GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2016

MEMORANDUM

PHYSICAL SCIENCES: CHEMISTRY (SECOND PAPER) (10842)

FISIESE WETENSKAPPE: CHEMIE (TWEEDE VRAESTEL) (10842)

14 pages

GAUTENG DEPARTMENT OF EDUCATION

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PHYSICAL SCIENCES: CHEMISTRY /
FISIESE WETENSKAPPE: CHEMIE
(Second Paper / *Tweede Vraestel*)

MEMORANDUM

QUESTION / *VRAAG* 1

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

QUESTION / *VRAAG* 2

2.1.1 Saturated / *Versadig* ✓ (2)

ANY ONE / *ENIGE EEN*:

- Have ONLY single bonds. / *Het slegs ENKELBINDINGE .*
- Have single bonds between C atoms./ *Het enkelbindinge tussen koolstofatome.*
- Have no double OR triple bonds OR multiple bonds. / *Het geen dubbel OF meervoudige bindinge nie.*
- Contains the maximum number of H atoms bonded to C atoms./ *Beskik oor die maksimum aantal H-atome wat aan koolstofatome kan bind.*

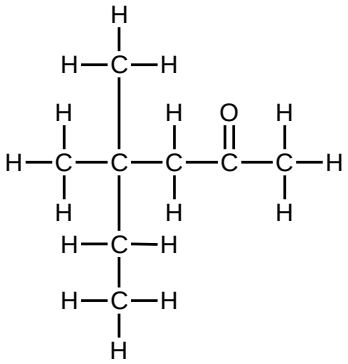
✓

✓

2.1.2 2,3-dimethylbutane ✓

2,3-*dimetielbutaan* (2)

2.2



Marking criteria / *Nasienriglyne*:

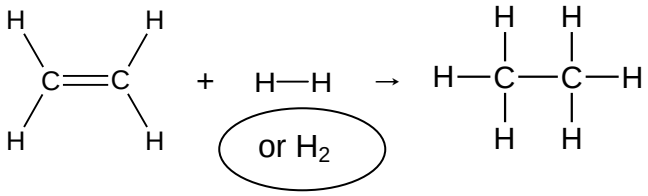
- Six C atoms in longest chain with functional group (carbonyl group) on C-2 ✓
- Two methyl substituents on C-4 ✓
- Whole structure correct ✓

- *Ses C atome in langste ketting met funksionele groep (karboniel groep) op C-2* ✓
- *Twee metielsubstituente op C-4* ✓
- *Volledige struktuur korrek* ✓

(3)

2.3 2.3.1 C_nH_{2n} ✓ (1)

2.3.2



Marking criteria / *Nasienriglyne*:
✓ reactants / *reaktante*
✓ product / *produk*
✓ balancing / *balansering*
Rules / *Reëls*:
Any additional reactant / product / incorrect balancing / arrow omitted
Enige addisionele reaktante / produk / verkeerde balansering / pyltjie uitgelaat **max 2/3** (3)

2.3.3 Hydrolysis / *Hidrolise* **OR / *OF*** Substitution / *Vervanging* ✓ (1)

2.3.4 HBr ✓ (1)

2.3.5 E ✓ (1)

2.3.6 E – concentrated / *gekonsentreerd* and / *en* G – diluted / *verdun* ✓

OR / *OF*

Base is more concentrated in reaction E than G. / *Basis is meer gekonsentreerd in reaksie E as in G*

OR / *OF*

Base in reaction E is dissolved in ethanol (no water added). / *Basis in reaksie E is in etanol opgelos (geen water bygevoeg nie.)* (1)

2.3.7 H_2SO_4/sulphuric acid / *swaelsuur*
OR / *OF*
H_3PO_4 phosphoric acid / *fosforsuur* ✓ (1)
[16]

QUESTION / *VRAAG* 3

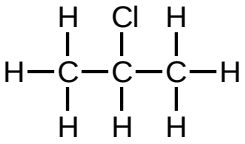
3.1 3.1.1 Aldehyde / *Aldehied* ✓ (1)

3.1.2 Ketone / *Ketoon* ✓ (1)

3.2 3.2.1 When molecules have the same molecular formula ✓ but different positions of the side chain, substituents or functional groups on the parent chain. ✓

Molekule met dieselfde molekulêre formule, maar met verskillende posisies van die sykettings, substituente of funksionele groepe op die hoofketting. (2)

3.2.2



Marking criteria / *Nasienriglyne*:

- Structure correct / *struktuur korrek* 2 / 2
- Any error / *enige foute*: 0 / 2

(2)

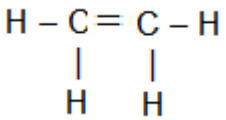
3.3 3.3.1 Pentan-1-ol ✓and butanoic acid ✓
Pentan-1-ol en butanoësuur (2)

3.3.2 Esterification ✓ or acid catalysed condensation.
Esterifikasie of suurgekataliseerde kondensasie. (1)

3.4 3.4.1 Polyethene / *Polieteen*✓

(1)

3.4.2



✓ (1)

3.4.3 Addition polymer / *Addisie polimeer* ✓

(1)

[12]

QUESTION / VRAAG 4

4.1 4.1.1 Type of organic compound / homologous series / functional group ✓

Tipe organiese verbinding / homoloë reeks / funksionele groep

(1)

4.1.2 Boiling point / *Kookpunt* ✓

(1)

4.1.3 Relative molecular mass / *Relatiewe molekulêre massa* ✓

(1)

4.2 LOWER THAN / *LAER AS* ✓ (1)



Negative marking from **Q 4.2 to Q 4.3**
*Negatiewe nasien vanaf **V 4.2 tot 4.3***

4.3 **Structure**:
Compound **A** / Pentane is less branched / no branches / less compact / less spherical / has larger surface area. ✓
Intermolecular forces:
Stronger / more intermolecular forces / induced dipole forces / London forces / dispersion forces. ✓
Energy:
More energy needed to overcome / break intermolecular forces. ✓

OR

Structure:
Compound **B** / 2-methylbutane is more branched / more compact / more spherical / has a smaller surface area. ✓
Intermolecular forces:
Weaker / less intermolecular forces / induced dipole forces / London forces / dispersion forces. ✓
Energy:
Less energy needed to overcome / break intermolecular forces. ✓

***Struktuur**:*
Verbinding A / Pentaan het geen sykettings / minder kompak / minder sferies / het groter oppervlakarea. ✓
Intermolekulêre kragte:
Sterker / meer intermolekulêre kragte / geïnduseerde dipool kragte / London kragte / dispersie kragte. ✓
Energie:
Meer energie nodig om intermolekulêre kragte te breek / oorkom ✓

OF

***Struktuur**:*
*Verbinding **B** / 2-metielbutaan het (meer) sykettings / meer kompak / meer sferiese molekule / het kleiner oppervlakarea* ✓
Intermolekulêre kragte:
Swakker / minder intermolekulêre kragte / geïnduseerde dipool kragte / London kragte / dispersie kragte. ✓
Energie:
Minder energie nodig om intermolekulêre kragte te oorkom/breek ✓

(3)

4.4 

HIGHER THAN / *HOËR AS*

Negative marking of QUESTION 4.4 to 4.5 / *Negatiewe nasien van VRAAG 4.4 na 4.5* (1)

4.5

- (D) propanoic acid has more sites for hydrogen bonding than C / forms dimers / is more polar than C. ✓
- D has stronger / more intermolecular forces / dipole-dipole forces. ✓
- D needs more energy to overcome / break the intermolecular forces. ✓

OR

- (C) butanol has less sites for hydrogen bonding than D / forms dimers / is more polar than D. ✓
- C has weaker / less intermolecular forces / dipole-dipole forces. ✓
- C needs less energy to overcome / break the intermolecular forces. ✓

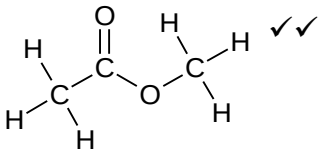
- *(D) propanoësuur het meer gebiede vir waterstofbindinge as C / vorm dimere / is meer polêr as C.* ✓
- *D het sterker / meer intermolekulêre kragte / dipool-dipool kragte.* ✓
- *D benodig meer energie om intermolekulêre kragte te oorkom / breek* ✓

OF

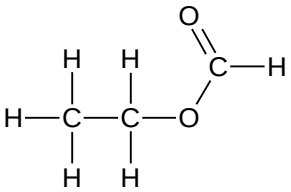
- *(C) butanol het minder gebiede vir waterstofbinding as D / vorm dimere / is meer polêr as D.* ✓
- *C het swakker / minder intermolekulêre kragte / dipool-dipool kragte.* ✓
- *C benodig minder energie om intermolekulêre kragte te oorkom / breek* ✓

(3)

4.6



✓✓



✓ ✓

Methyl ethanoate
Metieletanoaat

OR ethyl methanoate
etielmetanoaat

(4)

[15]

QUESTION / *VRAAG* 5

5.1 *Examples*:

- How will a change in concentration influence the reaction rate?
- What is the relationship between concentration and reaction rate?
- *Hoe sal 'n verandering in die konsentrasie die reaksietempo beïnvloed?*
- *Wat is die verwantskap tussen die konsentrasie en reaksietempo?*

Marking criteria:

- Identify dependent and independent variables correct / *Identifiseer afhanklike en onafhanklike veranderlikes korrek* ✓
- Ask a question about the relationship between the variables / *Vra vraag oor verwantskap tussen afhanklike en onafhanklike veranderlikes* ✓
- If question has a **yes/no** answer, **no marks** / *Indien die vraag 'n **ja/nee** antwoord het, **geen punte.*** (2)

5.2 HNO_3 / Nitric acid / *Salpetersuur*. ✓
The magnesium is used up / the magnesium is the limiting reagent. ✓

Die magnesium word opgebruik / die magnesium is die beperkende reagens. ✓ (2)

5.3

- Change in concentration of products / reactants ✓ per (unit) time. ✓
- *Verandering in konsentrasie van produkte / reaktanse per (eenheids)tyd.*

OR / *OF*

- Rate of change in concentration
- *Tempo van verandering in konsentrasie.*

OR / *OF*

- Change in amount / number of moles / volume / mass of reactants / products ✓ per (unit) time. ✓
- *Verandering in hoeveelheid / aantal / mol / volume / massa van reaktanse / produkte per (eenheids)tyd.*

OR / *OF*

- Amount / number of moles / volume / mass of products formed or reactants used per (unit) time.
- *Die hoeveelheid / aantal / mol / volume / massa van produk gevorm of reaktanse gebruik per (eenheid) tyd.* (2)

5.4 $\Delta n = 1,0 - 0,8$ ✓ $= 0,2$ mol

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

$$0,2 = \frac{m}{24} \quad ✓$$

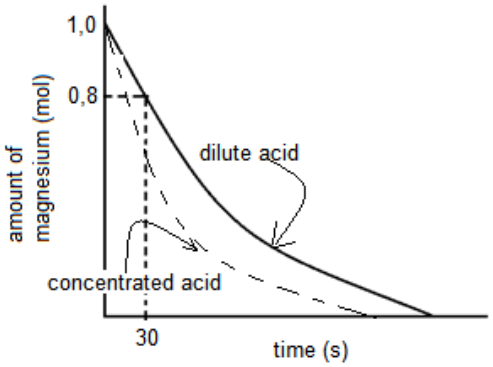
$$m = 4,8 \text{ g}$$

$$\text{Average rate / } \textit{gem. reaksietempo} = \frac{\Delta m}{\Delta t}$$

$$= \frac{4,8}{30 (-0)} \quad ✓ ✓$$

$$= 0,16 \text{ g·s}^{-1} \quad ✓$$ (5)

5.5



Criteria for marking of graph / *nasienriglyne*:

- Steeper slope below original graph. / *Skuinser helling onder oorspronklike grafiek* ✓
- Intercepts x-axis earlier. / *Sny x-as vroeër* ✓

(2)
[13]

QUESTION / *VRAAG* 6

6.1 6.1.1 Activation energy / *Aktiveringsenergie* ✓ (1)

6.1.2 (a) An <u>increase in the concentration</u> of one or both of the reactants. ✓
'n <u>Verhoging in die konsentrasie</u> van een of beide reaktanse. ✓ (1)

(b) <u>Increase</u> in <u>temperature</u> / *<u>Verhoging</u> van <u>temperatuur</u>* ✓

- <u>Increase</u> in average <u>kinetic energy</u> of molecules. / More molecules have enough / sufficient kinetic energy. / *<u>Verhoging</u> in gemiddelde <u>kinetiese energie</u> van molekules / Meer molekules het voldoende of genoeg kinetiese energie.* ✓
- <u>More effective collisions per (unit) time</u>. / <u>Meer effektiewe botsings per (eenheids)tyd</u>. ✓
- <u>Higher reaction rate</u>. / <u>Hoër reaksietempo</u> ✓ (4)

6.2 6.2.1 **Marking criteria/*Nasienriglyne*:**
<u>In terms of reducing agent / *In terme van die reduseermiddel*</u>:

- <u>Cu is a weaker reducing agent</u> ✓ than <u>H_2</u> ✓ and will not reduce H^+ (to H_2) ✓
- *<u>Cu is 'n swakker reduseermiddel</u>* ✓ *as <u>H_2</u>* ✓ *en sal nie die H^+ (na H_2) reduseer nie.*

<u>In terms of oxidising agent / *In terme van die oksideermiddel*</u>:

- <u>H^+ is a weaker oxidising agent</u> ✓ than <u>Cu^{2+}</u> ✓ and will not oxidise Cu (to Cu^{2+})✓
- *<u>H^+ is 'n swakker oksideermiddel</u>* ✓ *as <u>Cu^{2+}</u>* ✓ *en sal nie die Cu (na Cu^{2+}) oksideer nie.* ✓

(NOTE: Compare the two reducing agents in the two half-reactions involved OR the two oxidising agents in the two half-reactions involved.)
(NOTA: Vergelyk die twee reduseermiddels in die twee half reaksies OF die twee oksideermiddels in die twee halfreaksies.)

OR / OF
H^+ (H_2SO_4) is a weaker oxidizing agent than Cu (to Cu^{2+}.)
H^+*(H_2SO_4) is swakker oksideermiddel as die Cu (na Cu^{2+})*

Note/Nota:
<u>No marks</u> if referring to relative positions on the table./ *<u>Geen punte</u> indien na die relatiewe posisies op die tabel verwys word nie.*

(3)

6.2.2 (a) GREATER THAN. / *GROTER AS*. ✓
Surface area / state of division is larger in B. / *Die oppervlak area (reaksie oppervlakte / toestand van verdeeldheid) in B is groter.* ✓ (2)

(b) Smaller than / *Kleiner as* ✓
The Cu acts as a catalyst ✓for the reaction in test tube D.
Die Cu tree as 'n katalisator ✓ *op in proefbuis D.* (2)

[13]

QUESTION / *VRAAG 7*

7.1 7.1.1 Exothermic / *Eksotermies* ✓ (1)

7.1.2 Negative marking from **QUESTION** 7.1.1/ *Negatiewe nasien van **VRAAG** 7.1.1*

Marking criteria/*Nasienriglyne*:

- K_c decreases with increase in temperature. / *K_c verminder met verhoging in temperatuur*. ✓
- Reverse reaction is favoured. / [reactants] increase and [product] decreases. / *Terugwaartse reaksie word bevoordeel / [reaktanse] verhoog en [produk] verlaag*. ✓
- An increase in temperature favours the endothermic reaction. / *'n Verhoging in temperatuur bevoordeel die endotermiese reaksie.* ✓ (3)

7.1.3 Remains the same / *Bly dieselfde.* ✓ (1)

7.1.4 Only a change in temperature has an effect on the equilibrium constant / has an effect on K_c. / *Slegs 'n verandering in temperatuur beinvloed waarde van K_c* ✓ (1)

7.2

Marking criteria / *Nasienriglyne*:

- $n(O_2)$reacted / *gereageer* = $n(O_2)$eq - $n(O_2)$ini ✓
- Use ratio / *Gebruik verhouding* 2 : 2 : 1 ✓
- $n(SO_2)eq = n(SO_2)ini + n(SO_2)change$ / *verandering*
- $n(SO_3)eq = n(SO_3)ini - n(SO_3)change$ / *verandering* ✓
- n_{eq} divide by / *gedeel deur* 2 ✓
- K_c expression / *uitdrukking* ✓
- Substitute / *vervang* $[\ ]_{eq}$ into Kc expression / *uitdrukking* ✓
- Answer / *antwoord*: 125 ✓

	$2SO_3$	$2SO_2$	O_2
Initial mol *Aanvanklike mol*	24	0	0
Change mol *Verandering in mol*	20	20	10 Use ratio / *Gebruik verhouding* ✓
Equilibrium mol *Mol by ewewig*	24 – 2 (10) = 4 ✓	20	10 ✓
Concentration equilibrium *Ewewigskonsentrasie*	$c = \frac{n}{V} = \frac{4}{2} = 2$	$c = \frac{n}{V} = \frac{20}{2}$ = 10	$c = \frac{n}{V} = \frac{10}{2}$ ✓ = 5

$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$ ✓

$= \frac{(10)^2(5)}{(2)^2}$ ✓

= 125 ✓ (7)

[13]

QUESTION / *VRAAG* 8

8.1 Completes the circuit / allows for the overall charge in the beakers to remain neutral / allows ions to flow between the beakers / electrical neutrality. ✓

Voltooi die stroombaan / laat toe dat die totale lading in die bekers neutraal bly / laat ione vryelik tussen bekers vloei / elektriese neutraliteit. ✓ (1)

8.2 A galvanic (voltaic cell) converts chemical energy (change) into electrical energy, ✓ whereas in an electrolytic cell, electrical energy is converted into chemical energy (change). ✓

'n Galvaniese sel skakel chemiese energie in elektriese energie om, terwyl die elektrolitiese sel, elektriese energie in chemiese energie verander. (2)

8.3 Pt. ✓

MnO_4^- is reduced to Mn^{2+} / Reduction takes place. ✓

MnO_4^- word na Mn^{2+} gereduseer / Reduksie vind plaas. ✓ (2)

8.4 Fe^{2+} (ions/*ione*) ✓ (1)

8.5 $5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(\ell)$ (3)

Notes / *Aantekeninge*

- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ *Produkte* ✓ *Balansering* ✓
- Ignore / *Ignoreer* phases / *fases*
- Marking rule 6.3.10 / *Nasienreël 6.3.10*

8.6 $E_{cell} = E_{cathode/katode} - E_{anode}$ ✓

$= (+1,51)$ ✓ $- (+0,77)$ ✓

$= +0,84$ V ✓ (4)

[13]

QUESTION / *VRAAG* 9

9.1 A solution / liquid / dissolved substance that conducts electricity through the movement of ions. / *'n Oplossing / vloeistof / opgeloste stof wat elektrisiteit gelei deur die beweging van ione.* ✓✓ (2)

9.2 9.2.1 Silver nitrate / silver ethanoate / silver cyanide ✓

Silwernitraat / silweretanoaat / silwersianied ✓ (1)

9.2.2 Silver / *silwer* / Ag ✓ (1)

9.2.3 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

9.3 $n = \frac{m}{M}$ ✓

$= \frac{2}{108}$ ✓

$= 1,85 \times 10^{-2}$ mol Ag

✓ →

$6,02 \times 10^{23} \times 1,85 \times 10^{-2}$

$= 1,11 \times 10^{22}$ electrons needed / *elektrone nodig* ✓

Marking guidelines / *Nasienriglyne*:

- Formula / ratio / *Formule / verhouding* ✓
- Substitute / V*ervang* M (Ag) = 108 ✓
- Multiply by / *Vermenigvuldig met* N_A ✓
- Final answer = $1,11 \times 10^{22}$ electrons (accept $1,11 \times 10^{22} – 1,12 \times 10^{22}$) / *Finale antwoord = $1,11 \times 10^{22}$ elektrone (aanvaar $1,11 \times 10^{22} – 1,12 \times 10^{22}$)*

(4)

[10]

QUESTION / *VRAAG* 10

10.1 $pH = - \log [H^+]$ OR $pH = - \log [H_3O^+]$ ✓
$= - \log (5,6 \times 10^{-6})$ ✓
$= 5,25$ ✓ (3)

10.2 10.2.1 $c = \frac{n}{V}$ ✓
$n = cV$
$= (2,5)(0,5)$ ✓
$= 1,25$ mol NaOH ✓ (3)

10.2.2 **POSITIVE MARKING FROM QUESTION 10.2.1 / *POSITIEWE NASIEN VAN VRAAG 10.2.1***

$n_{acid} = c_a V_a$
$= (0,2)(0,95)$ ✓
$= 0,19$ mol H_2SO_4

$n(NaOH) = 2n(H_2SO_4)$
$= 2 \times 0,19$ ✓
$= 0,38$ mol NaOH

n(NaOH used/*gebruik*) = n(NaOH initial/*aanvanklik*) - n(NaOH excess/*oormaat*):
1,25 – 0,38 ✓ = 0,87 mol

$n[Mg(NO_3)_2] = \frac{0,87}{2}$ ✓
$= 0,435$ mol

$m[Mg(NO_3)_2] = nM$
$= 0,435 \times 148$ ✓
$= 64,38$ g ✓ (6)

Marking guidelines/ *Nasienriglyne*:
- Substitution into/*Vervang in* $c = \frac{n}{V}$ ✓
- Using ratio/*Gebruik verhouding* 2:1 ✓
- $n(NaOH_{used/gebr}) = n(NaOH_{initial/aanvk}) - n(NaOH_{excess/oormt})$ ✓
- $n[Mg(NO_3)_2] = ½n(NaOH)$ ✓
- Substitute/*Vervang* $M[Mg(NO_3)_2] = 148$ g·mol^{-1} ✓
- Final answer/*Finale antwoord*: 64,38 g ✓

[12]

QUESTION / *VRAAG* 11

11.1 11.1.1 The <u>proportion / ratio</u> ✓ of <u>nitrogen, phosphorus</u> and <u>potassium</u> (N.P.K). ✓

Die verhouding ✓van <u>stikstof, fosfor</u> en <u>kalium</u> (N.P.K). ✓ (2)

11.1.2 Percentage fertiliser / *persentasie kunsmisstof* ✓ (1)

11.2 Ammonium nitrate / *Ammoniumnitraat* (NH_4NO_3):

%N = $\frac{28}{80}$ x 100 ✓ = 35,0 % N

Urea / *Ureum* ($(NH_2)_2CO$):

%N = $\frac{28}{60}$ x 100 ✓ = 46,7 % N

✓(answers)

Urea – it has the highest percentage N / *Ureum het die hoogste persentasie N* ✓

Marking guidelines:
***Nasienriglyne*:**
- Molar masses / *Molêre massa* ✓
- Multiply with 100 / *Vermenigvuldig met 100*✓
- % N (35,0% and / *en* 46,7%) ✓
- Identify urea / *Identifiseer ureum* ✓

(4)

11.3 11.3.1 Fractional distillation (of liquid air) / Fraksio*nele distillasie van (vloeibare lug).* ✓ (1)

11.3.2 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(aq)$

<u>Marking criteria / *<u>Nasienriglyne</u>*:</u>
✓ reactants / *reaktanse*
✓ product / *produk*
✓ balancing / *balansering*
Rules/*Riglyne*:
- Any additional reactant / product / incorrect balancing / arrow
- omitted: max 2 / 3
- *Enige addisionele reaegense of produkte / verkeerde balansering / pyle uitgelaat: maks 2 / 3*

(3)

11.3.3 $(NH_4)_2\ SO_4$ ✓
ammonium sulphate / *ammoniumsulfaat* ✓ (2)

[13]

TOTAL / *TOTAAL*: 150