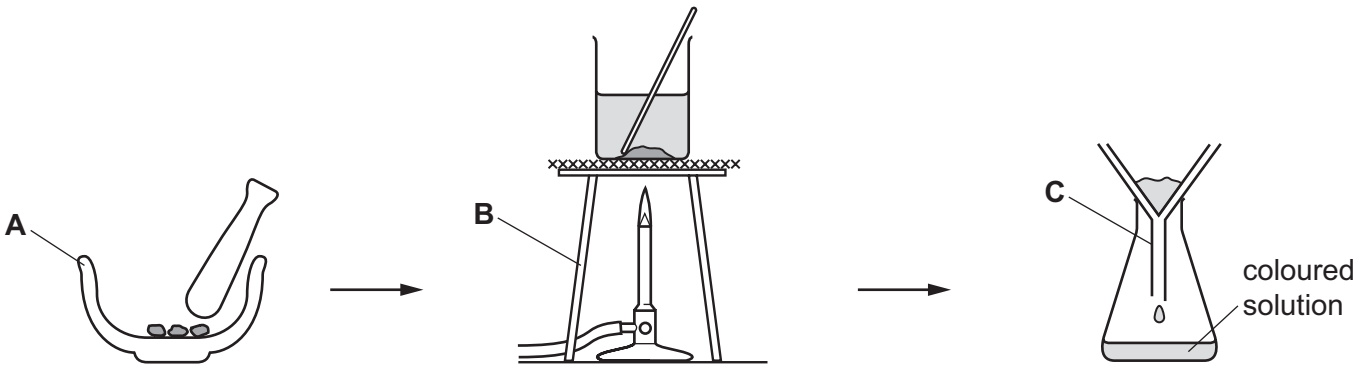
1 Many indicators are coloured substances obtained from plants.

A student extracted the coloured substances from some berries using the method shown.



the berries were crushed

the crushed berries were heated in water to form a coloured solution

the solid was removed from the coloured solution

(a) Name the items of apparatus labelled **A**, **B** and **C**.

A .....

B .....

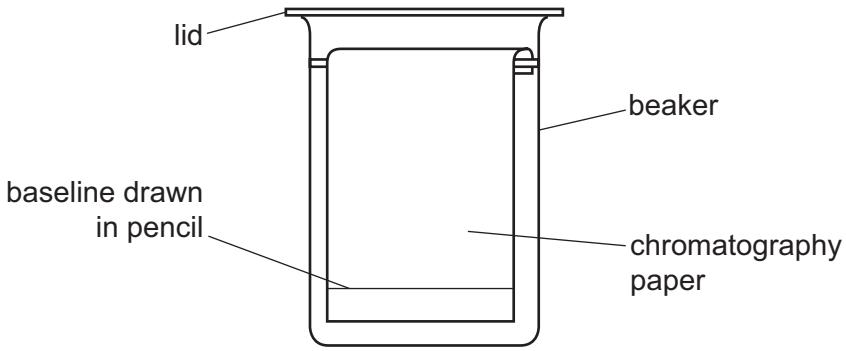
C .....

[3]

(b) The student analysed the coloured solution using chromatography.

(i) Complete the diagram to show:

- where the spot of coloured solution should be placed on the paper
- the level of the solvent in the beaker.



[2]

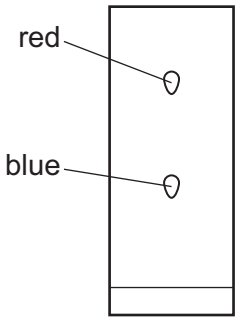
(ii) Explain why pencil is used to draw the baseline on the chromatography paper.

.....

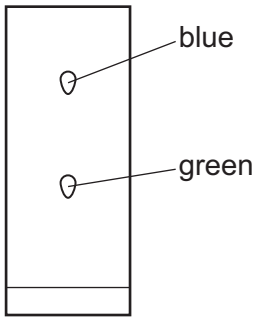
..... [1]

(c) The student made two chromatograms. After chromatography, one chromatogram was dipped in dilute hydrochloric acid and one was dipped in aqueous sodium hydroxide.

The results are shown.



chromatogram dipped in dilute hydrochloric acid



chromatogram dipped in aqueous sodium hydroxide

(i) Determine the number of coloured substances in the solution obtained from the berries.

..... [1]

(ii) The table gives the colours of some indicators in acid and alkali.

name of indicator	colour in acid	colour in alkali
anthocyanin	red	blue
bromothymol blue	yellow	blue
congo red	blue	red
methyl purple	purple	green

Use the data in the table and the results to give a possible identity for **one** indicator in the berries.

..... [1]

[Total: 8]

2 A student investigated the temperature decrease when sodium hydrogencarbonate reacts with dilute hydrochloric acid.

The student did six experiments.

Experiment 1

- Using a measuring cylinder, 25 cm^3 of dilute hydrochloric acid was poured into a conical flask.
- The initial temperature of the acid was measured using a thermometer.
- 1 g of sodium hydrogencarbonate was added to the conical flask. At the same time a stop-clock was started.
- The acid and sodium hydrogencarbonate mixture in the conical flask was stirred continuously using the thermometer.
- The temperature of the mixture after 1 minute was measured.
- The conical flask was rinsed with distilled water.

Experiment 2

- Experiment 1 was repeated using 2 g of sodium hydrogencarbonate instead of 1 g.

Experiment 3

- Experiment 1 was repeated using 3 g of sodium hydrogencarbonate instead of 1 g.

Experiment 4

- Experiment 1 was repeated using 5 g of sodium hydrogencarbonate instead of 1 g.

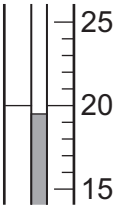
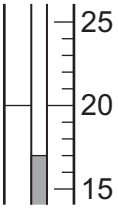
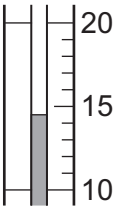
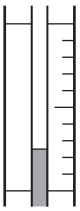
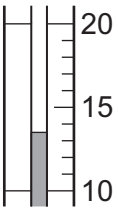
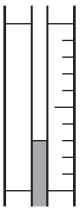
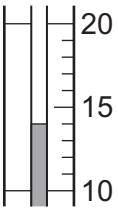
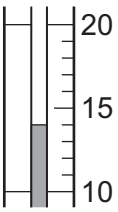
Experiment 5

- Experiment 1 was repeated using 6 g of sodium hydrogencarbonate instead of 1 g.

Experiment 6

- Experiment 1 was repeated using 7 g of sodium hydrogencarbonate instead of 1 g.

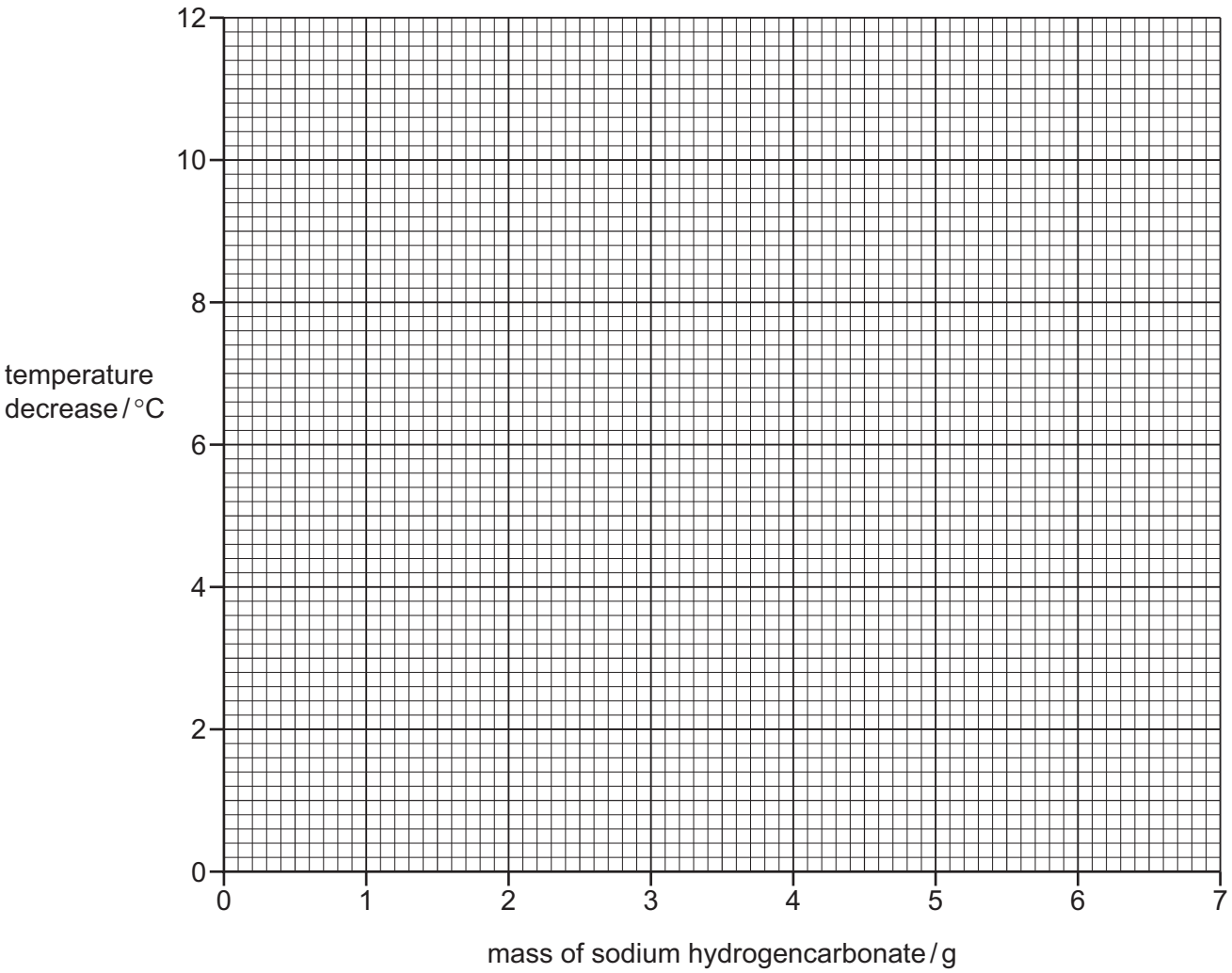
(a) Use the thermometer diagrams to complete the table and calculate the temperature decreases.

experiment	mass of sodium hydrogencarbonate / g	thermometer diagram	initial temperature of acid / °C	thermometer diagram	temperature after 1 minute / °C	temperature decrease / °C
1	1					
2	2					
3	3					
4	5					
5	6					
6	7					

[4]

(b) Plot the results from Experiments 1 to 6 on the grid.

Draw **two** best-fit straight lines through your points. The first straight line should be for the first three points and must pass through (0,0). The second straight line should be for the last three points and must be horizontal. Extend your straight lines so that they meet each other.



[4]

(c) (i) **From your graph**, determine the temperature decrease and mass of sodium hydrogencarbonate where your two straight lines meet. Include appropriate units in your answer.

Show clearly **on the grid** how you worked out your answer.

temperature decrease = ...

mass of sodium hydrogencarbonate = ...

[3]

(ii) Explain why the temperature decrease becomes constant for high masses of sodium hydrogencarbonate.

.....

..... [1]

[Turn over

(d) The investigation was repeated with dilute hydrochloric acid of half the concentration, but the same volume.

Sketch **on the grid** the graph you would expect to obtain.

Label your line **D**. [2]

(e) Suggest **two** changes that could be made to the apparatus that would improve the accuracy of the results. For each change explain why it would improve the accuracy of the results.

change 1 .....

explanation 1 .....

.....

change 2 .....

explanation 2 .....

.....

[4]

[Total: 18]

3 Solid **E** and solution **F** were analysed.
Tests were done on each substance.

tests on solid E

tests	observations
test 1 About half of solid **E** was placed in a test-tube and heated gently.	steam was given off; condensation appeared near the mouth of the test-tube
The remaining solid **E** was dissolved in distilled water to produce solution **E**. The solution was divided into four equal portions in three test-tubes and a boiling tube. **test 2** About 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate were added to the first portion of solution **E**.	no visible change
test 3 About 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate were added to the second portion of solution **E**.	white precipitate
test 4 Excess aqueous ammonia was added to the third portion of solution **E**.	white precipitate
test 5 Aqueous sodium hydroxide was added dropwise and then in excess to the fourth portion of solution **E** in the boiling tube.	white precipitate which dissolved in excess to form a colourless solution
test 6 The product from **test 5** was warmed gently and any gas given off was tested with damp red litmus paper.	the red litmus paper turned blue

(a) State the conclusion that can be made from the observations in **test 1**.

.....

..... [1]

(b) State the conclusion that can be made from the observation in **test 2**.

.....

..... [1]

(c) Identify the **three** ions in solid **E**.

.....

..... [3]

tests on solution F

Solution **F** was aqueous sodium hydroxide.

Complete the expected observations.

(d) A flame test was carried out on solution **F**.

observations ..... [1]

(e) The remaining solution **F** was divided into two approximately equal portions in two test-tubes.

(i) To the first portion of solution **F** a few drops of universal indicator solution were added.

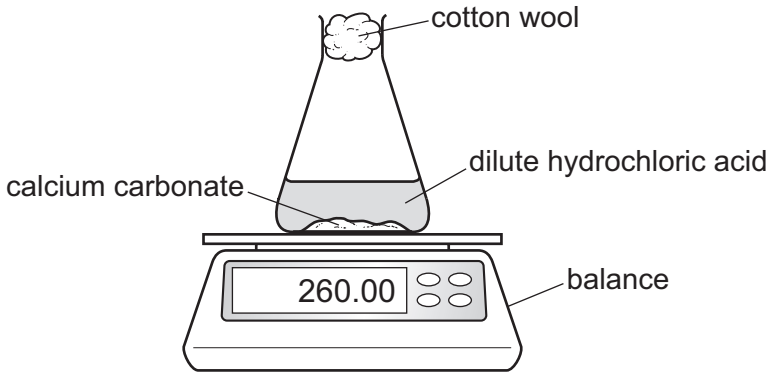
observations ..... [1]

(ii) To the second portion of solution **F** approximately 2 cm^3 of aqueous copper(II) sulfate was added.

observations ..... [1]

[Total: 8]

4 Dilute hydrochloric acid reacts with calcium carbonate to make carbon dioxide gas. The apparatus shown in the diagram can be used to follow the progress of the reaction. The carbon dioxide gas leaves the flask causing the mass shown on the balance to decrease.



Plan an investigation, using the apparatus shown in the diagram, to find out how the temperature of the dilute hydrochloric acid affects the rate of the reaction. Your plan should include how your results will show how the temperature of the dilute hydrochloric acid affects the rate of the reaction.

You are provided with dilute hydrochloric acid, calcium carbonate and common laboratory apparatus.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]