

GCSE SCIENCE

Virtual communities

Resources booklet

Published: Autumn 2022



Contents	Page
Example 1	4
Ofqual guidance for AO2	9
Example 2	11
Understanding demand	15
Example 3	16
Example 4	17
Example 5	18
Example 6	20
Sample unfamiliar contexts	22
Modelling accessing AO2 in a practical question	24
Example 7	26
Example 8	28
Example 9	30
Resources and links	32
Virtual communities resources on the website	33

Example 1

Extracts from 2022 GCSE Combined Science: Synergy 1F

0 5

Chlamydia, HIV and human papillomavirus (HPV) are sexually transmitted diseases (STDs).

0 5

. 1

Which other disease is sexually transmitted?

[1 mark]

Tick (✓) **one** box.

Flu

☐

Gonorrhoea

☐

Malaria

☐

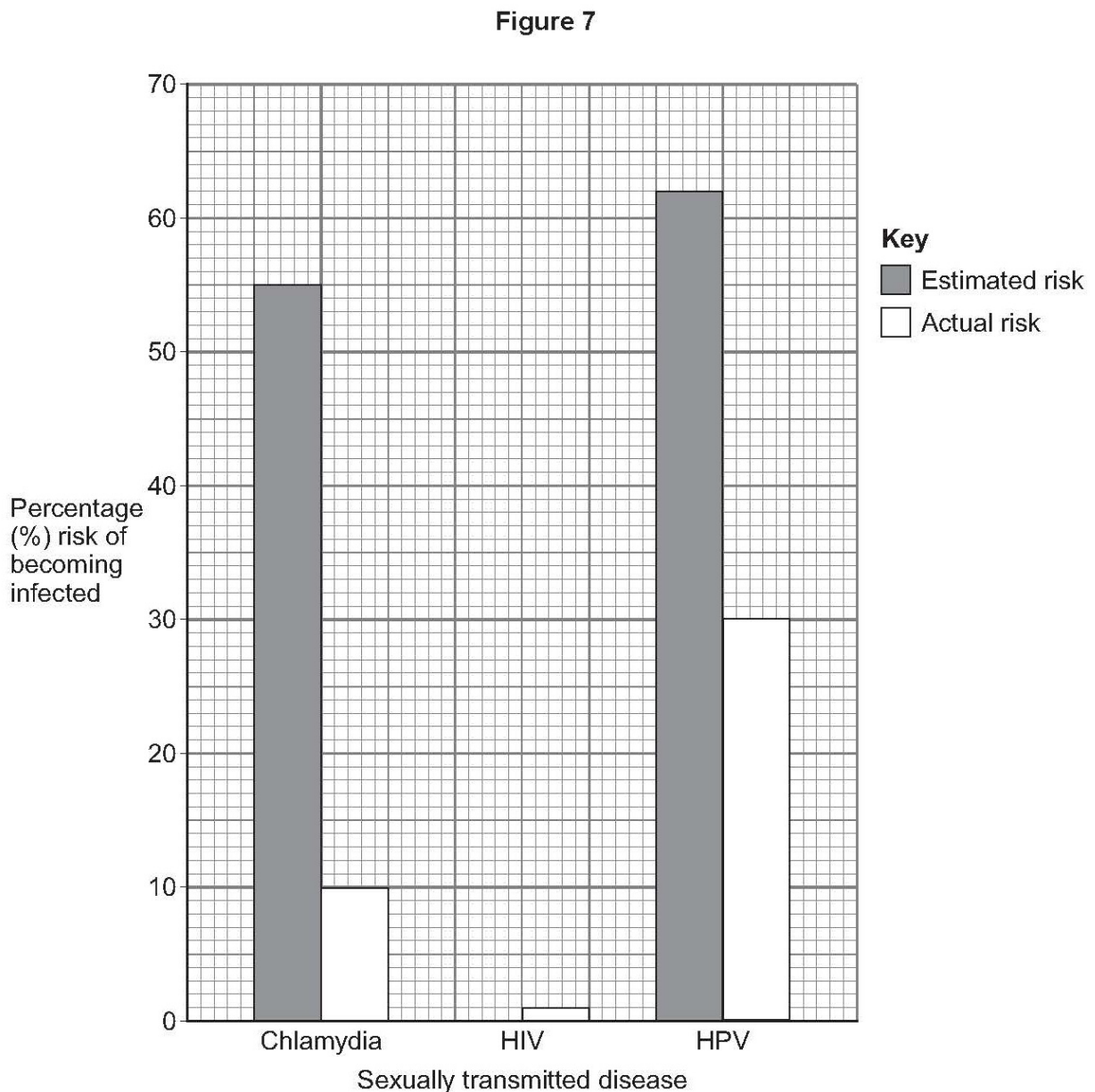
Measles

☐

Students were asked to estimate the percentage risk of a person becoming infected with different STDs.

The estimate was compared to the actual percentage risk of infection.

Figure 7 shows the results.



0 5 . 2 The students estimated that the risk of HIV infection was 60%.

Plot the students' estimated risk of HIV infection on Figure 7.

[1 mark]

0 5 . 3

Which STD in **Figure 7** shows the greatest actual risk?

[1 mark]

0 5 . 4

Calculate the difference between the estimated risk and the actual risk of becoming infected with chlamydia.

[2 marks]

0 7 . 1

An atom contains three types of particles.

Table 1 shows some information about the particles.

Table 1

Name of particle	Charge
Electron	-1
Neutron	
Proton	

Complete **Table 1**.

[2 marks]

Alpha particles can be used to investigate the structure of atoms.

0 7 . 3

Alpha particles have a relative mass of 4.

What is an alpha particle?

[1 mark]

Tick (✓) **one** box.

Two electrons and two neutrons

☐

Two neutrons and two protons

☐

Two protons and two electrons

☐

Alpha particles from a source were directed at thin gold foil.

Figure 11 shows some of the paths the alpha particles followed.

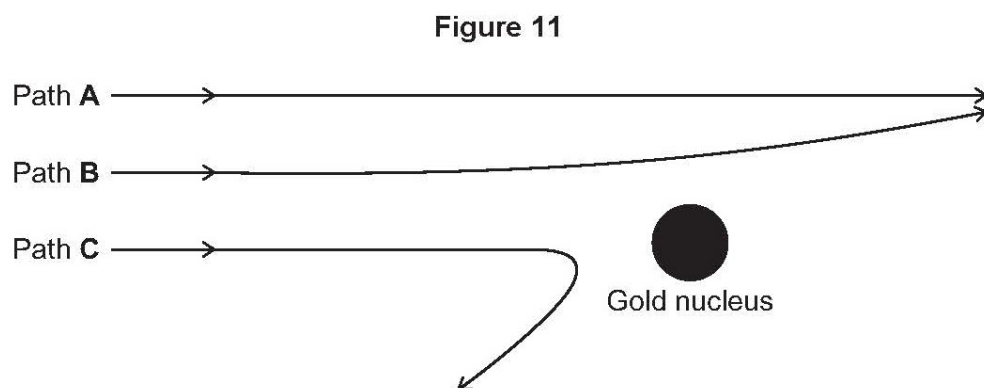


Table 2 shows the number of alpha particles that followed paths A, B and C.

Table 2

Path	Number of alpha particles
A	8 289 864
B	7 920
C	198

0 7 . 5 The ratio of alpha particles on path B to alpha particles on path C can be shown as:

7920 : 198

What is 7920 : 198 written as its simplest ratio?

[1 mark]

Tick (✓) **one** box.

40 : 1 ☐

500 : 1 ☐

8000 : 1 ☐

0 7 . 6 How does **Figure 11** provide evidence for a nucleus in a gold atom?

[1 mark]

Tick (✓) **one** box.

Alpha particles following path **C** are bounced back.

☐

Most alpha particles follow path **A**.

☐

The alpha particles from the source travel in straight lines.

☐

Ofqual guidance for A02

A02: Apply knowledge and understanding of:			40%
<ul style="list-style-type: none"> scientific ideas scientific enquiry, techniques and procedures. 			
Strands	Elements	Coverage	Interpretations and definitions
1 – Apply knowledge and understanding of scientific ideas. 2 – Apply knowledge and understanding of scientific enquiry, techniques and procedures.	<p>This strand is a single element.</p> <p>This strand is a single element.</p>	<ul style="list-style-type: none"> Full coverage in each set of assessments (but not in every assessment). 	<ul style="list-style-type: none"> 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. 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. 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: <ul style="list-style-type: none"> novel situations that are not clearly indicated in the specification; developing further material that is covered in the specification; making links between such types of material, which are not signalled in the specification. 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.

[GCSE Subject Level Guidance for Combined Science \(publishing.service.gov.uk\)](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/90212/gcse-subject-level-guidance-for-combined-science.pdf)

Contains public sector information licensed under the Open Government Licence

Understanding the Ofqual guidance

The key aspect of AO2 is the requirement to **apply** knowledge and understanding (third bullet point in the right-hand column). That means that students must use their knowledge of the subject content (including working scientifically, maths and practical skills) to explain something in order to give meaning to it.

The further detail to this bullet point requires that application must:

- Relate to **unfamiliar contexts** ('novel situations that are not clearly indicated in the specification').
- Expect students to take an idea from the specification and **develop or further it beyond the knowledge** in the specification.
- expect students to **make links** between different areas of knowledge to answer a question. For example, there may be a question about the effect of air pollution on the health of animals and/or plants in a particular environment, where they would need to understand what air pollutants there are (from one part of the specification) and link that to the effect of these on (eg) photosynthesis, respiration, etc) to give a full account.
- The links should be made by the student in their answer – we don't tell them in the question to make the specific links: that little extra phrase 'which are not signalled in the specification' says it all.
- Expect students to look at data or information and make sense of connections and links within it.

There are two strands for AO2. It's separated into ideas and enquiry, techniques and procedures. Again, the right-hand column gives more detail on what is meant here.

- **Ideas** assess subject content, which remember includes working scientifically, practical and maths skills. So it will include theories, models, methods and how they develop over time, as well as use of mathematical formulae and units
- **enquiry, techniques and procedures** mostly means practical skills, but also includes some of the technical maths skills such as drawing lines of best fit. Note that it says here 'is broader than' knowledge of the core practical activities. This means that we'll be assessing application of practical skills in contexts we'll give to students, other than just those in the required practicals – further pushing the relation of this assessment objective to unfamiliar contexts. It'll also cover the range of ideas featured in WS2 (Experimental skills and strategies)
- For some of the mathematical skills, the context in which the skill is applied will determine whether it is Strand 1 or Strand 2: there is a lot more to this assessment objective than you might think.

Coverage of strands: The guidance says that we have to cover both strands fully across the assessments for a specification but not in every assessment. We do our best to give a balance, but it's never exactly 50:50 and never exactly the same in any two assessments.

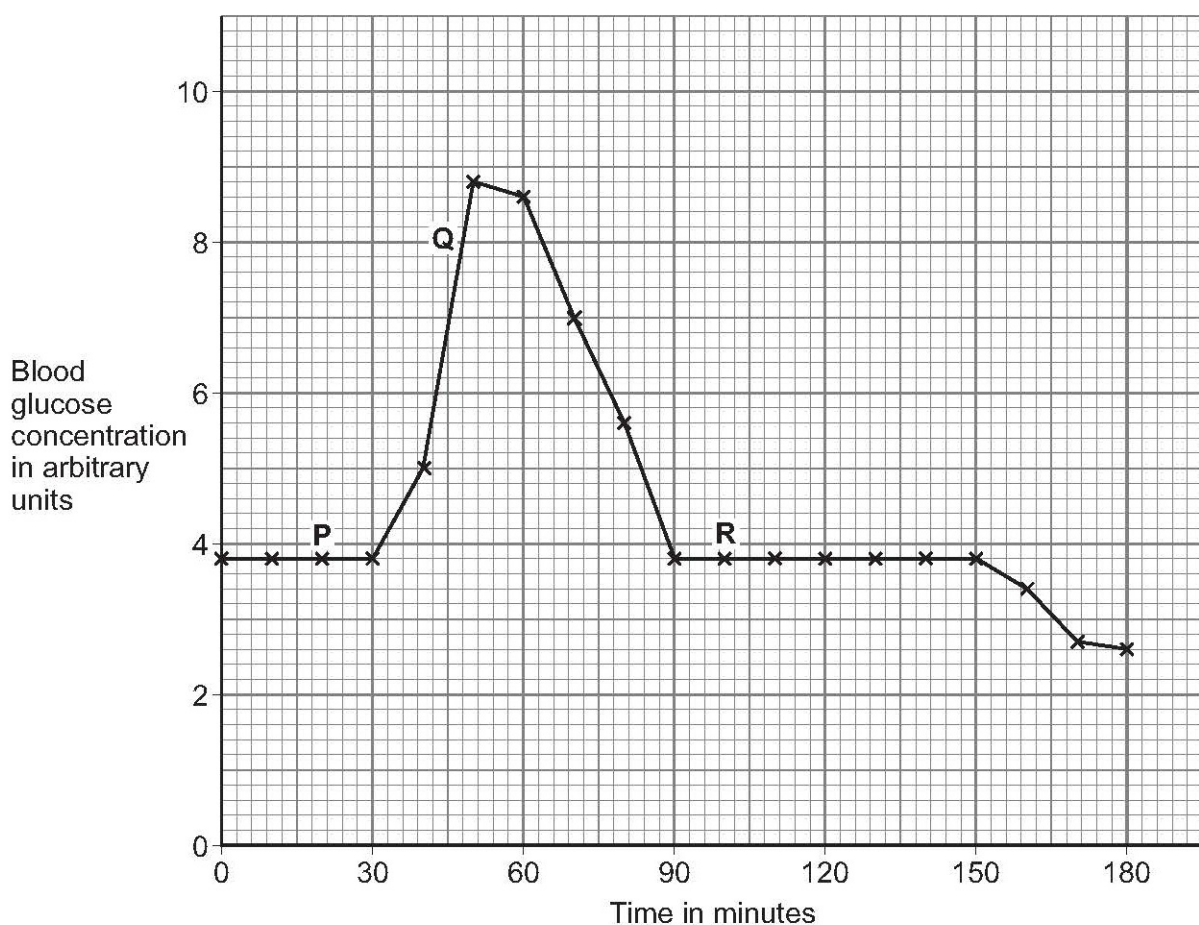
In all of these, you can see that students are applying skills and knowledge they have gained either through learning the content of the specification or through doing practical work.

Example 2

Extracts from 2022 GCSE Combined Science: Synergy 2F

Figure 2 shows the change in blood glucose concentration in a person during 180 minutes.

Figure 2



0 1 . 6 When did the person start eating a meal?

Use Figure 2.

[1 mark]

Tick (✓) one box.

P ☐ Q ☐ R ☐

0 2 . 5

The student heated water at its boiling point until all the liquid water changed to water vapour.

mass of water = 0.20 kg

specific latent heat of vaporisation of water = 2 260 000 J/kg

Calculate the energy required to change the liquid water into water vapour.

Use the equation:

energy for the change of state = mass \times specific latent heat of vaporisation

Choose the unit from the box.

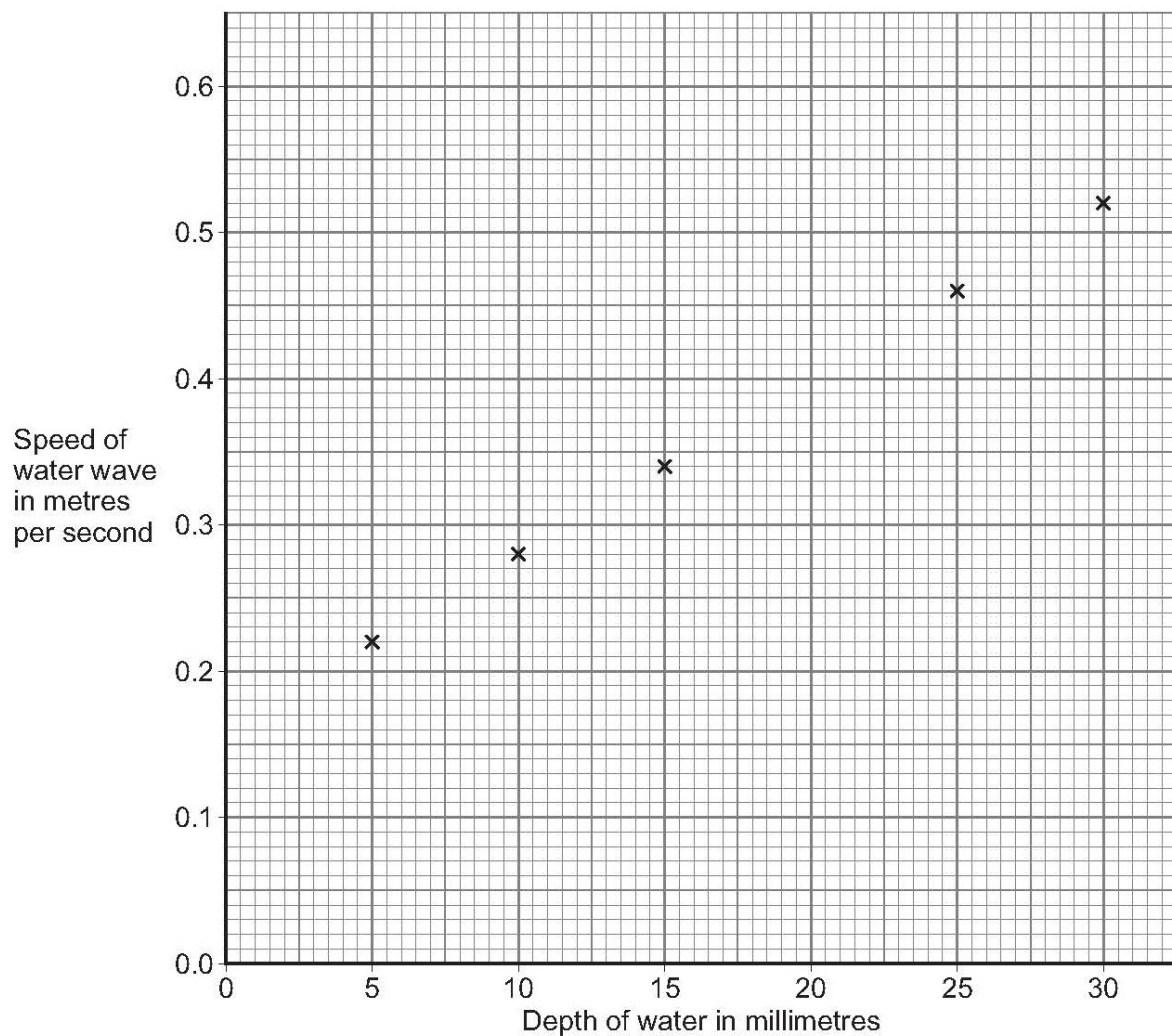
[3 marks]

°C	kg	J	J/kg
----	----	---	------

The student calculated the speed of the waves at each depth.

Figure 11 shows the results.

Figure 11



0 4 . 6 Draw a line of best fit on Figure 11.

[1 mark]

07

The tawny owl is one species of bird.

The tawny owl can have grey feathers or brown feathers.

The colour of the feathers is determined by one gene.

The allele for brown feathers is dominant (**B**).

The allele for grey feathers is recessive (**b**).

07.1

What is the genotype of a tawny owl with grey feathers?

[1 mark]

Tick (✓) **one** box.

BB ☐ **Bb** ☐ **bb** ☐

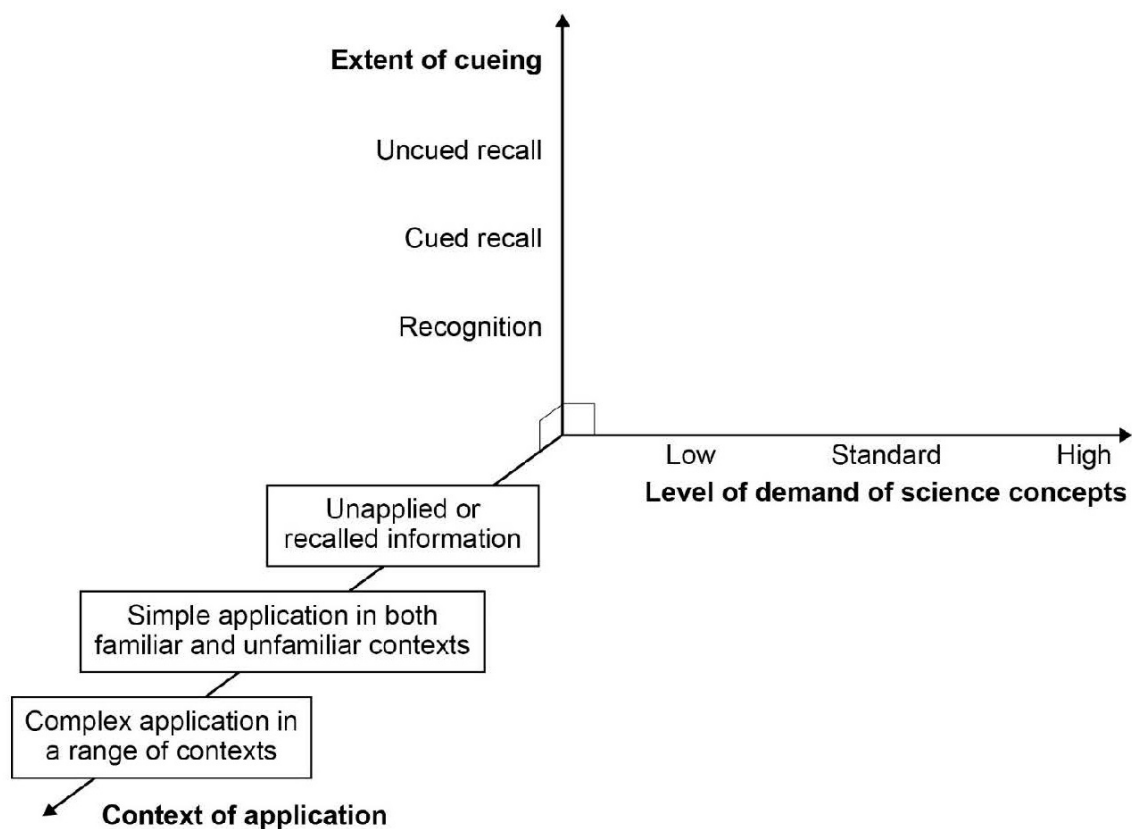
Understanding demand

Level of demand is determined by factors such as:

- Concept
- Context
- Command words

The more complex the situation and the more factors involved, the greater the demand of the question.

The below diagram illustrates the relationships between some of the factors that influence the demand of a question.

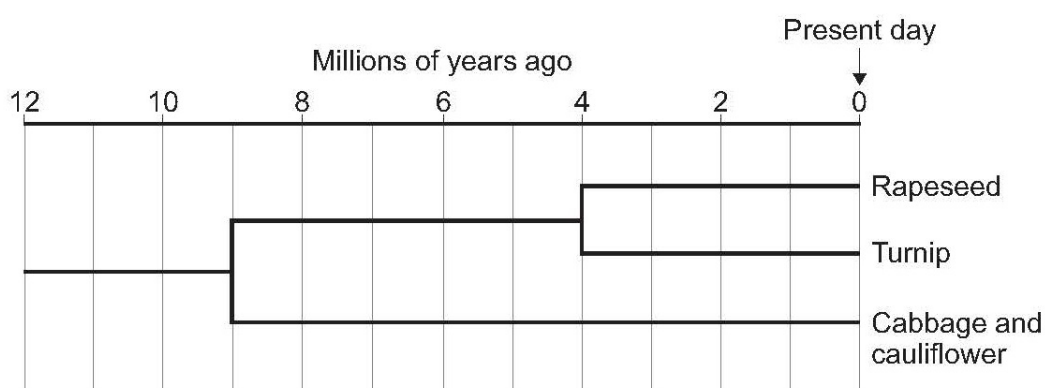


Example 3

2022 GCSE Combined Science: Synergy 1F Q4.3 (low demand)

Figure 5 shows the evolution of some plants.

Figure 5



0 4 . 3 Cabbage and cauliflower evolved into a new species 9 million years ago.

Rapeseed and turnip evolved more recently.

How many million years ago did rapeseed and turnip evolve into two species?

[1 mark]

_____ million years ago

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	4 (million years ago)	allow four	1	AO2 4.4.4.4 4.4.4.2

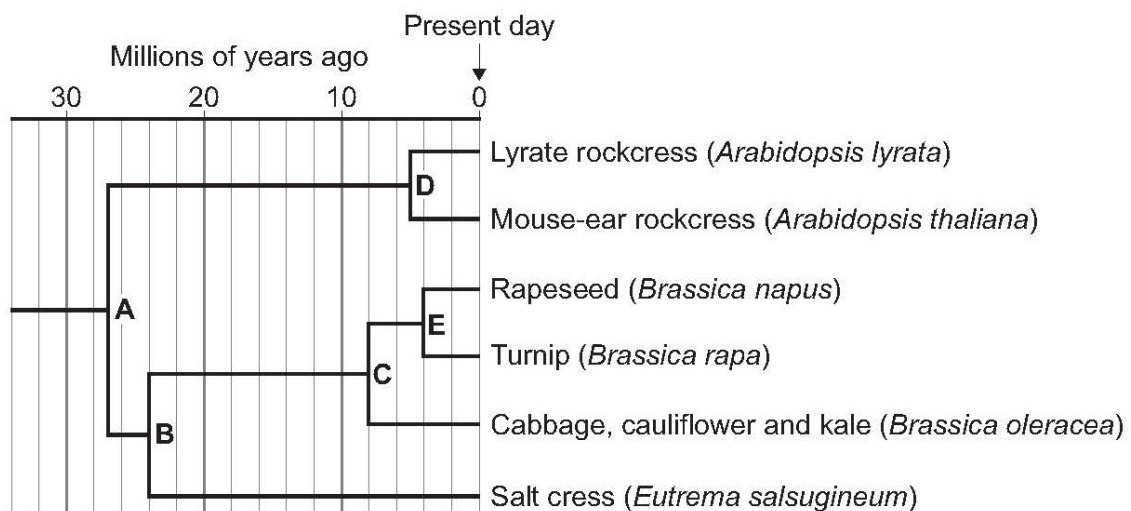
Example 4

2022 GCSE Combined Science: Synergy 1H Q4.2 (high demand)

0 4

Figure 4 shows the evolution of some plants.

Figure 4



A, B, C, D and E show when one species evolved into two species.

Use Figure 4 to answer Questions 04.1 to 04.3.

0 4 . 2

Cabbage, cauliflower and kale are all varieties of one species, *Brassica oleracea*.

How many years ago did rapeseed evolve to become a different species from cabbage, cauliflower and kale?

[1 mark]

_____ million years ago

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	8 (million years ago)		1	AO2 4.4.4.4

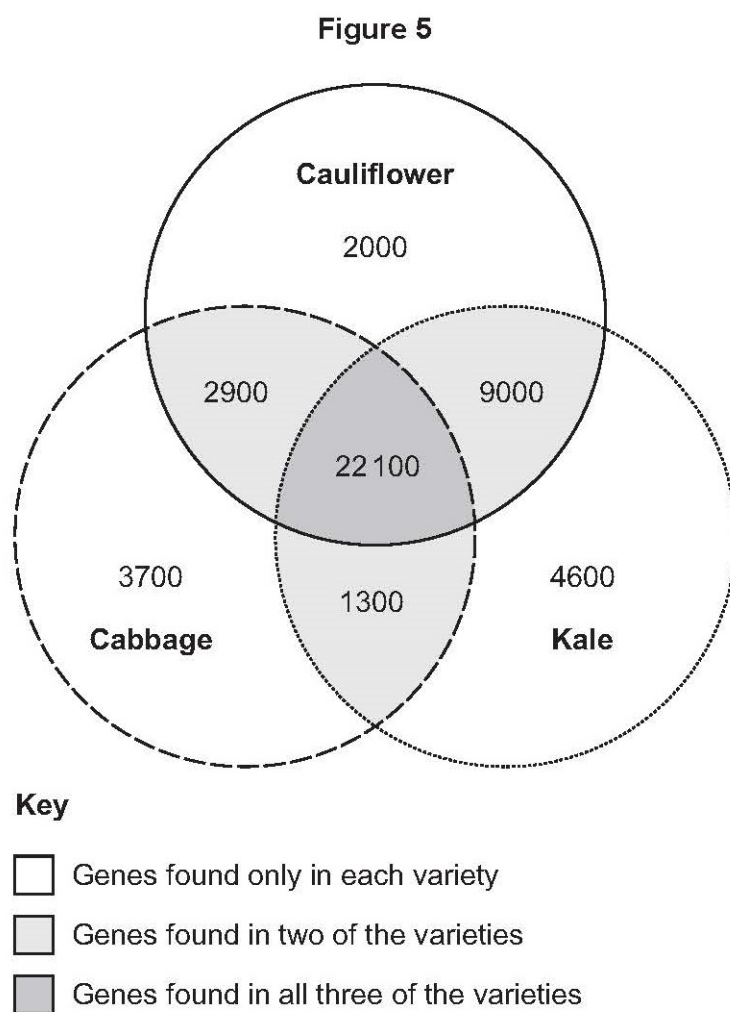
Example 5

2022 GCSE Combined Science: Synergy 1H Q4.9 (high demand)

Scientists investigated the genomes of three varieties of *Brassica oleracea*.

Figure 5 shows the number of genes in *Brassica oleracea* that are:

- found only in each variety
- found in two of the varieties
- found in all three of the varieties.



04.9 Calculate the percentage of the total number of genes in cauliflower that are in kale, but not in cabbage.

[2 marks]

Percentage = _____ %

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	$\frac{9000}{2000+2900+22\ 100+9000} \times 100$ <p>= 25 (%)</p>	allow $\frac{9000}{36\ 000} \times 100$	<p>1</p> <p>1</p>	<p>AO2</p> <p>4.4.4.4</p> <p>4.4.3.1</p>

Example 6

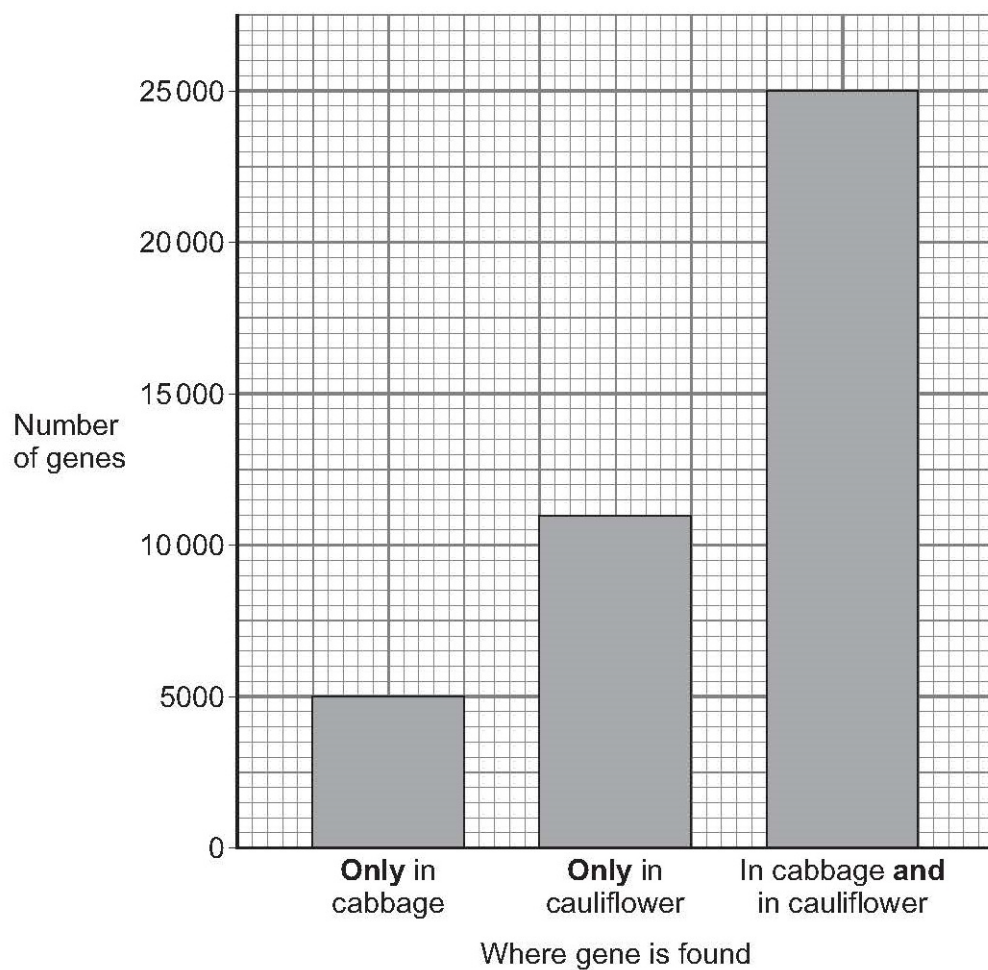
2022 GCSE Combined Science: Synergy 1F Q4.7 (low demand)

Cabbage and cauliflower have some of the same genes.

Figure 6 shows the number of genes found:

- only in cabbage
- only in cauliflower
- in cabbage and in cauliflower.

Figure 6



0 4 . 7 Cabbage contains a total of 30 000 genes.

Calculate the percentage of genes in cabbage that are found in both cabbage and cauliflower.

Use the equation:

$$\text{percentage} = \frac{\text{number of genes found in cabbage and in cauliflower}}{\text{total number of genes in cabbage}} \times 100$$

[3 marks]

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	25 000		1	AO2 4.4.3.1 4.4.4.4
	$\frac{25\,000}{30\,000} \times 100$	allow from an incorrect reading from figure	1	
	= 83.3 (%)	allow 83 (%) allow 83.3 (%) (recurring) allow an answer to more significant figures	1	

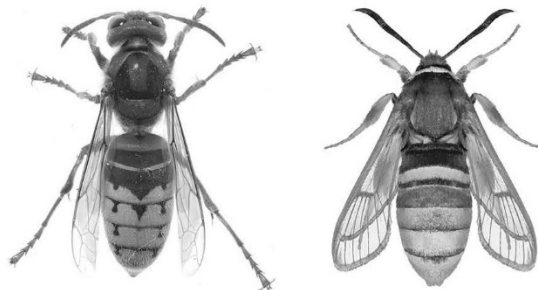
Sample unfamiliar contexts

2022 GCSE Biology 1H Q4.2

Mimicry is a mechanical adaptation seen in both plants and animals.

Figure 5 shows two insects.

Figure 5



Hornet

Hornet Moth

0 4 . 2 Hornets are insects that sting other animals and cause pain.

Hornet moths do **not** sting other animals.

Suggest how mimicry helps the **hornet moth** survive.

[1 mark]

2022 GCSE Chemistry 1F Q3.3 and Q6.7

0 3 . 3 A metal oxide reacts with an acid to produce zinc sulfate and water.

Name the metal oxide and the acid used in this reaction.

[2 marks]

Name of metal oxide _____

Name of acid _____

0 6 . 7 Calculate the relative formula mass (M_r) of carbonic acid (H_2CO_3).

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

2022 GCSE Physics 1F Q6.5

The highest point above sea level in England is the top of a mountain called Scafell Pike.

The height above sea level of Scafell Pike is 978 m.

0 6 . 5 A student climbs Scafell Pike.

Why does the atmospheric pressure decrease as the student climbs higher?

[2 marks]

Tick (✓) **two** boxes.

The air exerts a greater force on the student.

☐

The density of the air decreases.

☐

The mass of air above the student decreases.

☐

The temperature of the air increases.

☐

The volume of air above the student increases.

☐

Modelling accessing A02 in a practical question

2019 GCSE Chemistry 2H Q9

0 9

Some students investigated the rate of decomposition of hydrogen peroxide, H_2O_2

The equation for the reaction is:



The catalyst for the reaction is manganese dioxide.

0 9 . 1

Describe a test to identify the gas produced in the reaction.

Give the result of the test.

[2 marks]

Test _____

Result _____

Student **A** investigated the effect of the particle size of manganese dioxide on the rate of the reaction.

This is the method used.

1. Measure 25 cm^3 of 0.3 mol/dm^3 hydrogen peroxide solution into a conical flask.
2. Add a spatula of fine manganese dioxide powder to the conical flask.
3. Measure the volume of gas produced every minute for 10 minutes.
4. Repeat steps 1 to 3 with some coarse manganese dioxide lumps.

0 9 . 2

The method student **A** used did **not** give valid results.

What **two** improvements could student **A** make to the method to give valid results?

[2 marks]

Tick (✓) **two** boxes.

Measure the increase in mass of the conical flask and contents.

☐

Measure the volume of gas produced every 2 minutes.

☐

Place the conical flask in a water bath at constant temperature.

☐

Use 0.05 mol/dm^3 hydrogen peroxide solution.

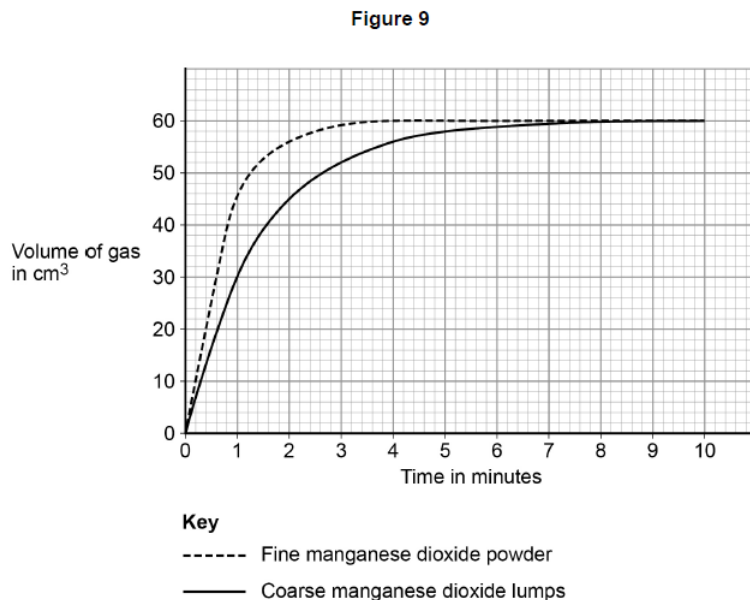
☐

Use a mass of 1 g manganese dioxide each time.

☐

Student **B** used a method which gave valid results.

Figure 9 shows student **B**'s results.



- 0 9 . 3** Determine the mean rate of reaction in cm³/s between 2 and 4 minutes for coarse manganese dioxide lumps.

Give your answer to 2 significant figures.

Use data from **Figure 9**.

[3 marks]

Hydrogen peroxide molecules must collide with manganese dioxide particles for catalysis to take place.

- 0 9 . 4** Student **B** repeated the experiment with coarse lumps of manganese dioxide.

Student **B** used the same volume of 0.2 mol/dm³ hydrogen peroxide instead of 0.3 mol/dm³ hydrogen peroxide.

Sketch on **Figure 9** the curve you would expect to see.

Assume that the reaction is complete after 9 minutes.

[2 marks]

- 0 9 . 5** The rate of reaction is different when manganese dioxide is used as a fine powder rather than coarse lumps.

Explain why.

You should answer in terms of collision theory.

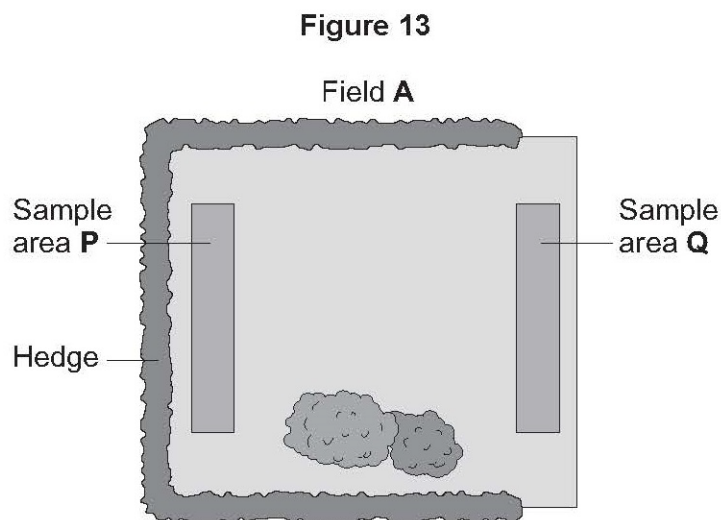
[2 marks]

Example 7

2022 GCSE Combined Science: Synergy 2F Q5.6

A student did a different investigation in field A.

Figure 13 shows the areas sampled.



0 5 . 6 Suggest **one** way to increase biodiversity in field A.

[1 mark]

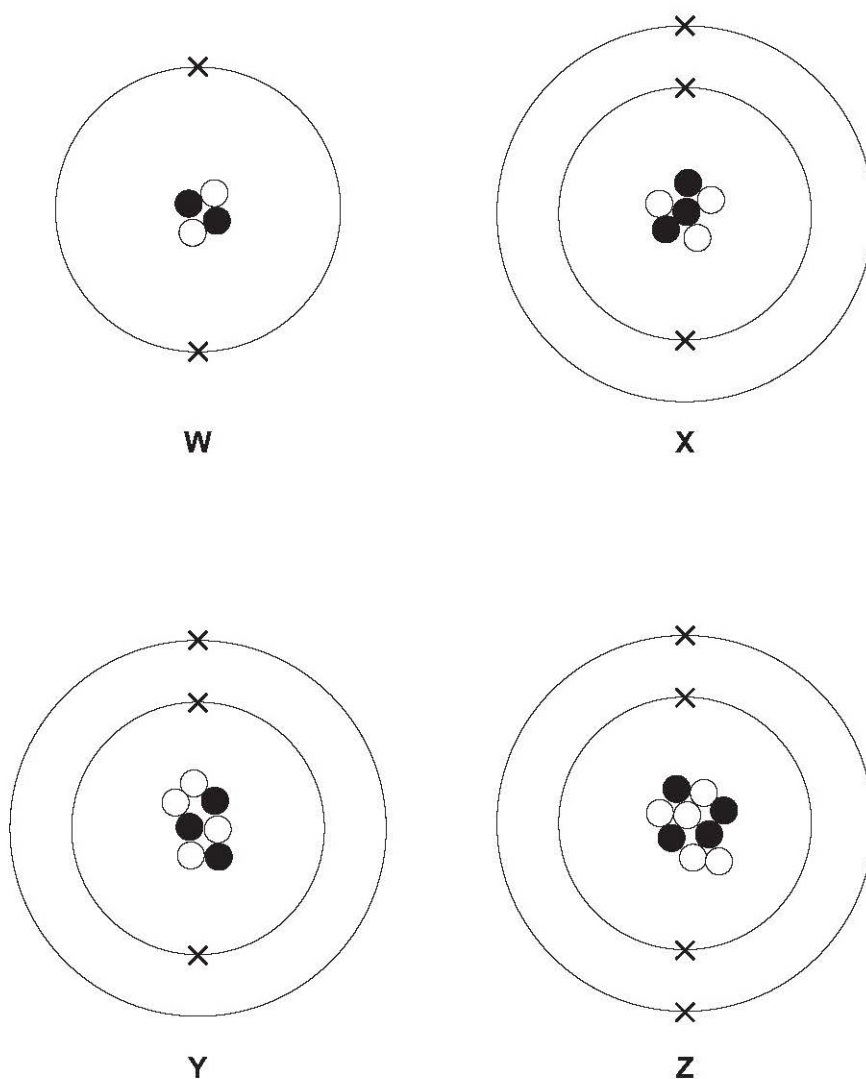
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any one from: <ul style="list-style-type: none"> • plant hedges / flowers / trees • add a pond • add a log pile or compost heap or beehive or bird box • avoid walking on it • avoid using pesticides / herbicides / insecticides • avoid using heavy machinery • avoid mowing (grass) • remove grazing animals • do not plant crops 		1	AO2 4.4.2.5 4.4.2.7

Example 8

2022 GCSE Combined Science: Synergy 1F Q7.8

Figure 12 represents four atoms.

Figure 12



07.8 Which two atoms in **Figure 12** represent isotopes of the same element? **[1 mark]**

Tick (✓) **one** box.

W and X

☐

W and Z

☐

X and Y

☐

Y and Z

☐

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	X and Y		1	AO2 4.1.2.4

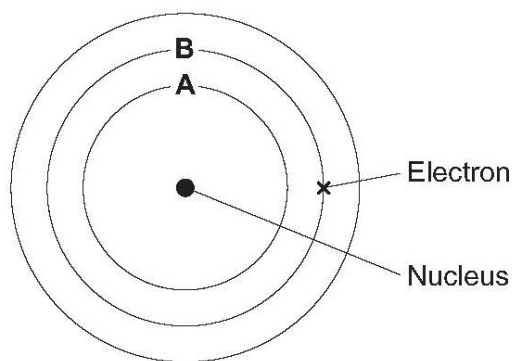
Example 9

2022 GCSE Combined Science: Synergy 1F Q9.2

0 9 . 2 Neon atoms can absorb electromagnetic radiation.

Figure 13 shows three of the energy levels around the nucleus of a neon atom.

Figure 13



The atom in Figure 13 has absorbed electromagnetic radiation.

What happens as an electron moves from energy level B to energy level A?

[1 mark]

Tick (✓) one box.

Light is absorbed

☐

Light is emitted

☐

Light is reflected

☐

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	light is emitted		1	AO2 4.3.2.1 4.1.2.5

Resources

Below are the links to the resources mentioned in the presentation.

[GCSE Subject level guidance for Combined Science](#)

[Virtual communities spring 2022](#)

[Virtual communities autumn 2021](#)

[Virtual communities spring 2020](#)

[AQA Hub autumn 2019](#)

[Focus on Success packs for AO2 and Maths in science](#)

Virtual communities resources on the website

The following table lists the pdf resources available for the GCSE science Hub and Virtual communities meetings, from spring 2020 to summer 2022. It also includes a brief description of what each document is about.

All resources can be downloaded from the [science virtual communities pages](#) on the AQA website. Usually only materials from the most recent three meetings are on this page, but all other materials (including pre-2020 materials) can be found on the [science virtual communities archive page](#).

Meeting session	Title of document	What it's about
Summer 2022	Presentation slides	<ul style="list-style-type: none">• Progression in practical skills• DfE criteria at each key stage• How the demand progresses through the stages• Identifying key skills at each stage to build competence• Skills to look at in benchmarking• Using questions to help the transition from KS3 to GCSE• AQA resources for supporting development
	Resource booklet	<ul style="list-style-type: none">• Practical skills and apparatus and techniques criteria• Starter activity flowchart• Example questions• AQA resources: Unit Award Scheme, KS3 syllabus and Entry level certificate
	Facilitation pack booklet	<ul style="list-style-type: none">• Resource for teachers to deliver their own CPD session for colleagues with activities and resources linked to the virtual community topic.
Spring 2022	Presentation slides	<ul style="list-style-type: none">• Supporting students in understanding subject content using AO1 questions• Understanding the different 'flavours' of AO1• Identifying the different types

		<ul style="list-style-type: none"> • Common mistakes students make in answering AO1 questions • Using the advance information, past papers and examiner reports to help students improve their confidence • Developing strategies to dispel misconceptions and misunderstandings • Developing formative questions to support learning and revision
	Resource booklet	<ul style="list-style-type: none"> • AO weightings in the GCSE Sciences • AO1 definitions and GCSE command words • Identifying knowledge in isolation questions • Using AO1 questions to identify and dispel misconceptions and misunderstandings
	Facilitation pack booklet	<ul style="list-style-type: none"> • Resource for teachers to deliver their own CPD session for colleagues with activities and resources linked to the virtual community topic
Autumn 2021	Presentation slides	<ul style="list-style-type: none"> • Supporting students in their application of practical skills in unfamiliar contexts • Understanding the differences between 'hands-on' and 'minds-on' • Advantages of using a 'minds-on' approach • Using questions to aid progression to 'minds-on' • Introducing Project Calibrate
	Resource booklet	<ul style="list-style-type: none"> • Working scientifically 'hands-on' and 'minds-on' criteria • Developing a framework of questions to encourage 'minds-on' approach to practical work • Suggested questions for interrogating an experimental method
	Facilitation pack booklet	<ul style="list-style-type: none"> • Resource for teachers to deliver their own CPD session for colleagues with activities and resources linked to the virtual community topic
	Facilitation pack presentation slides	<ul style="list-style-type: none"> • A copy of the PowerPoint from the meeting with notes for the presenter

Summer 2021	Presentation slides	<ul style="list-style-type: none"> Supporting transition from KS3 to GCSE and from GCSE to A-level using a key transferrable maths skill in science (use of standard form) as an example The requirements for the skill and how they are assessed at the different key stages Ideas for how you can enable student progression AQA resources to aid this progression Updates for arrangements for autumn 2021 and summer 2022
	Resource booklet	<ul style="list-style-type: none"> Links to online resources Example questions used in the activities Starter activity flowchart Example lesson activities Information on progression in two other key maths skills not covered in the presentation
Spring 2021	Presentation slides	<ul style="list-style-type: none"> Brief updates on the autumn 2020 series and what we know for summer 2021 Supporting the learning gap – ideas and resources from STEM Understanding the requirements of some key command words in exam papers using student responses
	Support booklet	<ul style="list-style-type: none"> Summaries of GCSE and A-level results for summer and autumn 2020 Links to organisations and resources Definitions, what examiners are looking for and examples of student responses for the command words describe, explain, compare, evaluate
	Commentaries booklet	Comments on the student responses regarding how they have, or have not, addressed the requirements of the command word
Autumn 2020 (Virtual communities)	Presentation slides	Focal points for group discussions

meetings)	Supporting materials	<ul style="list-style-type: none"> • Reminder of situation for 2020/2021 as known at the time • Points to consider in breakout groups for discussions on practical work and importance of mock exams • Details of Apparatus and Techniques criteria covered in the required practical activities for each GCSE Science
Spring 2020	Presentation slides	<ul style="list-style-type: none"> • Reflections on mocks and brief reminder on how to use MERiT • How we assess maths skills in GCSE Sciences at different levels of demand, using examples of student work • Discussion activity on ways of including opportunities for development of particular maths skills in schemes of work (using AQA schemes as examples) • Update on resources and draft plans for summer 2020 meetings
	Booklet 1	<ul style="list-style-type: none"> • Guidance on assessment of particular maths skills. • Student examples and commentaries for discussion in meeting and in school • Update on where to find resources
	Booklet 2	Extracts from AQA schemes of work for use in the exercise in the meeting
	Booklet 3	Extracts from AQA specifications for use in the exercise in the meeting
	Booklet 4	Guide to virtual communities resources on the website (now superseded by this table)
	Maths skills in science: Precision and decimal places	Link to Teachit resource referred to in meeting
	Maths skills in science: Significant figures	Link to Teachit resource referred to in meeting
	Mock analysis: Trilogy paper	Examples of how analysis of the Trilogy Paper 1 could be undertaken (repeated from Autumn 2019 meeting, by request)

Notes

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477 756

Email: gcsescience@aqa.org.uk

Twitter: [@AQA](https://twitter.com/AQA)

[aqa.org.uk](https://www.aqa.org.uk)