



Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa, Irebe leMundo
Provinsie van die Oos Kaap: Departement van Onderwys
Porafensie YA Kapa Botshabela, Letsapha la Tluto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2024

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKS: 150

TIME: 3 hours

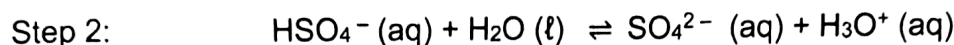
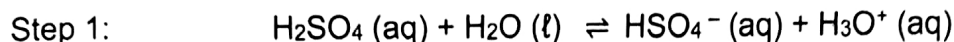


★ P H S C E 2 ★

This question paper consists of 19 pages, including 4 data sheets.

QUESTION 7 (Start on a new page.)

7.1 Sulphuric acid, H_2SO_4 is a strong acid that ionises in two steps as represented by the equations below:



7.1.1 Explain what is meant by *strong acid*. (2)

7.1.2 Give a reason why sulphuric acid is referred to as a diprotic acid. (1)

7.1.3 Write down the conjugate base of H_3O^+ . (1)

7.1.4 Write down the FORMULA of the substance that acts as an ampholyte during the ionisation of sulphuric acid. (2)

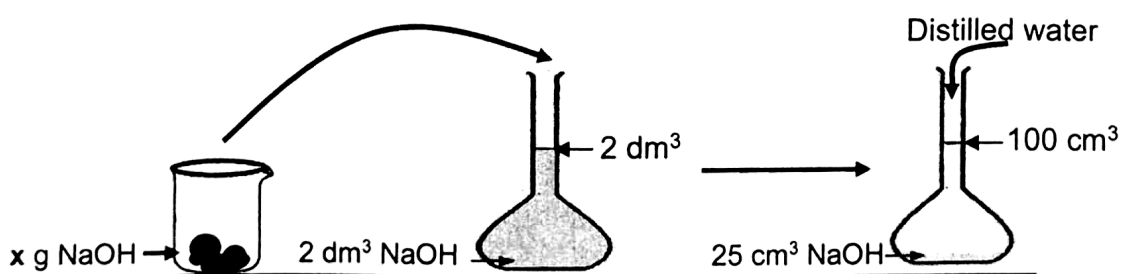
Sulphuric acid has a concentration of $0,1 \text{ mol} \cdot \text{dm}^{-3}$.

7.1.5 Calculate the pH value after complete ionisation. (4)

7.2 1,2 g of anhydrous oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) is dissolved in water to make a 50 cm^3 solution.

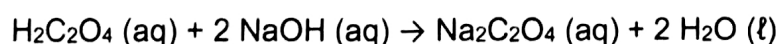
7.2.1 Calculate the concentration of the oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$. (3)

Learners dissolve $x \text{ g}$ of sodium hydroxide, NaOH to make a 2 dm^3 solution of sodium hydroxide, $\text{NaOH} (\text{aq})$. They transfer 25 cm^3 of the sodium hydroxide, NaOH solution to a volumetric flask and added distilled water to make a **diluted** 100 cm^3 solution.



They titrate $43,8 \text{ cm}^3$ of the **diluted** sodium hydroxide, NaOH solution against 25 cm^3 oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$ prepared in QUESTION 7.2.1 to reach the endpoint.

The balanced equation is:



7.2.2 Calculate the mass, $x \text{ g}$ of sodium hydroxide that was used to make the 2 dm^3 solution. (7)

[20]



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PREPARATORY EXAMINATION

GRADE 12

PHYSICAL SCIENCES P2 (CHEMISTRY)

SEPTEMBER 2024

MARKS: 150

TIME: 3 HOURS

This question paper consists of 13 pages and 4 data sheets.

6.2 The decomposition reaction of nitrosyl chloride (NOCl) is represented below:



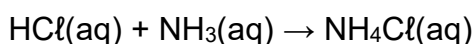
At a temperature of 50°C , 4 mol of NOCl is placed in a 2 dm^3 container. At equilibrium, it was found that $0,9\text{ mol}\cdot\text{dm}^{-3}$ of NO was formed.

6.2.1 Define the term *reversible reaction*. (1)

6.2.2 Calculate the value of K_c at 50°C . (7)
[16]

QUESTION 7 (Start on a new page.)

7.1 According to the balanced equation below, A dilute solution of HCl is used in titration against an ammonia solution.



7.1.1 Define the term *hydrolysis*. (2)

7.1.2 Will the final solution be ACIDIC or BASIC? (1)

7.1.3 Write down a balanced chemical equation that explains the answer to QUESTION 7.1.2. (3)

7.2 For the above titration, 25 cm^3 of a $0,1\text{ mol}\cdot\text{dm}^{-3}$ NH_3 solution is titrated against 40 cm^3 HCl solution.

7.2.1 Is HCl a STRONG or a WEAK acid? (1)

7.2.2 Explain the answer to QUESTION 7.2.1. (2)

7.2.3 Write down the name of the indicator that is most suitable for this reaction. (1)

7.2.4 Explain your choice of indicator. (2)

7.2.5 Calculate the number of moles of NH_3 in 25 cm^3 of the ammonia. (3)

7.2.6 Calculate the pH of the final solution if the concentration of the original HCl was $0,1\text{ mol}\cdot\text{dm}^{-3}$. (8)
[23]



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PREPARATORY EXAMINATION

2024

10842

PHYSICAL SCIENCES: CHEMISTRY
(PAPER 2)

PHYSICAL SCIENCES: Paper 2



10842E

TIME: 3 hours

MARKS: 150

16 pages + 4 information sheets

X05



P.T.O.

- 6.3 When the temperature of the original reaction mixture is increased, it is observed that the colour of the mixture changes to yellow.

6.3.1 Is the forward reaction ENDOTHERMIC or EXOTHERMIC? (1)

6.3.2 Explain the answer to QUESTION 6.3.1 in terms of Le Chatelier's principle. (3)

- 6.4 11 mol $\text{CrO}_4^{2-}(\text{aq})$ and x mol $\text{H}^+(\text{aq})$ are initially added together to make a $0,5 \text{ dm}^3$ solution and allowed to react.

When the reaction reaches equilibrium, the solution contains $9 \text{ mol} \cdot \text{dm}^{-3}$ $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$.

Calculate the initial mole of $\text{H}^+(\text{aq})$ placed in the container if the equilibrium constant is 0,09.

(8)
[18]

QUESTION 7 (Start on a new page.)

- 7.1 A solution of carbonic acid has a pH of 4,2 and the following K_a value:

$$K_a = 4,30 \times 10^{-7}$$

A solution of sulphuric acid has the following K_a value:

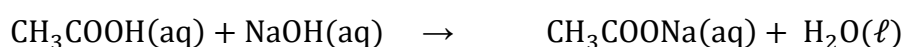
$$K_a = 1,0 \times 10^3$$

7.1.1 Calculate the concentration of the hydronium ions in the carbonic acid solution. (3)

7.1.2 How will the strength of the carbonic acid compare to that of sulphuric acid if both acids have a concentration of $0,02 \text{ mol} \cdot \text{dm}^{-3}$?

Write only that the carbonic acid is STRONGER THAN, WEAKER THAN or THE SAME AS sulphuric acid. Give a reason for the answer. (2)

- 7.2 A solution of vinegar can be neutralised with a solution of sodium hydroxide. The reaction takes place according to the following balanced equation:



The sodium acetate produced during this reaction can undergo hydrolysis.

7.2.1 Define the term *hydrolysis*. (1)

7.2.2 Will the pH of the sodium acetate solution be GREATER THAN or LESS THAN 7? (1)

7.2.3 Explain the answer to QUESTION 7.2.2 by referring to a balanced equation. (3)

P.T.O.

- 7.3 An unknown carbonate has a chemical formula of Y_2CO_3 . A learner is asked to identify element **Y**.

The learner adds 0,5865 g of the carbonate in a conical flask containing 25 cm³ hydrochloric acid solution with a concentration of 0,3 mol·dm⁻³. The balanced equation for the reaction that takes place is:



The hydrochloric acid is in EXCESS.

- 7.3.1 Calculate the initial mole of hydrochloric acid in the conical flask. (3)

Once the mixture has stopped fizzing, 15 cm³ of a 0,1 mol·dm⁻³ NaOH(aq) is added to the mixture to neutralise any remaining hydrochloric acid.

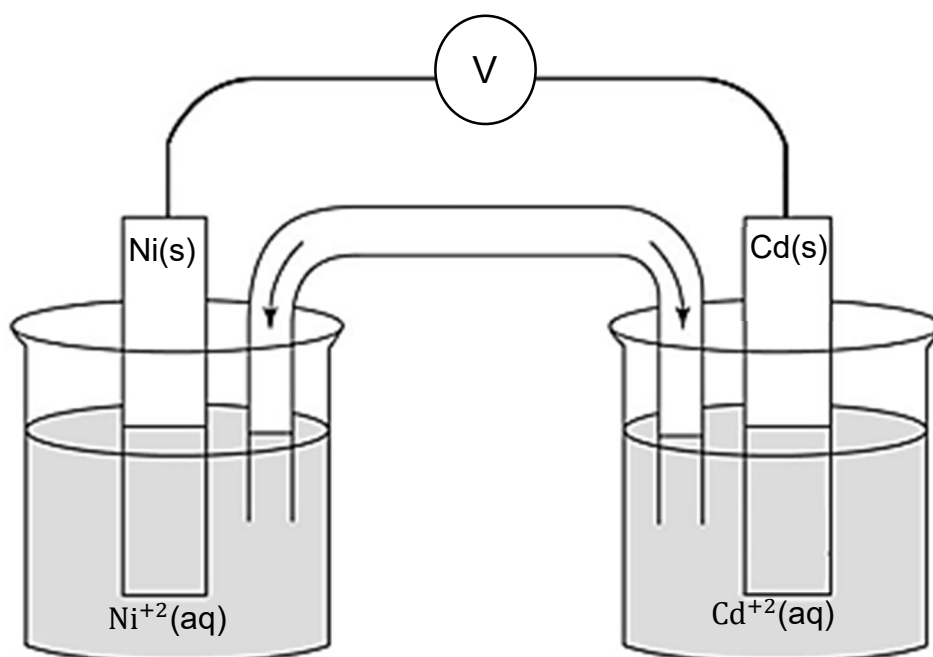
- 7.3.2 Calculate the amount of hydrochloric acid (in mole) that reacted with the unknown carbonate. (4)

- 7.3.3 Identify element **Y**. Show ALL calculations. (5)

[22]

QUESTION 8 (Start on a new page.)

- 8.1 A galvanic cell is constructed as shown in the diagram below.



- 8.1.1 Which electrode is cathode? Write only NICKEL or CADMIUM. (1)

- 8.1.2 Write down the equation for the oxidation half-reaction of this cell. (2)

P.T.O.



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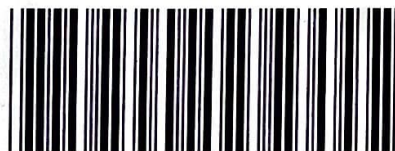
GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2024

MARKS: 150

TIME: 3 HOURS



EPHSCP2

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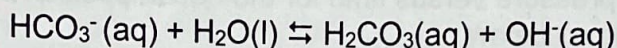
QUESTION 7 (Start on a new page.)

7.1 Sulphuric acid is a diprotic acid.

7.1.1 Define an *acid* in terms of the Lowry-Brønsted theory. (2)

7.1.2 Give a reason why sulphuric acid is a *diprotic acid*. (1)

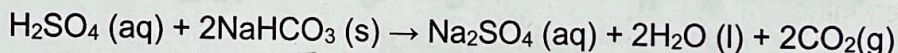
7.2 The hydrogen carbonate ion can act as both an acid and a base. It reacts with water according to the following balanced equation:



7.2.1 Write down ONE word for the underlined phrase. (1)

7.2.2 $\text{HCO}_3^-(\text{aq})$ acts as a base in the above reaction.
Write down the formula of the conjugate acid of $\text{HCO}_3^-(\text{aq})$. (1)

7.3 A chemist spills sulphuric acid of concentration $6 \text{ mol} \cdot \text{dm}^{-3}$ from a flask on a laboratory bench. She neutralises the spilled acid by sprinkling sodium hydrogen carbonate powder onto it. The reaction that takes place is: (Assume that the H_2SO_4 ionises completely.)



The fizzing, due to the formation of carbon dioxide, stops after the chemist has added 27 g sodium hydrogen carbonate to the spilled acid.

7.3.1 Calculate the volume of sulphuric acid that spilled. Assume that all the sodium hydrogen carbonate reacts with all the acid. (6)

The chemist now dilutes some of the $6 \text{ mol} \cdot \text{dm}^{-3}$ sulphuric acid solution in the flask to $0,1 \text{ mol} \cdot \text{dm}^{-3}$.

7.3.2 Calculate the volume of the $6 \text{ mol} \cdot \text{dm}^{-3}$ sulphuric acid solution needed to prepare 1 dm^3 of the dilute acid. (2)

During a titration 25 cm^3 of the $0,1 \text{ mol} \cdot \text{dm}^{-3}$ sulphuric acid solution is added to an Erlenmeyer flask and titrated with a $0,1 \text{ mol} \cdot \text{dm}^{-3}$ sodium hydroxide solution.

7.3.3 The chemist uses bromothymol blue as indicator.
What is the purpose of this indicator? (1)

7.3.4 Calculate the pH of the solution in the flask after the addition of 30 cm^3 of sodium hydroxide. The endpoint of the titration is not yet reached at this point. (8)

[22]



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GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

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MARKS: 150

TIME: 3 ure

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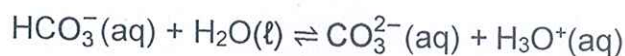
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QUESTION 7 (Start on a new page.)

7.1 The hydrogens carbonate ion (HCO_3^-) can act as an ampholyte.

7.1.1 Explain what is meant by the underlined term. (2)

7.1.2 Consider the following reaction:

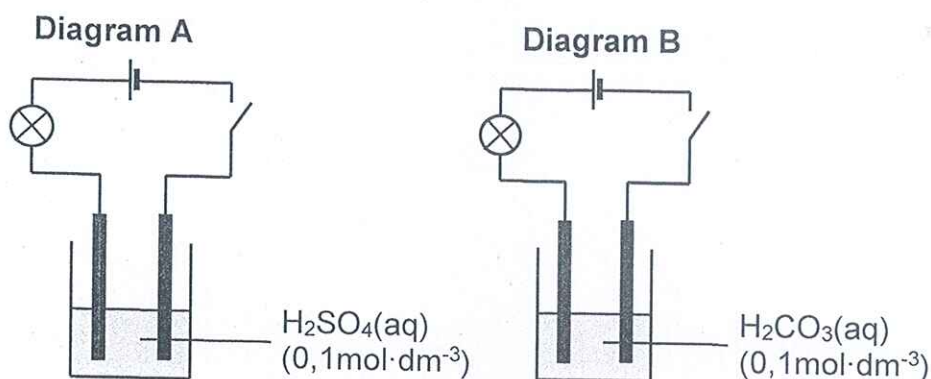


Is the HCO_3^- ion in this reaction acting as a Brønsted-Lowry acid or a base? Give a reason for the answer. (2)

7.1.3 Write down the FORMULA of the substance which forms a conjugate acid base pair with the HCO_3^- ion. (1)

7.2 Two identical electrolytic cells are set up as follows to determine the conductivity of sulphuric acid (H_2SO_4) and carbonic acid (H_2CO_3)

The concentration of both solutions is $0,1 \text{ mol} \cdot \text{dm}^{-3}$



Which diagram's bulb will burn the brightest? Give a reason for the answer by referring to the acids. (2)

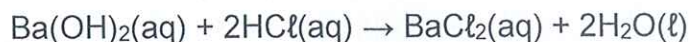
7.3 The concentration of the sulphuric acid (H_2SO_4) in a solution is $0,25 \times 10^{-3} \text{ mol} \cdot \text{dm}^{-3}$. Calculate the pH of the solution. (3)

7.4 Na_2CO_3 is a salt that forms when NaOH reacts with H_2CO_3 . This salt reacts with water.

7.4.1 Write down one word for the underlined part. (1)

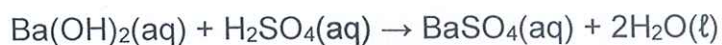
7.4.2 Is the aqueous solution of sodium carbonate (Na_2CO_3), ACIDIC, BASIC, or NEUTRAL? (1)

- 7.5 A standard solution was prepared by adding an unknown amount of $\text{Ba}(\text{OH})_2$ to 250 cm^3 water. $\text{Ba}(\text{OH})_2$ now reacts with $\text{HCl}(\text{aq})$ according to the following balanced equation.



25 cm^3 of the standard solution of $\text{Ba}(\text{OH})_2$ reacts with 100 cm^3 of the diluted HCl which has a concentration of $0,15 \text{ mol} \cdot \text{dm}^{-3}$.

The EXCESS $\text{Ba}(\text{OH})_2$ is neutralised by adding 50 cm^3 of a $0,05 \text{ mol} \cdot \text{dm}^{-3}$ H_2SO_4 . The reaction is as follows:



Calculate the initial mass of $\text{Ba}(\text{OH})_2$ used to prepare the standard solution.

(8)
[20]



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GRAAD/GRADE 12

FISIESE WETENSKAPPE/PHYSICAL SCIENCES

VRAESTEL/PAPER 2

CHEMIE/CHEMISTRY

SEPTEMBER 2024

PUNTE/MARKS: 150

TYD/TIME: 3 uur/hours

**Hierdie vraestel bestaan uit 15 bladsye en 4 gegewensblaaie./
This question paper consists of 15 pages and 4 data sheets.**

QUESTION 7 (Start on a new page.)

7.1 Hydrofluoric acid (HF) is a weak acid.

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

7.1.2 A sample of hydrofluoric acid has a pH of 4,5 at 25 °C.

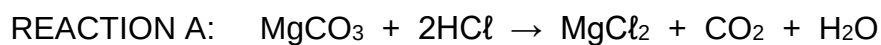
Calculate the concentration of the hydronium ions ($\text{H}_3\text{O}^+(\text{aq})$) in the sample. (3)

When hydrofluoric acid reacts with sodium hydroxide, sodium fluoride is formed.

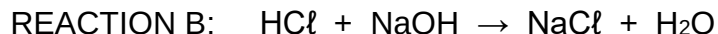
7.1.3 Will the pH of the sodium fluoride solution be GREATER THAN 7, SMALLER THAN 7 or EQUAL TO 7?

Give a reason for the answer. (2)

7.2 In REACTION A, 3,5 g of pure $\text{MgCO}_3(\text{s})$ reacted completely in 50 cm^3 of HCl . The balanced equation for the reaction is given below:



The EXCESS HCl neutralises exactly 20 cm^3 of a NaOH solution with a concentration of 1,2 $\text{mol}\cdot\text{dm}^{-3}$ in REACTION B.



7.2.1 Calculate the number of moles of HCl reacted in REACTION A. (3)

7.2.2 Calculate the concentration of the original solution of HCl . (6)
[16]



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GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

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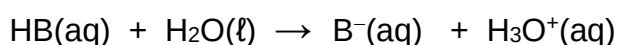
QUESTION 7 (Start on a new page.)

- 7.1 Solutions of two acids, HA and HB, each has a concentration of $X \text{ mol}\cdot\text{dm}^{-3}$. The pH of HA solution is 0,8 and pH of HB is 2,8.

7.1.1 Which acid is stronger? Choose from HA or HB. (1)

7.1.2 Explain the answer to QUESTION 7.1.1. (2)

The solution, HB, ionises in one step as follows:



7.1.3 Define the term *ionisation*. (2)

7.1.4 Calculate the concentration of the HB(aq). (3)

- 7.2 The HA solution reacts with calcium carbonate, CaCO_3 .

The balanced equation for the reaction is:



50 cm^3 of the HA solution is added to a 25 cm^3 of a $0,08 \text{ mol}\cdot\text{dm}^{-3}$ CaCO_3 solution:

7.2.1 Calculate the number of moles of the reactant which is in EXCESS? Show ALL your calculations (9)

7.2.2 Identify the reactant in QUESTION 7.2.1 (1)
[18]



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**PHYSICAL SCIENCES
PAPER 2**

GRADE 12

**MNED PLC CLUSTER PAPER
SEPTEMBER 2024**

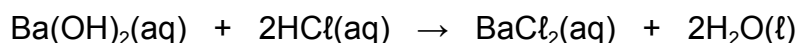
MARKS: 150

TIME: 3 hours

This paper consists of 15 pages and 4 data sheets

QUESTION 7 (Start on a new page)

150 g of impure barium hydroxide is dissolved in 2 dm³ of water. 2 dm³ of a hydrochloric acid solution, with a concentration of 0,75 mol.dm⁻³, is then added to the barium hydroxide solution. A scientist measures the pH of the solution after the addition of the hydrochloric acid solution and finds the combined solution to have a pH of 12. The reaction between barium hydroxide and hydrochloric acid is represented below:



- 7.1 Define an acid in terms of *Lowry-Brønsted*. (2)
- 7.2 Calculate the concentration of hydroxide ions present in the solution after the hydrochloric acid solution was added. (5)
- 7.3 Calculate the *percentage purity* of the sample of barium hydroxide. (7)
- 7.4 Suggest an indicator that would be appropriate to use to indicate the endpoint during a titration between barium hydroxide and hydrochloric acid. Choose from *methyl orange*, *bromothymol blue* or *phenolphthalein*. (1)
- 7.5 Explain your answer to QUESTION 7.4 by referring to the strengths of the acid and base as well as the pH. (3)

[18]

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GRADE 12

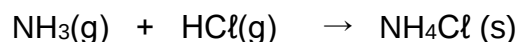
**PHYSICAL SCIENCES: CHEMISTRY (P2)
SEPTEMBER 2024**

MARKS : 150
TIME : 3 hours
DATE : 11 SEPTEMBER 2024

This question paper consists of 17 pages and 2 data sheets

QUESTION 8 (Start on a NEW page.)

8.1 NH_3 reacts with HCl to form a salt as shown below:



8.1.1 Identify the base in the above equation (1)

8.1.2 Give a reason for your answer in QUESTION 8.1.1 (1)

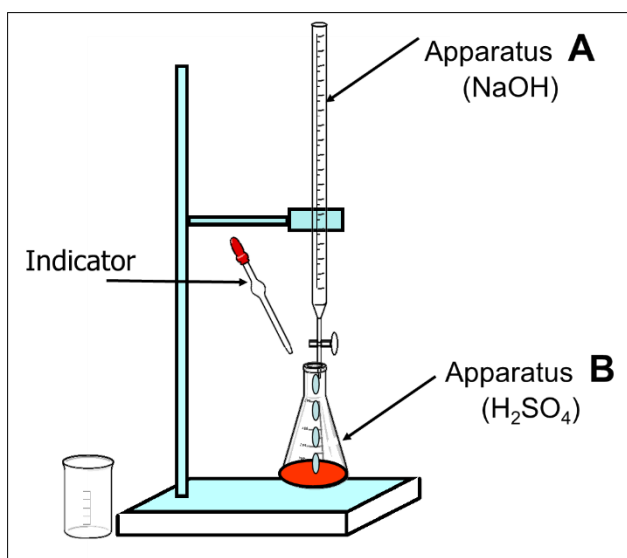
8.1.3 Write down the name of the salt formed. (1)

8.2 NH_4Cl can undergo hydrolysis.

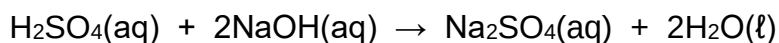
8.2.1 Define the term *hydrolysis*. (2)

8.2.2 Write down a balanced equation for the hydrolysis of NH_4Cl and indicate whether the solution will be ACIDIC, ALKALINE or NEUTRAL. (3)

8.3 The diagram below shows the titration of 25 ml of sulphuric acid of unknown concentration with 0,2 mol·dm⁻³ sodium hydroxide.



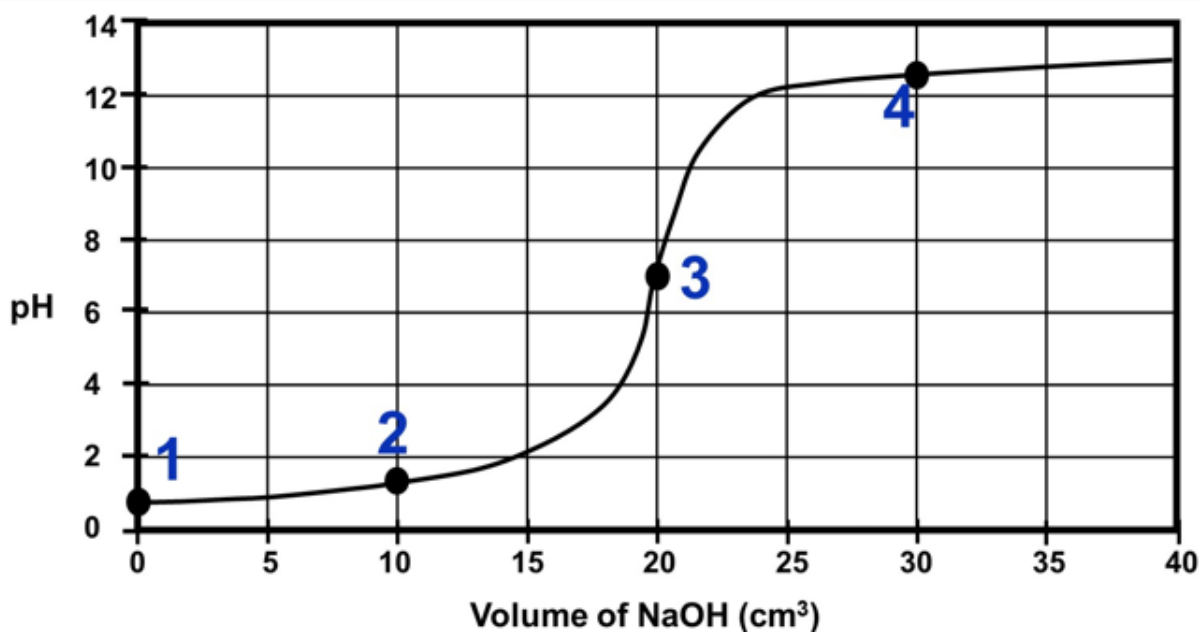
The balanced equation for the reaction is:



8.3.1 Identify apparatus A. (1)

8.3.2 Bromothymol blue was used as the indicator in the titration above. Write down the colour change observed. Choose between BLUE TO YELLOW or YELLOW TO BLUE. (1)

During this titration, the pH of the solution was measured as the volume of the base increased. The following graph was produced.



8.3.3 Give the name of the position labelled **3** on the graph
Choose from EQUIVALENCE POINT or END POINT. (1)

Use the graph and the information provided earlier to calculate:

8.3.4 The original concentration of the sulphuric acid (5)

8.3.5 The pH of the solution at the point labelled **4** on the graph (7)
[23]

WEST COAST EDUCATION DISTRICT

EXEMPLAR PAPER

PHYSICAL SCIENCES

SEPTEMBER 2024

GRADE 12

TOTAL: 150

FAT 5: CHEMISTRY EXAM

TIME: 180 min

EXAMINATION INSTRUCTIONS

1. Write your **NAME** on your answer script.
2. Answer all questions on your **ANSWER SHEET**.
3. **NEATNESS** and **ACCURACY** will count in your favor.
4. **START EACH QUESTION ON A NEW PAGE.**
5. **FORMULA SHEETS** are attached to the back of the paper.
6. **NUMBER** the answers according to the number system in this question paper.
7. You may use a non-programmable **CALCULATOR**.
8. Show **ALL FORMULAS** and substitutions in **ALL CALCULATIONS**.
9. Round off all numerical answers to a minimum of **TWO DECIMAL PLACES**.
10. Attach all **GRAPHS** and extra **ANSWER SHEETS** to your answer sheet.

6.2 Calculate the equilibrium constant (K_c) between t_1 and t_2 . (8)

6.3 How will the concentration of the ammonia (NH_3) change during the following changes to the closed system?

Write only INCREASE, DECREASE or STAY THE SAME. Explain your answer in each case using Le Chatelier's principle.

6.3.1 Increase in concentration of nitrogen (N_2). (2)

6.3.2 Increase in pressure by reducing the volume of the container. (2)

6.4 How will the value of the equilibrium constant (K_c) change after t_2 ? (3)

Write only INCREASE, DECREASE or STAY THE SAME. Explain your answer as fully as possible.

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QUESTION 7 [ACID-BASE REACTIONS]

7.1 Define the term: pH value (2)

7.2 In the following table two ampholytes are indicated. Copy the table onto your answer set and complete the conjugate acids and bases of each ampholyte. (4)

Conjugate Acid	Ampholyte	Conjugate Base
	H_2O	
	HSO_4^-	

7.3 Give the FORMULA of the salt formed during the following acid-base reactions:

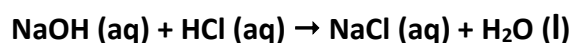
7.3.1 Ethanoic acid (CH_3COOH) and sodium hydroxide (NaOH) (1)

7.3.2 Nitric acid (HNO_3) and magnesium hydroxide [$\text{Mg}(\text{OH})_2$] (1)

- 7.4 During a reaction, a 9,75 g IMPURE zinc pebble is placed in 0,6 dm³ of hydrochloric acid (HCl) with a concentration of 0,5 mol.dm⁻³. The balanced equation of this reaction is: (8)



After the reaction, the EXCESS of hydrochloric acid is used to neutralize 0,4 dm³ of sodium hydroxide (NaOH) during a titration in the reaction:



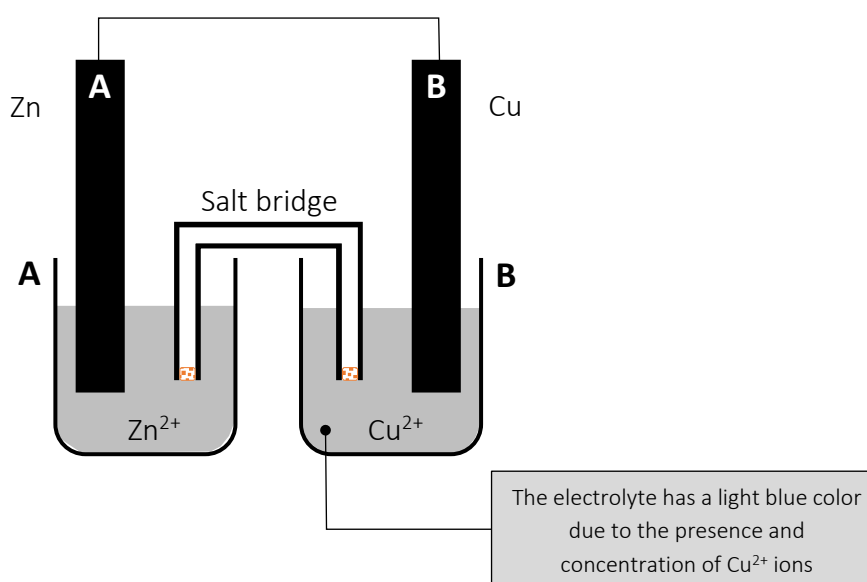
Calculate the pH value of the sodium hydroxide (NaOH) if the zinc pebble is only 60% pure.

16

QUESTION 8 [GALVANIC CELLS]

- 8.1 Define the term: GALVANIC CELL (2)

Consider the following cell:



- 8.2 Write down the half-reaction at the:

8.2.1 Anode (2)

8.2.2 Cathode (2)



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**PHYSICAL SCIENCES PAPER 2
GRADE 12**

**COMMON PRELIMINARY EXAMINATION
SEPTEMBER 2024**

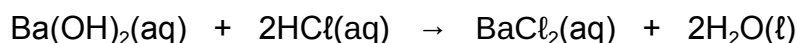
MARKS: 150

TIME: 3 hours

This exam paper consists of 15 pages and 4 datasheets

QUESTION 7 (Start on a new page)

150 g of impure barium hydroxide is dissolved in 2 dm³ of water. 2 dm³ of a hydrochloric acid solution, with a concentration of 0,75 mol.dm⁻³, is then added to the barium hydroxide solution. A scientist measures the pH of the solution after the addition of the hydrochloric acid solution and finds the combined solution to have a pH of 12. The reaction between barium hydroxide and hydrochloric acid is represented below:



- 7.1 Define an acid in terms of *Lowry-Brønsted*. (2)
- 7.2 Calculate the concentration of hydroxide ions present in the solution after the hydrochloric acid solution was added. (5)
- 7.3 Calculate the *percentage purity* of the sample of barium hydroxide. (7)
- 7.4 Suggest an indicator that would be appropriate to use to indicate the endpoint during a titration between barium hydroxide and hydrochloric acid. Choose from *methyl orange*, *bromothymol blue* or *phenolphthalein*. (1)
- 7.5 Explain your answer to QUESTION 7.4 by referring to the strengths of the acid and base as well as the pH. (3)

[18]



basic education

Department:
Basic Education
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SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

PHYSICAL SCIENCES: CHEMISTRY (P2)

MAY/JUNE 2024

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 4 data sheets.

QUESTION 7 (Start on a new page.)

- 7.1 A standard solution is prepared by dissolving 10 g of sodium carbonate, $\text{Na}_2\text{CO}_3(\text{s})$, in $0,7 \text{ dm}^3$ of water.

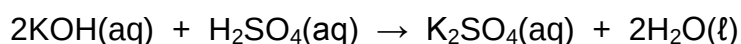
- 7.1.1 Calculate the concentration of the solution. (3)
- 7.1.2 Will the pH of the solution be GREATER THAN or LESS THAN 7? (1)
- 7.1.3 Write an equation that explains the answer to QUESTION 7.1.2. (2)

The sodium carbonate solution is titrated with dilute hydrochloric acid, $\text{HCl}(\text{aq})$. The following indicators are available for this titration.

INDICATOR	pH RANGE
P	3,4–4,5
Q	6,8–7,2
R	8,3–10

- 7.1.4 Which ONE of the indicators (**P**, **Q** or **R**) is most suitable for this titration? Give a reason for the answer by referring to the data in the table. (2)

- 7.2 When 0,01 moles of *dilute* sulphuric acid, $\text{H}_2\text{SO}_4(\text{aq})$, is mixed with 0,024 moles of potassium hydroxide, $\text{KOH}(\text{aq})$, the total volume of the final solution is $0,2 \text{ dm}^3$.



- 7.2.1 What is meant by a *dilute* acid? (2)
- 7.2.2 Calculate the pH of the final solution. (8)
- [18]**



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TOTAL
MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2024

PHYSICAL SCIENCES: PAPER II

EXAMINATION NUMBER

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Time: 3 hours 200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 28 pages as well as a DATA SHEET of 3 pages (i–iii). Please make sure that your question paper is complete.
2. Read the questions carefully.
3. Answer ALL the questions on the question paper and hand it in at the end of the examination. Remember to write your examination number in the space provided on the question paper.
4. Unless instructed otherwise, you do NOT have to give state symbols (phase indicators) when asked to write a balanced chemical equation.
5. Use the data and formulae whenever necessary.
6. Show all the necessary steps in calculations.
7. Where appropriate, give your answers to two decimal places.
8. It is in your own interest to write legibly and to present your work neatly.
9. TWO blank pages (pages 26 and 27) and extra graph paper (page 28) are included at the end of the examination paper. If you run out of space for an answer, use these pages. Clearly indicate the number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKERS TO ENTER MARKS

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total
Mark										
Marker Initial										
Moderated Mark										
Moderator Initial										
Question Total	20	14	32	25	28	20	21	17	23	200
Re-mark										
Initial										
Code										

QUESTION 5

Consider the reaction equation shown below:



- 5.1 Name the compound $\text{Na}_2\text{S}_2\text{O}_3$. (2)

- 5.2 The compound NaOH is a base. Circle the correct words between the brackets in the following sentence:

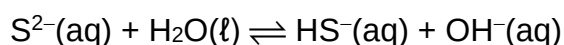
NaOH is a (STRONG / WEAK) base that (COMPLETELY / PARTIALLY) (IONISES / DISSOCIATES) in water. (3)

- 5.3 $\text{NaOH}(\text{s})$ melts at $318\text{ }^\circ\text{C}$. Explain why $\text{NaOH}(\text{s})$ has a high melting point. (4)

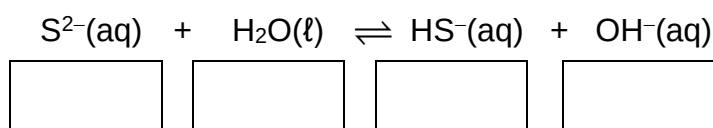
- 5.4 The compound Na_2S can be classified as a salt.

- 5.4.1 Define *salt*. (2)

- 5.4.2 Na^+ ions do not react with water. However, the S^{2-} ion reacts with water as follows:



Label and draw lines to link the conjugate acid-base pairs in the equation. (2)



5.4.3 Name this type of reaction of an ion (from a salt) with water. (1)

5.4.4 Classify Na_2S as an ACIDIC or a BASIC salt. Give a reason. (2)

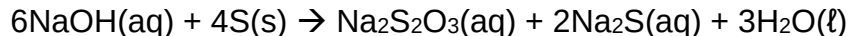
5.4.5 Consider the following statement: (1)

'The S^{2-} ion is amphoteric.'

Circle the correct option between the brackets:

The statement is (TRUE / FALSE).

5.5 2,24 g of S is added to $0,5 \text{ dm}^3$ of a $0,3 \text{ mol} \cdot \text{dm}^{-3}$ NaOH solution. The reaction equation is rewritten below:



5.5.1 Perform suitable calculations to determine the limiting reagent. (6)

5.5.2 Calculate the mass of **Na₂S₂O₃** produced if the reaction has a 75% yield. (5)

[28]



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**NATIONAL
SENIOR CERTIFICATE/
NASIONALE
SENIORSERTIFIKAAT**

GRADE/GRAAD 12

SEPTEMBER 2024

**PHYSICAL SCIENCES P2/
FISIESE WETENSKAPPE V2
MARKING GUIDELINE/NASIENRIGLYN**

MARKS/PUNTE: 150

This marking guideline consists of 22 pages./
Hierdie nasienriglyn bestaan uit 22 bladsye.

QUESTION 7/VRAAG 7

7.1.1 Strong acids ionise completely in water ✓ to produce a high concentration of the hydronium ions / (H_3O^+) ✓

Sterk sure ioniseer volledig in water om 'n hoë konsentrasie van die hydronium ione / (H_3O^+) te produseer. (2)

7.1.2 It donates two protons/ H^+ / *Dit skenk twee protone/ H^+* ✓ (1)

7.1.3 H_2O ✓ (1)

7.1.4 HSO_4^- ✓✓✓ (2)

7.1.5 **Marking criteria/ Nasienkriteria**

(a) Ratio/*Verhouding* $[\text{H}_3\text{O}^+] : [\text{H}_2\text{SO}_4]$ ✓

(b) Formula/*Formule* $\text{pH} = -\log [\text{H}_3\text{O}^+]$ ✓

(c) pH value substituted into formula/*vervang van pH-waarde in formule* ✓

(d) Final answer / *Finale antwoord* ✓

$$[\text{H}_3\text{O}^+] = 2(0,1) \text{ ✓ (a) } = 0,2 \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \text{ ✓ (b)}$$

$$\text{pH} = -\log(0,2) \text{ ✓ (c)}$$

$$\text{pH} = 0,70 \text{ ✓ (d)} \quad (4)$$

7.2.1

OPTION 1/OPSIE 1

$$c = \frac{m}{MV} \text{ ✓}$$

$$c = \frac{1,2}{(90)(50 \times 10^{-3})} \text{ ✓}$$

$$c = 0,27 \text{ mol} \cdot \text{dm}^{-3} \text{ ✓}$$

OPTION 2/OPSIE 2

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

$$n = \frac{1,2}{90}$$

$$n = 0,013 \text{ mol} \cdot \text{dm}^{-3}$$

$$c = \frac{n}{V} \text{ ✓}$$

$$c = \frac{0,013}{50 \times 10^{-3}} \text{ ✓}$$

$$c = 0,26 \text{ mol} \cdot \text{dm}^{-3} \text{ ✓}$$

(3)

7.2.2

Positive marking from/Positiewe nasien vanaf 7.2.1
Marking criteria/Nasienkriteria

- (a) Subst. values of $\text{H}_2\text{C}_2\text{O}_4$ into / Vervang waardes in $n = cV$ ✓
 (b) **Using** ratio / **Gebruik** verhouding $\text{H}_2\text{C}_2\text{O}_4$: NaOH 1:2 ✓
 (c) Subst of values of / Vervang waardes van NaOH into/ in $c = n/V$ ✓
 (d) Subst into values / Vervang waardes van NaOH into/ in $c_1V_1 = c_2V_2$ ✓
 (e) Formula / Formule $m = cMV$ ✓
 (f) Subst into / Vervang in $m = cMV$ ✓
 (g) Final answer / Finale antwoord ✓

$$\begin{aligned} n(\text{H}_2\text{C}_2\text{O}_4) &= cV \\ &= 0,27 \times 25 \times 10^{-3} \text{ (a) } \checkmark \\ &= 6,75 \times 10^{-3} \text{ mol} \\ n(\text{NaOH}) &= 2 \times 6,75 \times 10^{-3} \text{ (b) } \checkmark \\ n(\text{NaOH}) &= 0,0135 \text{ mol} \\ c(\text{NaOH}) &= \frac{n}{V} \\ c(\text{NaOH}) &= \frac{0,0135}{43,8 \times 10^{-3}} \text{ (c) } \checkmark \\ c(\text{NaOH}) &= 0,308 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

Positive marking from / Positiewe nasien vanaf 7.2.1
Marking criteria/Nasienkriteria

- (a) Subst. values of/ Vervang waardes in n_a / n_b into $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓
 (b) Subst. values of/ Vervang waardes in $c_a V_a$ into $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓
 (c) Subst. values of/ Vervang waardes in V_b into $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$ ✓
 (d) Subst into values/ Vervang waardes van NaOH into/ in $c_1 V_1 = c_2 V_2$ ✓
 (e) Formula / Formule $m = cMV$ ✓
 (f) Subst into Vervang in $m = cMV$ ✓
 (g) Final answer/ Finale antwoord ✓

$$\begin{aligned} \frac{c_a V_a}{c_b V_b} &= \frac{n_a}{n_b} \\ \frac{(0,27)(25) \text{ (b) } \checkmark}{c_b(43,8) \text{ (c) } \checkmark} &= \frac{1}{2} \text{ (a) } \checkmark \\ c_b &= 0,308 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$\begin{aligned} c_1 V_1 &= c_2 V_2 \\ c_1(25) &= (0,308)(100) \text{ (d) } \checkmark \\ c_1 &= 1,232 \text{ mol} \cdot \text{dm}^{-3} \\ m &= cMV \text{ (e) } \checkmark \\ m &= (1,232)(40)(2) \text{ (f) } \checkmark \\ m &= 98,56 \text{ g} \text{ (g) } \checkmark \end{aligned}$$

(7)
 [20]



education

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**PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)**

SEPTEMBER 2024

MARKS/PUNTE: 150

MARKING GUIDELINES/NASIENRIGLYNE

**These marking guidelines consist of 14 pages.
*Hierdie nasienriglyne bestaan uit 14 bladsye.***

QUESTION 7/VRAAG 7

7.1.1 The reaction of salt with water ✓✓
Die reaksie van soutwater met water (2)

7.1.2 Acidic/Suur ✓ (1)

7.1.3 $\text{NH}_4^+(\text{aq}) + \text{H}_2\text{O}(\ell) \checkmark \rightarrow \text{NH}_3 + \text{H}_3\text{O}^+(\text{aq}) \checkmark \checkmark$
OR / OF
 $\text{NH}_4^+(\text{aq}) + 2\text{H}_2\text{O}(\ell) \checkmark \rightarrow \text{NH}_4\text{OH} + \text{H}_3\text{O}^+(\text{aq}) \checkmark \checkmark$ (3)

7.2.1 Strong (acid) / Sterk (suur)✓ (1)

7.2.2 Ionises/dissociate completely in water✓to form a high concentration
of H_3O^+ ions. ✓
*loneer/dissosieer heeltemal in water om 'n hoë konsentrasie van
 H_3O^+ ione te vorm.* (2)

7.2.3 Methyl orange / Metiel oranje ✓ (1)

7.2.4 Titration of strong acid ✓ and weak base ✓
Titrasie van sterk suur en swak basis (2)

7.2.5 **Marking criteria/Nasienriglyne:**

- Formula / Formule $c = \frac{n}{V}$ ✓
- Substitute / Vervang 0,1 AND / EN 25×10^{-3} in $n = cV$ ✓
- Final answer/Finale antwoord: 0,0025 mol ✓

$$c = \frac{n}{V} \checkmark$$

$$n = 0,1 \times 25 \times 10^{-3} \checkmark$$

$$n = 2,5 \times 10^{-3} \text{ mol} \checkmark / 0,0025 \text{ mol (ACCEPT/AANVAAR: 0,003 mol)} \quad (3)$$

7.2.6

Marking criteria/Nasienriglyne:

- (a) Ratio / *Verhouding* $n(\text{HCl}) = n(\text{NH}_3)$ ✓
- (b) Formula / *Formule* $c = \frac{n}{V}$ / $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓
- (c) Substituting $n(\text{NH}_3)$ and volume of $0,04\text{dm}^3$ / *Vervang $n(\text{NH}_3)$ en volume van $0,04\text{dm}^3$*
- (d) Subtraction / *Aftrekking*: $c(\text{HCl})_{\text{initial}} - c(\text{HCl})_{\text{used}}$ ✓✓
- (e) $c(\text{H}_3\text{O}^+) = c(\text{HCl})$ ✓
- (f) Substituting / *Vervanging* $c(\text{H}_3\text{O}^+)$ in $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓
- (g) Final answer / *Finale antwoord* = 1,43 ✓

$$n(\text{HCl}) = n(\text{NH}_3) \checkmark (\text{a})$$

$$= 2,5 \times 10^{-3}$$

$$c(\text{HCl}) = \frac{n}{V}$$

$$= \frac{2,5 \times 10^{-3}}{0,04} \checkmark (\text{c})$$

$$= 0,0625 \text{ mol} \cdot \text{dm}^{-3}$$

$$c(\text{HCl})_{\text{excess/oormaat}} = 0,1 - 0,0625 \checkmark \checkmark (\text{d})$$

$$= 0,0375 \text{ mol} \cdot \text{dm}^{-3}$$

$$c(\text{H}_3\text{O}^+) = c(\text{HCl}) \checkmark (\text{e})$$

$$= 0,0375$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$= -\log(0,0375) \checkmark (\text{f})$$

$$= 1,43 \checkmark (\text{g})$$

ANY/ENIGE 1 ✓(b)

(8)
[23]



PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2024

MARKING GUIDELINES

NASIENRIGLYNE

10842

PHYSICAL SCIENCES: CHEMISTRY
FISIESE WETENSKAPPE: CHEMIE

(PAPER/VRAESTEL 2)

15 pages/bladsye

QUESTION/VRAAG 7

- 7.1 7.1.1 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓ or $[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$
 $4,2 = -\log[\text{H}_3\text{O}^+]$
 $[\text{H}_3\text{O}^+] = 10^{-4,2}$
 $[\text{H}_3\text{O}^+] = 6,31 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3}$ ✓ (3)

7.1.2 WEAKER THAN ✓

- H_2CO_3 has smaller K_a value than H_2SO_4 , indicating that it ionises incompletely/partially.
OR
- H_2CO_3 has a concentration of $0,02 \text{ mol} \cdot \text{dm}^{-3}$, but $[\text{H}_3\text{O}^+]$ is calculated at $6,31 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3}$. Therefore carbonic acid ionises incompletely/partially and is weaker than sulphuric acid that will ionise completely.
OR
- H_2CO_3 has a pH of 4,2. Sulphuric acid has a lower pH.
(ACCEPT ANY ONE OF THE OPTIONS AS MOTIVATION) ✓

SWAKKER AS

- H_2CO_3 het 'n laer K_a waarde as H_2SO_4 wat aandui dat dit onvolledig ioniseer.
OF
- H_2CO_3 het 'n konsentrasie van $0,02 \text{ mol} \cdot \text{dm}^{-3}$, maar $[\text{H}_3\text{O}^+]$ is bereken as $6,31 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3}$. Dus het koolsuur/karbonaatsuur onvolledig ioniseer en is swakker as swawelsuur wat wel volledig ioniseer.
OF
- H_2CO_3 het 'n pH van 4,2. Swawelsuur het 'n laer pH.
(AANVAAR ENIGE EEN VAN DIE OPSIES AS MOTIVERING) (2)

- 7.2 7.2.1 Hydrolysis is the reaction of a salt with water. ✓
Hidrolise is die reaksie van 'n sout met water. (1)

7.2.2 GREATER THAN 7/GROTER AS 7 ✓ (1)

- 7.2.3 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$ ✓
 (Accept/Aanvaar: $\text{CH}_3\text{COONa} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{NaOH}$)

- Hydrolysis of acetate forms hydroxide ions ✓
OR
- An increased concentration of hydroxide ions will make the solution more alkaline/increase pH
OR
- A weak acid (vinegar) reacting with a strong base (NaOH) results in an alkaline solution. (3)

- *Hidrolise van asetaat vorm hidroksied-ione*

OF

- *'n Toename in die konsentrasie hidroksied-ione sal die oplossing meer alkalies maak/die pH verhoog*

OF

- *As swak suur (asyn) reageer met 'n sterk basis (NaOH) sal die oplossing alkalies wees*

7.3 7.3.1 **OPTION 1/OPSIE 1:**

$$\begin{aligned} n(\text{HCl}) \text{ initially/aanvanklik} &= cV \checkmark \\ &= (0,3)(0,025) \checkmark \\ &= 0,01 \text{ mol } \checkmark \end{aligned}$$

OPTION 2/OPSIE 2:

$$\begin{aligned} n(\text{HCl}) \text{ initially/aanvanklik} &= cV \checkmark \\ &= (0,3)(0,025) \checkmark \\ &= 0,0075 \text{ mol } \checkmark \end{aligned} \quad (3)$$

7.3.2 **OPTION 1/OPSIE 1:** **Positive marking from 7.3.1**

$$\begin{aligned} n(\text{NaOH}) \text{ added/bygesit} &= cV \\ &= (0,1)(0,015) \checkmark \\ &= 0,0015 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{NaOH}): n(\text{HCl}) \text{ left /oor} \\ 1:1 \checkmark \end{aligned}$$

$$n(\text{HCl}) \text{ left /oor} = 0,0015 \text{ mol}$$

$$\begin{aligned} n(\text{HCl}) \text{ reacted/gereageer} \\ &= n(\text{HCl}) \text{ initially/aanvanklik} - n(\text{HCl}) \text{ left/oor} \\ &= (0,01) - (0,0015) \checkmark \\ &= 0,0085 \text{ mol } \checkmark \end{aligned}$$

OPTION 2/OPSIE 2: **Positive marking from 7.3.1**

$$\begin{aligned} n(\text{NaOH}) \text{ added/bygesit} &= cV \\ &= (0,1)(0,015) \checkmark \\ &= 0,0015 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{NaOH}): n(\text{HCl}) \text{ left /oor} \\ 1:1 \checkmark \end{aligned}$$

$$n(\text{HCl}) \text{ left /oor} = 0,0015 \text{ mol}$$

$$\begin{aligned} n(\text{HCl}) \text{ reacted/gereageer} \\ &= n(\text{HCl}) \text{ initially/aanvanklik} - n(\text{HCl}) \text{ left/oor} \\ &= (0,0075) - (0,0015) \checkmark \\ &= 0,006 \text{ mol } \checkmark \end{aligned}$$

(4)

7.3.3 OPTION 1/OPSIE 1:
Positive marking from 7.3.2

$n(\text{Y}_2\text{CO}_3)$: $n(\text{HCl})$ reacted with Y_2CO_3 /
gereageer met Y_2CO_3

1:2✓

$$n(\text{Y}_2\text{CO}_3) = 0,0085 \div 2 \\ = 0,00425 \text{ mol}$$

$$n = \frac{m}{M} \\ 0,00425 = \frac{0,5865}{M} \quad \checkmark \\ = 138 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Mr}(\text{CO}_3) = 12 + (3 \times 16) \\ = 60 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Mr}(\text{Y}_2) = 138 - 60 \quad \checkmark \\ = 78 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Ar}(\text{Y}) = 78 \div 2 = 39 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

Element Y is POTASSIUM/K✓
Element Y is KALIUM/K

OPTION 2/OPSIE 2:
Positive marking from 7.3.2

$n(\text{Y}_2\text{CO}_3)$: $n(\text{HCl})$ reacted with Y_2CO_3 /
gereageer met Y_2CO_3

1:2✓

$$n(\text{Y}_2\text{CO}_3) = 0,006 \div 2 \\ = 0,003 \text{ mol}$$

$$n = \frac{m}{M} \\ 0,003 = \frac{0,5865}{M} \quad \checkmark \\ = 195,5 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Mr}(\text{CO}_3) = 12 + (3 \times 16) \\ = 60 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Mr}(\text{Y}_2) = 195,5 - 60 \quad \checkmark \\ = 135,5 \text{ g} \cdot \text{mol}^{-1}$$

$$\text{Ar}(\text{Y}) = 135,5 \div 2 = 67,75 \text{ g} \cdot \text{mol}^{-1} \quad \checkmark$$

Element Y is ZINC/Zn ($\text{Ar}=65$)✓
Element Y is SINK/Zn

OR/OF

Element Y is GALLIUM/Ga ($\text{Ar}=70$)

OR/OF

*Element Y cannot be identified
 from periodic table/
 Element Y kan nie vanaf die
 periodieke tabel identifiseer word
 nie*

(5)
[22]



LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

MARKING GUIDELINES

SEPTEMBER 2024

This marking guideline consists of a cover page and 10 pages.

TOTAL: 150

TIME: 3 HOURS

- Graph ends parallel to x-axis to represent equilibrium. ✓ (3)
- 6.5.1 Decreases ✓ (1)
- 6.5.2 Decreases ✓ (1)
- 6.5.3 Decreases ✓ (1)
- 6.6 At lower T, the exothermic (forward) reaction is favoured. ✓
Therefore, the reverse reaction is favoured, ✓
reducing the concentration of the gas (products). ✓ If concentration of products decrease then K_c will also decrease ✓ (4)
- 6.7 $K_c = [CO_2] ✓ = 1,4 \times 10^{-2} ✓$ (2)

[17]

QUESTION 7

- 7.1.1 An acid is a proton (H⁺-ion) -donor. ✓✓ (2)
- 7.1.2 It ionises to form 2 protons/2 mol H⁺-ions. ✓ (1)
OR
It donates 2H⁺-ions per H₂SO₄ -molecule.
- 7.2.1 Amphiprotic (substance)/Ampholyte ✓ (1)
- 7.2.2 H₂CO₃ (aq) ✓ (1)
- 7.3.1 $n(H_2CO_3) = \frac{m}{M} ✓$
 $= \frac{27}{84} ✓$
 $= 0,32 \text{ mol} \quad (0,3214285714 \text{ mol})$
 $n(H_2SO_4) = \frac{1}{2} n(NaHCO_3)$
 $= \frac{1}{2} (0,32) ✓$
 $= 0,16 \text{ mol} \quad (0,1607142857 \text{ mol})$
 $c = \frac{n}{V}$
 $6 = \frac{0,16}{V} ✓✓ \quad (6 \text{ and } 0,16)$
 $\therefore V = 0,03 \text{ dm}^3 ✓ \quad (30 \text{ cm}^3 / 0,027 \text{ dm}^3 / 27 \text{ cm}^3) \quad (6)$
- 7.3.2 $n_a(\text{initial}) = n_a(\text{final})$
 $c_a v_a(\text{initial}) = c_a v_a(\text{final})$

$$\begin{aligned}\therefore (6)v_a &= (0,1)(1) \checkmark \\ \therefore v_a &= 0,02 \text{ dm}^3 \checkmark \\ &\quad (20 \text{ cm}^3 / 0,0167 \text{ dm}^3 / 16,7 \text{ cm}^3) \quad (2)\end{aligned}$$

7.3.3 Shows end point (of titration). $\checkmark$ /Shows when neutralisation occurs. (1)

7.3.4

Marking criteria:

- Substitute initial [acid] and volume
- Substitute initial [base] and volume
- Use ratio 1 : 2
- Initial mole acid – mole acid reacted
- Substitute volume acid + volume base
- pH formula
- Substitute $2 \times c_a$ in pH formula
- Final answer: 1,44

$$\begin{aligned}n_a(\text{initial}) &= c_a v_a \\ &= (0,1)(25 \times 10^{-3}) \checkmark \\ &= 2,5 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\begin{aligned}n_b(\text{reacted}) &= c_b v_b \\ &= (0,1)(30 \times 10^{-3}) \checkmark \\ &= 3 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\frac{n_a}{n_b} = \frac{1}{2}$$

$$\therefore n_a(\text{neutralised}) = \frac{1}{2}n_b = \frac{1}{2}(3 \times 10^{-3}) \checkmark = 1,5 \times 10^{-3} \text{ mol}$$

$$\begin{aligned}n_a(\text{left}) &= n_a(\text{initial}) - n_a(\text{neutralised}) \\ &= 2,5 \times 10^{-3} - 1,5 \times 10^{-3} \checkmark \\ &= 1 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\begin{aligned}c_a &= \frac{n}{V} \\ &= \frac{1 \times 10^{-3}}{(25 \times 10^{-3} + 30 \times 10^{-3}) \checkmark}\end{aligned}$$

$$= 0,018 \text{ mol. dm}^{-3}$$

$$\text{pH} = -\log[H_3O^+] \checkmark$$

$$\begin{aligned}&= -\log [2(0,018) \checkmark] \\ &= 1,44 \checkmark\end{aligned}$$

(8)

[22]



education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY P2

SEPTEMBER 2024

MARKING GUIDELINES

MARKS/PUNTE: 150

**This memorandum consists of 13 pages.
Hierdie memorandum bestaan uit 13 bladsye.**

QUESTION 7 / VRAAG 7

7.1.1 A substance that can act as either acid or base ✓✓
'n Stof wat as óf 'n suur óf 'n basis kan reageer (2)

7.1.2 Acid/Suur✓
It donates a proton/ H^+ /Was 'n protonskenker ✓ (2)

7.1.3 CO_3^{2-} ✓ (1)

7.2 A ✓
 H_2SO_4 ionises completely in water to form a high concentration (H_3O^+) ions. OR
 H_2CO_3 ionises incompletely in water to form a low concentration (H_3O^+) ions ✓
 H_2SO_4 ioniseer volledig in water en vorm 'n hoë konsentrasie (H_3O^+) ione. OF
 H_2CO_3 ioniseer onvolledig in water en vorm 'n lae konsentrasie (H_3O^+) ione (2)

7.3 $[H_3O^+] = 2[H_2SO_4]$
 $= 2(0,25 \times 10^{-3})$
 $= 0,5 \times 10^{-3} \text{ mol} \cdot \text{dm}^{-3}$
 $pH = -\log[H_3O^+]$ ✓
 $= -\log(0,5 \times 10^{-3})$ ✓
 $= 3,301$ ✓ (3)

7.4.1 Hydrolysis / Hidrolise ✓ (1)

7.4.2 Basic or alkaline/Basis of alkalies ✓ (1)

7.5 Marking criteria / Nasienkriteria:

- Substitution of $(0,15 \times 0,1)$ in formula ($n = c \times v$) to calculate $n(HCl)$ ✓
Vervanging van $(0,15 \times 0,1)$ in formula ($n = c \times v$) om $n(HCl)$ te bereken
- Use mole ratio/Gebruik molverhouding: $n(Ba(OH)_2)_{\text{reacted}} : n(HCl) = 1:2$ ✓
- Substitution of $(0,05 \times 0,05)$ in formula ($n = c \times v$) to calculate $n(H_2SO_4)$ ✓
Vervanging van $(0,05 \times 0,05)$ in formula ($n = c \times v$) om $n(H_2SO_4)$ te bereken.
- Use mol ratio/ Gebruik molverhouding $n(Ba(OH)_2)_{\text{(excess)}} : H_2SO_4 = 1:1$ ✓
- $n(Ba(OH)_2)_{\text{initial/aanvanklik}} = n(Ba(OH)_2)_{\text{reacted/gereageer}} + n(Ba(OH)_2)_{\text{excess/oormaat}}$ ✓
- Substitute $0,025 \text{ dm}^3$ to calculate $c(Ba(OH)_2)_{\text{initial}}$ ✓
Vervang $0,025 \text{ dm}^3$ om $c(Ba(OH)_2)_{\text{aanvanklik}}$ te bereken
- Substitute $c(Ba(OH)_2)_{\text{initial}}$ and $171 \text{ g} \cdot \text{mol}^{-1}$ in $c = \frac{m}{MV}$ ✓
Vervang $c(Ba(OH)_2)_{\text{aanvanklik}}$ en $171 \text{ g} \cdot \text{mol}^{-1}$ in $c = \frac{m}{MV}$
- Final answer / Finale antwoord ($17,1 \text{ g}$) ✓

$$\begin{aligned}
 n(\text{HCl}) &= cV \\
 &= (0,15)(0,1) \checkmark (a) \\
 &= 0,015 \text{ mol} \\
 n(\text{Ba(OH)}_{2(\text{reacted})}) &= \frac{1}{2}n(\text{HCl}) \\
 &= \frac{1}{2}(0,015) \\
 &= 0,0075 \text{ mol} \checkmark (b) \\
 n(\text{H}_2\text{SO}_4) &= cV \\
 &= (0,05)(0,05) \checkmark (c) \\
 &= 0,0025 \text{ mol} \\
 n(\text{Ba(OH)}_{2(\text{excess})}) &= n(\text{H}_2\text{SO}_4) \\
 &= 0,0025 \text{ mol} \checkmark (d) \\
 n\text{Ba(OH)}_{2(\text{initial/aanvanklik})} &= 0,0075 + 0,0025 \checkmark (e) \\
 &= 0,01 \text{ mol}
 \end{aligned}$$

OPTION 1/OPSIE 1

$$\begin{aligned}
 c &= \frac{n}{V} \\
 &= \frac{0,01}{0,025} \checkmark (f) \\
 &= 0,4 \text{ mol} \cdot \text{dm}^{-3}
 \end{aligned}$$

$$\begin{aligned}
 c &= \frac{m}{MV} \\
 0,4 &= \frac{m}{(0,25)(171)} \checkmark (g) \\
 m &= 17,1 \text{ g} \checkmark (h)
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 \text{mol in } 250 \text{ cm}^3 &= \frac{0,01 \times 250}{25} \\
 &= 0,1 \text{ mol} (f) \checkmark
 \end{aligned}$$

$$\begin{aligned}
 n &= \frac{m}{M} \\
 0,1 &= \frac{m}{171} \checkmark (g) \\
 &= 17,1 \text{ g} \checkmark (h)
 \end{aligned}$$

(8)
[20]



DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS
LEFAPHA LA THUTO
ISEBE LEZEMFUNDO

**PROVINCIAL PREPARATORY EXAMINATION/
PROVINSIALE VOORBEREIDENDE EKSAMEN**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: CHEMISTRY
FISIESE WETENSKAPPE: CHEMIE**

PAPER/VRAESTEL 2

SEPTEMBER 2024

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 14 pages./
Hierdie nasienriglyne bestaan uit 14 bladsye.**

QUESTION 7/VRAAG 7

- 7.1.1 An acid ionises incompletely in water ✓ to form a low concentration of H_3O^+ . ✓
'n Suur ioniseer onvolledig in water om 'n lae konsentrasie H_3O^+ te vorm. (2)

- 7.1.2 **OPTION 1** **OPTION 2**
 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓ $[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ ✓
 $4,5$ ✓ $= -\log[\text{H}_3\text{O}^+]$ $= 10^{-4,5}$ ✓
 $= 3,16 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3}$ ✓ $= 3,16 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3}$ ✓ (3)

- 7.1.3 Greater than 7 ✓
A strong base (NaOH) reacts with a weak acid (HF) ✓ / 'n Sterk basis (NaOH)
reageer met 'n swak suur (HF) (2)

- 7.2.1 $n(\text{MgCO}_3) = \frac{m}{M}$
 $= \frac{3,5}{84}$ ✓
 $= 0,042 \text{ mol}$
 $n(\text{HCl}) = 2n(\text{MgCO}_3) = (2)(0,042)$ ✓
 $= 0,084 \text{ mol}$ ✓ (3)

- 7.2.2 POSITIVE MARKING FROM QUESTION 7.2.1

$$\begin{aligned} n(\text{NaOH}) &= cV \quad \checkmark \\ &= (1,2)(0,02) \quad \checkmark \\ &= 0,024 \text{ mol} \\ n(\text{HCl})_{\text{excess}} &= n(\text{NaOH}) = 0,024 \text{ mol} \quad \checkmark \\ n(\text{HCl})_{\text{initial}} &= n_{(\text{reacted})} + n_{(\text{excess})} \\ &= 0,084 + 0,024 \quad \checkmark \\ &= 0,108 \text{ mol} \\ c(\text{HCl}) &= \frac{n}{V} \\ &= \frac{0,108}{0,05} \quad \checkmark \\ &= 2,16 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \\ \text{Range } (2,08 - 2,16) \end{aligned}$$

(6)
[16]



education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

**NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)
SEPTEMBER 2024
MARKING GUIDELINES/NASIENRIGLYNE**

MARKS/PUNTE: 150

**These marking guidelines consist of 14 pages.
Hierdie nasienriglyne bestaan uit 14 bladsye.**

$$K_c = \frac{[\text{NO}_2] \cdot [\text{NO}]}{(0,06) \cdot (0,29)}$$

$$K_c = 3,93 \checkmark$$

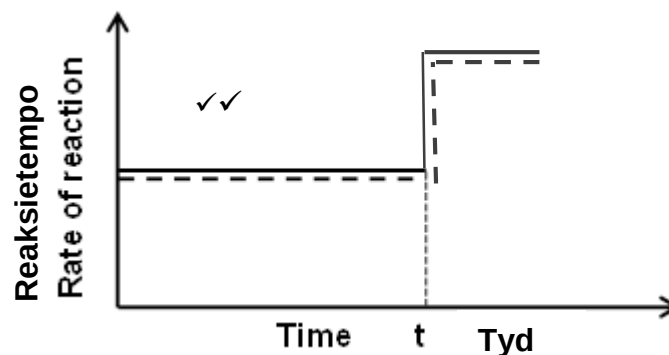
K_c decreases $\checkmark$

Decrease in temperature $\checkmark$ favours reverse reaction/exothermic reaction $\checkmark$

K_c neem af

Afname in temperatuur bevoordeel die terugwaartse/eksotermiese reaksie

6.3.5



[17]

QUESTION 7/VRAAG 7

7.1.1 HA $\checkmark$

(1)

7.1.2 HA ionises completely in water $\checkmark$ to form high concentration of H_3O^+ $\checkmark$
HA ioniseer volledig in water om 'n hoë konsentrasie H_3O^+ te vorm

(2)

7.1.3 Process in which ions are formed in a chemical reaction $\checkmark \checkmark$
Proses waarin ione in 'n chemiese reaksie gevorm word.

(2)

7.1.4 $\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark$
 $2,8 \checkmark = -\log[\text{H}_3\text{O}^+]$
 $[\text{H}_3\text{O}^+] = 0,0016 \text{ mol} \cdot \text{dm}^{-3} \checkmark$

(3)

7.2

7.2.1

Marking criteria/Nasienkriteria:

- $[\text{H}_3\text{O}^+] = 10^{-0,8} \checkmark$
- $[\text{HA}]_{\text{initial}} = 0,16 \text{ mol} \cdot \text{dm}^{-3} \checkmark$
- Formula $c = \frac{n}{V} \checkmark$
- Substitution of 0.05 in $n(\text{HA}) = 0,16 \times 0,05 \checkmark$
- $n(\text{CaCO}_3) = 0,08 \times 0,025 \checkmark$
- Using ratio $n(\text{CaCO}_3) = 2n(\text{HA})$ correctly $\checkmark$
- $n_{(\text{excess})} = \Delta n = n(\text{HA})_{(\text{initial})} - n(\text{HA})_{(\text{used})} = 0,008 - 0,004 \checkmark \checkmark$
- Final answer 0,004 mol $\checkmark$
- $[\text{H}_3\text{O}^+] = 10^{-0,8} \checkmark$
- $[\text{HA}]_{\text{aanv.}} = 0,16 \text{ mol} \cdot \text{dm}^{-3} \checkmark$
- Formule $c = \frac{n}{V} \checkmark$

• Vervanging van 0,05 in $n(\text{HA}) = 0,16 \times 0,05$ ✓
 • $n(\text{CaCO}_3) = 0,08 \times 0,025$ ✓
 • Gebruik verhouding $n(\text{CaCO}_3) = 2 \times n(\text{HA})$ korrek ✓
 • $n(\text{oormaat}) = \Delta n = n(\text{HA})_{(\text{aanv.})} - n(\text{HA})_{(\text{gereageer})} = 0,008 - 0,004$ ✓✓
 Finale antwoord 0,004 mol ✓

$[\text{H}_3\text{O}^+] = 10^{-0,8}$ ✓
 $[\text{H}_3\text{O}^+] = [\text{HA}] = 0,16 \text{ mol} \cdot \text{dm}^{-3}$ ✓
 $c = \frac{n}{V}$ ✓
 $n(\text{HA})_{\text{initial}} = 0,16 \times 0,05$ ✓ = 0,008
 $n(\text{CaCO}_3) = 0,08 \times 0,025$ ✓ = 0,002 mol
 $n(\text{CaCO}_3) = 2 \times n(\text{HA})$
 $= 2 \times 0,002$
 $= 0,004 \text{ mol}$ ✓
 $\Delta n = 0,008 - 0,004$ ✓✓
 $= 0,004 \text{ mol}$ ✓

(9)

7.2.2 HA (is in excess/oormaat) ✓

(1)

[17]

QUESTION 8/VRAAG 8

8.1 Cell in which chemical energy is converted to electric energy ✓✓
'n Sel waarin chemiese energie omgeskakel word na elektriese energie.

(2)

8.2 **ANY ONE:**

It completes the circuit/It maintains electrical neutrality ✓

ENIGE EEN:

Dit voltooi die stroombaan/Dit handhaaf elektriese neutraliteit

(1)

8.3. Cu ✓

reduction takes place at Cu/oxidation takes place at X ✓/
reduksie vind by Cu plaas/oksidasie vind by X plaas

(2)

8.4.1 $E^\ominus_{\text{cell}} = E^\ominus_{\text{reduction}} - E^\ominus_{\text{oxidation}}$ ✓

0,47 ✓ = 0,34 ✓ - X

X = -0,13 V ✓

$\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$ ✓✓

(6)

Notes:

- Accept any other correct formula from the data sheet.
- Any other formula using unconventional abbreviations, e.g.
 $E^\ominus_{\text{cell}} = E^\ominus_{\text{OA}} - E^\ominus_{\text{RA}}$ followed by correct substitutions: $\frac{3}{4}$

Nota:

- Aanvaar enige ander korrekte formule vanaf die gegewensblad.
- Enige ander formule wat onkonvensionele afkortings gebruik bv.
 $E^\ominus_{\text{sell}} = E^\ominus_{\text{OM}} - E^\ominus_{\text{RM}}$ gevolg deur die korrekte vervangings: $\frac{3}{4}$



**Western Cape
Government**

FOR YOU

Education

**PHYSICAL SCIENCES
PAPER 2
MARKING GUIDELINE DRAFT 2**

GRADE 12

**MNED PLC CLUSTER PAPER
SEPTEMBER 2024**

MARKS: 150

TIME: 3 hours

This marking guideline consists of 14 pages

QUESTION 7/ VRAAG 7

- 7.1 A proton donor. ✓ ✓ (2 or 0)
'n Proton skenker. ✓ ✓ (2 of 0) (2)

- 7.2 $\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark$
 $12 \checkmark = -\log[\text{H}_3\text{O}^+]$
 $[\text{H}_3\text{O}^+] = 1 \times 10^{-12}$
 $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] \checkmark$
 $1 \times 10^{-14} = [1 \times 10^{-12}][\text{OH}^-] \checkmark$
 $[\text{OH}^-] = 1 \times 10^{-2} \text{ mol.dm}^{-3} \checkmark$
- Mark allocation/Puntetoekenning:**
 a) pH formula/ pH formule
 b) Substitution into pH formula/ Vervanging in pH formule
 c) K_w formula/ K_w formule
 d) Substitution into K_w formula/ Vervanging in K_w formule
 e) Final answer correct/ Finale antwoord korrek (5)

- 7.3 $\text{Ba}(\text{OH})_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{BaCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$

$$\begin{aligned} n(\text{HCl}) &= cV \\ &= (0,75)(2) \checkmark \\ &= 1,5 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Ba}(\text{OH})_2)_{\text{reacts}} &= \frac{1}{2} n(\text{HCl}) \\ &= (0,5)(1,5) \checkmark \\ &= 0,75 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Ba}(\text{OH})_2)_{\text{excess}} &= \frac{1}{2} n(\text{OH}^-) \\ &= \frac{1}{2} cV \\ &= (0,5)(1 \times 10^{-2})(4) \checkmark \text{ Positive marking from Q7.2} \\ &= 0,02 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Ba}(\text{OH})_2)_{\text{total}} &= 0,75 + 0,02 \checkmark \\ &= 0,77 \text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{Ba}(\text{OH})_2) &= nM \\ &= (0,77)(171) \checkmark \\ &= 131,67 \text{ g} \end{aligned} \quad M = (137 + (2 \times 16) + 2) = 171 \text{ g.mol}^{-1}$$

$$\begin{aligned} \% \text{purity} &= \frac{131,67}{150} \times 100 \checkmark \\ &= 87,78\% \checkmark \end{aligned} \quad (7)$$

Mark allocation:	Puntetoekenning:
a) Calculate $n(\text{HCl})$	a) Bereken $n(\text{HCl})$
b) Mole ratio of $\text{Ba}(\text{OH})_2$ to HCl used	b) Molverhouding van $\text{Ba}(\text{OH})_2$ tot HCl gebruik
c) Calculate $n(\text{Ba}(\text{OH})_2)_{\text{excess}}$	c) Bereken $n(\text{Ba}(\text{OH})_2)_{\text{oormaat}}$
d) Calculate $n(\text{Ba}(\text{OH})_2)_{\text{total}}$	d) Bereken $n(\text{Ba}(\text{OH})_2)_{\text{totaal}}$
e) Substitution of $M = 171 \text{ g.mol}^{-1}$ and $n(\text{Ba}(\text{OH})_2)_{\text{total}}$ into $n = \frac{m}{M}$	e) Vervanging van $M = 171 \text{ g.mol}^{-1}$ en $n(\text{Ba}(\text{OH})_2)_{\text{totaal}}$ in $n = \frac{m}{M}$
f) $m(\text{Ba}(\text{OH})_2) \div 150 \text{g} \times 100$	f) $m(\text{Ba}(\text{OH})_2) \div 150 \text{g} \times 100$
g) Final answer = 87,78%	g) Finale antwoord = 87,78%

- 7.4 Bromothymol blue/ Broomtimolblou ✓ (1)

- 7.5 Barium hydroxide is a strong base ✓ and hydrochloric acid is a strong acid. ✓
The salt that is formed is neutral and at the endpoint the pH will be (around) 7. ✓

Bariumhidroksied is 'n sterk basis ✓ en soutsuur is 'n sterk suur. ✓

Die sout wat gevorm word is neutral en die pH by die eindpunt is (ongeveer) 7. ✓

Negative marking from Q7.2/Negatief merk vanaf V7.2

(3)

[18]

QUESTION 8/ VRAAG 8

- 8.1 A solution/liquid/dissolved substance that conducts electricity ✓ through the movement of ions. ✓
'n Oplossing/vloeistof/opgeloste stof wat elektrisiteit gelei ✓ deur die beweging van ione. ✓

(2)

- 8.2 Temperature at 25°C/ 298 K / Temperatuur van 25°C/ 298 K ✓
Concentration of 1 mol.dm⁻³ / Konsentrasie van 1 mol.dm⁻³ ✓

(2)

- 8.3 It is reduced, ✓ because Y²⁺ gains/accepts electrons from metal X / It is an oxidising agent / the oxidation number decreases. ✓
Word gereduseer, ✓ want Y²⁺ ontvang elektrone vanaf metaal X / Is 'n reduseermiddel / die oksidasie getal verminder ✓

(2)

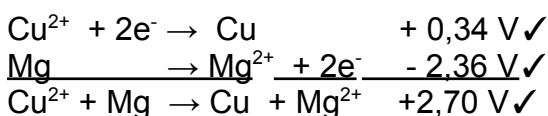
8.4 OPTION 1/OPSIE 1

Mg and/en Cu ✓

$$\begin{aligned} E^{\circ}_{\text{cell}} &= E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} \checkmark \\ E^{\circ}_{\text{sel}} &= E^{\circ}_{\text{katode}} - E^{\circ}_{\text{anode}} \\ &= (+0,34) \checkmark - (-2,36) \checkmark \\ &= 2,7 \text{ V} \end{aligned}$$

OPTION 2/OPSIE 2

Mg and/en Cu ✓



(4)

Notes/Aantekeninge

Accept any other correct formula from the data sheet/ Aanvaar enige ander korrekte formule vanaf gegewensblad.

Any other formula using unconventional abbreviations, e.g. $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{OA}} - E^{\circ}_{\text{RA}}$ followed by correct substitution:/ Enige ander formule wat onkonvensionele afkortings gebruik bv. $E^{\circ}_{\text{sel}} = E^{\circ}_{\text{OM}} - E^{\circ}_{\text{RM}}$ gevolg deur korrekte vervangings:
-1 mark/punt

[10]

METRO CENTRAL EDUCATION DISTRICT
PHYSICAL SCIENCES P2 MARKING GUIDELINES
SEPTEMBER 2024

QUESTION 1

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

QUESTION 8

- 8.1
- 8.1.1 NH_3 / Ammonia ✓ (1)
 - 8.1.2 It's a proton / H^+ / Hydrogen ion acceptor ✓ (1)
 - 8.1.3 Ammonium chloride ✓ (1)
- 8.2
- 8.2.1 Hydrolysis is the reaction of a salt with water. (2 or 0) ✓✓ (2)
 - 8.2.2 $\text{NH}_4^+ (\text{aq}) + \text{H}_2\text{O} (\text{l}) \checkmark \rightarrow \text{H}_3\text{O}^+ (\text{aq}) + \text{NH}_3 (\text{aq}) \checkmark$
Due to the formation of hydronium ions (H_3O^+) the solution is acidic ✓ (3)
- 8.3.1 Burette. ✓ (1)
- 8.3.2 Yellow to Blue ✓ (1)
- 8.3.3 Equivalence point ✓ (1)

What is the endpoint and equivalence point in titration?

Equivalence point refers to the point at which the chemical reaction comes to a stop, whereas **endpoint** refers to the point at which the colour change in a system or solution occurs.

As an example, take a strong acid solution as an analyte that is titrated with a strong base. In this case, the pH of the analyte starts out very low (as the analyte solution is a strong acid). As strong base is titrated into the solution, the pH increases slightly but in general will not change much. However, at some point the number of moles of base that have been added to the solution will be equal to the number of moles of acid in the original analyte. At this point the pH will change very dramatically as the solution will now be neutral. After this adding any more of the strong base will rapidly make the solution basic. It is the very large change in pH over a small range of the added titrate volume that is the reason to perform a titration. The point at which the number of moles of added base are equal to the number of moles of acid in the analyte solution is called the **equivalence point**. It is easy to identify this point in a titration because it is the volume at which the pH is rapidly changing. Technically, the equivalence point is where the titration curve exhibits an inflection point. At this point the curve has the steepest slope. The volume at the equivalence point can be used with the known concentration of the titrant to determine how many moles have been added to the solution. At the equivalence point the moles of added base will be equal to the moles of original acid, this allows the determination of the number of moles of original acid. This can then be combined with the original volume of the analyte solution to determine its concentration. In practice it is very important to use small aliquots to accurately determine the exact volume at the equivalence point.

8.3.4

Marking criteria:

- $c = \frac{n}{V}$ OR $\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ ✓
- Correct substitution ✓
- Ratio of moles ✓
- Substitution of 25 ml (0,025 dm³)
- Final answer: 0,08 mol ✓

OPTION 1

$$\begin{aligned} \text{(a)} \quad c(\text{NaOH}) &= \frac{n}{V} \quad \checkmark \\ 0,2 &= \frac{n}{0,02} \quad \checkmark \\ &= 0,004 \text{ mol NaOH} \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad n(\text{H}_2\text{SO}_4) &= \frac{1}{2} n(\text{NaOH}) \\ &= \frac{1}{2} \times 0,004 \quad \checkmark \\ &= 0,002 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{(c)} \quad c(\text{H}_2\text{SO}_4) &= \frac{0,002}{0,025} \quad \checkmark \\ &= 0,08 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \end{aligned}$$

OPTION 2

$$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} \quad \checkmark$$

$$\frac{c_a \times 25 \quad \checkmark}{0,2 \times 20 \quad \checkmark} = \frac{1}{2} \quad \checkmark$$

$$c(\text{H}_2\text{SO}_4) = 0,08 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

OPTION 3**Value read from graph: [Range for pH: 0,7 – 0,9]**

$$\begin{aligned} \text{(a)} \quad \text{pH} &= -\log [\text{H}_3\text{O}^+] \quad \checkmark \\ 0,8 &= -\log [\text{H}_3\text{O}^+] \quad \checkmark \\ [\text{H}_3\text{O}^+] &= 0,1585 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad [\text{H}_3\text{O}^+] : [\text{H}_2\text{SO}_4] \\ 2 : 1 \quad \checkmark \end{aligned}$$

$$\begin{aligned} \text{(c)} \quad [\text{H}_2\text{SO}_4] &= 0,079 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \\ &[\text{Range: } 0,063 \text{ mol} \cdot \text{dm}^{-3} - 0,0998 \text{ mol} \cdot \text{dm}^{-3}] \end{aligned}$$

(5)

8.3.5

Marking Guideline

- Formula $c = \frac{n}{V}$ / $c_1V_1 = c_2V_2$ ✓
- Substitution of $(30 - 20) = 10$ ml (0,01) ✓
- Substitution of $(30+25) = 55$ ml (0,055) ✓
- Using K_w to find $[H_3O^+]$ ✓
- Formula $pH = -\log[H_3O^+]$ ✓
- Substitution of $[H_3O^+]$ ✓
- Final answer: 12.56 ✓

OPTION 1	OPTION 2	OPTION 3
(a) $c(\text{NaOH}) = \frac{n}{V} \checkmark$ $0,2 = \frac{n}{(0,03-0,02)} \checkmark$ $n = 0,002 \text{ mol}$ $c(\text{NaOH}) = \frac{0,002}{(0,03+0,025)} \checkmark$ $= 0,03636 \text{ mol}\cdot\text{dm}^{-3}$	(a) $c_1V_1 = c_2V_2 \checkmark$ $(0,2)(0,03 - 0,02) \checkmark =$ $c_2(0,055) \checkmark$ $c_2 = 0,03636 \text{ mol}\cdot\text{dm}^{-3}$	$n_{\text{initial}} = c \cdot V \checkmark$ $= (0,2)(0,03)$ $= 0,006 \text{ mol}$ $n_{\text{reacted}} = c \cdot V$ $= (0,2)(0,02)$ $= 0,004 \text{ mol}$ $n_{\text{excess}} = n_{\text{initial}} - n_{\text{re}}$ $= 0,006 - 0,004 \checkmark$ $= 0,002 \text{ mol}$ $C = \frac{n}{V}$ $= \frac{0,002}{0,055} \checkmark$ $= 0,03636 \text{ mol}\cdot\text{dm}^{-3}$
(b) $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$ (Ratio 1: 1) $[\text{OH}^-] = 0,03636 \text{ mol}\cdot\text{dm}^{-3}$ (c) $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ $[\text{H}_3\text{O}^+] = \frac{1 \times 10^{-14}}{0,03636} \checkmark$ $= 2,75 \times 10^{-13} \text{ mol}\cdot\text{dm}^{-3}$ (d) $pH = -\log[\text{H}_3\text{O}^+] \checkmark$ $= -\log(2,75 \times 10^{-13}) \checkmark$ $= 12,56 \checkmark$		

(7)

Accept if pOH is calculated

[23]

WEST COAST EDUCATION DISTRICT

MEMORANDUM

PHYSICAL SCIENCES

SEPTEMBER 2024

GRADE 12

TOTAL: 150

FAT 5: CHEMISTRY EXAM

TIME: 180 min

QUESTION 1

- 1.1

A

✓✓

(2)
- 1.2

D

✓✓

(2)
- 1.3

C

✓✓

(2)
- 1.4

B

✓✓

(2)
- 1.5

B

✓✓

(2)
- 1.6

A

✓✓

(2)
- 1.7

B

✓✓

(2)
- 1.8

C

✓✓

(2)
- 1.9

C

✓✓

(2)
- 1.10

A

✓✓

(2)

20

QUESTION 7

- 7.1 **pH VALUE:** The negative logarithm of the hydrogen ion concentration (Hydronium ion concentration) in a solution. ✓✓ (2)

7.2 (4)

Conjugate Acid	Ampholyte	Conjugate Base
H₃O⁺ ✓	H ₂ O	OH⁻ ✓
H₂SO₄ ✓	HSO ₄ ⁻	SO₄²⁻ ✓

- 7.3.1 CH₃COONa ✓ (Also accept NaCH₃COO) (1)

- 7.3.2 Mg(NO₃)₂ ✓ (1)

7.4 (8)

	Zn	2HCl	ZnCl ₂	H ₂
n _i	0,15	0,3	0	0
Δn	60% van 0,15 = 0,09	0,18		
n _f		0,12		
	m _(Zn) = 9,75 g $n_{(Zn)} = \frac{m}{M} = \frac{9,75}{65}$ n _(Zn) = 0,15	V _(HCl) = 0,6 dm ³ c _(HCl) = 0,5 mol. dm ⁻³ n _(HCl) = (0,6)(0,5) n _(HCl) = 0,3 mol		

- ❶ Calculate the amount of moles of Zn reacting: ✓

$$n_{(Zn)} = \frac{m}{M} = \frac{9,75}{65} = 0,15$$

$$\Delta n_{(Zn)} = 60\% \text{ van } 0,15 = 0,09 \text{ mol}$$

- ❷ Calculate the EXCESS HCl: ✓

$$n_{(HCl)} = (0,6)(0,5) = 0,3 \text{ mol}$$

$$\Delta n_{(Zn)} : \Delta n_{(HCl)} = 1 : 2 \quad \therefore \Delta n_{(HCl)} = 0,18 \text{ mol}$$

$$\text{Excess HCl: } n_f = 0,3 - 0,18 = 0,12 \text{ mol}$$

	NaOH	HCl	NaCl	H ₂ O
n _i	0,12	0,12	0	0
Δn	0,12	0,12		
n _f	0	0		
	$V_{(\text{NaOH})} = 0,4 \text{ dm}^3$ $c_{(\text{NaOH})} = \frac{n}{V} = \frac{0,12}{0,4}$ $c_{(\text{NaOH})} = 0,3 \text{ mol. dm}^{-3}$			

③ Calculate the CONCENTRATION of the NaOH:

$$\Delta n_{(\text{NaOH})} : \Delta n_{(\text{HCl})} = 1 : 1 \quad \therefore \Delta n_{(\text{NaOH})} = 0,12 \text{ mol} \quad \checkmark$$

$$c_{(\text{NaOH})} = \frac{n}{V} = \frac{0,12}{0,4} = 0,3 \text{ mol. dm}^{-3} \quad \checkmark$$

④ Calculate the pH of the NaOH:

OPTION 1:

$$K_w = [\text{OH}^-][\text{H}_3\text{O}^+] = 1 \times 10^{-14}$$

$$K_w = (0,3)[\text{H}_3\text{O}^+] = 1 \times 10^{-14}$$

$$K_w = (0,3)[\text{H}_3\text{O}^+] = 3,33 \times 10^{-14} \quad \checkmark$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] \quad \checkmark$$

$$\text{pH} = -\log (3,33 \times 10^{-14}) \quad \checkmark$$

$$\text{pH} = 13,48 \quad \checkmark$$

OPTION 2:

$$[\text{OH}^-] = 0,3 \text{ mol. dm}^{-3}$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pOH} = -\log(0,3)$$

$$\text{pOH} \approx 0,52$$

$$\therefore \text{pH} = 14 - 0,52$$

$$\text{pH} = 13,48$$



**Western Cape
Government**

FOR YOU

Education

CAPE WINELANDS EDUCATION DISTRICT

**PHYSICAL SCIENCES MEMORANDUM PAPER 2
GRADE 12**

**COMMON PRELIMINARY EXAMINATION
SEPTEMBER 2024**

MARKS: 150

TIME: 3 hours

This marking guideline consists of 14 pages

OPTION/OPSIE 5

	SO ₂	O ₂	SO ₃	
Mole ratio/ Mol verhouding	2	1	2	
Initial concentration/ Aanvanklike konsentrasie	✓ $\frac{3,45}{3} = 1,15$	y	0	
Change in concentration/ Verandering in konsentrasie	0,65	0,325	0,65✓	Ratio✓
Concentration at equilibrium/ Konsentrasie by ewewig	0,5✓	y - 0,325	0,65	
$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} \checkmark$ $1,52 = \frac{(0,65)^2}{(0,5)^2(y - 0,325)} \checkmark$ $y = 1,4368 \text{ mol. dm}^{-3}$ $m(O_2) = cMV = (1,4368)(32)(3) \checkmark \checkmark$ $m(O_2) = 137,94g \checkmark$				

(9)

6.2.2.1 Remains the same ✓
Bly dieselfde ✓

(1)

6.2.2.2 Decrease ✓
Verminder ✓

(1)

[17]

QUESTION 7/ VRAAG 7

7.1 A proton donor. ✓ ✓
'n Proton skenker.

(2 or 0)
(2 of 0)

(2)

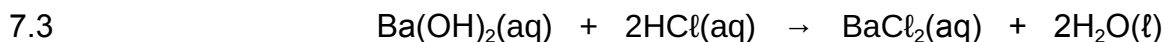
7.2 pH = -log[H₃O⁺] ✓
12 ✓ = -log[H₃O⁺]
[H₃O⁺] = 1 × 10⁻¹²

K_w = [H₃O⁺][OH⁻] ✓
1 × 10⁻¹⁴ = [1 × 10⁻¹²][OH⁻] ✓
[OH⁻] = 1 × 10⁻² mol.dm⁻³ ✓

Mark allocation:

- a) pH formula/ pH formule
b) Substitution into pH formula/
Vervanging in pH formule
c) K_w formula/ K_w formule
d) Substitution into K_w formula/
Vervanging in K_w formule
e) Final answer correct/ Finale antwoord korrek

(5)



$$\begin{aligned} n(\text{HCl}) &= cV \\ &= (0,75)(2) \checkmark \\ &= 1,5 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Ba(OH)}_2)_{\text{reacts}} &= \frac{1}{2} n(\text{HCl}) \\ &= (0,5)(1,5) \checkmark \\ &= 0,75 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Ba(OH)}_2)_{\text{excess}} &= \frac{1}{2} n(\text{OH}^-) \\ &= \frac{1}{2} cV \\ &= (0,5)(1 \times 10^{-2})(4) \checkmark \\ &= 0,02 \text{ mol} \end{aligned}$$

Positive marking from Q7.2

$$\begin{aligned} n(\text{Ba(OH)}_2)_{\text{total}} &= 0,75 + 0,02 \checkmark \\ &= 0,77 \text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{Ba(OH)}_2) &= nM \\ &= (0,77)(171) \checkmark \\ &= 131,67 \text{ g} \end{aligned}$$

$$M = (137 + (2 \times 16) + 2) = 171 \text{ g.mol}^{-1}$$

$$\begin{aligned} \% \text{purity} &= \frac{131,67}{150} \times 100 \checkmark \\ &= 87,78\% \checkmark \end{aligned}$$

Mark allocation: a) Calculate $n(\text{HCl})$ b) Mole ratio of Ba(OH)_2 to HCl used c) Calculate $n(\text{Ba(OH)}_2)_{\text{excess}}$ d) Calculate $n(\text{Ba(OH)}_2)_{\text{total}}$ e) Substitution of $M = 171 \text{ g.mol}^{-1}$ and $n(\text{Ba(OH)}_2)_{\text{total}}$ into $n = \frac{m}{M}$ f) $m(\text{Ba(OH)}_2) \div 150\text{g} \times 100$ g) Final answer = 87,78%	Puntetoekenning: a) Bereken $n(\text{HCl})$ b) Molverhouding van Ba(OH)_2 tot HCl gebruik c) Bereken $n(\text{Ba(OH)}_2)_{\text{oormaat}}$ d) Bereken $n(\text{Ba(OH)}_2)_{\text{totaal}}$ e) Vervanging van $M = 171 \text{ g.mol}^{-1}$ en $n(\text{Ba(OH)}_2)_{\text{totaal}}$ in $n = \frac{m}{M}$ f) $m(\text{Ba(OH)}_2) \div 150\text{g} \times 100$ g) Finale antwoord = 87,78%
--	--

(7)

7.4 Bromothymol blue/ Broomtimolblou $\checkmark$

(1)

7.5 Barium hydroxide is a strong base $\checkmark$ and hydrochloric acid is a strong acid. $\checkmark$
The salt that is formed is neutral and at the endpoint the pH will be (around) 7. $\checkmark$

Bariumhidroksied is 'n sterk basis en soutsuur is 'n sterk suur.

Die sout wat gevorm word is neutral en die pH by die eindpunt is (ongeveer) 7.

(3)

[18]



basic education

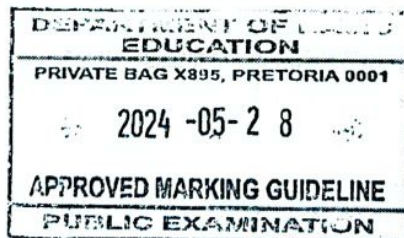
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

MAY/JUNE/MEI/JUNIE 2024

MARKING GUIDELINES/NASIENRIGLYNE



MARKS/PUNTE: 150

These marking guidelines consist of 20 pages./
Hierdie nasienriglyne bestaan uit 20 bladsye.

Approved
M. Keen
DBE Moderator
11-05-2024

Approved
DBE Moderator

Approved
V. Palas
unclassified Ex. Moderator

Approved!
V. Palas
unclassified Ex. Moderator

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QUESTION 7/VRAAG 7

7.1

Marking criteria:

- Any formula $c = \frac{m}{MV}$ or $n = \frac{m}{M}$ or $c = \frac{n}{V}$ ✓
- Substitute 10, 106 and 0.7 into formula ✓
- Final answer: 0,13 mol·dm⁻³ ✓

Nasienkriteria:

- Enige formule $c = \frac{m}{MV}$ of $n = \frac{m}{M}$ of $c = \frac{n}{V}$ ✓
- Vervang 10, 106 and 0.7 in formula ✓
- Finale antwoord: 0,13 mol·dm⁻³ ✓

7.1.1

OPTION 1/OPSIE 1:

$$c = \frac{m}{MV} \checkmark$$

$$= \frac{10}{(106)(0,7)} \checkmark$$

$$= 0,13 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

OPTION 2/OPSIE 2:

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

$$= \frac{10}{106} \checkmark$$

$$= 0,09 \checkmark$$

$$c = \frac{n}{V} \checkmark$$

$$= \frac{0,09}{0,7} \checkmark$$

$$= 0,13 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

Any one/Enige een ✓

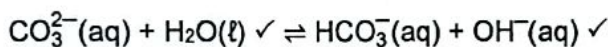
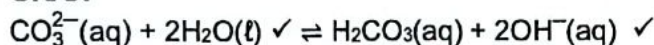
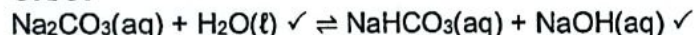
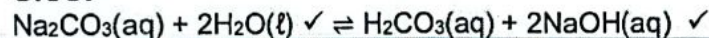
(3)

7.1.2

Greater than/Groter as ✓

(1)

7.1.3

**OR/OF****OR/OF****OR/OF****Marking criteria/Nasienkriteria:**

- Reactants ✓ Products ✓
- Reaktanse ✓ Produkte ✓
- Ignore/Ignoreer → and phases/en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(2)

7.1.4

P ✓
⊖

(Titration of) weak base and a strong acid./The equivalence point is lower than pH 7. ✓

(Titrasie van) 'n swak basis en 'n sterk suur./Die ekwivalente punt is laer as 'n pH van 7.

(2)

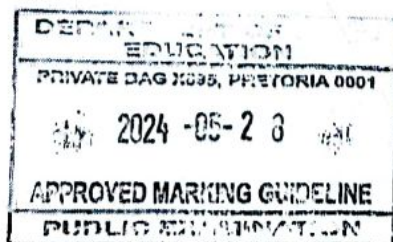
7.2

7.2.1

Dilute acid contains small amount/number of moles of acid in proportion to the volume of water. ✓✓ (2 or/of 0)

Verdunde sure bevat 'n klein hoeveelheid/getal mol suur in verhouding met die volume water.

(2)



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7.2.2

Marking criteria:

(a) USE of ratio:

$$n(\text{KOH})_{\text{reacted}} = 2n(\text{H}_2\text{SO}_4)_{\text{reacted}} /$$

$$[\text{KOH}]_{\text{reacted}} = 2n[\text{H}_2\text{SO}_4]_{\text{reacted}} \checkmark$$

(b) Subtract: $n(\text{KOH})_{\text{initial}} - n(\text{KOH})_{\text{reacted}} /$

$$[\text{KOH}]_{\text{initial}} - [\text{KOH}]_{\text{reacted}} \checkmark \checkmark$$

(c) Divide n by 0,20 dm³ in $c = \frac{n}{V}$ ✓(d) Either formulae: $\text{pH} = -\log[\text{H}_3\text{O}^+] /$

$$\text{pH} = -\log[\text{H}^+] / \text{pOH} = -\log[\text{OH}^-] \text{ AND}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14} /$$

$$\text{pH} + \text{pOH} = 14 \checkmark$$

(e) Substitute calculated $[\text{OH}^-]$ in

$$[\text{H}_3\text{O}^+][\text{OH}^-] / \text{in } \text{pOH} = -\log[\text{OH}^-] \checkmark$$

(f) Substitute calculated $[\text{H}_3\text{O}^+]$ in pH

$$\text{formula/ pOH in } \text{pH} + \text{pOH} = 14 \checkmark$$

(g) Final answer: 12,3 ✓

OPTION 1/OPSIE 1:

$$n(\text{KOH})_{\text{reacted}} = 2n(\text{H}_2\text{SO}_4)_{\text{reacted}}$$

$$= 2(0,01) \checkmark \text{ (a)}$$

$$= 0,02$$

$$n(\text{KOH})_{\text{excess}} = 0,024 - 0,02 \checkmark \checkmark \text{ (b)}$$

$$= 0,004 \text{ mol}$$

$$[\text{OH}^-] = \frac{n}{V}$$

$$= \frac{0,004}{0,20}$$

$$= 0,02 \text{ mol} \cdot \text{dm}^{-3} \checkmark \text{ (c)}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$$

$$[\text{H}_3\text{O}^+] (0,02) = 1 \times 10^{-14} \checkmark \text{ (e)}$$

$$[\text{H}_3\text{O}^+] = 5 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark \text{ (f)}$$

$$= -\log(5 \times 10^{-13}) \checkmark \text{ (f)}$$

$$= 12,3 \checkmark \text{ (g)}$$

OPTION 3/OPSIE 3

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pOH} = -\log(0,02) \checkmark \text{ (e)}$$

$$\text{pOH} = 1,7$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} + 1,7 = 14 \checkmark \text{ (f)}$$

$$\text{pH} = 12,3 \checkmark \text{ (g)}$$

Nasienkriteria:

(a) GEBRUIK verhouding:

$$n(\text{KOH})_{\text{gereageer}} = 2n(\text{H}_2\text{SO}_4)_{\text{gereageer}}$$

$$[\text{KOH}]_{\text{gereageer}} = 2n[\text{H}_2\text{SO}_4]_{\text{gereageer}} \checkmark$$

(b) Aftrek: $n(\text{KOH})_{\text{aanvanklik}} - n(\text{KOH})_{\text{gereageer}}$

$$[\text{KOH}]_{\text{aanvanklik}} - [\text{KOH}]_{\text{gereageer}} \checkmark \checkmark$$

(c) Deel n deur 0,20 dm³ in $c = \frac{n}{V}$ ✓(d) Enige een v formules: $\text{pH} = -\log[\text{H}_3\text{O}^+] /$

$$\text{pH} = -\log[\text{H}^+] / \text{pOH} = -\log[\text{OH}^-] \text{ EN}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14} /$$

$$\text{pH} + \text{pOH} = 14 \checkmark$$

(e) Vervang berekende $[\text{OH}^-]$ in

$$[\text{H}_3\text{O}^+][\text{OH}^-] / \text{in } \text{pOH} = -\log[\text{OH}^-] \checkmark$$

(f) Vervang berekende $[\text{H}_3\text{O}^+]$ in pH

$$\text{formule/ pOH in } \text{pH} + \text{pOH} = 14 \checkmark$$

(g) Finale antwoord: 12,3 ✓

OPTION 2/OPSIE 2:

$$[\text{KOH}] = \frac{n}{V}$$

$$= \frac{0,024}{0,20}$$

$$= 0,12 \text{ mol} \cdot \text{dm}^{-3} \checkmark \text{ (c)}$$

$$[\text{H}_2\text{SO}_4] = \frac{n}{V}$$

$$= \frac{0,01}{0,20}$$

$$= 0,05 \text{ mol} \cdot \text{dm}^{-3}$$

$$[\text{KOH}]_{\text{reacted}} = 2[\text{H}_2\text{SO}_4]_{\text{reacted}} \checkmark \text{ (a)}$$

$$= 2(0,05)$$

$$= 0,1 \text{ mol} \cdot \text{dm}^{-3}$$

$$[\text{KOH}]_{\text{excess}} = 0,12 - 0,1 \checkmark \checkmark \text{ (b)}$$

$$= 0,02 \text{ mol} \cdot \text{dm}^{-3}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$$

$$[\text{H}_3\text{O}^+] (0,02) = 1 \times 10^{-14} \checkmark \text{ (e)}$$

$$[\text{H}_3\text{O}^+] = 5 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark \text{ (f)}$$

$$= -\log(5 \times 10^{-13}) \checkmark \text{ (f)}$$

$$= 12,3 \checkmark \text{ (g)}$$

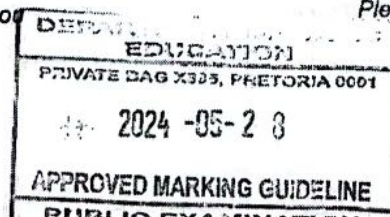
Any one/Enige een ✓ (d)

N. Visser

(8)
(18)

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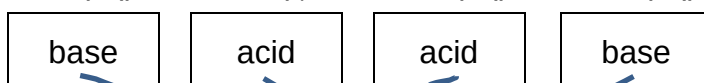
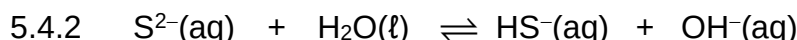
QUESTION 5

5.1 sodium ✓ thiosulfate ✓ (accept thiosulphate)

5.2 NaOH is a STRONG ✓ base that COMPLETELY ✓ DISSOCIATES ✓ in water.

- 5.3
- NaOH is a (giant) ionic solid. ✓ (accept if ionic bonds stated below)
 - There are **many** ✓ **strong** ✓ ionic bonds / electrostatic / coulombic forces of attraction
 - A lot of energy is needed to break/overcome the ionic bonds / them ✓

5.4 5.4.1 A substance in which the hydrogen of an acid ✓ has been replaced by a cation. ✓

*Labels ✓ links ✓*

5.4.3 hydrolysis ✓

5.4.4 BASIC ✓ The $[\text{OH}^{-}]$ increases OR $[\text{OH}^{-}] > [\text{H}_3\text{O}^{+}]$ ✓
OR it is a salt of a strong base and a weak acid ✓

5.4.5 FALSE ✓

5.5 5.5.1 $n(\text{S}) = \frac{m}{M} \checkmark = \frac{2,24}{32} (\checkmark \text{ sub both}) = 0,07 \text{ mol}$

$$n(\text{NaOH}) = cV \checkmark = 0,5 \times 0,3 (\checkmark \text{ sub both}) = 0,15 \text{ mol}$$

$$0,07 \text{ mol S reacts with } 0,07 \times \frac{6}{4} = 0,105 \text{ mol NaOH} < 0,15 \text{ mol } \checkmark$$

$$\text{OR: } 0,15 \text{ mol NaOH needs } 0,15 \times \frac{4}{6} = 0,1 \text{ mol S} > 0,07 \text{ mol } \checkmark$$

∴ S is limiting reagent ✓5.5.2 Carry over error from 5.5.1 (must use the amounts that react)
Calculate theoretical yield:

EITHER: 0,07 mol S (LR) produces $\frac{0,07}{4} \checkmark = 0,0175 \text{ mol Na}_2\text{S}_2\text{O}_3$

OR: 0,105 mol NaOH produces $\frac{0,105}{6} \checkmark = 0,0175 \text{ mol Na}_2\text{S}_2\text{O}_3$

Calculate actual yield and mass:

EITHER: $m(\text{Na}_2\text{S}_2\text{O}_3) = nM = 0,0175 \checkmark \times 158 \checkmark = \mathbf{2,765 \text{ g}}$

Actual yield = 75% ✓ of 2,765 = **2,07 g ✓**

OR: Actual yield = 75% ✓ of 0,0175 = **0,0131 mol ✓**

$m(\text{Na}_2\text{S}_2\text{O}_3) = nM = 0,0131 \times 158 \checkmark = \mathbf{2,07 \text{ g } \checkmark}$