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

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

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

SEPTEMBER 2018

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 15 pages./
Hierdie memorandum bestaan uit 15 bladsye.

QUESTION 1/*VRAAG 1*

1.1 D (2)

1.2 C (2)

1.3 B (2)

1.4 C (2)

1.5 D (2)

1.6 C (2)

1.7 D (2)

1.8 A (2)

1.9 B, C, D (2)

1.10 B (2)

[20]

QUESTION 2/*VRAAG 2*

2.1 Molecules with the same molecular formulae, but different types of chains. ✓ ✓
Molekule met dieselfde molekulêre formule, maar verskillende tipes kettings. (2)

2.2

2.2.1 D✓ and/*en* F ✓ (2)

2.2.2 2,2 – dimethyl propane /*2,2–dimetielpropaan* ✓✓ (2)

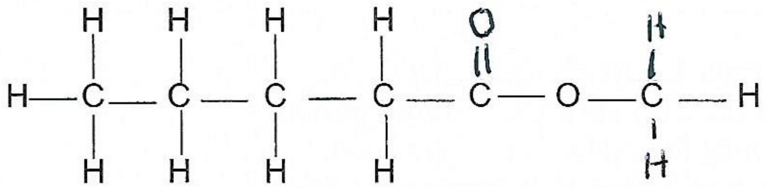
2.3

2.3.1 Saturation Test/*versadigingstoets* ✓ (1)

2.3.2 ~~Substitution~~ Addition/Halogenation/Bromination. ✓
~~Substitusie~~ Addisie/halogenering/bromering (1)

2.3.3 C✓; has a double bond between C-atoms✓/unsaturated.
C; het 'n dubbelband tussen C-atome/onversadigd (2)

2.4

 ✓✓

Methyl pentanoate /*Metielpentanoaat* ✓✓ (4)

[14]

QUESTION 3/*VRAAG 3*

3.1 The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓
Die druk uitgeoefen deur 'n damp wat in ewewig is met sy vloeistoffase, in 'n geslote sisteem. (2)

3.2 Butan-1-ol. ✓ (1)

3.3

No side chains

3.3.1 Use straight chain✓ primary alcohols. ✓
Gebruik reguitketting✓primêre alkohole ✓ (2)

Geen sykettings

3.3.2

a) **Structure**
Chain length/number of carbon atoms in the chain/molecular size/molecular mass/surface area increases from top to bottom or from butan-1-ol to hexan-1-ol. ✓
Struktuur
Kettinglengte/aantal koolstofatome in die ketting/molekulêre grootte/molekulêre massa/kontakoppervlak neem toe van bo na onder of van butan-1-ol tot by heksan-1-ol.

b) **Intermolecular forces**
Intermolecular forces/Van der Waals forces/ London forces/ Dispersion forces increase from top to bottom or from butan-1-ol to hexan-1-ol. ✓
Intermolekulêre kragte
Intermolekulêre kragte/ Van der Waalskragte/ Londonkragte/ Dispersiekragte neem toe van bo na onder of van butan-1-ol tot by heksan-1-ol.

c) **Energy**
Energy needed to overcome/break intermolecular forces increases from top to bottom or from butan-1-ol to hexan-1-ol. ✓
Energie
Energie nodig om intermolekulêre kragte te oorkom/breek, neem toe van bo na onder of van butan-1-ol tot by heksan-1-ol. (3)

3.4 Remains the same. *Bly dieselfde.* ✓ (1)

3.5

Marking criteria:
• Mole ratio for $V(CO_2)$ correctly used. *Molverhouding vir $V(CO_2)$ korrek gebruik.*
• Mole ratio for $V(H_2O)$ correctly used. *Molverhouding vir $V(H_2O)$ korrek gebruik.*
• Mole ratio for $V(O_2$ reacted) correctly used. *Molverhouding vir $V(O_2$ gereageer) korrek gebruik.*
• $V(O_2$ excess) = $V(O_2$ initial) - $V(O_2$ change) *$V(O_2$ oormaat) = $V(O_2$ oorspronklik) - $V(O_2$ verandering)*
• $V_{total/totaal} = 95\ cm^3$

OPTION 1/*OPSIE 1*

$V(CO_2) = 4V(C_4H_{10})$ $= 4(10)$ ✓ $= 40$

$V(H_2O) = 5V(C_4H_{10})$ $= 5(10)$ ✓ $= 50$

$V(O_2$ reacted/*gereageer*$) = \frac{13}{2}V(C_4H_{10})$ $= \frac{13}{2}(10)$ ✓ $= 65\ cm^3$

$V(O_2$ excess/*oormaat*$) = 70 - 65$ ✓ $= 5\ cm^3$

$V_{total/totaal} = 40 + 50 + 5$
$= 95\ cm^3$ ✓ (5)

OPTION 2 /*OPSIE 2*

	C_4H_{10}	O_2	CO_2	H_2O
Initial/*Aanvangs* V(cm^3)	10	70	0	0
Change in/*Verandering in* V(cm^3)	10	50 ✓	40 ✓	50 ✓
Final/*Finale* V(cm^3)	0	5 ✓	40	50

$V_{total/totaal} = 40 + 50 + 5 = 95\ cm^3$ ✓ **[14]**

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Addition/Hydrogenation. ✓
Addisie/hidrogenering (1)

4.1.2 Substitution/halogenation/chlorination. ✓
Substitusie/halogenering/chlorinering (1)

4.1.3 Elimination/dehydration. ✓
Eliminasie/dehidrasie (1)

4.2 2-bromo propane/*2-bromopropaan* ✓✓ (2)

4.3

4.3.1 Dehydrohalogenation/dehydrobromination. ✓
Dehidrohalogenering/dehidrobromering (1)

4.3.2 Hot✓ ethanolic strong base. ✓
Warm etanoliese sterk basis (2)

OR/*OF*

- Concentrated strong base/NaOH/KOH
  Gekonsentreerde sterk basis/NaOH/KOH

OR/*OF*

- Strong base with no water
  Sterk basis met geen water nie

OR/*OF*

- Strongly heated or hot base
  Sterk verhitte of warm basis

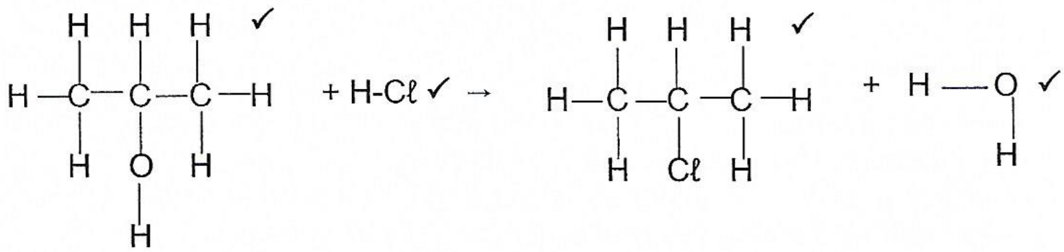
OR/*OF*

- High temperature/heat strongly
  Hoë temperatuur/verhit sterk

4.4

4.4.1 $H_2O/H_2SO_4/H_3PO_4$ (1)

4.4.2



(4)

- Accept HCℓ, H_2O and OH/ *Aanvaar HCℓ, H_2O en OH*
- Incorrect balancing – max $\frac{3}{4}$
  Foutiewe balansering – maks $\frac{3}{4}$
- Molecular/condensed formulae – $\frac{2}{4}$
  Molekulêre/gekondenseerde formules – $\frac{2}{4}$
- Accept coefficients that are multiples
  Aanvaar balanseringsgetalle wat veelvoude is
- Any additional reactant or/and product – $\frac{3}{4}$
  Enige addisionele reactant en/of produk – $\frac{3}{4}$

4.5

4.5.1 A reaction in which small molecules join to form very large molecules by adding on at double bonds. ✓✓
'n Reaksie waarin klein molekule verbind om baie groot molekule te vorm deur byvoeging van dubbelbindings. (2)

4.5.2 Freezer bags/soft bottles/bendable cables/shopping bags/plastic crates/plastic pipes/toys. ✓
Vriessakkies/ sagte bottels/ buigbare kabels/inkopiesakke/plastiekkratte/ plastiekpype/ speelgoed (1)

[16]

QUESTION 5/*VRAAG 5*

5.1 **ANY ONE/*ENIGE EEN*:**

- Change in concentration of products/reactants per (unit) time. ✓✓
  Verandering in konsentrasie van produkte/reaktante per (eenheid) tyd.
- Rate of change of concentration.
  Tempo van verandering in konsentrasie.
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
  Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktante per (eenheid) tyd.
- Amount/number of moles/volume/mass of products or reactants used per (unit) time.
  Hoeveelheid/getal mol/volume/massa van produkte of reaktante gebruik per (eenheid) tyd. (2)

5.2 Reaction rate/*Reaksietempo* ✓ (1)

5.3 Powder/poeier ✓

Powder has a larger surface area ✓and there will be more effective collisions per unit time. ✓ The reaction rate will increase.
Poeier het 'n groter kontakoppervlakte en meer effektiewe botsings per tydseenheid vind plaas. Die reaksietempo sal verhoog. (3)

5.4 $n = \frac{m}{M}$

$= \frac{1,5}{100}$ ✓

$= 0,015$ mol

$CaCO_3 : CO_2$
1 : 1 ✓

$m(CO_2) = nM$
$= (0,015)(44$✓$)$
$= 0,66$ g ✓ (4)

$n = \frac{m}{M}$
$= \frac{1,5}{100}$ ✓
$= 0,015$ mol
$n = \frac{m}{M}$
✓ $0,015 = \frac{m}{44}$ ✓
$m = 0,66$ g ✓

5.5.1 The rate of the reaction will increase /
Die tempo van die reaksie sal verhoog. ✓✓ (2)

5.5.2 Increasing temperature increases the average kinetic energy (of the reacting particles). ✓ More effective collisions per unit time/Frequency of effective collisions increases.✓, thus increase the rate of the reaction. ✓/ *Die verhoogde temperatuur verhoog die gemiddelde kinetiese energie (van die partikels wat reageer). Meer effektiewe botsings per eenheidstyd/ Frekwensie van effektiewe botsings neem toe, dus verhoog die tempo van die reaksie.* (3)

[15]

QUESTION 6/*VRAAG 6*

6.1 0,5 mol X_2Y_3 ✓ (1)

6.2 **OPTION 1/*OPSIE 1***

2 mol X + 3 mol Y yields/*lewer* 1 mol X_2Y_3
Thus/*dus* 1 mol X + 1,5 mol Y yields/*lewer* 0,5 mol X_2Y_3 ✓

After/Na 50 s:
4 – 1 = 3 mol X ✓
4 – 1,5 = 2,5 mol Y✓
0,5 mol X_2Y_3

$c = \frac{n}{V}$:

$[X] = \frac{3}{2}$ ✓ $= 1,5\ mol.dm^{-3}$

$[Y] = \frac{2,5}{2} = 1,25\ mol.dm^{-3}$

$[X_2Y_3] = \frac{0,5}{2} = 0,25\ mol.dm^{-3}$

$Kc = \frac{[X_2Y_3]}{[X]^2[Y]^3}$ ✓

$= \frac{0,25}{(1,5)^2(1,25)^3}$ ✓

$= 0,057$ ✓ (7)

OPTION 2/*OPSIE 2*

	2X(g)	3Y(g)	X_2Y_3(g)
Initial moles/*Aanvangsmol*	4	4	0
Moles reacted/*mol gereageer*	1	1,5	0,5 ✓
Moles at equilibrium/*mol by ewewig*	3✓	2,5✓	0,5
Equilibrium concentration/ *Ewewigskonsentrasie* ($mol.dm^{-3}$)	1,5	1,25	0,25

✓ (divide by 2/*deel deur* 2)

$$Kc = \frac{[X_2Y_3]}{[X]^2[Y]^3} ✓$$

$$= \frac{0,25}{(1,5)^2(1,25)^3} ✓$$

$$= 0,057 ✓$$

6.3 At 70 s/*By 70 s*:

- Increase in temperature increases the number of moles of reactants/ decreases the number of moles of the products. ✓
  Verhoging in temperatuur verhoog die aantal mol van reaktante/ verlaag die aantal mol van die produk.
- reverse reaction is favoured ✓
  terugwaartse reaksie is bevoordeel
- hence the forward reaction is exothermic.
  dus die voorwaartse reaksie is eksotermies

Accept/Aanvaar:

- the reverse reaction is endothermic/ absorbs the heat energy✓ /
  die terugwaartse reaksie endotermies/ absorbeer die hitte-energie (3)

6.4 Kc decreases. /*K_C verlaag*✓ (1)

[12]

QUESTION 7/*VRAAG 7*

7.1 An acid is a substance that produces hydrogen ions (H^+)/ hydronium ions (H_3O^+) when it dissolves in water. ✓✓
'n Suur is 'n stof wat waterstofione (H^+)/ hidroniumione (H_3O^+) vorm wanneer dit in water oplos. (2)

7.2.

7.2.1 P ✓ (1)

7.2.2

(a) $NH_4^+ + H_2O$ ✓ $\rightleftharpoons NH_3 + H_3O^+$ ✓ bal ✓ (3)

(b) Acidic/ *suur* ✓
Hydronium ions (H_3O^+) are formed in the solution. ✓
Hidroniumione (H_3O^+) word gevorm in die oplossing (2)

7.3 7.3.1

$$c = \frac{m}{MV} ✓$$

$$= \frac{4}{(40)(0,5)} ✓$$

$$= 0,2\ mol \cdot dm^{-3} ✓$$

OR/OF

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

$= \frac{4}{40}$

$= 0,1 \text{ mol}$ ✓

$c = \frac{n}{V}$

$= \frac{0,1}{0,5}$ ✓

$= 0,2 \text{ mol·dm}^{-3}$ ✓ (3)

7.3.2 $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓

✓ $\frac{c_a(25)}{(0,2)(12,5)} = \frac{1}{2}$ ✓

$c_a = 0,05 \text{ mol·dm}^{-3}$

OR/OF

$C_b V_b = n_b$

$(0,2)(12,5 \times 10^{-3}) = n_b$ ✓

$n_b = 2,5 \times 10^{-3} \text{ mol}$

$n_a = ½ (2,5 \times 10^{-3})$

$c_a = \frac{n_a}{V_a}$ ✓

$= \frac{1,25 \times 10^{-3}}{25 \times 10^{-3}}$ ✓

$= 0,05 \text{ mol·dm}^{-3}$

$c_a = 0,05 \text{ mol·dm}^{-3}$

$[H_3O^+] = 2(0,05)$ ✓

$pH = - \log [H_3O^+]$ ✓

$pH = -\log (0,1)$ ✓

$pH = 1$ ✓ (7)

[18]

QUESTION 8/*VRAAG 8*

8.1 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)

8.2 Temperature at 25°C /298 K/ *Temperatuur van 25°C /298 K* ✓
Concentration of 1 mol·dm^{-3}/ *Konsentrasie van 1 mol·dm^{-3}* ✓ (2)

8.3. It is reduced✓, because Y^{2+} gains/accepts electrons from metal X ✓/it is an oxidising agent/the oxidation number decreases.
Word gereduseer, want Y^{2+} neem elektrone op vanaf metaal X/ dit is 'n reduseermiddel/ die oksidasiegetal verminder (2)

8.4 Y, X, Z ✓ (1)

8.5 8.5.1 **OPTION 1/OPSIE 1**

$E^{\ominus}_{cell} = E^{\ominus}_{cathode} - E^{\ominus}_{anode}$ ✓

$E^{\ominus}_{sel} = E^{\ominus}_{katode} - E^{\ominus}_{anode}$

$= +0,34$ ✓ $- (-2,36)$ ✓

$= 2,7$ V ✓

OPTION 2/ OPSIE 2

$Cu^{2+} + 2e^- \rightarrow Cu(s)$ +0,34V✓

✓ $Mg \rightarrow Mg^{2+} + 2e^-$ - 2,36V✓

$Cu^{2+}(aq) + Mg \rightarrow Cu(s) + Mg^{2+}(aq)$

> **Notes/Aantekeninge**
> Accept any other correct formula from the data sheet/*Aanvaar enige ander korrekte formule vanaf gegewensblad.*
> Any other formula using unconventional abbreviations, e.g. $E^{\ominus}_{sel} = E^{\ominus}_{OA} - E^{\ominus}_{RA}$ followed by correct substitutions:/ *Enige ander formule wat onkonvensionele afkortings gebruik bv. $E^{\ominus}_{sel} = E^{\ominus}_{OM} - E^{\ominus}_{RM}$ gevolg deur korrekte vervangings:*
> Max/*Maks*: 3/4

(4)

8.5.2 $Mg(s)/ Mg^{2+}(aq)$ ✓ // ✓ $Cu^{2+}(aq)/Cu(s)$ ✓ (3)

8.5.3 ~~Endothermic/*Endotermies*~~. ✓ (1)
Exothermic / Eksotermies **[15]**

QUESTION 9/*VRAAG 9*

9.1 Electrical energy is converted to chemical energy. ✓✓
Elektriese energie word omgeskakel na chemiese energie. (2)

9.2 P ✓ (1)

9.3 Q ✓ (1)

9.4 $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$ ✓✓ (2)

9.5 The rate of oxidation (at the anode) equals to the rate of reduction (at the cathode). ✓✓
Die tempo van oksidasie (by die anode) is gelyk aan die tempo van reduksie (by die katode) (2)

OR/OF

The rate at which copper (Cu) is oxidized equals to the rate at which copper ions(Cu^{2+}) are reduced.
Die tempo waarteen koper (Cu) geoksideer word, is gelyk aan die tempo waarteen koperione (Cu^{2+}) gereduseer word.

9.6 P ✓
$2Cl^- \rightarrow Cl_2 + 2e^-$ ✓✓ (3)

9.7 Decreases/ Verminder ✓ (1)
[12]

QUESTION 10/*VRAAG 10*

10.1 Contact (process)/*Kontak (proses)*✓ (1)

10.2

10.2.1 $2SO_2(g) + O_2$ ✓ $\rightleftharpoons$ $2SO_3(g)$ ✓✓ (3)

10.2.2 Vanadium pentoxide or (V_2O_5) ✓✓ (2)
Vanadiumpentoksied (V_2O_5).

10.3

10.3.1 ammonia/ammoniak ✓ (1)

10.3.2 $2NH_3(g) + H_2SO_4(aq)$ ✓ $\rightarrow$ $(NH_4)_2SO_4(aq)$ ✓✓ (3)

10.4

$M\ (NH_4)_2SO_4 = 2(14) + 4(2) + 32 + 4(16)$
$= 132\ g{\cdot}mol^{-1}$ ✓

$\% N = \frac{28}{132}$ ✓ x 100 ✓

$= 21{,}21\ \%$ ✓ (4)
[14]

TOTAL/*TOTAAL*: 150