education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

NATIONAL

SENIOR CERTIFICATE

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)

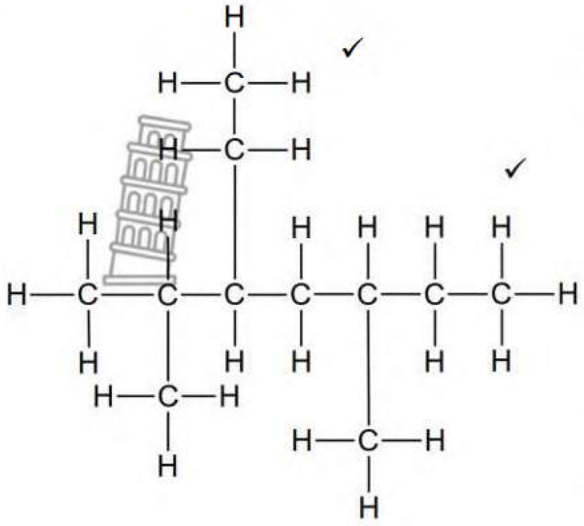
2.2.1 2,4-dimethylhex-1-ene/*2,4-dimetielheks-1-een*

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

Nasienkriteria:
- *Korrekte stam d.i. hekseen.* ✓
- Dimetiel✓
- *IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens 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)

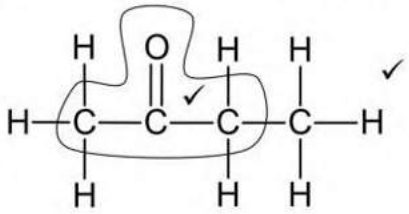
2.2.4 Bromine (water)/*Broom(water)*/Br_2 ✓ (1)

2.3.1 Aldehyde/*Aldehied* ✓ (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 hidroksiel/-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/langer 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/aldehiede: 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/aldehied 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-een
- 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.*

$CH_2CHCH_2CH_3$ ✓ + HBr → $CH_3CHBrCH_2CH_3$✓✓

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 formule*

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

OPTION1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\Delta Zn = 7 - 0,5$✓ $= 6,5$ g $n(Zn_{used/gebruik}) = \frac{m}{M}$ $= \frac{6,5}{65}$✓ $= 0,1$ mol Zn $n(HCl) = 2n(Zn)$✓ $= 2(0,1)$ $= 0,2$ mol✓	$n(Zn_{3s}) = \frac{m}{M} = \frac{7}{65}$✓ $= 0,108$ mol Zn $n(Zn_{12s}) = \frac{0,5}{65}$ $= 0,0077$ mol Zn $\Delta n(Zn) = 0,108 - 0,0077$✓ $= 0,1$ mol Zn $n(HCl) = 2n(Zn)$✓ $= 2(0,1)$ $= 0,2$ mol✓

(4)

5.4

Marking criteria/*Nasienriglyne*

- Substitute/*Vervang* 2,5 x 10^{-4} in ave rate/*gem. Tempo* $= \frac{\Delta n}{\Delta t}$✓
- Substitute/*Vervang* 12 x 60 (720 s) in ave rate/*gem. Tempo* $= \frac{\Delta n}{\Delta t}$✓
- Use mol ratio/*Gebruik molverhouding:* n(Zn)=2n(H_2) ✓
- Substitute/*Vervang* 65 g·mol^{-1} in $n = \frac{m}{M}$ ✓
- Final answer/*Finale antwoord:* 10,08 g ✓

ave rate/*gem. tempo* $= -\frac{\Delta n}{\Delta t}$

$\therefore 2,5 \times 10^{-4}$✓ $= -\frac{\Delta n}{720 - (0)}$✓

$\Delta n = -0,18$ mol

$0 - n_i = -0,18$

$n(Zn) = n(H_2) = 0,18$ mol ✓

$n(Zn) = 0,18 \times 65$✓

$= 11,7$ g ✓

(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 Verhooging 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 $nS(s)_{initial}$ and 0,253 in $nS(s)_{final}$ in table✓
   Vervang 0,334 in $nS(s)_{aanvanklik}$ *en 0,253 in* $nS(s)_{finaal}$ *in tabel*
c. Use mol ratio / *Gebruik mol verhouding* : 1:1:1 ✓
d. n Equilibrium/ n Ewewig = nReactants / $nReaktante_{initial/begin}$ – nReactants / $nReaktante_{reacted/\ reageer}$ ✓
e. n Equilibrium/ *n Ewewig* = n $SO_{2\ initial/begin}$ + n $SO_{2\ reacted/\ reageer}$ ✓
f. Divide by the volume (0,5)/ *Deel deur die volume (0,5)* ✓
g. Correct Kc expression / *Korrekte Kc uitdrukking* ✓
h. Correct substitute into Kc expression / *Korrekte invervanging in* K_c *– uitdrukking* ✓
i. Final answer / Finale antwoord (0,37) ✓

$n_i = \frac{m}{M}$
$= \frac{10,7}{32}$ ✓(a)
$= 0,334$ mol

$n_f = \frac{m}{M}$
$= \frac{8,1}{32}$
$= 0,253$ mol

	S(s)	$O_2(g)$	$SO_2(g)$	
Initial mol Aanvanklike mol	0,334	0,3	0	
Change in mol Verandering in mol ✓(b)	-0,081	-0,081	+0,081	Ratio ✓(c)
Equilibrium mol Ewewigs mol	0,253	0,219 ✓(d)	0,081 ✓(e)	
Equilibrium concentration Ewewigskonstante		0,438	0,162	Divided by/*deel deur 0,5* ✓(f)

$K_c = \frac{[SO_2]}{[O_2]}$ ✓(g)
$= \frac{0,162}{0,438}$ ✓(h)
$= 0,36986$ ✓(i)
$= 0,37$ (9)

6.5.2 $K_c = \frac{1}{0,37}$
$= 2,704$ ✓✓ (2)
[19]

QUESTION 7 / VRAAG 7

7.1.1 Hydrogen sulphate ion/*Waterstofsulfaatioon*/HSO_4^- ✓, Ka 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
$$c_iV_i = c_fV_f$$
$$(0,63)(0,05)✓ = c_f(1)✓$$
$$c_f = 0,0315 \text{ mol} \cdot \text{dm}^{-3}✓$$ (3)

POSITIVE MARKING FROM QUESTION 7.2.2

7.2.3

Marking criteria / Nasienkriteria:
a. Use of formula (n = c x v) and (m = n x M)✓
b. Substitute answer in 7.2.2 concentration n_{NaOH} = c x v ✓
Vervang antwoord in 7.2.2 as konsentrasie in n_{NaOH} = c x V
c. Ratio / *Verhouding* n(NaOH) : 2 : 1✓
d. Substitude / *Vervang* 90 g·mol^{-1} in m($C_2H_2O_4$) = n x M ✓
e. Divide m($C_2H_2O_4$) by given mass / *Deel m($C_2H_2O_4$) deur gegewe massa*✓
f. Answer / *Antwoord* (22,68%)✓

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

$$n(C_2H_2O_4) = ½n(NaOH)$$
$$= ½(1,26 \times 10^{-3})$$
$$= 6,3 \times 10^{-4} \text{ mol} ✓ (c)$$

$$m(C_2H_2O_4) = nM$$
$$= (6,3 \times 10^{-4})(90)✓(d)$$
$$= 0,0567 \text{ g}$$

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

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

7.3.2 Increases / *Neem toe* ✓
CH_3COO^- + H_2O ✓ → OH^- + CH_3COOH ✓
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 Mg / Mg^{2+} ✓ // ✓ Cu^{2+} / Cu ✓ (3)

8.1.3 Magnesium ✓ (1)

8.1.4 Concentration / *Konsentrasie*: 1 mol·dm^{-3} ✓
Temperature / *Temperatuur*: 25°C ✓ (2)

8.2 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$= 0,34$ ✓ $- (- 2,36)$ ✓
$= 2,7V$ ✓ (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 $Cu \rightarrow Cu^{2+} + 2e^{-}$ ✓✓ (2)

9.4

Marking criteria / Nasienkriteria:
- Use Formula / gebruik formule $n = \frac{N}{NA}$ ✓
- Answer / *antwoord* n = 3,7525 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) ✓

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

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

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

(5)
[11]

GRAND TOTAL/*GROOTTOTAAL* [150]

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MPUMALANGA PROVINCE
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ERRATA: PHYSICAL SCIENCES 2023

GRADE 12 PREPAROTARY EXAM PAPER 2

QUESTION

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

ONLY **AFRIKAANS** QUESTION PAPER ERRATA:

4.6.2 Butiel✓metanoaat✓ (2)

9.4

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

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

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

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

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

$$m(Cu) = nM$$

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

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

(5)