UCLSE NEW CURRICULUM CHEMISTRY PRACTICAL WORK BOOK

WAKATA PUBLISHERS

UCLSE
New Curriculum

Chemistry

Practical Workbook

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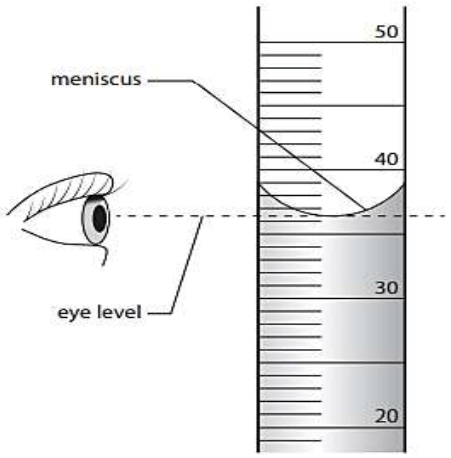
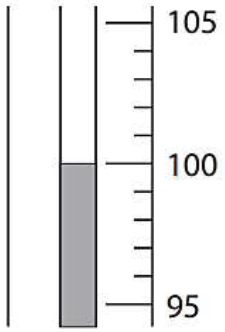
Contents

variety of different apparatus. When using measuring cylinders you will need to look for the meniscus, which is the bottom of the curve formed by the liquid.



Thermometers are a very common tool for measuring temperature in chemistry experiments so you will need to be able to take readings reliably. Not all of the points of the scale on a thermometer will be marked but you will still need to be able to determine the temperature. To do this you will need to work out the value of each graduation. In the diagram below there are four marks between 95 and 100. Each of these marks indicates 1°C.



Recording

When you are working on investigations, your ability to record data accurately is very important. Sometimes a table will be supplied; however, you need to be able to draw your own table with the correct headings and units.

The first task is to identify the **independent** and **dependent** variables for the investigation you are doing.

The **independent variable** is the one that you are changing, to see if this affects the dependent variable.

The **dependent variable** is the one that you will measure and record in the table.

The variables and their units need to go into the top two boxes in your results table. The independent variable goes in the left -hand column and the dependent variable(s) goes in the

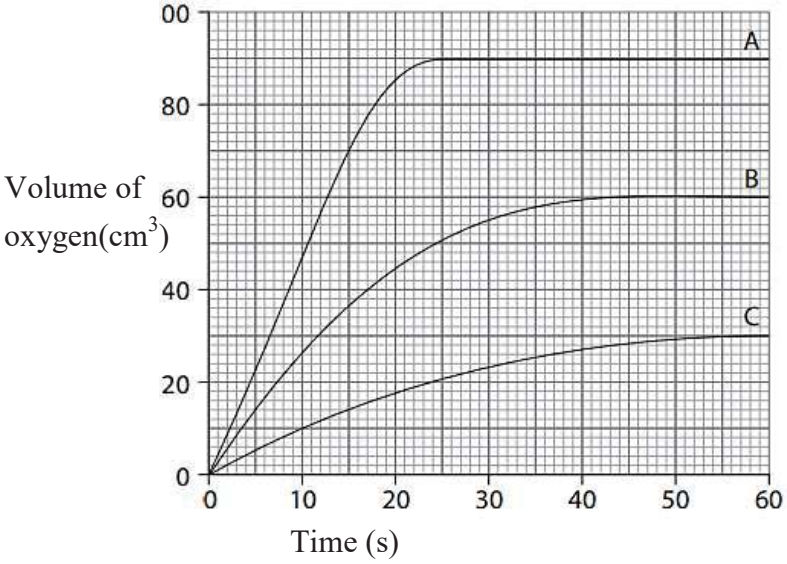
right-hand column(s). Separate the name of the variable and its unit by a bracket ( ), for example, Time (seconds).

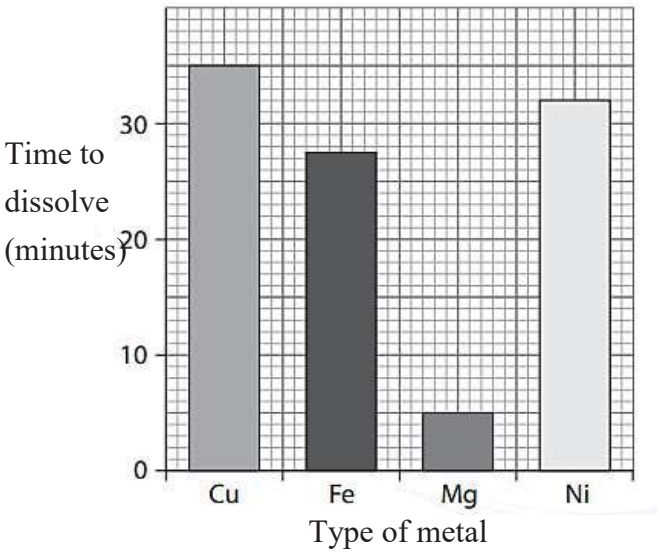
Next, count how many different values you have for the independent variable. This is the number of data rows you will need to add below the column headings. Finally, add the values for the independent variable into left –hand column. Your table is now ready for you to add the results from your investigation in the right-hand column(s).

The number of significant figures that you use in your answer should match the number used in any data you have been given. You may not be awarded credit if you use an inappropriate number of significant figures in your answers to questions. If you are recording raw data from an investigation, always try to use the maximum number of significant figures available. The first significant figure is the first non-zero digit in the number. The number 456 is: 500 to 1 signifi cant figure; 460 to 2 significant figures; 456 to 3 significant figures; 456.0 to 4 significant figures, etc. Digits of 5 or greater are rounded up; and digits of 4 and below are rounded down. It is important that numbers are not rounded up during calculations until you have your final answer, otherwise the final answer may be affected.

Graphing

When drawing a graph it is useful to follow a set procedure every time to ensure that when you are finished the graph is complete. Axes: You must label the axes with your independent and dependent variables. The independent variable is used to label the x-axis (horizontal axis) and the dependent variable is used to label the y-axis (vertical axis). Remember to also add the units for each of the variables. An easy way to ensure that you get this correct is to copy the column headings from the table of data you are using to draw the graph.





Practical investigation 4. Changing physical state

Objective

In chemistry, there are several states of matter: solid, liquid, gas, plasma etc. By changing the temperature of an element it is possible for us to change the state that it exists in. For example, if we heat water to 100 ^{o}C, it will begin to boil and change into a gas. Likewise, if we cool water to 0 ^{o}C, it will freeze and turn into ice. When changing states, energy is required to break the intermolecular forces between molecules. In this experiment, we will examine what happens to the temperature of water as it is heated from ice until it becomes steam. By the end of this investigation you should be able to describe changes of state in terms of melting, boiling, evaporation, freezing and condensation.

Equipment

- Clamp stand with clamp and boss
- heat-resistant mat
- Bunsen burner, thermometer
- beaker (250cm^3)
- ice
- timer
- pestle
- mortar
- tripod
- gauze
- stirring rod

Method

(a) Add seven ice cubes to the mortar and crush them with the pestle until you are left with only small pieces. Do this carefully so that the ice cubes do not come out of the mortar.
(b) Place the crushed ice in the beaker until it is half full.
(c) Set up the Bunsen burner on the heat-resistant mat.
(d) Place the beaker on the tripod and gauze. Use the clamp and clamp stand to hold the thermometer in the beaker. You can use the diagram in Figure **(b)** to help you.
(e) Measure the temperature of the ice in the beaker and record the result in the results table.
(f) Start the timer. Begin to heat the beaker of water with the Bunsen burner on a gentle blue flame.
(g) Record the temperature every minute. Use the stirring rod to make sure the ice melts evenly.
(h) Once the water is boiling (bubbles forming within the liquid), only take one more reading.

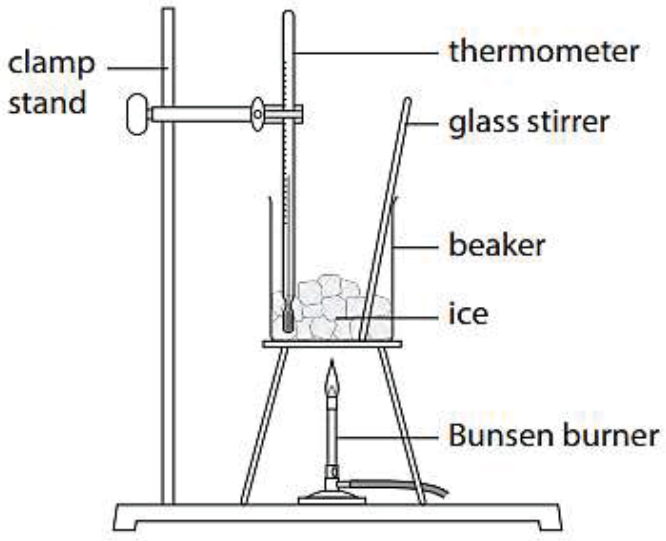


Fig. (b)

Safety considerations

Wear eye protection throughout. You will need to stand for the practical because hot liquids will be used. Remember to take care when handling hot glassware and also to be careful when the water is boiling as the steam will be very hot.

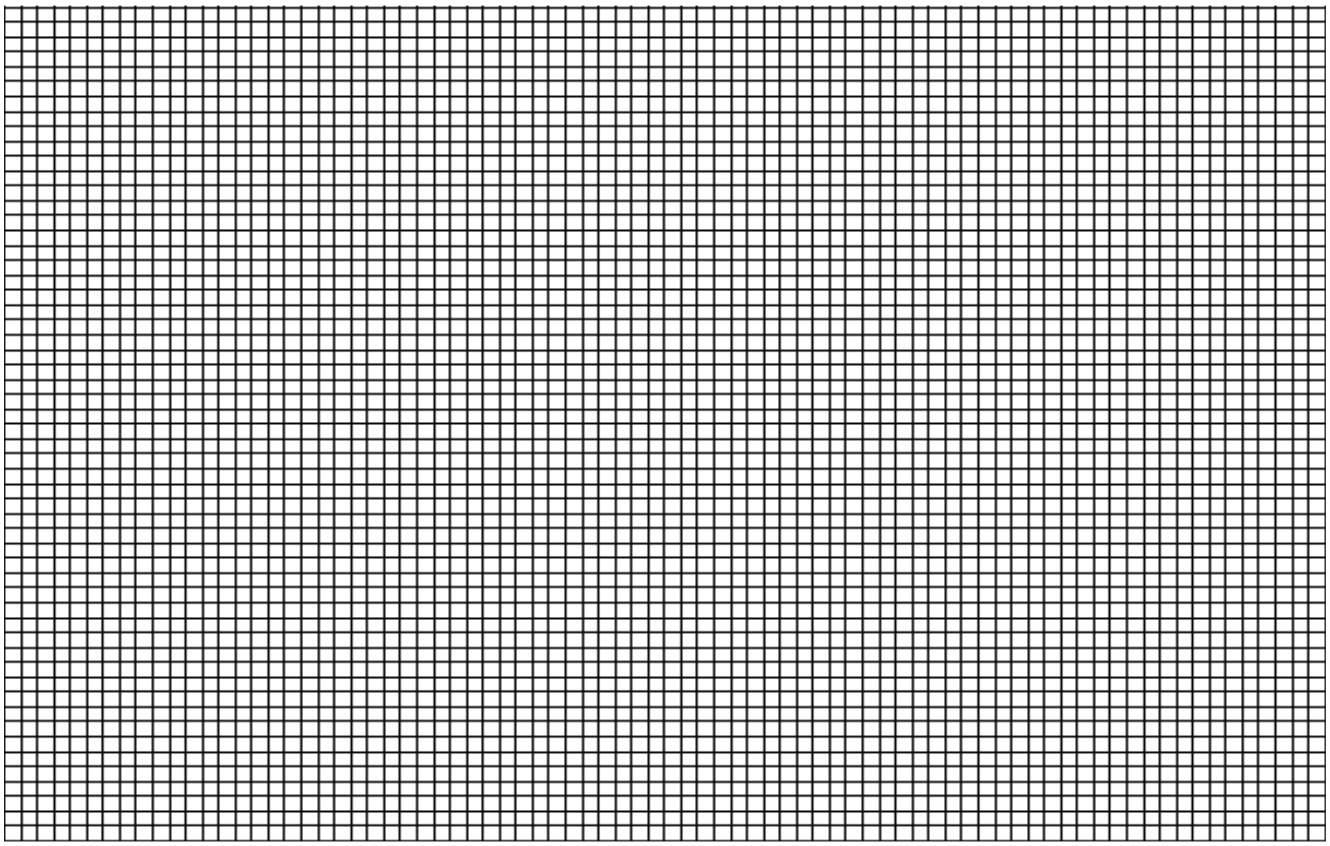
Recording data

(a) Record your results in the results table below. The units are missing and need to be added.

Time ( )	Temperature ( )
0	
1	
2	
3	
4	
5	
6	
7	
8	

Handling data

(b) Plot the results of your experiment on the graph paper below. Think about whether you will need to plot a line graph or a bar graph.



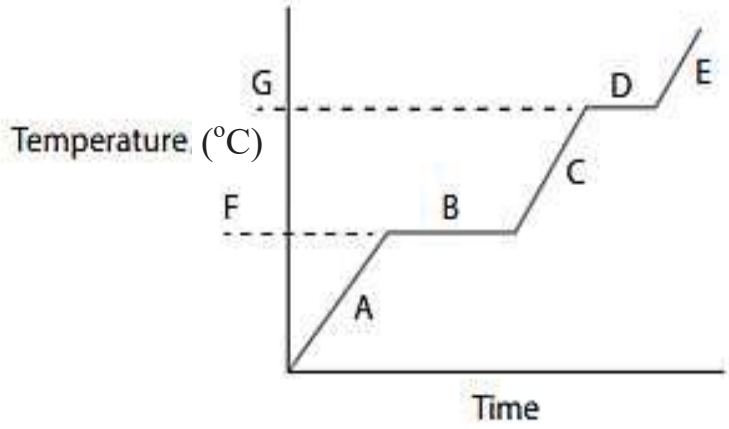
Analysis

(c) Use the words given to complete the conclusion paragraph below.

molecules	intermolecular	melting	temperature	boiling	liquid	gas	heating

At first, the …… inside the beaker did not change. This is because the energy being added by …… was being used to break the intermolecular forces between the water …… . This is called ……. Once all of the solid water had turned into …… water, the temperature began to increase. It stopped increasing once the water reached its point. The energy being added was now used to break …… the forces between the water molecules in the liquid state. This meant that the water could turn into a …….

(d) Look at the graph in Figure **(c)**.



Match the correct letter to each of the following words or terms:

(i) melting point ……

(ii) boiling point ……

(iii) solid ……

(iv) liquid ……...

(v) gas Evaluation ……

(e) Think about your experiment. How could you have made the results more accurate?

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(f) How would adding an impurity, such as salt, to the ice in this experiment affect the results? Sketch a graph to support your ideas.

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Exam style questions

Worked example

Plan an investigation to determine the Volume of sulphuric acid required for complete neutralization of 25cm^3 of sodium hydroxide solution .

You are provided with solutions **BA1** which is a 1M sulphuric acid and **BA2** which contains sodium hydroxide and common laboratory apparatus.

Write a report about your findings. Your report should include the following:

(a) Aim of the experiment
(b) Variables of the experiment
(c) Hypothesis
(d) List of apparatus and materials
(e) Procedure of the experiment
(f) Tabulation of data
(g) A graph of graph of temperature against volume of **BA1**.
(h) Conclusion from the investigation

Answer

(a) **Aim of the experiment:**
To determine the Volume of sulphuric acid required for complete neutralization of 25cm^3 of sodium hydroxide solution. ✓ **01 mark**

(b) **Variables of the experiment** ✓
Independent Variable: Volume of BA1 (1M sulphuric acid). ✓
Dependent Variable: Maximum Temperature during the neutralization reaction. ✓
Controlled Variable: Initial concentration and volume of BA2 (sodium hydroxide solution)
03 marks

(c) **Hypothesis**

The reaction between sodium hydroxide and sulphuric acid is expected to be exothermic, resulting in a temperature increase. The volume of **BA1** needed for neutralization can be used to calculate the neutralizing capacity of **BA2**. **01 mark**

(d) **List of apparatus and materials**

Burette
Pipette
Conical flask
Plastic cup/ beaker
Thermometer
Stirring rod
Clamp and stand
Towel or tissue
Safety equipment (lab coat, goggles, gloves)

01 mark

(e) Procedure of the experiment

(i) Exactly 25cm^3 of **BA2** is measured using a clean dry measuring cylinder and transferred into a plastic beaker and its temperature is recorded.

(ii) The burette is filled with **BA1,** 5cm^3 is run into **BA2** in a plastic beaker. The Mixture is stirred using a thermometer and the maximum temperature, T reached by the mixture is recorded.

(iii) Both the thermometer and the plastic beaker are washed and dried.

(iv) Steps (i) to (iii) are repeated using the set of volumes of **BA1** indicated in the table below.

(v) The values of highest temperatures, T reached by the mixture are recorded in the same table

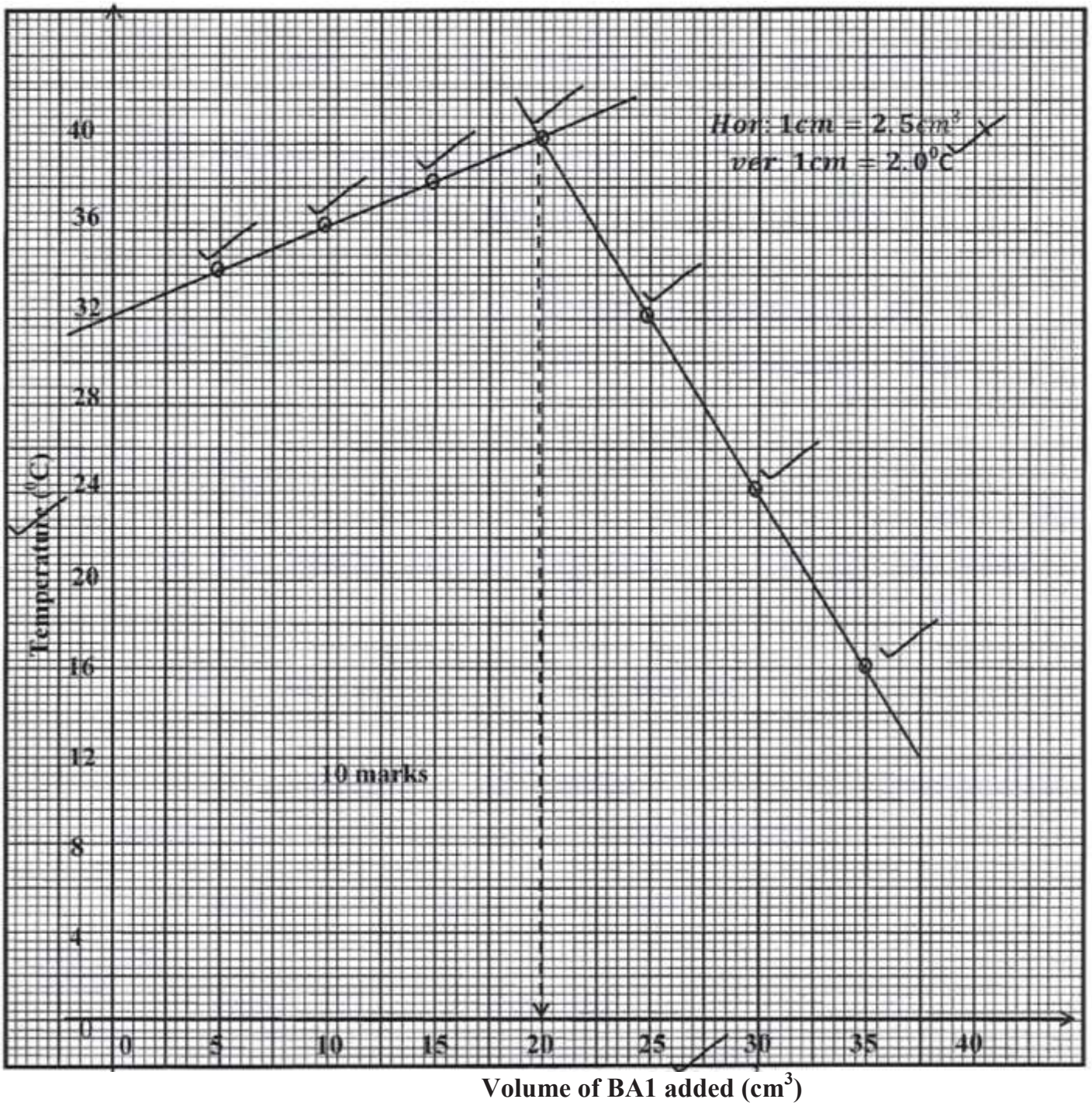
05 marks

(f) **Tabulation of data**

Experiment Number	1	2	3	4	5	6	7
Volume of **BA1** (cm^3)	5	10	15	20	25	30	35
Maximum temperature T(°C)	34	36	38	40	32	24	16

07marks

(g) A graph of temperature against volume of **BA1**.



(h) **Conclusion from the investigation**

Volume of **BA1** required for complete neutralization of 25cm^3 of **BA2** is obtained from the graph and it is approximately equal to 20.0cm^3
The experiment confirms the hypothesis regarding the neutralizing capacity of **BA2**.

02marks

Total = 30marks

Experiment 20

You are going to investigate the solubility of salt **A** in water at various temperatures.

Read all the instructions below carefully before starting the experiments.

Instructions

Experiment 20. 1

You are provided with a clean boiling tube containing 12 g of **A**.
Fill the burette provided with distilled water and add 10.0cm^3 of water to the boiling tube.
Heat the mixture of salt **A** and water carefully until all of the solid has dissolved.
You will have to boil the solution **gentl**y.

Remove the boiling tube from the heat and allow the solution to cool.
Stir the solution gently with the thermometer.

Note the temperature at which crystals first appear and record the temperature in the table.

Keep the boiling tube and its contents for the remaining experiments in this question.

Experiment 20.2

From the burette, add 2.0 cm^3 more of the water into the boiling tube and contents from Experiment 20.1.

Repeat the experiment exactly as before to find the temperature at which crystals first appear.
It may help if the boiling tube is dipped for short periods of time in a beaker of cold water to speed up the cooling.
Record, in the table, the total volume of water in the boiling tube and the temperature at which crystals first appear.

Experiment 20.3

From the burette, add 2.0 cm^3 more of the water into the boiling tube and contents from Experiment 20.2.
Repeat the experiment exactly as before and record, in the table, the total volume of water used and the temperature at which crystals first appear.

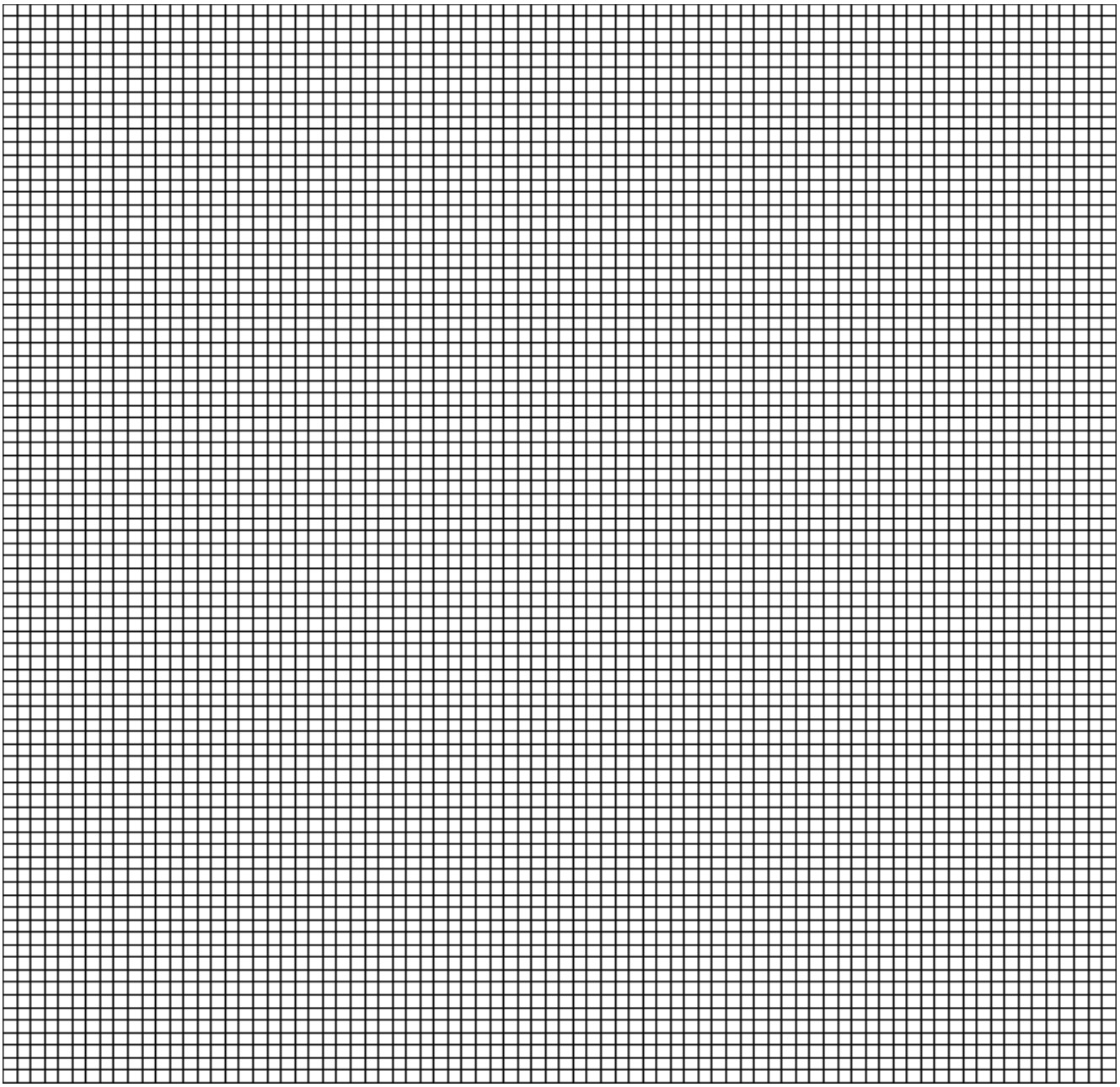
Continue this procedure for Experiment 20.4 with one more addition of 2.0cm^3 of water. Note all the results in the table.

At the end of Experiment 20.4, the total volume of water in the boiling tube will be 16.0cm^3.

Table of results

experiment	total volume of water (cm^3)	temperature at which crystals first appear (°C)
1	10.0	
2		
3		
4		

(a) Plot a graph of temperature at which crystals first appear against total volume of water for your results on the grid below and draw a straight line graph.



(b) How did you know when salt **A** was completely dissolved in the water?

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(c) From your graph, find the temperature at which crystals of **A** would first appear if the total volume of water in the solution were 9.0cm^3.

Show clearly on the graph how you worked out your answer.

…… °C

(d) Salt **B** is more soluble in water than salt **A**. Sketch on the grid the graph you would expect for **B**. Label this graph.

(e) Suggest, with a reason, how the results would be different if 6 g of salt **A** were used instead of 12 g.

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(f) Explain one improvement you could make to the experimental procedure to obtain more accurate results in this investigation.

improvement ……

explanation ……

Experiment 21

Potassium chloride is a salt that dissolves in water. The solubility of a salt is the mass in grams of the salt that dissolves in 100 cm^3 of water at a particular temperature.

Plan an investigation to determine the solubility of potassium chloride in water at 40 °C .
You are provided with potassium chloride and common laboratory apparatus.

Write a report about your findings. Your report should include the following:

(a) Aim of the experiment

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(b) Variables of the experiment

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(c) Hypothesis

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(d) List of apparatus and materials

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(e) Procedure of the experiment

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(f) Tabulation of data

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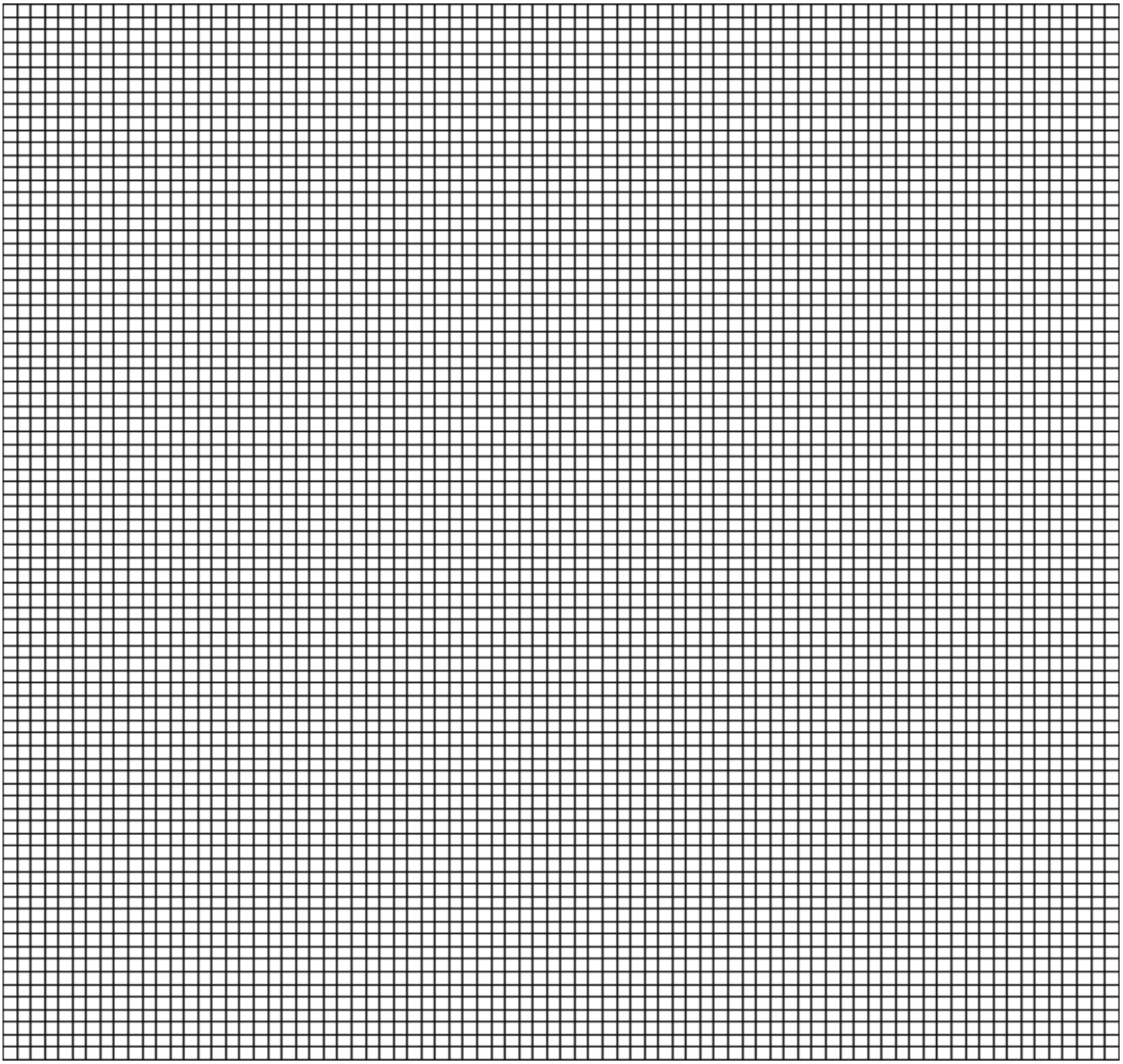
(g) A graph of solubility of potassium chloride against temperature.



(h) Conclusion from the investigation

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Experiment 36

You are provided with one solid, solid **E**, and one solution, solution **F**.
Do the following tests on the substances, recording all of your observations at each stage.
tests on solid **E**.

(a) Place about half of solid **E** in a hard-glass test-tube. Heat the solid gently for about 30 seconds.
Record your observations.

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Transfer the remaining solid **E** to a boiling tube. Add about 10 cm^3 of distilled water to the boiling tube.
Place a stopper in the boiling tube and shake the tube to dissolve solid **E** and form solution **E**.
Divide solution **E** into three approximately equal portions in two test-tubes and one boiling tube.

(b) To the first portion of solution **E** in a test-tube, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.
Record your observations.

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(c) To the second portion of solution **E** in a test-tube, add excess aqueous ammonia.
Record your observations.

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(d) To the third portion of solution E in the boiling tube, add aqueous sodium hydroxide dropwise and then in excess.
Keep the product for use in (e).
Record your observations.

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(e) Gently warm the product from (d). Test any gas produced.
Record your observations.

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(f) Identify the three ions contained in solid **E**.

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……..……

tests on solution F

(g) Carry out a flame test on solution **F**.
Record your observations.

……..……

(h) Divide the remaining solution **F** into two approximately equal portions in two test-tubes.

(i) To the first portion of solution **F** add a few drops of universal indicator solution.
Record your observations.

……..……

……..……

(ii) To the second portion of solution **F** add approximately 2 cm depth of aqueous copper(II) sulfate.
Record your observations.

……..……

……..……

(i) Identify solution **F**.

……..……

……..……