Province of the
EASTERN CAPE
EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## JUNE 2022

# PHYSICAL SCIENCES: CHEMISTRY P2

**MARKS:** **150**

**TIME:** **3 hours**

This question paper consists of 20 pages, including 2 data sheets.

## INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
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-QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example. 1.11 E.

1.1 Which ONE of the following is the general formula of alkenes?

A $C_nH_{2n}$

B $C_2H_{2n+2}$

C $C_nH_{2n-2}$

D $C_nH_{2n+1}$ (2)

1.2 When the carbonyl group is located at the end of an organic molecule, to which ONE of the given homologous series does the molecule belong?

A Alcohol

B Aldehyde

C Ketone

D Haloalkane (2)

1.3 Which ONE of the following compounds has the HIGHEST boiling point?

A Octane

B 2-methylheptane

C 2,3-dimethylhexane

D 2,2,3-trimethylpentane (2)

1.4 Which ONE of the following changes will INCREASE the average kinetic energy of particles?

A Catalyst

B Decrease in temperature

C Increase in temperature

D Increase in surface area (2)

1.5 Consider the organic reaction below in which compound **P** is the MAJOR organic product.

$$CH_3CH(CH_3)CH_2CH = CH_2 + H_2O \rightarrow \text{compound } \mathbf{P}$$

The correct IUPAC name of the major organic product **P** is …

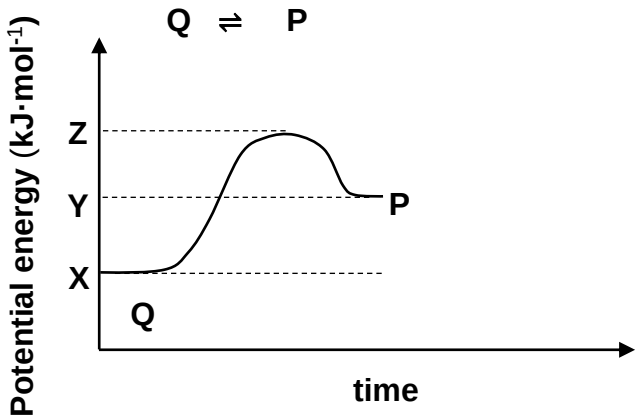
A 4-methylpentan-1-ol.

B 4-methylpentan-2-ol.

C 2-methylpentan-1-ol.

D 2-methylpentan-2-ol. (2)

1.6 Consider the potential energy diagram for the following hypothetical reversible reaction.




Which ONE of the following is the CORRECT interpretation of the information displayed in the graph?

| | **ΔH forward reaction** | **ΔH reverse reaction** |
|---|---|---|
| | | |
| A | **Y – Z** | **Z – Y** |
| | | |
| B | **Z – Y** | **Y – Z** |
| | | |
| C | **X – Y** | **Y – X** |
| | | |
| D | **Y – X** | **X – Y** |

(2)

1.7 Consider the following reaction at equilibrium at temperature **T**.

$$NO_2(g) \rightleftharpoons N_2O_4(g) \quad \Delta H < 0$$

The temperature of the reaction mixture is increased.

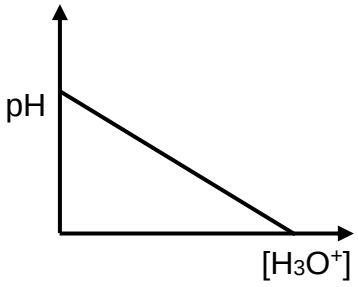
Which ONE of the following is CORRECT about the RATE OF THE FORWARD REACTION and the YIELD of $N_2O_4$ immediately after the temperature is increased?

| | **Rate of the forward reaction** | **Yield of $N_2O_4$** |
|---|---|---|
| | | |
| A | Decreases | Increases |
| | | |
| B | Increases | Decreases |
| | | |
| C | Increases | Increases |
| | | |
| D | Decreases | Decreases |

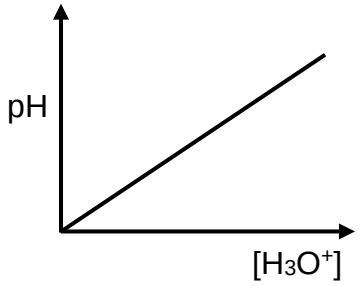
(2)

1.8 Which ONE of the following graphs CORRECTLY describe the relationship between the $[H_3O^+]$ and pH?

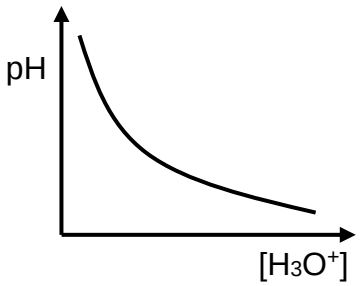
A



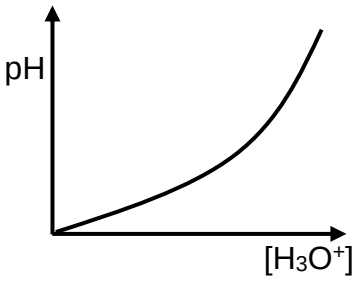

B




C




D




(2)

1.9 Consider the acid-base reaction below.

$$H_2PO_4^- + OH^- \rightleftharpoons H_2O + \mathbf{Q}$$

The correct formula for substance **Q** is …

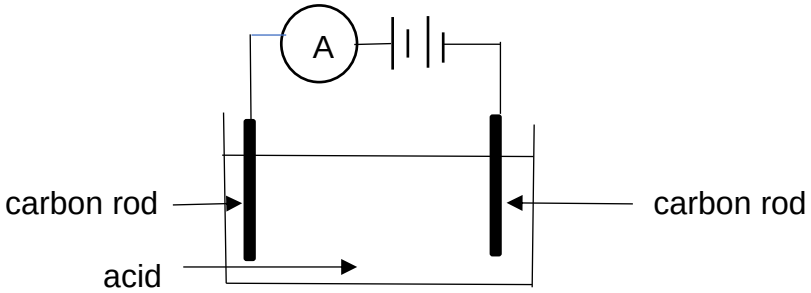
A $H_3PO_4$.

B $HPO_4^{2-}$.

C $PO_4^{3-}$.

D $H_3O^+$. (2)

1.10 The following circuit is used to test the conductivity of acids, HA and HB, at 25 °C. Both acids have a concentration of 1 mol·dm$^{-3}$.




The learners' results are shown in the table below.

| ACID | AMMETER READING (A) |
|---|---|
| HA | 0,8 |
| HB | 1,5 |

Learners write the following statements as their conclusions down:

**I.** HA is a stronger acid than HB

**II.** pH of HB is lower than that of HA

**III.** $K_a$ value of HB is higher than that of HA

Which ONE of the above statements is/are CORRECT?

A **I** only

B **II** only

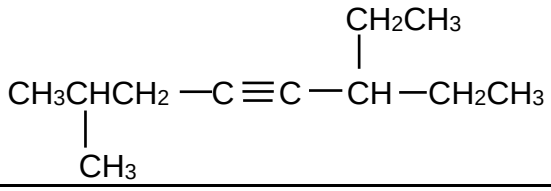
C **I** and **II** only

D **II** and **III** only (2)

**[20]**

**QUESTION 2 (Start on a new page.)**

Consider the organic compounds **A** to **F** given in the table below.

| | | | |
|---|---|---|---|
| **A** |  | **B** | propan-2-one |
| **C** | Bromomethane | **D** | $C_4H_8O$ |
| **E** | $C_7H_{15}COOH$ | **F** | Hexane |

2.1 To which homologous series do the following compounds belong?

2.1.1 Compound **A** (1)

2.1.2 Compound **C** (1)

2.2 Write down a LETTER for the compound that meets the following description:

2.2.1 A carboxylic acid (1)

2.2.2 A compound whose formula is the same as the empirical formula of compound **E** (1)

2.3 Compound **A** is a hydrocarbon.

2.3.1 Define the term *hydrocarbon.* (2)

2.3.2 Is compound **A** SATURATED or UNSATURATED?

Give a reason for the answer. (2)

2.3.3 Write down the IUPAC name of compound **A**. (3)

2.4 Write down the structural formula of compound **B**. (2)

2.5 Compound **D,** a straight chain molecule, has only ONE CHAIN ISOMER.

For compound **D** write down the:

2.5.1 IUPAC name (2)

2.5.2 STRUCTURAL formula of its CHAIN ISOMER (2)

2.6 A group of learners use compound **F** as a fuel by reacting it with excess oxygen.

Write down the:

2.6.1 Name of the reaction between compound **F** and oxygen (1)

2.6.2 Write down a balanced equation for the reaction of compound **F** with excess oxygen, by using the MOLECULAR FORMULAE (3)

2.6.3 Give a reason why alkanes are used as fuel (1)

**[22]**

**QUESTION 3 (Start on a new page.)**

3.1 A group of learners compare the boiling points of THREE compounds **A**, **B** and **C** during an investigation. The compounds have comparable molecular mass.

The data the learners obtained for the compounds is shown in the table below.

| | Compound | Boiling point (°C) |
|---|---|---|
| | | |
| **A** | Pentane | 36,1 |
| | | |
| **B** | Butan-2-one | 79,64 |
| | | |
| **C** | Butan-1-ol | 117,7 |

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

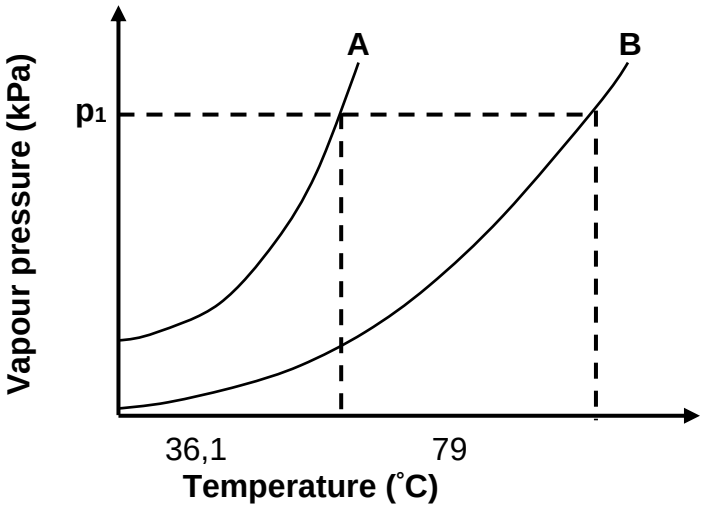
3.1.2 Identify the independent variable for this investigation. (1)

3.1.3 Which intermolecular forces are comparable in this investigation? (1)

3.1.4 Explain why the boiling point of compound **C** is HIGHER than that of compound **B** by referring to TYPE, RELATIVE STRENGTHS of intermolecular forces and ENERGY. (4)

3.2 The graphs below show how the vapour pressure of compounds **A** and **B** (shown in the table above) changes with temperature.

**GRAPH OF TEMPERATURE VERSUS VAPOUR PRESSURE**




3.2.1 Define the term *vapour pressure.* (2)

3.2.2 Write down the value of $p_1$ shown in the graph. (1)

3.2.3 In what phase is compound **A** at 50 ˚C?

Explain the answer. (2)

3.2.4 How would the vapour pressure of compound **C** compare, to that of compound **A** at 36,1 ˚C?

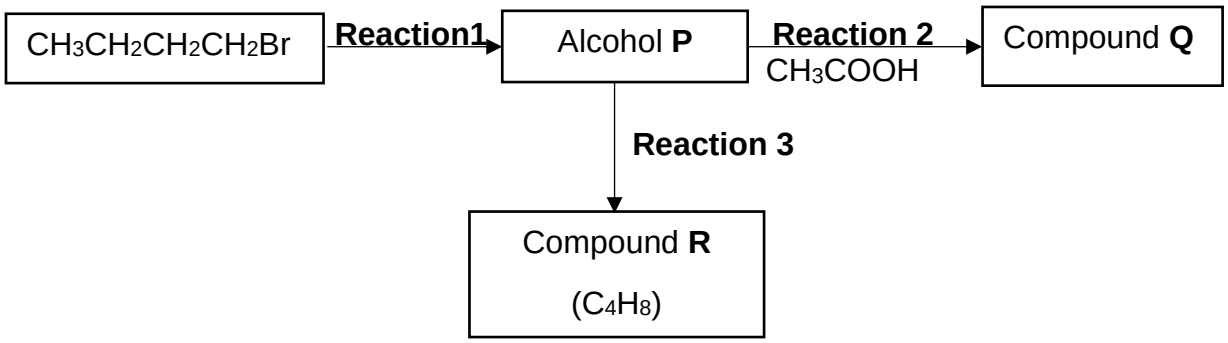
Choose from HIGHER THAN, LOWER THAN or EQUAL TO. (1)

3.2.5 Explain your answer to QUESTION 3.2.4. (2)

**[16]**

**QUESTION 4 (Start on a new page.)**

Consider the flow diagram given below. Compounds **P**, **Q** and **R** are organic products of **reactions 1, 2** and **3** respectively.




For **REACTION 1** write down the:

4.1 Name of the type of reaction taking place (1)

4.2 Condensed structural formula of compound **P** (2)

4.3 Is alcohol **P** a primary, secondary, or tertiary alcohol?

Give a reason for the answer. (2)

For **REACTION 2** write down the:

4.4 Name of the reaction taking place (1)

4.5 IUPAC name and structural formula of the organic product **Q** (4)

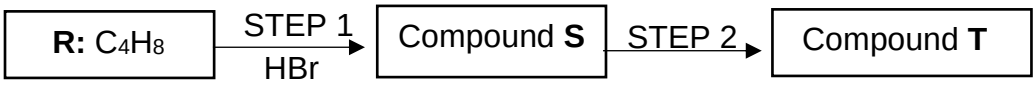
4.6 Type of elimination reaction represented by **REACTION 3** (1)

4.7 ONE reaction condition other than heat for **REACTION 3** (1)

Compound **R**, $C_4H_8$, produced in reaction **3** in the flow diagram above is converted to compound **T** in a TWO step process as shown below.

Compounds **R** and **T** are unbranched POSITIONAL isomers.




4.8 Define the term *positional isomer.* (2)

4.9 Write down a balanced equation using structural formulae for the reaction taking place in STEP 2. (6)
**[20]**

**QUESTION 5 (Start on a new page.)**

The decomposition of hydrogen peroxide represented by the balanced equation below is used to investigate the factors that influence reaction rate.

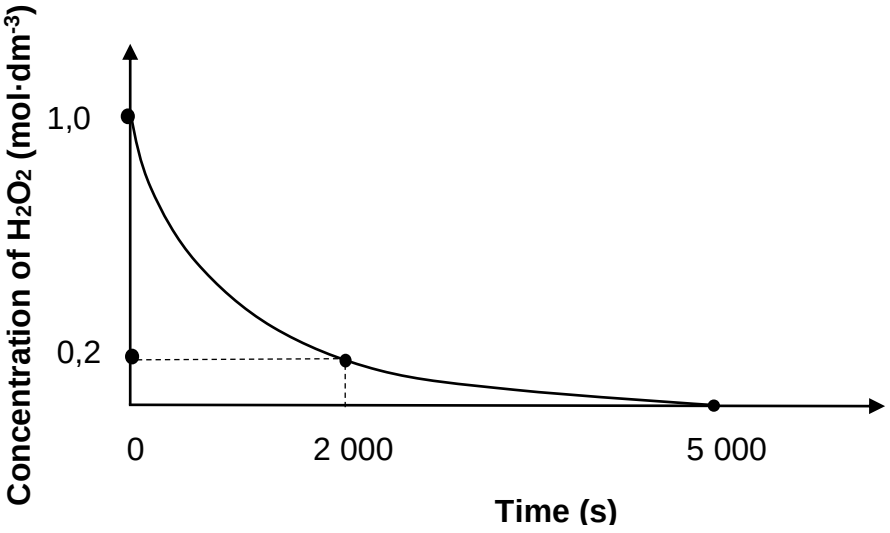
$$H_2O_2(aq) \rightarrow H_2(g) + O_2(g) \quad \Delta H < 0$$

5.1 Define *reaction rate.* (2)

5.2 Besides temperature, write down TWO factors that affect the rate of this reaction. (2)

5.3 During an experiment (**experiment 1**),150 $cm^3$ of $H_2O_2$ decomposes at 30 ˚C in a flask.

The graph below shows the results of **experiment 1**.




5.3.1 Give a reason why the rate of reaction decreases between t = 2 000 s and t = 5 000 s. (2)

5.3.2 How long (in seconds) did the reaction take to reach completion? (1)

Calculate the:

5.3.3 Average rate of reaction (3)

5.3.4 Volume of oxygen produced during the interval t = 0 to t = 2 000 s. Assume that the molar gas volume at 30 ˚C is 25 000 $cm^3 \cdot mol^{-1}$.

ASSUME THAT THE VOLUME OF THE SOLUTION REMAINS CONSTANT. (5)

5.4 How will the following be affected if the volume of hydrogen peroxide ($H_2O_2$) used in **experiment 1** is doubled?

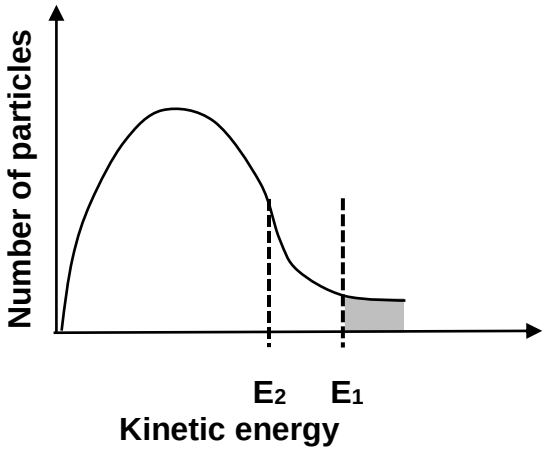
Choose from INCREASES, DECREASES or REMAINS THE SAME.

5.4.1 Average rate of reaction (1)

5.4.2 Total volume of oxygen produced (1)

5.5 In **experiment 2** hydrogen peroxide decomposes under the same conditions as in **experiment 1**, but a small amount of manganese dioxide is added.

The Maxwell-Boltzmann distribution curve for the reaction in **experiment 1** and **experiment 2** is shown below.




**$E_1$** and **$E_2$** represent activation energies for the reaction in **experiments 1** and **2**.

5.5.1 Define *activation energy.* (2)

5.5.2 Describe what is represented by the shaded area in the graph. (1)

5.5.3 Which ONE of **$E_1$** or **$E_2$** would yield a higher reaction rate? Explain the answer by referring to the collision theory. (4)

**[24]**

**QUESTION 6 (Start on a new page.)**

6.1 The following reaction reaches equilibrium at a temperature of 327 ˚C.

$$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g) \qquad \Delta H < 0$$

6.1.1 What is the meaning of the double arrow "⇌"? (1)

How does the rate of the forward reaction compare to the rate of the reverse reaction during the following time intervals?

Choose from HIGHER THAN, LOWER THAN or EQUAL TO.

6.1.2 Before equilibrium is reached for the first time (2)

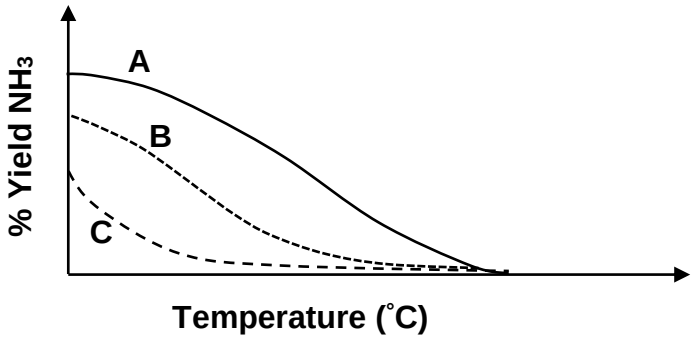
6.1.3 At equilibrium (1)

The reaction is started by placing 4,88 moles of $N_2$ and 6,18 moles of $H_2$ in a 2 $dm^3$ sealed container and allowed to react. When equilibrium is established at 327 ˚C it is found the 41,48 grams of $NH_3$ is present.

6.2 Calculate the equilibrium constant, Kc, at 327 ˚C. (8)

6.3 Write down the name of a factor that affects the value of Kc. (1)

6.4 The graph below shows how the percentage yield of $NH_3$ varies with pressure at different temperature values.




Which graph (**A**, **B** or **C**) represents percentage yield values obtained at the HIGHEST pressure?

Explain the answer by referring to Le Chatelier's principle. (4)

6.5 What effect will the following changes have on the yield of $NH_3$ at equilibrium?

Choose from INCREASES, DECREASES or NO EFFECT.

6.5.1 More $N_2$ is pumped into the container. (1)

6.5.2 A suitable catalyst is added. (1)

6.5.3 The volume of the container is increased at constant temperature. (1)

**[20]**

**QUESTION 7 (Start on a new page.)**

7.1 Sulphuric acid, $H_2SO_4$ ionises according to the balanced equation below:

$$H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$$

7.1.1 Define an *acid* according to the Lowry-Brønsted theory. (2)

7.1.2 Write down the formulae of the TWO bases in the reaction above. (2)

7.1.3 Identify a substance in the reaction that can act as an ampholyte in some reactions. (1)

7.2 The table below gives information about solutions of two acids and a salt.

| NAME OF SUBSTANCE | FORMULA | Ka value or pH |
|---|---|---|
| Ethanoic acid | $CH_3COOH$ | $K_a = 1,8 \times 10^{-4}$ at 25 ˚C |
| Sulphuric acid | $H_2SO_4$ | pH = 3 |
| Sodium carbonate | $Na_2CO_3$ | pH = 7,8 |

7.2.1 Is $CH_3COOH$ a STRONG or a WEAK acid?

Give a reason for the answer. (2)

7.2.2 Which acid, $CH_3COOH$ or $H_2SO_4$, would react faster with $Na_2CO_3$?

Assume the acids have the same concentration and are in excess. (1)

7.2.3 Calculate the concentration of the $H_2SO_4$ solution. (4)

7.2.4 Explain by using a relevant equation, why the pH of $Na_2CO_3$ is greater than 7. (3)

7.3 A standard solution is prepared by dissolving 1,74 g of $Mg(OH)_2$ in water to make 200 $cm^3$ of the solution.

7.3.1 Define the term *standard solution.* (2)

7.3.2 Show by calculation that the concentration of the $Mg(OH)_2$ solution is 0,15 $mol \cdot dm^{-3}$. (2)

A group of learners added 50 $cm^3$ of a **dilute** hydrochloric acid solution to 40 $cm^3$ of the standard solution of $Mg(OH)_2$.

The balanced equation for the reaction is:

$$Mg(OH)_2 + 2\ HC\ell \rightarrow MgC\ell_2 + 2\ H_2O$$

The **diluted** hydrochloric acid solution was obtained by adding 5 $cm^3$ of 10 $mol \cdot dm^{-3}$ of concentrated hydrochloric acid to water to produce 100 $cm^3$ of the **diluted** acid solution. ONE of the ions ($OH^-$ or $H_3O^+$) is found to be in excess at the completion of the reaction.

7.3.3 Calculate the concentration of the ions in excess. (9)
**[28]**

**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

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

## TABLE 2: FORMULAE/TABEL 2: FORMULES

| | | |
|---|---|---|
| $n = \frac{m}{M}$ or/of<br>$n = \frac{N}{N_A}$ or/of<br>$n = \frac{V}{V_o}$ | $c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$<br>$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ | $pH = -\log[H_3O^+]$<br>$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$<br>at/by 298 K |
| | | |
| $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$<br>$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$<br>$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$ | | |

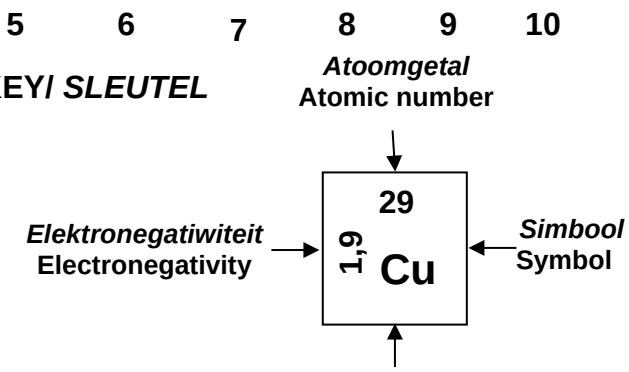
 

## TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

| 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*



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# NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

## GRADE/*GRAAD* 12

## JUNE/*JUNIE* 2022

# PHYSICAL SCIENCES: CHEMISTRY P2
# MARKING GUIDELINE/
# *FISIESE WETENSKAPPE: CHEMIE V2*
# *NASIENRIGLYN*

**MARKS/*PUNTE*: 150**

This marking guideline consists of 13 pages./
*Hierdie nasienriglyn bestaan uit 13 bladsye.*

## QUESTION/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 C ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

1.7 B ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 D ✓✓ (2)

**[20]**

## QUESTION/*VRAAG 2*

2.1 2.1.1 Alkyne ✓ (1)

2.1.2 Haloalkane ✓ (1)

2.2 2.2.1 E ✓ (1)

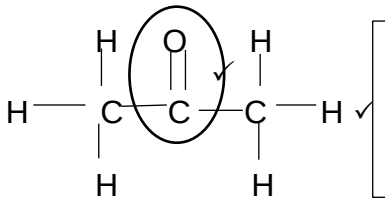
2.2.2 D ✓ (1)

2.3 2.3.1 Compound that contains carbon and hydrogen atoms only. ✓✓ (2 or 0)
*Verbinding wat slegs koolstof- en waterstof-atome bevat. (2 of 0)* (2)

2.3.2 UNSATURATED ✓ Contains triple bond ✓/multiple bonds (between the C-atoms in die hydrocarbon chain)
*ONVERSADIG Bevat 'n drievoudige binding/ meervoudige bindings (tussen C-atome in die koolwaterstofketting)* (2)

2.3.3 6-ethyl ✓-2-methyl ✓oct-4-yne ✓ / 6-ethyl-2-methyl-4-octyne
*6-etiel-2-metielokt-4-yne / 6-etiel-2-metiel-4-oktyn* (3)

2.4

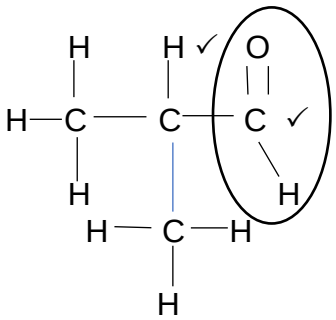


**Marking criteria/*Nasienkriteria***:
- Whole structure correct/*Hele struktuur korrek: (2/2)*
- Only functional group correct
  *Slegs funksionele groep korrek* Max./*Maks. (1/2)*

(2)

2.5 2.5.1 Butanal ✓✓ (2)

2.5.2



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

(2)

2.6 2.6.1 Combustion ✓/Oxidation
*Verbranding / Oksidasie* (1)

2.6.2 $2\ C_6H_{14} + 19\ O_2$ ✓ → $12\ CO_2 + 14\ H_2O$ ✓ (✓ Balancing/ *balansering*) (3)

2.6.3 Compound A reacts exothermically with oxygen / releases heat when it reacts with oxygen. ✓
*Verbinding A reageer eksotermies met suurstof / hitte word vrygestel wanneer dit met suurstof reageer.* (1)

**[22]**

## QUESTION/*VRAAG* 3

3.1 3.1.1 Boiling point is the temperature ✓at which the vapour pressure of a liquid equals the atmospheric pressure. ✓
*Kookpunt is die temperatuur waarby die dampdruk van 'n vloeistof gelyk is aan die atmosferiese druk.* (2)

3.1.2 Functional group/ ✓Homologous series/ Type of intermolecular forces.
*Funksionele groep / Homoloë reeks / Tipe intermolekulêrekragte.* (1)

3.1.3 London forces ✓/induced dipole forces/dispersion forces.
*Londonkragte/geïnduseerde dipool kragte/verspreidingskragte.* (1)

3.1.4 **C** has hydrogen bonds ✓ (in addition to London forces)
**B** has dipole-dipole forces ✓(in addition to London forces)
Hydrogen bonds are stronger than dipole dipole-forces ✓
More energy is needed to overcome intermolecular forces in **C** ✓

***C** het waterstofbinding (bykomend tot Londonkragte)*
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*
*Waterstofbindings is sterker as die dipool-dipoolkragte*
*Meer energie word benodig om die intermolekulêrekragte te oorkom in **C***

**OR/*OF***

**C** has hydrogen bonds ✓ (in addition to London forces)
**B** has dipole-dipole forces ✓(in addition to London forces)
Dipole dipole forces are weaker than hydrogen bonds ✓
Less energy is needed to overcome intermolecular forces in **B** ✓

***C** het waterstofbinding (bykomend tot Londonkragte)*
***B** het dipool-dipoolkragte (bykomend tot Londonkragte)*
*Dipool-dipool is swakker as die waterstofbindings*
*Minder energie word benodig om die intermolekulêrekragte te oorkom in **B***** (4)

3.2 3.2.1 Vapour pressure is the pressure exerted by a vapour ✓ in equilibrium with its liquid in a closed container./ ✓
*Dampdruk is die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem.* (2)

3.2.2 $\mathbf{p_1}$ = 100 (kPa) ✓/101,3 (kPa) / 1 atmosphere / *atmosfeer* (1)

3.2.3 Gas ✓ **A** is above its boiling point / *Bo **A** se kookpunt* ✓ (2)

3.2.4 LOWER THAN/*LAER AS* ✓ (1)

3.2.5 Compound C only reached its boiling point at 117,7 ˚C where its vapour pressure will equal 101,3 kPa. ✓✓
*Verbinding C bereik eers sy kookpunt by 117,7 ˚C waar sy dampdruk eers gelyk aan 101,3 kPa gaan wees.* (2)

**[16]**

## QUESTION/*VRAAG* 4

4.1 Substitution ✓/Hydrolysis (of haloalkanes)
*Substitusie / Hidrolise (van haloalkane)* (1)

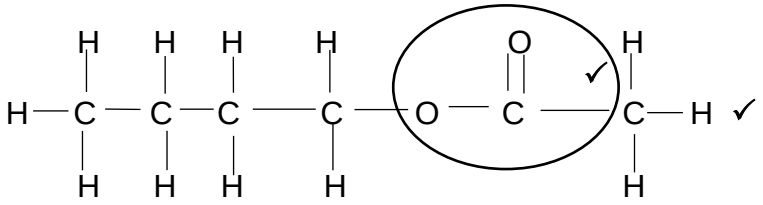
4.2 $CH_3CH_2CH_2CH_2OH$ ✓✓ (2)

4.3 Primary alcohol ✓
The carbon atom that contains the hydroxyl group (-OH) is bonded to one other carbon atom only. ✓
*Primêre alkohol*
*Die koolstof-atoom wat die hidroksielgroep (-OH) bevat is verbind aan slegs een ander koolstof-atoom.* (2)

4.4 Esterification/Condensation ✓
*Esterifikasie / Kondensasie* (1)

4.5 Butyl ethanoate / *Butiel-etanoaat* ✓✓

**Marking criteria/*Nasienkriteria*:**
- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/
  *Hele struktuur korrek* ✓ *(2/2)*



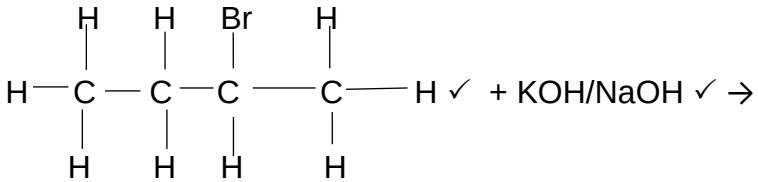
(4)

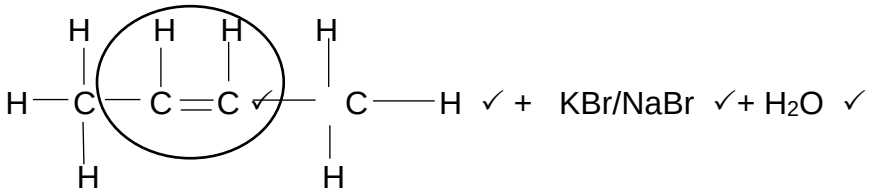
4.6 Dehydration / *Dehidrasie* ✓ (1)

4.7 (concentrated / *gekonsentreerde*) $H_2SO_4$ ✓ (1)

4.8 Compounds with same molecular formula ✓ but different positions of the functional group ✓/side chains/substituent on the parent chain./
*Verbindings met dieselfde molekulêre formule maar verskillende posisies van die funksionele groep/sykettings/substituent op die stamketting.* (2)

4.9




**Marking criteria/ *Nasienkriteria***

**Reactants / *Reaktanse***

- Organic molecule correct/ *Organiese molecule korrek* ✓
- KOH/NaOH ✓

**Products / *Produkte***

- **Organic molecule / *Organiese molekule***
- Functional group/*Funksionele groep.* ✓ (1/2)
- Whole structure correct/
  *Hele struktuur korrek* ✓ *(2/2)*

**Inorganic products / *Anorganiese produkte***

- KBr/NaBr ✓
- $H_2O$ ✓

(6)
**[20]**

## QUESTION 5/*VRAAG 5*

5.1 Change in concentration ✓per unit time. ✓/Amount of product formed/reactant used up per unit time.
*Verandering in konsentrasie per eenheid tyd / Hoeveelheid produk gevorm / reaktanse opgebruik per eenheidstyd.*

**OR/*OF***

Rate of change in concentration **(2 or 0)**
*Tempo van verandering in konsentrasie **(2 of 0)*** (2)

5.2 Concentration ✓ and a catalyst. ✓/
*Konsentrasie en 'n katalisator.* (2)

5.3 5.3.1 Concentration (of $H_2O_2$) decreases / *Konsentrasie (van $H_2O_2$) verlaag* ✓✓ (2)

5.3.2 t = 5 000(s) ✓ (1)

5.3.3 Rate/*tempo* = - $\Delta c/\Delta t$ = - ( 1,0 – 0) ✓/(0 – 5 000) ✓
= 2 x $10^{-4}$ ✓$mol \cdot dm^{-3} \cdot s^{-1}$ (3)

5.3.4 $\Delta c = 0,8\ mol \cdot dm^{-3}$

$n (H_2O_2) = cV$
$= 0,8 \times (0,15)$ ✓
$= 0,12\ mol$

$n (H_2O_2) = n (O_2) = 0,12\ mol$ ✓ (Ratio / *verhouding*)

$n = V/Vm$ ✓

$0,12 = V/25\ 000$ ✓

$V = 3\ 000\ cm^3$ ✓/$(3\ dm^3)$ (5)

5.4 5.4.1 Decrease / *Verlaag* ✓ (1)

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

5.5 5.5.1 Minimum energy required for a reaction to take place. ✓✓/
*Minimum energie benodig vir 'n reaksie om plaas te vind.* (2)

5.5.2 Particles with sufficient kinetic energy to react. ✓/
*Deeltjies met genoeg kinetiese energie om te reageer.* (1)

5.5.3 $E_2$ ✓

Calatyst lowers the activation energy ✓
More particles have sufficient kinetic energy to react ✓
More effective collisions per unit time ✓/Frequency of effective collisions increases
*'n Katalisator verlaag die aktiveringsenergie.*
*Meer deeltjies het genoeg kinetiese energie om te reageer*
*Meer effektiewe botsings per eenheid tyd / Frekwensies van die effektiewe botsings neem toe* (4)

**[24]**

## QUESTION 6/*VRAAG 6*

6.1 6.1.1 Reversible ✓ (reaction) / *Omkeerbare (reaksie)* (1)

6.1.2 HIGHER THAN / *HOËR AS* ✓✓ (2)

6.1.3 EQUAL TO / *GELYK AAN* ✓ (1)

6.2 **OPTION 1/ *OPSIE 1* : MOLE OPTION / *MOL OPSIE***
**Marking Criteria/ *Nasienkriteria*:**

- Divide by 17 to calculate $n(NH_3)_{equilibrium.}$ ✓
  *Deel deur 17 om $n(NH_3)_{ewewig}$ te bereken.*
- $\Delta n\ NH_3$ ✓
- Use mole ratio $N_2:H_2:\ NH_3$ / *Gebruik mol verhouding* $N_2:H_2:\ NH_3$ ✓
- n equilibrium / *ewewig* $N_2$ and/*en* $H_2$ ✓
- Divide 2 $dm^3$ all $n_{equilibrium}$ / *Deel deur 2 $dm^3$ in alle $n_{ewewig}$* ✓
- Correct $K_c$ expression/*Korrekte $K_c$ uitdrukking.* ✓
- Substitution into $K_c$ expression ✓/*Vervanging in $K_c$ uitdrukking.*
- Final answer / *Finale antwoord* (0,41) ✓

$n\ (NH_3) = m/M = 41,48/17$ ✓ $= 2,44$ mol

| | $N_2$ | $3\ H_2$ | $2\ NH_3$ | |
|---|---|---|---|---|
| $n_i$ | 4,88 | 6,18 | 0 | |
| $\Delta n$ | 1,22 | 3,66 | 2,44 ✓ | **Ratio / *verhouding*** |
| $n_e$ | 3,66 | 2,52 ✓ | 2,44 ✓ | |
| $c_e$ | 1,83 | 1,26 | 1,22 ✓ | **(Div/by *deel met* 2 $dm^3$)** |

$Kc = [NH_3]^2/[N_2].[H_2]^3$ ✓

$= 1,22^2/1,83 \times 1,26^3$ ✓

$= 0,41$ ✓

**OPTION 2: CONCENTRATION / *OPSIE 2: KONSENTRASIE***
**Marking criteria/ *Nasienkriteria*:**

- Calculate c $(NH_3)_{equilibrium.}$ ✓
  *Bereken* $c(NH_3)_{ewewig}$
- $\Delta c\ NH_3$ ✓
- $c_i\ N_2$ and/*en* $H_2$ ✓
- Use conc. ratio $N_2:H_2:NH_3$/*Gebruik gekonsen. verhouding* $N_2:H_2:NH_3$ ✓
- c equilibrium /*ewewig* $N_2$ and/*en* $H_2$ ✓
- Correct $K_c$ expression/*Korrekte* $K_c$ *uitdrukking.* ✓
- Substitution into Kc expression ✓/*Vervanging in* $K_c$ *uitdrukking.*
- Final answer/*Finale antwoord* (0,41) ✓

$n\ (NH_3) = m/M = 41,48/17 = 2,44$ mol

$c_e\ (NH_3) = n/V = 2,44/2$ ✓ $= 1,22\ mol{\cdot}dm^{-3}$

$c_i\ (N_2) = n/V = 4,88/2 = 2,44\ mol{\cdot}dm^{-3}$

$c_i\ (H_2) = n/V = 6,18/2 = 3,09\ mol{\cdot}dm^{-3}$

| | $N_2$ | $3\ H_2$ | $2\ NH_3$ | |
|---|---|---|---|---|
| $c_i$ | 2,44 | 3,09 | 0 | |
| $\Delta c$ | 0,61 | 1,83 | 1,22 ✓ | **Ratio / *verhouding*** |
| $c_e$ | 1,83 | 1,26 ✓ | 1,22 ✓ | |

$Kc = [NH_3]^2/[N_2].[H_2]^3$ ✓

$= 1,22^2/1.83 \times 1,26^3$ ✓

= 0,41 ✓ (8)

6.3 Temperature / *Temperatuur* ✓ (1)

6.4 **A** ✓
At a given temperature the yield of $NH_3$ is the highest ✓ (in graph **A**)
Increase pressure favours reaction which produces less gas moles ✓
Forward reaction is favoured ✓
*By 'n gegewe temperatuur is die opbrengs van* $NH_3$ *die hoogste (in grafiek **A**)*
*Toename in druk bevoordeel die reaksie wat die minste gas mol produseer*
*Voorwaartse reaksie word bevoordeel* (4)

6.5 6.5.1 Increase / *Toeneem* ✓ (1)

6.5.2 No effect / *Geen effek* ✓ (1)

6.5.3 Decrease/ *Afneem* ✓ (1)
**[20]**

## QUESTION 7/*VRAAG 7*

7.1 7.1.1 An acid is a proton ($H^+$-ion) donor ✓✓
*'n Suur is 'n proton ($H^+$-ioon) -skenker* (2)

7.1.2 $H_2O$ ✓ and / *en* $H_2SO_4^-$ ✓ (2)

7.1.3 $H_2O$ or/*of* $HSO_4^-$ (Any ONE / *Enige EEN* ✓) (1)

7.2 7.2.1 WEAK ACID ✓ Low Ka value/ Ka < 1 ✓
*SWAKSUUR Lae Ka-waarde / Ka < 1* (2)

7.2.2 $H_2SO_4$ ✓ (1)

7.2.3 pH = - log $[H_3O^+]$ ✓

3 = - log $[H_3O^+]$ ✓

$[H_3O^+]$ = 1 x $10^{-3}$ mol·dm$^{-3}$

$[H_2SO_4]$ = ½ x $10^{-3}$ ✓

= 5 x $10^{-4}$ mol.dm$^{-3}$ ✓ (4)

**Marking criteria/ *Nasienkriteria***
- pH formula / formule
- Substitution / Substitusie
- Ratio / Verhouding
- Final answer / Finale antwoord

7.2.4 $CO_3^{2-}$ + $H_2O$ ✓ → $HCO_3^-$ + $OH^-$✓

$Na_2CO_3$ + $H_2O$ → $NaHCO_3$ + NaOH

(Excess) $OH^-$ formed / *(oormaat) $OH^-$ word geproduseer* ✓ (3)

7.3.1 It is a solution of known concentration ✓✓
*Dit is 'n oplossing van bekende konsentrasie* (2)

7.3.2

| **OPTION 1 / *OPSIE 1:*** | **OPTION 2 / *OPSIE 2:*** |
|---|---|
| n = m/M<br>n = 1,74/58 ✓<br>= 0,03 mol<br>c = n/V<br>= 0,03 / 0,2 ✓<br>= 0,15 mol·dm$^{-3}$ | c = m/MV<br>c = 1,74 / (58)(0,2) ✓✓<br>= 0,15 mol·dm$^{-3}$ |
| **OPTION 3 / *OPSIE 3*:** | **OPTION 4 / *OPSIE 4:*** |
| n = cV<br>= (0,15)(0,2) ✓<br>n = 0,3 mol<br>m = nM<br>= (0,3)(58) ✓<br>= 1,74 g | m = cMV<br>= (0,15)(58)(0,2) ✓✓<br>m = 1,74 g |

(2)

7.3.3 **Marking guideline / *Nasienriglyn***

- Calculating mole for $Mg(OH)_2$ / *Bereken mol vir* $Mg(OH)_2$
- Calculating the diluted concentration for HCl / *Bereken die verdunde konsentrasie van HCl*
- Calculating the total mole for HCl / *Bereken die totale mol van HCl*
- Calculating the reacted mole for HCl / *Bereken die mol van HCl wat gereageer het*
- Determining the remaining mole for HCl / *Bepaal die mol van HCl wat oorbly*
- Use of formula c = n/V in calculating the concentration of excess ions / *Gebruik formule c = n/V om die konsentrasie van die oormaat ione te bereken*
- Substituting into / *Vervanging in* c = n/V
- Final answer/ *Finale antwoord*

n $[Mg(OH)_2]$ = cV
= 0,15 x 0,04 ✓
= 0,006 mol

$c_1V_1 = c_2V_2$
5 x10 = $c_2$(100) ✓
$c_2$ = 0,5 mol·dm$^{-3}$

**OR/OF**

n = cV
= (10)5 x $10^{-3}$ )
n = 0,05 mol
c = $\frac{n}{V}$ ✓
= $\frac{0,05}{0,1}$
c = 0,5 mol.dm$^{-3}$

n (HCl) = cV
= 0,5 x 0,05 ✓
= 0,025 mol

n (HCl) reacting = 2 x 0,006 ✓ = 0,012 mol

n (HCl) remaining = 0,025 – 0,012 ✓✓ = 0,013 mol

c (HCl) = n/V ✓= 0,013 / (0,09) ✓ = 0,14 mol·dm$^{-3}$ ✓ (9)
**[28]**

**TOTAL/*TOTAAL*: 150**