AQA GCSE (9–1)

Biology

Required Practicals Lab Book: Exam practice and further application

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Contents

Answers can be found in the accompanying teacher book and also online at www.hoddereducation.co.uk/AQAGCSELabBook

We have carried out a health and safety check of this text and have attempted to identify all recognised hazards and suggest appropriate cautions. However, the Publishers and the authors accept no legal responsibility on any issue arising from this check; whilst every effort has been made to carefully check the instructions for practical work described in this book, it is still the duty and legal obligation of schools to carry out their own risk assessments for each practical in accordance with local health and safety requirements. Suitable blank and model risk assessments are publicly available and can be found readily online.

The text has not been through the AQA endorsement process.

For further health and safety information (e.g. Hazcards) please refer to CLEAPSS at www.cleapss.org.uk.

How to use this book

This book will help you keep a record of the required practicals you have completed, as well as your results and conclusions. It covers the AQA GCSE (9–1) Biology (separate science) specification.

Practical structure

Completing the practical

At the start of each practical, there is a brief context to help explain how the science behind the practical ties into the wider course. There are also **page references** for further information that will direct you to the **AQA GCSE (9–1) Biology Student Book**.

The **aim** of each practical is laid out, with a list of **equipment** needed. Your teacher will inform you if all equipment is available, and if the method needs to be adapted as a result.

Before you begin, you must read and understand the **health and safety** notes and take precautions as necessary. Once you have carried out a risk assessment, you should check with your teacher if you can start working through the **method**.

The **method** provides step-by-step instructions for the practical; read it at least once before you start. Once you have understood everything, you can follow the steps to complete the practical. **Tips** may be provided to help.

Observations and questions

Each practical has an **observations** section to record your results; you may wish to use separate sheets of paper for additional workings. Scaffolded questions are provided to help you with **conclusions** and **evaluations** for the practical.

There are **exam-style questions** related to each practical. Your teacher may decide to set these as part of the lesson or at a later date. The exam-style questions are followed by a **further application** section, which provides questions that apply the scientific theory from the practical to different contexts. This will help to consolidate your understanding.

Other features to help you through the practical include:

Health and safety 

Each practical includes health and safety guidance to help you carry out the experiment safely. However, it is still the duty and legal obligation of schools to carry out their own risk assessments for each practical in accordance with local health and safety requirements.

Key terms 

Key terms and definitions that will help you understand vocabulary relevant to the practical.

Key equations 

Equations that are required in the practical's results or questions. Some of the more commonly-known equations may have been omitted to mimic examination papers. A full list of equations is provided on page 66.

Maths opportunities 

Opportunities to cover mathematic skills. These usually only list those skills most relevant to the practical, but additional minor skills may also be covered.

Tip 

Guidance about, for example, the recommended way to complete a practical or answer certain questions.

Note 

Key points to help if, for example, there are alternatives to the given method or equipment.

Answers to all questions are provided in the teacher book and can be found online here:
www.hoddereducation.co.uk/AQAGCSELabBook

The accompanying teacher book is available at **www.hoddereducation.co.uk/AQATeacherLabBook** and can also be bought as part of a classroom pack at **www.hoddereducation.co.uk/AQASingleSciLabClassroomPack**.

How you will be assessed

In AQA GCSE (9–1) Biology, you are not assessed on the required practicals independently. However, you are expected to complete these experiments as part of the wider science course.

In AQA, questions on these (or similar) practicals count for at least 15% of the overall marks. It is important to note that the exams are not restricted to asking questions on these specific practicals, and instead are designed to focus on investigative skills. This means they are likely to test how well you can apply your practical knowledge to unfamiliar contexts. It is for this reason that we have included **Further Application** within this lab book.
You should be sure to keep this book safe as it may prove a useful resource when it comes to revising for your exams.

Required practical 3: Investigating the effect of sugar or salt on the mass of plant tissue

In this practical you will investigate the effect of a range of concentrations of sugar or salt solutions on the mass of plant tissue. Water moves by the process of **osmosis** from a solution of higher **water potential** (i.e. more dilute) to one of lower water potential (i.e. more concentrated). The movement of water can be traced by measuring mass changes in living tissue.

Further information can be found in the **AQA GCSE (9–1) Biology Student Book** on pages:

- 29–32: Diffusion
- 33–35: Osmosis.

Aim

Investigate the effect of a range of concentrations of sugar (or salt) solutions on the mass of plant tissue.

Equipment and reagents

- Potato
- Cork borer
- Rule
- 10 cm^3 measuring cylinder
- Labels
- Five boiling tubes
- Test tube rack
- Paper towels
- Scalpel
- White tile
- Range of sugar or sodium chloride solutions (0.25, 0.5, 0.75 and 1.0 mol/dm^3)
- Distilled water
- Top-pan balance accurate to at least 0.01 g

Maths opportunities

- Subtraction
- Calculating percentages
- Recognise and use expressions in decimal form
- Calculating means
- Plotting variables, and translating information between graphical and numerical forms
- Understanding linear graphs

Key terms

Osmosis: The net movement of water molecules through a selectively permeable membrane from a more dilute solution to a more concentrated solution.

Water potential: A measure of the tendency of water to move from one area to another due to osmosis.

Health and safety

- Wear eye protection.
- Scalpels, knives and cork borers can cut. If you are cutting your own potato cylinders, care should be taken.

Key equation

$$\% \text{ change in mass} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

Note

Controlling the length and diameter of the potato cylinders controls the surface area.

Note

As we are controlling the length and diameter, it is impossible to control the mass as well. We account for this by recording percentage change in mass.

Tip

It is best to blot the cylinders dry with paper tissue, so that any water on the surface is not weighed.

Method

1. Label four of the boiling tubes with the different concentrations of solution used, and label the fifth one 'water'.
2. Add 10 cm^3 of the appropriate sugar/salt solution to the first four tubes, and add 10 cm^3 of distilled water to the one labelled 'water'.
3. Use a cork borer to cut five potato cylinders of the same diameter.
4. Use a scalpel to cut the cylinders so that they are all 3 cm in length.
5. Use a balance to measure the mass of the first cylinder. Record the result in the 'Distilled water' column of the table in the **observations** section of the questions on page 12. Then place this cylinder in the 'water' tube.
6. Repeat step 5 with the other four potato cylinders, placing each one in a tube marked with the appropriate concentration. Ensure that you write the correct values in the correct columns of your table.
7. Leave the potato cylinders in the boiling tubes overnight.
8. Remove the cylinder from the 1 M sugar/salt tube and measure its mass. Record your results in your table (in the **observations** section).
9. Repeat step 8 for each of the other cylinders, ensuring that the results are recorded in the correct column.
10. Calculate the percentage change in mass for each.
11. Draw a graph of your results with 'Concentration of sugar/salt solution/M' on the *x*-axis and 'Percentage change in mass' on the *y*-axis.

Observations

1 Record your results in the following table:

	Distilled water	0.25 mol/dm^3 solution	0.5 mol/dm^3 solution	0.75 mol/dm^3 solution	1.0 mol/dm^3 solution
Initial length/mm					
Final length/mm					
Initial mass/g					
Final mass/g					
% change in mass					

2 Describe any trend seen in your results.

Conclusions

3 When the concentration of the outside solution is the same as that of the **cell sap** in the potato cells, the mass of the potato cylinder will not change. Explain why.

Key term

Cell sap: The solution found in the central vacuole of plant cells. Sugars are the principal solutes.

4 Use your graph to estimate the concentration of the cell sap in the potato cells.

Evaluation

5 To make the test fair, it was important that the cylinders were all the same length. Explain why.

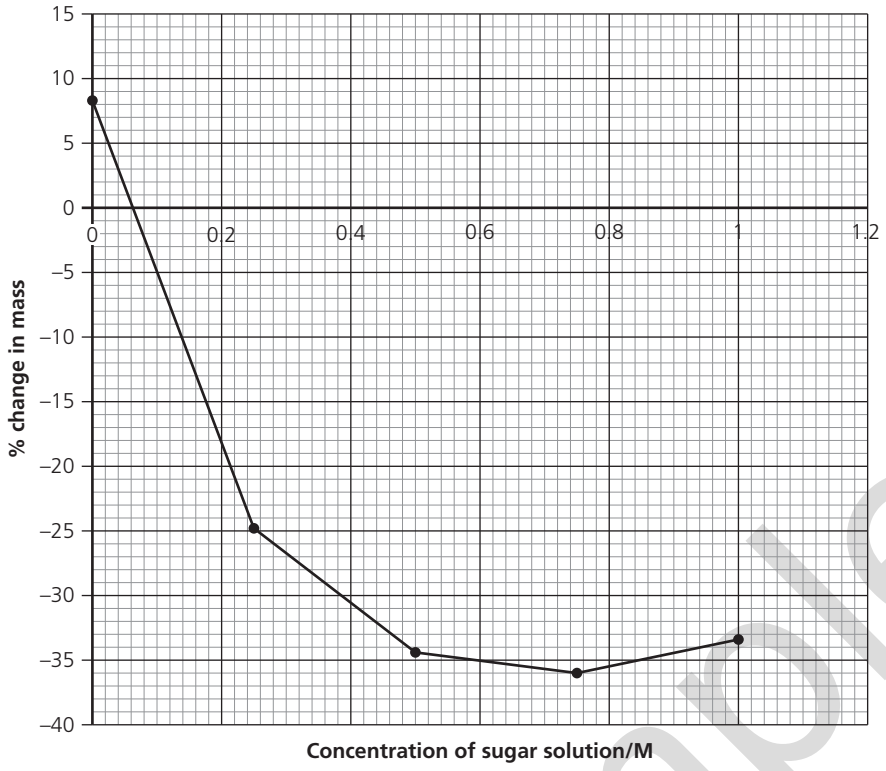
6 Why was percentage change in mass used to plot the graph, rather than just change in mass?

7 The practical could have used change in length of the cylinders as the dependent variable. Suggest why change in mass is likely to give more accurate results.

8 Suggest one way in which the strength of evidence could be improved in this experiment.

Exam-style questions

1 A student weighed five cylinders of potato, of equal length and diameter, then placed them into different strengths of sugar solution and left them for 24 hours. They then re-weighed them and recorded the percentage change in mass. Their results are shown below.



a) Name the process that is causing the change in mass. **[1]**

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b) Describe the trend seen in the results. **[3]**

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c) Explain the percentage change in mass seen in distilled water (0 M). **[3]**

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d) Explain the results between 0.5 and 1.0 M. **[3]**

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2 Some students prepared three cylinders of potato of equal diameter and length. They placed each cylinder into water baths at three different temperatures and left them for 30 minutes. The students then measured the lengths again and calculated the percentage change in length. Their results are shown in the table below.

Temperature/°C	Initial length/mm	Final length/mm	Change in length/mm	% change in length
35	50	57.3	7.3	+14.6
25	50	53.4	3.4	+6.8
5	50	51.8	1.8	

a) Calculate the percentage change in length of the potato cylinder kept at 5° C. **[2]**

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b) Explain the trend seen in the results. **[5]**

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c) Suggest a reason why temperatures higher than 35° C were not used. **[1]**

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d) Suggest one way in which the strength of evidence from this experiment could be improved. **[1]**

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3 Two restaurant workers were preparing some carrots for cooking. They each placed a large batch of carrots into a pan and covered them in water. One worker added salt to the water for flavour, but the other did not. One hour later, the chef came to cook the carrots and noticed that one batch was no longer covered in water, but the other one was. The two pans were the same size, had the same number of carrots in them and the amount of water added was the same.

a) Which of the two batches was no longer covered in water? **[1]**

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b) Explain the differences in the water levels in the two pans. **[4]**

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[Total = ... /24 marks]

Further application

1 A chicken egg is a single large cell encased in a shell. The shell can be removed by leaving the raw egg in dilute acid for several days. This leaves the cell (egg) surrounded by a cell membrane.

A student used shelled eggs for an experiment on osmosis. They weighed three shelled eggs and placed one in distilled water, one in 5% salt solution, and one in 15% salt solution. They left them for 24 hours.

After this time, the egg in distilled water had burst. The student re-weighed the other two eggs. Both had lost weight.

a) Explain why the egg in distilled water had burst. **[3]**

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b) The student calculated that the egg in 15% salt solution had lost 20% of its weight. Suggest what the percentage weight change of the egg in 5% salt solution was. Choose from the four possibilities below by underlining your choice. **[1]**

A –10%

B –25%

C +2%

D –20%

c) The experiment investigated the process of osmosis. Explain the term osmosis in the context of this experiment. **[3]**

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2 Rock pools on rocky shores contain salt water (a solution of sodium chloride). At low tide on summer days, the heat causes some of the water to evaporate, but the rock pools do not dry up.

a) Explain why the evaporation of some of the water could be a danger to the animals living in the rock pool. **[4]**

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b) River estuaries contain salt water at high tide, but fresh water at low tide. Estuaries tend to have a very low biodiversity – few species live there, although the populations of the species that do are often large.

i) Suggest why very few species live in estuaries. **[3]**

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ii) Suggest why the populations of these species are often large. **[1]**

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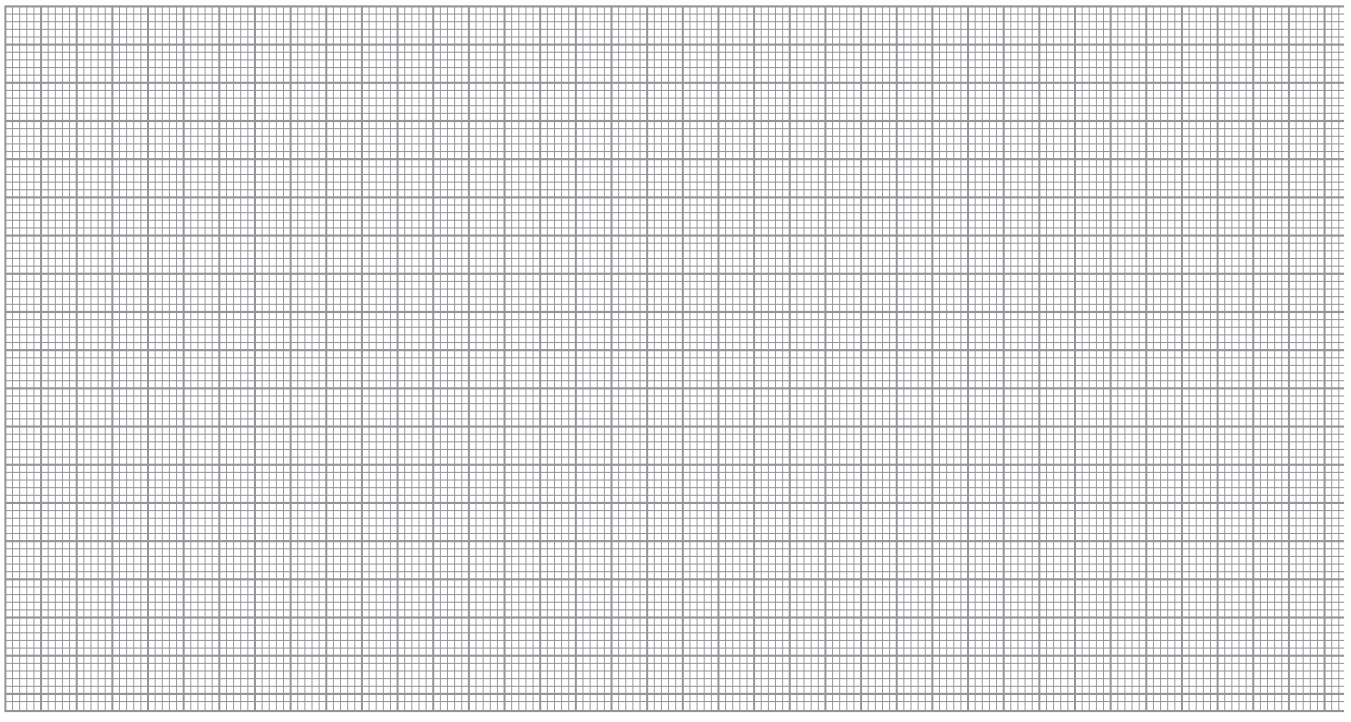
3 A scientist was doing an experiment on the effect of temperature on osmosis. Ten identical cubes of potato were weighed and placed in each of six beakers of water and left for 24 hours. Each beaker was placed in a water bath at different temperatures. After 24 hours the cubes were removed, blotted dry and re-weighed. The percentage increase in weight was calculated. The results are shown in the table below.

Temperature/°C	% change in mass
10	5
20	13
30	26
40	32
50	8
60	2

a) Plot the results on the graph paper. **[4]**



[Total = ... /19 marks]