



**GAUTENG PROVINCE**  
EDUCATION  
REPUBLIC OF SOUTH AFRICA



# PROVINCIAL EXAMINATION

## NOVEMBER 2023

### GRADE 10

**PHYSICAL SCIENCES: CHEMISTRY**  
**PAPER 2**

*Stanmorephysics*

**TIME: 2 hours**

**MARKS: 100**

**10 pages + 2 data sheets**





## INSTRUCTION AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SEVEN questions. Answer ALL the 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. Write neatly and legibly.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the DATA SHEETS that are attached.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a minimum of TWO decimal places.



### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question numbers (1.1 to 1.9) in the ANSWER BOOK, e.g. 1.10 D.

- 1.1 Which of the following solids consist of a lattice of positive ions in a “sea” of delocalised electrons?
- A Ice   
B Iodine  
C Diamond  
D Potassium (2)
- 1.2 The chemical properties of an element are determined by the number and arrangement of the element's ...
- A atoms.  
B protons.  
C electrons.  
D ions. (2)
- 1.3 An atom X forms an ion  $X^+$ . The atom X and ion  $X^+$  have the same ...
- A number of electrons.  
B atomic radius.  
C ionisation energy.  
D number of protons. (2)
- 1.4 Metal M forms a nitrate with the formula  $MNO_3$ . Which of the following formulae for compounds of M is NOT correct?
- A  $M_2SO_4$   
B  $MCl$   
C  $M(OH)_2$   
D  $M_2CO_3$  (2)
- 1.5 Which of the following represents the electron configuration of an alkaline-metal ion?
- A  $1s^2$   
B  $1s^2 2s^2$   
C  $1s^2 2s^2 2p^5$   
D  $1s^2 2s^2 2p^6 3s^1$   (2)

1.6 Which of the following equations represents a chemical change?

- A  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$
- B  $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$
- C  $\text{NaCl}(\text{s}) \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
- D  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$  (2)

1.7 The percentage water in  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  is:

- A 51,22
- B 48,78
- C 21
- D 7 (2)

1.8 All of the following consist of approximately one mole of particle EXCEPT:

- A  $6 \times 10^{23}$  helium atoms
- B 1 g of hydrogen molecules
- C 12 g of carbon atoms
- D  $22,4 \text{ dm}^3$  ammonia at STP (2)

1.9 2,7 g of sodium hydroxide is added to  $250 \text{ cm}^3$  distilled water. Which of the following is the CORRECT concentration of solution in  $\text{mol} \cdot \text{dm}^{-3}$ ?

- A 0,15
- B 0,5
- C 0,27
- D 2,5 (2)

[18]



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

Use the table of substances below to answer the following questions.

$\text{Br}_2$	C	$\text{CuSO}_4 \cdot x\text{H}_2\text{O}$	$\text{H}_3\text{O}^+$
$\text{H}_2\text{O}$	$\text{NH}_3$	$\text{OH}^-$	Ni
Brass	S	Si	$\text{KMnO}_4$

2.1 Write down a substance that is:

2.1.1 An anion (1)

2.1.2 A metalloid (1)

2.1.3 A magnetic substance (1)

2.1.4 A non-metal that is a conductor of electricity (1)

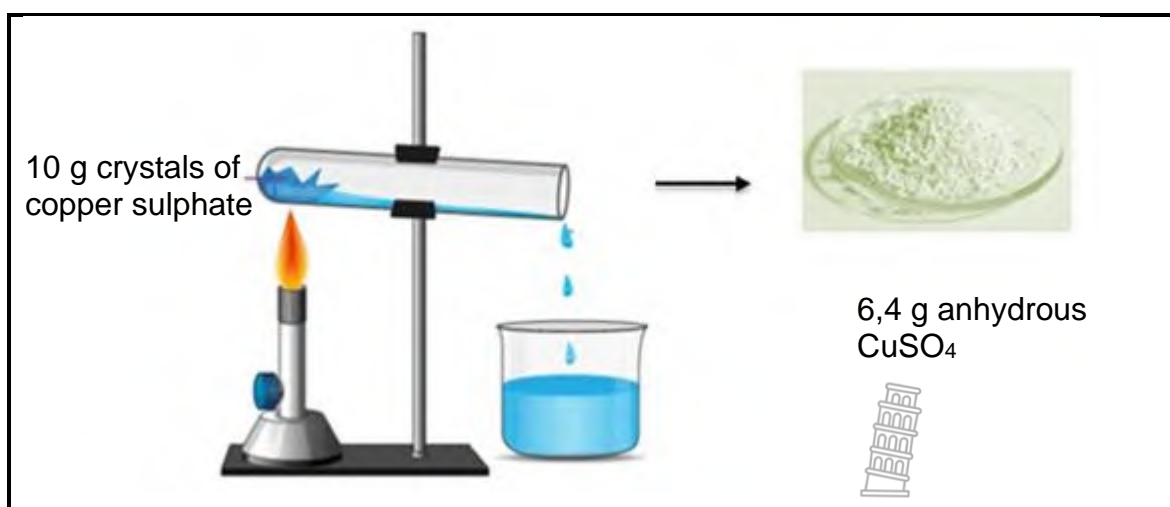
2.1.5 An alloy (1)

2.1.6 A diatomic molecule (1)

2.2 Compare the first ionisation energy of C and Si. (1)

2.3 Draw the Aufbau diagram of S. (3)

2.4 The experimental setup below is used to dry 10 g hydrated blue copper (II) sulphate crystals,  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ , to form 6,4 g anhydrous salt.



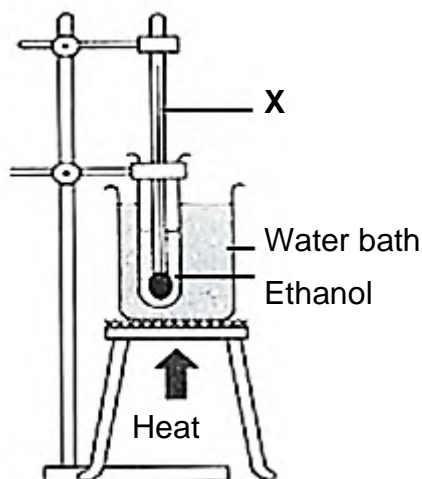
2.4.1 Define term *anhydrous*. (2)

2.4.2 Determine the number of moles, **X**, of water of crystallization. (4)

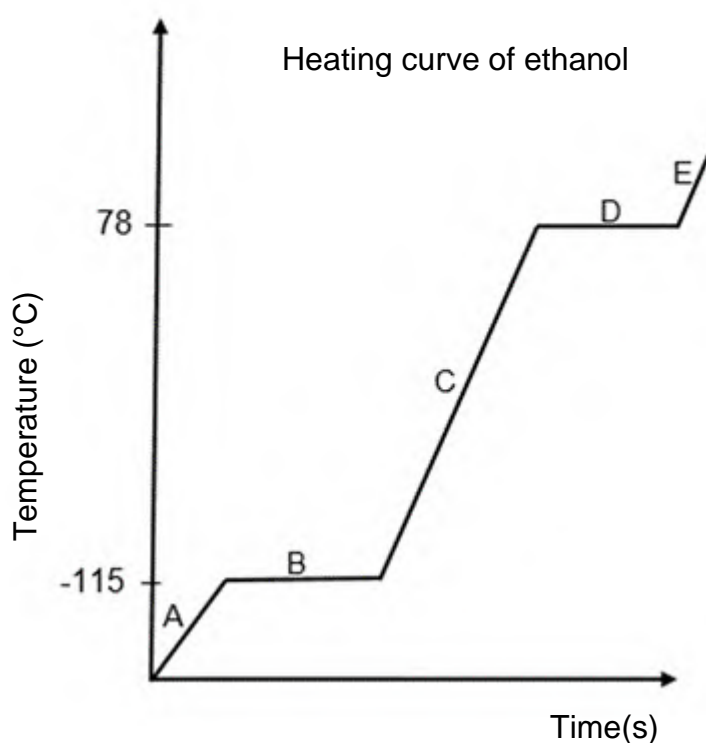
**[16]**

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

The grade 10 learners conducted an experiment to investigate the effect of the increase in temperature on ethanol over a period of time at standard pressure.



The graph below was drawn using the results obtained.

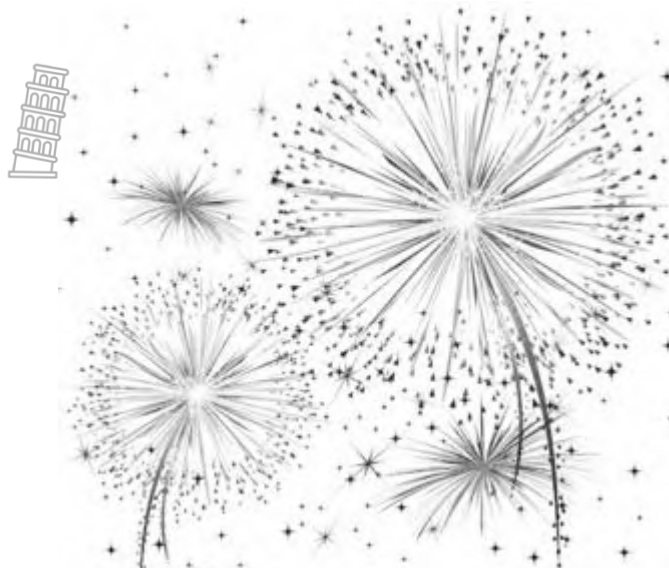


- 3.1 Define the term *melting point*. (2)
- 3.2 Write down the value of standard pressure. (1)
- 3.3 Give the name of apparatus **X**. (1)
- 3.4 In what phase is ethanol at 0 °C? (1)
- 3.5 Explain, using the kinetic molecular theory, what is happening at section **D**. (3)
- 3.6 Will water or ethanol boil first at standard pressure? Explain the answer. (3)



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

Strontium is best known for the brilliant reds it produces from its salts in fireworks and flares.



Strontium is an element on the Periodic Table in period 5 group 2. The four isotopes of strontium have isotopic mass numbers of 84, 86, 87 and 88 and relative abundance of 0,56%, 9,86%, 7% and 82,58% respectively.

- 4.1 Define the term *isotope*. (2)
- 4.2 Write down the symbol of strontium. (1)
- 4.3 How many valence electrons does strontium have? (1)
- 4.4 Compare the atomic radius of strontium and magnesium. (2)
- 4.5 Calculate the relative atomic mass of strontium. (3)

**[9]**



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

An unknown organic compound has a formula of  $C_xH_yO_z$ . The molar mass of this compound is  $88 \text{ g}\cdot\text{mol}^{-1}$ .



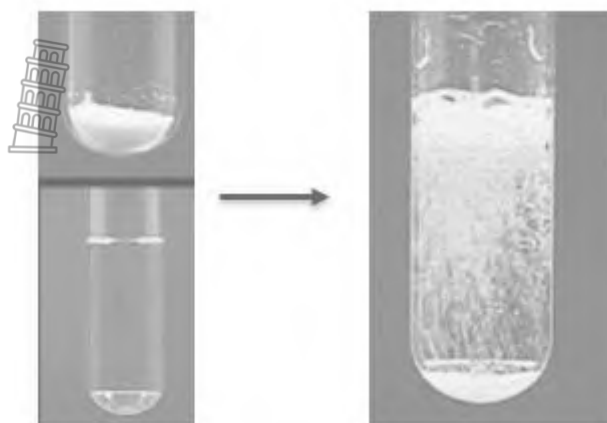
- 5.1 Define the term *empirical formula*. (2)
- 5.2 A 2 g sample of this compound contains 1,09 g carbon and 0,18 g hydrogen.  
Calculate the:
- 5.2.1 Mass oxygen in this sample (1)
- 5.2.2 Empirical formula of this compound (6)
- 5.3 Determine the molecular formula of this compound. (3)
- [12]**





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

In the reaction below, 3 g of  $\text{Na}_2\text{CO}_3$  were reacted with hydrochloric acid solution and an effervescence is observed.

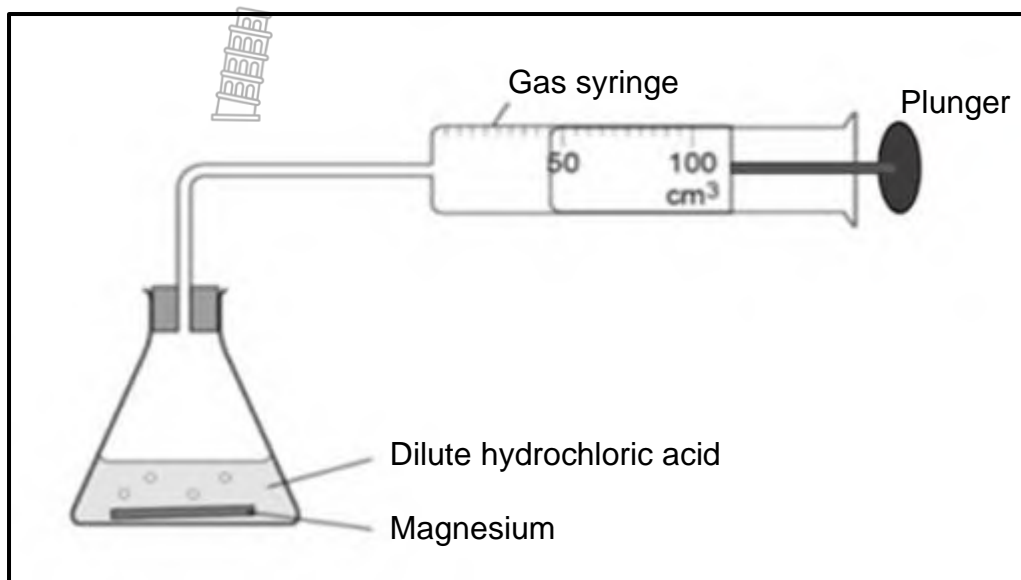
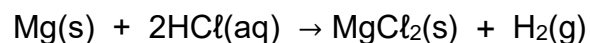


- 6.1 Copy and balance the chemical equation. (2)
- 6.2 Write the NAME and FORMULAE of the substance that caused the effervescence. (2)
- 6.3 From the chemical equation write down the FORMULAE of TWO compounds that are:
- 6.3.1 Covalent bonded (2)
- 6.3.2 Ionic bonded (2)
- 6.4 Draw Lewis dot diagrams for:
- 6.4.1  $\text{CO}_2$  (2)
- 6.4.2  $\text{H}_2\text{O}$  (2)
- 6.5 Calculate the molar mass of  $\text{Na}_2\text{CO}_3$ . (2)
- 6.6 Calculate the number of moles of the 3 g of  $\text{Na}_2\text{CO}_3$  used. (3)
- 6.7 Determine the number of oxygen atoms present in the 3 g of  $\text{Na}_2\text{CO}_3$  used. (4)

**[21]**

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

In the reaction below, magnesium ribbon reacts with excess hydrochloric acid according to the following balanced chemical equation. When the reaction has stopped, the plunger in the syringe remained in the position as shown in the diagram below.



- 7.1 Define *one-mole* of a substance. (2)
- 7.2 Write down the volume of H<sub>2</sub> gas collected in the syringe. (2)
- 7.3 Write down ONE physical observation that indicates that a reaction is taking place. (1)
- 7.4 Calculate the number of moles of hydrogen gas formed at STP. (4)
- 7.5 Determine the mass of the magnesium ribbon used. (4)

**[13]**

**TOTAL: 100**



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

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

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$



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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(I)	(II)											(III)	(IV)	(V)	(VI)	(VII)	(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 99	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**

Atomic number  
Atoomgetal

Electronegativity  
Elektronegatiwiteit

Symbol  
Simbool

Approximate relative atomic mass  
Benaderde relatiewe atoommassa

29  
Cu  
63,5



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**PROVINCIAL EXAMINATION**  
**NOVEMBER 2023**  
**GRADE 10**  
**MARKING GUIDELINES**

**PHYSICAL SCIENCES: CHEMISTRY (PAPER 2)**

6 pages



### QUESTION 1 MULTIPLE-CHOICE QUESTIONS

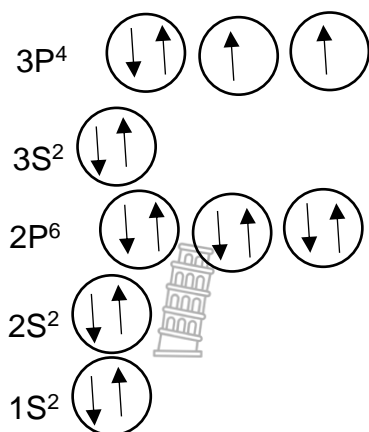
- |     |   |    |             |
|-----|---|----|-------------|
| 1.1 | D | ✓✓ | (2)         |
| 1.2 | C | ✓✓ | (2)         |
| 1.3 | D | ✓✓ | (2)         |
| 1.4 | C | ✓✓ | (2)         |
| 1.5 | A | ✓✓ | (2)         |
| 1.6 | B | ✓✓ | (2)         |
| 1.7 | A | ✓✓ | (2)         |
| 1.8 | B | ✓✓ | (2)         |
| 1.9 | C | ✓✓ | (2)         |
|     |   |    | <b>[18]</b> |

### QUESTION 2

- |     |  |                 |     |
|-----|--|-----------------|-----|
| 2.1 | 2.1.1                                      | $\text{OH}^-$ ✓ | (1) |
|     | 2.1.2                                      | Si ✓            | (1) |
|     | 2.1.3                                      | Ni ✓            | (1) |
|     | 2.1.4                                      | C ✓             | (1) |
|     | 2.1.5                                      | Brass ✓         | (1) |
|     | 2.1.6                                      | $\text{Br}_2$ ✓ | (1) |
| 2.2 | C has greater ionisation energy than Si. ✓ |                 | (1) |



2.3



✓ energy level 1 ✓ energy level 2 ✓ energy level 3 (3)

2.4 2.4.1 Free of water. ✓✓ (2)



10g                      6,4g                       $\Delta m = 10 - 6,4 = 3,6 \text{ g}$  ✓

$n(\text{CuSO}_4) = m/M = \frac{6,4}{159,5} \checkmark = 0,04 \text{ mol}$

$n(\text{H}_2\text{O}) = \frac{3,6}{18} \checkmark = 0,2 \text{ mol}$

$n(\text{CuSO}_4) : n(\text{H}_2\text{O})$

0,04 : 0,2

1 : 5

$\therefore x = 5 \checkmark$

(4)  
[16]

**QUESTION 3**

3.1 The temperature at which a solid, given sufficient heat, becomes a liquid. ✓✓ (2)

3.2 1,013 x 10<sup>5</sup> Pa or 101,3 kPa or 1 atm or 1 bar or pressure at sea level ✓ (1)

3.3 Thermometer ✓ (1)

3.4 Liquid ✓ (1)

3.5 – Temperature remains constant, phase change is taking place (liquid to gas). ✓  
 – All the heat absorbed is used to weaken the intermolecular forces. ✓  
 – Kinetic energy remains constant, but potential energy increases. ✓ (3)

3.6 – Ethanol will boil faster than water. ✓  
 – Ethanol boils at 78 °C and water boils at a higher temperature, 100 °C at standard pressure. ✓  
 – The water molecules need more energy to overcome the stronger forces. ✓ (3)

[11]

### QUESTION 4

- 4.1 Atoms of the same element, with the same number of protons but different number of neutrons. ✓✓ (2)
- 4.2 Sr ✓ (1)
- 4.3 2 ✓ (1)
- 4.4 – Atomic radius decreases across the period and increases down the group. ✓  
– Strontium's atomic radius is bigger than that of Magnesium. ✓ (2)
- 4.5 Average atomic mass =  $\frac{(84 \times 0,56) + (86 \times 9,86) + (87 \times 7) + (88 \times 82,58)}{100}$  ✓  
= 87,71  
≈ 88 ✓ (3)

[9]

### QUESTION 5

- 5.1 The simplest whole-number ratio of atoms in a compound. ✓✓ (2)
- 5.2 5.2.1 0,73 g ✓ (1)
- 5.2.2  $n = \frac{m}{M}$  ✓
- $n = \frac{1,09}{12} \checkmark = 0,09 \text{ mol C}$
- $n = \frac{0,18}{1} \checkmark = 0,18 \text{ mol H}$
- $n = \frac{0,73}{16} \checkmark = 0,046 \text{ mol O}$
- $\frac{0,09}{0,046} : \frac{0,18}{0,046} : \frac{0,046}{0,046} \checkmark$
- 2 : 4 : 1
- Empirese formule = C<sub>2</sub>H<sub>4</sub>O ✓ (6)
- 5.3 Empirical formula molar Mass = 44 g.mol<sup>-1</sup> ✓  
ratio =  $\frac{88}{44} = 2 \checkmark$   
Molecular formula = C<sub>4</sub>H<sub>8</sub>O<sub>2</sub> ✓ (3)

[12]



**QUESTION 6**



6.2 Carbon (IV) oxide or carbon dioxide ✓ and  $\text{CO}_2$  ✓ (2)

6.3 6.3.1  $\text{CO}_2$ ;  $\text{H}_2\text{O}$  of HCl ✓✓ (Any TWO) (2)

6.3.2 NaCl ✓ and  $\text{Na}_2\text{CO}_3$  ✓ (2)



6.5  $M(\text{Na}_2\text{CO}_3) = (2 \times 23) + 12 + (3 \times 16)$   
 $= 106 \text{ g}\cdot\text{mol}^{-1}$  ✓✓ (2)

6.6  $n = \frac{m}{M}$  ✓  
 $n = \frac{3}{106}$  ✓  
 $n = 0,028 \text{ mol}$  ✓ (3)

6.7  $n = \frac{N}{N_A}$  ✓  
 $0,028 = \frac{N}{6,02 \times 10^{23}}$  ✓  $N = 1,7 \times 10^{22}$  formula units ✓  
 $n(\text{Na}_2\text{CO}_3) : n(\text{O})$   
 $1 : 3$   
 $1,7 \times 10^{22} : 5,11 \times 10^{22}$  oxygen atoms ✓ (4)

**[21]**



**QUESTION 7**

7.1 The amount of substance containing the same number of elementary particles (atoms, ions or molecules) as there are atoms in 12 g of carbon-12. ✓✓ (2)

7.2 45 cm<sup>3</sup> or 0,045 dm<sup>3</sup> ✓✓ (2)

7.3 Bubbles/Effervescence of hydrogen gas in the conical flask. ✓ (1)

7.4  $n = \frac{V}{V_m}$  ✓  
 $= \frac{0,045}{22,4}$  ✓  
 $= 0,002 \text{ mol or } 2,0 \times 10^{-3} \text{ mol}$  ✓ (4)

7.5 n(Mg) : n(H<sub>2</sub>)  
 1 : 1  
 0,002 : 0,002 ✓  
 $n = \frac{m}{M}$  ✓  
 $0,002 = \frac{m}{24} =$  ✓  
 $m = 0,048 \text{ g or } 0,05 \text{ g}$  ✓ (4)

[13]

**TOTAL: 100**

