Margaret Royal, Adrian Schmit

INTERNATIONAL GCSE (9–1)

Biology

for Edexcel International GCSE

Core Practicals Lab Book:
Exam practice and further application

HODDER EDUCATION
LEARN MORE

Contents

Asterisks* are used to indicate which practicals are for separate sciences only.

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 Edexcel 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 core practicals you have completed, as well as your results and conclusions. It covers the Edexcel International GCSE (9-1) Biology specification, as well as the Biology component of the Edexcel International GCSE (9-1) Science Double Award.

Practical structure

Completing the practical

At the start of each practical, we have provided a brief context to help explain how the science behind the practical ties in to the wider course. There are also page references for further information, which will direct you to the **Edexcel International GCSE (9–1) Biology Student Book.**

The **aim** of each practical is then laid out, along with a list of **equipment** needed to complete the practical as suggested. Your teacher will inform you whether they have decided to change any of the equipment 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. See the health and safety feature below for more details. 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 also provided to help you develop **conclusions** and **evaluations** for the practical.

Once the practical is completed, there are **exam-style questions** related to each practical, which provide useful practice. Your teacher may decide to set this as part of the lesson or at a later date. This is followed by a **further application** section, which provides additional questions that apply the scientific theory learned from the practical to different contexts. This will help to consolidate your understanding.

Answers to all of the Student Lab Book questions are provided in the accompanying Teacher Book. They can also be found online here: **www.hoddereducation.co.uk/EdexcelIGCSELabBook**

Features to help you use the book

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

These are key terms and definitions that will help you understand vocabulary relevant to the practical.

Key equations

If a practical requires the use of a particular equation in either the results or the subsequent questions, these are usually flagged in this section. Some of the more commonly known equations may have been omitted to mimic the actual exam papers. A full list of equations is provided on page 87.

Maths opportunities

These highlight opportunities to cover the recommended mathematical skills. These usually only list the mathematical skills most relevant to the practical, but additional minor skills may also be covered.

Tips

These provide 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.

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

How you will be assessed

In Edexcel International GCSE (9-1) Biology, you are not assessed on the core practicals independently. However, you are expected to complete these experiments as part of the wider science course in the exam.

For Edexcel International GCSEs, 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 practical knowledge to unfamiliar contexts. It is for this reason that we have included **further application** sections 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.

Core Practical 3: Investigate how pH affects enzyme activity

In this practical you will investigate the effect of **pH** on the activity of amylase **enzyme**. Amylase catalyses the breakdown of starch into maltose and is found in saliva and pancreatic juice. The reaction is followed by monitoring the rate of breakdown of starch, using iodine solution to test for the presence of starch in the reaction mixture.

Aim

Investigate how enzyme activity can be affected by changes in pH.

Equipment and reagents

- 10 × test tubes
- Test tube rack
- Electric water bath, or a Bunsen burner, tripod and beaker, at 35 °C
- Spotting tile
- 5 cm^3 measuring cylinder
- Pasteur pipettes, syringes or 5 cm^3 measuring cylinders
- Stopwatch
- Labels
- Thermometer
- Iodine solution (0.01 mol dm^{-3})
- Starch solution (1%)
- Fungal amylase solution (0.1%)
- Labelled buffered solutions at pH 4, 5, 6 and 7

Method

1. Prepare a water bath at 35 °C (electrical, or Bunsen burner and beaker).
2. Place a single drop of iodine solution into each well on the spotting tile.
3. Label a test tube with the pH to be tested.
4. Place 2 cm^3 of amylase into the test tube.
5. Add 1 cm^3 of buffer solution to the test tube.
6. Place in the water bath and leave to equilibrate for approximately 1 minute.

Note

If using a beaker of water as a water bath, use the thermometer to check that the temperature is maintained at 35 °C (± 2 °C).

7. Add 2 cm^3 of starch to the amylase/buffer solution and start the stopwatch.
8. Mix using a plastic pipette.
9. After 10 seconds, use the plastic pipette to place one drop of the mixture on the first drop of iodine. The iodine solution should turn blue-black.
10. Return the rest of the solution back into the test tube.
11. Wait a further 10 seconds. Remove a second drop of the mixture to add to the next drop of iodine.
12. Repeat step 11 until the iodine solution and the amylase/buffer/starch mixture remain orange. This indicates that the starch has been completely broken down.
13. Count how many iodine drops you have used, each one equalling 10 seconds of reaction time. Record this time on a separate piece of paper.
14. Repeat the whole procedure with another of the pH buffers, until you have used all four of those provided.

Further information can be found in the **Edexcel International GCSE (9-1) Biology Student Book** on these pages:
- 27–28: Enzymes
- 30–31: pH and enzyme activity

Key terms

pH: measure of the acidity or alkalinity of a solution.

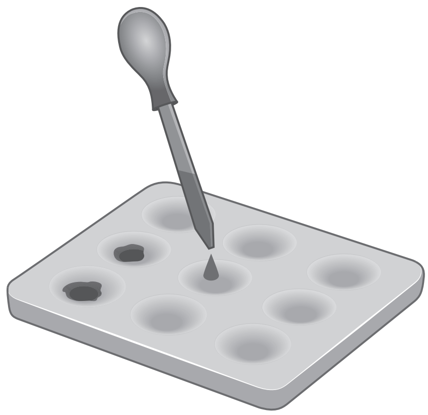
Enzyme: biological catalyst, which speeds up the rate of a given reaction but is itself unchanged by the reaction.

Health and safety

Safety glasses must be worn. Amylase solution is low hazard once made up. Iodine solution is an irritant to both skin and eyes. Any spills should be mopped up with paper towels. Iodine solution on the skin should be washed off with plenty of water.

Maths opportunities

- Using an appropriate number of significant figures
- Understanding and finding the arithmetic mean (average)
- Translating information between graphical and numerical form
- Plotting two variables (discrete and continuous) from experimental or other data
- Determining the slope and intercept of a linear graph



Note

If the iodine solution turns orange immediately, the reaction is going too fast. Speak to your teacher – you may need to dilute the amylase solution.

Observations

1 Plot a graph of reaction rate $\left(\frac{1}{\text{time}}\right)$ against pH.

> **Note**
>
> It is better to plot reaction rate $\left(\frac{1}{\text{time}}\right)$ on the *y*-axis rather than just time, as it makes the graph 'the right way up' (in other words, when the reaction goes faster, the line goes upwards).

2 Describe and explain any trend seen in your results.

Conclusions

3 Estimate the optimum pH for fungal amylase.

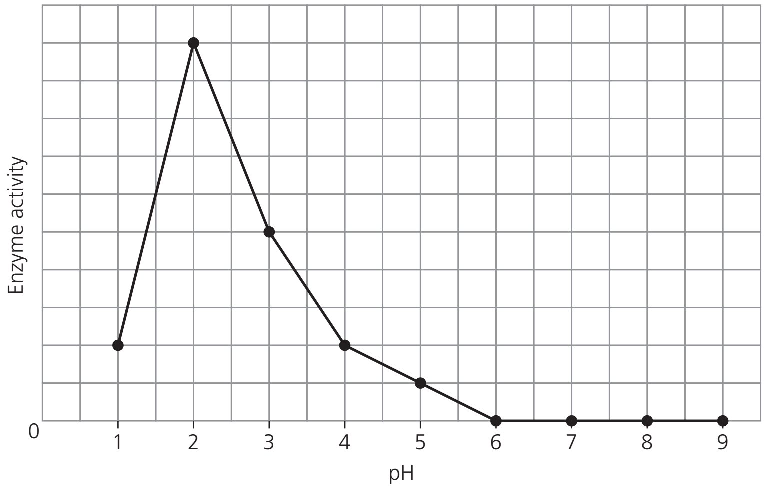
Evaluation

4 Evaluate the strength of evidence for your estimation of the optimum pH.

5 Suggest **two** improvements to the experimental technique.

Exam-style questions

1 Scientists did an experiment to find the optimum pH of the enzyme pepsin. Pepsin is a protease found in the stomachs of mammals. The results are shown below.



(a) Estimate the optimum pH for pepsin. **[1]**

....

(b) Suggest **one** modification to the experimental procedure that would give a more accurate estimate of the optimum pH. **[1]**

....

....

(c) Suggest **three** factors that the scientists would need to control in this experiment. **[3]**

....

....

....

(d) The optimum pH for pepsin is lower than for most enzymes.

Suggest **one** reason for this. **[2]**

....

....

(e) Suggest **one** reason for the results obtained at pH values 6–9. **[1]**

....

....

2 A student was planning to do an experiment on the effect of temperature on an enzyme. They planned to control the pH and the concentration of the enzyme.

(a) State **one** further factor that the student should control in this experiment. **[1]**

....

(b) How could they control pH? **[2]**

....

....

(c) Enzymes have different optimum pH values.

Describe a preliminary experiment the student would need to do if they were to control the pH at the correct value. **[2]**

(d) Suggest the range of temperatures that the student should use when testing the effect of temperature on the enzyme. **[2]**

3 Enzymes have an optimum pH value at which they work best, but this value varies in different enzymes.

Some of the bonds in an enzyme molecule are stable at a particular pH, but when the pH is a long way from the optimum, they break. This can result in the enzyme becoming denatured.

(a) Explain how the breaking of bonds in an enzyme can cause it to denature. **[3]**

(b) Suggest an explanation for the different optimum pH values of different enzymes. **[3]**

4 Protease enzymes break down proteins into amino acids. The breakdown can be followed using albumen solution.

Albumen is a protein, and albumen solution is cloudy. When the protein is broken down, the solution goes clear.

Describe how you would carry out an experiment to test the effect of pH on protease.

Include details of control variables and the range of pH values that you would use. **[6]**

[Total = ... / 27 marks]

Further application

1 It is difficult to make pineapple jelly. Jelly sets due to the formation of bonds between protein fibres in gelatin. Pineapple contains a mixture of protease enzymes called bromelain, which breaks these bonds as they form, and so the jelly never sets.

The problem can be overcome by using tinned pineapple, which has been heated during the canning process.

Bromelain can also cause problems for some people after eating fresh pineapple. They experience a sore mouth and/or tongue, and if they eat pineapple regularly they may even develop mouth ulcers.

(a) What does the term *protease* mean? **[1]**

....

....

(b) Explain why heating the pineapple during the canning process allows the use of the fruit to make jelly. **[4]**

....

....

....

....

....

....

(c) Suggest **one** reason why some people experience sore mouths after eating fresh pineapple. **[1]**

....

....

(d) Suggest **one** reason why bromelain causes problems in the mouth, but never affects the stomach. **[2]**

....

....

....

2 Many plants do not grow well when the pH of the soil is below 5. There are many reasons for this, but one is that the growth of nitrogen-fixing bacteria in the soil is reduced by low pH.

Nitrogen-fixing bacteria convert nitrogen into nitrates, which are necessary for plant growth. The growth of the bacteria may be inhibited by low pH because some of their enzymes could be denatured. The bacterial populations survive in acidic soils but grow slowly.

(a) What group of chemicals, essential for growth, requires nitrogen? **[1]**

....

(b) Growth requires energy. Suggest why the denaturing of certain enzymes in the bacteria can result in lack of growth. **[2]**

....

....

....

(c) Explain the process by which an enzyme becomes denatured. **[3]**

....

....

....

....

....

3 Meat tenderisers contain enzymes that break down protein links in the meat fibres, so the fibres become looser and the meat is more tender.

Meat tenderiser is applied to the meat an hour or so before cooking. It is best to leave the meat outside the fridge during this time.

(a) The enzymes in meat tenderiser have a low *specificity*. Explain the meaning of this term. **[1]**

....

....

(b) Explain why it is best to apply the tenderiser an hour before cooking the meat (even if the cooking time is quite long). **[2]**

....

....

....

(c) Explain why it is recommended that the meat is not left in the fridge during the tenderisation period. **[2]**

....

....

....

[Total = ... / 19 marks]