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/*GRAAD* 12

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

SEPTEMBER 2019

MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: 150

These marking guidelines consists of 16 pages.
Hierdie nasienriglyne bestaan uit 16 bladsye.

Copyright reserved/*Kopiereg voorbehou*

QUESTION 1/*VRAAG 1*

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

[20]

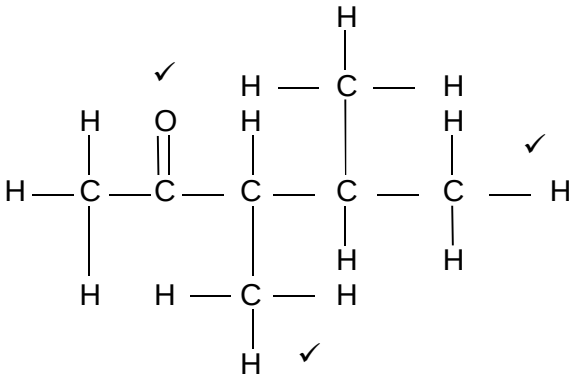
QUESTION 2/*VRAAG 2*

2.1 A bond / an atom/ a group of atoms that determine(s) the (physical and chemical) properties of a group of organic compounds. ✓ ✓ (2 or 0)
'n Binding/ 'n atoom/ 'n groep atome wat die (fisiese en chemiese) eienskappe van 'n groep organiese verbindings bepaal. (2)

2.2

2.2.1 Ketones ✓*Iketone*

2.2.2



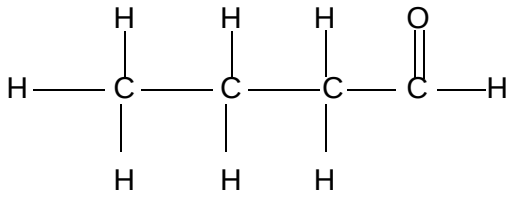
Marking criteria:

- Only functional group correct:/*Slegs funksionele groep korrek.* Max: ½
- Only two methyl groups/ *Slegs twee metielgroepe*: ½
- Whole structure correct/ *Hele struktuur korrek*: Max: ½

2.3

2.3.1 C_2H_{2n-2} ✓ (1)

2.3.2



Accept any correct structural formula for the given compound. *Aanvaar enige korrekte strukturele formule vir die gegewe verbinding*.

(2)

2.3.3 2-bromo-3-chloro-4-methylpentane
2-bromo-3-chloro-4-metielpentaan

Marking criteria:
- Stem, i.e. pentane/ *Stamnaam is pentaan* ✓
- All three substituents correctly identified/ *al drie substituente korrek geïdentifiseer*: ✓
- Correct numbering of substituents and functional group/ *Substituente en funksionele groep korrek genommer*: ✓
- Any error e.g. hyphens omitted and/or incorrect sequence/ *Enige fout bv.koppelteken uitgelaat en/of foutiewe volgorde*: Max. $\frac{?}{?}$

(3)
[12]

QUESTION 3/*VRAAG 3*

3.1

3.1.1 Molecular mass (or different homologous series)/ *Molekulêre massa (of verskillende homoloë reeks)* ✓ (1)

3.1.2 Vapour pressure/ *Dampdruk* ✓ (1)

3.2

- Butane (alkane) have London/dispersion/induced-dipole forces. ✓
  Butaan (alkane) het London/dispersie/geïnduseerde dipoolkragte
- Butanol (alcohol) have hydrogen bonding (in addition to the London/dispersion/induced dipole forces and dipole-dipole forces). ✓
  Butanol (alkohol) het waterstofbinding (bykomend tot London/dispersie/geïnduseerde dipoolkragte)
- The intermolecular forces in alcohol are stronger than the intermolecular forces than in butane(alkanes). ✓
  Die intermolekulêre kragte in alkohole is sterker as die intermolekulêre kragte gevind in butaan (alkane).

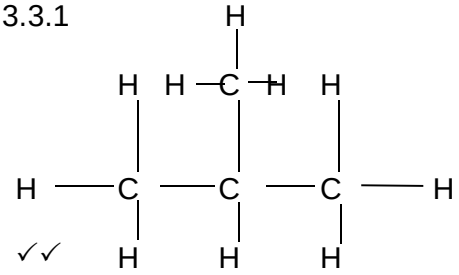
OR/OF

More energy is needed to overcome/break intermolecular forces in Butan-1-ol (alcohols) than in butane (alkanes).
Meer energie is nodig om die intermolekulêre kragte in butan-1-ol (alkohole) te oorkom as in butaan (alkane).

- Butan-1-ol (alcohols) have lower vapour pressure than alkanes (butane). ✓
  Alkohole (butan-1-ol) het 'n laer dampdruk as butaan (alkane). (4)

3.3

3.3.1



✓✓ (2)

3.3.2 2-methylpropane/ *2-metielpropaan* ✓✓ (2)

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

3.4 **D** (butan-1-ol). ✓
Lowest vapour pressure/ strongest intermolecular forces ✓
Laagste dampdruk/ sterkste intermolekulêre kragte. (2)
[13]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 - Room temperature /*kamertemperatuur* ✓
- Absence of water/*Geen water nie* ✓ (2)

4.1.2 2-chlorobutane / *2-chlorobutaan* ✓✓ (2)

4.2.1 addition/hydrohalogenation ✓
addisie/hidrohalogenering (1)

4.2.2 substitution/hydrolysis ✓ (1)
s*ubstitusie/hidrolise*

4.2.3 elimination/dehydration. ✓ (1)
e*liminasie/dehidrasie*

4.3

4.3.1 - Secondary/*sekondêre* ✓
- Carbon atom to which the OH-group is attached, is attached to two other carbon atoms. ✓✓/*Koolstofatoom waaraan OH- vebind is, is verbind aan twee ander koolstofatome.* (3)

4.3.2 **ANY ONE/*ENIGE EEN*:**
- (Alcohol/ethanol) is flammable/catches fire easily. ✓
  (Alkohol/etanol) is vlambaar/slaan maklik aan die brand.
- To heat it evenly./*Om dit eweredig te verhit.*
- Water bath is used for low heat/low temperature./*Waterbad word gebruik vir lae hitte/lae temperatuur.*
- Alcohol/ethanol will evaporate too quickly./*(Alkohol/etanol) sal te vinnig verdamp.*

Accept/*Aanvaar*:
(Alcohol/ethanol) is volatile./*(Alkohol/etanol) is vlugtig.* (1)

4.4.1 A polymer formed by monomers with two functional groups ✓that are linked together in a condensation reaction in which a small molecule, usually water, is lost. ✓
'n Polimeer wat gevorm word deur twee monomere met verskillende funksionele groepe ✓*wat aan mekaar skakel in 'n kondensasiereaksie waarin 'n klein molekuul, gewoonlik water, verloor word* .✓ (2)

4.4.2 A ✓ (1)

4.4.3 C_2H_4 ✓ (1)
[15]

QUESTION 5/*VRAAG 5*

5.1.1 The number of particles with sufficient kinetic energy for a reaction to take place/successful collision/effective collision/energy higher than E_a. ✓
Die aantal deeltjies met voldoende kinetiese energie vir 'n reaksie om plaas te vind/suksesvolle botsings/effektiewe botsings/energie hoër as E_a. (1)

5.1.2 Graph B/*grafiek B* ✓ (1)

5.2.1 (a)

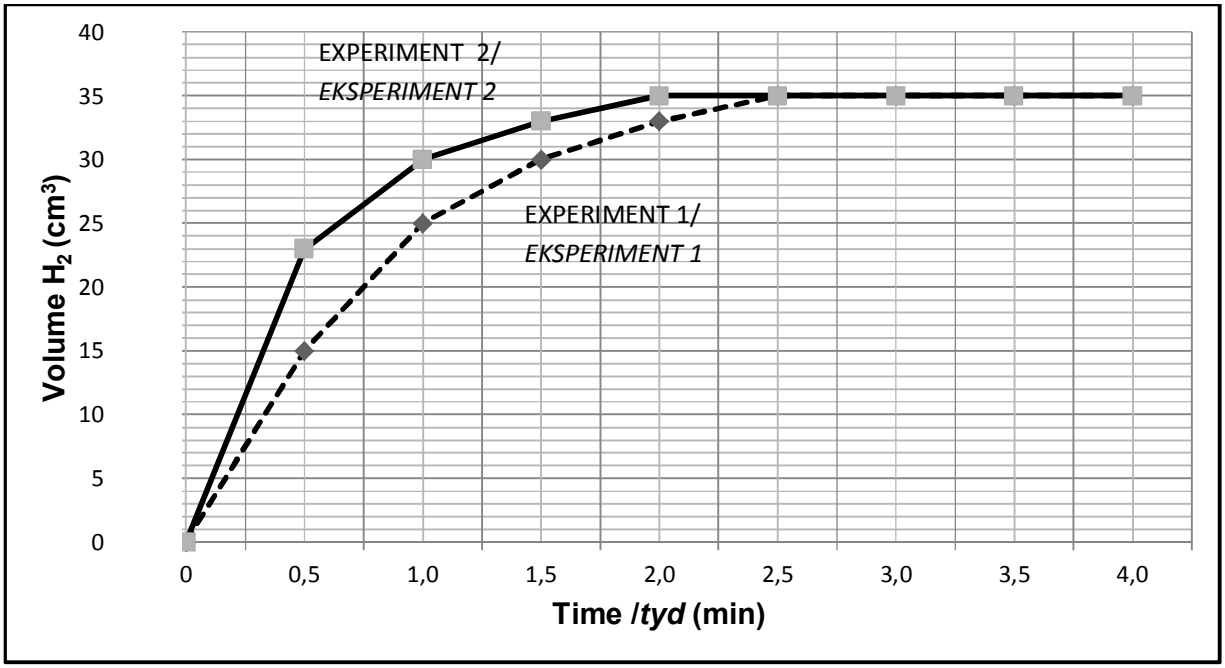
Marking guideline/*Nasienriglyne*	
Dependent and independent variables correctly identified. *Afhanklike en onafhanklie veranderlikes korrek geïentifiseer.*	✓
Relationship between variables in question form. *Verwantskap tussen veranderlikes in vraagvorm.*	✓

- What is the influence of state of division/ surface area on reaction rate?
- *Wat is die invloed van toestand van verdeeldheid/ reaksieoppervlakte op reaksietempo?*

(b) ANY TWO OF: Temperature, mass of magnesium, concentration of HCă✓✓
ENIGE TWEE VAN: Temperatuur, massa magnesium, konsentrasie HCℓ (2)

5.2.2 Reaction is complete/ all Mg is used up/ Mg is the limiting reagent. ✓
Reaksie het volledig verloop/ al die magnesium het gereageer/ Mg is die beperkte reaktant. (1)

5.2.3 Graph of Volume of H_2 (cm^3) vs time (min) / *Grafiek van volume H_2 (cm^3) teenoor tyd (min)*



Marking criteria	
Labelled x- and y-axes/ *Byskrifte van x- en y-as*	✓
Plotting of points/ *Stip van punte*	✓
Labelling graph/ *Benoem grafieke*	✓
Shape of graph/ *vorm van grafiek*: Experiment 1/*Eksperiment 1*	✓
Experiment 2/*Eksperiment 2*	✓

(5)

5.2.4 Experiment 2/ *eksperiment 2* ✓ (1)

5.2.5 Reaction surface area of Mg increases/ powdered Mg has a larger surface area / more contact points✓ more effective collisions with the correct orientation ✓ per unit time ✓/ Frequency of effective collisions increases.
Reaksie-oppervlakte van Mg is verhoog/ Poeier van Mg het 'n groter reaksie-oppervlakte/meer kontakpunte ✓, meer effektiewe botsings met die regte oriëntasie ✓per tydseenheid ✓/Frekwensie van effektiewe botsings neem toe. (3)

5.2.6 Rate of reaction/ *reaksietempo* $= \frac{\text{change in volume } H_2}{\text{change in time/tyd}}$

$= \frac{(15 - 0)✓}{(0{,}5 - 0)✓}$

$= 30\ cm^3 . min^{-1}$ ✓ (3)

[18]

QUESTION 6/*VRAAG 6*

6.1 A system without external force/ influence/ 'n sisteem sonder eksterne kragte/invloede. ✓✓ (2)

6.2 Endothermic/ *endotermies* ✓
Heat is added to reagents/heat appears on the left hand side of the equation/ *Hitte word by reaktante gevoeg/ warmte verskyn aan die linkerkant van die vergelyking*. ✓ (2)

6.3 Larger than/ *Groter as*. ✓ $K_c > 1$✓ /K_c large/*groot* (2)

6.4

Marking guidelines/*Nasienriglyne*

- Substituting/vervang 28 g.mol^{-1} in $n = \frac{m}{M}$ ✓
- USE ratio/*GEBRUIK verhouding:* $CO_2 : CO = 1:2$ ✓
- $n(CO_2)_{eq/ewe} = n(CO_2)_{initial/begin} - \Delta n(CO_2)$.
  $n(CO_2)_{eq/ewe} = n(CO)_{initial/begin} + \Delta n(CO)$. ✓
- Divide equilibrium moles by 2 dm^3/*Deel ewewigsmol deur 2 dm^3.* ✓
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c uitdrukking (formules in vierkanthakies).
- Substitution of K_c value/*Vervanging van K_c-waarde*. ✓
- Substitution of concentrations into correct K_c expression. ✓
  Vervanging van konsentrasies in korrekte K_c-uitdrukking.
- Final answer/*Finale antwoord*: 4,29 (mol) ✓

OPTION 1/*OPSIE 1*

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

$$= \frac{168}{28} \checkmark$$

$$= 6 \text{ mol}$$

	$CO_2(g)$	CO(g)
Mole ratio	1	2
Initial moles/*Aanvangsmol*	X	0
Moles reacted/*mol gereageer*	3	6✓ (ratio) ✓
Moles at equilibrium/*mol by ewewig*	X-3✓	6✓
Equilibrium concentration/ *Ewewigskonsentrasie* (mol·dm^{-3})	X-3/2	3

✓ (divide by 2/*deel deur 2*)

$$K_c = \frac{[CO]^2}{[CO_2]} \checkmark$$

$$14 = \frac{(3)^2}{(\frac{x-3}{2})} \checkmark$$

X = 4,29 mol ✓ (9)

OPTION 2/*OPSIE 2*

$$n(CO_{\text{at eq}}) = \frac{m}{M}$$

$$= \frac{168}{28} \checkmark$$

$$= 6 \text{ mol}$$

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

$$= \frac{6}{2} \checkmark \text{ divide by 2/deel deur 2}$$

$$= 3 \text{ mol}$$

	$CO_2(g)$	CO(g)
Mole ratio	1	2
Initial concentration/*Aanvangskonsentrasie*	X	0
Change in concentration($mol \cdot dm^{-3}$)	1,5✓	3✓(ratio)
Equilibrium concentration/ *Ewewigskonsentrasie* ($mol \cdot dm^{-3}$)	X- 1,5✓	3

$$K_c = \frac{[CO]^2}{[CO]_2} \checkmark$$

$$14 = \frac{(3)^2}{(x - 15)} \checkmark$$

$$X = 2{,}14 \text{ mol} \cdot dm^{-3} \checkmark$$

$$n(CO_2) = c\ V$$

$$= 2{,}14 \times 2$$

$$= 4{,}29 \text{ mol} \quad \checkmark$$

OPTION 3/*OPSIE 3*

$$n(CO_{\text{at eq}}) = \frac{m}{M}$$

$$= \frac{168}{28} \checkmark$$

$$= 6 \text{ mol}$$

	$CO_2(g)$	CO(g)
Mole ratio	1	2
Initial moles/*Aanvangsmol*	4,28	0
Moles reacted/*mol gereageer*	3	6✓ (ratio) ✓
Moles at equilibrium/*mol by ewewig*	1,28✓	6 ✓
Equilibrium concentration/ *Ewewigskonsentrasie* ($mol \cdot dm^{-3}$)	0,64	3 multiply by 2✓

$$K_c = \frac{[CO]^2}{[CO]_2} \checkmark$$

$$14 = \frac{(3)^2}{[CO]_2} \checkmark$$

$$[CO_2] = 0{,}64 \text{ mol} \cdot dm^{-3} \checkmark$$

6.5 Remains the same/ *Bly dieselfde* ✓ (1)

[16]

QUESTION 7/*VRAAG 7*

7.1.1 It is a proton donator/ *protonskenker*. ✓ (2)

7.1.2 An acid that donates ONLY one proton per molecule.✓✓
'n Suur wat slegs EEN PROTON per molekule skenk. (2)

7.1.3 Strong acid / *sterk suur*✓
It completely ionises in water /Dit *ioniseer volledig in water*✓ (2)

7.1.4

(a) $[H_3O^+][OH^-] = k_w = 1 \times 10^{-14}$ ✓
$[H_3O^+](1 \times 10^{-11})$ ✓ $= 1 \times 10^{-14}$
$[H_3O^+] = 1 \times 10^{-3}$ mol·dm^{-3}✓
(3)

(b) $pH = - \log [H_3O^+]$ ✓
$pH = -\log (10^{-3})$ ✓
$pH = 3$✓ (3)

7.2

7.2.1 $CO_3^{-2}(aq) + H_2O(aq)$ ✓⇌ $HCO_3^-(aq) + OH^-(aq)$✓ bal ✓ (3)

N.B. Accept/*Aanvaar* single arrow/*enkel pyl* (→) Phases not necessary/ *fases nie nodig*.

7.2.2 HCO_3^- ✓ (1)

7.2.3 $n = \frac{m}{M}$ ✓
$= \frac{4,24}{106}$ ✓
$= 0,04$ mol

HCă: Na_2CO_3 = 1:2
Thus n(HCă) = 2(0,04) = 0,08 mol✓

$c = \frac{n}{V}$ ✓
$= \frac{0,08}{0,25}$ ✓
$= 0,32$ mol·dm^{-3}✓

OR/OF

$\frac{C_aV_a}{C_bv_b} = \frac{n_a}{n_b}$ ✓
✓ $\frac{c_a(0,25)}{(0,04)} = \frac{2}{1}$ ✓
✓

$C_a(0,25)$ ✓ $= 0,08$ mol·dm^{-3} ✓
$C_a = 0,32$ mol·dm^{-3}✓ (6)

[22]

QUESTION 8/*VRAAG 8*

8.1 Galvanic/Voltaic (cell)/ *Gavaniese/voltaïese (sel)*. ✓ (1)

8.2

8.2.1 $Ba(s) \rightarrow Ba^{2+}(aq) + 2e^-$ ✓✓ (2)

8.2.2 Barium to Iodine/ *Barium na jodium* ✓ (1)

8.2.3 $Ba(s) / Ba^{2+}(aq)$ ✓ (1 mol.dm^3) // ✓ $I^-(aq) / I_2(g) / Pt$ ✓ (3)

OR/OF

$Ba(s) / Ba^{2+}(aq) // I^-(aq) / I_2(g) / Pt$

OR/OF

$Ba(s) / Ba^{2+} // I^- / I_2 / Pt$

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

8.3. **OPTION 1/OPSIE 1**

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

$E^\ominus_{sel} = E^\ominus_{katode} - E^\ominus_{anode}$

$= +0,54$ ✓ $- (-2,90)$ ✓

$= +3,44$ V ✓

OPTION 2/ OPSIE 2

$Ba(s) \rightarrow Ba^{2+} + 2e^-$ $E^\ominus = +2,90$ V✓

$2I^- + 2e^- \rightarrow I_2(g)$ $E^\ominus = +0,54$ V✓

$2I^-(aq) + Ba(s) \rightarrow I_2(s) + Ba^{2+}(aq)$ $E^\ominus = +3,44$ V ✓ (4)

8.4 Spontaneous.✓ The emf / $E^\ominus_{cell}$ is positive ✓/It produces electrical energy.
Spontaan. Die emk/ $E^\ominus_{sel}$ is positief/ dit produseer elektriese energie (2)

8.5 Decreases. / Verlaag✓ (1)

[14]

QUESTION 9/*VRAAG 9*

9.1 The chemical process in which electrical energy is converted to chemical energy.✓✓
Die proses waarin die elektiese energie omgeskakel word na chemiese energie. (2)

9.2

9.2.1 $2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ ✓✓ (2)

9.2.2 Chlorine gas/*chloorgas*/ $Cl_2(g)$ ✓ (1)

9.2.3 $2H_2O(l) + 2Cl^-(aq)$✓ $\rightarrow Cl_2(g) + H_2(g) + 2OH^-(aq)$ ✓ Bal ✓ (3)
[8]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 Haber (process)/*Haber (proses)*✓ (1)

10.1.2 Platinum ✓ (1)

10.1.3 $N_2(g) + 3H_2(g)$ ✓ $\rightarrow 2NH_3(g)$ ✓ bal ✓ (3)

10.1.4 NH_4NO_3 ✓ and / en $(NH_4)_2SO_4$ ✓ (2)

10.2

10.2.1 Ammonium nitrate.✓ It provides nitrogen for healthy leaves. ✓
Ammoniumnitraat. Dit gee stikstof wat gesonde blare bevorder. (2)

10.2.2 $M(NH_4NO_3) = 14 + 1(4) + 14 + 3(16)$
$= 80\ g\cdot mol^{-1}$ ✓

$\%\ N = \frac{28}{80}$ ✓ x 100

$= 35\ \%$ ✓ (3)
[12]

TOTAL/*TOTAAL*: 150

NW DEPARTMENT OF EDUCATION Physical Sciences Grade 12 Paper 2 NSC SEPT 2019 ANALYSIS GRID

Question No.	Taxonomy													Knowledge area			Marks	
		Knowledge,Recall, Low Demand			COMPREHENSION, Basic Questions			APPLICATION, ANALYSIS, Problem Solving			EVALUATION,Higher Abilities, Hard new problems, Challenge Level			TOTAL	MATTER & MATERIALS	CHEMICAL CHANGE	CHEMICAL SYSTEMS	TOTAL MARKS	Question Totals
	Content	E	M	D	E	M	D	E	M	D	E	M	D	150	Marks				150
1.1	Hydocarbon	2												2	2			2	
1.2	Sructural formula		2											2	2			2	
1.3	IUPAC name								2					2	2			2	
1.4	Empirical formula							2						2		2		2	
1.5	Acids and bases								2					2		2		2	
1.6	Energy diagram		2											2		2		2	
1.7	Acids and bases				2									2		2		2	
1.8	Equilibrium													2		2		2	
1.9	Electrochemistry							2						2		2		2	
1.10	Fertilisers								2					2			2	2	**20**
2.1	Organic compounds	2												2	2			2	
2.2.1	Homologous series							1						1	1			1	
2.2.2	Structural formula							3						3	3			3	
2.3.1	General formula													1	1			1	
2.3.2	Isomers				2									2	2			2	
2.3.3	IUPAC name				3									3	3			3	**12**

Copyright reserved/*Kopiereg voorbehou*

3.1.1	Physical poperties		1											1	1			1	
3.1.2	Physical poperties		1											1	1			1	
3.2.	Physical poperties							4						4	4			4	
3.3.1	Isomers							2						2	2			2	
3.3.2	Isomers				2									2	2			2	
3.3.3	Isomers								1					1	1			1	
3.4	Boiling point											2		2	2			2	**13**
4.1.1	Reaction conditions							2						2	2			2	
4.1.2	IUPAC name				2									2	2			2	
4.2.1	Type of reaction				1									1	1			1	
4.2.2	Type of reaction				1									1	1			1	
4.2.3	Type of reaction				1									1	1			1	
4.3.1	Secondary alcohol				1									3	3			3	
4.3.2	Heating of alcohols				1									1	1			1	
4.4.1	Polymers		1											2	2			2	
4.4.2	Polymers		1											1	1			1	
4.4.3	Monomer					1								1	1			1	**15**
5.1.1	Reaction rate		1											1		1		1	
5.1.2	Reaction rate			1										1		1		1	
5.2.1(a)	Investigative question					2								2		2		2	
5.2.1(b)	Controlled variables							2						2		2		2	
5.2.2	Interpretation of table													1		1		1	
5.2.3	Graph								4					4		4		4	
5.2.4	Reaction rate			1		1			1					1		1		1	
5.2.5	Collision theory							3						3		3		3	
5.2.6	Reaction rate								3					3		3		3	**18**

Copyright reserved/*Kopiereg voorbehou*

6.1	Cosed system		2		1									2		2		2	
6.2	Endo- or exothermic				2				2					2		2		2	
6.3	Equilibrium				2									2		2		2	
6.4	Equilibrium											9		9		9		9	
6.5	Equilibruim		1											1		1		1	**16**
7.1.1	Bronsted-Lowry acid		2											2		2		2	
7.1.2	Monoprotic acid					2								2		2		2	
7.1.3	Weak/strong acid					2								2		2		2	
7.1.4(a)	Concentration of hydronium ions							3						3		3		3	
7.1.4(b)	Calculation of pH							3						3		3		3	
7.2.1	Hydrolysis							3						3		3		3	
7.2.2	Conjugate acid		1											1		1		1	
7.2.3	Concentration calculation											6		6		6		6	**22**
8.1	Type of Electrochemical cell		1											1		1		1	
8.2.1	Oxidation half-reaction					2								2		2		2	
8.2.2	Electron flow					1								1		1		1	
8.2.3	Cell notation									3				3		3		3	
8.3	Calculating emf									4				4		4		4	
8.4	Electrochemical cells					2								2		2		2	
8.5	Electrochemical cells		1											1		1		1	**14**
9.1	Electrlysis					2								2			2	2	
9.2.1	Half-cell reaction					2								2			2	2	
9.2.2	Electrochemistry					1								1			1	1	
9.2.3	Overall reaction					3								3			3	3	**8**

Copyright reserved/*Kopiereg voorbehou*

10.1.1	Haber	1											1			1	1	
10.1.2	Catalyst					1							1			1	1	
10.1.3	Fertilisers					3							3			3	3	
10.1.4	Formulae of fertilisers					2							2			2	2	
10.2.1	Fertilisers					2							2			2	2	
10.2.2	Fertilisers					3							3			3	3	**12**
		5	**17**	**2**	**21**	**25**	**9**	**21**	**19**	**17**	**0**	**14**	**0**	**150**	**40**	**70**	**20**		**150**
		24			**55**			**57**			**14**			**150**	**50**	**84**	**16**		
		16,0%			36,7%			38,0%			9,3%				33,3	56,0	10,7		
		15%			**40%**			**35%**			**10%**				**48%**	**84%**	**18%**		

Overall

E	**M**	**D**
36	66	43
27,3%	44%	28,7%
30	**40**	**30**

Copyright reserved/*Kopiereg voorbehou*