



education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GERT SIBANDE DISTRICT

GRADE 10

PHYSICAL SCIENCES TOPIC TEST
TOPIC: QUANTITATIVE ASPECTS OF CHEMICAL CHANGE
JULY/AUGUST 2023

MARKS: 50

TIME: 1 hour

This question paper consists of 7 pages including the data sheets

INSTRUCTIONS AND INFORMATION

1. This question paper consists of FOUR questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
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. Write neatly and legibly.

QUESTION 1

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 number (1.1–1.3) in the ANSWER BOOK, for example 1.4 D

1.1 The number of atoms in ONE formula-unit of copper(II)sulphate (CuSO_4) is ...

- A 4.
- B 16.
- C 6.
- D 12.

(2)

1.2 Which ONE of the following represents 1 mole of a substance?

- A 16 g oxygen gas
- B $22,4 \text{ cm}^3$ nitrogen gas
- C $22,4 \text{ dm}^3$ copper
- D 1 g hydrogen gas



(2)

1.3 Study the equation below:



Which ONE of the statements below is CORRECT?

- A 2 molecules of hydrogen gas react with 1 atom of oxygen gas to form 2 atoms of water vapour.
- B 4 atoms of hydrogen gas react with 2 molecules of oxygen gas to form 2 moles of water vapour.
- C 2 moles of hydrogen gas react with 1 mole of oxygen gas to form 2 moles of water vapour.
- D 4 g of hydrogen gas react with 16 g of oxygen gas to form 18 g of water vapour.

(2)

[6]

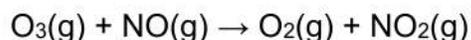
QUESTION 2

- 2.1 Calcium sulphate exist in anhydrous form (CaSO_4) or hydrated form ($\text{CaSO}_4 \cdot n\text{H}_2\text{O}$).
- 2.1.1 Define water of crystallisation. (2)
- 2.1.2 Calculate the percentage of oxygen in anhydrous calcium sulphate, CaSO_4 . (3)
- 2.1.3 A sample of hydrated calcium sulphate, $\text{CaSO}_4 \cdot n\text{H}_2\text{O}$, has a relative formula mass of 172. Calculate the number of moles of water of crystallisation (n) in the salt. (3)
- 2.2 One of the active ingredients in vinegar is Ethanoic acid. Ethanoic acid has a molecular mass of $60\text{g}\cdot\text{mol}^{-1}$ with the following percentage composition: C; 39.9%, H; 6.7% and O; 53.4%.
- 2.2.1 Define the term empirical formula. (2)
- 2.2.2 Determine the empirical formula of Ethanoic acid. (6)
- 2.2.3 What is the molecular formula of Ethanoic acid? (2)

[18]

QUESTION 3

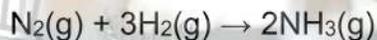
- 3.1 Consider the reaction between ozone and nitrogen monoxide represented below:



In one such reaction 0,74 g of O_3 (g) reacts with NO (g).

- 3.1.1 Define the term *one mole of a substance*. (2)
- Calculate:
- 3.1.2 the number of moles of O_3 (g) present at the start of the reaction. (3)
- 3.1.3 the volume of O_2 (g) formed at STP. (3)
- 3.1.4 the number of molecules of NO_2 (g) formed. (3)

- 3.2 Hydrogen, $\text{H}_2(\text{g})$, and nitrogen, $\text{N}_2(\text{g})$, react to form ammonia, $\text{NH}_3(\text{g})$.
The reaction that takes place is represented by the following equation:



3.2.1 State *Avogadro's Law*. (2)

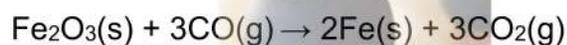
3.2.2 How many moles of $\text{NH}_3(\text{g})$ will be produced when 6 moles of H_2 react with excess nitrogen? (2)

3.2.3 1,48 mol of $\text{NH}_3(\text{g})$ is separately made to fill the balloon to a volume of $23,2\text{dm}^3$. Calculate the new volume the gas will occupy if the number of moles of the gas is increased to 2,10 moles. The temperature and pressure remain constant. (3)

[18]

QUESTION 4

In an experiment Iron, Fe is obtained by reacting 150 g of Iron ore, Fe_2O_3 with excess carbon monoxide, CO. The reaction that takes place is represented by the balanced chemical equation below.



4.1 Calculate the theoretical yield of Fe. (5)

4.2 If the actual yield of Fe is 87,9 g, calculate the percentage yield. (3)

TOTAL: 50 [8]

DATA FOR PHYSICAL SCIENCES GRADE 10

PAPER 2 (CHEMISTRY)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature	T^θ	273 K
Charge on electron	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's' number	N_A	$6,02 \times 10^{23}$

TABLE 2: FORMULAE

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



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MARKING GUIDELINES

MARKS: 50

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These marking guidelines consists of 4 pages

QUESTION 1

- 1.1 C ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 C ✓✓ (2)
- [6]**

QUESTION 2

- 2.1.1 The water that is stoichiometrically bound into a crystal. ✓✓ (2)
- 2.1.2 $M(\text{CaSO}_4) = 40 + 32 + (4 \times 16) = 136 \text{ (g.mol}^{-1}\text{)}$ ✓
 $\%(\text{O}) = \frac{4 \times 16}{136} \times 100$ ✓
 $\%(\text{O}) = 47,059$ ✓ (3)
- 2.1.3 $40 + 32 + (4 \times 16) + n(2 + 16) = 172$ ✓
 $n = 2$ ✓ (3)
- 2.2.1 the simplest ratio of atoms in a molecule. ✓✓ (2)

2.2.2

Elements	C	H	O
$n = \frac{m}{M}$	$\frac{39,9}{12}$ = 3.33 mol ✓	$\frac{6,7}{1}$ = 6.7 mol ✓	$\frac{53,4}{16}$ = 3.34 mol ✓
÷ by the smallest	$\frac{3,33}{3,33}$ = 1	$\frac{6,7}{3,33}$ = 2	$\frac{3,34}{3,33}$ } ✓ = 1 } ✓
Empirical formula :		CH ₂ O ✓	

(6)

2.2.3 **OPTION 1**

$M(\text{CH}_2\text{O}) = 12 + 2(1) + 16 = 30 \text{ g.mol}^{-1}$ ✓
 Therefore, the molecular formula is C₂H₄O₂ ✓

OPTION 2

$(\text{CH}_2\text{O})_x = 60 \text{ g.mol}^{-1}$
 $(12 + 2 + 16)_x = 60$
 $X = 2$ ✓

Therefore, the molecular formula is C₂H₄O₂ ✓

(2)
[18]

QUESTION 3

3.1.1 The amount of substance with the same number of particles as there are atoms in 12 g carbon-12. ✓✓ (2)

3.1.2 $n = \frac{m}{M}$ ✓
 $n(\text{O}_3) = \frac{0,74}{48} = 0,0154 \text{ mol}$ ✓ (3)

3.1.3 $n(\text{O}_2) = n(\text{O}_3) = 0,0154 \text{ mol}$ ✓
 $n = \frac{V}{V_m}$ ✓
 $\therefore V = (0,0154)(22,4)$ ✓
 $\therefore V = 0,34 \text{ dm}^3$ ✓ (3)

3.1.4 $n(\text{O}_2) = n(\text{NO}_2) = 0,0154 \text{ mol}$

$$n = \frac{N}{N_A} \checkmark$$

$$0,0154 = \frac{N}{(6,02 \times 10^{23})} \checkmark$$

$$N(\text{NO}_2) = 9,2708 \times 10^{21} \text{ molecules} \checkmark$$
 (3)

3.2.1 One mole of any gas occupies the same volume at the same temperature and pressure. (2)

3.2.2 $n(\text{H}_2): n(\text{NH}_3) = 3:2$
 $n(\text{NH}_3) = \frac{2}{3} \times 6 = 4 \text{ mol}$ ✓ (2)

$$3.2.3 \frac{V_1}{n_1} = \frac{V_2}{n_2}$$

$$\frac{23,2}{1,48} \checkmark = \frac{V_2}{2,10} \checkmark$$

$$V_2 = 32,92 \text{ dm}^3 \checkmark$$
 (3)

[18]

QUESTION 4

4.1 $n(\text{Fe}_2\text{O}_3) = \frac{m}{M} \checkmark = \frac{150}{160} \checkmark = 0,94 \text{ mol}$

$n(\text{Fe}_2\text{O}_3) : n(\text{Fe}) = 1:2$

$n(\text{Fe}) = 0,94 \times 2 \checkmark = 1,88 \text{ mol}$

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

$1,88 = \frac{m}{56} \checkmark$

$m(\text{Fe}) = 105,28 \text{ g} \checkmark$ (5)

4.2 Percentage yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \checkmark$

Percentage yield = $\frac{87,9}{105,28} \times 100 \checkmark$

Percentage yield = 83.49 % \checkmark

(3)
[8]

TOTAL : 50