Education and Sport Development

Department of Education and Sport Development
Departement van Onderwys en Sportontwikkeling
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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.

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]

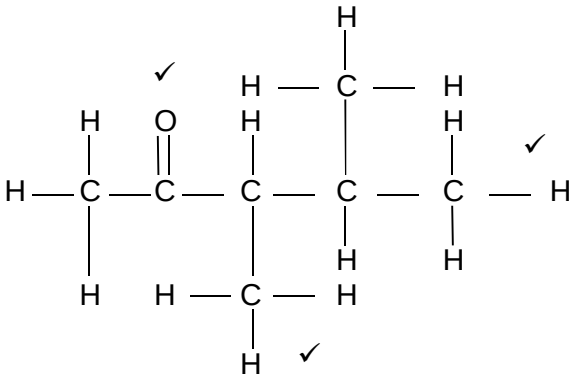
QUESTION 2/*VRAAG 2*

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



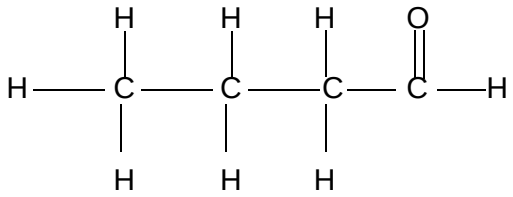
Marking criteria:

- 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).

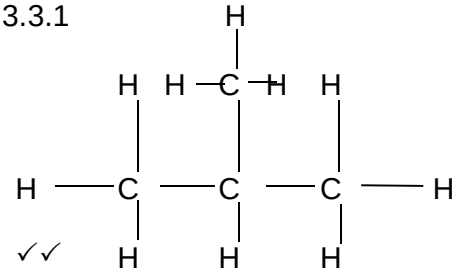
OR/OF

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)

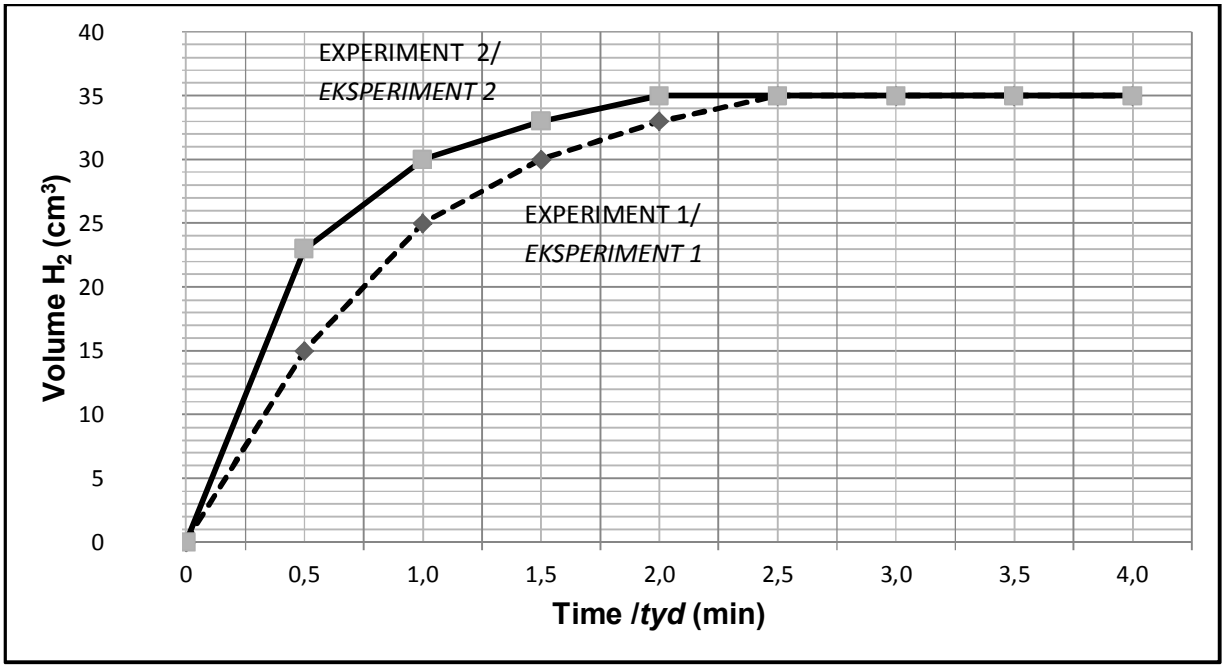
Marking guideline/*Nasienriglyne*	
Dependent and independent variables correctly identified. *Afhanklike en onafhanklie veranderlikes korrek geïentifiseer.*	✓
Relationship between variables in question form. *Verwantskap tussen veranderlikes in vraagvorm.*	✓

- 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**

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**

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**

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**