \text{ ✓ (c)} \end{aligned}$$

$$\begin{aligned} m(\text{C}_2\text{H}_2\text{O}_4) &= nM \\ &= (6,3 \times 10^{-4})(90) \text{ ✓ (d)} \\ &= 0,0567 \text{ g} \end{aligned}$$

$$\begin{aligned} \% \text{ purity / suiwerheid} &= \frac{0,0567}{0,25} \text{ ✓ (e)} \times 100 \\ &= 22,68\% \text{ ✓ (f)} \end{aligned} \quad (6)$$

7.3.1 Reaction of a salt with water / *Reaksie van 'n sout met water.* ✓✓ (2)

7.3.2 Increases / *Neem toe* ✓
 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{OH}^- + \text{CH}_3\text{COOH}$ ✓
 OH^- ions formed causes the solution to become more alkaline therefore pH increases/
 OH^- ione wat gevorm word veroorsaak dat oplossing meer alkalies word en dus die pH laat toeneem. ✓ (4)

[21]

QUESTION 8 / VRAAG 8

- 8.1.1 Galvanic cell / *Galvaniese sel* ✓ (1)
- 8.1.2 $\text{Mg} / \text{Mg}^{2+}$ ✓ // ✓ $\text{Cu}^{2+} / \text{Cu}$ ✓ (3)
- 8.1.3 Magnesium ✓ (1)
- 8.1.4 Concentration / *Konsentrasie*: $1 \text{ mol} \cdot \text{dm}^{-3}$ ✓
Temperature / *Temperatuur*: 25°C ✓ (2)
- 8.2 $E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$ ✓
= $0,34$ ✓ - $(- 2,36)$ ✓
= $2,7\text{V}$ ✓ (4)
- 8.3 Increases / *Neem toe* ✓ (1)
- 8.4
 - The light bulb is a resistor. / *Gloeilamp is 'n weerstand* ✓
 - The potential difference is enough but the current is too small. / *Die potensiaalverskil is genoeg maar die stroom is te klein.* ✓ (2)
- [14]**

QUESTION 9 / VRAAG 9

- 9.1 Is a substance of which the aqueous solution contains ions / substance that dissolves in water to give a solution that conducts electricity. ✓✓
'n Stof waarvan die oplossing ione het / 'n Stof wat in water oplos om 'n oplossing te vorm wat elektriese stroom gelei. (2)
- 9.2 Cu^{2+} ✓ (1)
- 9.3.1 Decreases / *Afneem* (1)
- 9.3.2 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ ✓✓ (2)
- 9.4 **Marking criteria / Nasienkriteria:**
- Use Formula / gebruik formule $n = \frac{N}{N_A}$ ✓
 - Answer / antwoord $n = 3,7525 \text{ mol}$ ✓
 - Use mol ratio / Gebruik mol verhouding - 2e^- : Cu 2:1 ✓
 - Substitute 63,5 in formula / Vervang 63,5 in formule $n = \frac{m}{M}$ ✓
 - Final answer / Finale antwoord (119,13 g) ✓

$$\begin{aligned}n &= \frac{N}{N_A} \checkmark \\&= \frac{2,259 \times 10^{24}}{6,02 \times 10^{23}} \\&= 3,7525 \text{ mol } \checkmark\end{aligned}$$

$$\begin{aligned}n(\text{Cu}) &= \frac{3,7525}{2} \checkmark \\&= 1,876 \text{ mol}\end{aligned}$$

$$\begin{aligned}m(\text{Cu}) &= nM \\&= (1,876)(63,5) \checkmark \\&= 119,13 \text{ g } \checkmark\end{aligned}$$

(5)
[11]

GRAND TOTAL/GROOTTOTAAL [150]



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QUESTION

2.3.3 2-methyl✓propanal✓ / *2-metielpropanaal* (2)

ONLY **AFRIKAANS** QUESTION PAPER ERRATA:

4.6.2 Butiel✓metanoaat✓ (2)

9.4

$$n = \frac{N}{N_A} \checkmark$$

$$= \frac{2259 \times 10^{24}}{6,02 \times 10^{23}}$$

$$= 3752,49 \text{ mol } \checkmark$$

$$n(\text{Cu}) = \frac{3752,49}{2} \checkmark$$

$$= 1876,246 \text{ mol}$$

$$m(\text{Cu}) = nM$$

$$= (1876,246)(63,5) \checkmark$$

$$= 119141,61 \text{ g } \checkmark$$

(5)