



**education**

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**Department:**

**Education**

**PROVINCE OF KWAZULU NATAL**

**PHYSICAL SCIENCES  
PRACTICAL EXAMINATION  
AUGUST 2017**

**UMLAZI DISTRICT**

**GRADE 12**

**TIME: 2 hours**

**MARKS: 100**

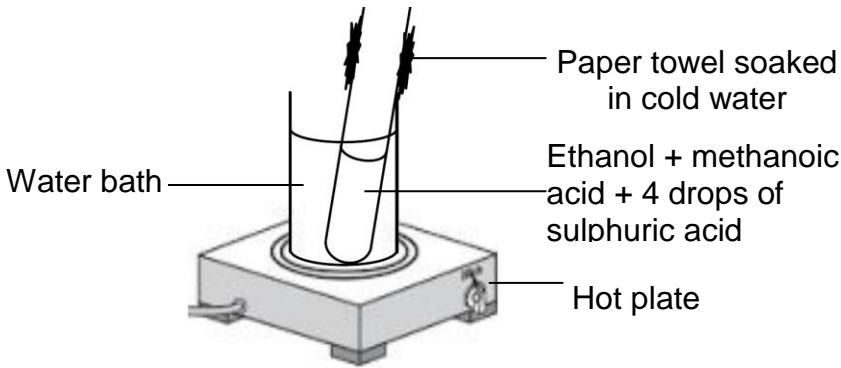
**This question paper consists of 9 pages.**

## **INSTRUCTIONS AND INFORMATION**

1. Write your name in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions in the ANSWER BOOK
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Give brief motivations, discussions, et cetera where required.
7. Round off your final numerical answers to a minimum of TWO decimal places.

## QUESTION ONE: PREPARATION OF AN ESTER

Learners prepare ethyl methanoate, an ester, in the laboratory using the following apparatus and procedure.



Water bath

Paper towel soaked in cold water

Ethanol + methanoic acid + 4 drops of sulphuric acid

Hot plate

Procedure

- Pour 2 cm<sup>3</sup> of methanoic acid and 2 cm<sup>3</sup> of ethanol into a test tube.
- Carefully add four drops of concentrated sulphuric acid to the mixture.
- Shake the contents of the test tube and place the test tube in a water bath. Place a paper towel soaked in cold water near the mouth of the test tube.
- Heat the water bath.
- After a while pour the contents of the test tube into a beaker of cold water.
- Hold the test tube about 30 cm from the nose and waive the fumes towards you with your hand and note the smell in your notebook.

- 1.1 Name the homologous series to which each of the following belong:
  - 1.1.1 ethanol (1)
  - 1.1.2 methanoic acid (1)
- 1.2 What is the function of the sulphuric acid in this reaction? (2)
- 1.3 Explain the function of the paper towel soaked in water in this experiment. (2)
- 1.4 The learners finds it difficult to smell the ester. Their teacher suggests that they should add 10 drops of a dilute sodium carbonate solution to the contents of the test tube. Explain briefly why this suggestion can be a solution to the problem. (2)
- 1.5 Using structural formulae, write down the balanced equation for the formation of this ester. (5)
- 1.6 Write down the IUPAC name for this ester. (2)

**[15]**

## QUESTION TWO: CONSERVATION OF MOMENTUM

Learners want to verify the Law of Conservation of Momentum.

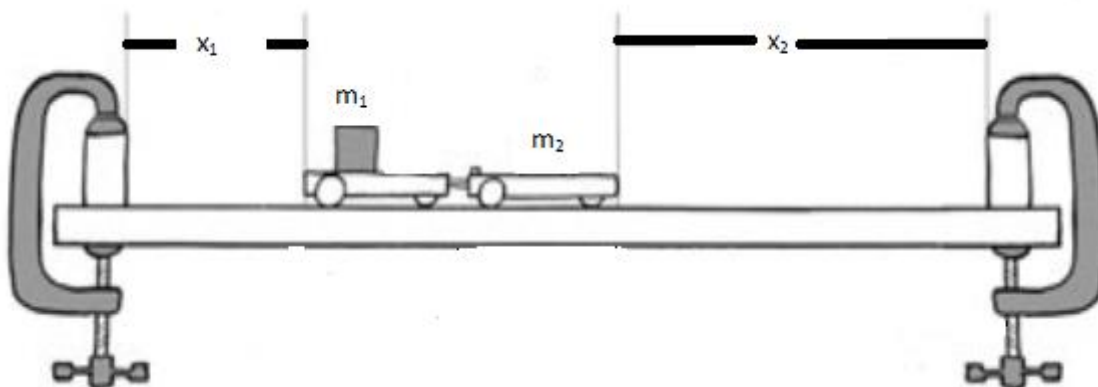
### Apparatus:

- Two spring loaded trolleys
- Trolley track
- Two stop watches
- Meter stick
- Mass meter
- Masking tape

### Method:

1. Clamp the barriers 2,5 metre apart onto a flat surface as shown in the experimental setup below.
2. Find the mass of each trolley and place a known mass on each trolley.
3. Place the two trolleys between the barriers end to end so that the spring on the one trolley is in contact with the flat surface of the other trolley
4. Release the spring by hitting the release knob and observe how the trolleys push each other apart.
5. Repeat the above steps with the trolleys at the same positions, each time noting the time they take to strike the barriers.
6. Measure the distances  $x_1$  and  $x_2$  that the trolleys cover.
7. Repeat the experiment for a different combinations of masses for each trolley.

### The experimental Setup



The following data is obtained for this experiment.

Table

|              | Trolley 1 + mass piece |                  |                  |  | Trolley 2 + mass piece |                  |                  |
|--------------|------------------------|------------------|------------------|--|------------------------|------------------|------------------|
|              | Mass (kg)              | $\Delta x_1$ (m) | $\Delta t_1$ (s) |  | Mass (kg)              | $\Delta x_2$ (m) | $\Delta t_1$ (s) |
| Experiment 1 | 1,4                    | 0,5              | 4                |  | 0,9                    | 1,5              | 7                |
| Experiment 2 | 1,6                    | 0,5              | 5                |  | 1,2                    | 1,5              | 13               |
| Experiment 3 | 2                      | 0,5              | 6                |  | 1,6                    | 1,5              | 14               |
| Experiment 4 | 2,5                    | 0,5              | 7                |  | 2,2                    | 1,5              | X                |

2.1 For **experiment 1**, calculate:

2.1.1 the final momentum of trolley 1.

(2)

2.1.2 the final momentum of trolley 2.

(2)

2.2 For **experiment 3**, calculate:

2.2.1 the final momentum of trolley 1. (1)

2.2.2 the final momentum of trolley 2. (1)

2.3 What conclusion, within experimental reason, can be made about the total momentum of this system. (2)

2.4 The learners forgot to record the time (**X** in table) for trolley 2 in **experiment 4**. Calculate the value of **X**. (3)

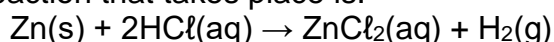
2.5 Excluding inaccuracies in recording times, name one other factor that is the major cause of experimental error when conducting this experiment. (3)  
How is this experimental error minimised?

**[14]**

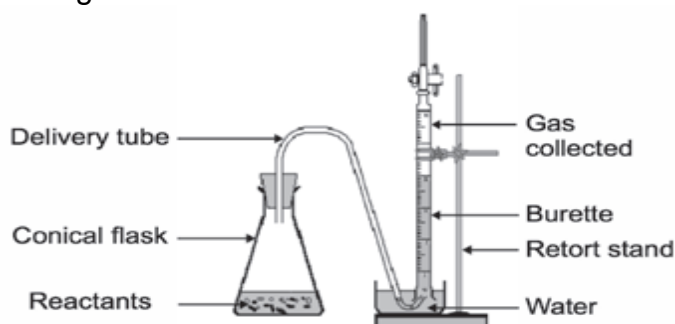
### QUESTION THREE: RATES OF REACTION

A group of learners use the reaction between hydrochloric acid and zinc powder to investigate one of the factors that influence the rate of a chemical reaction.

The reaction that takes place is:



The learners use the apparatus and follow the method shown below to conduct the investigation.



#### Method for Experiment 1:

Step 1: Place a spatula (spoon) of zinc in a conical flask and add 50 cm<sup>3</sup> HCl(aq) of known concentration.

Step 2: Simultaneously start the stopwatch and close the flask with the rubber stopper containing the delivery tube.

Step 3: Measure the volume of the H<sub>2</sub>(g) formed in time intervals of 30 seconds.

#### Method for Experiment 2:

Repeat steps 1 to 3 above, but use only 25 cm<sup>3</sup> of the same HCl(aq) diluted to 50 cm<sup>3</sup> with distilled water.

**NOTE:** A GRAPH SHEET IS PROVIDED. USE THIS TO ANSWER QUESTIONS 3.5; 3.6 AND 3.10

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

3.2 Write down a hypothesis for this investigation. (2)

3.3 Why should the learners ensure that equal amounts of zinc are used in each of the two experiments? (2)

3.4 The learners use an excess of  $\text{HCl(aq)}$  for the two experiments. What meaning does the term 'excess' have in this situation? Give a reason why the excess  $\text{HCl(aq)}$  will not influence the results. (2)

3.5 The following data was obtained for **experiment 1**.

Plot a graph volume  $\text{H}_2$  versus time.

Label this graph as **experiment 1**.

**Table**

| Time/s | Volume $\text{H}_2$ gas / $\text{cm}^3$ |
|--------|---|
| 30     | 0,0                                     |
| 60     | 15                                      |
| 90     | 25                                      |
| 120    | 30                                      |
| 150    | 33                                      |
| 180    | 35                                      |
| 210    | 35                                      |
| 240    | 35                                      |

(5)

3.6 On the same set of axes, sketch a possible curve that would be obtained in **experiment 2**. Label this as **experiment 2**. (2)

3.7 How would the final volume of  $\text{H}_2$  gas produced in **experiment 1** compare to that of **experiment 2**? Give a reason. (2)

3.8 Calculate the average rate of reaction for **experiment 1** after 60 s (3)

3.9 Calculate the mass of zinc used in **experiment 1**. Take the molar volume of gas to be  $24 \text{ dm}^3$  at  $25^\circ\text{C}$ . (5)

3.10 In another experiment, using the same quantities of reactants as in **experiment 1**, some copper is added to the flask. Copper does not react with the hydrochloric acid, however the rate of production of gas increases. (1)

3.10.1 What is the function of copper in this reaction? (2)

3.10.2 On the same system of axes of the graphs that you drew, sketch a possible curve that can be obtained for this experiment. Label this as **experiment 3**.

3.11 **Experiment 1** is repeated but this time at a HIGHER temperature. How will the following now be affected? Write down INCREASES, DECREASES or REMAINS THE SAME.

3.11.1 The volume of  $\text{H}_2$  gas produced after 20 s. (1)

3.11.2 The final volume of  $\text{H}_2$  gas produced. Write down a reason. (2)

**[30]**

#### QUESTION FOUR: ACID – BASE TITRATION

Learners wish to prepare  $250 \text{ cm}^3$  of a standard solution of oxalic acid ( $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ ) of concentration  $0,2 \text{ mol.dm}^{-3}$ .

4.1 What is a standard solution? (2)

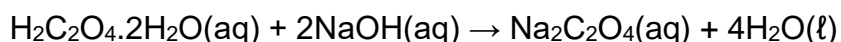
4.2 Calculate the mass of oxalic acid needed to prepare this solution. (4)

In a titration to standardise a dilute sodium hydroxide (NaOH) solution using this oxalic acid solution, the following data was obtained.

| Titration | Volume of oxalic acid solution (cm <sup>3</sup> ) | Volume of NaOH solution (cm <sup>3</sup> ) |
|-----------|---|--|
| 1         | 25,00   | 20,24                                      |
| 2         | 25,00   | 19,80                                      |
| 3         | 25,00   | 19,87                                      |
| 4         | 25,00   | 19,92                                      |

- 4.3 Why is the titration done four times? (1)
- 4.4 Write down the name of the apparatus used to measure the volume of oxalic acid in this experiment. (1)
- 4.5 Write down the name of the apparatus used to measure the volume of sodium hydroxide in this experiment. (1)
- 4.6 During this titration learners wash the inside of the conical flask with distilled water.
- 4.6.1 Why is this done? (1)
- 4.6.2 Explain why the addition of distilled water will not affect the results of this experiment. (2)
- 4.7 Distinguish between end - point and equivalence – point of a titration. (2)

The balanced equation for the reaction taking place is:



- 4.8 Calculate the concentration of the base. (5)
- The following indicators are available for this titration:

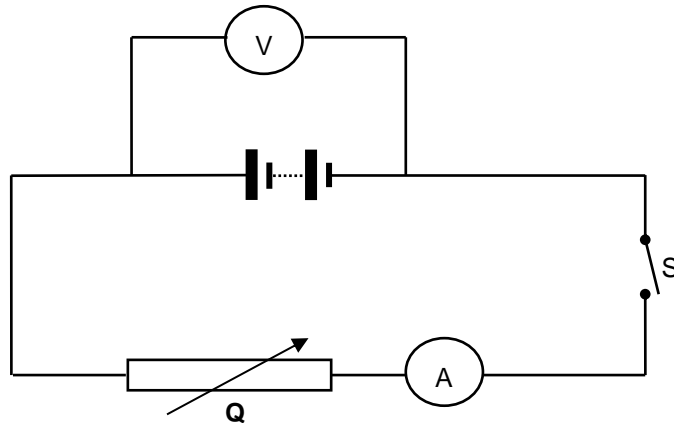
| INDICATOR        | pH RANGE   |
|------------------|------------|
| Bromothymol blue | 6,0 – 7,6  |
| Phenolphthalein  | 8,3 – 10,0 |
| Methyl Orange    | 3,1 – 4,4  |

- 4.9 Which one of the above indicators is most suitable to use in this titration? Give a reason for your answer. (2)

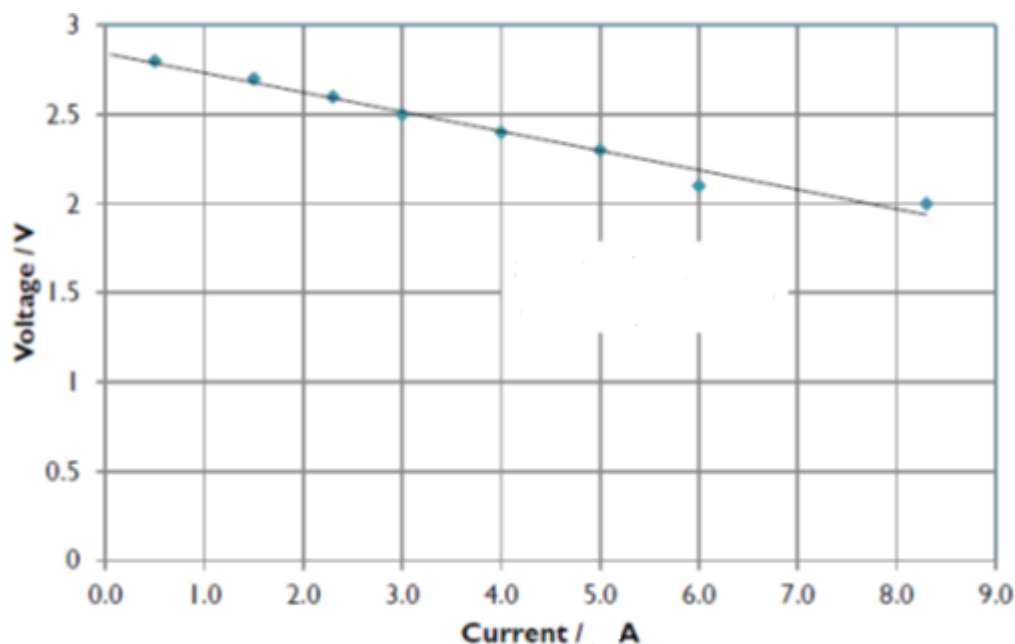
[21]

### QUESTION FIVE: INTERNAL RESISTANCE

Learners do an experiment to determine the internal resistance of a battery. They use the following circuit in which a variable resistor **Q** is used to adjust the total resistance of the circuit. They set up the variable resistor on various resistances and then measure the voltage (potential difference) and the current through the circuit. In order to take the voltmeter and ammeter readings, the switch is closed for a SHORT PERIOD.



They present their results in the following graph.



- 5.1 Write down the name of component Q. (1)
- 5.2 What quantity does the voltmeter measure when the switch is open? (1)
- 5.2 What quantity does the voltmeter measure when the switch is closed? (1)
- 5.4 **Use the graph** to determine:
  - 5.4.1 The internal resistance of the battery. (4)
  - 5.4.2 The emf of the battery. (1)
- 5.5 Why is not advisable to keep the switch on for an extended period of time? (2)

**[10]**

## QUESTION SIX: SERIES – PARALLEL NETWORK

Learners want to determine the equivalent resistance of a **SERIES – PARALLEL** network.

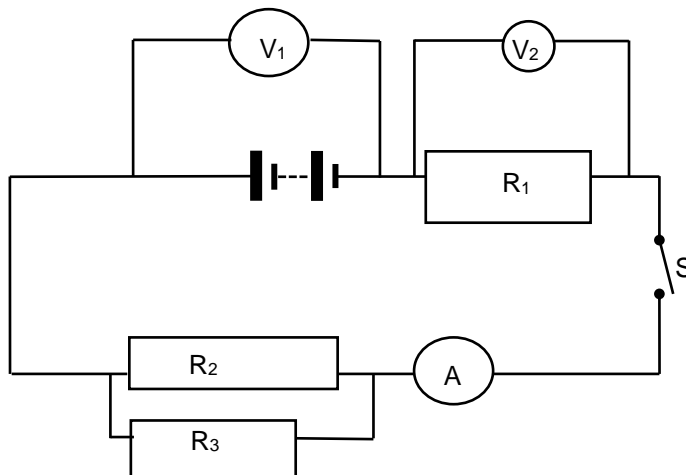
They set up a circuit with the following components:

A number of 1,5 V cells, three resistors  $R_1$ ,  $R_2$  and  $R_3$  of unknown resistances, connecting wires, switch, an ammeter and two voltmeters.

The internal resistance of the battery and the resistance of the connecting wires are negligible and can be ignored.

They connect the components of the circuit as shown below.

The switch is closed and record the following readings:



**When switch S is open:**

$$V_1 = 6 \text{ V}$$

**When switch S is closed:**

$$\text{Ammeter reading} = 0,5 \text{ A}$$

$$V_2 = 2,0 \text{ V}$$

6.1 State Ohm's Law, in words. (2)

6.2 If  $R_2$  is twice the size of  $R_3$ , calculate the value of each resistor. (8)

**[10]**

Total Marks: **[100]**

Data

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

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

$$R = \frac{V}{I}$$

$$R = R_1 + R_2 + \dots$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$\mathcal{E} = IR + Ir$$

Relative atomic masses: C=12 ; O=16; H=1; Zn=65