



**HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE**

**GRADE 12
PAPER 2- CHEMISTRY MEMORANDUM 2**

SEPTEMBER 2013

TIME: 3 HOURS

MARK: 150

SECTION A

QUESTION 1: ONE-WORD ITEMS

1.1 Dynamic equilibrium

1.2 Activated complex

1.3 Dehydration

1.4 Temperature

1.5 Electrode

[5]

QUESTION 2: MULTIPLE CHOICE QUESTIONS

2.1 C

2.2 A

2.3 B

2.4 C

2.5 B

2.6 C

2.7 B

2.8 A

2.9 D

2.10 B

[10X2=20]

TOTAL SECTION A: [25]

SECTION B

QUESTION 3

3.1

3.1.1 A ✓ (1)

3.1.2 D & F ✓✓ (2)

3.1.3 D ✓ (1)

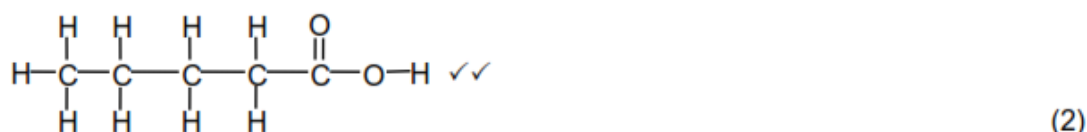
3.1.4 E ✓ (1)

3.1.5 B ✓ (1)

3.2

3.2.1 2-methyl ✓ but-1-ene ✓
2-metiel ✓ but-1-een ✓ (2)

3.2.2



3.3


3.3.1 Pleasant odour ✓
Aangename geur (1)3.3.2 Ethanol ✓✓
Etanol (2)3.3.3 Ethyl propanoate ✓✓
Etielpropanoaat (2)
[15]

QUESTION 4

4.1

4.1.1 Gas ✓ (1)


4.1.2 Lower than ✓


 Isomers of A:

More branching/Molecules more compact./Smaller surface area (over which the intermolecular forces act.) ✓

Weaker/less intermolecular forces. ✓

Less energy needed to overcome intermolecular forces. ✓


 Laer as ✓

Isomere van A:

Meer vertak/Molekule meer kompak./Kleiner oppervlakte (waaroor intermolekulêre kragte werk.) ✓

Swakker/minder intermolekulêre kragte. ✓

Minder energie benodig om intermolekulêre kragte te oorkom. ✓

OR/OF

Lower than ✓

- ⊖ **A** is less branched./has less compact molecules./has larger surface area (over which intermolecular forces act). ✓
Stronger/more intermolecular forces. ✓
More energy needed to overcome intermolecular forces. ✓

Laer as ✓

- ⊖ **A en B** is minder vertak./het minder kompakte molekule./ het groter oppervlakte (waaroor intermolekulêre kragte werk). ✓
Sterker/meer intermolekulêre kragte. ✓
Meer energie benodig om intermolekulêre kragte te oorkom. ✓

(4)

**Notes/Aantekeninge**

- | | | |
|-----------------------------------|------------|---------------|
| • Reactants ✓ | Products ✓ | Balancing ✓ |
| • Reaktanse ✓ | Produkke ✓ | Balansering ✓ |
| • Ignore/Ignoreer = | | |
| • Marking rule 3.9/Nasienreël 3.9 | | |

(3)

- 4.1.4 Compound **B** contains a carbonyl group/O atom (bonded to C atom) ✓
 and is a polar (molecule)/dipole. ✓

*Verbinding B bevat 'n karbonielgroep/O-atoom (gebind aan 'n C-atoom) ✓
 en is 'n polêre (molekuul)/dipool. ✓*

(2)

4.2

- 4.2.1 Compound D: Two sites for hydrogen bonding/forms dimers ✓
 Compound C: One site for hydrogen bonding ✓

*Verbinding D: Twee punte vir waterstofbindings/vorm dimere ✓
 Verbinding C: Een punt vir waterstofbinding ✓*

Both compounds have hydrogen bonding (between molecules). ✓
 Compound D has two sites for/stronger/more hydrogen bonding./ ✓
*Beide verbindings het waterstofbindings (tussen molecule).
 Verbinding D het twee punte vir/sterker/meer waterstofbinding.*

(2)

- 4.2.2 ⊖ (Compound/Verbinding) C ✓
 ⊖ Lowest boiling point/Laagste kookpunt ✓

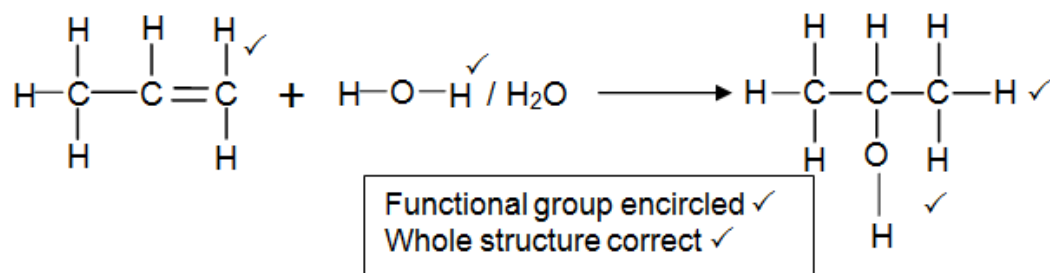
(2)

[14]

QUESTION 5

- 5.1
 5.1.1 Addition / hydration ✓ (1)
 5.1.2 Substitution / Hydrolysis ✓ (1)
 5.1.3 Elimination / Dehydrohalogenation / Dehydrobromination ✓ (1)

5.2



5.3 ✓ ✓
 Propan-2-ol (2)

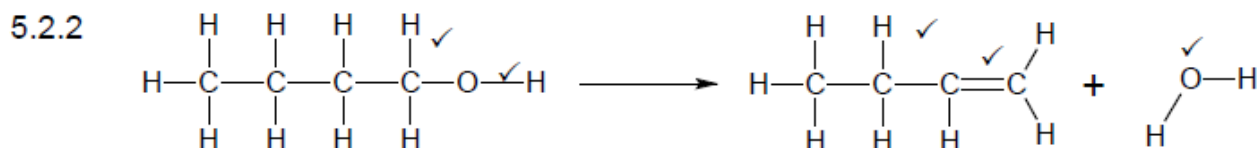
- 5.4 **ANY TWO**
Dilute / Aqueous base / KOH / NaOH OR Excess water ✓
 • Mild heat / low heat / warming / heat ✓ (2)
 • Haloalkane dissolved in ethanol. ✓ [11]

QUESTION 5/VRAAG 5

5.1 Primary/Primêr ✓ (1)

5.2

5.2.1 Elimination/dehydration ✓
Eliminasie/dehidreëring/dehidrasie ✓ (1)



Functional group/Funksionele groep: ✓
Whole structure correct/Hele struktuur korrek: ✓

Notes/Aantekeninge:

- Accept -OH as condensed in structural formula.
Aanvaar -OH as gekondenseerd in struktuurformule.
- Accept H₂O as condensed or any shape.
Aanvaar H₂O as gekondenseerd of enige vorm.

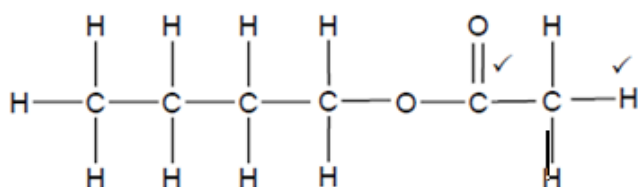
- Condensed/semistructural formulae or mixture of both: Max. $\frac{4}{5}$
Gekondenseerde/semistruktuurformules of mengsel van beide: Maks. $\frac{4}{5}$
- Molecular formula for all structures, e.g. C₄H₁₀O: Max. $\frac{1}{5}$
Molekulêre formules vir alle strukture, bv. C₄H₁₀O: Maks. $\frac{1}{5}$
- Any additional reactants or products: Max. $\frac{4}{5}$
Enige addisionele reaktanse of produkte: Maks. $\frac{4}{5}$
- Everything correct, wrong balancing: Max. $\frac{4}{5}$
Alles korrek, verkeerde balansering: Maks. $\frac{4}{5}$

(5)

5.3

5.3.1 Esterification/(Acid catalysed) condensation ✓
Verestering/(Suurgekataliseerde) kondensasie/Esterifikasie ✓ (1)

5.3.2

**Notes/Aantekeninge**

Functional group: ✓
Whole structure correct: ✓

Funksionele groep: ✓
Hele struktuur korrek: ✓

(2)

Notes/Aantekeninge:

- Condensed or semistructural formula: $\frac{1}{2}$
Gekondenseerde of semistruktuurformule: $\frac{1}{2}$
- Molecular formula/Molekulêre formule: $\frac{0}{2}$

5.4

5.4.1 Substitution ✓
Substitusie ✓ (1)

5.4.2 1-bromo✓butane ✓
1-bromo✓butaan ✓ (2)

QUESTION 6

- 6.1 Conical (flask)/*Koniese (fles)* ✓
OR/OF
 Erlenmeyer (flask/*fles*) (1)
- 6.2 Collect gas produced./Measure volume of gas produced. ✓
Vang bereide gas op./Meet volume gas berei. ✓ (1)
- 6.3
 6.3.1 Concentration/*Konsentrasie* ✓ (1)
- 6.3.2 **ANY ONE/ENIGE EEN:**
 Temperature ✓
 Surface area/State of division
Temperatuur ✓
Reaksieoppervlak/Toestand van verdeeldheid (1)
- 6.4 P ✓
 Higher (acid) concentration in experiment 2. ✓
 Steeper slope/Greater gradient ✓
Hoër (suur)konsentrasie in eksperiment 2. ✓
Steiler helling/Groter gradiënt. ✓
OR/OF
 Higher (acid) concentration in experiment 2. ✓
 Same volume of gas produced/collected in a shorter time/faster. ✓
Hoër (suur)konsentrasie in eksperiment 2. ✓
Dieselfde volume gas berei/opgevang in 'n korter tyd/vinniger. ✓ (3)
- 6.5 Concentration of acid decreases as reaction proceeds. ✓
Konsentrasie van suur verminder soos wat die reaksie verloop. ✓
OR/OF
 Surface area of Zn decreases.
Reaksieoppervlak van Zn verminder. (1)

6.6

$$\begin{aligned}
 n(\text{H}_2) &= \frac{V}{V_m} \\
 &= \frac{0,24}{24,04} \checkmark \\
 &= 0,01 \text{ mol} \checkmark \\
 n(\text{Zn}) &= \frac{m}{M} \\
 \therefore 0,01 &= \frac{m}{65} \checkmark \\
 \therefore m &= 0,65 \text{ g} \checkmark
 \end{aligned}$$

OR/OF

$$\begin{aligned}
 1 \text{ mole/mol H}_2 \text{ gas} &= 24,04 \text{ dm}^3 \checkmark \\
 0,01 \text{ mol/mol H}_2 \text{ gas} &= 0,24 \text{ dm}^3 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 65 \text{ g Zn} &= 1 \text{ mole/mol} \checkmark \\
 0,65 \text{ g} &= 0,01 \text{ mole/mol} \checkmark
 \end{aligned}$$

Mark Allocation/Puntetoekening

- Substitute volume.
Vervang volume.
- Substitute molar volume.
Vervang molêre volume.
- $n(\text{H}_2) = 0,01 \text{ mol}$
- $n(\text{Zn}) = n(\text{H}_2)$
- Substitute/Vervang $65 \text{ g} \cdot \text{mol}^{-1}$.
- Answer/Antwoord

(6)
[14]**QUESTION 7**

7.1

7.1.1

When the equilibrium in a closed system is disturbed \checkmark
 the system will shift the equilibrium position **OR** re-instate a new equilibrium
 as to **OR** favour the reaction that will \checkmark
oppose **OR** cancel **OR** counteract the change **OR** disturbance. \checkmark

*Wanneer die ewewig in 'n geslote sisteem versteur word, \checkmark
 skuif die sisteem die ewewigsposisie sodanig deur **OF** word 'n nuwe ewewig
 ingestel deur **OF** die reaksie bevoordeel wat \checkmark
 die effek van die versteuring **OF** verandering teen te werk **OF** te kanselleer. \checkmark*

OR / OF

When a stress / change is placed on a system in equilibrium \checkmark
 The system shifts the equilibrium (position) **OR** re-instate a new equilibrium \checkmark
 so as to remove **OR** cancel **OR** oppose the stress / change. \checkmark

OR / OF

When the conditions affecting an equilibrium are changed, \checkmark
 the equilibrium (position) shifts in such a way \checkmark
 as to oppose the change **OR** cancel the change. \checkmark
*Wanneer die toestande wat 'n ewewig beïnvloed, verander word, \checkmark
 sal die ewewig (posisie) sodanig verskuif \checkmark
 dat die verandering teengewerk word **OF** gekanselleer word. \checkmark*

(3)

7.1.2 Decreases ✓

When the pressure is increased,
the reverse reaction is favoured. ✓

The reaction that produced the smaller volume/amount of gas is favoured. ✓

OR

4 mol or volumes of gas produces 2 mol or volumes of gas.

Verminder ✓

*Wanneer die druk verhoog word,
 word die terugwaartse reaksie bevoordeel.* ✓

Die reaksie wat 'n kleiner volume / aantal mol vorm, word bevoordeel. ✓

OF

4 mol of volumes gas reageer om 2 mol of volumes gas te vorm.

(3)

7.1.3 Products form at faster rate. ✓

Higher yield of products. ✓

Only one of these reasons

Option 1 / Opsie 1:

$n(\text{H}_2\text{O})$ at equilibrium / by ewewig = 0,2 mol (given)

$n(\text{H}_2\text{O})$ formed / gevorm = $n(\text{CO})$ formed/ gevorm = 0,2 (mol) } ✓
 $n(\text{H}_2)$ reacted = (0,2 mol): $n(\text{CO}_2)$ reacted = (0,2 mol)

At equilibrium / By ewewig:

$n(\text{H}_2) = (x - 0,2)/(x - \text{change / verandering})$ } ✓
 $n(\text{CO}_2) = 0,1 \text{ (mol)}/(0,3 - \text{change / verandering})$ } ✓
 $n(\text{H}_2\text{O}) = n(\text{CO}) = 0,2 \text{ (mol)}$ ✓

Equilibrium concentration / Ewewigskonsentrasies:

$$\left. \begin{aligned} c(\text{H}_2) &= \frac{n}{V} = \frac{x-0,2}{10} \\ c(\text{CO}_2) &= \frac{n}{V} = \frac{0,1}{10} \\ c(\text{H}_2\text{O}) &= \frac{n}{V} = \frac{0,2}{10} \\ c(\text{CO}) &= \frac{n}{V} = \frac{0,2}{10} \end{aligned} \right\} \checkmark$$

$$K_C = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \checkmark \therefore \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \checkmark = 4 \checkmark$$

$$\therefore x = 0,3 \therefore n(\text{H}_2) = 0,3 \text{ mol} \checkmark$$

Option 2/Opsie 2

	H ₂	CO ₂	H ₂ O	CO	
Initial quantity (mol) <i>Aanvangshoeveelheid (mol)</i>	x	0,3	0	0	
Change (mol) <i>Verandering (mol)</i>	- 0,2	-0,2	+ 0,2	+ 0,2	ratio ✓ verhouding
Quantity at equilibrium (mol)/ <i>Hoeveelheid by ewewig(mol)</i>	x - 0,2	0,1 ✓	0,2	0,2 ✓	
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x - 0,2}{10}$	0,01	0,02	0,02	Divide by 10 ✓ Deel deur 10

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \checkmark \therefore \frac{(0,02)(0,02)}{\left(\frac{x - 0,2}{10}\right)(0,01)} \checkmark = 4 \checkmark \therefore x = 0,3 \therefore n(\text{H}_2) = 0,3 \text{ mol } \checkmark$$

CALCULATIONS USING CONCENTRATION**Option2/Opsie2**

	H ₂	CO ₂	H ₂ O	CO	
Initial concentration (mol·dm ⁻³) <i>Aanvangskonsentrasie (mol·dm⁻³)</i>	$\frac{x}{10}$	0,03	0	0	Divide by 10 ✓
Change in concentration (mol·dm ⁻³) <i>Verandering in konsentrasie (mol·dm⁻³)</i>	0,02	0,02	0,02	0,02	ratio ✓
Equilibrium concentration (mol·dm ⁻³) <i>Ewewigskonsentrasie (mol·dm⁻³)</i>	$\frac{x}{10} - 0,02$	0,01 ✓	0,02	0,02 ✓	

$$K_c = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{H}_2][\text{CO}_2]} \checkmark \therefore \frac{(0,02)(0,02)}{(0, x - 0,02)(0,01)} \checkmark = 4 \checkmark \therefore x = 0,3 \therefore n(\text{H}_2) = 0,3 \text{ mol } \checkmark \quad (8)$$

7.2.2 Exothermic ✓

A decrease in K_c implies: Lower product concentration / less products **OR**
higher reactant concentration / more reactants. ✓

Reverse reaction favoured. ✓ This means the forward reaction is exothermic.

Eksotermies ✓

'n Afname in K_c beteken: 'n laer produkkonsentrasie / minder produkte **OF**
hoër reaktanskonsentrasie / meer reaktanse. ✓

Terugwaartse reaksie bevoordeel. ✓ Dus is die voorwaartse reaksie
eksotermies.

OR / OF

Exothermic

Decrease in K_c – reverse reaction is favoured. ✓

Increase in temperature favours the endothermic reaction. ✓

∴ Forward reaction is exothermic.

Eksotermies

Afname in K_c – terugwaartse reaksie word bevoordeel ✓

Toename in temperatuur bevoordeel die endotermiese reaksie ✓

∴ Voorwaartse reaksie is eksotermies.

(3)
[19]

QUESTION 7/VRAAG 7

7.1 Exothermic ✓
 ΔH is negative./less than zero. ✓

Eksotermies ✓
 ΔH is negatief./kleiner as nul. ✓

OR/OF

Exothermic/Eksotermies ✓
 Energy is released./Energie word vrygestel. ✓

(2)

7.2

7.2.1 Greater than/Greater at t_1 than at t_2 . ✓
 Larger/Steeper gradients/slopes. ✓

Groter as/Groter by t_1 as t_2 .
 Groter/steiler gradiënte/hellings.

OR/OF

Smaller at t_2 than at t_1 . ✓
 Smaller/less steep gradients/slopes. ✓

Kleiner by t_2 as by t_1 . ✓
 Kleiner/minder steil gradiënte/hellings. ✓

(2)

7.2.2 Equal to/Gelyk aan ✓

(1)

7.3 Decreases ✓

Higher temperature favours the endothermic reaction. ✓
 The reverse reaction is favoured. ✓
 Less products/more reactants. ✓

Verminder ✓
 Hoër temperatuur bevoordeel die endotermiese reaksie. ✓
 Die terugwaartse reaksie word bevoordeel. ✓
 Minder produkte/meer reaktanse. ✓

(4)

7.4

7.4.1 Decreases/Verminder ✓

(1)

7.4.2 Remains the same/Bly dieselfde ✓

(1)

7.4.3 Decreases/Verminder ✓

(1)

[21]

QUESTION 10

8.1 Chemical (energy) to electrical (energy) ✓
Chemiese (energie) na elektriese (energie) ✓ (1)

8.2 Completes the circuit. / *Voltooi die stroombaan.* ✓

OR / OF

Maintains electrical neutrality. ✓
Handhaaf elektriese neutraliteit. ✓ (1)

8.3 $\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$ ✓✓ (2)

8.4 Pb to Cu ✓ (1)

8.5 $\text{Pb} + \text{Cu}^{2+} \rightarrow \text{Pb}^{2+} + \text{Cu}$ ✓ Balancing ✓ (3)

8.6 Exothermic / *eksotermies* ✓ (1)

8.7 $E^\ominus_{\text{cell}} = E^\ominus_{\text{cathode}} - E^\ominus_{\text{anode}}$ ✓
 $= 0,34 - (-0,13)$ ✓
 $E^\ominus_{\text{cell}} = 0,47 \text{ V}$ ✓ (4)

8.8 Measurements not done at:
 Temperature of 25 °C / 298 K ✓✓
 Concentration of 1 mol·dm⁻³ ✓✓

Metings nie gedoen by:
Temperatuur van 25 °C / 298 K ✓✓
Konsentrasie van 1 mol·dm⁻³ ✓✓

(4)
[17]

QUESTION 11

- 9.1 Electrical energy to chemical energy. ✓
Elektriese energie na chemiese energie ✓ (1)
- 9.2 The polarity of the electrodes must remain constant during plating. ✓
Die polariteit van die elektrodes moet konstant bly tydens elektroplatering. (1)
- 9.3 Reduction/*Reduksie* ✓ (1)
- 9.4
- 9.4.1 $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$ ✓✓ (2)
- 9.4.2 Silver nitrate/*Silwernittraat*/ AgNO_3 ✓
- OR/OF**
Silver ethanoate/silver acetate/*Silweretanoaat/silwerasetaat* ✓
 $\text{CH}_3\text{COOAg}/\text{AgC}_2\text{H}_3\text{O}_2/\text{AgCH}_3\text{CO}_2$ (1)
- 9.5 Rate of oxidation is equal to the rate of reduction. ✓✓
Tempo van oksidasie is gelyk aan die tempo van reduksie. (2)
- 9.6 **Protection/Beskerming**
Protects it from rusting / corrosion./*Beskerm dit teen roeskorrosie.* ✓
- OR/OF**
Appearance/Voorkoms
Improve appearance of spoons. / *Verbeter voorkoms van die lepels.* (1)
- 9.7 Cost of electricity/ *Koste van elektrisiteit.* ✓
Cost of silver/ *Koste van silwer* ✓ (2)

[11]

TOTAL SECTION B: [125]

GRAND TOTAL: [150]