Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2017

PHYSICAL SCIENCES P2

MARKS: **150**

TIME: **3 hours**

This question paper consists of 20 pages, including data sheets.

INSTRUCTIONS AND INFORMATION

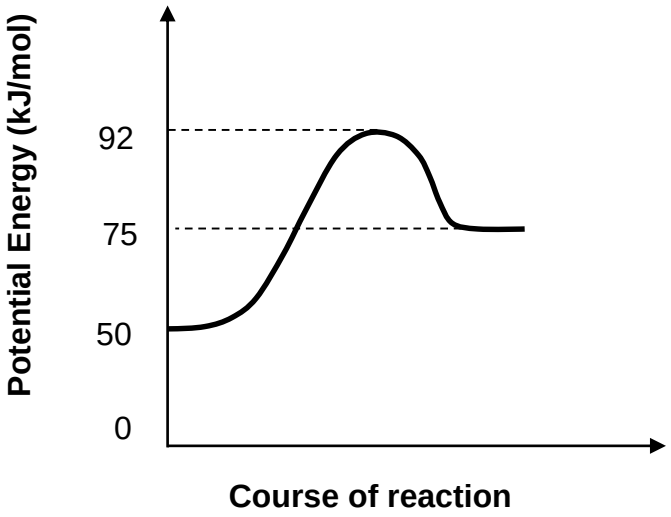
1. Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number your answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the correct letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for e.g. 1.11 E.

1.1 A potential energy diagram for a hypothetical reaction is given below:

$X_2(g) \longrightarrow 2\ X(g)$



The ΔH for the reaction in kJ/mol is …

A 17.
B -17.
C 25.
D -25. (2)

1.2 Which pair of compounds represents UNSATURATED hydrocarbons?

A Alkenes and Alkynes
B Alkanes and Alkynes
C Alkanes and Alkenes
D Alcohols and Alkenes (2)

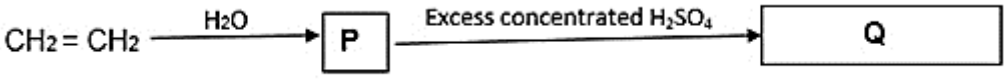
1.3 An atom, group of atoms or a bond that gives a group of organic compounds its characteristic physical and chemical properties is called a …

A polymer.
B monomer.
C functional group.
D homologous series. (2)

1.4 Which ONE of the following statements is always TRUE about the relationship between strength of intermolecular forces and boiling point?

A Boiling point is directly proportional to the strength of intermolecular forces.
B As the strength of intermolecular forces increases boiling point increases.
C As the strength of intermolecular forces increases boiling point decreases.
D As the strength of intermolecular forces increases the boiling point is not affected. (2)

1.5 In the flow diagram below, **P** and **Q** represent two organic compounds.



Which ONE of the following is the CORRECT condensed molecular formula for compound **Q**?

A CH_2CH_2
B CH_3CH_3
C CH_3CH_2Br
D CH_3CH_2OH (2)

1.6 In a homogeneous reaction the reactants and products are always …

A gases.
B liquids.
C solids.
D in the same phase. (2)

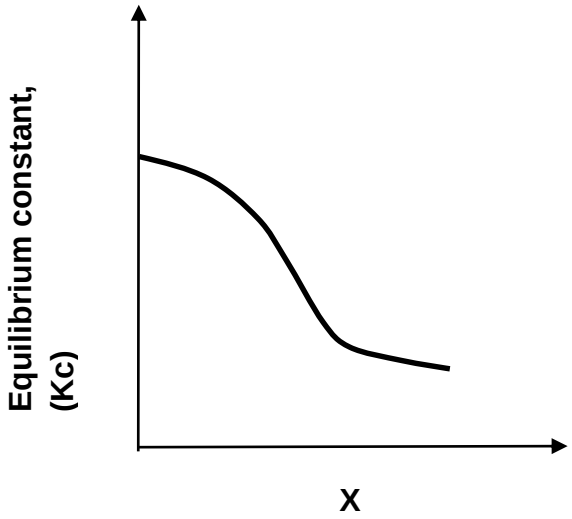
1.7 Which ONE of the following changes will NOT INFLUENCE the rate at which oxygen is produced?

$$2\ H_2O_2\ (aq) \longrightarrow 2\ H_2O(\ell) + O_2(g)$$

A Increase pressure
B Increase temperature
C Add a suitable catalyst
D Increase the concentration of H_2O_2 (2)

1.8 The following graph shows the relationship between the equilibrium constant Kc and the quantity **X** for the hypothetical reaction:

$$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$$



What quantity is represented by **X** on the horizontal axis?

A Mass
B Pressure
C Temperature
D Concentration (2)

1.9 A strong acid is titrated with a base. The dissociation constant for the base, K_b is $2,8 \times 10^{-6}$ at 25 °C.

Which ONE of the following indicators is most suitable for the titration?

Indicator	**pH range over which indicator changes colour**
A	4,2 to 6,2
B	6,0 to 7,6
C	8,0 to 9,6
D	10,0 to 12

(2)

1.10 Chromate (yellow solution) and dichromate ions (orange solution) are in equilibrium with each other in an aqueous solution according to the following balanced equation:

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(\ell)$$

Yellow Orange

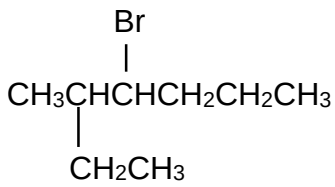
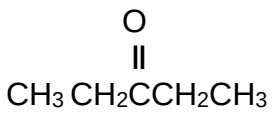
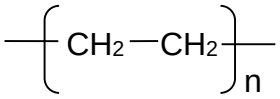
What ONE of the following changes should be made to change the colour of the solution to orange?

A Add more H_2O
B Lower the pH
C Increase the pH
D Increase $[Cr_2O_7^{2-}]$ (2)

[20]

QUESTION 2

The letters **A** to **H** in the table represent eight organic compounds:

A		**B**	
C	$C_4H_{10}O$	**D**	Methyl ethanoate
E	2,3-dimethylbutane	**F**	
G	Ethanoic acid	**H**	C_nH_{2n}

2.1 Write down the letter that represents a compound that is:

2.1.1 A proton donor (1)

2.1.2 A large molecule composed of small monomer units covalently bonded in a repeating pattern (1)

2.2 Write down the:

2.2.1 GENERAL FORMULA of the homologous series to which compound **E** belongs (1)

2.2.2 NAME of the functional group found in compound **G** (1)

2.2.3 EMPIRICAL FORMULA of compound **H** (1)

2.3 Write down the IUPAC name of:

2.3.1 Compound **A** (3)

2.3.2 Compound **B** (2)

2.3.3 A FUNCTIONAL ISOMER of compound **G** (2)

2.4 Write down the STRUCTURAL FORMULA of compound **E**. (2)

2.5 Compound **D** is prepared from the reaction of a carboxylic acid and an alcohol in the presence of an inorganic acid catalyst. A water bath is used to heat the reaction mixture.

Write down the:

2.5.1 NAME or FORMULA of the inorganic acid catalyst (1)

2.5.2 STRUCTURAL FORMULA of compound **D** (2)

2.5.3 Property of alcohols that make it necessary to use a water bath to heat the reaction mixture instead of direct heat (1)

2.6 Compound **C** is a TERTIARY alcohol.

Write down the STRUCTURAL FORMULA and IUPAC name of compound **C**. (4)

2.7 Write down the MOLECULAR FORMULAE of the TWO products formed during the complete combustion of compound **E**. (2)

[24]

QUESTION 3

Learners use alcohols **A** to **C** to investigate a factor that influences boiling points of alcohols.

3.1 Define the term *boiling point*. (2)

Compounds	Alcohols
A	CH_3OH
B	CH_3CH_2OH
C	$CH_3CH_2CH_2OH$

3.2 For this investigation write down the:

3.2.1 Independent variable (1)

3.2.2 Apparatus used to measure the boiling point (1)

3.3 Which ONE of the three compounds will have the HIGHEST boiling point? (1)

3.4 Explain your answer to QUESTION 3.3. (3)

3.5 The learners now compare the boiling points of compounds **D** and **E**, shown in the table below. Compounds **D** and **E** belong to different homologous series.

	Compounds	Boiling point (°C)
D	Ethanol	78,1
E	Ethanal	20,2

3.5.1 Define the term *homologous series*. (2)

3.5.2 Explain fully why the boiling point of compound **D** is HIGHER than that of compound **E**. (4)

3.5.3 Which ONE of the compounds **D** or **E** will have a HIGHER vapour pressure? Use information from the table to give a reason. (2)

[16]

QUESTION 4

The flow diagram below shows three organic reactions that involve the compound 2-bromobutane.

Reaction A: Alkane + **Y** ⟶ 2-bromobutane + HBr

Reaction B: 2-bromobutane + KOH ⟶ Compound **X** + KBr + H_2O

Reaction C: 2-bromobutane + KOH ⟶ Alcohol + KBr

4.1 Write down the type of reaction represented by:

4.1.1 Reaction **A** (1)

4.1.2 Reaction **B** (1)

4.2 For reaction **A**, write down the:

4.2.1 NAME or FORMULA of the inorganic reagent **Y** (1)

4.2.2 One reaction condition needed for the reaction to take place (1)

4.2.3 IUPAC name of the alkane (2)

4.3 Write down the STRUCTURAL FORMULA of compound **X** the major organic product produced in reaction **B.** (2)

4.4 Write down the STRUCTURAL formula of the alcohol produced in reaction **C**. (2)

4.5 In both reactions **B** and **C** the same inorganic reagent KOH is used. Write down TWO reaction conditions that will favour reaction **C** over reaction **B**. (2)

[12]

QUESTION 5

A group of learners uses the reaction of hydrochloric acid with magnesium ribbon to investigate the factors that influence rate of reaction. The balanced equation for the reaction is given below:

$$Mg(s) + 2\,HC\ell\,(aq) \longrightarrow MgC\ell_2(aq) + H_2(g)$$

The hydrochloric acid is in EXCESS and the same mass of magnesium is used in ALL the experiments.

Experiment	REACTION CONDITIONS			
	Concentration of $HC\ell$ (aq) ($mol.dm^{-3}$)	Temperature (°C)		State of division of 0,24 g Magnesium
		Before	After	
1	2	35	57	powder
2	2	30	48	ribbon
3	2	20	33	ribbon
4	1,5	30	45	ribbon

5.1 Define *reaction rate*. (2)

5.2 In which experiment is the reaction rate HIGHEST? Give TWO reasons. (3)

5.3 The reaction in **Experiment 2** is compared to the reaction in **Experiment 4.**

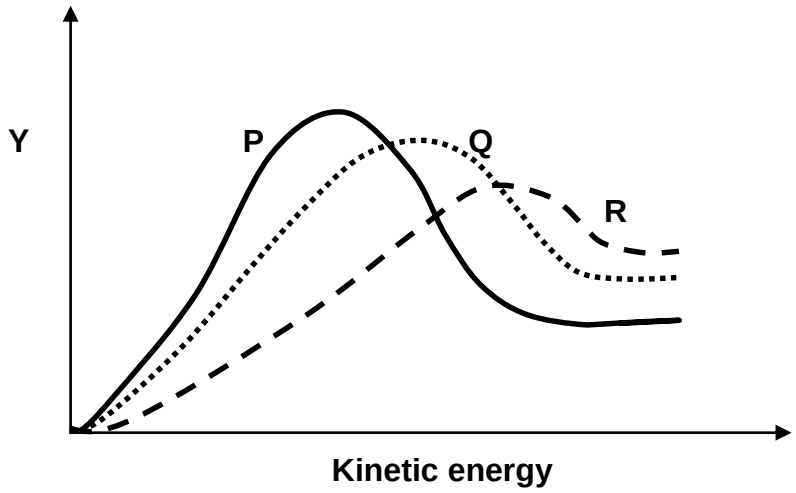
5.3.1 Write down ONE control variable for this comparison. (1)

5.3.2 How does the amount of hydrogen gas produced in **Experiment 2** compare to the amount produced in **Experiment 4** if the same volume of acid is used in both experiments?
Write down only HIGHER THAN, SMALLER THAN or EQUAL TO.
Give a reason for your answer. (2)

5.4 Give a reason why it is not a fair test to compare the rate of reaction of **Experiment 1** with that of **Experiment 3**. (1)

5.5 Calculate the mass of hydrochloric acid that remains in the flask at the completion of the reaction in **Experiment** 1 if the initial volume of the hydrochloric acid is 80 cm^3. (7)

5.6 The Maxwell-Boltzman distribution curves labelled **P**, **Q** and **R** for the reactions in experiments 1, 2 and 3 in random order are shown below.



5.6.1 Write down the name of the label, **Y,** on the vertical axis. (1)

5.6.2 Which curve (**Q**, **P** or **R**) represents the results of **Experiment 3**? (1)

5.6.3 With the aid of the collision theory explain the effect of temperature on reaction rate. (4)
[22]

QUESTION 6

The following reaction reaches chemical equilibrium in a sealed container at 70 °C.

$$N_2O_4\,(g) \quad \rightleftharpoons \quad 2\,NO_2\,(g)$$

6.1 Define the term *chemical equilibrium*. (2)

6.2 What effect will the following changes have on the number of moles of NO_2 at equilibrium?

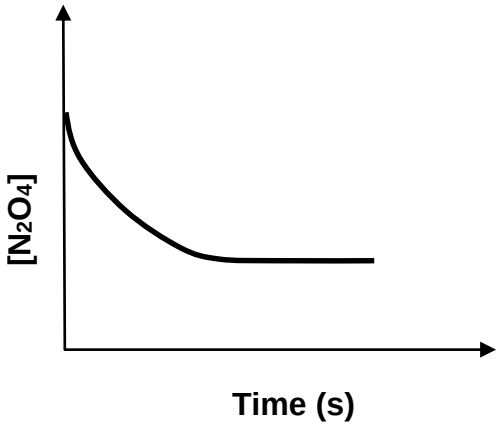
Write down only INCREASES, DECREASES or REMAINS UNCHANGED.

6.2.1 Adding more N_2O_4 into the container. (1)

6.2.2 Increasing the pressure by decreasing the volume. (1)

6.3 Explain the answer to QUESTION 6.2.2 above by referring to Le Chatelier's principle. (3)

6.4 The following graph shows the changes in the concentration of N_2O_4 against time.



Redraw the graph on the same set of axes use a dotted line to sketch a graph that would be obtained when a catalyst is added to the reaction mixture at the start of the reaction. (2)

6.5 The table below gives the equilibrium constant values Kc for the reaction at different temperatures.

Temperature (°C)	**K_c**
23	8,03
70	0,32
100	0,067

6.5.1 At which temperature is the yield of NO_2 highest? Give a reason. (2)

6.5.2 When the reaction establishes equilibrium at 70 °C it is found that the concentration of N_2O_4 in the equilibrium mixture is 0,5 mol.dm^{-3}. Calculate the initial concentration of N_2O_4. (7)

6.5.3 Is the forward reaction ENDOTHERMIC or EXOTHERMIC? With the aid of information from the table and Le Chateliers' principle, fully explain the answer. (4)

[22]

QUESTION 7

7.1 Ethanoic acid is a monoprotic acid that ionises in water according to the equation.

$CH_3COOH(\ell) + H_2O(\ell) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$ $K_a = 1,8 \times 10^{-5}$ at 25 ºC

7.1.1 Define the term *monoprotic acid*. (2)

7.1.2 Write down the NAME or FORMULA of the conjugate base of ethanoic acid. (1)

7.1.3 Is ethanoic acid a STRONG or WEAK acid?
Refer to the given information to give a reason. (2)

7.2 A sodium hydroxide solution (NaOH) has a concentration of 1×10^{-5} mol.dm^{-3}.

Calculate the:

7.2.1 pH of the solution (4)

7.2.2 Volume to which 10 cm^3 of the sodium hydroxide solution must be diluted to obtain a solution with a concentration of 1×10^{-6} mol.dm^{-3} (3)

7.3 A certain compound has sodium carbonate (Na_2CO_3) as the main ingredient. To determine the amount of sodium carbonate present in a sample of the compound 100 cm^3 of a 0,8 mol.dm^{-3} solution of sulphuric acid was added to the sample in a flask.

The sulphuric acid solution is in EXCESS.
The equation below shows the reaction taking place in the flask.

$Na_2CO_3(s) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + CO_2(g) + H_2O(\ell)$ **Reaction 1**

7.3.1 Calculate the amount in moles of sulphuric acid added to the flask. (3)

*In a titration exactly 35 cm^3 of a 0,3 mol.dm^{-3} potassium hydroxide solution neutralises the excess amount of sulphuric acid left over in **Reaction 1** according to the balanced equation shown below*.

$2\ KOH(aq) + H_2SO_4(aq) \longrightarrow K_2SO_4(aq) + 2\ H_2O(\ell)$ **Reaction 2**

7.3.2 Calculate the mass of sodium carbonate present in the sample. (8)

7.4 Write down a balanced equation for the hydrolysis of sodium carbonate (Na_2CO_3). (3)

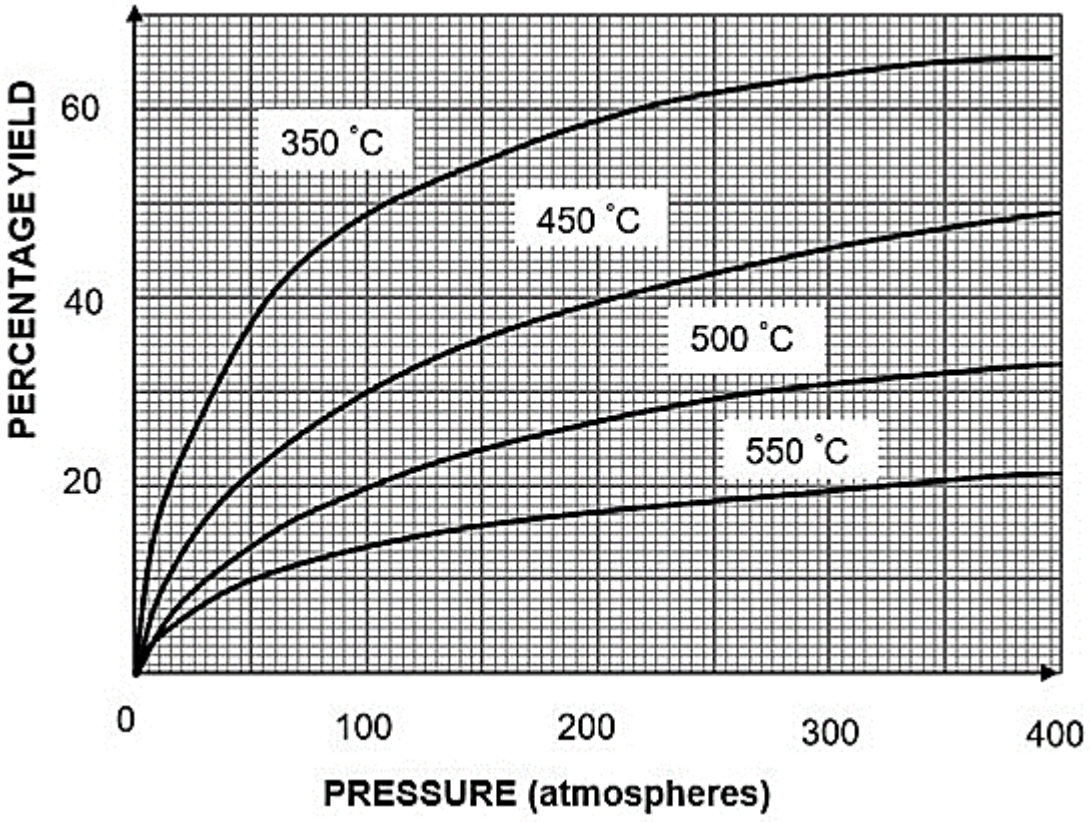
[26]

QUESTION 8

The graph of percentage yield of NH_3, produced in the reaction given below, versus pressure at different temperatures is shown below.

$$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$$

GRAPH OF PERCENTAGE YIELD AT DIFFERENT TEMPERATURES VERSUS PRESSURE



8.1 Write down:

8.1.1 In words the relationship between temperature and percentage yield at constant pressure for this reaction (2)

8.1.2 The percentage yield at a temperature of 350 °C and a pressure of 100 atmospheres (1)

8.1.3 The pressure at which the percentage yield is 40% at 450 °C (1)

8.2 Exactly 112 grams of nitrogen gas was allowed to react with hydrogen gas in a closed container. The reaction reached equilibrium at a temperature of 350 °C and a pressure of 200 atmospheres.

Calculate the actual yield (in moles) of NH_3. (4)
[8]

TOTAL: 100

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAAM/*NAME*	SIMBOOL/*SYMBOL*	WAARDE/*VALUE*
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume teen STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron Lading op elektron	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant Avogadro se konstante	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_o}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at /by 298K

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$

$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2.0 5 B 11	2.5 6 C 12	3.0 7 N 14	3.5 8 O 16	4.0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1.5 13 Aℓ 27	1.8 14 Si 28	2.1 15 P 31	2.5 16 S 32	3.0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1.6 31 Ga 70	1.8 32 Ge 73	2.0 33 As 75	2.4 34 Se 79	2.8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1.7 49 In 115	1.8 50 Sn 119	1.9 51 Sb 122	2.1 52 Te 128	2.5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	1.8 81 Tℓ 204	1.8 82 Pb 207	1.9 83 Bi 209	2.0 84 Po	2.5 85 At	86 Rn
0,7 87 Fr	0,9 88 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

KEY/ *SLEUTEL*

Atoomgetal

Atomic number

29

Elektronegatiwiteit / Electronegativity

1,9 Cu

Simbool / Symbol

Benaderde relatiewe atoommassa

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD REDUKSIEPOTENSIALE

Half-reactions/*Halfreaksies*			E^{θ} (V)
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	– 0,06
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	– 0,13
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	– 0,14
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	– 0,27
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	– 0,28
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	– 0,40
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	– 0,41
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	– 0,44
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	– 0,74
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	– 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	– 0,83
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	– 0,91
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	– 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	– 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	– 2,36
$Na^+ + e^-$	$\rightleftharpoons$	Na	– 2,71
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	– 2,87
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	– 2,89
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	– 2,90
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	- 2,92
$K^+ + e^-$	$\rightleftharpoons$	K	– 2,93
$Li^+ + e^-$	$\rightleftharpoons$	Li	– 3,05

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

Half-reactions/*Halfreaksies*			E^{θ} **(V)**
$Li^+ + e^-$	$\rightleftharpoons$	Li	− 3,05
$K^+ + e^-$	$\rightleftharpoons$	K	− 2,93
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	− 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	− 2,90
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	− 2,89
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	− 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	− 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,36
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,91
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	− 0,74
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	− 0,44
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	− 0,40
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	− 0,28
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	− 0,27
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	− 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	− 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	− 0,06
$2H^+ + 2e^-$	**$\rightleftharpoons$**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+1,77
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE/*GRAAD* 12

JUNE COMMON PAPER 2017

PHYSICAL SCIENCES P2/ *FISIESE WETENSKAPPE V2* MEMORANDUM

MARKS: 150

This memorandum consists of 19 pages./
Hierdie memorandum bestaan uit 19 bladsye.

GUIDELINES FOR MARKING/*RIGLYNE VIR NASIEN*

This section provides guidelines for the way in which marks will be allocated. The broad principles must be adhered to in the marking of Physical Sciences tests and examinations.

Hierdie afdeling verskaf riglyne vir die manier waarop punte toegeken sal word. Die breë beginsels moet tydens die nasien van Fisiese Wetenskappe toetse en eksamens gevolg word.

1.1 MARK ALLOCATION/*PUNTETOEKENNING*

1.1.1 **Definitions/*Definisies*:** Two marks will be awarded for a correct definition. No marks will be awarded for an incorrect or partially correct definition. *Twee punte sal vir 'n korrekte definisie toegeken word. Geen punte sal vir 'n verkeerde of gedeeltelik korrekte definisie toegeken word nie.*

1.1.2 **Calculations/*Berekeninge*:**

- Marks will awarded for: correct formula, correct substitution, correct answer with unit.
  Punte sal toegeken word vir: korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.
- No marks will be awarded if an incorrect or inappropriate formula is used, even though there may be relevant symbols and applicable substitutions.
  Geen punte sal toegeken word waar 'n verkeerde of ontoepaslike formule gebruik word nie, selfs al is daar relevante simbole en relevante substitusies.

1.1.3 **Explanations and interpretations/Verduidelikings en interpretasie:** Allocation of marks to questions requiring interpretation or explanation e.g. AS 1.4, 2.2, 2.3, 3.1, 3.2 and 3.3, will differ and may include the use of rubrics, checklists, memoranda, etc. In all such answers emphasis must be placed on scientific concepts relating to the question.
Toekenning van punte by vrae wat interpretasie of verduideliking vereis bv. AS 1.4, 2.2, 2.3, 3.1, 3.2 en 3.3, sal verskil en mag die gebruik van rubrieke, kontrolelyste, memoranda, ens. insluit. By al hierdie antwoorde moet die beklemtoning op die wetenskaplike konsepte, met betrekking tot die vraag, val.

1.2 FORMULAE AND SUBSTITUTIONS/*FORMULES EN SUBSTITUSIE*

1.2.1 Mathematical manipulations and change of subjects of appropriate formulae carry no marks, but if a candidate starts with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulering en verandering van die voorwerp van toepaslike formules dra geen punte nie, maar as 'n kandidaat begin met die korrekte formule en dan die voorwerp van die formule verkeerd uitwerk, sal punte vir die formule en korrekte substitusie toegeken word.

1.2.2 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
*Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusie toegeken word, maar **geen verdere punte** sal toegeken word nie.*

1.2.3 Marks are only awarded for a formula if a calculation had been **attempted,** i.e. substitutions have been made or a numerical answer given.
*Punte sal slegs toegeken word vir 'n formule as 'n **poging aangewend was** om 'n berekening te doen d.w.s. substitusie was gedoen of 'n numerieke antwoord word verskaf.*

1.2.4 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formules ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.

1.2.5 All calculations, when not specified in the question, must be done to two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot twee desimale plekke gedoen word.

1.3 **UNITS/*EENHEDE***

1.3.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question or sub-question.**
*'n Kandidaat sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag of subvraag.***

1.3.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord tot 'n vraag verlang.

1.3.3 Marks are only awarded for an answer, and not for a unit per se. Candidates will therefore 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.

Punte word slegs vir 'n antwoord en vir 'n eenheid per se toegeken nie. Kandidate sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:

- *korrekte antwoord + verkeerde eenheid*
- *verkeerde antwoord + korrekte eenheid*
- *korrekte antwoord + geen eenheid*

1.3.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this. (This instruction only applies to Paper 1).
SI-eenhede moet gebruik word behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ inplaas van of $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ inplaas van $m \cdot s^{-1}$ waar die vraag dit verlang. (Hierdie instruksie geld slegs by Vraestel 1).

1.4 POSTIVE MARKING/*POSITIEWE NASIEN*

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekeninge sal in die volgende gevalle geld:

1.4.1 **Sub-question to sub-question**: When a certain variable is calculated in one sub-question (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** are to be awarded for the subsequent sub-questions.
Subvraag na subvraag: *Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. Indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word volpunte aan die daaropvolgende subvraag toegeken.*

1.4.2 **A multi-step question in a sub-question**: If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
'n Vraag met veelvuldige stappe in 'n subvraag: *Indien 'n kandidaat byvoorbeeld, die aantal mol verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

1.4.3 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/ appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord tot 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

1.4.4 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.
Vrae waar 'n reeks berekeninge gedoen moet word (bv. 'n stroombaan diagram vraag) hoef nie noodwendig altyd dieselfde orde te volg nie. VOLPUNTE sal toegeken word mits dit 'n geldige oplossing tot die probleem is. Maar, enige berekening wat nie die kandidaat nader aan die antwoord bring as die oorspronklike data, sal geen punte tel nie.

1.4.5 If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

1.4.6 Normally, if based on a conceptual mistake, an incorrect answer cannot be correctly motivated. If the candidate is therefore required to motivate in question 3.2 the answer given to question 3.1, and 3.1 is incorrect, no marks can be awarded for question 3.2. However, if the answer for e.g. 3.1 is based on a calculation, the motivation for the incorrect answer for 3.2 could be considered.
Normaalweg, as dit gebaseer is op 'n voorstellingsfout, kan 'n verkeerde antwoord nie korrek gemotiveer word nie. As die kandidaat derhalwe gevra word met 'n vraag in 3.2 om die antwoord in vraag 3.1 te motiveer, en 3.1 is verkeerd, sal geen punte vir vraag 3.2 toegeken word nie. Maar, as die antwoord in bv. 3.1 gebaseer is op 'n berekening, kan die motivering vir die verkeerde antwoord oorweeg word.

1.4.7 If instructions regarding method of answering are not followed, e.g. the candidate does a calculation when the instruction was to ***solve by construction and measurement*****,** a candidate may forfeit all the marks for the specific question.
Indien instruksies aangaande metode van beantwoording nie gevolg word nie, bv. die kandidaat doen 'n berekening wanneer die instruksie ***los op deur konstruksie en meting*** *was, mag die kandidaat al die punte vir die spesifieke vraag verbeur.*

1.4.8 For an **error of principle, no marks** are awarded (Rule 1) e.g. If the potential difference is 200 V and resistance is 25 Ω, calculate the current.
Vir 'n ***foutdraendebeginsel,*** *sal* ***geen punte*** *toegeken word nie (Reël 1) bv. As die potensiaalverskil 200 V en die weerstand 25 Ω is, bereken die stroom*.

CORRECT *KORREK*	ANSWER (1) *ANTW. (1)*	POSSIBLE *MOONTLIK*	ANSWER (2) *ANTW. (2)*	POSSIBLE *MOONTLIK*
$I = \frac{V}{R}$ ✓ $= \frac{200}{25}$ ✓ $= 8A$ ✓	$R = \frac{V}{I}$ ✓ $= \frac{200}{25}$ ***x*** $= 8A$ ***x***	$R = \frac{V}{I}$ ***x*** $= \frac{200}{25}$ $= 8A$	$R = \frac{V}{I}$ ✓ $I = \frac{R}{V}$ ***x*** $= \frac{25}{200}$ $= 0{,}125\ A$ ***x***	$I = \frac{V}{R}$ ✓ $= 8A$ ✓

1.5 GENERAL PRINCIPLES OF MARKING IN CHEMISTRY/ *ALGEMENE BEGINSELS VAN NASIEN BY CHEMIE*

The following are a number of guidelines that specifically apply to Paper 2.
Die volgende is 'n aantal riglyne wat spesifiek op Vraestel 2 van toepassing is.

1.5.1 When a chemical **FORMULA** is asked, and the **NAME** is given as answer, only one of the two marks will be awarded. The same rule applies when the **NAME** is asked and the **FORMULA** is given.
*Wanneer 'n chemiese **FORMULE** gevra word en die **NAAM** word as antwoord gegee, sal slegs een van die twee punte toegeken word. Dieselfde reël geld wanneer die **NAAM** gevra word en die **FORMULE** gegee word.*

1.5.2 When redox half-reactions are to be written, the correct arrow should be used. If the equation
$H_2S \rightarrow S + 2H^+ + 2e^-$ ($^2/_2$)

is the correct answer, the following marks will be given:
Wanneer redokshalfreaksies geskryf moet word, moet die korrekte pyltjie gebruik word. Indien die bostaande vergelyking die korrekte antwoord is, sal die volgende punte toegeken word:

$H_2S \leftrightharpoons S + 2H^+ + 2e^-$ ($^1/_2$)
$H_2S \leftarrow S + 2H^+ + 2e^-$ ($^0/_2$)
$S + 2H^+ + 2e^- \leftarrow H_2S$ ($^2/_2$)
$S + 2H^+ + 2e^- \leftrightharpoons H_2S$ ($^0/_2$)

1.5.3 When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, the following is unacceptable:

- 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 for instance be: 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.

Wanneer kandidate 'n verduideliking moet gee oor die relatiewe sterkte van oksideer- en reduseermiddels, is die volgende onaanvaarbaar.

- *Meld slegs die posisie van 'n stof op tabel 4 (bv. Cu is bo Mg).*
- *Gebruik slegs relatiewe reaktiwiteit (bv. Mg is meer reaktief as Cu).*
- *Die korrekte antwoord sal byvoorbeeld wees: Mg is 'n sterker reduseermiddel as Cu en derhalwe sal Mg in staat wees om Cu^{2+}-ione na Cu te reduseer. Die antwoord kan ook in terme van die relatiewe sterkte van elektronakseptors of donors gegee word.*

1.5.4 One mark will be forfeited when the charge of an ion is omitted per equation.
Een punt sal verbeur word wanneer die lading van 'n ioon per vergelyking weggelaat is.

1.5.5 The error carrying principle does not apply to chemical equations or half-reactions. For example, if a learner writes the wrong oxidation/reduction half-reaction in the sub-question and carries the answer to another sub-question (balancing of equations or calculations of E^{θ}_{cell}) then the learner is not credited for this substitution.
Die foutdraendebeginsel geld nie vir chemiese vergelykings of halfreaksies nie. Byvoorbeeld, indien 'n leerder die verkeerde oksidasie/reduksie-halfreaksie vir die subvraag skryf en die antwoord na 'n ander subvraag dra (balansering van vergelyking of E^{θ}_{sel}) dan word die leerder nie vir die substitusie gekrediteer nie.

1.5.6 When a calculation of the cell potential of a galvanic cell is expected, marks will only be awarded for the formula if one of the formulae indicated on the data sheet (Table 2) is used. The use of any other formula using abbreviations etc. will carry no marks.
Wanneer 'n berekening van die selpotensiaal van 'n galvaniese sel verlang word, sal punte slegs vir die formule toegeken word as een van die formules op die gegewensblad (Tabel 2) gebruik word. Die gebruik van enige ander formule, die gebruik van afkortings, ens. Sal geen punte dra nie.

1.5.7 In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks will be deducted if hydrogen atoms are omitted.
In die struktuurformules van 'n organiese molekuul moet alle waterstofatome getoon word. Punte sal afgetrek word vir die weglating van waterstofatome.

1.5.8 When a structural formula is asked, marks will be deducted if the candidate writes the condensed formula.
Wanneer 'n struktuurformule gevra word, sal punte afgetrek word indien die leerder die gekondenseerde formule skryf.

1.5.9 When an IUPAC name is asked, and the candidate omits the hyphen (e.g. instead of 1-pentene the candidate writes 1 pentene), marks will be forfeited.
Wanneer die IUPAC naam gevra word en die koppelteken(s) in die naam word uitgelaat (bv. In plaas van pent-1-een of 1-penteen skryf 'n kandidaat pent 1 een of 1 penteen), sal punte verbeur word.

QUESTION/*VRAAG 1*

1.1 C ✓✓

1.2 A ✓✓

1.3 C ✓✓

1.4 B ✓✓

1.5 A ✓✓

1.6 D ✓✓

1.7 A ✓✓

1.8 C ✓✓

1.9 A ✓✓

1.10 B ✓✓ (10 x 2) **[20]**

QUESTION/*VRAAG 2*

2.1 2.1.1 G ✓ (1)

2.1.2 F ✓ (1)

2.2 2.2.1 C_nH_{2n+2} ✓ (1)

2.2.2 Carboxylic group ✓/*Karboksiel-groep* (1)

2.2.3 CH_2 ✓ (1)

2.3 2.3.1 4-bromo-3-methylheptane
4-broom-3-metielheptaan

Marking criteria/ Nasienriglyne:
- Stem i.e. heptane./*Stam d.i heptaan.* ✓
- Bromo and methyl/*Broom en metiel* ✓
- Substituents correctly numbered, hyphens, commas and sequence correctly used. ✓
  Substituente korrek genommer, koppeltekens en kommas korrek gebruik.

(3)

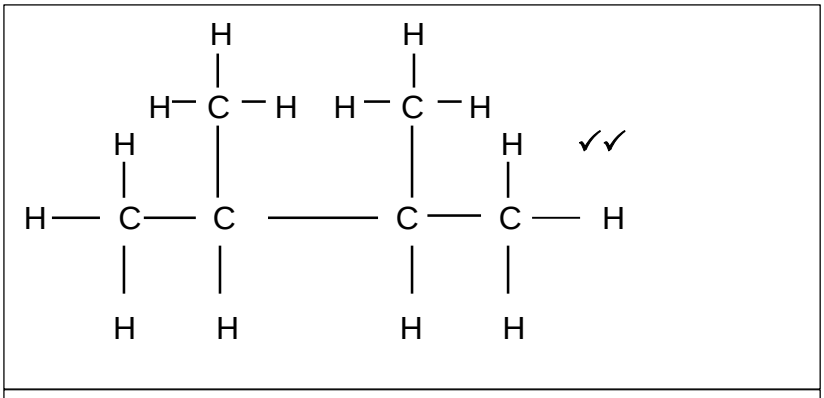
2.3.2 pentan-3-one ✓✓/*pentan-3-oon*
Accept/*Aanvaar:*3-pentanone/*3-pentanoon*

IF/INDIEN:
pentanone / pentanoon (1/2)

(2)

2.3.3 methyl ✓ methanoate ✓ / *metiel metanoaat* (2)

2.4

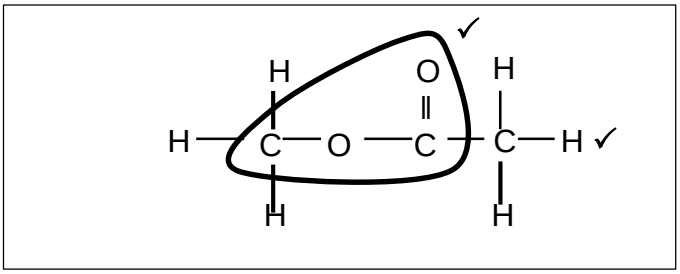


Marking criteria/ Nasienriglyne:
Whole structure correct/*Hele struktuur korrek*. (2/2)
TWO methyl groups/TWEE metiel-groepe (1/2)

(2)

2.5 2.5.1 Sulphuric acid/H_2SO_4 ✓
Swawelsuur/ H_2SO_4 (1)

2.5.2

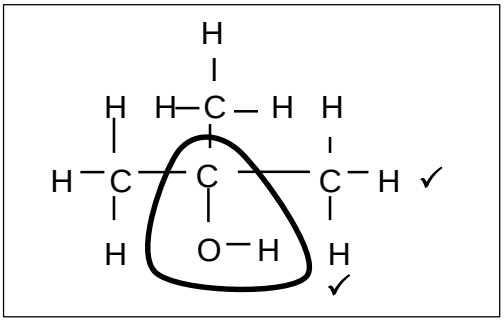


Marking criteria/ Nasienriglyne:
Whole structure correct/*Hele struktuur korrek*. (2/2)
Functional group correct/Funksionele groep korrek (1/2)
Notes/Aantekeninge:
Condensed structural formula or semi structural formule/
Gekondenseerde formule of semi-struktuurformule (1/2)

(2)

2.5.3 Flammable/Volatile ✓
Vlambaar/Vlugtig (1)

2.6



Marking criteria/ Nasienriglyne:
Whole structure correct/*Hele struktuur korrek*.
Functional group correct/*Funksionele groep korrek* (2/2)
Notes/Aantekeninge:
Condensed structural formula or semi structural formule/
Gekondenseerde formule of semi-struktuurformule (1/2)

2-methyl ✓propan-2-ol✓
2-metiel propan-2-ol

Accept/*Aanvaar*: 2-methyl-2-propanol/*2-metiel-2-propanol*

Marking criteria/ Nasienriglyne
2-methyl/*2-metiel*
Propan-2-ol

(2)

2.7 CO_2, ✓ H_2O ✓ (2)
[24]

QUESTION/*VRAAG 3*

3.1 The temperature at which the vapour pressure equals the atmospheric (external) pressure. ✓✓
Die temperatuur waar die dampdruk gelyk aan die atmosferiese (eksterne) druk is. ***(2 or/of 0)*** (2)

3.2.1 Chain length/surface area/molecular size(mass)/number of C atoms. ✓
Kettinglengte/oppervlaks area/molekulêre grootte (massa)/ aantal C atome. (1)

3.2.2 Thermometer ✓/*Termometer* (1)

3.3 **C**/ $CH_3CH_2CH_2OH$ ✓ (1)

3.4 **From A to C**

- Chain length/surface area/molecular size/molecular mass/ number of C's in the chain increases. ✓
- Strength of intermolecular forces/London forces/induced dipole/dispersion forces increases. ✓
- More energy needed to overcome/break intermolecular forces. ✓

Van A na C

- *Kettinglengte/oppervlaksarea/molekulêre grootte/ molekulêre massa/aantal C's in ketting neem toe.*
- *Sterkte van intermolekulêre kragte/London kragte/ geïnduseerde dipole/dispersie kragte vermeerder.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.*

From C to A

- The chain length/surface area/molecular size/molecular mass/number of C's in the chain decreases. ✓
- Strength of intermolecular forces/London forces/induced dipole/dispersion forces decreases. ✓
- Less energy needed to overcome/break intermolecular forces.

Van C na A

- *Kettinglengte/oppervlaksarea/molekulêre grootte/molekulêre massa/aantal C's in ketting neem af.*
- *Sterkte van intermolekulêre kragte/London kragte/geïnduseerde dipole/dispersie kragte verminder.*
- *Minder energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.5 3.5.1 A series of organic compounds with the same general formula. ✓✓
OR in which one member differs from the next with a CH_2 group.
'n *Reeks organiese verbindings met dieselfde algemene formule OF waarin EEN lid van die volgende met 'n CH_2 groep verskil*. **(2 or/of 0)** (2)

3.5.2 Between molecules of **D** there are hydrogen bonds. ✓
Between molecules of **E** there are dipole-dipole forces. ✓.
Hydrogen bonds are stronger than dipole-dipole forces. ✓
More energy needed to overcome/break intermolecular forces.in **D.** ✓

*Tussen molekules van **D** is daar waterstofbindings.*
*Tussen molekules van **E** is daar dipool-dipool kragte.*
Waterstofbindings is sterker as dipool-dipoolkragte.
*Meer energie benodig om intermolekulêre kragte te oorkom/breek in **D**.*

OR/*OF*

Between molecules of **D** there are hydrogen bonds. ✓
Between molecules of **E** there are dipole-dipole forces. ✓
Dipole-dipole forces are weaker than hydrogen bonds. ✓
Less energy needed to overcome/break intermolecular forces in **E**. ✓

*Tussen molekules van **D** is daar waterstofbindings.*
*Tussen molekules van **E** is daar dipool-dipool kragte.*
Dipool-dipoolkragte is swakker as waterstofbindings.
*Minder energie benodig om intermolekulêre kragte te oorkom/breek in **E**.* (4)

3.5.3 **E** ✓
Higher boiling point ✓/*Hoër kookpunt* (2)
[16]

QUESTION/*VRAAG* 4

4.1 4.1.1 (a) Substitution/halogenation/bromination. ✓
Substitusie/halogenasie/halogenering/bromering (1)

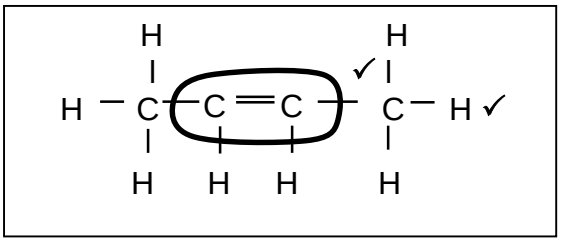
4.1.2 Elimination/dehydrohalogenation ✓
Eliminasie/dehalogenasie/dehidrogenering (1)

4.2 4.2.1 Bromine/Br_2 ✓
Bromied/Br_2 (1)

4.2.2 Heat/Ultraviolet ✓
Hitte/Ultraviolet-lig (1)

4.2.3 Butane/*Butaan* ✓✓ (2)

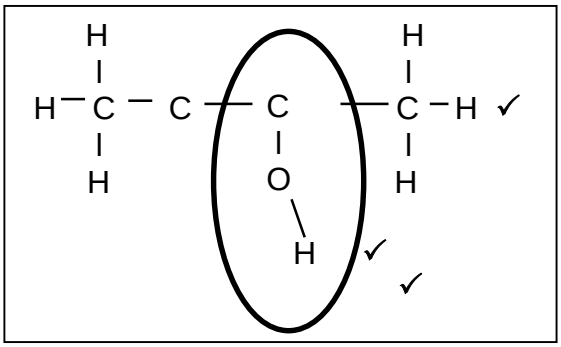
4.3



(2)

Marking criteria/ Nasienriglyne:
Whole structure/*Hele struktuur* *(2/2)*
Only functional group correct/*Slegs funksionele groep korrek*. (1/2)

4.4



Marking criteria/ Nasienriglyne:
Whole structure/*Hele struktuur* *(2/2)*
Only functional group correct/*Slegs funksionele groep korrek*. (1/2) (2)

4.5 Dilute KOH ✓ and mild heat ✓
Verdunde KOH en matige hitte (2)
[12]

QUESTION/*VRAAG 5*

5.1 The change in concentration/mass/number (amount) of moles/volume ✓ of reactants or products per unit time. ✓
Die verandering in konsentrasie ✓/massa/ aantal (hoeveelheid) mol/volume van reaktanse of produkte per eenheidstyd. ✓ (2)

5.2 Experiment/*Ekspirement* 1 ✓
- Highest temperature ✓/ *Hoogste temperatuur*
- Largest surface area ✓/ *Grootste oppervlaksarea* (3)

5.3 5.3.1 Temperature✓/Surface area/State of division.
Temperatuur/Oppervlak-area (1)

5.3.2 Equal to ✓*IGelyk aan*
Number/amount of mol/mass of Mg used is the same. ✓
Hoeveelheid/aantal mol/massa van Mg gebruik is dieselfde. (2)

5.4 More than ONE independent variable. ✓
Meer as EEN onafhanklike veranderlike. (1)

5.5

Marking criteria/ Nasienriglyne:

* Formula/*Formule* : n = cV ✓
* Substitution into/Vervanging in: n = cV ✓
*Divide by 24 /*Deel deur 24* ✓
*Use of ratio/*Gebruik verhoudings*.: n(HCℓ) = 2n(Mg) ✓
* n(HCℓ) remaining = n(HCℓ)initial - n(HCℓ)reacting n(HCℓ) ✓
n(HCℓ) oorgebly = n(HCℓ)aanvanklik- n(HCℓ)gereageer
* Substitution of 36,5 into n = m/M ✓
Vervanging van 36,5 in n = m/M
*Final answer/*Finale antwoord.* ✓

n(HCℓ) initial/*aanvanklik* = c.V ✓
= 2 x 80/1 000 ✓ = 0,16 mol

n(Mg)reacting/*gereageer* = m/M
= 0.24/24 ✓
= 0.01 mol

n(HCℓ)reacting/*gereageer* = 2 x 0.01✓ = 0.02 mol

n (HCℓ)remaining/*oorgebly* = 0.16 – 0.02 ✓= 0.14 mol

m(HCℓ)remaining/*oorgebly* = nM = 0.14 x 36,5 ✓= 5,11 g ✓ (7)

5.6 5.6.1 Number/Fraction of molecules/particles ✓
Aantal/Gedeelte van molekules/deeltjies (1)

5.6.2 P ✓ (1)

5.6.3 Increase in temperature/*Toename in temperatuur*

- Increases (average) kinetic energy of particles. ✓
Toename in (gemiddelde) kinetiese energie van deeltjies.
- More particles have enough/sufficient (kinetic) energy to react./ $E_K \geq E_A$ ✓
Meer deeltjies het genoegsame (kinetiese) energie om te reageer./ $E_K \geq E_A$
- More effective collisions per unit time/second. ✓
Meer effektiewe botsings per eenheidstyd/sekonde.

OR/OF

Rate/Frequency of effective collisions increases. ✓
Tempo/Frekwensie van effektiewe botsings neem toe.

- Increases reaction rate ✓
Toename in reaksie-tempo. (4)

[22]

QUESTION/*VRAAG* 6

6.1 The stage in a chemical reaction when the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓
Die stadium in 'n chemiese reaksie wanneer die tempo van die voortwaartse reaksie gelyk aan die tempo van die terugwaaartse reaksie is. **(2 or/of 0)** (2)

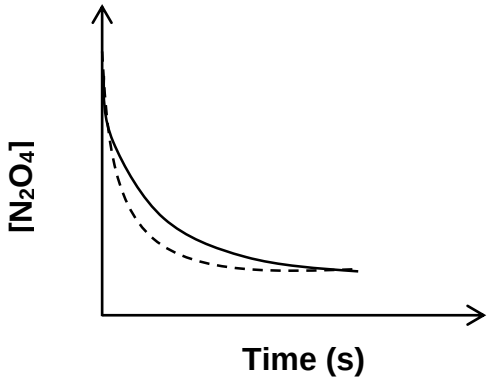
6.2 6.2.1 Increases ✓/*Toeneem* (1)

6.2.2 Decreases ✓/*Afneem*

(1)

6.3 Change is opposed/Increase in pressure is opposed/The reaction that will oppose this increase in pressure/decrease the pressure will be favoured. ✓
Verandering is teengewerk/Toename in druk is teengewerk/Die reaksie wat hierdie toename in druk teenwerk/laat afneem sal bevoordeel word.
Increase in pressure favours the reaction which produces less gas moles/volume. ✓
Toename in druk bevoordeel die reaksie wat minder mol/volume gas produseer.
The reverse reaction is favoured. ✓
Die terugwaartse reaksie word bevoordeel. (3)

6.4



Notes/Aantekeninge:
- Curves starts at same concentration and intercept at the same final concentration. ✓
  Kurwes begin by dieselfde konsentrasie en sny af by dieselfde finale konsentrasie.
- Broken line on graph is below solid line and levels off faster than the solid line. ✓
  Stippellyn op grafiek is onder vastelyn en neem vinniger af as vastelyn.

(2)

6.5 6.5.1 T = 23 ˚C ✓

- Largest K_C value. ✓/*Grootste K_C waarde.* (2)

6.5.2

Marking criteria/ Nasienriglyne:

- Correct K_C expression (formulae in square brackets). ✓
  Korrekte K_C uitdrukking(formules in vierkanthakies)
- Substitution of 0,32 for K_C value. ✓
  Vervanging van 0,32 as K_C waarde.
- Substitute 0,5 as $[N_2O_4]$/*Vervang 0,5 as $[N_2O_4]$* ✓
- $[NO_2]$equilibrium/$[NO_2]$ *by ewewig* ✓
- Change in concentration of NO_2/*Verandering in konsentrasie van NO_2* ✓
- Using ratio/Gebruik verhouding: N_2O_4: NO_2 = 1:2 ✓
- Initial$[N_2O_4]$ = Equilibrium$[N_2O_4]$ + Change in $[N_2O_4]$ ✓
  Aanvanklike $[N_2O_4]$ = Ewewig$[N_2O_4]$ + Verandering in $[N_2O_4]$

$K_C = [NO_2]^2/[N_2O_4]$ ✓
0,32 ✓ = $[NO_2]^2$/0,5 ✓
$[NO_2]$ = 0,4 mol.dm^{-3}

	N_2O_4	NO_2	
Initial concentration (mol.dm^{-3}) *Aanvangskonsentrasie (mol.dm^{-3})*	✓ 0,7	0	
Change in concentration (mol.dm^{-3}) *Verandering in konsentrasie (mol.dm^{-3})*	0,2	0,4 ✓	Ratio ✓ *Verhouding*
Equilibrium concentration (mol.dm^{-3}) *Ewewigskonsentrasie (mol.dm^{-3})*	0,5	0,4 ✓	

(7)

6.5.3 Exothermic. ✓*IEksotermies*

- When temperature increases, K_C decreases ✓ therefore [products] decreases.
  Wanneer die temperatuur toeneem, sal K_C toeneem daarom neem [produkte] af.
  Reverse reaction is favoured. ✓
  Terugwaartse reaksie word bevoordeel.
  Increase in temperature favours the endothermic reaction (reverse reaction). ✓
  Toename in temperatuur bevoordeel endotermiese reaksie (terugwaartse reaksie.) (4)

[22]

QUESTION/*VRAAG* 7

7.1 7.1.1 An acid that <u>donates one proton (H^+)</u> ✓ per molecule.
'n Suur wat een proton (H^+) per molekuul skenk. (2)

7.1.2 CH_3COO^- ✓ (1)

7.1.3 Weak acid ✓/*Swak suur*

Low K_a value ✓/*Lae K_a waarde* (2)

7.2 7.2.1

<u>OPTION/*OPSIE 1*</u>

$K_W = [OH^-][H_3O^+]$
$10^{-14} = 1 \times 10^{-5}\,[H_3O^+]$ ✓
$[H_3O^+] = 10^{-9}$ mol.dm^{-3}

$pH = -\log [H_3O^+]$ ✓
$= -\log 10^{-9}$ ✓
$= 9$ ✓

<u>OPTION/*OPSIE 2*</u>

$pOH = -\log [OH^-]$ ✓
$= -\log(1 \times 10^{-5})$ ✓
$= 5$

$14 = pH + pOH$
$14 = pH + 5$ ✓
$pH = 9$ ✓ (4)

7.2.2 $c_1V_1 = c_2V_2$
$(1 \times 10^{-5})(10)$ ✓ $= (1 \times 10^{-6})V_2$ ✓
$V_2 = 100$ cm^{-3} ✓ (3)

7.3 7.3.1 $n = cV$ ✓
$= (0{,}8(100/1\,000)$ ✓
$= 0{,}08$ ✓ (mol) (3)

7.3.2

<u>Marking criteria/Nasienriglyne:</u>

- n (KOH) = cV ✓
- Substitution of c and V to find n(KOH) ✓
- *Substitusie van c en V om* c(KOH) te bereken.
- Use MOL RATIO/*Gebruik MOLVERHOUDING*: $n(H_2SO_4) : n(KOH) = 1 : 2$ ✓
- $n(H_2SO_4)_{reacted/gereageer} = n(H_2SO_4)_{initial/aanvanklik} - n(H_2SO_4)_{excess/oormaat}$ ✓
- Use MOL RATIO/*Gebruik MOLVERHOUDING*: $n(H_2SO_4) : n(Na_2CO_3) = 1 : 1$ ✓
- Substitution into m = nM to calculate $m(Na_2CO_3)$ ✓
  Substitusie in m = nM om $m(Na_2CO_3)$ te bereken.
- Final answer/*Finale antwoord*: 7.92 g/ 7.95 g ✓

-

POSITIVE MARKING from QUESTION 7.3.1
POSITIEWE NASIEN vanaf VRAAG 7.3.1

$n(KOH) = cV$ ✓ $= (0,3)(0,035)$ ✓ $= 0,01$ mol

$n(H_2SO_4) = 1/2n(KOH) = 0,5(0,01)$ ✓ $= 0,005$ mol

$n(H_2SO_4)_{reacted/gereageer} = 0,08 - 0,005$ ✓$= 0,075$ mol

$n(Na_2CO_3) = n(H_2SO_4)_{reacted/gereageer} = 0,075$ mol ✓

$m(Na_2CO_3) = nM = (0,075)(106)$ ✓ $= 7,95$ g ✓ (8)

7.4 $CO_3^{2-} + H_2O$ ✓ $\rightleftharpoons HCO_3 + OH^-$ ✓ ✓ bal
OR/*OF* $CO_3^{2-} + H_2O \rightleftharpoons H_2CO_3 + OH^-$
OR/*OF* $Na_2CO_3 + H_2O \rightleftharpoons NaHCO_3 + OH^-$

Accept/*Aanvaar*: Single arrow/*Enkel pyltjie*

Marking guidelines/ Merkriglyne:
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Marking rule 6.3.10/*Nasienreël 6.3.10*

(3)
[26]

QUESTION/*VRAAG* 8

8.1 8.1.1 Percentage yield decreases as the temperature increases. ✓
Persentasie opbrengs neem af soos die temperatuur toeneem.

OR/*OF*

Percentage yield increases as the temperature decreases. ✓
Persentasie opbrengs neem toe soos die temperatuur afneem. (2)

8.1.2 50 ✓ (%) (1)

8.1.3 200 ✓ (atmosphere/*atmosfeer*) (1)

8.2 $n(N_2) = m/M = 112/28$ ✓ $= 4$ mol

$n(NH_3) = 2n(N_2) = 2(4)$ ✓ $= 8$ mol

% Yield = Actual yield/Theoretical yield x 100
% Opbrengs = Werklike opbrengs/Teoretiese opbrengs x 100

60 = Actual yield/*Werklike opbrengs* x 100/8 ✓
Actual yield/*Werklike opbrengs* = 4,8 mol ✓ (4)

[8]

TOTAL/*TOTAAL:* 150