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

PROVINCIAL MID YEAR EXAMINATIONS
PROVINSIALE HALFJAAR EKSAMENS

GRADE 12
GRAAD 12

PHYSICAL SCIENCES /FISIESE WETENSKAPPE:
CHEMISTRY (P2) / CHEMIE (V2)
MAY / JUNE 2018
MEI/JUNIE 2018
MEMORANDUM

MARKS / PUNTE: 150

TIME / TYD: 3 hours / ure

This memorandum consists of 13 pages.

Hierdie memorandum bestaan uit 13 bladsye.

GENERAL GUIDELINES

1. **CALCULATIONS**

1.1 **Award marks** for: correct formula, correct substitution and correct answer with unit.

1.2 **Do not award any marks** if **an incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.

1.3 When an error is made during substitution into a correct formula, award a mark for the correct formula and for the correct substitutions, but do **not** give **any further marks**.

1.4 If **no formula** is given, but all substitutions are correct, the candidate forfeits **one mark**.
Example:

No K_c expression, correct substitution:

$$K_c = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark \qquad (\frac{2}{3})$$

1.5 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer is given.

1.6 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.

1.7 All calculations, when not specified in the question, must be done correctly to TWO decimal places.

2. **DEFINITIONS**

Award TWO marks for a correct definition. Do not award any marks for an incorrect or partially correct definition.

3. **UNITS**

3.1 Candidates must be penalised only once for the repeated use of an incorrect unit **within a question or subquestion.**

3.2 Units are only required in the final answer of a calculation.

3.3 Award marks for an answer only and not for a unit *per se*. Candidates forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

3.4 Separate compound units with a multiplication dot, not a full stop, for example, mol·dm^{-3}. Accept mol.dm^{-3} (or mol/dm^3) for marking purposes.

4. GENERAL

4.1 If one answer or calculation is required, but the candidate gives two, mark only the first one, irrespective of which one is correct. If two answers are required, mark only the first two, etc.

4.2 When a chemical **FORMULA** is asked, and the **NAME** is given as answer, the candidate forfeits the marks. The same rule applies when the **NAME** is asked and the **FORMULA is** given.

4.3 When redox half-reactions are to be written, the correct arrow should be used. If the equation

$$H_2S \rightarrow S + 2\,H^+ + 2e^- \quad (2/2)$$

is the correct answer, the marks must be given as follows:

$H_2S \rightleftharpoons S + 2\,H^+ + 2e^-$ $(1/2)$

$H_2S \leftarrow S + 2\,H^+ + 2e^-$ $(0/2)$

$S + 2H^+ + 2e^- \leftarrow H_2S$ $(2/2)$

$S + 2H^+ + 2e^- \rightleftharpoons H_2S$ $(0/2)$

4.4 When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, do not accept the following:

- Stating the position of a substance on table 4 only. (e.g. Cu is above Mg).
- Using relative reactivity only (e.g. Mg is more reactive than Cu).
- The correct answer would be for instance: Mg is a stronger reducing agent than Cu and therefore Mg will be able to reduce Cu^{2+} ions to Cu. The answer can also be given in terms of the relative strength as electron acceptors and donors.

4.5 One mark is forfeited when the charge of an ion is omitted per equation.

4.6 The error carrying principle does not apply to chemical equations or half reactions. For example, if a learner writes the wrong oxidation/reaction half-reaction in the subquestion and carries the answer to another sub-question (balancing of equations or calculation of E^{θ}_{cell}) then the learner must not be credited for this substitution.

4.7 In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks must be deducted if hydrogen atoms are omitted.

4.8 When a structural formula is asked, marks must be deducted if the learner writes the condensed formula.

4.9 When an IUPAC name is asked and the candidate omits the hyphen (e.g. instead of pent-1-ene or 1-pentene the candidate writes pent 1 ene or 1 pentene), marks must be forfeited.

4.10 When a chemical reaction is asked, marks are awarded for correct reactants, correct products and correct balancing.
If only a reactant(s) followed by an arrow, or only a product(s) preceded by an arrow is/are written, marks may be awarded for the reactant(s) or product(s). If only a reactant(s) or only a product(s) is written without an arrow, no marks are awarded for the reactant(s) or product(s).

Example: $N_2 + 3H_2$✓ $\longrightarrow$ $2NH_3$✓ bal. ✓

$N_2 + 3H_2 \longrightarrow$✓	1/3
$\longrightarrow NH_3$✓	1/3
$N_2 + 3H_2$	0/3
NH_3	0/3

5. POSITIVE MARKING

Positive marking regarding calculations is followed in the following cases:

5.1 **Subquestion to subquestion**: When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, full marks must be awarded for the subsequent subquestions.

5.2 **A multi-step question in a subquestion**: if the candidate has to calculate, for example, the number of moles in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer is forfeited.

5.3 If the final answer of a calculation is correct, full marks are not automatically awarded. Markers must always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.

QUESTION 1 / VRAAG 1

1.1 B ✓✓

1.2 C ✓✓

1.3 C ✓✓

1.4 C ✓✓

1.5 C ✓✓

1.6 A ✓✓

1.7 A ✓✓

1.8 B ✓✓

1.9 C ✓✓

1.10 C ✓✓

[20]

QUESTION 2 / VRAAG 2

2.1.1 A and /*en* G ✓ (1)

2.1.2 D ✓ (1)

2.1.3 F ✓ (1)

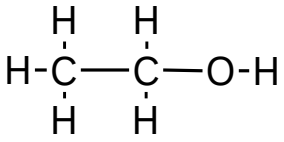
2.2.1 2-methylbut-2-ene ✓✓ / *2-metielbut-2-een* (2)

2.2.2 haloalkanes /alkyl halide✓ / *haloalkaan / alkielhalied* (1)

2.2.3 $2C_2H_2$ + $5O_2$ (excess) ✓ → 4 CO_2 + $2H_2O$✓ (balance ✓) (3)
(*oormaat*) (*balanseer*)

Ethyl methanoate ✓✓ / *etielmetanoaat* (2)

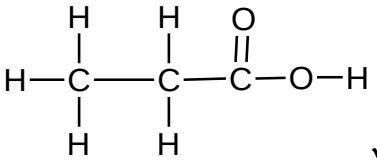
2.3.2



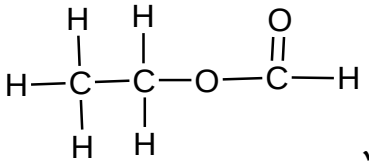
✓✓ (2)

2.3.3 Methanoic acid ✓ / *metanoësuur* (1)

2.4 Compounds with the same molecular formula✓ / *verbindings met dieselfde molekulêre formule* ($C_5H_{10}O_2$ OR $C_5O_2H_{10}$)
but different functional groups and structure✓. / *maar verskillende funksionele groepe en structure*



✓



✓ (4)

[18]

QUESTION 3 / VRAAG 3

3.1 The temperature at which the vapour pressure of a substance is equal to the atmospheric pressure. ✓✓ (2)
Die temperatuur waar die dampdruk van 'n stof gelyk is aan die atmosferiese druk

3.2.1 Type of functional group (type of homologous series or compound) ✓ (1)
Tipe funksionele groep (homoloë reeks of verbinding)

3.2.2 Boiling point ✓ / *kook punt* (1)

3.3 What is the relation between the functional group (type of homologous series or compound) and the boiling point of a substance? ✓✓ (2)
Wat is die verband tussen die funksionele groep (tipe homoloë reeks of verbinding) en die kookpunt van 'n stof?

3.4 Act as a controlled variable that will not have an effect on the boiling points of those compounds ✓ (1)
Tree op soos 'n gekontroleerde veranderlike wat nie 'n effek op die kookpunte van die verbindings het nie.

3.5 Between molecules of hexane (E) there are only weak London forces. ✓

Between molecules of pentan-1-ol (A) there are stronger hydrogen Bonds as there is one site of bonding in addition to weak London forces. ✓

Between molecules of butanoic acid (C) there are very strong hydrogen bonds as it has two sites of hydrogen bonding in addition to the weak London forces. ✓

Much more energy is required to break (overcome) intermolecular forces in C than in A which is in turn more than the energy required in E. ✓

(4)

Daar is slegs swak London kragte tussen heksaan (E) molekules. ✓

Daar is sterker waterstof bindings agv 'n enkel waterstof binding sowel as swak London kragte tussen pentan-1-ol (A) molekules. ✓

Daar is sterker waterstof bindings tussen molekules van butanoësuur omdat daar twee / dubbel waterstofbindings vorm sowel as swak London kragte ✓

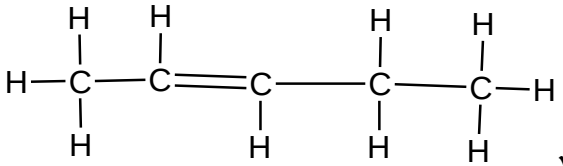
Baie meer energie is nodig om die intermolekulêre kragte in C te breek (oorkom) as in A; wat weer meer is as die enrgie benodig in E. ✓

[11]

QUESTION 4 / VRAAG 4

4.1.1 Heat ✓ / *Hitte* (1)

4.1.2 Elimination / Dehydrohalogenation ✓/ *Eliminasie / dehidrohlogenering* (1)

4.1.3  ✓✓ (2)

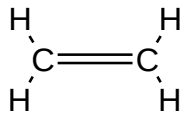
4.1.4 Water or dilute sodium hydroxide✓
Water of verdunde natrium hidroksied (1)

4.1.5 Substitution / hydrolysis ✓ / *Substitusie / hidrolise* (1)

4.1.6 Elimination /dehydration✓ / *Eliminasie / dehidrasie* (1)

4.2.1 Esterification✓ / *Esterifikasie* (1)

4.2.2 Sulphuric acid / H_2SO_4✓ / *swaelsuur* / H_2SO_4 (1)

4.3.1  ✓✓ (2)

4.3.2 Addition ✓ / *addisie* (1)

[12]

QUESTION 5 / VRAAG 5

5.1.1 Surface area /state of division/reaction surface ✓ (1)
Oppervlak / verdeeldheid / reaksie oppervlak

5.1.2 <u>There are more particles</u> available for reaction. ✓ / <u>more collisions</u>.
There are a <u>greater number of effective collisions</u> ✓ <u>per unit of time</u>✓
Therefore it increases. (3)
<u>Daar is meer deeltjies</u> besksikbaar vir reaksie ✓/ <u>meer botsings</u>
Daar is 'n <u>groter aantal effektiewe botsings</u> ✓<u>per tydseenheid</u> ✓
Daarom neem dit toe

5.1.3 Mass of / *massa van*15% of original / van *oorspronklike* 2g =0,3g ✓
Number of moles of / *aantal mol van* $CaCO_3$ 0,3g:

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

$= \frac{0,3}{100}$ ✓

$= 0,003$ mol

$nCaCO_3 : nHC\ell$ ✓ for both equations. / *vir albei formules*
1 : 2

0,003 : 0,006 ✓

$C_{HC\ell} = \frac{n}{V}$

$0,2 = \frac{0,006}{V}$

$V = 0,03\ dm^3$ ✓ (5)

5.2.1 Concentration ✓ / *konsentrasie* (1)

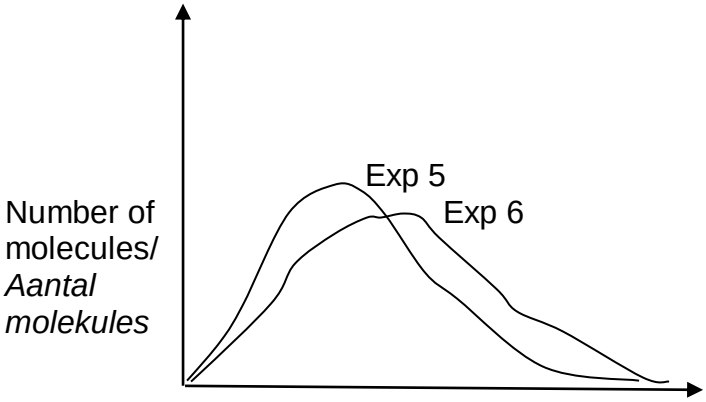
5.2.2 Equal to ✓ / *gelyk aan* (1)

5.2.3 The <u>same number of moles/mass/ number of particles</u> of $CaCO_3$ ✓
(produce <u>same number of moles of carbon dioxide</u>).
$CaCO_3$ is the limiting agent/Acid is in excess (1)
<u>Dieselfde aantal mol/massa/aantal deeltjies</u> van $CaCO_3$ ✓
(produseer dieselfde <u>aantal mol koostof dioksied</u>)

$CaCO_3$ is die beperkte reaktans/die suur is in oormaat

5.3.1 (Experiment / *eksperiment*) 6✓ (1)

5.3.2



Criteria for graph K / *Kriteria vir grafiek*	Mark/ *Punt*
Correct shape for both graphs/ *korrekte vorm vir beide grafieke*	✓
Graph of experiment 5 reaches a higher maximum/peak value than experiment 6 / *Grafiek vir eksp 5 bereik 'n hoër maksimum/ piek waarde as eksp 6*	✓
Correct/*Korrekte* x and/*en* y-axes/*asse*	✓
Graph of experiment 6 shows more molecules of higher kinetic energy / *Grafiek vir eksp 6 toon meer molekules met hoër kinetiese energie*	✓

If no labels on axes : max ¾ *Asse nie benoem: maks ¾*

(4)

[17]

QUESTION 6 / VRAAG 6

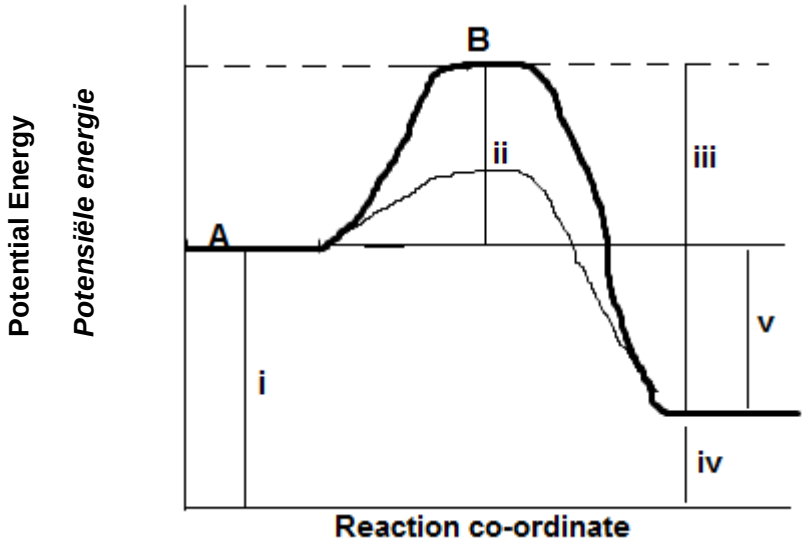
6.1 The amount of energy that is added or removed from a chemical reaction. ✓✓ / Heat energy released / absorbed during a chemical reaction (2)
Die hoeveelheid energie wat bygevoeg of weggeneem word in 'n chemiese reaksie / Hitte energie absorber of afgegee tydens 'n chemiese reaksie

6.2

6.2.1 i - Energy of reactants. ✓ / *Energie van reaktanse*
ii – Activation energy ✓/ *Aktiverings energie*
iii – Energy of product formation✓ / *energie vir produk vorming*
iv – Energy of products✓ / *energie van produkte*
v – Heat of reaction (enthalpy) ✓ / *reaksie warmte (entalpie)* (5)

6.2.2 Exothermic. ✓The energy of the products after the reaction is less than the energy of the reactants before the reaction. ✓ (2)
Eksotermies ✓Die energie van die produkte aan die einde van die reaksie is minder as die enrgie van die reaktanse aan die begin van die reaksie ✓

6.3



(2)

6.4 There is no change in energy (v). ✓ For energy (ii) the catalyst provides an alternative energy path✓ thus lowering the amount of activation energy✓ required for the reaction to proceed. (3)
Daar is geen verandering in energie (v). ✓Die katalisator verskaf 'n alternatiewe pad vir energie (ii) ✓dus word die aktiverings energie verlaag ✓ wat nodig is om die reaksie te voltooi

[14]

QUESTION 7 / VRAAG 7

7.1 It is a reversible reaction, so the forward and reverse reactions will occur at the same rate. ✓✓ (2)
Dit is 'n omkeerbare reaksie, dus sal die voorwaartse en terugwaartse reaksies teen dieselfde tempo plaasvind

7.2 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that oppose the disturbance. ✓✓ (2)
Wanneer die ewewig in 'n ges;ote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die verandering sal teenwerk

7.3 NO_2 is the reactant and N_2O_4 is the product ✓since the $[NO_2]$ decreases✓ and $[N_2O_4]$ increases✓ from the graph. (3)
NO_2 is die reaktans en N_2O_4 is die produk ✓aangesien die $[NO_2]$ afneem ✓ en die $[N_2O_4]$ toeneem ✓vanuit die grafiek

7.4 $2NO_2(g)$ ✓ ⇌ $N_2O_4(g)$ ✓ bal ✓ (3)

7.5 $K_c = \frac{[N_2O_4]}{[NO_2]^2}$ ✓

$= \frac{(0,030)}{(0,015)^2}$ ✓✓

$= 133,33$✓ (4)

7.6 N_2O_4. ✓The / *Die* Kc >1, ✓ thus the ratio of the product to reactant is large. ✓
Die verhouding van die produk tot reaktans is groot (3)
[17]

QUESTION 8 / VRAAG 8

8.1. A solution of precisely known concentration ✓✓**.** (2)
'n Oplossing waarvan die konsentrasie presies bekend is

8.2. $C_2H_2O_4$/ $C_2O_4^{2-}$ ✓✓ and/*en* H_2O/ OH^- ✓✓ (4)

8.3.1. $c = n/V$

$n = cV$ ✓

$= 0,1 \times 0.035$ ✓

$= 0.0035$mol ✓ (3)

8.3.2**.** n (excess/*oormaat*)NaOH = c V

$= 0.012 \times 0,1$✓

$= 0.0012$ mol✓

n (reacted/*reageer*)NaOH = 0.0035-0.0012

$= 0.0023$mol✓

n (oxalic acid reacted/*oksaalsuur reageer)* = ½ (0,0023)

$= 0,00115$ mol✓

c(oxalic acid/*oksaalsuur*) = n/V

= 0,000115/0,04✓

= 0,03mol.dm^{-3} ✓ (6)

8.4 B ✓

The titration is between a strong base and a weak acid. ✓ The solution at the end point will be slightly alkaline✓. Indicator B changes colour in a slightly alkaline medium✓**.** (3)

Die titrasie is tussen 'n sterk basis en swak suur ✓Die oplossing sal by die eindpunt effens alkalies wees ✓ Indikator B verander kleur in 'n effens alkalise medium ✓

8.5 Decreases ✓More moles of NaOH present per volume of solution used✓✓ (3)
Afneem ✓Meer mol NaOH teenwoordig per volume oplossing gebruik ✓✓

[21]

QUESTION 9 / VRAAG 9

9.1 This is the ability of ions to react with water molecules, thus altering the pH of the solution. ✓✓/ When salts completely dissociates in water. (2)

Die vermoë van ione om met water molekules te reageer, en sodoende die pH van die oplossing te verander/ Wanneer soute volledig in water dissosieer.

9.2 Acidic✓ */ suur*
Forms H_3O^+ during hydrolysis. ✓ / *Vorm H_3O^+ tydens hidrolise*
OR/*OF*
Salt of strong acid and weak base / *Sout van 'n sterk suur en swak basis* (2)

9.3

9.3.1 n = Cv ✓
= (0,1) (0,1) ✓
=0,01 mol✓ (3)

9.3.2

OPTION 1/ *OPSIE 1*	OPTION 2/ *OPSIE 2*
[OH-]=[NaOH] = 0,05 mol.dm^3 Kw = $[H_3O^+][OH^-]$ 1x10 $^{-14}$ = $[H_3O^+]$ 0,5✓ Therefore/d*us* $[H_3O^+]$ = 2x10^{-14} mol.dm^{-3} pH=-log$[H^+]$✓ =-log(2x10^{-14}) ✓ =13,7✓	pOH = - log$[OH^-]$✓ = - log(0,5) ✓ = 0,301 pH + pOH =14 pH = 14 – 0,301✓ = 13,7✓

(4)

9.4

Element	**g/100g**	**n = m/M**	**Simplest ratio /** ***Eenvoudigste verhouding***	**Empirical formula/** ***empiriese formule***
N	30,43	30,43/14,0 ✓= 2,17	2,17/2,17= 1✓	NO_2 ✓
O	69,57	69,57/16 = 4,35✓	4,35/2,17= 2✓	

(5)

9.6 The molar mass of the empirical formula NO_2:
Die molêre massa van die empiriese formule NO_2
(14 + 32) $g.mol^{-1}$ = 46 $g.mol^{-1}$

$\frac{92\ g.mol^{-1}}{46\ g.mol^{-1}}$ ✓ = 2 ✓

Molecular formula subscripts = 2 x empirical formula subscripts. ✓
Empirical formula: NO_2
Therefore molecular formula: N_2O_4✓ (4)
Molekulêre formule onderskrifte = 2x empiriese formule onderskrite
Empiriese formule: NO_2
Dus molekulêre formule: N_2O_4

[20]

TOTAL MARKS: [150]
TOTALE PUNTE: [150]

NW DEPARTMENT OF EDUCATION **Physical Sciences Grade 12 Paper 2** **NSC JUNE 2018** **ANALYSIS GRID**

Question No.		Taxonomy													Knowledge area			Marks	
		Knowledge,Recall, Low Demand			COMPREHENSION, Basic Questions			APPLICATION, ANALYSIS, Problem Solving			SYNTHESIS, 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	Homologous series	2												2	2			2	
1.2	Type of reaction		2											2	2			2	
1.3	IUPAC naming				2									2		2		2	
1.4	Homolgous series								2					2		2		2	
1.5	Chemical equilibruim								2					2		2		2	
1.6	Chemical equilibrium					2								2		2		2	
1.7	Acids & bases					2								2		2		2	
1.8	Rates of reaction					2								2		2		2	
1.9	Acids & Bases								2					2		2		2	
1.10	Stoichiometry		2											2			2	2	20
2.1.1	Isomers	1												1	1			1	
2.1.2	Alcohols				1									1	1			1	
2.1.3	Carboxyl				1									1	1			1	
2.2.1	IUPAC naming					2								2	2			2	
2.2.2	Homologous series								1					1	1			1	
2.2.3	Molecular formula				3									3	3			3	

2.3.1	IUPAC naming			2										2	2			2	
2.3.2	Structural formula				2									2	2			2	
2.3.3	IUPAC				2									2	2			2	
2.4	Isomer					1								1	1			1	18
3.1	IMF					2								2	2			2	
3.2	IMF									3				3	3			2	
3.3.1	Variables				1									1	1			1	
3.3.2	Variables				1									1	1			1	
3.4	IMF		1											1	1			1	
3.5	IMF						5							5	5			4	11
4.1.1	Type of reaction				1									1	1			1	
4.1.2	Type of reaction				1									1	1			1	
4.1.3	Type of reaction		2											2	2			2	
4.1.4	Type of reaction	1												1	1			1	
4.1.5	Type of reaction								1					1	1			1	
4.1.6	Type of reaction			1				1						1	1			1	
4.2.1	Type of reaction				1									1	1			1	
4.2.2	Catalyst				1									1	1			1	
4.3.1	Polymer				2									2		2		2	
4.3.2	Polymer				1									1		1		1	12
5.1.1	Reaction rate				1									1		1		1	
5.1.2	Reaction rate					3								3		3		3	
5.1.3	Reaction rate											5		5		5		5	
5.2.1	Reaction rate			1										1		1		1	
5.2.2	Reaction rate				1									1		1		1	
5.2.3	Reaction rate									1				1		1		1	17

5.3.1	Reaction rate	1												1		1		1	
5.3.2	Reaction rate						4							4		4		4	17
6.1	Energy diagram	2												2		2		2	
6.2.1	Energy diagram	5												5		5		5	
6.2.2	Energy diagram								2					2		2		2	
6.3	Energy diagram		2											2		2		2	
6.4	Energy diagram					3								3		3		3	14
7.1	Equilibruim					2								2		2		2	
7.2	Equilibruim				2									2		2		2	
7.3	Equilibruim								3					3		3		3	
7.4	Balancing equation									3				3		3		3	
7.5	Kc									4				4		4		4	
7.6	Equilibruim		3											3		3		3	17
8.1	Titration	2												2		2		2	
8.2	Acids & bases							4						4		4		4	
8.3.1	Titration								3					3		3		3	
8.3.2	Titration								6					6		6		6	
8.4	Acids & bases								2					2		2		2	
8.5	Titration	4												4			4	4	21
9.1	Hydrolysis							2						2			2	2	
9.2	Acids & bases								2					2			2	2	
9.3.1	Acids & bases							3						3			3	3	
9.3.2	Acids & bases							4						4			4	4	
9.4	Stoichiometry		5											1			1	1	
9.5	Stoichiometry					4								4			4	4	20

		11	14	0	22	22	5	9	30	23	0	0	14	150				150
		25			**49**			**62**			**14**			**150**	**48**	**85**	**17**	
		16,6%			32.0%			42.0%			9,3%				32.0	56.7	11.3	
		15%			**35%**			**40%**			**10%**				**32 %**	**56 %**	**12 %**	

Overall

E	M	D
42	66	43
27,3%	44%	28,7%
30	**40**	**30**