Education and Sport Development

Department of Education and Sport Development
Departement van Onderwys en Sportontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko
NORTH WEST PROVINCE

PROVINCIAL MID YEAR EXAMINATIONS

GRADE/GRAAD 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

FISIESE WETENSKAPPE: CHEMIE (V2)

MAY/JUNE 2019

MEI/JUNIE 2019

MEMORANDUM

MARKS/ PUNTE: 150

TIME/TYD: 3 hours/ure

This memorandum consists of 13 pages.

Hierdie memorandum bestaan uit 13 bladsye

GENERAL GUIDELINES

1. CALCULATIONS

1.1 **Award marks** for: correct formula, correct substitution and correct answer with unit.

1.2 **Do not award any marks** if **an incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.

1.3 When an error is made during substitution into a correct formula, award a mark for the correct formula and for the correct substitutions, but do **not** give **any further marks**.

1.4 If **no formula** is given, but all substitutions are correct, the candidate forfeits **one mark**.
Example:

No K_c expression, correct substitution:

$$K_c = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark \qquad (\frac{2}{3})$$

1.5 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer is given.

1.6 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.

1.7 All calculations, when not specified in the question, must be done correctly to TWO decimal places.

2. DEFINITIONS

Award TWO marks for a correct definition. Do not award any marks for an incorrect or partially correct definition.

3. UNITS

3.1 Candidates must be penalised only once for the repeated use of an incorrect unit **within a question or subquestion.**

3.2 Units are only required in the final answer of a calculation.

3.3 Award marks for an answer only and not for a unit *per se*. Candidates forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

3.4 Separate compound units with a multiplication dot, not a full stop, for example, mol·dm^{-3}. Accept mol.dm^{-3} (or mol/dm^3) for marking purposes.

4. GENERAL

4.1 If one answer or calculation is required, but the candidate gives two, mark only the first one, irrespective of which one is correct. If two answers are required, mark only the first two, etc.

4.2 When a chemical **FORMULA** is asked, and the **NAME** is given as answer, the candidate forfeits the marks. The same rule applies when the **NAME** is asked and the **FORMULA is** given.

4.3 When redox half-reactions are to be written, the correct arrow should be used. If the equation

$$H_2S \rightarrow S + 2\,H^+ + 2e^- \quad (2/2)$$

is the correct answer, the marks must be given as follows:

$H_2S \rightleftharpoons S + 2\,H^+ + 2e^-$ (1/2)

$H_2S \leftarrow S + 2\,H^+ + 2e^-$ (0/2)

$S + 2H^+ + 2e^- \leftarrow H_2S$ (2/2)

$S + 2H^+ + 2e^- \rightleftharpoons H_2S$ (0/2)

4.4 When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, do not accept the following:

- Stating the position of a substance on table 4 only. (e.g. Cu is above Mg).
- Using relative reactivity only (e.g. Mg is more reactive than Cu).
- The correct answer would be for instance: Mg is a stronger reducing agent than Cu and therefore Mg will be able to reduce Cu^{2+} ions to Cu. The answer can also be given in terms of the relative strength as electron acceptors and donors.

4.5 One mark is forfeited when the charge of an ion is omitted per equation.

4.6 The error carrying principle does not apply to chemical equations or half reactions. For example, if a learner writes the wrong oxidation/reaction half-reaction in the subquestion and carries the answer to another sub-question (balancing of equations or calculation of E^{θ}_{cell}) then the learner must not be credited for this substitution.

4.7 In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks must be deducted if hydrogen atoms are omitted.

4.8 When a structural formula is asked, marks must be deducted if the learner writes the condensed formula.

4.9 When an IUPAC name is asked and the candidate omits the hyphen (e.g. instead of pent-1-ene or 1-pentene the candidate writes pent 1 ene or 1 pentene), marks must be forfeited.

4.10 When a chemical reaction is asked, marks are awarded for correct reactants, correct products and correct balancing.
If only a reactant(s) followed by an arrow, or only a product(s) preceded by an arrow is/are written, marks may be awarded for the reactant(s) or product(s). If only a reactant(s) or only a product(s) is written without an arrow, no marks are awarded for the reactant(s) or product(s).

Example: $N_2 + 3H_2$✓ $\rightarrow$ $2NH_3$✓ bal. ✓

$N_2 + 3H_2 \rightarrow$ ✓	1/3
$\rightarrow NH_3$✓	1/3
$N_2 + 3H_2$	0/3
NH_3	0/3

5. POSITIVE MARKING

Positive marking regarding calculations is followed in the following cases:

5.1 **Subquestion to subquestion**: When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, full marks must be awarded for the subsequent subquestions.

5.2 A multi-step question in a subquestion: if the candidate has to calculate, for example, the number of moles in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer is forfeited.

5.3 If the final answer of a calculation is correct, full marks are not automatically awarded. Markers must always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.

QUESTION 1 / *VRAAG 1*

1.1 B ✓✓

1.2 B ✓✓

1.3 C ✓✓

1.4 B ✓✓

1.5 D ✓✓

1.6 A ✓✓

1.7 B ✓✓

1.8 B ✓✓

1.9 C ✓✓

1.10 A ✓✓

[20]

QUESTION 2 / *VRAAG 2*

2.1 Organic molecules with the same molecular formula, but different positions of the side chains, substituent or functional groups on the parent chain. ✓✓
Organiese molekules met dieselfde molekulêre formule, maar verskillende posisies vir sykettings, substituente of funksionele groepe aan die

hoofketting ✓✓ (2)

2.2 C ✓ and/en F✓ (2)

2.3 2.3.1 C_nH_{2n} ✓ (1)

2.3.2 D ✓ (1)

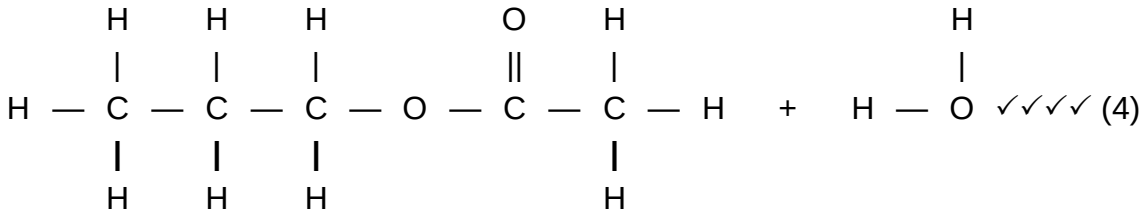
2.3.3 Propan-2-one / *propan-2 -oon*✓✓ (2)

2.4

2.4.1 Breaking up large saturated hydrocarbons into smaller more useful unsaturated compounds. ✓✓
Om groot versadigde koolwaterstowwe in kleiner meer bruikbare onversadigde verbindings op te breek✓✓ (2)

2.4.2 C_2H_6✓ $\xrightarrow{\text{STEAM/STOOM}}$ $CH_2 = CH_2 + H_2$ ✓ ✓ (bal) (3)

2.5



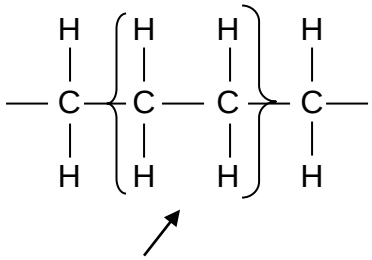
✓✓✓✓ (4)

2.6

2.6.1 Smaller repeating units or molecules from which polymers are composed. ✓✓
Klein herhalende eenhede of molekules waaruit polimere saamgestel is ✓✓ (2)

2.6.2 Addition polymerisation / *Addisie polimerisasie* ✓ (1)

2.6.3



✓✓ (2)

[22]

QUESTION 3 / *VRAAG 3*

3.1 The temperature at which the vapour pressure of a substance is equal to the atmospheric pressure. ✓✓
Die temperatuur waar by die dampdruk van 'n stof gelyk is aan die atmosferiese druk ✓✓ (2)

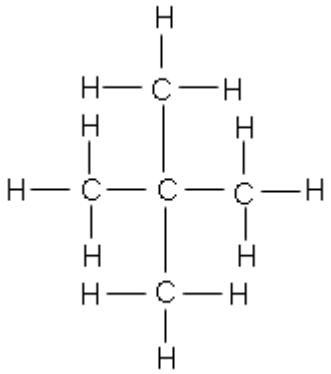
3.2

3.2.1 Chain length/molecular size/molecular mass/number of carbon atoms in the chain and the boiling point of a substance. ✓
Kettinglengte/grootte van molekule/molekulêre massa/aantal koolstof atome in die ketting en die kookpunt van die stof ✓ (1)

3.2.2 Boiling point / *kookpunt* ✓ (1)

3.2.4 Chain isomer / *ketting isomeer* ✓ (1)

3.2.4



✓✓ (2)

3.3 **A**. ✓ Compounds **B** and **C** have branches✓ which tend to lower their boiling points.✓ /
*Verbindings **B** en **C** het sytakke✓ wat lei tot laer kookpunte* ✓ (3)

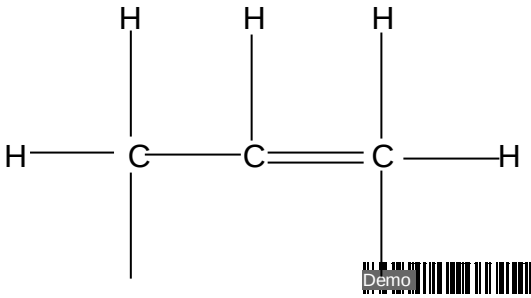
3.4 Branched alkanes have lower boiling points than straight chain alkanes. ✓✓
Vertakte alkane het laer kookpunte as reguit ketting alkane ✓✓ (2)

3.5 Lower than / *Laer as* ✓ (1)
[13]

QUESTION 4 / *VRAAG 4*

4.1

4.1.1



✓✓

H H

(2)

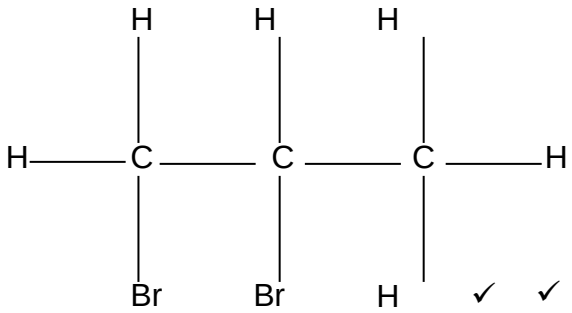
4.1.2 Elimination/Dehydration.✓
Eliminasie / dehidrasie ✓ (1)

4.1.3 H_2SO_4 / H_3PO_4 ✓ (1)

4.2

4.2.1 1,2-dibromopropane / *1,2 – dibroompropaan* ✓✓ (2)

4.2.2



✓ ✓

(2)

4.2.3 Halogenation / Bromination ✓
Halogenering / brominering ✓ (1)

4.3

4.3.1 Unsaturation /Saturation Test. ✓✓
Toets vir versadiging / onversadiging ✓✓ (2)

4.3.2

Addition of Br_2 / *Byvoeging van Br_2*	
Alkanes / *Alkane*	**Alkenes / *Alkene***
Brown/Orange colour remains ✓✓ *Bruin/Oranje kleur verdwyn nie*✓✓	Brown/Orange colour becomes colourless.✓✓ *Bruin/Oranje kleur verdwyn* ✓✓

(4)

[15]

QUESTION 5 / *VRAAG 5*

5.1 Is the energy absorbed or released during a chemical reaction OR ✓✓
The net change of chemical potential energy of the system. (2)

Die energie absorbeer of vrygestel tydens 'n chemiese reaksie OF

Die netto verandering van chemiese potensiële energie van die sisteem ✓✓

5.2 $\Delta H = H_{products} - H_{reactants}$ ✓ $\Delta H = H_{produkte} - H_{reaktante}$
$= 10 - 20$ ✓
$= -10$ kJ ✓ (3)

5.3 Exothermic. ✓The energy of the products is less than that of the reactants✓ and thus energy is released✓ (during the reaction.)

Eksotermies. ✓Die energie van die produkte is minder as die van die reaktanse ✓en energie is dus vrygestel (tydens die reaksie) ✓ (3)

5.4 The activated complex / transition state or intermediate state. ✓✓
Die geaktiveerde kompleks / oorgangs staat / intermediêre staat ✓✓ (2)

5.5 $E_A = E_{activated\ complex} - E_{reactants}$ ✓ / $E_A = E_{aktiveerde\ kompleks} - E_{reaktante}$ ✓
$= 53 - 20$✓
$= 33$ kJ✓ (3)

[13]

QUESTION 6 / *VRAAG 6*

6.1.1 What is the relationship between the reaction surface of a solid and the rate of reaction? / How does reaction surface (or state of division) influence the rate of a chemical reaction? ✓✓ (2)
OR
What is the relationship between the reaction surface of a solid and the time that the reaction takes to progress completely? ✓✓

Wat is die verwantskap tussen die reaksie oppervlak van 'n vaste stof en die reaksie tempo? / Hoe beïnvloed die reaksie oppervlak (staat van verdeeldheid) die reaksietempo? ***OF*** *Wat is die verwantskap tussen die reaksie oppervlak van 'n vaste stof en die tyd wat dit neem om die reaksie te voltooi?* ✓✓

6.1.2 $CaCO_3(s) + 2\ HCl(aq)$ ✓→ $CaCl_2(aq) + H_2O(l) + CO_2(g)$ ✓ bal ✓ (3)

6.2 Reaction A. ✓ At t= 4.0, the mass is constant✓/the reaction has stopped.
Reaksie A. ✓By t = 4.0, die massa bly konstant ✓/die reaksie het gestop (2)

6.3 Higher than / *hoër as* ✓ (1)

6.4 - There is a greater surface area for collision to occur. ✓
- More effective collisions per unit time / the frequency of effective collisions✓

- Energy of the particles/ only particles with $E_k \geq E_A$ collide effectively✓
- Particles with correct orientation. ✓ (4)

- *Daar is 'n groter reaksie oppervlak waarop botsings kan plaasvind* ✓
- *Meer effektiewe botsings per tyd eenheid / die frekwensie van effektiewe botsings neem toe* ✓
- *Energie van die deeltjies / slegs deeltjies met $E_k \geq E_A$ bots effektief* ✓
- *Deeltjies bots met die regte oriëntasie* ✓

6.5 From the balanced equation / *Uit die gebalanseerde vergelyking*:

$CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

$n = c \times V$ ✓
$= 0,5 \times 0,15$ ✓
$= 0,075$ mol

$nHC\ell : n\ CO_2$

2 : 1 ✓
0,075 : 0,0375

$n = \frac{V}{V_m}$ ✓
$V = n\ V_m$

$= 0,0375 \times 22,4$ ✓

$= 0,84\ dm^3\ CO_2$ gas ✓ (6)
[18]

QUESTION 7 / *VRAAG 7*

7.1 Minimum activation energy / *Minimum aktiverings energie*. ✓ (1)

7.2 A. ✓ (1)

7.3 No. ✓Together they will have the same average kinetic energy. ✓
(but each molecule's kinetic energy is determined by its mass and its own average speed). (2)

Nee. ✓Saam sal hulle dieselfde gemiddelde kinetiese energie hê ✓
(maar elke molekule se kinetiese energie word bepaal deur sy massa en eie gemiddelde spoed)

7.4 It indicates the % of molecules✓ which will have more energy than the activation energy at that temperature. ✓ At low temperature, the % is represented by the area shaded with squares. ✓At high temperature, it is represented with both vertical lines and squares. ✓ (4)

Dit dui die % molekules ✓aan wat meer energie het as die aktiverings energie by daardie temperatuur. ✓By die lae temperatuur word die % verteenwoordig deur die area ingekleur met vierkante. ✓ By die hoë temperatuur word dit voorgestel deur beide vertikale lyne en vierkante ✓

7.5 The activation energy of the reaction is decreased by adding a catalyst. ✓ The line thus shifts to the left. ✓ It implies that at both low and high temperatures, there will now be a greater % of molecules available✓ for effective collisions per second. ✓/ frequency of effective collisions . (4)

Die aktiverings energie van die reaksie word verminder deur 'n katalisator by te voeg ✓Die lyn skuif dus na links ✓. DIt beteken dus dat by beide hoë en lae temperature daar 'n groter % molekules beskikbaar ✓is vir effektiewe botsings per sekonde ✓/ frekwensie van effektiewe botsings verhoog

[12]

QUESTION 8 / *VRAAG 8*

8.1

	AX	**BY**	**AB + XY**
Initial number of mole (mol) / *Aantal mol aan die begin*	0,25	0,10	0
Number of moles used/formed (mol) / *Aantal mol gebruik of gevorm*	0,05 ✓	0,025 ✓	0,05
Number of moles at equilibrium(mol) / *Aantal mol by ewewig*	0,20	0,075 ✓	0,05 ✓
Equilibrium [ ] (mol·dm^{-3}) / *Ewewigs [ ] (mol·dm^{-3})*	$\frac{0,20}{0,25} = 0,8$ ✓	$\frac{0,075}{0,25} = 0,3$	$\frac{0,05}{0,25} = 0,2$

$K_c = \frac{[AB + XY]^2}{[AX]^2[BY]}$ ✓

$= \frac{(0,2)^2}{(0,8)^2(0,3)}$ ✓

$= 2,083 \times 10^{-1}$ ✓ (8)

8.2 Solid line / *Soliede lyn*: $2AX_{(g)} + BY_{(g)} \longrightarrow 2(AB_{(g)} + XY_{(g)})$ ✓✓ (2)

Dotted line / *stippel lyn*: $2(AB_{(g)} + XY_{(g)}) \longrightarrow 2AX_{(g)} + BY_{(g)}$ ✓✓ (2)

8.3

8.3.1 - Reverse reaction is favoured. ✓
- An increase in temperature occurred. ✓ (2)

- *Die terugwaartse reaksie is bevoordeel* ✓
- *Die temperatuur het verhoog* ✓

8.3.2 - Rate of the forward reaction increased sharply. ✓
- An increase in the concentration of one of the reactants (AX or BY) occurred. ✓ (2)

- *Die tempo van die voorwaartse reaksie het skerp toegeneem* ✓
- *'n toename in die konsentrasie van een van die reaktanse (AX of BY) het plaasgevind* ✓

8.4 - Change in temperature ✓
- An increase in temperature will favour the reverse reaction ✓
- Concentrations of AB and XY decreases whereas the concentrations of AX and BY increases. ✓
-Thus K_c will now decrease. ✓ (4)

- *Verandering in temperatuur* ✓
- *'n verandering in temperatuur sal die terugwaartse reaksie bevoordeel* ✓
- *Konsentrsies van AB en XY sal afneem terwyl die konsentrasies van AX en BY sal toeneem* ✓
- *Die K_c waarde sal dus afneem* ✓

[20]

QUESTION 9 / *VRAAG 9*

9.1 Proton (H^+) donor / *Proton (H^+) skenker* ✓ (1)

9.2

9.2.1 n$CaCO_3$(g) that reacted / *reageer*:

= n = m/M
= 1 /100✓
= 0,01 mol✓

Ratio / *verhouding*:

$\left.\begin{matrix}1 \text{ mol } CaCO_3 : 2 \text{ mol } HC\ell \\ 0{,}01 \text{ mol } CaCO_3 : 0{,}02 \text{ mol } HC\ell\end{matrix}\right\}$ ✓

NaOH:

n = c x v

= 0,1 x 0,0225

= 2,5 x10 ^{3} mol✓

2,5 x10 ^{3} mol HCℓ + 2,5 x10 ^{3} mol NaOH gives / *gee*:

HCℓ total / *totaal* n = 0,02 + 2,5 x10 ^{3}

= 0,0225 mol ✓

Thus original [HCℓ] / *dus die oorspronklike [HCℓ]:*

c = n/v

= 0.0225/0.05 ✓

= 0,45 mol.dm^{-3} ✓ (7)

9.2.2 pH = -log[H_3O^+]✓

= -log(0,45) ✓

= 0,35 ✓✓ (4)

9.3

9.3.1 A substance that can act either as an acid or a base. ✓✓ (2)
'n Stof wat soos 'n suur of 'n basis kan optree

9.3.2 H_3PO_4 & $H_2PO_4^-$ ✓ ; H_2O & H_3O^+✓ (2)

9.3.3 H_2O or/*of* $H_2PO_4^-$ ✓ (1)
[17]

TOTAL MARKS / *TOTAAL*: 150