LIMPOPO

PROVINCIAL GOVERNMENT

REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P2: CHEMISTRY
FISIESE WETENSKAPPE VR 2: CHEMIE

SEPTEMBER 2016

MEMORANDUM

MARKS: 150

QUESTION?VRAAG 1

1.1 A✓✓ (2)
1.2 D✓✓ (2)
1.3 B✓✓ (2)
1.4 C✓✓ (2)
1.5 D✓✓ (2)
1.6 C ✓✓ (2)
1.7 A✓✓ (2)
1.8 A✓✓ (2)
1.9 C✓✓ (2)
1.10 B✓✓ (2)
[20]

QUESTION/VRAAG 2

2.1

2.1.1 Esters ✓ (1)

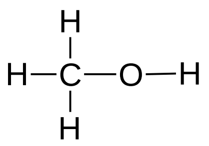
2.1.2 Carboxyl group✓/karboksiel groep (1)

2.1.3 A✓ (1)

2.1.4 5-bromo✓-2,4-dimethyl✓heptane✓ // (3)
5-broom–2,4–dimetielheptaan of / 5-bromo–2,4–dimetielheptaan

2.1.5 C_nH_{2n}✓ (1)

2.1.6



✓✓

Notes

- Functional group ✓
- Whole structure correct ✓

(2)

2.1.7 propanoic acid ✓ / propanoësuur (1)

2.2

2.2.1 Polyethene/ Polythene✓/ polieteen/ politeen/ polietileen
Accept: Polyethylene✓ (1)

2.2.2 Addition Polymerisation ✓ addisie polimerisasie (1)

2.2.3 (a) CH_2 ✓ (1)

(b) CH_2 ✓ (1)
[14]

QUESTION/VRAAG 3

3.1 A series of organic compounds that can be described by the same general formula. ✓✓ / ‘n reeks organiese verbindings wat deur ‘n algemene formule beskryf kan word

OR: A series of organic compounds in which one member differs from the next with a CH_2 group./ ‘n reeks organiese verbindings waar een van die ander me CH_2 groep/eenheid verskil

NOTES: 2 or 0

3.2 Ketones ✓/ ketone (1)

3.3 Butanoic acid✓/ butanoöesuur (1)

3.4.1 Boiling point✓/ kookpunt (1)

3.4.2 Molecular mass✓ / molekulêre massa (1)

3.5 The boiling point of carboxylic acids > b.p of alcohols > b.p of aldehydes (1)
Kookpunt van karboksielsure > k.pt alkohole > k.pt van aldehiede

3.6
- Both compounds **A** and **B** are hydrogen bonded✓ / beide A en B het waterstofbinding IM kragte
- Compound **A** has two (more) sites for hydrogen bonding /**A** forms dimers/**A** is more polar/ **B** has less/one sites for hydrogen bonding ✓// A het twee plekke vir waterstofbinding (B het slegs 1 plek vir H-bd)
- Therefore **A** has stronger intermolecular forces than **B/B** has weaker Intermolecular forces than **A** ✓ / A het sterke IM kragte (3)

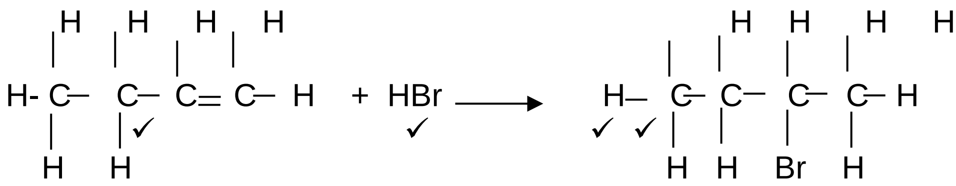
3.7 The stronger/weaker the intermolecular forces, the lower/higher the vapour pressure. ✓// hoe sterker die IM kragte hoe swakker is die dampdruk / h swakker die IM kragte hoe hoer is die dampdruk (1)

[11]

QUESTION/VRAAG 4

4.1.1 Addition/hydrobromination / Hydrohalogeantion ✓/ Addisie/ hidrohalogenasie aanvaar: hidrobromasie (1)

4.1.2



(4)

Notes: Reactants✓✓ Product✓✓ Marking Rule 6.3.10.

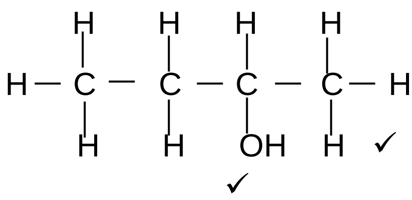
4.1.3 2-bromobutane ✓✓/ 2-broombutaan/2-bromobutaan

Notes
- 2-bromo ✓
- butane ✓

(2)

4.2.1 Substituition ✓ /Hydrolysis / substitusie/ hidroliese (1)

4.2.2

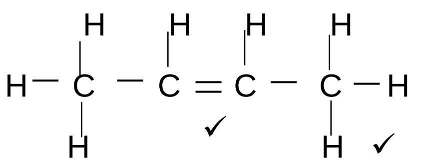


Notes:
- Functional group correct ✓/ Funksionele groep korrek
- Whole structure correct ✓/ Hele struktuur korrek

(2)

4.2.3 Butan-1-ol / 1- butanol ✓✓ (2)

4.3



Marking Rules:

Functional group correct ✓/ korrekte funksionele groep
Whole structure correct ✓ / hele struktuur reg

(2)

4.4
4.4.1 Alkene ✓ / alkene (1)
4.4.2 Potassim bromide/KBr ✓/ kaliumbromied
Water /H_2O ✓ (2)

[17]

QUESTION/VRAAG 5

5.1 Carbon dioxide/CO_2 / koolstofdioksied (2)

5.2.1 The decrease in concentration of hydrochloric acid per unit time. ✓✓/ die afname in soutsuur konsentrasie per eenheidstyd (2)
(2 or 0)

5.2.2 Concentration(of the acid) ✓/ konsentrasie (1)

5.2.3 For a fair test/comparison✓ / vir 'n regverdige toets (1)

5.2.4 Higher acid concentration in experiment 2 means:

- More particles/molecules per unit volume✓
- More particles have kinetic energy equal to or greater than activation energy/More particles have enough kintetic energy ✓
- More effective collisions per unit time/frequency of effective collisions increases/Rate of effective collisions increases. ✓ (3)

Hoër konsentrasie suur vir eksperiment beteken:

- Meer deeltjies/ eenheidsvolume
- Meer deeltjies het genoeg E_K gelyk of groter as aktiverings energie/ genoeg E_K
- Meer effektiewe botsings/ eenheidstyd

5.2.5 $n(CaCO_3) = \frac{m}{M}$

$= \frac{4}{100}$ ✓

$= 0{,}04$ mol

$n(HC\ell):n(CaCO_3) = 2 : 1$

$\therefore n(HC\ell) = 2(0{,}04)$ ✓ $= 0{,}08$ mol

$c(HC\ell) = \frac{n}{V}$

$0{,}4 = \frac{0{,}08}{V}$ ✓

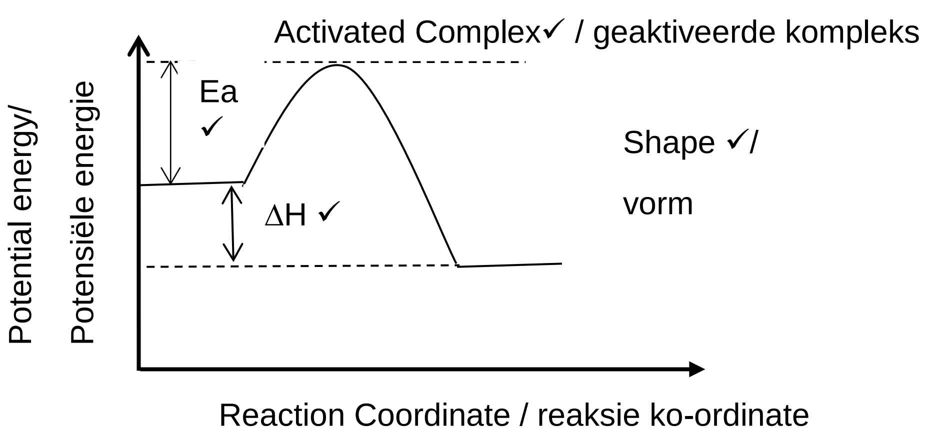
$\therefore V = 0{,}2\ dm^3 = 200\ cm^3$ ✓

(4)

Marking Guidelines:

- Substitution into $n = \frac{m}{M}$
- Ratio $n(HC\ell) = \frac{1}{2}n(CaCO_3)$
- Substitution in c = n/V
- Final answer

5.3 POTENTIAL ENERGY VERSUS REACTION COORDINATE GRAPH



(4)

[17]

QUESTION/VRAAG 6

6.1 3 to 4 minutes (Any value from 3 min to 4 min can be accepted) / 3 - 4 minute (1)

6.2.1 Greater than✓/ groter as (1)

6.2.2 Equal to ✓/ gelyk aan (1)

6.3 **<u>CALCULATION USING NUMBER OF MOLES / bereken met aantal mol</u>**

Marking Criteria: • Correct K_c expression/ korrekte K_c uitdrukking • Substituting the K_c value in the expression/ vervanging van K_c waarde • Substituting concentration value of $PC\ell_5$(g) in K_c/ vervanging van [$PC\ell_5$] in K_c • Equilibrium concentration $PC\ell_3$ and $C\ell_2$ = 0,91 mol·dm^{-3}/ [ewewig] $PC\ell_3$ = $C\ell_2$ = 0,91 • Using n = cV to find the n of $PC\ell_5$ (multiplying c by 2)/ x 2 om n van $PC\ell_5$ te kry • Ratio of n($PC\ell_5$): n($PC\ell_3$): n($C\ell_2$) = 1:1:1/ verhouding [$PC\ell_5$]: [$PC\ell_3$]: [$C\ell_2$] = 1:1:1 • Calculating n ($PC\ell_5$) initial = 2,12 mol/ berekening van aanvanklik $PC\ell_5$ = 2,12

Assume that the equilibrium concentration of $PC\ell_3$(g) is *x*

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} \checkmark$$

$$5.55 \checkmark = \frac{(x)(x)}{0,15} \checkmark$$

$$\therefore x = 0.91 \text{ mol·dm}^{-3} \checkmark$$

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$	
Initial Quantity (mol)	2,12 ✓	0	0	
Change in quantity (mol)	-1,82	+1,82	+1,82	R✓
Equilibrium quantity (mol)	0,30 ✓	1,82	1,82	X 2 ✓
Concentration at equilibrium (mol·dm^{-3}) V = 2 dm^3	0,15	0,91	0,91	

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

$$2,12 = \frac{m}{102} \checkmark$$

m = 216,24 g ✓

CALCULATION USING CONCENTRATION/ berekening met [ ]

- Correct K_c expression/ korrekte K_c uitdrukking
- Substituting the K_c value in the expression/ vervanging van K_c waarde
- Substituting concentration value of $PC\ell_5$(g) in K_c / vervanging van [$PC\ell_5$] in K_c
- Equilibrium concentration for $PC\ell_3$ and $C\ell_2$ = 0,91 mol·dm^{-3} / [ewewig] $PC\ell_3$ = $C\ell_2$ = 0,91
- Ratio of [$PC\ell_5$]: [$PC\ell_3$]: [$C\ell_2$] = 1:1:1 / verhouding [$PC\ell_5$]: [$PC\ell_3$]: [$C\ell_2$] = 1:1:1
- Initial concentration of $PC\ell_5$(g) / aanvanklike [$PC\ell_5$]
- Substituting 2 in c = n/V / deel deur 2 vir [ ]
- Substituting 102 in n = m/M / vervanging van 102 in n = m/M
- Final answer / finale antwoord

Assume that the equilibrium concentration of $PC\ell_3$(g) is *x*

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} \checkmark$$

$$5.55 \checkmark = \frac{(x)(x)}{0,15} \checkmark$$

$$\therefore x = 0.91 \text{ mol·dm}^{-3} \checkmark$$

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$
Initial concentration (mol·dm^{-3}) aanvanklik	1,06 ✓	0	0
Change in concentration (mol·dm^{-3}) Verandering	-0,91	+0,91	+0,91
Equilibrium concentration (mol·dm^{-3}) Ewewig	0,15	+0,91	+0,91

Ratio✓/ verhouding

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

$$1.06 = \frac{n}{2} \checkmark$$

n = 2,12 mol

OR/ of

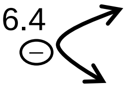
m = cMV

=(1,06)(102)(2)

=216,24 g

m = n M = (2,12)(31+5 x 31,5) ✓

= 443,02 g ✓ (9)

6.4  Endothermic. ✓ endotermies

Decrease in temperature **increases [PCℓ$_5$]** and **decreases [Cℓ$_2$]** and **[PCℓ$_3$],** which implies that the reverse reaction is favoured/equilibrium position shifts to the left. ✓According to Le Chatelier 's Principle, the decrease in temperature favours the exothermic reaction.✓ Therefore, the forward reaction is endothermic. /
Afname in temperatuur verhoog **[PCℓ$_5$]** en verlaag **[Cℓ$_2$]** en **[PCℓ$_3$],** dus word terugwaartse reaksie bevoordeel/ ewewig skuif na links
Volgens Le Chatelier se beginsel sal 'n afname in temperatuur die eksotermiese reaksie bevoordeel (d.w.s terugwaartse reaksie is endotermies)
Dus is die voorwaartse reaksie endotermies (3)

[15]

QUESTION/VRAAG 7

7.1

7.1.1 Concentrated acid- contains a large amount (number of moles) of acid in proportion to the volume of water.✓
Dilute acid – contains a small amount (number of moles) of acid in proportion to the volume of water.✓/ (2)
Gekonsentreede suur: bevat 'n groot hoeveelheid /mol suur in verhouding to die volume water
Verdunde suur bevat 'n klein hoeveelheid / aantal mol suur in verhouding tot die volume water

7.1.2 It ionises completely in water to form a high concentration of H_3O^+ ions.✓ ✓// dit ioniseer volledig in water en vorm 'n hoë konsentrasie H_3O^+ ione (2)

Note: 2 or 0

7.1.3 pH = -log[H_3O^+]✓
= - log(0,20)✓
= 0,7✓ (3)

7.2.1 Basic ✓/ basies (1)

7.2.2 CO_3^{2-}(aq) + H_2O (ℓ) → HCO_3^- (aq) + OH^- (aq)
(reactants ✓ products ✓)
Excess OH^- (aq) ions are produced/it is a salt of strong base and weak acid (and the resultant solution is basic.) ✓
'n Oormaat OH^- ione word geproduseer/ dit is die sout van 'n sterk basis en 'n swak suur (3)

Marking Criteria / nasienkriteria:

- Substitution into/vervanging in $n = \frac{V}{V_m}$
- Using mole ratio/ gebruik molverhouding
- Multiplying by/ vermenigvuldig met 106
- Percentage purity / pesentasie suiwerheid

7.3.1 $n(CO_2) = \frac{V}{V_m}$

$= \frac{4,48}{22,4}$ ✓

= 0,2 mol

$n(Na_2CO_3)$: $n(CO_2)$ = 1:1

∴ $n(Na_2CO_3)$ = 0,2 mol ✓

$m(Na_2CO_3)$ = n·M = (0,2)(106) ✓ = 21,2 g

∴ % purity = $\frac{\text{mass of pure } Na_2CO_3}{\text{mass of impure } Na_2CO_3} \times 100\%$

$= \frac{21,2}{25} \times 100$ ✓

= 84,8%✓ (5)

7.3.2 Mass of impurity/ massa onsuiwerheid = 25 -21,2✓ = 3,8 g✓

OR % impurity/ onsuiwerheid = 100-84,8 = 15,2%

$\frac{15,2}{100}$x 25 = 3,8 g (2)

[18]

QUESTION/VRAAG 8

8.1.1 Reduction is a <u>gain in electron</u>(s) (by a chemical substance)✓✓// die bykry van elektrone (2)

Note: 2 or 0

8.1.2 Aluminium is a stronger reducing agent✓ than Sn/ Ag/ Hg and therefore it is easily oxidised✓ and a current flows✓, simulating the pain sensors./ (3)
Al is 'n sterker reduseermiddel as sn/Ag/Hg en word daarom maklike geoksideer. 'n Stroom vloei wat pyn veroorsaak

8.2.1 $2Cr^{2+}(aq) + Cu^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + Cu(s)$
(reactants✓, products✓, balancing✓) (3)

8.2.2 $E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓

=+0,34✓-(-0,41)✓

= 0,75 V ✓

OR

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

= +0,34✓+0,41✓

= 0,75 V✓ (4)

8.2.3 Increases ✓ / verhoog
Increase in temperature <u>increases the rate of electron transfer</u> as well as the movement of ions in the electrolyte.✓
(This increases the rate of flow of charge in the cell.)/ (2)

'n verhoging in temperatuur verhoog die tempo van electron oordrag en die beweging van ione in die elektroliet

8.2.4 As the cell operates, [cation]/[Cr $^{3+}$]increases in the anode half cell and [cation]/[Cu $^{2+}$]decreases in the cathode ✓half cell.
Anions from the salt bridge move into the anode half-cell to balance out excess cations.✓
Cations from the salt bridge move into the cathode half-cell to balance out shortage of cations.✓/ (3)
Soos die sel werk, verhoog [katione] / [Cr $^{3+}$] in die anode/Cr halfsel en [katione] / [Cu $^{2+}$] verlaag in die katode/Cu halfsel. Anione / negatiewe ione va die soutbrug beweeg na die anode/ Cr halfsel om die oormaat katione/ Cr $^{3+}$ uit te balanseer
Katione / negatiewe ione van die soutbrug beweeg na die katode/ Cu halfsel om die tekort van katione/ Cu^{2+} te balanseer

[17]

QUESTION/VRAAG 9

9.1 Bauxite ✓✓/ Bauksiet (2)

9.2 Carbon ✓/ Koolstof (1)

9.3 The anode reacts with the oxygen produced to form CO_2. ✓// Die anode reageer met die suurstof wat geproduseer word en vorm CO_2. (1)

9.4 Cryolite ✓/ Krioliet (1)

9.5 $Aℓ + 3e^- \rightarrow Aℓ$✓✓ (2)

9.6 1890 C~ 0,176 g Aℓ
96500 C ~ x g Aℓ

$\therefore x = \frac{(96500)(0{,}176)}{(1890)}$ ✓

= 8,98 g✓

1 mol of metal ~ 27 g
Since 8,98 g of metal are discharged by 1 mol of electrons,
27 g of metal are discharged by $\frac{27g}{8{,}98g}$ ✓ =3 moles of electrons.
If 1 mole of metal needs 3 moles of electrons, the charge on the cations is +3/
1 mol metaal ~ 27 g
Omdat 8,98 g metaal ontlaai word deur 1 mol elektrone, sal
27 g metaal ontlaai word deur $\frac{27g}{8{,}98g}$ ✓ =3 mol elektrone
Indien 1 mol metal 3 mol elektrone benodig, is die lading van die katioon +3 (3)

[10]

QUESTION/VRAAG 10

10.1

10.1.1 Increase in population requires an increase in the production of food.✓ OR Removing plant material from the soil depletes the nutrients so more fertilizer must be added to the soil. ✓/ Toename in bevolking vereis 'n toename in voedselproduksie OF verwydering van plantmateriaal vanuit die grond veroorsaak uitputting van voedingstowwe so meer kunsmis moet tot die grond toegevoeg word (1)

10.1.2 Allows nutrients to be absorbed through roots with water.✓/ laat toe dat voedingstowwe deur die wortels opgeneem word (1)

10.1.3 Run off/ leaching results in the cost of lost nutrients/ eutrophication✓/ eutrifikasie/ afloop /loging veroorsaak verhoogte koste as gevolg van verlore voedingstowwe (1)

10.2

10.2.1 Contact process✓/ kontakproses (1)

10.2.2 Oleum/ pyrosulphuric acid/ fuming sulphuric acid✓/oleum/rokende swael (1)

10.2.3 $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$
(reactants✓, products✓, balancing✓) (3)

Note: Marking rule 6.3.10

10.2.4 Ammonium sulpahte /$(NH_4)_2SO_4$ ✓/ ammoniumsulfaat (1)

10.2.5 (a) For stems and leaves development ✓/ vir ontwikkeling van blare en stamme (1)

(b) Fractional distillation of liquid air ✓/ fraksionele distillasie van vloeibare lug (1)

[11]

GRAND TOTAL : 150