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INTERNATIONAL GCSE (9–1)

Chemistry

for Edexcel International GCSE

Core Practicals Lab Book:

Exam practice and further application

HODDER EDUCATION
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Contents

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

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) Chemistry specification, as well as the Chemistry component of the Edexcel International GCSE Science Double Award (9–1).

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) Chemistry 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 74.

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.

Answers available online at **www.hoddereducation.co.uk/EdexcelIGCSELabBook**

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

How you will be assessed

In Edexcel International GCSE (9–1) Chemistry, 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 the **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 5: Determine the approximate percentage by volume of oxygen in air

Air is made from a **mixture** of gases, one of which is oxygen. Because oxygen reacts with certain elements under the right conditions, the percentage of oxygen in air can be measured experimentally. The element chosen to react with the oxygen must produce a solid oxide. This is so that the oxygen atoms are removed from the air when they bond to the atoms of the chosen element. This reduces the volume of air present at the end of the experiment.

Further information can be found in the **Edexcel International GCSE (9–1) Chemistry Student Book** on pages:

- 119–122: The air
- 116: **Oxidation**
- 136–137: **Rusting**

Aim

Determine the approximate percentage by volume of oxygen in air using a metal.

Equipment and reagents

- Test tube
- Glass rod
- 250 cm^3 beaker
- Iron or steel wool (a piece about half the size of your finger)
- Ruler

Key terms

Mixture: When two or more elements or compounds are combined but not chemically bonded.

Oxidation: When oxygen atoms are gained in a reaction.

Rusting: When iron or steel is oxidised by air in the presence of moisture.

Key equation

$$\text{percentage decrease in volume of air} = \frac{\text{decrease in height of air}}{\text{starting height of air}} \times 100$$

Health and safety

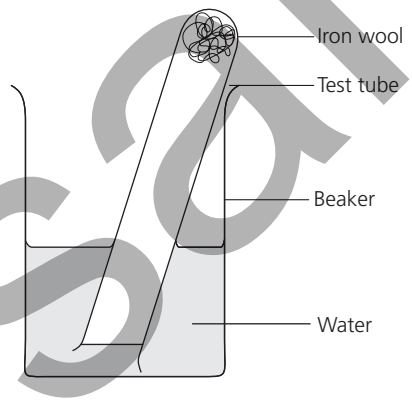
Wear eye protection.

Maths opportunities

- Recognising and using numbers in decimal form
- Using ratios and fractions
- Using an appropriate number of significant figures

Method

1 Use the glass rod to poke some iron wool into the bottom of a test tube. Use enough iron wool so that it is approximately 3 cm deep in the test tube.
2 Add a little water to the test tube and shake it, so that the iron wool is wet. Pour out any excess water.
3 Invert the test tube into a beaker that is half full of water.



Tip

Do not compact the iron wool because this might prevent it from reacting with all the oxygen in the air in the test tube.

4 With the test tube vertical, measure the height (in mm) of the air in the test tube. Record this in the **observations** section.
5 Arrange the test tube at an angle, as shown in the diagram, and leave for at least one week.
6 With the test tube vertical, measure the height of the air in the test tube.

Tip

The height of the air in the test tube is the distance between the sealed end of the test tube and the level of the water in the test tube.

Observations

1 Complete the table:

Height of air in test tube at the start in mm (A)	
Height of air in test tube after one week in mm (B)	

Conclusions

2 Record the decrease in height of air: ..... mm *(This is A – B)*

3 Use the equation below to calculate the percentage decrease in the volume of air:

$$\text{percentage decrease in volume of air} = \frac{\text{decrease in height of air}}{\text{starting height of air}} \times 100$$

Percentage of oxygen in air: ..... %

Evaluation

4 Compare your value for the composition of air with the values from other students in your class, or the values given to you by your teacher. Comment on the similarities or differences.

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5 Calculate a mean value for the percentage of oxygen in the air, using your result and results from other students.

Mean percentage of oxygen in air: ..... %

6 Why is it necessary to ensure that the test tube is angled in the beaker and not placed vertically?

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7 A student repeated the experiment but only added a very small amount of iron wool. State whether this would lead to a value for the percentage of oxygen in air that was too high or too low and explain your answer.

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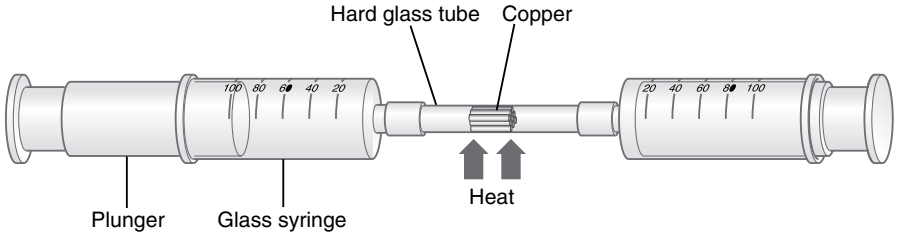
Exam-style questions

1 The percentage of oxygen in air can be determined by reacting the oxygen in air with a metal such as copper.



a) State the word equation for the reaction occurring. **[2]**

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b) At the start of the experiment, one of the glass syringes contains 98 cm^3 of air. The copper is heated strongly and the air is passed back and forth over the copper for several minutes. The apparatus is allowed to cool.

i) At the end of the experiment, the remaining air is pushed into one of the syringes. There is 75 cm^3 of air remaining. Calculate an approximate percentage by volume of oxygen in air in this experiment. **[3]**

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Mean percentage of oxygen in air: ..... %

ii) The correct percentage of oxygen in the air is 21%. The incorrect value from this experiment was because the apparatus was not completely airtight. Explain how this caused the incorrect value. **[2]**

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c) Another student repeated the experiment with airtight apparatus but did not allow the apparatus to cool before measuring the volume of air at the end of the experiment. Explain the effect that this would have on the calculated percentage of oxygen in the air. **[3]**

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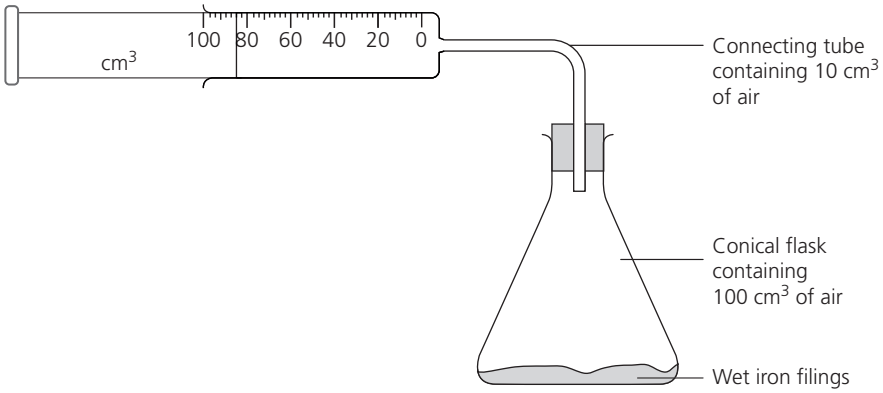
2 A student set up an experiment to calculate the percentage by volume of oxygen in the air by reacting it with iron powder. The apparatus used is shown in the diagram. The table shows the results of the investigation.



Syringe reading at start in cm³	82
Syringe reading at end in cm³	43

a) Calculate the percentage of oxygen in the air using these results. **[3]**

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Percentage of oxygen in the air: ..... %

b) Another student used the same mass of iron, but instead of using powdered iron they used iron nails. Suggest why their measured volume of oxygen in the air was lower than the result obtained when using powder. **[2]**

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c) State the effect of leaving the apparatus shown in the diagram above in a warm place for a week.

i) Effect on the volume of oxygen in the air **[1]**

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ii) Effect on the rate of reaction **[1]**

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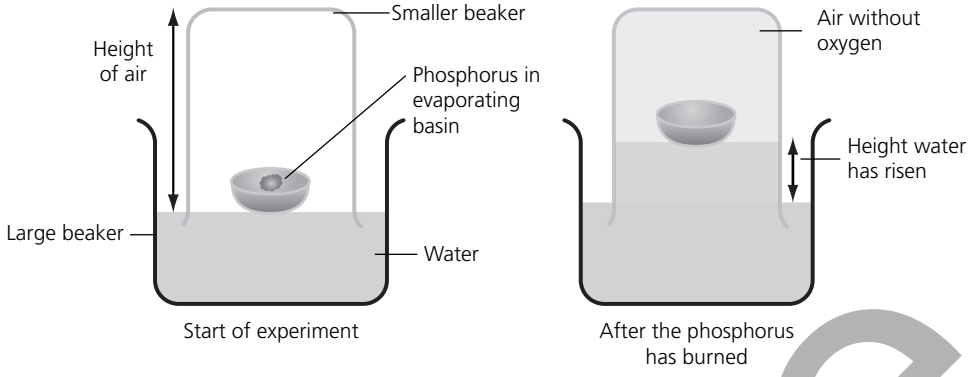
[Total = ... / 17 marks]

Further application

1 A teacher used the reaction of the non-metal phosphorus with air to calculate the percentage by volume of oxygen in air. The diagram shows the apparatus used.



The method used is as follows:

- The large beaker is half filled with water.
- An evaporating basin is floated on the water in the beaker.
- A small piece of phosphorus is placed in the evaporating basin. If it does not ignite spontaneously, it is lit using a burning splint.
- The smaller beaker is immediately put over the top of the evaporating basin.
- At the end of the experiment, the height of the air in the beaker is measured.
- It is assumed when using this method that the height of the air in the beaker at the beginning of the reaction was the same as the height of the beaker.

a) Write a balanced symbol equation, including state symbols, to show the reaction of phosphorus (P_4) with oxygen to form phosphorus oxide (P_2O_5). **[2]**

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b) The height of the smaller beaker was 12.5 cm. At the end of the experiment, the height of the air remaining in the beaker was 10.3 cm. Calculate the percentage by volume of oxygen in the air using these results. Give your answer to 2 significant figures. **[3]**

Percentage of oxygen in the air: ..... %

c) Another teacher repeated the demonstration but used a large conical flask instead of a beaker to put over the top of the evaporating basin containing the burning phosphorus. Explain why this would not allow for an accurate value for the percentage of oxygen in the air to be obtained. **[2]**

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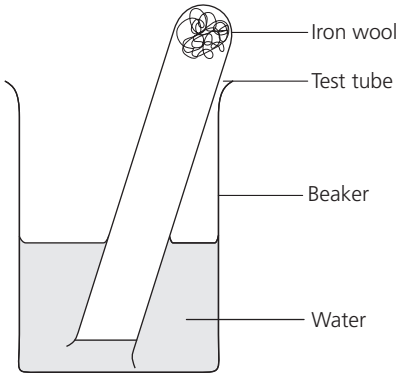
2 A group of students completed an investigation to determine the percentage of oxygen in the air, using iron wool in the method shown in the diagram.



Different students within the class used different masses of iron wool. Their results are shown in the table.

Mass of iron wool used in g	Height of air in test tube at start in mm	Height of air in test tube at end in mm	Decrease in air height in mm	% of oxygen in air
0.1	86	79	7	8.1
0.4	78	60	18	23.1
0.5	72	57		
0.2	91	80		
0.7	96	75	21	21.9
0.6	90	72	18	20.0

a) Complete the table with the missing values. **[4]**

b) Calculate the mean value for the percentage of oxygen in the air, ignoring any anomalous results. **[3]**

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c) Suggest a reason for the anomalous results. **[3]**

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[Total = ... / 17 marks]