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PREPARATORY EXAMINATION VOORBEREIDENDE EKSAMEN 2016 MEMORANDUM

PHYSICAL SCIENCES: CHEMISTRY P2 (10842)
FISIESE WETENSKAPPE: CHEMIE V2 (10842)

13 pages

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION – 2016

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 C ✓✓
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.*

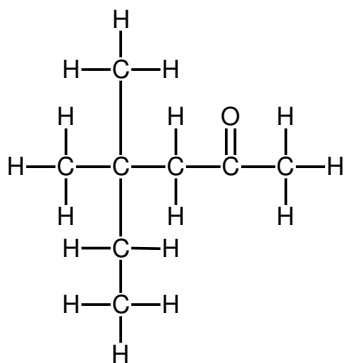
✓

2.1.2 2,3-dimethylbutane ✓

2,3-dimetielbutaan

(2)

2.2

**Marking criteria / Nasienriglyne:**

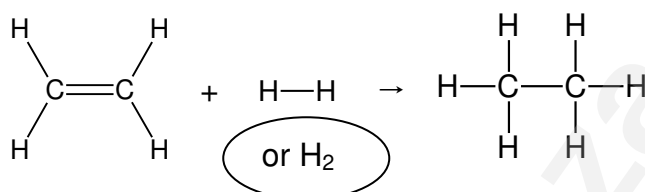
- Six C atoms in longest chain with functional group (carbonyl group) on C-2 ✓
- Two methyl substituents on C-4 ✓
- Whole structure correct ✓
- Ses C atome in langste ketting met funksionele groep (karboniel groep) op C-2 ✓
- Twee metielsubstituenten op C-4 ✓
- Volledige struktuur korrek ✓

(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]

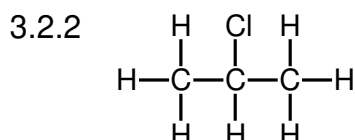
QUESTION / VRAAG 3

3.1 3.1.1 Aldehyde / *Aldehyd* ✓ (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, substituenten of funksionele groepe op die hoofketting. (2)

**Marking criteria / Nasienriglyne:**

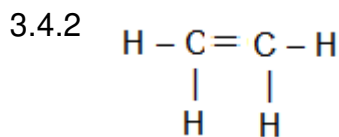
- Structure correct/*struktuur korrek* 2 / 2
- Any error/*enige foute*: 0 / 2

(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)



✓

(1)

3.4.3 Addition polymer. / Addisie polimeer ✓ (1)

[12]**QUESTION / VRAAG 4**

4.1 4.1.1 Boiling point / *Kookpunt* ✓ (1)

4.1.2 Type of organic compound / homologous series / functional group ✓
Tipe organiese verbinding / homoloë reeks / funksionele groep (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**

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



Hoër as

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. ✓

(3)

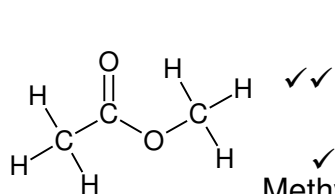
OR

- (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) propaansuur 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

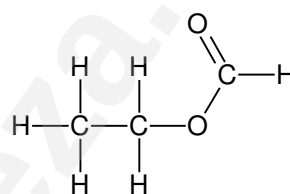
- (C) butanol het minder gebiede vir waterstofbinding as D / vorm dimere / is meer polêr as D. ✓
- C het swakker / minder intermolekulêre kragte / dipool-dipool kragte. ✓
- C benodig minder energie om intermolekulêre kragte te oorkom/breek ✓

4.6



Methyl ethanoate
Metieletanoaat

OR



ethyl methanoate
etielmetanoaat

(4)
[12]

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

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

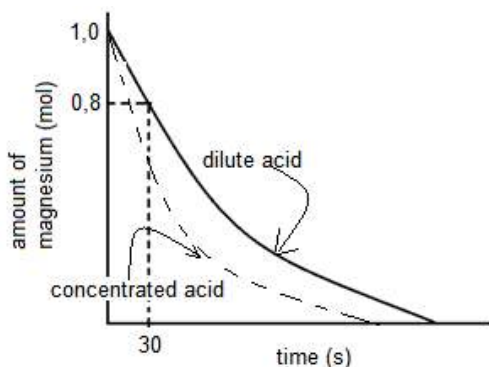
$$0,2 = \frac{m}{24} \quad \checkmark$$

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

$$\begin{aligned} \text{Average rate / gem. reaksietempo} &= \frac{\Delta m}{\Delta t} \\ &= \frac{4,8}{30 - 0} \checkmark \\ &= 0,16 \text{ g} \cdot \text{s}^{-1} \quad \checkmark \end{aligned}$$

(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 increase in the concentration of one or both of the reactants. ✓
'n Verhoging in die konsentrasie van een of beide reaktanse. ✓

(1)

(b) Increase in temperature / Verhoging van temperatuur ✓

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

(4)

6.2 6.2.1 **Marking criteria/Nasienriglyne:**

In terms of reducing agent/In terme van die reduseermiddel:

- Cu is a weaker reducing agent ✓ than H₂ ✓ and will not reduce H⁺ (to H₂) ✓
- Cu is 'n swakker reduseermiddel ✓ as H₂ ✓ en sal nie die H⁺ (na H₂) reduseer nie.

In terms of oxidising agent/In terme van die oksideermiddel:

- H⁺ is a weaker oxidising agent ✓ than Cu²⁺ ✓ and will not oxidise Cu (to Cu²⁺) ✓
- H⁺ is 'n swakker oksideermiddel ✓ as Cu²⁺ ✓ en sal nie die Cu (to Cu²⁺) 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⁺ (H₂SO₄) is a weaker oxidizing agent than Cu (to Cu²⁺.)

H⁺ (H₂SO₄) is swakker oksideermiddel as die Cu (na Cu²⁺)

Note/Nota:

No marks if referring to relative positions on the table./ Geen punte indien na die relatiewe posisies op die redokstabel 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 beïnvloed waarde van K_c* ✓ (1)

7.2

Marking criteria/Nasienriglyne:

- $n(\text{O}_2)_{\text{reacted/gereageer}} = n(\text{O}_2)_{\text{eq}} - n(\text{O}_2)_{\text{ini}}$ ✓
- Use ratio/*Gebruik verhouding* 2 : 20 : 0 ✓
- $n(\text{SO}_2)_{\text{eq}} = n(\text{SO}_2)_{\text{ini}} + n(\text{SO}_2)_{\text{change/verandering}}$ } ✓
- $n(\text{SO}_3)_{\text{eq}} = n(\text{SO}_3)_{\text{ini}} - n(\text{SO}_3)_{\text{change/verandering}}$ }
- n_{eq} divide by / *gedeel deur 2* ✓
- K_c expression/*uitdrukking* ✓
- Substitute/*vervang* []_{eq} into K_c expression/*uitdrukking* ✓
- Answer/*antwoord*: 125 ✓

	2SO ₃	2SO ₂	O ₂
Initial mol <i>Aanvanklike mol</i>	24	0	0
Change mol <i>Verandering in mol</i>	20	20	10 Use ratio ✓
Equilibrium mol <i>Mol by ewewig</i>	24 – 2 (10) = 4 ✓	20	10 ✓
Concentration equilibrium <i>Ewewigskonsentrasie</i>	$c = \frac{n}{V} = \frac{4}{2} = 2$	$c = \frac{n}{V} = \frac{20}{2}$ = 10	$c = \frac{n}{V} = \frac{10}{2}$ ✓ = 5

$$K_c = \frac{[\text{SO}_2]^2 [\text{O}_2]}{[\text{SO}_3]^2} \checkmark$$

$$= \frac{(10)^2 (5)}{(2)^2} \checkmark$$

$$= 125 \checkmark$$

(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 bekere neutraal bly / laat ione vryelik tussen bekere 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 $5\text{Fe}^{2+}(\text{aq}) + \text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) \rightarrow 5\text{Fe}^{3+}(\text{aq}) + \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\ell)$ (3)

Notes / Aantekeninge

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

- 8.6 $E_{\text{cell}} = E_{\text{cathode/katode}} - E_{\text{anode}}$ ✓
 $= (+1,51) \checkmark - (+0,77) \checkmark$
 $= +0,84 \text{ V} \checkmark$ (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 ✓
Silvernitraat / silveretanoaat / silwersianied ✓ (1)

9.2.2 Silver/silwer / Ag ✓ (1)

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

9.3 $n = \frac{m}{M}$ ✓
 $= \frac{2}{108}$ ✓
 $= 1,85 \times 10^{-2} \text{ mol Ag}$
 $6,02 \times 10^{23} \times 1,85 \times 10^{-2}$ ✓
 $= 1,11 \times 10^{22} \text{ electrons needed /}$
elektrone nodig ✓

Marking guidelines / Nasienriglyne:

- Formula / ratio / *Formule / verhouding* ✓
- Substitute/Vervang $M(\text{Ag}) = 108$ ✓
- 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 $\text{pH} = -\log [\text{H}^+]$ OR $\text{pH} = -\log [\text{H}_3\text{O}^+]$ ✓
 $= -\log (5,6 \times 10^{-6})$ ✓
 $= 5,25$ ✓

(3)

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

(3)

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

$n_{\text{acid}} = c_a V_a$
 $= (0,2)(0,095)$ ✓
 $= 0,019 \text{ mol H}_2\text{SO}_4$

$n(\text{NaOH}) = 2n(\text{H}_2\text{SO}_4)$
 $= 2 \times 0,019$ ✓
 $= 0,038 \text{ mol NaOH}$

$n(\text{NaOH used/gebruik}) = n(\text{NaOH initial/aanvanklik}) - n(\text{NaOH excess/oormaat})$
 $1,25 - 0,038$ ✓ $= 1,212 \text{ mol}$

$n[\text{Mg}(\text{NO}_3)_2] = \frac{1,212}{2}$ ✓
 $= 0,606 \text{ mol}$

$m[\text{Mg}(\text{NO}_3)_2] = nM$
 $= 0,606 \times 148$ ✓
 $= 89,69 \text{ g}$ ✓

(6)

[12]**Marking guidelines/ Nasienriglyne:**

- Substitution into/Vervang in $c = \frac{n}{V}$ ✓
- Using ratio/Gebruik verhouding 2:1 ✓
- $n(\text{NaOH}_{\text{used/gebr}}) = n(\text{NaOH}_{\text{initial/aanvk}}) - n(\text{NaOH}_{\text{excess/oormt}})$ ✓
- $n[\text{Mg}(\text{NO}_3)_2] = \frac{1}{2}n(\text{NaOH})$ ✓
- Substitute/Vervang $M[\text{Mg}(\text{NO}_3)_2] = 148 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Final answer/Finale antwoord: 89,69 g ✓

QUESTION / VRAAG 11

- 11.1 11.1.1 The proportion / ratio ✓ of nitrogen, phosphorus and potassium (N.P.K). ✓
Die verhouding ✓ *van* *stikstof, fosfor* en *kalium* (N.P.K). ✓ (2)
- 11.1.2 Percentage fertiliser / *persentasie kunsmisstof* ✓ (1)
- 11.2 Ammonium nitrate/*Ammoniumnitraat*
 (NH₄NO₃): ✓
 $\%N = \frac{28}{80} \times 100 = 35,0 \% N$
 Urea/*Ureum* ((NH₂)₂CO):
 $\%N = \frac{28}{60} \times 100 = 46,7 \% N$
 Urea – it has the highest percentage N /
Ureum het die hoogste persentasie ✓
 } ✓ (answers) (4)
- Marking guidelines:**
Nasienriglyne:

 - Molar masses / *Molare massa* ✓
 - Multiply with 100 / *Vermenigvuldig met 100* ✓
 - % N (35,0% and/en 46,7%) ✓
 - Identify urea / *Identifiseer ureum* ✓
- 11.3 11.3.1 Fractional distillation (of liquid air) / *Fraksionele distillasie van (vloeibare lug)*. ✓ (1)
- 11.3.2 N₂(g) + 3H₂(g) ⇌ 2NH₃(aq)
Marking criteria / *Nasienriglyne:*
 ✓ 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 (NH₄)₂ SO₄ ✓
 ammonium sulphate / *ammoniumsulfaat* ✓ (2)

[13]

TOTAL / TOTAAL: 150