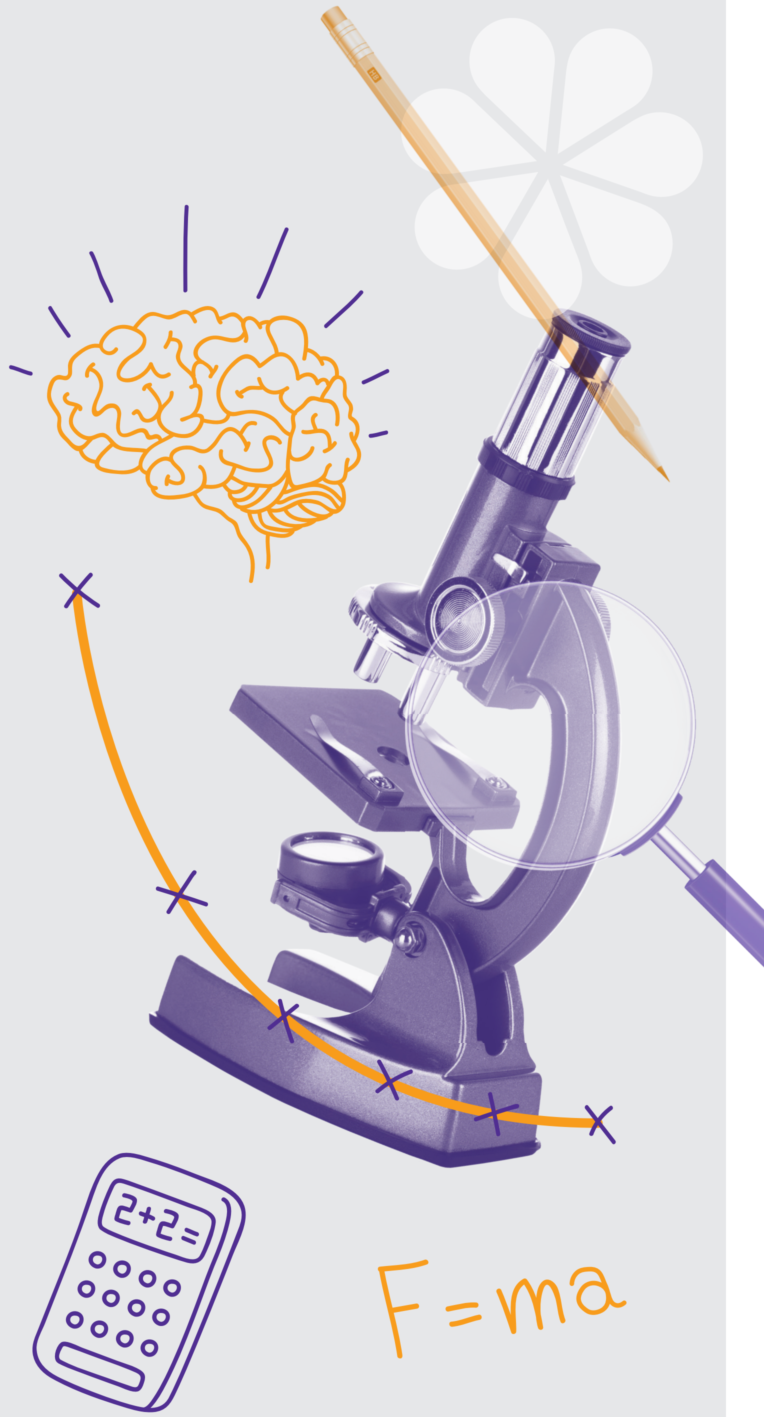
AQA
Realising potential

# Focus on success: GCSE science

## AO2

Build on your students' assessment performance using our self-guided, modular training pack




Activities booklet

# Contents

# Activity 1a

## Quiz

### Question 1
What does AO2 assess in general?

### Question 2
What percentage of marks are assigned to AO2?

### Question 3
Which of the following are assessed as AO2?
- graphs
- applying formulas
- writing a conclusion
- using Punnett squares
- stating the word equation for combustion
- using the particle model to explain changes in state
- identifying errors in a practical

# Activity 1b

## Understanding the Ofqual guidance

- In pairs, read through the following Ofqual subject level guidance document.
- Highlight or underline the key points that AO2 covers that you think should be considered when planning your lessons or writing a scheme of work.
- Discuss your answers to activities 1a and 1b as a whole group.

| AO2: Apply knowledge and understanding of:<br>▪ scientific ideas<br>▪ scientific enquiry, techniques and procedures. | | | *40%* |
|---|---|---|---|
| **Strands** | **Elements** | **Coverage** | **Interpretations and definitions** |
| **1 – Apply knowledge and understanding of scientific ideas.** | This strand is a single element. | ▪ Full coverage in each set of assessments (but not in every assessment). | ▪ **Scientific ideas** are aspects of the subject content. They include the subject-specific requirements and the requirements for Working Scientifically as set out in the Content Document – for example, theories, models and the use of relevant mathematics.<br>▪ **Scientific enquiry, techniques and procedures** encompasses, but is broader than, knowledge and understanding of the core practical activities. In the context of this assessment objective, it involves applying such knowledge and understanding to a given context.<br>▪ The emphasis in this assessment objective is on Learners applying their knowledge and understanding to provide meaning or explanation – for instance, to connect theory with particular contexts, stimuli or materials. This application should relate principally to:<br>▫ novel situations that are not clearly indicated in the specification;<br>▫ developing further material that is covered in the specification;<br>▫ making links between such types of material, which are not signalled in the specification.<br>▪ Application of knowledge should also involve determining how to make sense of connections and linkages within data, information and detail – although not to the extent of drawing conclusions or making judgements. |
| **2 – Apply knowledge and understanding of scientific enquiry, techniques and procedures.** | This strand is a single element. | | |

# 2 Working scientifically

Science is a set of ideas about the material world. We have included all the parts of what good science is at GCSE level: whether it be investigating, observing, experimenting or testing out ideas and thinking about them. The way scientific ideas flow through the specification will support you in building a deep understanding of science with your students. We know this will involve talking about, reading and writing about science plus the actual doing, as well as representing science in its many forms both mathematically and visually through models.

This specification encourages the development of knowledge and understanding in science through opportunities for working scientifically. Working scientifically is the sum of all the activities that scientists do. We feel it is so important that we have woven it throughout our specification and written papers.

Our schemes of work will take this further for you and signpost a range of ways to navigate through this qualification so your students are engaged and enthused. These free resources support the use of mathematics as a tool for thinking through the use of mathematical language in explanations, applications and evaluations.

The tables below show examples of the ways working scientifically could be assessed.

## 1 Development of scientific thinking

| Students should be able to: | Examples of what students could be asked to do in an exam |
|---|---|
| WS 1.1<br>Understand how scientific methods and theories develop over time. | Give examples to show how scientific methods and theories have changed over time.<br>Explain, with an example, why new data from experiments or observations led to changes in models or theories.<br>Decide whether or not given data supports a particular theory. |
| WS 1.2<br>Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. | Recognise/draw/interpret diagrams.<br>Translate from data to a representation with a model.<br>Use models in explanations, or match features of a model to the data from experiments or observations that the model describes or explains.<br>Make predictions or calculate quantities based on the model or show its limitations.<br>Give examples of ways in which a model can be tested by observation or experiment. |
| WS 1.3<br>Appreciate the power and limitations of science and consider any ethical issues which may arise. | Explain why data is needed to answer scientific questions, and why it may be uncertain, incomplete or not available.<br>Outline a simple ethical argument about the rights and wrongs of a new technology. |
| WS 1.4<br>Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. | Describe and explain specified examples of the technological applications of science.<br>Describe and evaluate, with the help of data, methods that can be used to tackle problems caused by human impacts on the environment. |
| WS 1.5<br>Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. | Give examples to show that there are hazards associated with science-based technologies which have to be considered alongside the benefits.<br>Suggest reasons why the perception of risk is often very different from the measured risk (eg voluntary vs imposed risks, familiar vs unfamiliar risks, visible vs invisible hazards). |
| WS 1.6<br>Recognise the importance of peer review of results and of communicating results to a range of audiences. | Explain that the process of peer review helps to detect false claims and to establish a consensus about which claims should be regarded as valid.<br>Explain that reports of scientific developments in the popular media are not subject to peer review and may be oversimplified, inaccurate or biased. |

## 2 Experimental skills and strategies

| Students should be able to: | Examples of what students could be asked to do in an exam |
|---|---|
| WS 2.1<br>Use scientific theories and explanations to develop hypotheses. | Suggest a hypothesis to explain given observations or data. |
| WS 2.2<br>Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. | Describe a practical procedure for a specified purpose.<br>Explain why a given practical procedure is well designed for its specified purpose.<br>Explain the need to manipulate and control variables.<br>Identify in a given context:<br>• the independent variable as the one that is changed or selected by the investigator<br>• the dependent variable that is measured for each change in the independent variable<br>• control variables and be able to explain why they are kept the same.<br>Apply understanding of apparatus and techniques to suggest a procedure for a specified purpose. |
| WS 2.3<br>Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. | Describe/suggest/select the technique, instrument, apparatus or material that should be used for a particular purpose, and explain why. |
| WS 2.4<br>Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. | Identify the main hazards in specified practical contexts.<br>Suggest methods of reducing the risk of harm in practical contexts. |
| WS 2.5<br>Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. | Suggest and describe an appropriate sampling technique in a given context. |
| WS 2.6<br>Make and record observations and measurements using a range of apparatus and methods. | Read measurements off a scale in a practical context and record appropriately. |
| WS 2.7<br>Evaluate methods and suggest possible improvements and further investigations. | Assess whether sufficient, precise measurements have been taken in an experiment.<br>Evaluate methods with a view to determining whether or not they are valid. |

## 3 Analysis and evaluation

Apply the cycle of collecting, presenting and analysing data, including:

| Students should be able to: | Examples of what students could be asked to do in an exam |
|---|---|
| WS 3.1<br>Presenting observations and other data using appropriate methods. | Construct and interpret frequency tables and diagrams, bar charts and histograms.<br>Plot two variables from experimental or other data. |
| WS 3.2<br>Translating data from one form to another. | Translate data between graphical and numeric form. |
| WS 3.3<br>Carrying out and represent mathematical and statistical analysis. | For example:<br>• use an appropriate number of significant figures<br>• find the arithmetic mean and range of a set of data<br>• construct and interpret frequency tables and diagrams, bar charts and histograms<br>• make order of magnitude calculations<br>• change the subject of an equation<br>• substitute numerical values into algebraic equations using appropriate units for physical quantities<br>• determine the slope and intercept of a linear graph<br>• draw and use the slope of a tangent to a curve as a measure of rate of change<br>• understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate. |
| WS 3.4<br>Representing distributions of results and make estimations of uncertainty. | Apply the idea that whenever a measurement is made, there is always some uncertainty about the result obtained.<br>Use the range of a set of measurements about the mean as a measure of uncertainty. |
| WS 3.5<br>Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. | Use data to make predictions.<br>Recognise or describe patterns and trends in data presented in a variety of tabular, graphical and other forms.<br>Draw conclusions from given observations. |
| WS 3.6<br>Presenting reasoned explanations including relating data to hypotheses. | Comment on the extent to which data is consistent with a given hypothesis.<br>Identify which of two or more hypotheses provides a better explanation of data in a given context. |

| Students should be able to: | Examples of what students could be asked to do in an exam |
|---|---|
| WS 3.7<br>Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. | Apply the following ideas to evaluate data to suggest improvements to procedures and techniques.<br>• An accurate measurement is one that is close to the true value.<br>• Measurements are precise if they cluster closely.<br>• Measurements are repeatable when repetition, under the same conditions by the same investigator, gives similar results.<br>• Measurements are reproducible if similar results are obtained by different investigators with different equipment.<br>• Measurements are affected by random error due to results varying in unpredictable ways; these errors can be reduced by making more measurements and reporting a mean value.<br>• Systematic error is due to measurement results differing from the true value by a consistent amount each time.<br>• Any anomalous values should be examined to try to identify the cause and, if a product of a poor measurement, ignored. |
| WS 3.8<br>Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms. | Present coherent and logically structured responses, using the ideas in 2 Experimental skills and strategies and 3 Analysis and evaluation, applied to the required practicals, and other practical investigations given appropriate information. |

# 4 Scientific vocabulary, quantities, units, symbols and nomenclature

| Students should be able to: | Examples of what students could be asked to do in an exam |
|---|---|
| WS 4.1<br>Use scientific vocabulary, terminology and definitions.<br><br>WS 4.2<br>Recognise the importance of scientific quantities and understand how they are determined.<br><br>WS 4.3<br>Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.<br><br>WS 4.4<br>Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano).<br><br>WS 4.5<br>Interconvert units.<br><br>WS 4.6<br>Use an appropriate number of significant figures in calculation. | The knowledge and skills in this section apply across the specification, including the required practicals. |

# Key assessment points of AO2

Apply knowledge and understanding of scientific ideas to **both** specific content and **working scientifically** requirements 1–3.

Apply knowledge and understanding of scientific enquiry, techniques and procedures.

Includes, but is **broader** than, the Required Practicals.

Apply knowledge and understanding to explain **novel** or **unfamiliar** situations not stated on the specification.

**AO2**

Develop further material covered in the specification.

**Both** strands 1 and 2 are covered in the assessment.

Make **links** between material on the specification.

# Activity 2

## Identifying AOs on exam items

- In small groups look at the questions below.
- For each item, note down which AO it is addressing (AO1, 2 or 3).
- If the item is addressing AO2, identify which strand (2.1 or 2.2).
- Identify what part of the specification it is covering (detailed spec reference not required).
- As a whole group, share what you decided for each item.

## Biology Paper 1F, Q4, 2019

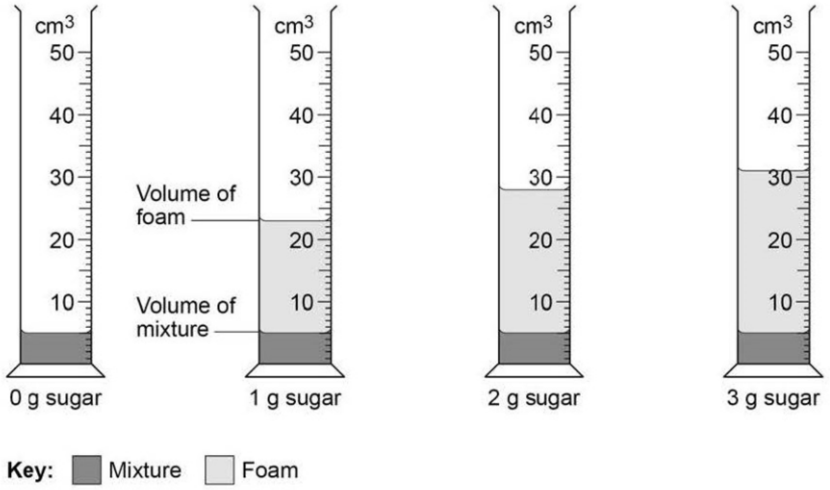
**0 4** A student investigated respiration in yeast.

This is the method used.

1. Add 5 $cm^3$ of a yeast and water mixture to each measuring cylinder.
2. Add different masses of sugar to each measuring cylinder.
3. Mix the contents of each measuring cylinder gently for 5 seconds.
4. Put the measuring cylinders in a water bath at 25 °C
5. Over the next 20 minutes, record the maximum volume the foam reaches in each measuring cylinder.

**Figure 8** shows the student's results.

**Figure 8**




**0 4 . 1** Which **two** variables did the student control in the method?

**[2 marks]**

Tick (✓) **two** boxes.

| | |
|---|---|
| Mass of sugar | ☐ |
| pH of the mixture | ☐ |
| Temperature | ☐ |
| Volume of foam | ☐ |
| Volume of yeast and water | ☐ |

**Table 3** shows the results.

**Table 3**

| Mass of sugar in g | Maximum volume in $cm^3$ |
|---|---|
| 0 | 5 |
| 1 | 23 |
| 2 | **X** |
| 3 | 31 |

**0 4 . 2** What is value **X** in **Table 3**?

Use **Figure 8**.

**[1 mark]**

**X** = ____________________ $cm^3$

In the investigation, the yeast respires and releases a gas which causes the foam to rise.

**0 4 . 3** Which gas causes the foam to rise?

**[1 mark]**

Tick (✓) **one** box.

Carbon dioxide ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

**0 4 . 4** What conclusion can you make about the relationship between the mass of sugar used and the volume of gas produced?

**[1 mark]**

**0 4 . 5** Why was no foam produced in the mixture with 0 g of sugar?

**[1 mark]**

**0 4 . 6** Why was the measuring cylinder with 0 g of sugar included in the investigation?

**[1 mark]**

**0 4 . 7** The top of the mixture can be covered with a layer of oil after step 3 in the method.

Suggest why the layer of oil stops the yeast respiring aerobically.

**[1 mark]**

**0 4 . 8** What other substance is produced during **anaerobic** respiration in yeast?

**[1 mark]**

Tick (✓) **one** box.

Ethanol ☐

Hydrochloric acid ☐

Lactic acid ☐

Water ☐

## Biology Paper 1H, Q7, 2019

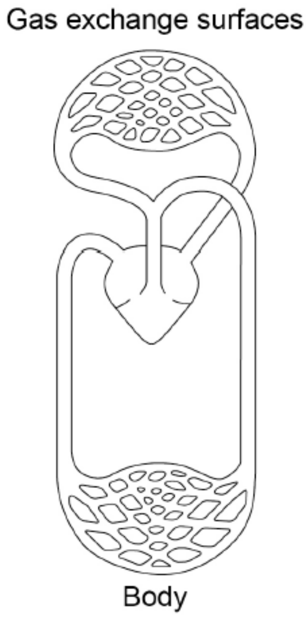
**0 7** A small animal called an axolotl lives in water. The axolotl has a double circulatory system.

**0 7 . 1** Define the term double circulatory system.

**[1 mark]**

**Figure 7** shows the double circulatory system of the axolotl.

**Figure 7**




Source: Vertebrates: Comparative anatomy, function, evolution by K Kardong. Published by McGraw Hill Education

**0 7 . 2** The heart of the axolotl has only one ventricle.

Label the ventricle on **Figure 7**.

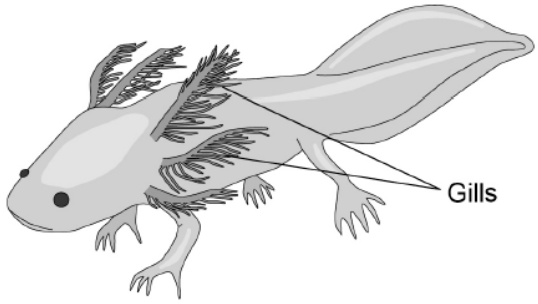
**[1 mark]**

**0 7 . 3** Explain why having only one ventricle makes the circulatory system less efficient than having two ventricles.

**[2 marks]**

**Figure 8** shows an axolotl.

**Figure 8**




**0 7 . 4** Explain why an axolotl may die in water with a low concentration of oxygen.

**[4 marks]**

If a gill of an axolotl is removed, a new gill will grow in its place.

Scientists hope to use information on how axolotls grow new gills to help with regenerating human tissue.

**0 7 . 5** Name the type of cell that divides when a new gill grows.

**[1 mark]**

**0 7 . 6** Name **one** condition that could be treated using regenerated human tissue.

**[1 mark]**

**0 7 . 7** Suggest **one** reason why an axolotl is a suitable animal for research in the laboratory.

**[1 mark]**

**0 7 . 8** An axolotl may **not** be a suitable animal to study when researching regeneration in human tissue.

Suggest **one** reason why.

**[1 mark]**

## Chemistry Paper 3F (synergy), Q1, 2019

**0 1** A student investigated the rate of the reaction between magnesium and hydrochloric acid.

The reaction produced a gas.

**0 1 . 1** Which gas is produced in the reaction?

**[1 mark]**

Tick (✓) **one** box.

Carbon dioxide ☐

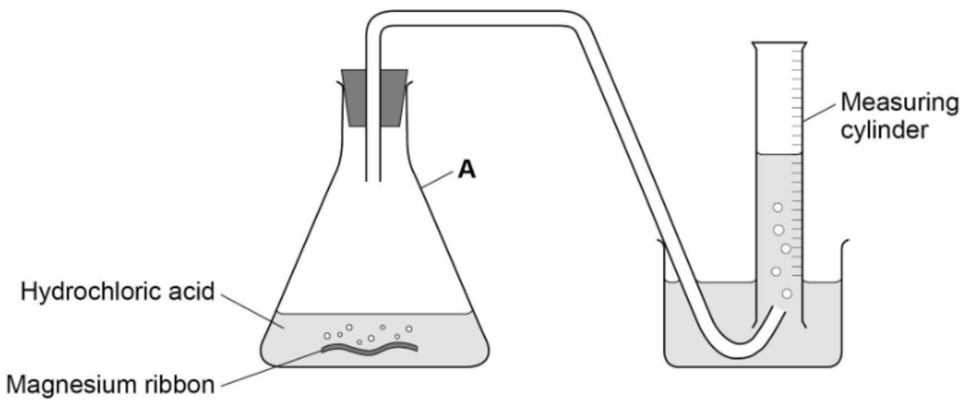
Chlorine ☐

Hydrogen ☐

Oxygen ☐

**0 1 . 2** **Figure 1** shows the apparatus used.

**Figure 1**



What is the piece of equipment labelled **A**?

**[1 mark]**

Tick (✓) **one** box.

Conical flask ☐

Delivery tube ☐

Glass beaker ☐

Test tube ☐

**0 1 . 3** The student saw that a chemical reaction was taking place.

Give **two** observations that would show a chemical reaction was taking place.

**[2 marks]**

**0 1 . 4** At the start of the investigation the volume of gas in the measuring cylinder was zero.

The student measured the volume of gas collected every 20 seconds for 2 minutes.

The readings for the volume of gas were 24 $cm^3$, 44 $cm^3$, 59 $cm^3$, 70 $cm^3$, 76 $cm^3$ and 79 $cm^3$

Complete **Table 1**.

**[3 marks]**

**Table 1**

| **Time in seconds** | |
|---|---|
| 0 | 0 |
| | 24 |
| | 44 |
| | 59 |
| | 70 |
| | 76 |
| | 79 |

**0 1 . 5** How could the student make the reaction faster?

**[1 mark]**

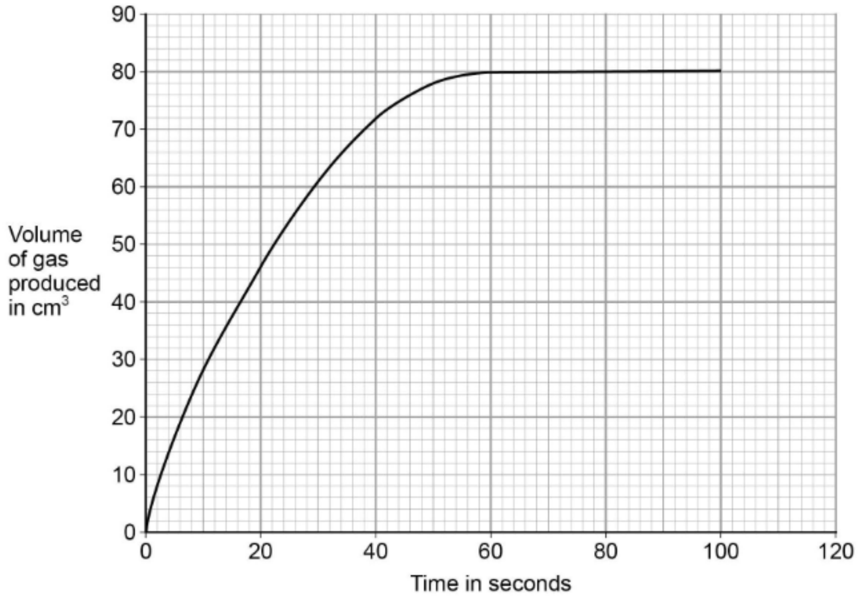
Tick (✓) **one** box.

| | |
|---|---|
| Dilute the hydrochloric acid | ☐ |
| Replace magnesium ribbon with magnesium powder | ☐ |
| Use a larger measuring cylinder | ☐ |
| Use a smaller volume of hydrochloric acid | ☐ |

The student repeated the investigation at a higher temperature.

**Figure 2** shows the results.

**Figure 2**




**0 1 . 6** Determine the mean rate of reaction for the first 10 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas formed}}{\text{time taken}}$$

Give the unit.

Choose the unit from the box.

**[3 marks]**

| | | | |
|---|---|---|---|
| $cm^3$ / s | g / s | s / $cm^3$ | s / g |

Mean rate of reaction = ____________________ Unit ____________________

**0 1 . 7** Determine the time at which the reaction finished and no more gas was produced.

Use **Figure 2**.

**[1 mark]**

Time = ____________________ s

**0 1 . 8** Why does the rate of reaction increase when the temperature is higher?

**[2 marks]**

Tick (✓) **two** boxes.

Concentration of particles increases ☐

Particles collide more often ☐

Particles have more energy ☐

Particles increase in size ☐

Particles move more slowly ☐

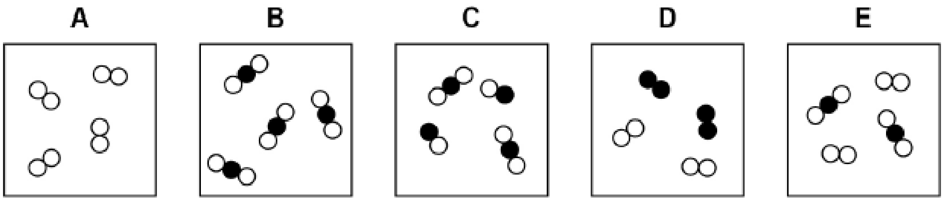
## Chemistry Paper 1F, Q3, 2019

**0 3** This question is about elements, compounds and mixtures.

**Figure 5** shows five different substances, **A**, **B**, **C**, **D** and **E**.

○ and ● represent atoms of different elements.

**Figure 5**




Use **Figure 5** to answer Questions **03.1** to **03.3**

**0 3 . 1** Which substance is only one compound?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**0 3 . 2** Which substance is a mixture of elements?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**0 3 . 3** Which substance is a mixture of an element and a compound?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

Substances are separated from a mixture using different methods.

0 3 . 4 Draw **one** line from each method of separation to the substance and mixture it would separate.

**[2 marks]**

| **Method of separation** | **Substance and mixture** |
|---|---|
| | blue food colour from a mixture of food colours |
| chromatography | |
| | copper from an alloy of copper and zinc |
| | copper sulfate from copper sulfate solution |
| crystallisation | |
| | ethanol from a mixture of ethanol and water |

0 3 . 5 Sand does not dissolve in water. A student separates a mixture of sand and water by filtration.

Draw a diagram of the apparatus the student could use.

You should label:

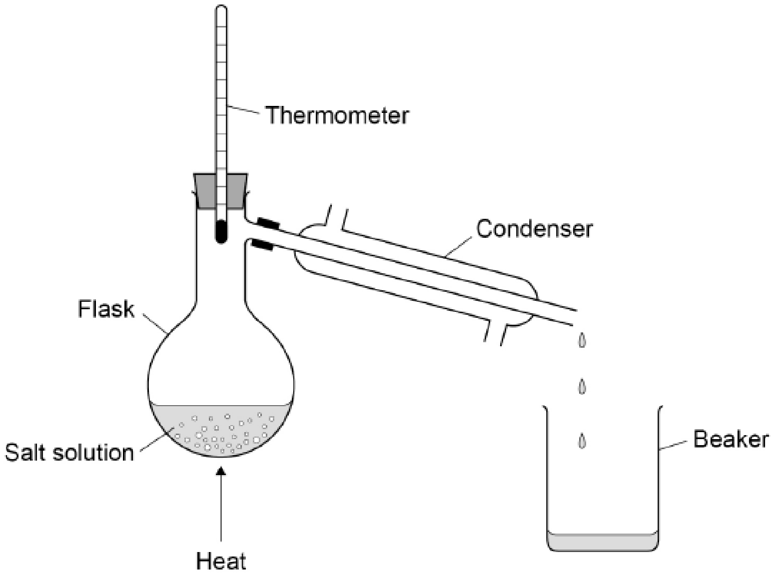
- where the sand is collected
- where the water is collected.

**[3 marks]**

**0 3 . 6** A student distils a sample of salt solution to produce pure water.

**Figure 6** shows the apparatus.

**Figure 6**




What temperature would you expect the thermometer to show?

**[1 mark]**

Tick (✓) **one** box.

| | |
|---|---|
| 0 °C | ☐ |
| 10 °C | ☐ |
| 50 °C | ☐ |
| 100 °C | ☐ |

**0 3 . 7** Describe how the process of distillation shown in **Figure 6** produces pure water from salt solution.

**[4 marks]**

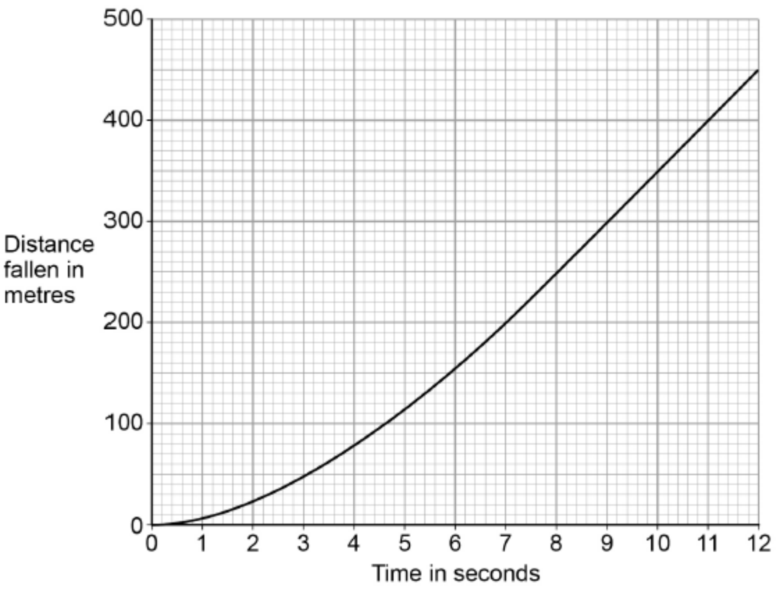
## Physics Paper 2H, Q8, 2019

**0 8** An aeroplane is 4000 m above the Earth's surface.

A skydiver jumps from the aeroplane and falls vertically.

**Figure 15** shows the distance the skydiver falls during the first 12 seconds after jumping.

**Figure 15**

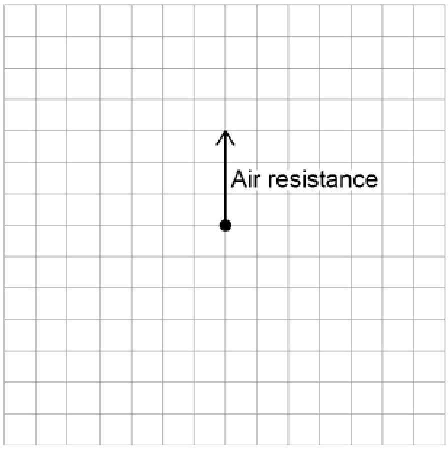



**0 8 . 1** **Figure 16** shows part of the free body diagram for the skydiver three seconds after jumping.

Complete the free body diagram for the skydiver.

**[2 marks]**

**Figure 16**



**0 8 . 2** Explain the changing motion of the skydiver in terms of the forces acting on the skydiver.

**[4 marks]**

**0 8 . 3** Use **Figure 15** to determine the speed of the skydiver between 7 seconds and 12 seconds.

**[3 marks]**

**0 8 . 4** In 2012 a skydiver jumped from a helium balloon 39 000 metres above the Earth's surface. The skydiver reached a maximum speed of 377 m/s

Jumping from 39 000 metres allowed the skydiver to reach a much higher speed than a skydiver jumping from 4000 metres.

Explain why.

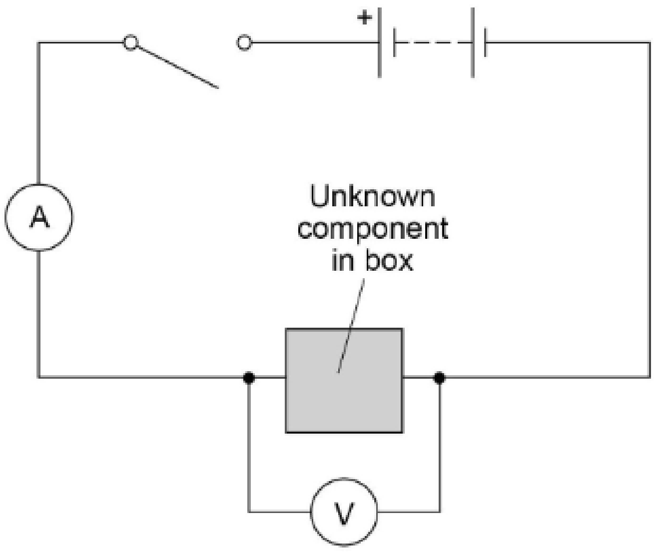
**[3 marks]**

## Physics Paper 4H (synergy), Q4, 2019

**0 4** A teacher gave a student an unknown electrical component hidden in a box.

The student connected the box in the circuit shown in **Figure 4**.

**Figure 4**




**0 4 . 1** The student measured the potential difference across the component and the current in the component.

She repeated this for several values of potential difference.

Give **one** way the circuit could be altered so that the potential difference across the component could be varied.

**[1 mark]**

**0 4 . 2** Explain why the student needed to switch the circuit off between readings.

**[2 marks]**

**Table 2** shows the student's results.

**Table 2**

| Potential difference in volts | Current in amps |
|---|---|
| 0.00 | 0.00 |
| 0.20 | 0.00 |
| 0.40 | 0.00 |
| 0.60 | 0.13 |
| 0.80 | 0.68 |
| 1.00 | 1.50 |

**0 4 . 3** What was the resolution of the ammeter?

**[1 mark]**

Tick (✓) **one** box.

0.01 A ☐

0.05 A ☐

0.10 A ☐

1.50 A ☐

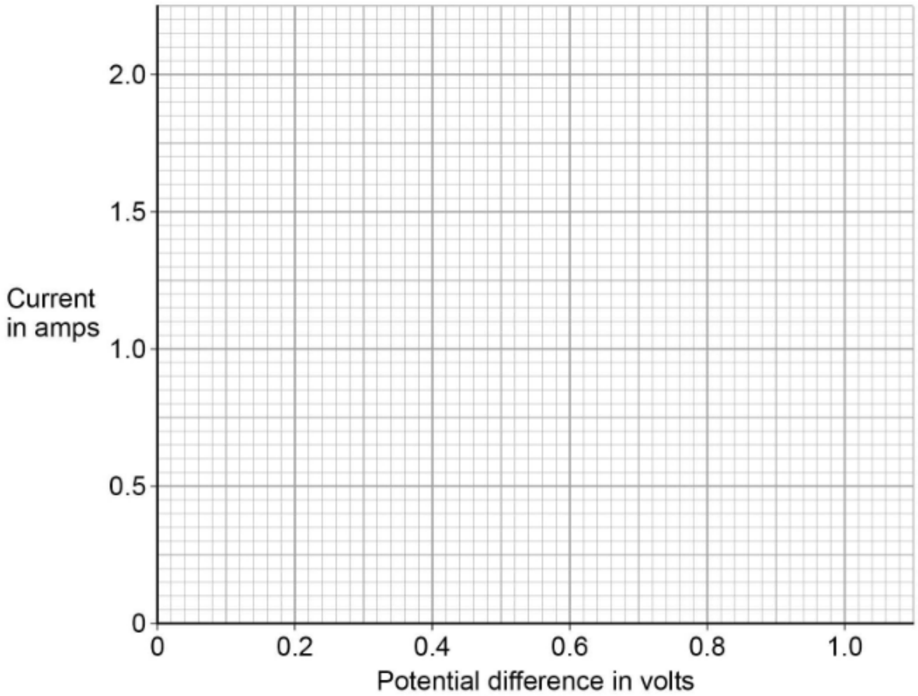
**0 4 . 4** Complete **Figure 5**.

You should:

- plot the data from **Table 2**
- draw a line of best fit.

**[3 marks]**

**Figure 5**




**0 4 . 5** What was the unknown electrical component given to the student?

**[1 mark]**

Tick (✓) **one** box.

Diode ☐

Filament lamp ☐

Resistor ☐

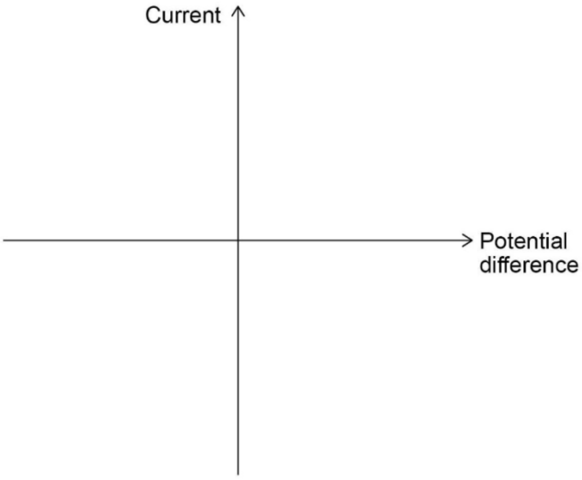
Thermistor ☐

**0 4 . 6** An ohmic conductor has constant resistance when its temperature is constant.

Sketch a current-potential difference graph for an ohmic conductor at constant temperature on **Figure 6**.

**[2 marks]**

**Figure 6**



# Activity 3

## Adding unfamiliar context into schemes of work

- From your scheme of work choose a topic you feel could benefit from having unfamiliar contexts added.
- In subject groups, look at the lessons in the relevant parts of the schemes of work.
- Add examples for the teacher to use in the lesson where the phenomena/content can be used in an **everyday** context.
- Come together as a whole group and discuss your suggestions.

**Remember**, not all lessons or topics will lend themselves to being set in a different context.

A column has been added to the following amended schemes of work to show some examples of how some unfamiliar context could be used in the lessons.

## 4.3 Infection and response

### 4.3.1 Communicable diseases

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
|---|---|---|---|---|---|
| 4.3.1.1 | Communicable (infectious) diseases | Students should be able to explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants.<br><br>Pathogens are microorganisms that cause infectious disease. Pathogens may be viruses, bacteria, protists or fungi. They may infect plants or animals and can be spread by direct contact, by water or by air.<br><br>Bacteria and viruses may reproduce rapidly inside the body. | Define pathogen.<br><br>Describe the different kinds of pathogen and give examples of the diseases they cause. | Use plasticine and pipe cleaners to make models of a bacteria, virus, protist and fungus.<br><br>Set up agar plates to investigate the action of hand sanitiser and antiseptic on the growth of microorganisms found around the lab. These will be used in lesson 4.3.1.3 Bacterial diseases below. | Practical – Working Scientifically – discuss why scientists use models.<br>Why models are only a best fit.<br>What the merits and limitations of their models.<br><br>Context of companies like Reckitt Benckiser Group who produce Dettol and might want to do research into how effective it is killing bacteria to use in a marketing campaign. |
| 4.3.1.1 | Preventing the spread of disease | The spread of diseases can be reduced or prevented by:<br>• simple hygiene measures<br>• destroying vectors | Describe the ways that disease can be transmitted.<br><br>Describe the methods that infections can be prevented. | Students can model the transmission of disease through direct contact (quietly put glitter on two students' hands at the start of the lesson) – by the end | Modelling – Comparative judgement how effective is the glitter model compared to who disease are spread? |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | | • isolation of infected individuals<br>• vaccination. | | of the lesson anyone with glitter on them is infected.<br><br>Model airborne disease by using a bubble maker – anyone touched by a bubble over the course of the lesson has been infected. | Use the context of the 2009 pandemic of swine flu or the Ebola virus. |
| 4.3.1.2 | Viral diseases | Viruses live and reproduce inside cells, causing cell damage.<br><br>Symptoms, complications and cures/prevention of measles, HIV, tobacco mosaic virus (TMV). | Draw a flow diagram to illustrate how viruses reproduce inside cells.<br><br>Describe the symptoms, complications and cures/ prevention of measles, HIV, tobacco mosaic virus. | Students can compare the relative sizes of viruses and bacteria by looking at scale diagrams. | Recent rise in people not getting their children vaccinated against measles – good for complications. Good data from Public Health England on how vaccination figures have changed recently.<br>**This is a sensitive issue as you may have students who have not been vaccinated for valid reasons.** |
| 4.3.1.3 | Bacterial diseases | Bacteria may produce poisons (toxins) that damage tissues and make us feel ill.<br><br>Symptoms, complications | Draw a flow diagram to illustrate how bacteria reproduce to cause disease. Ask students to compare bacterial and viral diseases | Examine the bacteria growth on agar plate set up in previous lesson (4.3.1.1 – Communicable (infectious) diseases). | Start the lesson with one of the many news stories about Salmonella in eggs or chickens poisoning people. Discuss what is making |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | | and cures/prevention of Salmonella and Gonorrhoea. | and their effects on cells in the body.<br><br>Describe the symptoms, complications and cures/ prevention of Salmonella and Gonorrhoea. | | them feel ill in terms of toxins and the damage to tissues. |
| 4.3.1.4 | Fungal diseases | Symptoms, complications and cures/prevention of rose black spot. | Describe the symptoms, complications and cures/ prevention of rose black spot. | Examine yeast budding under the light microscope.<br><br>Examine bread mould using a hand lens. | |

## 5.8 Chemical analysis
### 5.8.1 Purity, formulations and chromatography

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop scientific communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| 5.8.1.1 | In chemistry, a pure substance is a single element or compound, not mixed with any other substance.<br><br>Pure elements and compounds melt and boil at specific temperatures. Melting point and boiling point data can be used to distinguish pure substances from mixtures.<br><br>In everyday language, a pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, eg pure milk. | Be able to use melting point data to distinguish pure from impure substances.<br><br>WS 2.2, 4.1 | Define the terms<br>• pure substance<br>• compound.<br><br>Recall melting and boiling points especially substances that include negative values<br><br>Identify the contents of mineral waters sold as pure water.<br><br>Draw diagrams to illustrate pure distilled water with bottled water. | Students investigate the difference in boiling points of two unknown samples of water (brine and distilled) to determine which one is not pure water.<br><br>Recap the test for pure water. | Identify controls when doing a comparison<br><br>Context of public health/ water boards wanting to check the safety of the drinking water in an area which has been contaminated. |
| 5.8.1.2 | A formulation is a mixture that has been designed as | Identify formulations given appropriate | Define the terms:<br>• mixture | Making soap: [Nuffield Foundation - Making]() | Consider the formulation of different garden |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop scientific communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | a useful product. Many products are complex mixtures in which each chemical has a particular purpose.<br><br>Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties. Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods. | information.<br><br>Students do **not** need to know the names of components in proprietary products.<br><br>WS 1.4, 2.2 | • formulation.<br><br>Carry out one or more of the applied chemistry experiments.<br><br>Produce a display that describes the composition of the one of the following formulations:<br>• fuel<br>• cleaning agents<br>• paints<br>• medicines<br>• alloys<br>• fertilisers<br>• foods.<br>Identify the purpose of the chemicals in the chosen formulation and share with class. | Soap<br><br>Making glue: Nuffield Foundation - Making a glue<br><br>Making cut flower preservative: RSC - Making a cut flower preservative<br><br>Comparing detergents: RSC - comparing light and heavy duty detergents<br><br>Producing a foam: RSC - producing a foam<br><br>Making milk of Magnesia: RSC - Making milk of magnesia<br><br>Investigating pigments: RSC - Investigating pigments | fertilisers – tomato feed, strawberry feed, lawn feed, etc. Whilst these are all based on an NPK fertiliser formulation, the proportions of each component vary depending upon the need to develop strong leaf growth, encourage flowering or support the development of fruit. The important point to make is that each component is present for a particular reason – and all are required in order for the outcome to be achieved.<br><br>The formulation for different paints – how and why is emulsion paint different from household gloss paint? |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop scientific communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | | | | Making fertiliser: RSC - Making a fertiliser<br><br>Making an alloy: RSC- Making an alloy solder | How does 'low volatile' paint compare to 'high volatile' paint? Why the shift from 'high volatiles' to 'low volatiles'? Is there any difference in the formulation of cheaper discount brand paints and 'trade' paints? If so, why might this be? |

## 6.5 Forces
### 6.5.1 Forces and their interactions

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| 6.5.1.1 | Scalar and vector quantities. | Scalar quantities have magnitude only.<br><br>Vector quantities have magnitude and an associated direction.<br><br>The arrow notation for vectors. | Describe the difference between scalar and vector quantities and give examples.<br><br>Draw vector diagrams for vectors where the size and direction of the arrow represents the size and direction of the vector. | Why is direction important when looking at forces?<br><br>Students could model displacement vectors by sketching a scale drawing for displacement vectors eg 3m East followed by 5m North in the playground. Then back in the classroom get them to draw a scale diagram (ie 1m = 1cm) of this using the arrow notation. | Examples will be given when describing the difference between scalar and vector.<br><br>Emphasise that the examples used in exam questions may be different. |
| 6.5.1.2 | Contact and non-contact forces. | Force is a vector quantity and can be described as contact or non-contact.<br><br>Examples of contact forces include friction, air resistance, tension and normal contact force.<br><br>Examples of non-contact forces are gravitational force, | Gives examples of contact and non-contact forces.<br><br>Describe the effects of forces in terms of changing the shape and/or motion of objects.<br><br>Describe examples of contact forces explaining how the force is produced. | What do forces do to objects?<br><br>How do objects move other objects that are not in contact?<br><br>Investigate contact and non-contact forces. This can include magnets, friction along a surface eg when a shoe is pulled along a surface. You can change the surface to explore how the change affects the amount of force required to move the shoe. | Many of these investigations can be put in a context, eg why do training shoes have different trends for different sports.<br><br>Do different size parachutes fall at the same rate?<br>How are the forces changing as you fall. |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | | electrostatic force and magnetic force. | Describe examples of non-contact forces and state how the force is produced, eg gravitational force caused by two objects with mass exerting an attractive force on each other. | You could also add a lubricant eg water/oil to the surface.<br><br>To illustrate static electricity as a non-contact force pupils could rub a polythene rod with a duster and then use the charged rod to attract small pieces of paper (eg from a hole punch) or bend water. | Why does your hair stick up when some types of material rub against it?<br><br>Link with charges in electricity topic. |
| 6.5.1.3 | Weight and gravitational fields. | Weight is the force acting on an object due to gravity. The force of gravity close to the Earth is due to the gravitational field around the Earth. | Describe and explain what weight is and why objects on Earth have weight.<br>State the units used to measure weight. | How do we measure weight?<br><br>Find the weight of objects within the laboratory using Newtonmeters and then their mass using laboratory balances or for heavier objects bathroom scales. | Why are astronauts said to be weightless even though they are pulled down by gravity.<br>Explain the science behind this. |
| 6.5.1.3 | Calculating the weight of an object.<br><br>Equation for calculating the weight of an object should be known. | The weight of an object can be calculated using the equation:<br><br>weight = mass x gravitational field strength<br><br>$[W = m\,g]$ | Define weight and mass and explain the difference between them.<br><br>Calculate the weight of an object on Earth using $W = mg$. Rearrange this equation to find any unknown quantity. | Would aliens living on a massive planet be smaller than humans on Earth?<br><br>How can a spring be used to find the weight of an object on Earth? | Applying the formula using a constant mass on different planets which have different gravitational field strength. |

| Spec ref | Summary of the specification content | Learning outcomes<br>What most students should be able to do | Opportunities to develop Scientific Communication skills | Opportunities to develop and apply practical and enquiry skills | Possible AO2 context practical and unfamiliar context |
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| | | weight, *W*, in newtons, N<br>mass, *m*, in kilograms, kg<br>gravitational field strength, *g*, in newtons per kilogram, N/kg | Give the correct units of weight and mass.<br><br>Convert quantities into SI units eg grams into Kg | | |

# Activity 4

## Integrating AO2 into practicals

- In groups of specialism, review the following legacy ISA case studies that are relevant to the Required Practicals (RPs).
- Choose one or two of the RPs from the table and add to the case studies section.
- Discuss how the case studies might be used in class/at home to present the RP in an unfamiliar context.
- Add some notes to illustrate to students how this practical might be presented differently in an exam question.
- Share ideas as a whole group.

In the following table we have provided some ideas for themes that teachers could use to put practical work into a novel context, for a number of the Required Practicals. Most of these ideas are based on the case studies from the legacy ISAs, which are referenced in the second and third columns. The legacy ISA materials are available for download from Secure Key Materials on e-AQA if you want to look at them in more detail.

We have also included examples of common experiments that are not Required Practicals but which you might include as part of normal teaching and illustrate what is meant by ‘broader than the RP’ statement in the Ofqual subject criteria document.

In some, we have exemplified how you could use the practical so it allows students to apply the science behind the practical they have done in class, to a different version.

## Biology

| Topic for required practical or common practical | ISA set | ISA title | Brief summary of ISA experiment | Themes and ideas |
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| Osmosis (Required Practical) | B | BU3.2b Solutions | Factors affecting osmosis.<br>Case study using colour intensity as a measure of salt uptake. | Themes that could be used:<br>• concentration of solutions: look at the effect of different concentrations on plant material<br>• different vegetables: use slices of different vegetables such as sweet potato, apple, sugar cane or carrot<br>• surface area: look at the effect of larger or smaller surface area on uptake<br>• different ways of measuring the effect of osmosis: change in mass, shrinking or swelling of cells, using colour intensity of a coloured protein<br>• salt and sugar solutions: look at effect of salt or sugar on plant cells.<br><br>**Ideas for varying the practical**<br>Measure the change in mass of slices or chunks of different vegetables such as potato, sweet potato or carrot in sugar or salt solutions of different concentration.<br><br>When plant cells are put into sucrose solution the cell may swell up or shrink. Look at red onion cells under a microscope in different concentrations of sucrose solution and note the effect. Count 100 cells and record how many have shrunken cell contents for each solution. |

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| | F | BU3.6b Surface area | Effect of surface area on water uptake<br>Case study looking about effect of smoke particles on oxygen uptake. | Using cubes cut into different dimensions to give different surface areas. Place in water and calculate percentage increase in mass of each piece after 10 minutes.<br><br>Use sugar solution instead of water.<br><br>**Theoretical case studies**<br>Scientists put pieces of potato into six different concentrations of salt solution. Each solution contained equal concentrations of a coloured protein that did not affect the concentration. They measured the colour intensity of each solution after four hours, to indicate uptake.<br><br>We can breathe in tiny particles from the air. The tiny particles can make the cells at the surface of the lung produce extra mucus. The extra mucus reduces the amount of oxygen going into the blood. Scientists investigated how smoke particles in the air affect mucus production and the amount of oxygen going into the blood. |
| Enzymes (Required Practical) | G | BU2.7 Enzymes | Factors affecting an enzyme controlled reaction. | Themes that could be used:<br>• effect of temperature: for example carry out reaction at a range of different temperatures<br>• effect of pH: carry out a reaction at a range of different pH values<br>• different ways of measuring rate of reaction: volume of gas produced, length of a piece of solid egg white, disappearance of a stain on cloth<br>• different reagents: hydrogen peroxide and catalase; egg white and protease; effect of biological and non-biological detergents on biological stains |

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| | | | | **Ideas for varying the practical**<br>Rate of reactions producing a gas can be measured by number of bubbles or by the volume in mm3 produced per unit time (eg per minute).<br><br>Study the number of bubbles (or volume in mm3) produced in the reaction between catalase and hydrogen peroxide at constant pH and temperatures in 5° C or 10° C increments.<br>Study the digestion of egg white by a protease enzyme at different pH values or different temperatures. Fill narrow tubes with fresh egg white, boil the tubes so the egg white becomes solid, place each tube into a different beaker containing protease at a different pH (or different temperature) and measure the length of solid egg white in each tube after 24 hours.<br><br>Investigate the action of different detergents (biological and non-biological) in removing blood stains, at different temperatures by estimating the percentage of blood stain remaining on the cloth. |
| Photosynthesis (Required Practical) | B | BU2.2 Photosynthesis | Effect of light intensity on photosynthesis Case study looking at effect of $CO_2$ concentration. | Themes that could be used:<br>• different methods of measuring the effect: number of bubbles or volume of oxygen produced, percentage of oxygen in the air, using bacteria sensitive to oxygen to indicate where oxygen is being given off<br>• different methods of varying light intensity: distance of light source from organism, different brightness of bulb. |

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| | F | BU2.6 Factors affecting photosynthesis | Effect of different wavelengths on rate of photosynthesis<br>Case study using pure chlorophyll. | **Ideas for varying the practical**<br>Could do further studies on factors affecting rate of photosynthesis, eg investigate the effect of changing the temperature on photosynthesis by a piece of pondweed. Investigate the effect of different wavelengths of light on the rate of photosynthesis, using filters of different colours on the light source.<br><br>**Theoretical case studies**<br>A farmer investigated the effect of using an electric heater and a paraffin-burning heater (gives off $CO_2$ ) on growth of tomato plants.<br><br>Using just a sample of pure chlorophyll from pondweed scientists measured the percentage of light absorbed at different wavelengths by the chlorophyll sample and investigated the rate of photosynthesis in pondweed at the same wavelengths. |
| Field investigations (Required Practical) | | | | Themes that could be used:<br>• sampling using different size quadrats other than standard $1m^2$<br>• line transects across different habitats, eg coastal transect, wetland plants, vertical tree transect<br>• different types of quadrat, eg square quadrat, point quadrat. |
| Transpiration flow (common practical) | | | Measuring transpiration rates. | Themes that could be used:<br>• why do plants wilt?<br>• how changing the humidity or temperature or air flow around the plant affects the rate of transpiration (using a potometer if available). |

## Chemistry

| Topic for required practical or common practical | ISA set | ISA title | Brief summary of ISA experiment | Themes and ideas |
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| Making salts (Required Practical) | | | | Themes that could be used:<br>• neutralisation reactions using different named acids and bases, alkali or metal carbonates<br>• use the context of making a fertiliser to prepare a particular salt. |
| Temperature changes (Required Practical) | B | CU2.2 Self-heating cans | Factors affecting temperature change in the reaction between calcium oxide and water.<br><br>Using the reaction to heat different foods. | Themes that could be used:<br>• different reactants: look at reactions using different solids and liquids, such as calcium oxide and water, ammonium nitrate and water, different metal powders and copper chloride or copper sulfate solutions<br>• mass of solid reactant: look at the effect using different masses of solid in the same volume of liquid<br>• volume of liquid reactant: look at the effect of using same mass of solid in different volumes of liquid.<br><br>**Ideas for varying the practical**<br>Investigate the temperature rise when different masses of calcium oxide are added to the same volume of water. |
| | C | CU3.3a Sports injury packs | Factors affecting temperature changes in reaction between ammonium nitrate and water.<br><br>Context of sports injury packs. | |

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| | E | CU1.5 Reactivity of metals | Temperature changes in reactions of different metals with copper chloride and copper sulfate solutions.<br><br>Good to identify the different types of variables. | Investigate the temperature rise when 10g of calcium oxide is dissolved in different volumes of water.<br><br>Use the reaction when 15g of calcium oxide is added to 50 $cm^3$ of water to heat 400g of different foodstuffs.<br><br>Investigate the temperature decrease when different masses of ammonium nitrate are added to 50 $cm^3$ of water.<br><br>Investigate the temperature decrease when 10g of ammonium nitrate is dissolved in different volumes of water.<br><br>Using 8g of ammonium nitrate and 100 $cm^3$ of water in a plastic beaker, record the temperature every 3 minutes to see how cold the mixture stays over 15 minutes.<br><br>Investigate the temperature rise when different masses of magnesium ribbon are reacted with the same volume and concentration of copper chloride solution.<br><br>Investigate the temperature rise when 0.5g of different metal powders (lead, nickel, iron, zinc, magnesium) are reacted with the same volume and concentration of copper chloride solution.<br><br>Investigate the temperature rise when 0.5g of magnesium powder reacts with copper chloride solution of different concentrations.<br><br>Investigate the temperature rise when increasing masses of iron, magnesium and zinc powders are reacted with the same volume and concentration of copper sulfate solution.<br><br>**Theoretical case study**<br><br>Context of a medical supplier designing a cool pack for use on an injured arm. This pack is used as a sleeve over the injured |

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| | | | | arm to keep it cool. The pack is filled with water and contains a plastic bag of ammonium nitrate which can be broken.<br><br>The pack was tested using temperature sensors on different parts of the arm. A subject, who was lying down, wore the pack on their arm. The bag of ammonium nitrate was broken.<br><br>The decrease in the temperature at each sensor was recorded every 2 minutes for 10 minutes.<br><br>The mean temperature decrease was also calculated. |
| Rates of reaction (Required Practical) | F | CU2.6 Rates of reaction | Factors affecting rate of chemical reactions.<br><br>A context of slime: concentration of PVA reacting with borax on setting time. | Themes that could be used:<br>• different reactants: look at reactions between zinc and nitric acid, or sodium thiosulfate and hydrochloric acid, or between calcium carbonate and hydrochloric acid<br>• different measures of rate of reaction: time for reaction to stop fizzing, for metal strip to completely disappear, for cross on a piece of paper to disappear, time for a certain volume of gas to be produced, or height of bounce of a ball of PVA 'slime'.<br><br>**Ideas for varying the practical**<br>Investigate the effect that changing the concentration of nitric acid has on the time it takes for a 1 cm zinc strip to completely react.<br><br>Investigate how changing the concentration of sodium thiosulfate would affect the time it takes for the cross to completely disappear in a reaction with hydrochloric acid.<br><br>A further experiment could be to investigate how changing the temperature of the solution affects the results at each concentration. |

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| | | | | Investigate the effect of temperature on the rate of a reaction between tablets of calcium carbonate with hydrochloric acid.<br><br>Measure the time taken for 100 $cm^3$ of carbon dioxide gas to be produced at different temperatures.<br><br>Make 'slime' by reacting different concentrations of dilute PVA adhesive with borax solution. A ball of slime bounces when dropped on a hard surface. Measure the height of the bounce of the slime for different concentrations of PVA. |
| Chromatography (Required Practical) | | | | Themes that could be used:<br>• identifying unknown dyes in inks, colours in paints , food testing (2013 horsemeat scandal)<br>• industrial processes to purify chemicals, test for trace amounts of substances<br>• use the context of creating vaccinations, forensic testing. |
| Electrolysis (Required Practical) | C | CU2.3 Electrolysis | Factors affecting mass of metal deposited on the negative electrode | Themes that could be used:<br>• effect of time: mass of metal deposited at different times during electrolysis<br>• effect of concentration of electrolysis solution: how concentration affects the mass of metal deposited<br>• effect of current: how increasing the current affects the mass of metal deposited.<br><br>**Ideas for varying the practical**<br>Electroplate a steel teaspoon with silver and measure the increase in the mass of the teaspoon over a period of time.<br><br>Measure the increase in mass caused by nickel deposition on a steel negative electrode in 10 minutes using different concentrations of nickel sulfate solution. |

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| | | | | Measure the increase in mass due to chromium deposition on an electrode using different currents in a 2 moles per dm3 solution of chromium sulfate. |
| Neutralisation (Required Practical) | C | CU3.3b Titrations | Acid-alkali neutralisations using different acids and hydroxides.<br><br>Case study of a farmer carrying out a soil test. | Themes that could be used:<br>• different reactants: look at neutralisation reactions using alkalis such as potassium hydroxide, sodium hydroxide or ammonium hydroxide with acids such as hydrochloric or nitric acid<br>• concentration of reactants: look at neutralisation using different concentrations of alkali with same concentration of acid, or different concentrations of acid with same concentration of alkali<br>• volumes of reactants: look at neutralisations using same concentrations of acid and alkali but different volumes of alkali.<br><br>**Ideas for varying the practical**<br>Investigate the volume of 0.1 mol/dm$^3$ hydrochloric acid needed to neutralise a volume of potassium hydroxide of different concentrations.<br><br>Neutralise different concentrations of potassium hydroxide solution with nitric acid. Record the pH as different volumes of acid are added to see change in pH.<br><br>Investigate the volume of 0.2 mol/dm$^3$ nitric acid needed to neutralise different concentrations of sodium hydroxide solution.<br><br>Investigate the volume of (1) sulfuric acid needed to neutralise different volumes of ammonium hydroxide or (2) hydrochloric acid to neutralise different volumes of sodium hydroxide. Both acid and alkali are of the same concentration in each |
| | E | CU3.5a Neutralisation | Acid-alkali neutralisations using different acids and hydroxides.<br><br>Case study on the effect of drinking cola on indigestion. | |

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| | | | | experiment.<br><br>**Theoretical case studies**<br>A farmer used a testing kit to find out which of his fields needed to be treated to make them alkaline so that he can grow cabbages. He uses the results of titration of solutions made from the soil samples to work out the mass of calcium hydroxide he needs to add to each field to make it the best alkaline condition for the cabbages.<br><br>A group of students investigated whether drinking cola causes indigestion. Cola drinks contain phosphoric acid. This raises the concentration of hydrogen ions in the stomach and can cause indigestion. For the first week, the students drank only 300 $cm^3$ of water with each meal, but drank no cola. For the second week, the students drank only 300 cm3 of cola with each meal but drank no water. They recorded the number of students who had indigestion, and how many times each week they had indigestion. |
| The reactivity series (common practical) | | | | Themes that could be used:<br>Why do plumbers use copper pipes instead of aluminium?<br>Investigate which metal you would recommend a plumber to use for piping out of calcium, aluminium, iron, lead and copper. |

## Physics

| Topic for required practical or common practical | ISA set | Relevant ISA title | Brief summary of ISA experiment | Themes and ideas |
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| I-V characteristics (Required Practical) | C | PU2.3 Resistance | Factors affecting resistance of filament bulbs.<br><br>Case study on product testing of theatre spotlights. | Themes that could be used:<br>• different components: look at the characteristics of a variety of different circuit elements such as filament bulbs, light-emitting diodes, light-dependent resistors, thermistors<br>• effect of changing one characteristic on another: look at how factors such as how resistance varies with current, potential difference, power, temperature of a component.<br><br>Ideas for varying the practical<br>Investigate how resistance varies:<br>• in a filament bulb as the current through the bulb changes<br>• with the potential difference across a filament bulb<br>• using filament bulbs of different power<br>• with the temperature of a thermistor<br>• using different types of thermistor<br>• in a LDR as light intensity is changed (simply by moving the light source or by using different light sources)<br>• in a LDR as the current through it is changed.<br><br>Use the above list as a start for investigating a different factor, for instance how current through a filament bulb changes with resistance. |
| | D | PU2.4 Thermistors | Investigating the effect of temperature on resistance of thermistors.<br><br>Case studies based on product testing of different types of thermistor. | |

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| | E | PU2.5 Light-dependent resistors | Investigating factors affecting resistance of an LDR.<br><br>Case study of a manufacture using a LDR as a light detector. | **Theoretical case studies**<br>Very large filament bulbs are used in theatre spotlights. When the bulb is first switched on there is a high initial current. The current then decreases to its normal value.<br><br>A company tested how the resistance of four different types of thermistor varied with the temperature.<br><br>A manufacturer uses thermistors as thermostats to control the temperature of a room. The manufacturer tested several different types of thermistor to find out which would be the best to use in a house where the room temperature is about 20 °C.<br><br>A manufacturer using a LDR to detect light measured how much light could be detected by two different LDRs, for different wavelengths of light.<br><br>The manufacturer also measured how much light could be detected by the human eye for different wavelengths of light. |
| Force and extension (Required Practical) | B | PU2.2 Stretching | Factors affecting extension of a rubber band.<br><br>Case study of testing strength of bungee ropes. | Themes that could be used:<br>• effect of force on extension of different materials: look at materials such as rubber bands, springs, bungees<br>• look at different configurations and strengths of springs/bands.<br><br>**Ideas for varying the practical**<br>Investigate the extension of a rubber band as weights added to the band are increased.<br><br>Investigate the extension of different thicknesses of rubber band when a weight of 10 N is added.<br><br>Investigate how the extension of a spring varies as different |
| | G | PU2.7 Springs | Factors affecting extension of springs. | |

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|---|---|---|---|---|
| | | | | weights are added.<br><br>Investigate the extension of different springs using the same weight.<br><br>Use springs in different configurations, for example one spring added to the bottom of another or two springs in parallel, and see how the extension varies with weight added.<br><br>**Theoretical case study**<br>A manufacturer of bungee ropes has been testing one of the bungee ropes they manufacture to measure the extension with different forces applied. |
| Light (Required Practical) | E | PU3.5a Refraction | Investigating refraction of light by different materials.<br><br>Case study of a lens manufacturer testing refraction through different types of glass at different wavelengths. | Themes that could be used:<br>• relationship between angle of incidence and angle of refraction<br>• effect of material: look at refraction of light through different materials such as Perspex, acrylic or glass<br>• effect of wavelength: look at how light of different wavelengths is refracted through different materials.<br><br>**Ideas for varying the practical**<br>Measure the angle of incidence and the angle of refraction of light through a Perspex block.<br><br>Use the same method to study refraction through blocks of different materials.<br><br>**Theoretical case study**<br>A lens works by changing the direction of rays of light by refraction. A lens manufacturer has been investigating how the refractive index of different types of glass varies with the wavelength of light shone through it. |

# Activity 1a answers

## Question 1
What does AO2 assess in general?

## Answer
Application of knowledge and understanding of scientific ideas, scientific enquiry, technics and procedures. Applying knowledge and understanding of all sections of the specification, not just the content shown in section 3.

## Question 2
What percentage of marks are assigned to AO2?

## Answer
40% – this is across the award and not always a perfect 50:50 split across the two papers.

## Question 3
Which of the following are assessed as AO2?

- graphs
- applying formulas
- writing a conclusion
- using Punnett squares
- stating the word equation for combustion
- using the particle model to explain changes in state
- identifying errors in a practical

## Answer
- graphs
- applying formulas
- using Punnett squares
- using the particle model to explain changes in state

# Activity 2 answers

## Biology Paper 1F, Q4

| Question | AO |
|---|---|
| 4.1 | AO3 |
| 4.2 | AO2/2 |
| 4.3 | AO2/1 |
| 4.4 | AO 3 |
| 4.5 | AO 2 |
| 4.6 | AO 2 |
| 4.7 | AO 2 |

## Biology Paper 1H, Q7

| Question | AO |
|---|---|
| 7.1 | AO1 |
| 7.2 | AO2/1 |
| 7.3 | AO3 |
| 7.4 | AO2/1 |
| 7.5 | AO2/1 |
| 7.6 | AO1 |
| 7.7 | AO3 |
| 7.8 | AO3 |

## Chemistry Paper 3F (synergy), Q1

| Question | AO |
|---|---|
| 1.1 | AO1 |
| 1.2 | AO1 |
| 1.3 | AO2/2 |
| 1.4 | AO2/2 |
| 1.5 | AO1<br>AO2/2 |
| 1.6 | AO2/2 |
| 1.7 | AO2/2 |
| 1.8 | AO1 |

## Chemistry Paper 1F, Q3

| Question | AO |
|---|---|
| 3.1 | AO2/1 |
| 3.2 | AO2/1 |
| 3.3 | AO2/1 |
| 3.4 | AO2/1 |
| 3.5 | AO1<br>AO2/1 |
| 3.6 | AO2/2 |
| 3.7 | AO1 |

## Physics Paper 2H, Q8

| Question | AO |
|---|---|
| 8.1 | AO2/1 |
| 8.2 | AO1<br>AO2/1<br>AO3 |
| 8.3 | AO2/2 |
| 8.4 | AO1<br>AO2/1 |

## Physics Paper 4H (synergy), Q4

| Question | AO |
|---|---|
| 4.1 | AO1 |
| 4.2 | AO1 |
| 4.3 | AO2/2 |
| 4.4 | AO2/2 |
| 4.5 | AO3 |
| 4.6 | AO1 |

# Personal action plan

Following your training session and results of your post-session health check, use this action plan to help continue your development in specific areas.

| Knowledge/competency area | Development notes |
| --- | --- |
| The key assessment areas and strands of AO2 | |
| Including context in schemes of work, the classroom and homeworks | |
| Integrating the application of knowledge and understanding into practicals | |

| Personal development aim/target: |
|---|
| What do I need to achieve? |
| Actions: |
| Support required: |
| Measure(s) of success: |
| Review date(s):<br><br>Achievement date: |

# Group action plan

Following the group reflection on the session, complete this action plan to support the department's continued development.

| |
|---|
| **Department goal:** |
| **Where is the knowledge and expertise?** |
| **Actions:**<br>Who has ownership of each area? |
| **Support required:**<br>How will we work together?<br>How will we hold each other to account? |
| **Measure(s) of success:**<br>How will we evidence achievements? |
| **Review date(s):**<br><br>**Achievement date:** |

# Notes

## Contact us

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