Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2019

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKS: **150**

TIME: **3 hours**

JPHSCE2

This question paper consists of 16 pages, including a formula sheet and 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 SEVEN questions.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the 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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D), corresponding to the correct answer of your choice, next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

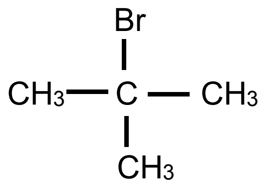
1.1 Which ONE of the following compounds has a DOUBLE BOND in its structure?

A Ethane
B Ethene
C Polyethene
D Bromoethane (2)

1.2 By definition the boiling point of a liquid is the temperature at which …

A a liquid changes to vapour.
B the vapour pressure equals atmospheric pressure.
C the vapour pressure is less than the atmospheric pressure.
D the vapour pressure is greater than the atmospheric pressure. (2)

1.3 Which ONE of the following is the CORRECT IUPAC name of the compound shown below?



$$CH_3-\overset{\overset{\textstyle Br}{|}}{\underset{\underset{\textstyle CH_3}{|}}{C}}-CH_3$$

A 2-bromobutane
B 2-methyl-2-bromopropane
C 2-bromo-2-methylpropane
D 2,2,2-trimethylbromomethane (2)

1.4 Consider the reaction represented by the equation below:

$$CH_3Br + H_2O \rightarrow CH_3OH + HBr$$

The TYPE of reaction shown above is …

A substitution.
B combustion.
C esterification.
D polymerisation. (2)

1.5 The boiling points of propanal and propanone are compared.

Which ONE of the following is the INDEPENDENT variable in this comparison?

A Molar mass
B Chain length
C Hydrogen bonds
D Homologous series (2)

1.6 Which ONE of the following factors will change the value of the equilibrium constant, Kc?

A Pressure
B Surface area
C Temperature
D Concentration (2)

1.7 The reaction of magnesium powder and hydrochloric acid is used to investigate the factors that affect reaction rate. The balanced equation for the reaction is:

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

In ALL the experiments the hydrochloric acid is in EXCESS and the magnesium powder is completely covered.

The results of the experiments are shown in the table below:

Experiment	**Concentration of HCℓ ($mol.dm^{-3}$)**	**Volume of HCℓ (cm^3)**	**Mass of Mg (g)**
P	1,5	200	1,8
Q	1,2	400	1,8
R	0,8	200	1,4
S	1,5	200	1,5

Which experiments will produce the SAME amount of hydrogen at same temperature and pressure?

A **P** and **Q**
B **Q** and **R**
C **R** and **S**
D **P** and **S** (2)

1.8 Diluted hydrochloric acid is spilt on floor tiles in the laboratory.

Which ONE of the following substances can be used to neutralise the acid?

A $NaC\ell$
B $NH_4C\ell$
C H_2SO_4
D Na_2CO_3 (2)

1.9 Study the ionisation reactions given below:

$$H_3PO_4 + H_2O \rightarrow H_2PO_4^- + H_3O^+$$

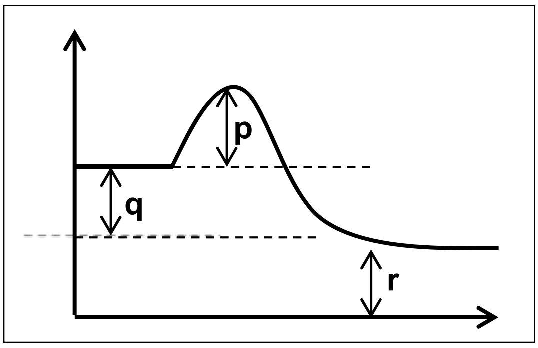
$$H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$$

In the reactions H_2O acts as a(n) …

A base.
B ampholyte.
C weak acid.
D strong acid. (2)

1.10 The potential energy diagram shown below is for the reversible hypothetical reaction shown below:

$$2\ \mathbf{AB}(g) \rightleftharpoons \mathbf{A}_2\mathbf{B}_2(g)$$



Consider the following statements about the reaction:

I The forward reaction is endothermic
II The value of ΔH for the REVERSE reaction is equal to **q**
III The activation energy for the reverse reaction is equal to **p** + **q**

Which of the above statements is/are TRUE?

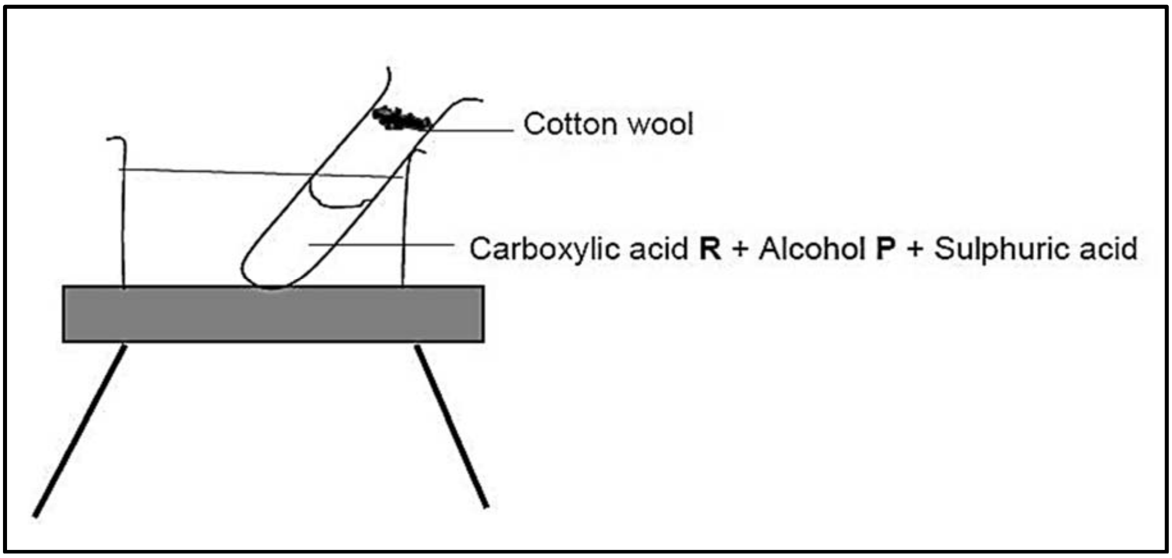
A **I** only
B **I** and **II**
C **III** only
D **II** and **III** (2)

[20]

QUESTION 2

A test tube containing an alcohol **P**, carboxylic acid **R** and sulphuric acid is heated in a water bath, as illustrated below. A piece of wet cotton wool is placed at the mouth of the test tube.

$$\text{Alcohol } \mathbf{P} + \text{Carboxylic acid } \mathbf{R} \longrightarrow \text{Ester} + \mathbf{X}$$



2.1 Is the sulphuric acid that is used CONCENTRATED or DILUTE? (1)

2.2 What is the purpose of placing cotton wool at the mouth of the test tube? (1)

2.3 Write down the molecular formula of the inorganic product, **X**. (1)

2.4 Alcohol **P** is a positional isomer of propan-2-ol.

Write down the IUPAC name of alcohol **P**. (2)

2.5 Chemical analysis shows that carboxylic acid **R** contains 54,55% C, 9,1% H and **x** % O.

The molar mass of the **ester** produced is 130 g·mol^{-1}.

Determine by calculation the MOLECULAR formula of carboxylic acid **R**. (8)

[13]

QUESTION 3

3.1 The boiling points of three compounds (**A**, **B** and **C**) are compared in the table below:

	COMPOUND	**BOILING POINT (˚C)**
A	Pentan-1-ol	138
B	Butanoic acid	164
C	Methyl propanoate	68

3.1.1 For compound **C** write down the:

(a) Name of the homologous series to which it belongs (1)

(b) STRUCTURAL formula (2)

3.1.2 Give a reason why this is a fair comparison. (2)

3.1.3 Explain why hydrogen bonds are stronger in compound **B** than in compound **A**. (2)

3.2 The vapour pressure values of a secondary and a tertiary alcohol are compared in the table below:

	COMPOUND	**MOLECULAR FORMULA**	**VAPOUR PRESSURE (kPa at 20 ˚C)**
D	Secondary alcohol	$C_4H_{10}O$	**X**
E	Tertiary alcohol	$C_4H_{10}O$	**Y**

3.2.1 Are compounds **D** and **E** STRUCTURAL isomers?
Write down Yes or No.

Give a reason for the answer. (3)

3.2.2 Which ONE of the two values, **X** or **Y** is HIGHER?

Fully explain the answer. (4)
[14]

QUESTION 4

4.1 Study the two reactions shown below. **P** is an inorganic compound. **R** is an organic compound.

I: 3-methylbut-1-ene + **P** $\longrightarrow$ 1,2-dichloro-3-methylbutane

II: 2-bromobutane + Base $\longrightarrow$ **R** + NaBr + H_2O

4.1.1 Write down the TYPE of reaction represented by:

(a) Reaction **I** (1)

(b) Reaction **II** (1)

4.1.2 Write down the:

(a) STRUCTURAL formula of 1,2-dichloro-3-methylbutane (3)

(b) Name of the inorganic reactant **P** (1)

4.1.3 For reaction **II** write down:

(a) The structural formula and IUPAC name of the major product, **R** (4)

(b) ONE reaction condition (1)

4.2 The equation shown below shows **n** molecules of $H_2C=CH_2$ reacting to produce a polymer.

$H_2C=CH_2$ in the equation below represents <u>small organic molecules that can be covalently bonded to each other in a repeating pattern</u>

$$\mathbf{n}\ H_2C=CH_2 \xrightarrow{\text{Polymerisation}} [\ CH_2CH_2]_{1000}$$

4.2.1 Is this reaction an example of ADDITION or CONDENSATION polymerisation? (1)

Write down:

4.2.2 The value of **n** (1)

4.2.3 A term used for the underlined phrase (1)

4.2.4 ONE use of the polymer produced in this reaction (1)

4.3 The following equation represents the cracking reaction of octane (C_8H_{18}). **Y** is a straight chain organic compound.

$$C_8H_{18} \xrightarrow{\text{High temperature/High pressure}} \mathbf{Y} + C_2H_4$$

4.3.1 Define the term *cracking* reaction. (2)

4.3.2 Is this reaction an example of THERMAL CRACKING or CATALYTIC CRACKING? (1)

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

[22]

QUESTION 5

Hydrogen peroxide (H_2O_2) decomposes according to the following equation:

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

5.1 State THREE factors that can INCREASE the rate of this reaction. (3)

5.2 Define the term *reaction rate.* (2)

The rate of decomposition of hydrogen peroxide is investigated in THREE experiments. The initial temperature of H_2O_2 is the same in ALL the experiments.

The reaction runs to completion in ALL the experiments.

5.3 In **experiment 1** a solution of hydrogen peroxide is heated to 35 °C.

The concentration of H_2O_2 was measured at different time intervals during the experiment.

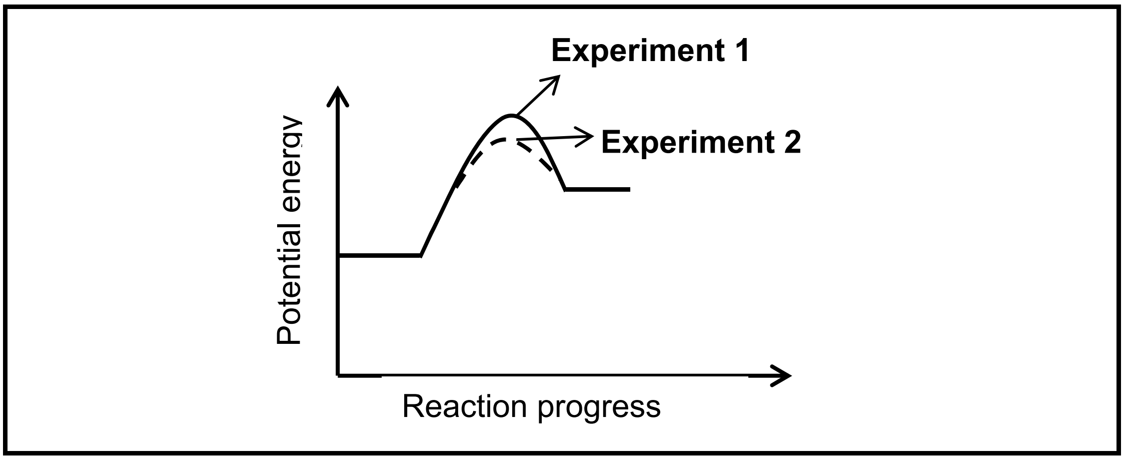
The following results were obtained:

TIME (MINUTES)	**H_2O_2 CONCENTRATION ($mol{\cdot}dm^{-3}$)**
0	1,9
15	1,45
55	1,10
100	0,85
215	0,60

5.3.1 Calculate the average reaction rate, in $mol{\cdot}dm^{-3}{\cdot}min^{-1}$ during the first 15 minutes. (3)

5.3.2 Give a reason why the average reaction rate is HIGHER during the first 15 minutes, compared to the time interval 100 to 215 seconds. (2)

5.4 In **experiment 2,** a small amount of manganese dioxide is added to the same H_2O_2 solution (used in **experiment 1**) and the mixture is heated to 35 °C.

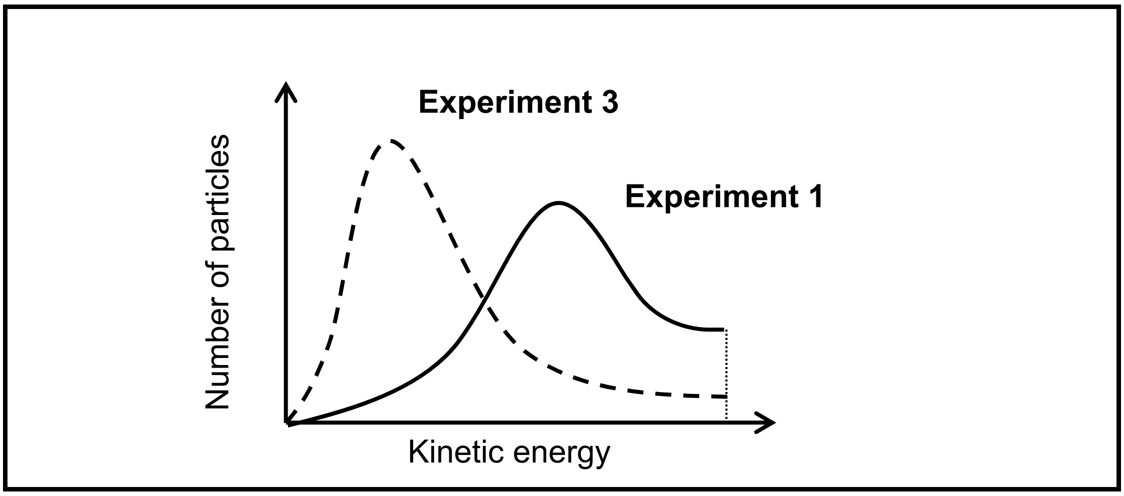


5.4.1 Is the reaction EXOTHERMIC or ENDOTHERMIC? (1)

5.4.2 Use the collision theory to explain the effect of manganese dioxide on the rate of decomposition of H_2O_2. (4)

5.5 In **experiment 3** the same volume of the solution of H_2O_2 (used in **experiment 1**) is used but ONLY the temperature to which the solution is heated is changed.

The Maxwell-Boltzman distribution curves for **experiment 1** and **3** are shown below:



5.5.1 Which experiment (**1** or **3**) was carried out at a HIGHER temperature?

Give a reason for the answer. (2)

5.5.2 How does the area under the graph of **experiment 1** compare to the area under the graph of **experiment 3**?

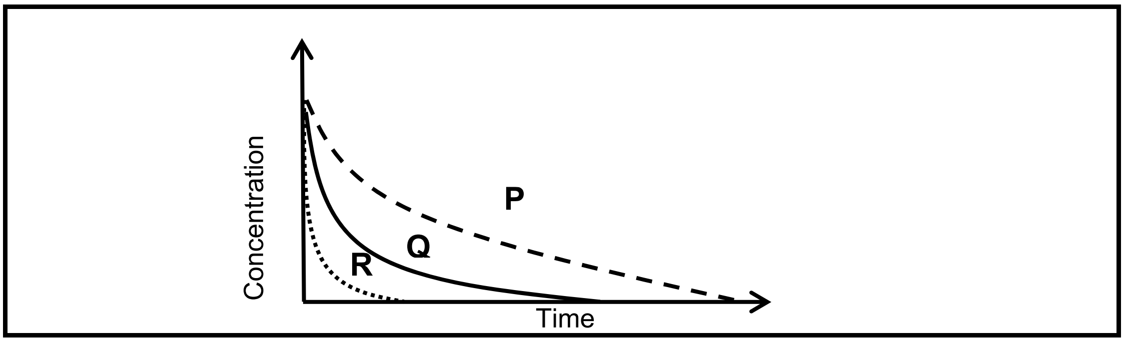
Write down GREATER THAN, EQUAL TO or LESS THAN.

Explain the answer. (2)

5.6 In **experiment 2** the total volume of oxygen produced at 35 ˚C is 0,2 dm^3.

Calculate the mass of H_2O_2 that decomposed in **experiment 2** if the molar volume of oxygen at 35 ˚C is 24,8 $dm^3 \cdot mol^{-1}$. (5)

5.7 The graphs below show how the concentration of H_2O_2 changes with time in the experiments.



Which graph (**P, Q** or **R**) represents the results of:

5.7.1 Experiment 1 (1)

5.7.2 Experiment 2 (1)

5.7.3 Experiment 3 (1)
[27]

QUESTION 6

Carbon dioxide gas, $CO_2(g)$, reacts with carbon, C(s), according to the following balanced equation:

$$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$$

The system reaches equilibrium at 1 000 ˚C.

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

6.2 How will EACH of the following changes affect the number of moles of CO(g) at equilibrium?

Choose from INCREASES, DECREASES or REMAINS CONSTANT.

6.2.1 The addition of more carbon, C (1)

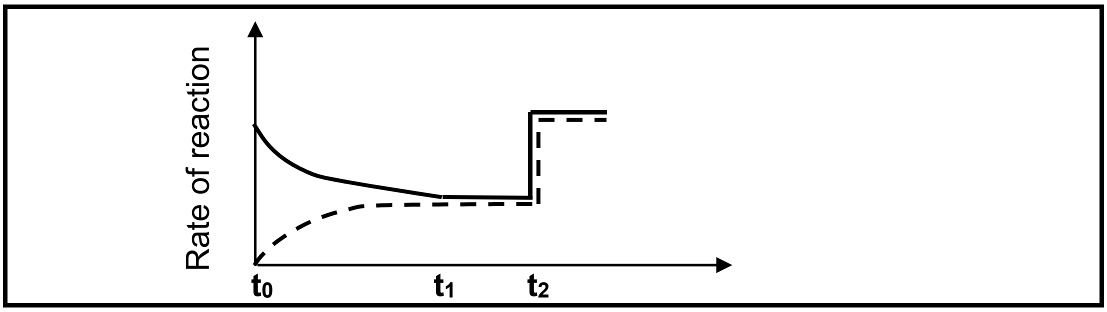
6.2.2 The addition of more CO_2 (1)

6.2.3 Decreasing the pressure by increasing the volume (1)

6.3 Use Le Chatelier's principle to explain the answer to QUESTION 6.2.3 above. (3)

6.4 The sketch graph given below shows the changes in the rates of reaction from the moment the reagents are introduced into the container. The reaction reaches equilibrium for the first time at **t_1**.

A change is made to the equilibrium mixture at **t_2**.



6.4.1 Which reaction (FORWARD or REVERSE) is represented by the broken line? (1)

6.4.2 What change was made at **t_2**? (2)

Initially 104,72 g of CO_2 was heated with EXCESS carbon C in a sealed flask of volume 250 cm^3. The equilibrium mixture was found to contain 1,90 mol of CO_2.

6.5 Calculate the value of the equilibrium constant, K_c at 1 000 ˚C. (8)

6.6 The value of K_c for the reaction decreases to 0,333 when the temperature is changed to 25 °C.

6.6.1 Is there a HIGH or LOW yield at 25 °C?

Give a reason for the answer. (2)

6.6.2 Is the FORWARD reaction ENDOTHERMIC or EXOTHERMIC?

Explain the answer fully. (4)

[25]

QUESTION 7

7.1 The hydrogen carbonate ion (HCO_3^-) undergoes hydrolysis according to the equation:

$$HCO_3^-(aq) + H_2O(\ell) \rightleftharpoons CO_3^{2-}(aq) + H_3O^+(aq)$$

7.1.1 Define the term *hydrolysis*. (2)

7.1.2 Give a reason why HCO_3^- is regarded as an ampholyte. (2)

Write down the FORMULA of the:

7.1.3 Conjugate acid of CO_3^{2-} (1)

7.1.4 Conjugate acid of HCO_3^- (not in the equation) (1)

7.2 A weak monoprotic acid is dissolved in water to produce a <u>solution of accurately known concentration.</u>

7.2.1 Write down a term for the underlined phrase. (1)

7.2.2 Which ONE of the following is an example of a *weak monoprotic* acid?

CH_3COOH	$HC\ell$	H_2CO_3

The weak monoprotic acid has a concentration of 0,2 mol.dm^{-3}. (2)

7.2.3 Calculate the volume to which 20 cm^3 of the acid must be diluted to produce a solution with a concentration of 0,16 mol·dm^{-3}. (3)

7.3 During a titration a learner adds 30 cm^3 of NaOH solution of concentration 0,1 $mol.dm^{-3}$ to an Erlenmeyer flask and titrates this solution with 25 cm^3 HCℓ solution. The balanced equation for the reaction that takes place is:

$$NaOH + HC\ell \longrightarrow NaC\ell + H_2O$$

7.3.1 Name this type of reaction. (1)

7.3.2 At what pH range will a suitable indicator for this titration change colour?

Choose from:

6,8 to 7,2	3 to 5	8,6 to 10

Give a reason for the answer. (3)

7.3.3 Calculate the concentration of the HCℓ that was used to neutralise the NaOH in the Erlenmeyer flask. (4)

The learner passes the endpoint by adding an extra 8 cm^3 of the HCℓ solution.

7.3.4 Define the term *endpoint*. (2)

7.3.5 Calculate the pH of the solution in the flask after the addition of the extra 8 cm^3 of HCℓ. (7)

[29]

TOTAL: 150

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

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 $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	pH= $-\log[H_3O^+]$ $K_w = [H_3O^+][OH^-] = 1x10^{-14}$ 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*

KEY/ *SLEUTEL*

Atoomgetal Atomic number	29
Elektronegatiwiteit Electronegativity	1,9
Simbool Symbol	Cu
Benaderde relatiewe atoommassa Approximate relative atomic mass	63,5

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)
1 2, H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2.0 B 11	6 2.5 C 12	7 3.0 N 14	8 3.5 O 16	9 4.0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1.5 Aℓ 27	14 1.8 Si 28	15 2.1 P 31	16 2.5 S 32	17 3.0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1.6 V 51	24 1,6 Cr 52	25 1.5 Mn 55	26 1.8 Fe 56	27 1.8 Co 59	28 1.8 Ni 59	29 1.9 Cu 63,5	30 1.6 Zn 65	31 1.6 Ga 70	32 1.8 Ge 73	33 2.0 As 75	34 2.4 Se 79	35 2.8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1.9 Tc	44 2.2 Ru 101	45 2.2 Rh 103	46 2.2 Pd 106	47 1.9 Ag 108	48 1.7 Cd 112	49 1.7 In 115	50 1.8 Sn 119	51 1.9 Sb 122	52 2.1 Te 128	53 2.5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 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	81 1.8 Tℓ 204	82 1.8 Pb 207	83 1.9 Bi 209	84 2.0 Po	85 2.5 At	86 Rn
87 0,7 Fr	88 0,9 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

Province of the
EASTERN CAPE
EDUCATION

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2019

PHYSICAL SCIENCES P2
MARKING GUIDELINE/
FISIESE WETENSKAPPE V2
NASIENRIGLYN

MARKS/*PUNTE*: **150**

This marking guideline consists of 10 pages.
Hierdie nasienriglyn bestaan uit 10 bladsye.

QUESTION 1/*VRAAG 1*

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

[20]

QUESTION 2/*VRAAG 2*

2.1 CONCENTRATED √
GEKONSENTREERD (1)

2.2 To prevent reagents escaping √ /To smell the ester/Acts as a condenser
Om te voorkom dat reagense ontsnap / Om die esters te ruik√ */ Dit tree as 'n kondensor op* (1)

2.3 H_2O √ (1)

2.4 propan-1-ol √√ *Accept* 1-propanol propanol (1/2)
propaan-1-ol Aanvaar 1- propanol propanol (1/2) (2)

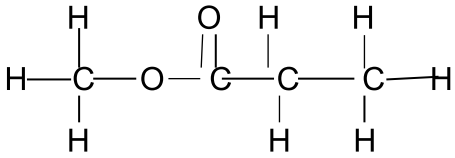
2.5 n= 54,55/12 √ = 4,55 n = 9,1/1 √= 9,1 n =(100-54.55-9.1) √ /16 √ = 2.27
= 2 = 4
Empirical formula/*Empiriese formule* C_2H_4O √
Molar mass(**R**)/*Molêre massa(**R**)* = 130 + 18 – 60= 88 √
MMolar Mass (Empirical formula)/*Molêre massa (Empiriese formule)*= 2 x 12 + 4 x 1 + 1 x 16 = 44 √
Molecular formula/*Molekulêre formule*= $C_4H_8O_2$ √ (8)

[13]

QUESTION 3/*VRAAG 3*

3.1 3.1.1 (a) Esters √ (1)

(b)



Marking Criteria
Whole structure correct 2/2
Volle struktuur 2/2

Only functional group correct ½
Slegs funksionele groep korrek ½

(2)

3.1.2 Same molecular mass √√ /Same molar mass
Dieselfde molekulêre massa / Dieselfde molêre massa (2)

3.1.3 **B** has two sites for hydrogen bonding √. **A** has one site for hydrogen bonding √
***B** het twee plekke vir waterstofbinding. √ **A** het een plek vir waterstofbinding* (2)

3.2 3.2.1 Yes √
Ja
Same molecular formula √ but different structural formulae √
Dieselfde molekulêre formule maar verskillende struktuurformules (3)

3.2.2 **Y** √
D has a larger surface area/chain length than **E** √
D** het 'n groter oppervlakte/ kettinglengte as **E
London forces/Induced-dipole forces √/Dispersion forces stronger√ in **D** than in **E**
*Londonkragte/geïnduseerde-dipool kragte/Dispersie-kragte is sterker in **D** as in **E***
More energy needed to break/overcome forces in **D**√
*Meer energie word benodig om die kragte te breek/oorkom in **D***
OR/OF
Y √
E has a smaller surface area/chainlength than **D** √
E** het 'n kleiner oppervlakte/ kettinglengte as **D
London forces/Induced-dipole forces √/Dispersion forces weaker in **E** than in **D**
*Londonkragte/geïnduseerde-dipool kragte/Dispersie-kragte is swakker in **E** as in **D***
Less energy needed to break forces in **E** √
*Minder energie word benodig om intermolekulêre kragte te breek/oorkom in **E***

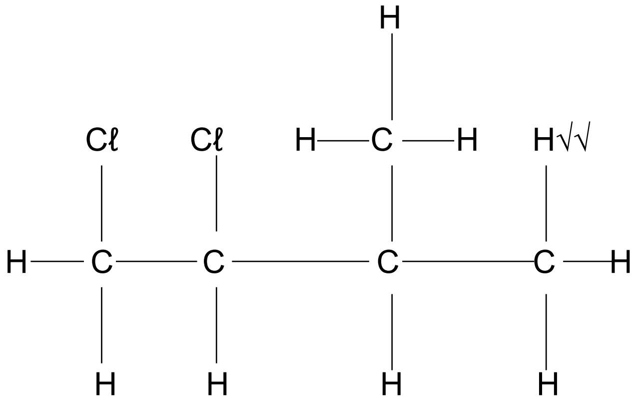
(4)
[14]

QUESTION 4/*VRAAG 4*

4.1 4.1.1 (a) Addition √ /Halogenation/Bromination √
Addisie / Halogenasie √/Brominasie (1)

(b) Elimination √/Dehydrohalogenation √
Eliminasie / Dehidrohalogenering (1)

4.1.2 (a)



Marking criteria/*Nasienriglyne*

- Whole structure correct 3/3
- *Volle struktuur korrek 3/3*
- Two Br atoms in structure 1/3
- *Twee Br atome in struktuur 1/3*

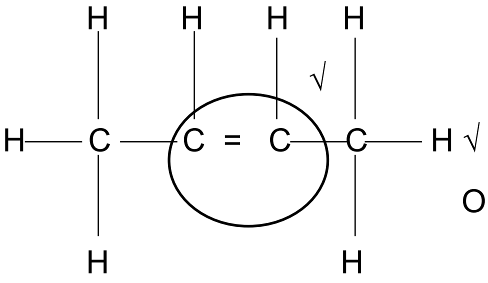
(3)

(b) Chlorine √
Choor (1)

4.1.3 (a)

R

`



but-2-ene√ √

OR 2-butene

but-2-een

OF 2-buteen

Marking criteria/*Nasienriglyne*
Whole structure correct 2/2
Vollestruktuur korrek 2/2
Only functional group correct ½
Slegs een funksionele groep korrek ½

(4)

(b) Strong heat √ OR <u>Concentrated strong base</u>
Vurige hitte OF <u>Gekonsentreerde sterk basis</u> (1)

4.2 4.2.1 ADDITION √
ADDISIE (1)

4.2.2 n = 1000 √ (1)

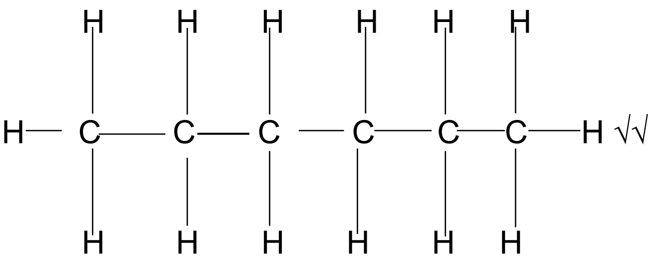
4.2.3 Monomer √
Monomeer (1)

4.2.4 Make plastics√/ (*Any other correct answer)*
Vervaardiging van plastiek / (Enige ander korrekte antwoord) (1)

4.3 4.3.1 Breaking down of a long chain √ /hydrocarbon/alkane into more useful shorter chains √
Breek van 'n lang ketting / koolwaterstof / alkaan in nuttiger korter kettings (2)

4.3.2 THERMAL CRACKING √
TERMIESE KRAKING (1)

4.3.3



$$\begin{array}{cccccccc} & H & H & H & H & H & H & \\ & | & | & | & | & | & | & \\ H- & C- & C- & C- & C- & C- & C & -H\ \surd\surd \\ & | & | & | & | & | & | & \\ & H & H & H & H & H & H & \end{array}$$

Hexane √√

Heksaan

Marking criteria/*Nasienriglyne*
- Whole structure correct 2/2
- *Volle struktuur korrek 2/2*
- If one or more hydrogens are omitted ½
- *Een of meer waterstofatoome uitgesluit ½*

(4)
[22]

QUESTION 5/*VRAAG 5*

5.1 Temperature√/Concentration √ (of H_2O_2)/Add a catalyst √
Temperatuur / Konsentrasie (van H_2O_2) / addisie van 'n katalisator (3)

5.2 Change in concentration per unit time/Rate of change of concentration √√
OR change in amount/volume/mass of reactant/product per unit time.

Verandering in konsentrasie per eenheidstyd / Tempo van verandering van konsentrasie
OF *'n verandering in hoeveelheid / volume / massa van reaktant / produk per eenheidstyd* (2)

5.3 5.3.1 Average rate/*Gemiddelde tempo* = $-\Delta c/\Delta t$= - (1,45-1,9) √ /(15-0) √

= 0,03√ ($mol\cdot dm^{-3}\cdot min^{-1}$) (3)

5.3.2 High concentration √√ (of H_2O_2 initially)
Hoë konsentrasie (van H_2O_2 oorspronklik) (2)

5.4 5.4.1 ENDOTHERMIC √
ENDOTERMIES (1)

5.4.2 Catalyst increases rate of reaction√/*Katalisator verhoog reaksietempo*

- By lowering activation energy /*Deur aktiveringsenergie te verlaag* √
- More particles have sufficient E_k to react √/More particles have E_k greater or equal to E_a/*Meer deeltjies het genoeg* E_k *om te reageer* √ / *meer deeltjies het 'n* E_k *groter of gelyk aan* E_a √
- More effective collisions per unit time √/*Meer effektiewe botsings per eenheidstyd* (4)

5.5 5.5.1 Experiment 1 √ : More particles have higher Ek √
Eksperiment 1 : Meer deeltjies het hoër Ek (2)

5.5.2 EQUAL TO √
GELYK AAN

Same amount of H_2O_2 used in both experiments √
Dieselfde hoeveelheid H_2O_2 word in beide eksperimente gebruik (2)

5.6 $nO_2 = V/V_m$ = 0,2/24,8 √ = 8,065 x 10^{-3} mol
nH_2O_2 = 2 √ x 8,065 x 10^{-3}
= 0,061 mol
m H_2O_2 = nM √= 0,0161 x (2+32) √
= 0,547g√ (0,55 g) (5)

5.7 5.7.1 Q √ (1)

5.7.2 R √ (1)

5.7.3 P √ (1)

[27]

QUESTION 6/*VRAAG 6*

6.1 Stage reached by a chemical reaction where the rate of forward reaction equals the rate of reverse reaction √√
Fase word bereik deur 'n chemiese reaksie waar die tempo van voorwaartse reaksie gelyk is aan die tempo van terugwaartse reaksie (2)

6.2 6.2.1 REMAINS THE SAME √
BLY DIESELFDE (1)

6.2.2 INCREASES √
TOENEEM (1)

6.2.3 INCREASES √
TOENEEM (1)

6.3 Decreasing pressure is opposed √
Reaction which produces more gas moles is favoured √
Forward reaction is favoured √
Afnemende druk is word teengestaan
Reaksie wat meer gasmol produseer, word bevoordeel
Voorwaartse reaksie word bevoordeel (3)

6.4 6.4.1 REVERSE √
TERUGWAARTS (1)

6.4.2 Catalyst √√ (added)
Katalisator (bygevoeg) (2)

OPTION 1/*OPSIE 1*
6.5 **CALCULATIONS USING NUMBER OF MOLES**
BEREKENINGE MET DIE GEBRUIK VAN AANTAL MOL

- Divide by/*Deel deur* 44 in n = m/M √
- Divide $nCO_{2\ equilm}$ & $nCO_{\ equilm}$ by 2 √
- $\Delta n(CO_2) = n_{initial} - n_{eq}$ √
- Ratio *verhouding* CO_2 : CO 1 : 2 √
- $n_{equil}\ CO = nCO_{initial} + \Delta n(CO)$ √
- Kc expression/*Uitdrukking* √
- Substituting/*Substitusie* $c_{equilmCO}$ en $c_{equilimCO2}$ √
- Final answer /Finale *antwoord* √

OPTION 1/*OPSIE 1*

$n_{initial}$ CO_2= m/M = 104,72/44 √ = 2,38 mol

	CO_2	C	CO
$n_{initial}$	2,38		0
Δn	0,48 √		0,96√(Ratio)
n_{equilm}	1,9		0,96√
c_{equilm}	7,6		3,84√(Division by 0,25)

Kc = $[CO]^2/[CO_2]$ √
= $3,84^2/7,6$ √
= 1,94 √

OPTION 2/*OPSIE 2*

CALCULATIONS USING CONCENTRATION
BEREKENINGE MET DIE GEBRUIK VAN KONSENTRASIE

- Substitute into / *Substitusie in* C=m/MV
  Substitute into/ *Substitusie in* c=n/V√
- $\Delta c(CO_2) = c_{initial} - c_{eq}$ √
- Ratio/*Verhouding* CO_2 : CO 1:2 √
- c_{equil} CO = $cCO_{initial} + \Delta c(CO)$ √
- Kc expression /*Uitdrukking* √
- Substituting /*Substitusie* $c_{equilmCO}$ and $c_{equilimCO2}$ √
- Final answer /*Finale antwoord* √

Initial Concentration of CO_2 *Aanvanklike konsentrasie van CO_2*	Equilibrium concentration of CO_2 *Ekwilibrium konsentrasie van CO_2*
$c = \frac{m}{MV}$ $c = \frac{104,72}{(44)(0,25)}$ √ $c = 9,52 mol \cdot dm^{-3}$	$c = \frac{n}{v}$ $c = \frac{1,9}{0,25}$ √ $c = 3,84 mol \cdot dm^{-3}$

	CO_2	C	CO
$C_{initial}$	9,52	-	0
Δc	1,90√	-	3,84√(Ratio)
c_{equilm}	7,60	-	3,84√

Kc = $[CO]^2/[CO_2]$ √
= $3,84^2/7,6$ √
= 1,94 √

(8)

6.6 6.6.1 Low √ Yield/ *Lae Opbrengs*
Kc is low √/ Kc is less than 1/ [REACTANTS] > [PRODUCTS]
Kc is laag / Kc is minder as 1 / [REAKTANTE]> [PRODUKTE] (2)

6.6.2 Exothermic √ *Eksotermies*

- As <u>temperature decreases,</u> Kc decreases, <u>[Products] decreases</u> √
  OR [Reactants increases]
- Reverse reaction is favoured √
- Decrease in temperature favours exothermic reaction √
- *Soos temperatuur afneem, verminder Kc, verminder [Produkte]* √
  OF [Reaktante neem toe]
- *Omgekeerde reaksie word bevoordeel* √
- *Afname in temperatuur bevoordeel eksotermiese reaksie* √ (4)

[25]

QUESTION 7

7.1 7.1.1 Reaction of a salt with water √√
Reaksie van 'n sout met water (2)

7.2 7.1.2 Can act as acid and as a base √√/Can donate H^+ and accept H^+
Kan as suur en as 'n basis optree / kan H^+ *skenk en* H^+ *aanvaar* (2)

7.1.3 HCO_3^- √ (1)

7.1.4 H_2CO_3 √ (1)

7.2 7.2.1 Standard √ (solution)
Standaard (oplossing) (1)

7.2.2 CH_3COOH √√ (2)

7.2.3

$c_1V_1=c_2V_2$	n=cV=(0,2)(0.02) √ =0,004 mol	
0,2 x 20 √ = 0,16 x V_2 √	V=n/c= (0,004)/(0,16) √	
V_2 = 25 cm^3 √ OR 0,025 dm^3	V=25 cm^3 √ **OR/OF** 0,025 dm^3	(3)

7.3 7.3.1 Neutralisation √
Neutralisasie (1)

7.3.2 6,8 to 7,2 √
Titration between <u>strong base and a strong acid</u> √
Solution at endpoint is neutral √
Titrasie tussen <u>sterk basis en 'n sterk suur</u>
Oplossing by eindpunt is neutraal (3)

7.3.3 $n_{NaOH\ reacting}$ = cV = 0,1 x 30/1000 √= 0,003 mol
n_{HCl} reacting = 0,003 mol √
c_{HCl} = n/V = 0,003/(25/1000) √
= 0,12 mol.dm^{-3} √
OR c_AV_A/c_BV_B= n_A/n_B
c_A x 25/0,1 x30 = 1/1
c_A = 0,12 mol.dm^{-3} (4)

7.3.4 Point where an <u>indicator changes colour</u> √√
Punt waar 'n <u>indikator van kleur verander</u> (2)

7.3.5 **<u>POSITIVE MARKING FROM 7.3.3</u>**
$n_{HCl\ excess}$ = cV√ = 0,12 x 8/1000 √
=9,6 x 10^{-4} mol
c_{HCl}= n/V = 9,6 x 10^{-4}/(30 + 25 + 8) √/1 000 √
= 0,015 mol.dm^{-3}

pH = -log[H_3O^+] √
= - log (0,15) √
= 0,82 √ (7)

[29]

TOTAL /*TOTAAL:* 150