1 A student is given three colourless solutions, **H**, **J** and **K**.

These three solutions are the halide solutions shown.

sodium bromide solution
sodium chloride solution
sodium iodide solution

The student does not know which solution is which.

He carries out tests to identify the solutions.

(a) Steps

- He places about 2 cm^3 of solution **H** in a test-tube.
- He adds a few drops of silver nitrate solution.
- He then adds ammonia solution until the test-tube is nearly full.
- He stirs the mixture carefully.
- He records his observations in Table 2.1.

He repeats the above steps for solutions **J** and **K**.

Table 2.1

	observations		
test	solution **H**	solution **J**	solution **K**
add silver nitrate solution	white ppt.	cream coloured ppt.	pale yellow ppt.
then add excess ammonia solution and stir	ppt. dissolves to form colourless solution	ppt. dissolves slightly	ppt. remains unchanged

(i) Use the observations in Table 2.1 to identify which solution, **H**, **J** or **K**, is sodium chloride solution.

Explain how you reached your identification.

sodium chloride solution is .....

explanation .....

.....

[1]

(ii) State **and** explain whether the addition of silver nitrate solution followed by excess ammonia solution can be used to distinguish between the three halide solutions, **H**, **J** and **K**.

.....

.....

.....[1]

(iii) Nitric acid is usually added to the unknown solution before adding silver nitrate solution.

Explain why adding nitric acid first is not necessary in this test for this investigation.

.....

.....[1]

(b) The student then adds chlorine water to separate samples of the three solutions, **H**, **J** and **K**.

He records his observations in Table 2.2.

Table 2.2

	observations		
test	solution **H**	solution **J**	solution **K**
add chlorine water	no visible change	solution becomes yellow	solution becomes very dark orange

(i) Use the observations in Table 2.2 to suggest which **two** solutions of **H**, **J** and **K** could be sodium bromide solution.

Explain your answer in terms of the reactions which take place.

sodium bromide solution could be..... or .....

explanation .....

.....

[1]

(ii) Suggest **one** precaution that the student should take when using chlorine water.

.....

.....[1]

(iii) Describe another test that could be carried out on the two solutions you identified in **(b)(i)** to show which solution is sodium bromide and which solution is sodium iodide.

State the expected observations for sodium bromide solution and sodium iodide solution.

.....

.....

.....[2]

(c) A sample of sodium chloride solution can be made by reacting hydrochloric acid with sodium hydroxide solution.

Sodium hydroxide solution is added slowly to 25 cm^3 of hydrochloric acid in the presence of an indicator.

When the indicator changes colour, the volume of sodium hydroxide solution which has been added is recorded.

The reaction is then repeated using 25 cm^3 of hydrochloric acid and the recorded volume of sodium hydroxide solution but without the indicator.

(i) Name a suitable piece of apparatus for measuring the volume of the sodium hydroxide solution.

.....[1]

(ii) Explain why the reaction is repeated without the indicator.

.....

.....[1]

(iii) Suggest a change to the experiment which would enable the volume of sodium hydroxide solution added to be determined more accurately.

.....

.....[1]

2 A student is studying cells.

Fig. 4.1 shows a photograph of some animal duodenum cells.

One of these cells is labelled cell **A**.

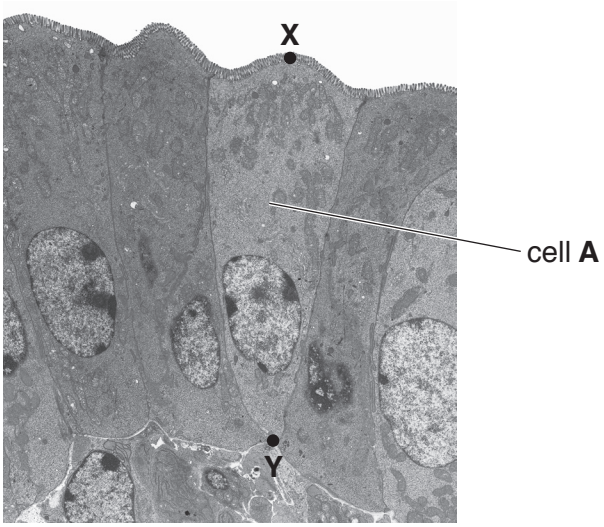


Fig. 4.1

(a) (i) In the box below, make an enlarged and detailed pencil drawing of cell **A**.

[3]

(ii) Draw a label line to label the nucleus of the cell in your drawing. [1]

(b) (i) Measure in millimetres, to the nearest millimetre, the length of cell **A** between points **X** and **Y** in Fig. 4.1.

length = ... mm [1]

(ii) Draw the line **X**–**Y** on your drawing in the same place as **X** and **Y** are shown in Fig. 4.1.

Measure this line, in millimetres, to the nearest millimetre.

length = ... mm [1]

(iii) Use your **two** measurements to calculate the magnification of your drawing.

Show your working in the space below.

magnification = ... [1]

(c) Describe how you could test cells in a liquid sample for the presence of fat.

reagents used and method .....

.....

.....

observation for a positive result .....

[3]

3 A student investigates the reactions of metal oxide **H**, a red solid.

(a) She places some of **H** in a hard glass test-tube and heats it strongly.

A black solid forms. She leaves this black solid to cool.

(i) She adds an acid to the black solid and warms carefully.

After heating, she allows the mixture to settle and observes a blue solution.
She suspects that the solution contains the Cu^{2+} ion.

Describe a test that the student could carry out on the solution to identify the cation present.

Include in your answer the observations that will identify the cation as Cu^{2+}.

test .....

.....

observations .....

.....

[2]

(ii) The acid the student used in **(a)(i)** is either hydrochloric acid or sulfuric acid.

Complete Table 2.1 to describe two tests which she uses to identify the acid.

Include in Table 2.1 the observations which would be expected for both tests on each acid.

Table 2.1

test	observation with hydrochloric acid	observation with sulfuric acid

[3]

(b) Next the student takes another sample of red solid **H** and adds acid to it.
She heats the mixture and allows it to cool.
She then filters the mixture.
The residue is red-brown and the filtrate is blue.

Draw a labelled diagram of the apparatus that the student uses for the filtering of the mixture.

Identify the positions of the filtrate and the residue on your diagram.

[2]

(c) The student places the blue filtrate from **(b)** into a beaker. She adds one spatula load of magnesium powder and stirs.

The beaker becomes quite hot.

When the mixture settles the solution is now colourless and the powder is pink.

(i) Name the type of reaction that takes place between magnesium and the filtrate from **(b)**.

.....[1]

(ii) Identify the pink powder.

.....[1]

(d) Suggest why the test-tube used in **(a)** is a hard glass test-tube.

.....

.....[1]

4 A student investigates if light and chlorophyll are needed for photosynthesis.

She has two plants. Before she can start her investigation she needs to de-starch (remove the starch from) both plants.

(a) Describe how she de-starches the plants.

.....

.....

.....[2]

(b) She places one of these plants in the dark and the other plant in the light for a few days. A leaf from each plant is tested for the presence of starch using iodine solution.

Describe how she carries out this test. Include in your answer:

- method
- safety precautions
- observation for a positive result.

.....

.....

.....

.....

.....

.....[4]

(c) Explain why the student needs to de-starch the plants.

.....

.....[1]

(d) The plant in the light tests positive for starch. The plant in the dark does not.

The green pigment chlorophyll is also needed for photosynthesis.

Fig. 4.1 shows two leaves from another de-starched plant. Leaf **A** is kept in the light and leaf **B** is kept in the dark.

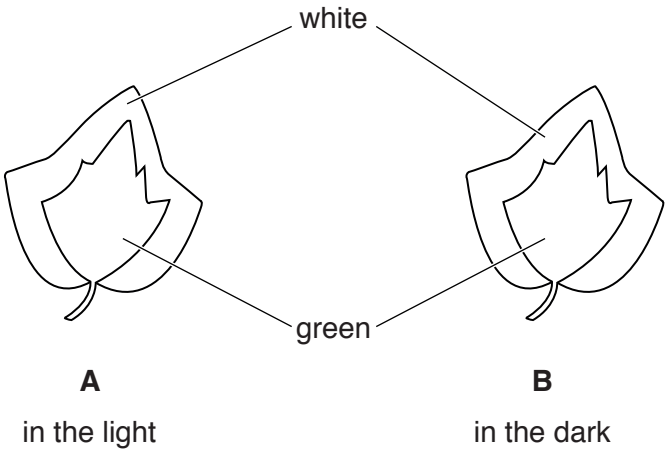


Fig. 4.1

The student tests these leaves for the presence of starch.

On Fig. 4.2, complete the label lines to show her observations after she tests the leaves with iodine solution.

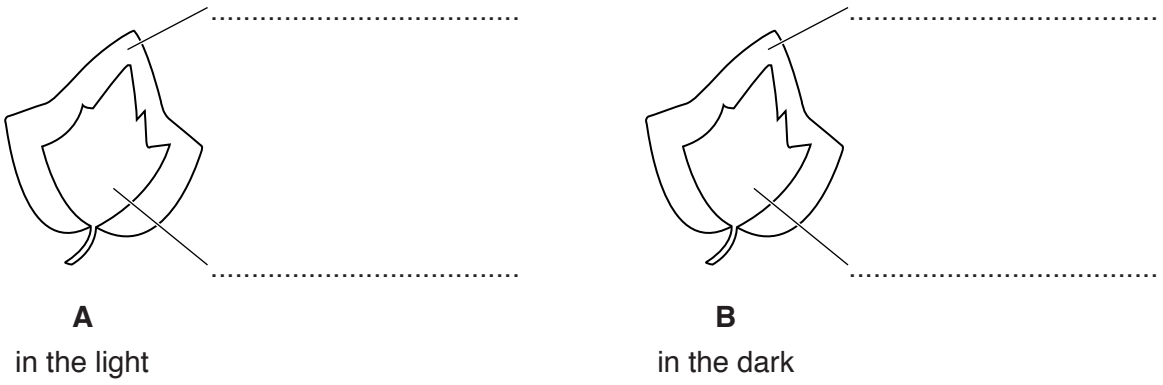


Fig. 4.2

[3]

5 A student investigates the rate of reaction of calcium carbonate with hydrochloric acid.

Calcium carbonate reacts with hydrochloric acid to form calcium chloride, water and carbon dioxide gas. As the carbon dioxide gas is given off during the reaction the mass of the reactants decreases.

(a) Procedure

- She places 5 g of finely powdered calcium carbonate (which is an excess) into a conical flask.
- She adds 50 cm^3 of dilute hydrochloric acid into the conical flask.
- The acid is at a temperature of 25 °C.
- She quickly places cotton wool into the neck of the flask and puts the flask onto the balance, as shown in Fig. 5.1.

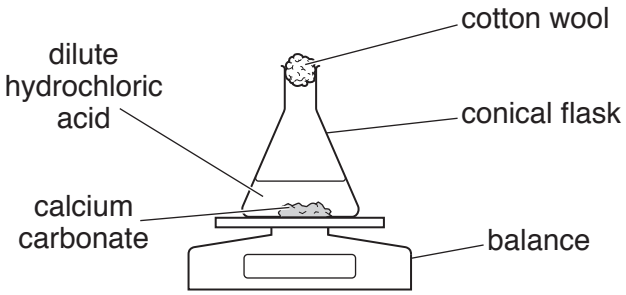
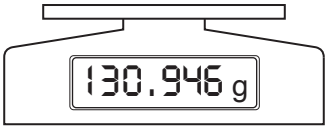


Fig. 5.1

- She immediately measures the mass of the flask and contents and records it in Table 5.1 at time t = 0 minutes.
- She measures and records, in Table 5.1, the mass of the flask and contents every minute until there is no further change in mass.

Fig. 5.2 shows the reading for the mass of the flask and contents at t = 5 minutes. **Record this mass in Table 5.1.**



mass at 5 minutes

Fig. 5.2

Table 5.1

t / minutes	mass of flask and contents / g
0	132.62
1	131.74
2	131.40
3	131.21
4	131.06
5	
6	130.88
7	130.82
8	130.81
9	130.80
10	130.80

[1]

(b) (i) Use the values in Table 5.1 to calculate the total mass of carbon dioxide gas given off.

mass = ... g [1]

(ii) The total amount of carbon dioxide gas expected is 1.90 g.

Suggest **one** reason why your value in **(b)(i)** is different from this.

.....

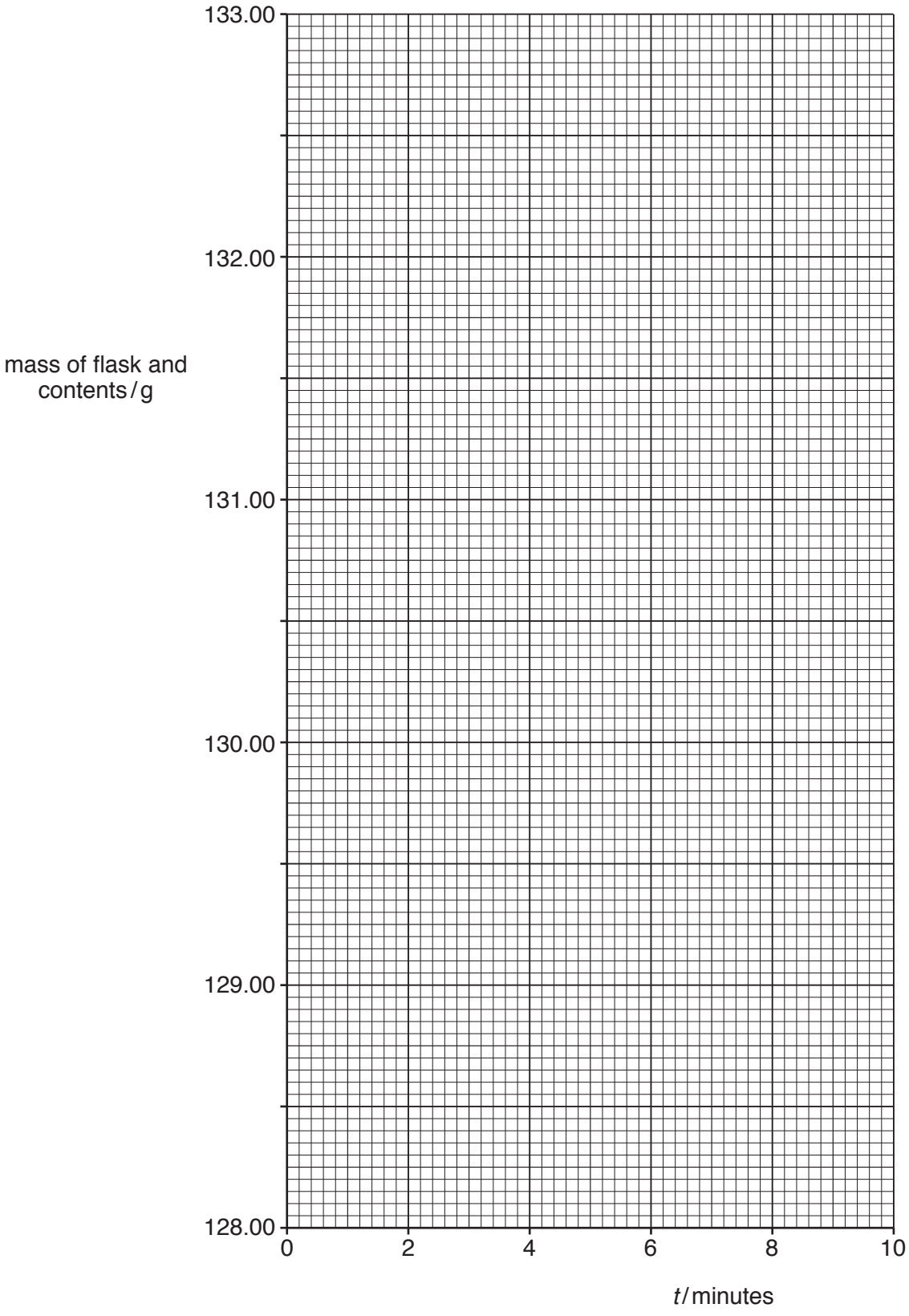
.....[1]

(c) Explain why cotton wool was placed into the neck of the flask.

.....

.....[1]

(d) (i) On the grid provided, plot a graph of mass of flask and contents against time.



[1]

(ii) Draw the best-fit curve. [1]

(e) (i) The student repeats the procedure in **(a)** using 100 cm^3 of the same dilute hydrochloric acid at the same temperature. The 5 g of powdered calcium carbonate is still an excess.

Sketch on the grid in **(d)(i)** the line she should expect to get from her experiment. Assume that the starting mass of the flask and contents at time $t = 0$ is 132.62 g. Label this line **F**. [2]

(ii) The student repeats the procedure in **(a)** using 50 cm^3 of the same dilute hydrochloric acid but which is at a temperature of 40 °C.

Sketch on the grid in **(d)(i)** the line she should expect to get from her experiment. Start the line in the same place as the line drawn in **(d)(ii)**. Label this line **M**. [2]