UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical **May/June 2007**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE ON ANY BARCODES.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
At the end of the examination, fasten all your work securely together.

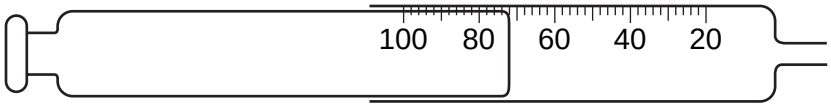
For Examiner's Use

This document consists of **18** printed pages and **2** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

1 **(a)** Name the apparatus shown below.



.....[1]

(b) What volume of gas is in the apparatus?

..... cm^3 [1]

[Total: 2]

2 A student made some zinc sulphate by reacting zinc carbonate with dilute sulphuric acid.

The powdered zinc carbonate was added to a beaker half-filled with dilute sulphuric acid. Carbon dioxide was produced.

(a) Give a test for carbon dioxide.

test .....

observation .....[1]

(b) **(i)** The acid was in excess. How did the student know that the reaction had stopped?

.....[1]

(ii) If the zinc carbonate was in excess, what additional observation would the student make?

.....[1]

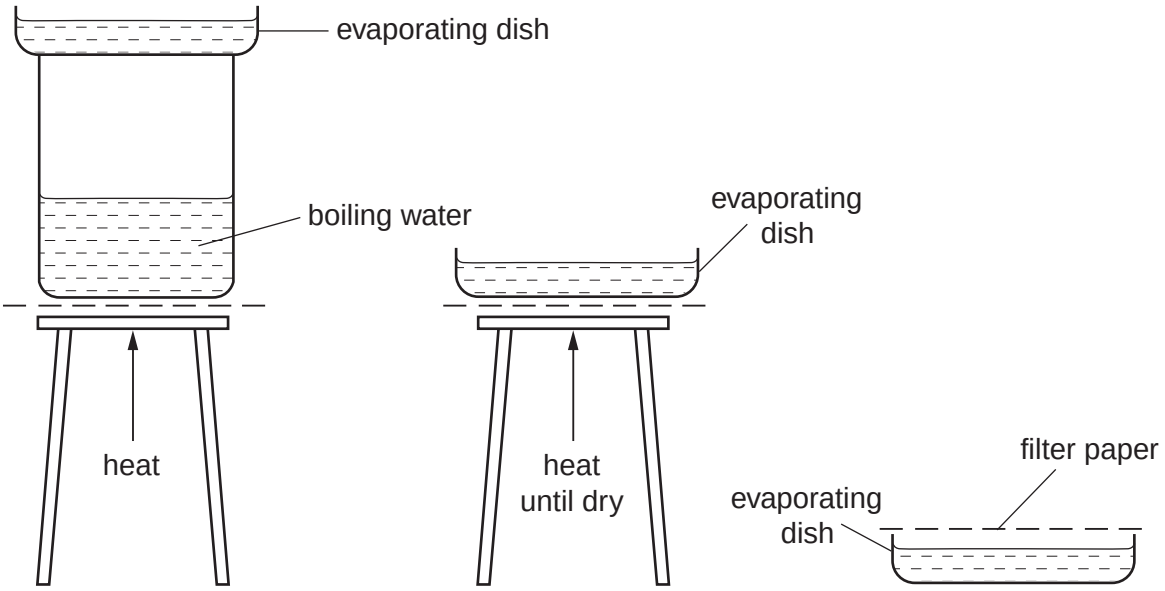
To ensure that all the acid had been neutralised, the student added excess zinc carbonate The mixture was well stirred.

(c) How was the unreacted zinc carbonate removed from the mixture?

.....[1]

[Turn over

The solution produced in **(c)** was transferred to an evaporating dish. The student was told to select one of the following techniques to produce large crystals of zinc sulphate.



(i) **(ii)** **(iii)**

(d) Which technique, **(i)**, **(ii)** or **(iii)**, would produce the largest crystals?

.....[1]

The student then repeated the experiment, this time adding 100 cm^3 of 0.25 mol/dm^3 sulphuric acid to an excess of zinc carbonate.

The equation for the reaction is

$$ZnCO_3 + H_2SO_4 \longrightarrow ZnSO_4 + CO_2 + H_2O$$

(e) Calculate the number of moles of sulphuric acid used in this experiment.

..... moles [1]

(f) Use your answer to **(e)** and the equation to calculate the mass of zinc sulphate produced.
[A_r: Zn, 65; S, 32; O, 16]

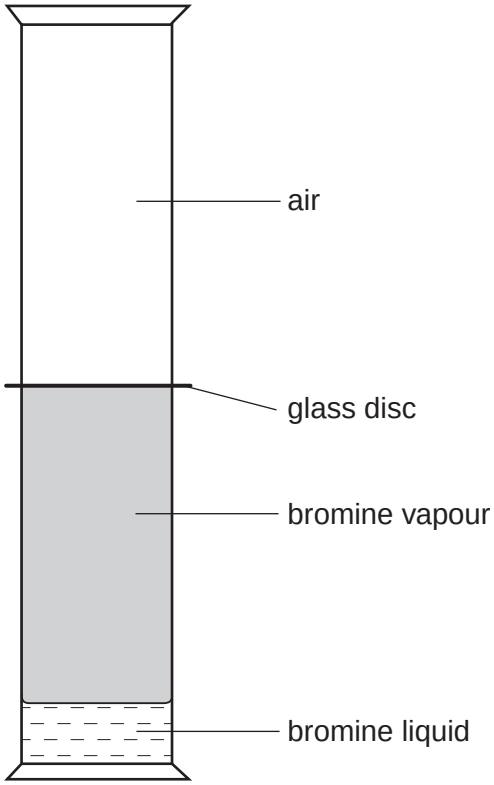
..... g [1]

(g) Calculate the volume of carbon dioxide produced during the reaction.
[One mole of a gas occupies 24 dm^3 at room temperature and pressure.]

..... dm^3 [1]

[Total: 8]

3 **(a)** A student set up the apparatus shown in the diagram. She then carefully removed the glass disc allowing the contents of the gas jars to mix.



(i) What change did she see after a few minutes?

.....[1]

(ii) Name the process illustrated in this experiment.

.....[1]

(b) Another student was given a sample of a hydrocarbon. She added it to aqueous bromine and a reaction took place.

(i) State the colour of aqueous bromine

before the addition of the hydrocarbon ..... ,

after the addition of the hydrocarbon ..... . [1]

(ii) What do these results suggest about the structure of the hydrocarbon?

.....[1]

(iii) What general name is given to this reaction?

.....[1]

(iv) 1 mole of the hydrocarbon reacts with 1 mole of bromine.
In this experiment 4.2 g of the hydrocarbon reacted with 16 g of bromine. Calculate the formula of the hydrocarbon and state its name.
[A_r: C, 12; H, 1; Br, 80]

formula of the hydrocarbon .....

name of the hydrocarbon .....
[2]

[Total: 7]

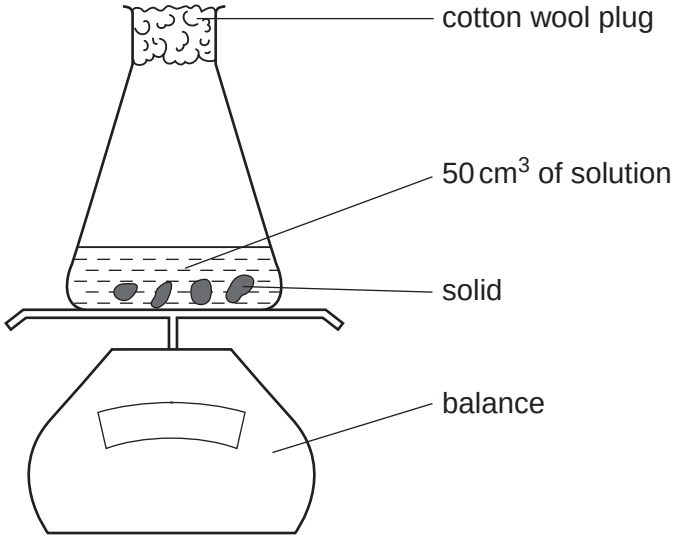
For questions 4 to 7 inclusive, place a tick in the box against the best answer.

4 A piece of sodium was placed in a beaker of water. The sodium reacted and produced a gas and a solution.
Which pair of observations is correct?

	gas	solution	
(a)	pops in a flame	turns litmus blue	☐
(b)	relights a glowing splint	turns litmus blue	☐
(c)	pops in a flame	turns litmus red	☐
(d)	relights a glowing splint	turns litmus red	☐

[1]

5 The diagram below shows the apparatus used to record the change in mass during the course of a reaction. 50 cm^3 of an aqueous solution of either an acid or an alkali was added to 10 g of a solid.



The total mass was observed to **decrease** as the reaction progressed.

Which of the following reactions could **not** be taking place?

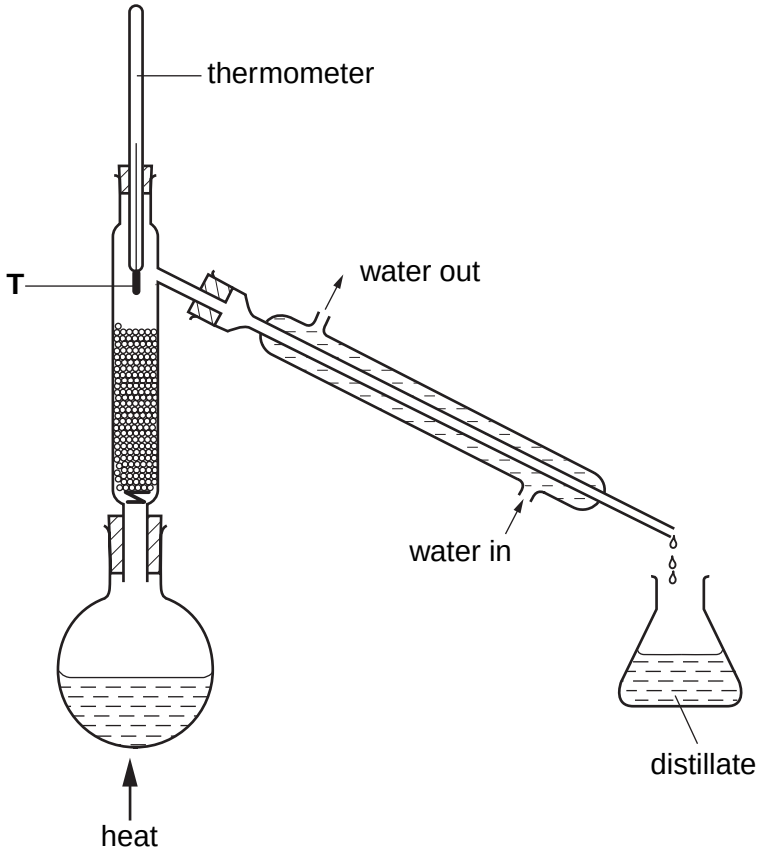
(a) zinc with hydrochloric acid ☐

(b) ammonium chloride with sodium hydroxide ☐

(c) magnesium oxide with hydrochloric acid ☐

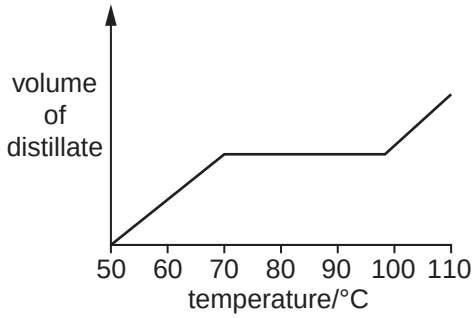
(d) calcium carbonate with hydrochloric acid ☐ [1]

6 The diagram below shows the apparatus used to separate hexane (boiling point, 70°C) and heptane (boiling point, 98°C).

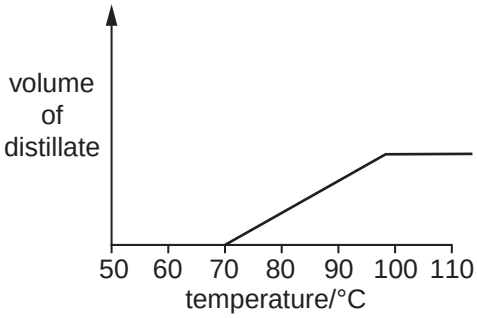


Which graph would be obtained if the total volume of distillate collected was plotted against the temperature at point **T**?

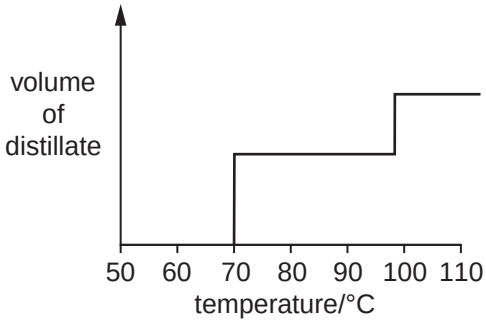
(a) ☐



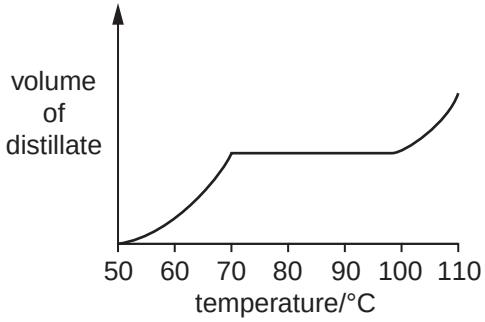
(b) ☐



(c) ☐

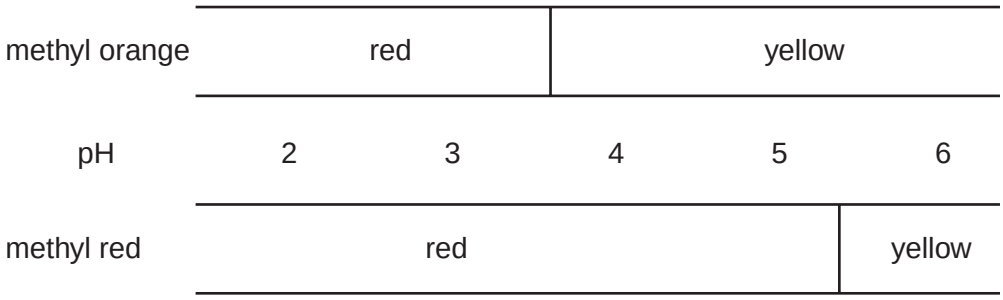


(d) ☐



[1]

7 The diagram below shows the pH at which a change in colour occurs for the indicators methyl orange and methyl red.



A student was given three solutions. The pH of each is shown in the table below.

solution	X	Y	Z
pH	3.0	5.0	6.0

In which of the solutions will both indicators be yellow?

(a) X only ☐

(b) X and Y ☐

(c) Y and Z ☐

(d) Z only ☐ [1]

8 A student was given a sample of an organic acid, **T**, and asked to

- determine its relative molecular mass, and
- suggest its molecular formula.

A sample of the acid was placed in a previously weighed container and reweighed.

mass of the container and the acid = 8.25 g
mass of container = 6.74 g

(a) Calculate the mass of the acid used in the experiment.

..... g [1]

The student transferred the sample to a beaker and added 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide. The contents of the beaker were allowed to react and then transferred to a volumetric flask. The solution was made up to 250 cm^3 with distilled water. This was solution **S**.

25.0 cm^3 of **S** was transferred into a conical flask.

(b) What piece of apparatus was used to measure this volume of **S**?

.....[1]

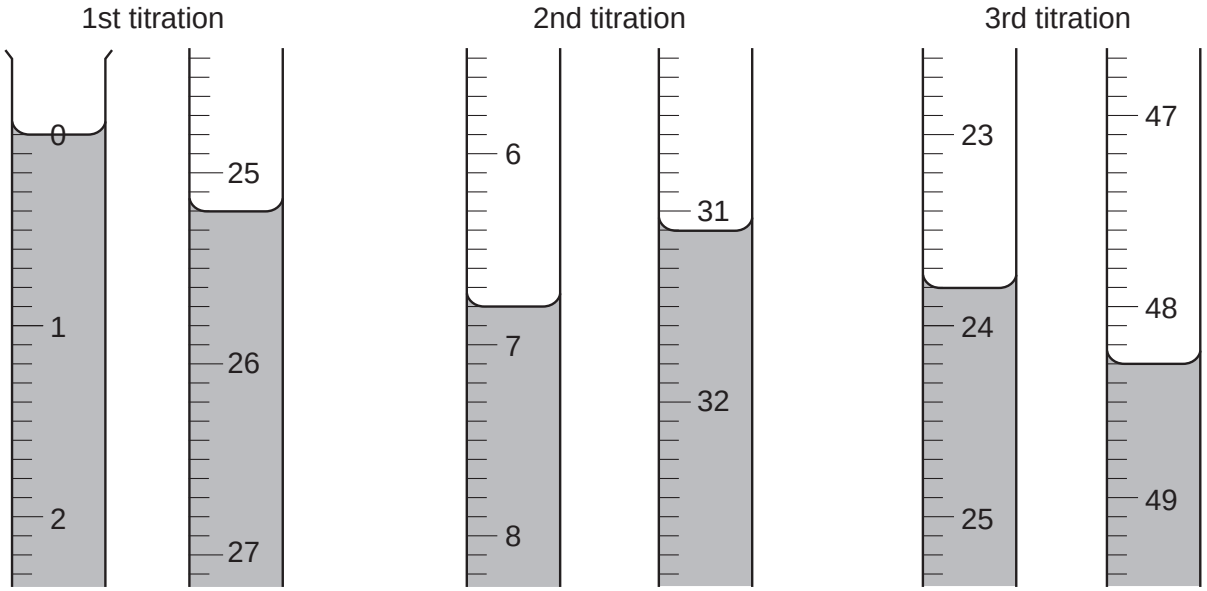
A few drops of phenolphthalein indicator were added to the conical flask.
0.100 mol/dm^3 hydrochloric acid was placed in a burette and added to the solution in the conical flask until an end-point was reached.
Phenolphthalein is colourless in acidic solution and pink in alkaline solution.

(c) What was the colour of the solution in the conical flask

- before the acid was added, ...
- at the end-point? .....

[1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and the end of each titration.



(d) Use the diagrams to complete the following table.

titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume of hydrochloric acid used / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of hydrochloric acid required was ..... cm^3. [4]

(e) Calculate the number of moles of hydrochloric acid in the average volume of 0.100 mol / dm^3 hydrochloric acid calculated in **(d)**.

..... moles [1]

(f) Hydrochloric acid reacts with sodium hydroxide according to the following equation.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Deduce the number of moles of sodium hydroxide present in 25.0 cm^3 of solution **S**.

..... moles [1]

(g) Using your answer in **(f)**, calculate the number of moles of sodium hydroxide in 250 cm^3 of solution **S**.

..... moles [1]

(h) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide.

..... moles [1]

(i) By subtracting your answer in **(g)** from your answer in **(h)**, calculate the number of moles of sodium hydroxide that reacted with the original sample of the organic acid, **T**.

..... moles [1]

(j) Given that **one** mole of **T** reacted with **two** moles of sodium hydroxide, calculate the number of moles of **T** in the sample.

..... moles [1]

(k) Using your answers to **(a)** and **(j)** calculate the relative molecular mass of the acid **T**.

.....[1]

The acid **T** contains two carboxylic acid groups and has the formula

$$HOOCC_xH_yCOOH$$

where **x** and **y** are whole numbers.

(l) Deduce the values of **x** and **y** in the formula.
[A_r: C, 12; O, 16; H, 1]

x .....

y .....
[2]

(m) A sample of the acid **T** was reacted with an excess of ethanol in the presence of a small volume of sulphuric acid.

(i) Give the formula of the organic product.

.....[1]

(ii) To which group of compounds does the product belong?

..... [1]
[Total: 18]

9 A student was given a sample of a substance **V**. The table below shows the tests the student did on **V**. Complete the table by adding the conclusion for test **(a)**, the observations for test **(b)(i)** and **(b)(ii)** and the tests **and** observations for tests **(c)(i)**, **(c)(ii)** and **(d)**.

test	observations	conclusions
(a) Substance **V** was dissolved in water and the resulting solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A colourless solution was formed.	
(b) **(i)** To the first part aqueous sodium hydroxide was added until a change was seen. **(ii)** An excess of aqueous sodium hydroxide was added to the mixture from **(b)(i)**.		**V** may contain Al^{3+} ions or Zn^{2+} ions.
(c) **(i)** **(ii)**		The presence of Zn^{2+} ions was confirmed.
(d)		**V** contains Cl^- ions.

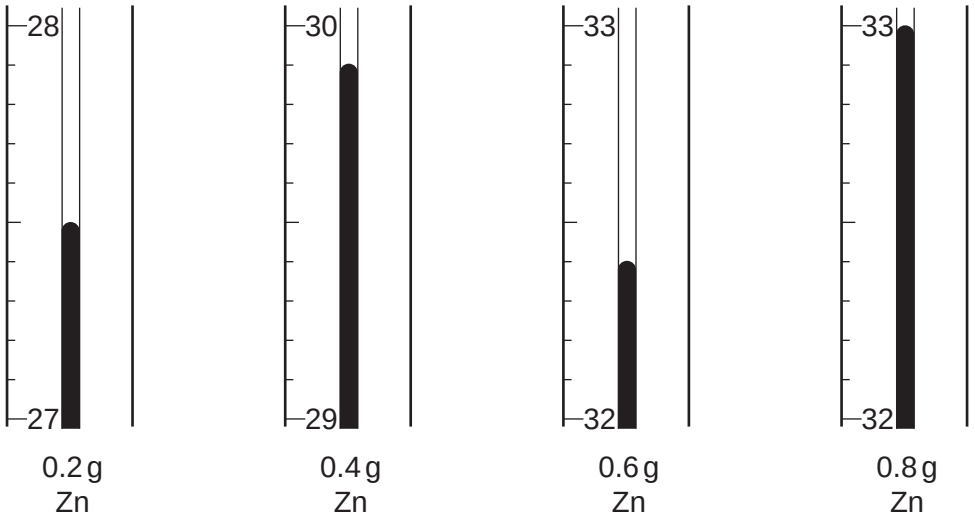
[9]

[Total: 9]

[Turn over

10 A student did two experiments to investigate the effect of temperature change when iron and zinc are added separately to 50.0 cm^3 samples of copper(II) sulphate solution. The results for the addition of iron to the copper(II) sulphate have been entered into the table in part **(a)**.

The student repeated the experiment using zinc. The diagrams below show parts of the thermometer stems for the highest temperature recorded after each addition of zinc.



(a) You are to record these temperatures in the table below and then calculate the rise in temperature for each reading.

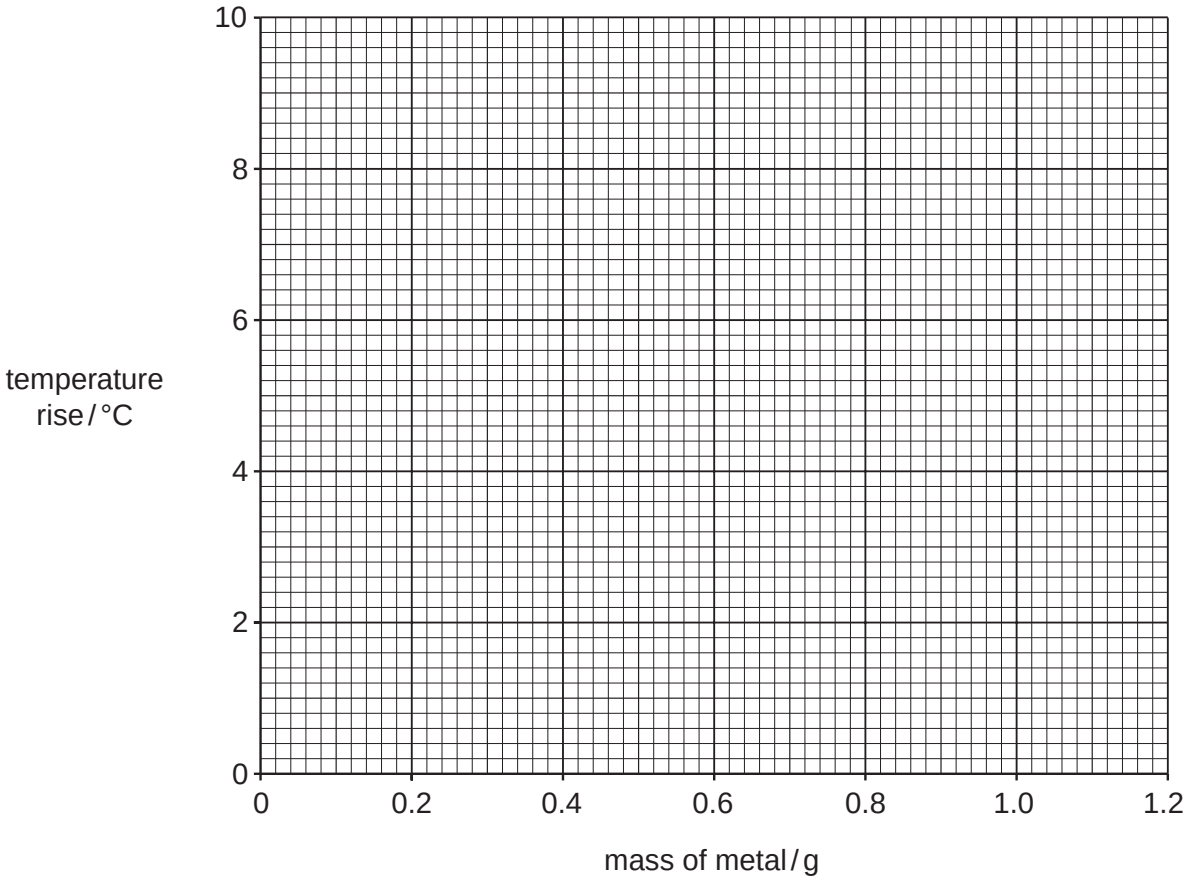
NOTE: for both experiments the initial temperature of the copper(II) sulphate solution was 25.0 °C.

experiment with iron	
mass of iron / g	temperature rise / °C
0.0	0.0
0.2	1.8
0.4	3.6
0.6	5.4
0.8	6.2
1.0	6.2
1.2	6.2

experiment with zinc		
mass of zinc / g	temperature /°C	temperature rise / °C
0.0	25.0	0.0
0.2		
0.4		
0.6		
0.8		
1.0	33.0	8.0
1.2	33.0	8.0

[2]

(b) Plot the results for both experiments on the grid below. For **each** metal join the points with two intersecting straight lines. Label the lines as iron and zinc.



[4]

Use your graphs to answer the following questions.

(c) What mass of zinc is required to produce a rise in temperature of 4.0 °C?

..... g [1]

(d) What mass of iron is required to produce a temperature of 30.0 °C?

..... g [1]

(e) **(i)** What is the minimum mass of zinc required to produce the maximum temperature?

..... g [1]

(ii) What is the minimum mass of iron required to produce the maximum temperature?

..... g [1]

(f) The experiment was repeated using silver. Suggest, giving a reason, how the results of this experiment would compare with those using iron and zinc.

.....[2]

[Total: 12]

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