

Focus on success: GCSE science

A03

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

Activities
booklet



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Activity 1: What is A03

1a

Using the Ofqual strand document for AO3, read the different strands and elements highlight the skills students need to develop in lessons.

AO3: Analyse information and ideas to:			20%
<ul style="list-style-type: none"> interpret and evaluate make judgements and draw conclusions develop and improve experimental procedures. 			
Strands	Elements	Coverage	Interpretations and definitions
1 – Analyse information and ideas to interpret and evaluate.	1a – Analyse information and ideas to interpret.	<ul style="list-style-type: none"> Full coverage in each set of assessments (but not in every assessment). A reasonable balance between the strands within this assessment objective, and between the elements within each strand. 	<ul style="list-style-type: none"> Develop and improve covers a range of approaches to assessment, including questions related to adapting, modifying and enhancing experimental procedures. Learners should not be expected to develop their own procedures. Experimental procedures encompasses, but is broader than, the core practical activities. In the context of this assessment objective, questions/tasks should take an analytical form such as suggesting the limitations of a particular method. The emphasis here is on the outcome that Learners produce through the analysis of information – for instance, the interpreting, evaluating, judgement, conclusion or modification/improvement of procedures that stems from their reasoning and synthesis of skills. The abilities to interpret and evaluate in this context are both linked and complementary. Questions/tasks should address a range of sources here – for example, written, numerical, theoretical, practical, ethical, social, economic and environmental.
	1b – Analyse information and ideas to evaluate.		
2 – Analyse information and ideas to make judgements and draw conclusions.	2a – Analyse information and ideas to make judgements.		
	2b – Analyse information and ideas to draw conclusions.		
3 – Analyse information and ideas to develop and improve experimental procedures.	3a – Analyse information and ideas to develop experimental procedures.		
	3b – Analyse information and ideas to improve experimental procedures.		

1b

Look at the AO3 questions below, using your knowledge from the previous table, identify which strand it is targeting and what the level of demand is.

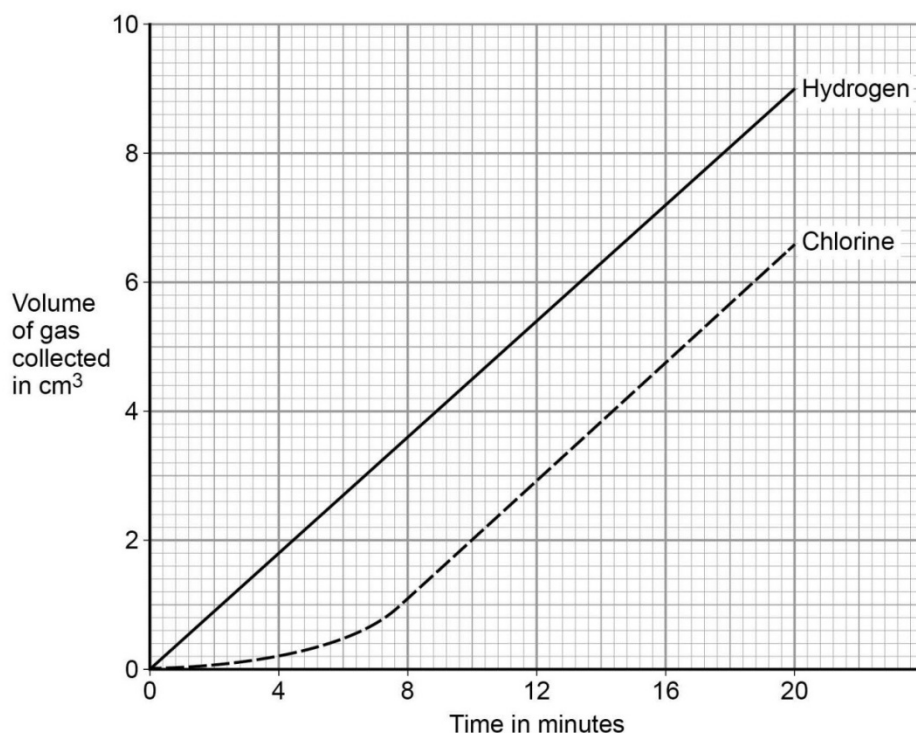
Level of demand	Target grades
Low	1-3
Standard	4-5
High	6-9

Example 1

Chemistry questions 4.2 and 4.3

Figure 6 shows the results of the investigation.

Figure 6



0 4 . 2

Which of the lines on **Figure 6** show that the volume of gas collected is directly proportional to the time?

[1 mark]

Tick **one** box.

Both lines

☐

Chlorine line only

☐

Hydrogen line only

☐

Neither line

☐

0 4 . 2

Which of the lines on **Figure 6** show that the volume of gas collected is directly proportional to the time?

[1 mark]

Tick **one** box.

Both lines

☐

Chlorine line only

☐

Hydrogen line only

☐

Neither line

☐

0 4 . 3

Which of the lines on **Figure 6** show a positive correlation between the volume of gas collected and time?

[1 mark]

Tick **one** box.

Both lines

☐

Chlorine line only

☐

Hydrogen line only

☐

Neither line

☐

Example 2

Physics question 7.2

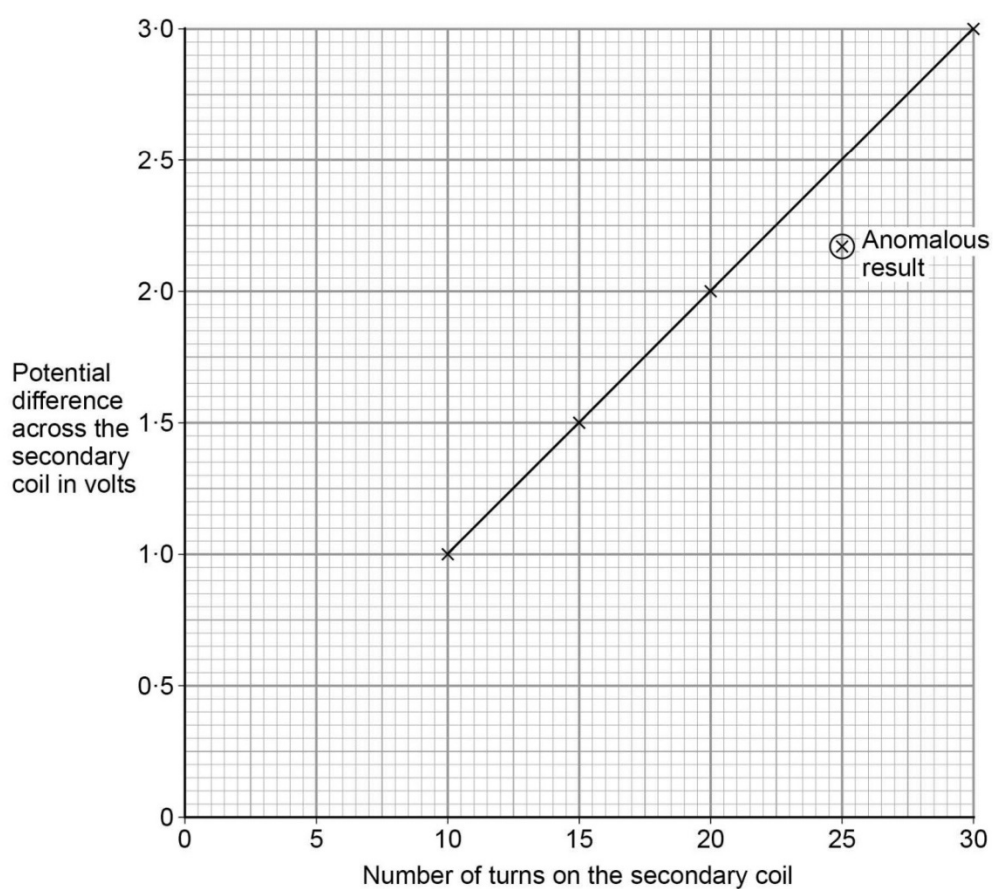
07

A student used a simple transformer to investigate how the number of turns on the secondary coil affects the potential difference (p.d.) across the secondary coil.

The student kept the p.d. across the primary coil fixed at 2V.

Figure 12 shows the results collected by the student.

Figure 12



07

2

The transformer changes from being a step-down to a step-up transformer.

How can you tell from Figure 12 that this happens?

[1 mark]

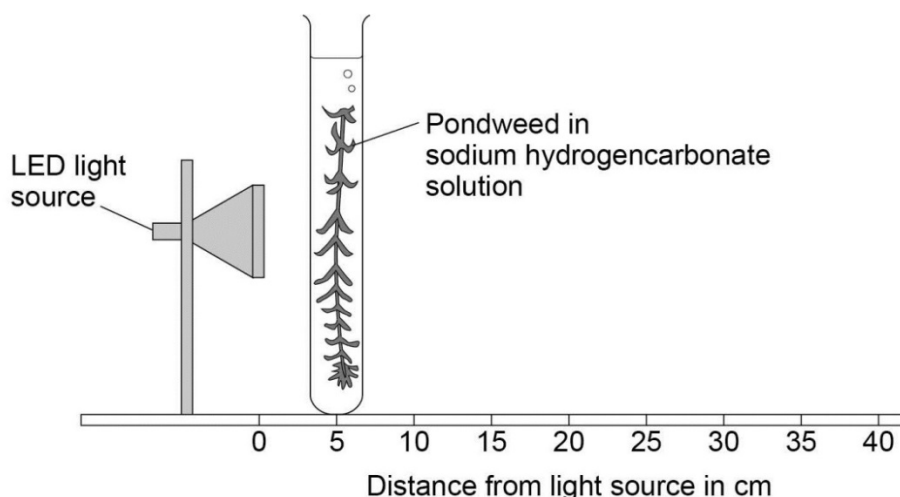
Example 3

Trilogy Biology question 2.2

A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Place the pondweed at 5 cm from the light source.
2. Measure the rate of photosynthesis by counting the number of bubbles produced in 30 seconds.
3. Repeat the investigation with the pondweed at different distances from the light source.

0 2 . 2 How could the student measure the rate of photosynthesis more accurately?

[2 marks]

Tick **two** boxes.

Count the number of bubbles produced in 1 minute

☐

Measure the change in mass of the pondweed in 30 seconds

☐

Measure the volume of gas produced in 30 seconds

☐

Place the pondweed further from the light source

☐

Use water instead of sodium hydrogencarbonate solution

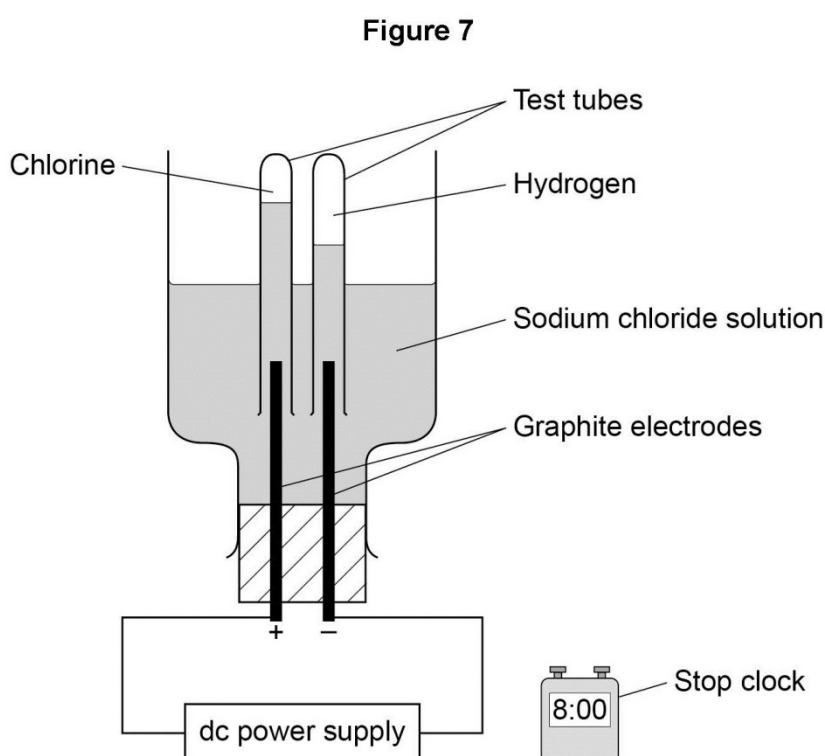
☐

Example 4

Chemistry question 6.3

The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

Figure 7 shows the apparatus.



0 6 . 3 The student made an error in selecting the apparatus for this investigation.

How should the apparatus be changed?

Give **one** reason for your answer.

[2 marks]

Example 5

Chemistry question 3.1

Polymers are used to make fabrics.

Table 1 shows some properties of two polymers.

Table 1

Property	Polymer J	Polymer K
Density in g/cm ³	0.9	1.4
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 3 . 1 Polymer fabrics are used to make firefighter uniforms.

Complete Table 2 by deciding for each property whether polymer J or polymer K is **best** for firefighter uniforms.

Use Table 1.

Density has been completed for you.

[2 marks]

Tick **three** boxes.

Table 2

Property	Polymer J	Polymer K
Density in g/cm ³	✓	
Melting point in °C		
Flame resistance		
Water absorption		

Example 6

Synergy question 9.1

The subject content covered by this question is common with Combined Science: Trilogy 6.6.2 (Electromagnetic waves).

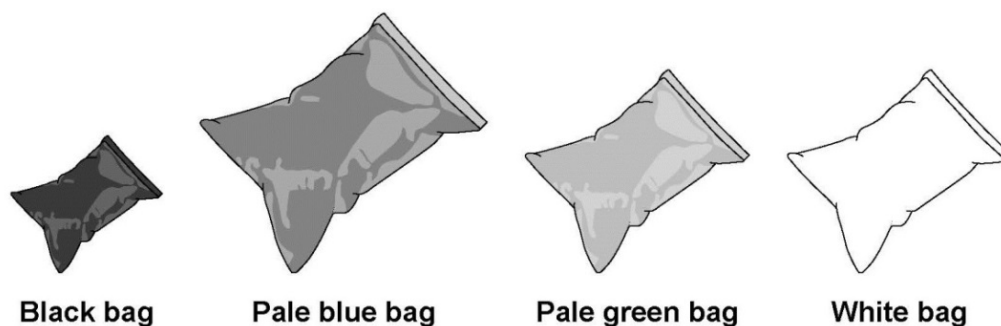
0 9

A solar water bag can be used to heat water for an outdoor swimming pool.

A student wanted to find out if the colour of the solar water bag affects the temperature increase of the water inside the bag.

Figure 12 shows some of the equipment used.

Figure 12



This is the method used.

1. Fill each bag with water.
2. Place the four bags on the ground outside.
3. After three hours, measure the temperature of the water inside each bag.
4. Repeat steps 1–3 on the next two days.

0 9

1

Suggest **three** changes the student should make to this method to get valid results.

[3 marks]

1 _____

2 _____

3 _____

Example 7

Biology question 8.4

Regular exercise can increase metabolic rate.

Two people did five minutes of gentle exercise from rest.

Table 6 shows the effect of the exercise on their heart rates.

Table 6

Time in minutes	Heart rate in beats per minute	
	Person R	Person S
0 (at rest)	60	78
1	76	100
2	85	110
3	91	119
4	99	129
5	99	132

0 8 . 4 Describe **two** differences in the response of person **R** and person **S** to the exercise.

Use information from **Table 6**.

[2 marks]

1 _____

2 _____

Example 8

Physics question 5.3

Table 2

Angle of incidence	Angle of reflection			
	Test 1	Test 2	Test 3	Test 4
20°	19°	22°	20°	19°
30°	31°	28°	32°	30°
40°	42°	40°	43°	41°
50°	56°	49°	53°	46°

0 5 . 3 Estimate the uncertainty in the angle of reflection when the angle of incidence is 50°.

Show how you determine your estimate.

[2 marks]

Uncertainty = $\begin{matrix} + \\ - \end{matrix}$ _____ °

Example 9

Trilogy Physics question 4.4

Table 3 shows the half-lives of two of the radioactive isotopes that contaminated the environment.

Table 3

Isotope	Half-life
Caesium-137	30 years
Iodine-131	8 days

0 4 . 4 A soil sample was taken from the area around Chernobyl in 1986

The soil sample was contaminated with equal amounts of caesium-137 and iodine-131

Explain how the risk linked to each isotope has changed between 1986 and 2018

Both isotopes emit the same type of radiation.

[4 marks]

Example 10

Physics question 7.1

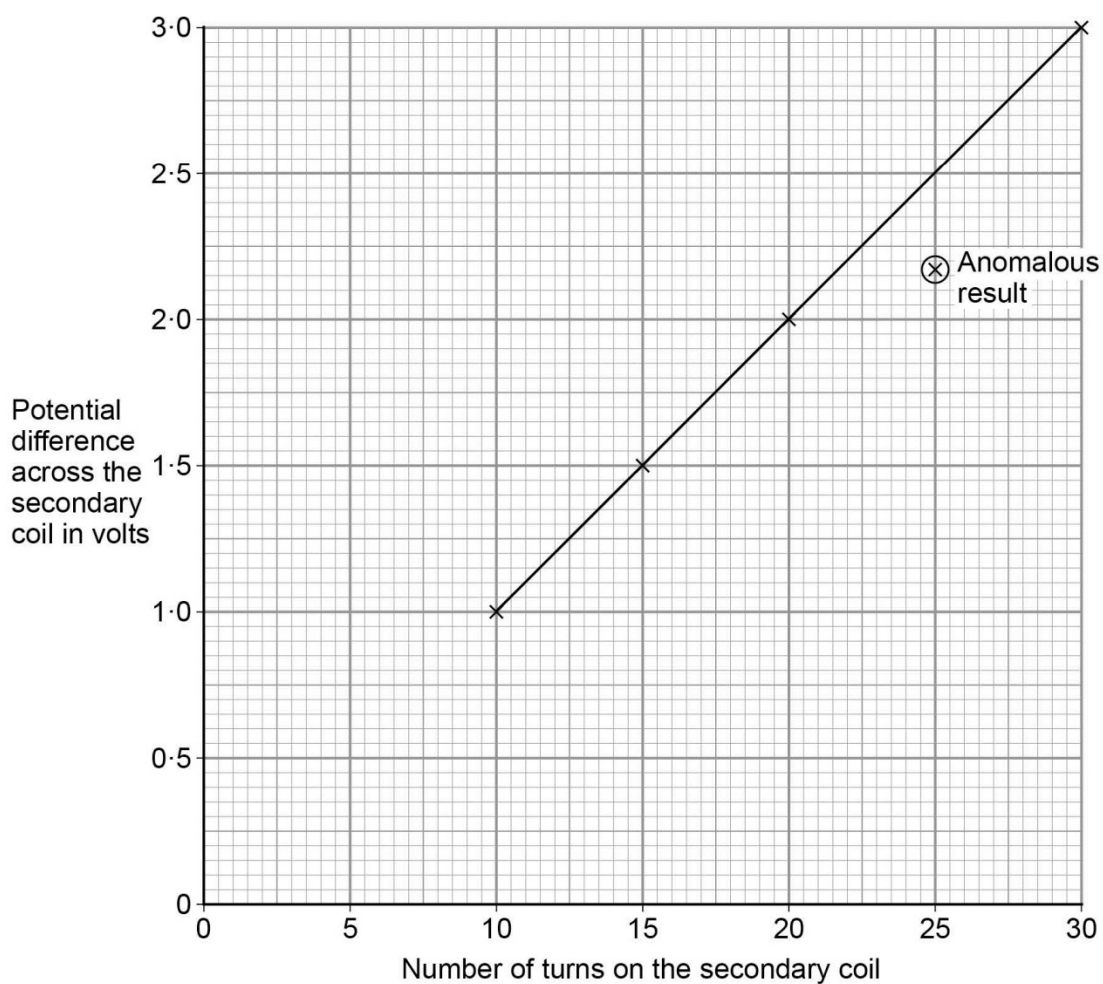
0 7

A student used a simple transformer to investigate how the number of turns on the secondary coil affects the potential difference (p.d.) across the secondary coil.

The student kept the p.d. across the primary coil fixed at 2V.

Figure 12 shows the results collected by the student.

Figure 12



0 7. 1

Figure 12 contains one anomalous result.

Suggest **one** possible reason why this anomalous result occurred.

[1 mark]

Activity 2: Progression of demand in A03

Look at the following questions.

Each set of questions assess the same strand of AO3, but at different levels of demand.

In your group consider:

- What has the examiner done to make the question work at the different levels of demand?
- How might you adapt your questions in class and homework tasks to ensure there is the appropriate level of challenge for different groups of students?

Interpret and evaluate

Low demand: Physics 1F Question 6.4

0 6 . 4

The UK currently generates a lot of electricity by burning natural gas. This process releases carbon dioxide into the atmosphere.

Figure 7 shows how the concentration of carbon dioxide in the atmosphere has changed over the past 115 years.

Figure 7

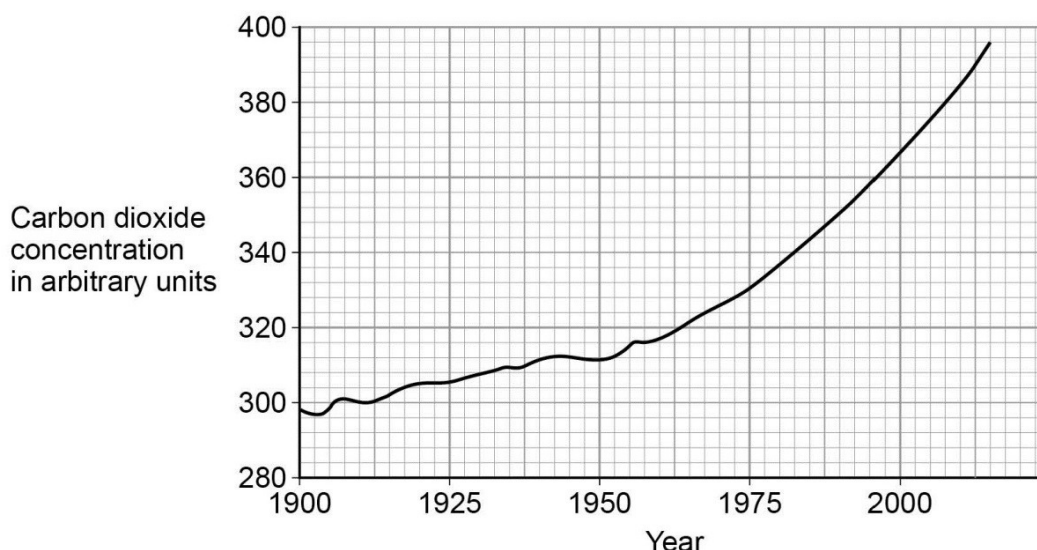
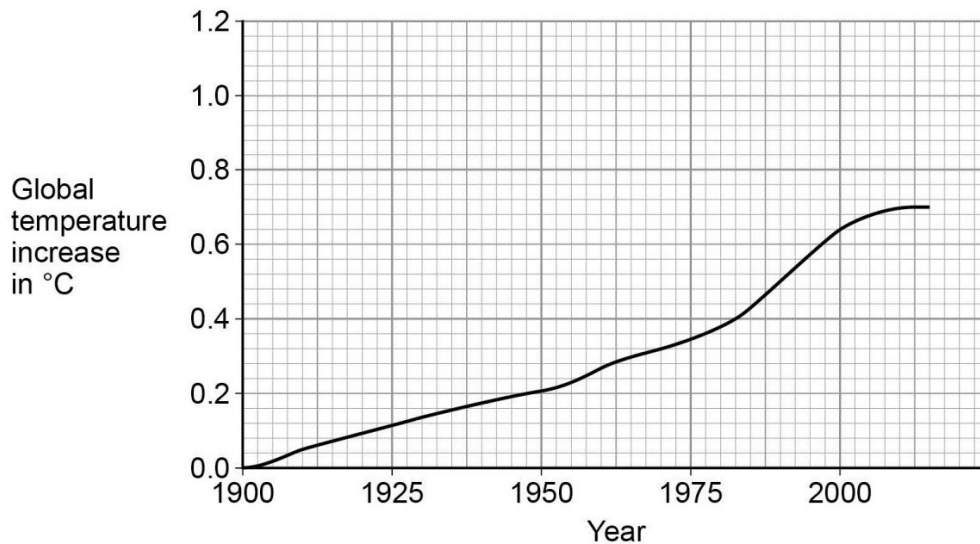


Figure 8 shows how the global temperature has changed over the past 115 years.

Figure 8



Give **one** similarity and **one** difference between the data in Figure 7 and Figure 8.

[2 marks]

Similarity _____

Difference _____

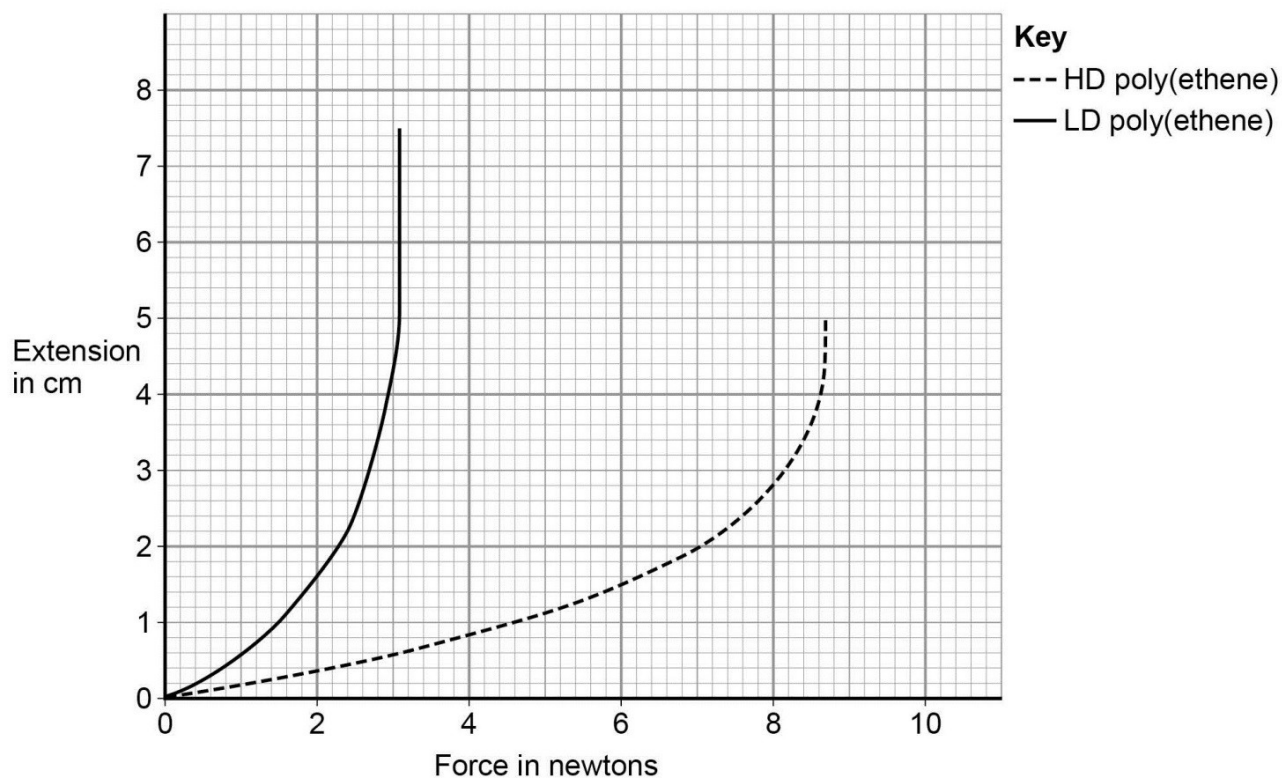
06.4	similarity: (carbon dioxide concentration and global temperature have) both increased	allow they both show a positive correlation	1	AO3 4.1.3
	difference: the carbon dioxide (concentration) continues to increase whereas temperature (increase) levels off	allow carbon dioxide (concentration) increases more quickly than temperature (increase)	1	

Standard demand: Synergy 4F Question 9.4

The subject content covered by this question is common with Combined Science: Trilogy 6.5.3 (Forces and elasticity).

Figure 14 shows the results for HD poly(ethene) and LD poly(ethene).

Figure 14



0 9 . 4 Give **two** comparisons between the results for HD poly(ethene) and for LD poly(ethene).

Use **Figure 14**.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

09.4	<p>any two from:</p> <ul style="list-style-type: none"> • both have increasing extension with increasing force • both extend non-linearly • HD poly(ethene) has a smaller extension (than LD poly(ethene)) for a given force • HD poly(ethene) has a smaller maximum extension (than LD poly(ethene)) 	<p>allow LD poly(ethene) stretches more for a given force allow correct readings of extension for a given force for both polymers</p> <p>allow HD poly(ethene) breaks at a greater (maximum) force</p> <p>ignore references to strong / weak</p>	2	AO3 4.6.1.6
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High demand: Synergy 2H Question 6.5

The subject content covered by this question is common with Combined Science: Trilogy 4.5.2 (The human nervous system) and 6.5.4.3.2 (Reaction time).

Scientists investigated the effect of lack of sleep and the effect of alcohol consumption on the human nervous system.

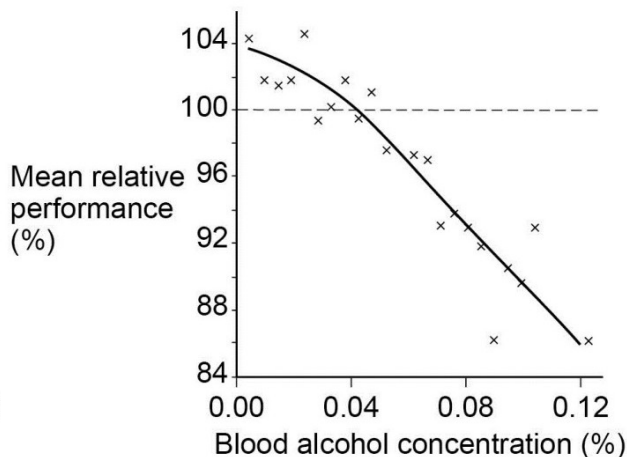
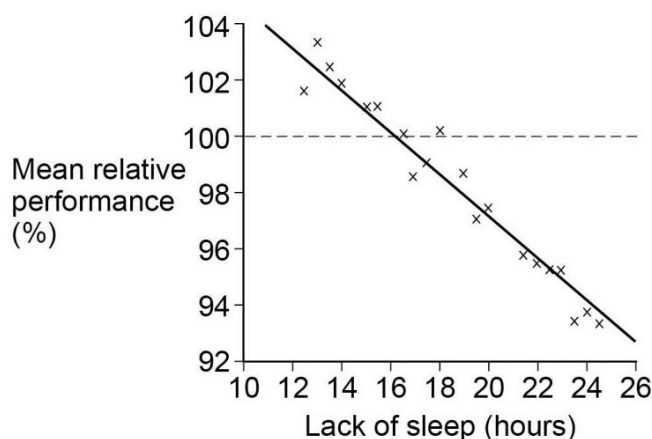
This is the method used.

1. Each person completes an accuracy test using a computer.
2. Their average score is taken as 100%.
3. Half of the group are kept awake for 24 hours.
4. The other half of the group drink alcohol until their blood alcohol level reaches 0.12%.
5. Each person repeats the accuracy test at regular intervals using a computer.

Figure 4 and Figure 5 show the results of the investigation.

Figure 4

Figure 5



0 6 . 5

Mean relative performance is a comparison with the person's original score. For example, 50% means their accuracy on the test was half of their original score.

If your blood alcohol concentration is above 0.08% it is against the law to drive in the UK.

A newspaper states the following:

Driving whilst tired is as dangerous as driving after drinking alcohol.

Evaluate the newspaper's statement.

Use information from Figure 4 and Figure 5.

[4 marks]

06.5	<p>reasons in support:</p> <ul style="list-style-type: none"> • performance / accuracy decreases with increasing alcohol concentration and performance / accuracy decreases as lack of sleep increases • reduction in performance at the legal alcohol limit / 0.08% (for driving) is the same as (more than) 24 hours without sleep <p>reasons against:</p> <ul style="list-style-type: none"> • idea that the statement is sensationalised and does not use (quantifiable) data • the (performance) scales are different, so difficult to make comparison or the (performance) scales are different so the data is misleading • being tired is subjective / different for everyone • there is wide variation in the data • (the graph shows that) some people have 16 / 18 hours without sleep and don't have a drop in performance • at alcohol levels of 0.09% some people have a 14% drop in performance (which is much higher than lack of sleep) • (data contradicts the statement because) for some a small amount of alcohol improves performance 	<p>max 3 marks if only reasons in support or reasons against given ignore study design</p> <p>allow idea that lack of sleep does not necessarily correlate with tiredness</p> <p>allow other correct points of comparison</p>	4	AO3 4.2.1.6
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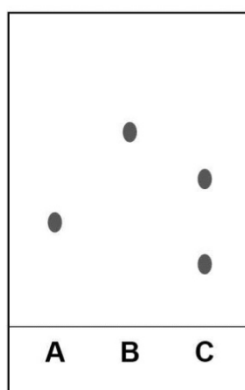
Make judgements and draw conclusions

Low demand: Chemistry 2F Question 5.3

0 5 . 3 Another student sets up the apparatus correctly.

Figure 3 represents the student's results.

Figure 3



What **two** conclusions can be made from **Figure 3**?

[2 marks]

Tick **two** boxes.

Flower **A** contains a single pure colour

☐

Flowers **A** and **B** contain the same colours

☐

The colour in flower **C** is a mixture

☐

The colour in flower **B** was the least soluble

☐

Two of the colours have the same R_f value

☐

05.3	flower A contains a single pure colour		1	AO3 4.8.1.3
	the colour in flower C is a mixture		1	

Standard demand: Trilogy Biology 2F Question 6.7

Table 7 shows the results.

Table 7

	Distance from tree in metres					
	0	2	4	6	8	10
Percentage cover of grass	15	50	35	16	15	15
Percentage cover of plantain	0	5	10	40	25	30
Percentage cover of daisy	0	0	0	4	20	10
Percentage cover of clover	1	10	25	40	40	45
Total percentage cover of plants	16	65	70	100	100	100
Light intensity in arbitrary units	37	59	150	175	>200	>200

06.7 Which plant species in Table 7 will only grow at high light intensity?

[1 mark]

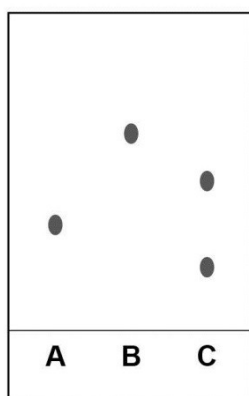
06.7	daisy		1	AO3 4.7.2.1
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High demand: Chemistry 2H Question 4.2

0 4 . 2 Another student set up the apparatus correctly.

Figure 5 represents the student's results.

Figure 5



Give **two** conclusions you can make from **Figure 5**.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

04.2	any two from: <ul style="list-style-type: none"> the flowers have no colours in common A / B contain one colour C contains two colours (the colour in) B is most soluble 	allow the flowers are not the same colour allow C is a mixture of colours allow (the colour in) B has the highest R_f value allow one of the colours in C is the least soluble	2	AO3 4.8.1.3
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Develop and improve experimental procedures

Low demand: Chemistry 2F Question 5.2

0 5

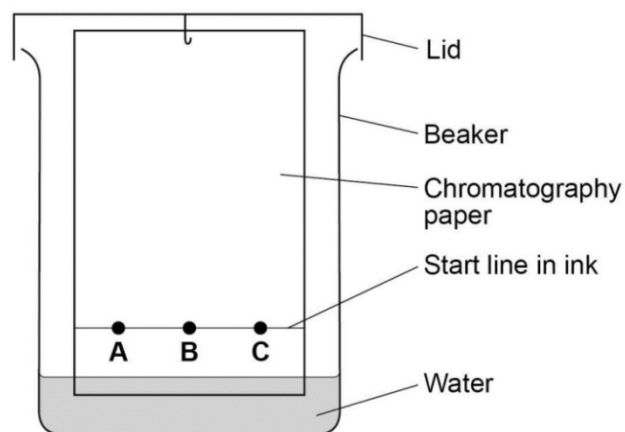
A student investigated the colours in three different flowers, **A**, **B** and **C**, using paper chromatography.

The colours are soluble in ethanol but are insoluble in water.

0 5 . 2

Figure 2 shows the apparatus used.

Figure 2



What **two** mistakes did the student make in setting up the apparatus?

[2 marks]

Tick **two** boxes.

The paper does not touch the beaker

☐

The start line is drawn in ink

☐

The water level is below the start line

☐

Uses a lid on the beaker

☐

Uses water as the solvent

☐

05.2	the start line is drawn in ink		1	AO3 4.8.1.3
	uses water as the solvent		1	

High demand: Chemistry 2H Question 4.1

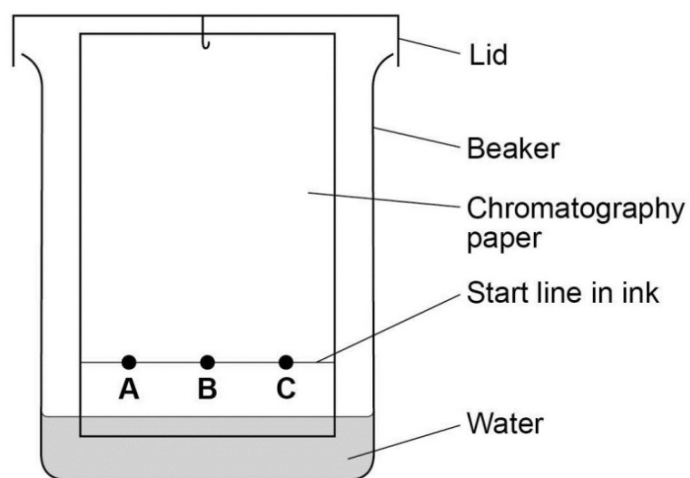
0 4

A student investigated the colours in three different flowers, **A**, **B** and **C**.

The colours are soluble in ethanol but are insoluble in water.

Figure 4 shows the apparatus used.

Figure 4



0 4 . 1

The student made **two** mistakes in setting up the apparatus.

Give **one** problem caused by each mistake.

[4 marks]

Mistake 1 _____

Problem caused _____

Mistake 2 _____

Problem caused _____

04.1	start line drawn in ink	allow start line should have been drawn in pencil	1	AO3 4.8.1.3
	(so) ink dissolves or ink runs in solvent / water	(as) pencil does not dissolve or pencil does not run in solvent / water	1	
	water used (as solvent) or water in beaker	allow ethanol not used	1	
	(so) colours will not dissolve / move		1	

Activity 3: A03 teaching and learning

Below you can see the types of assessment tasks students might be required to do for each strand of A03.

- Split into three groups taking one strand each
- Add actions/reminders of things to do in lessons to help students develop these skills
- Add any strategies students could use to access the questions more successfully
- These might be different depending on the level of demand you are focusing on

Interpret and evaluate

How this might be assessed

- Identify/describe patterns and trends in information
- Compare patterns and trends
- Draw inferences from patterns and trends
- Use information given to support or disprove a conclusion, judgement or hypothesis
- Interpret information to give advantages and disadvantages
- Calculate uncertainties
- Identify anomalous results

Make judgements and draw conclusions

How this might be assessed

- Use data/information to make a judgement (eg about which of two statements is correct)
- Use data/information to come to a conclusion about what the data is showing
- Use data/information to explain phenomena and relationships
- Consider the validity of data in presenting and justifying conclusions
- Make predictions based on data

Develop and improve experimental procedures

How this might be assessed

- Adapt/develop a given method to test/prove a hypothesis, answer a query, produce a particular result
- Identify variables that need to be controlled
- Identify and explain sources of error in experiments
- Identify reasons for anomalous results
- Identify and explain risks in experimental procedures
- Change a method to improve it eg to correct/eliminate errors, increase accuracy

Activity 4: Data resources to support teaching

As part of the training materials we have produced three data source booklets, one for each science. These materials are taken from the legacy specification controlled assessments (ISAs).

Not all the ISAs are relevant to the new specification so the data booklet includes those ISAs that:

- link directly to the required practicals
- link to areas of the subject content.

Using the [data source booklets](#) from the website

- As a group familiarise yourselves with the information provided, particularly page 4.
- In smaller groups discuss how you can use the ISA materials to develop your students AO3 skills.

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

Personal development aim/target:
What do I need to achieve?
Actions:
Support required:
Measure(s) of success:
Review date(s):
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: Who has ownership of each area?
Support required: How will we work together? How will we hold each other to account?
Measure(s) of success: How will we evidence achievements?
Review date(s):
Achievement date:

Appendix

Activity 2: Commentaries

Interpret and evaluate

Physics 1F Question 6.4

Students should compare the patterns shown in the two simple line graphs and identify how they are similar and how they are different. In the question paper the two graphs are opposite each other on facing pages so they can do the comparison easily. They are prompted into a comparison by the instruction 'Give one similarity and one difference' Students are being asked for a comparison and at this level may struggle with the command word, so the question is scaffolded and simply put, steering students to what is required.

Synergy 4F Question 9.4

This question assesses aspects of working scientifically 3.5.

Students should study the patterns in the graph for both materials and identify similarities and differences. Having two sets of data on one graph, with a key that they need to interpret increases the level of demand from that shown in the previous question. This question clearly asks students to compare and does not steer them towards similarities or differences, which opens it up and gives less scaffolding as to what is required. The mark scheme credits similarities and differences.

Synergy 2H Question 6.5

The question assesses aspects of Working scientifically 3.5 and 3.6, and maths skill 4a.

This is a very high demand example, intended only for the most able, which occurs about two thirds of the way through the Synergy HT paper (Synergy papers typically have eight or nine questions). Students need to interpret the data in the two graphs, which are more complicated than those in the previous examples. They then need to compare the data and use their interpretations to justify or refute the statement given. There is a lot of information that students need to process in order to evaluate the statement. This example shows how the complexity of the task ramps up with the level of demand, and more than one aspect of AO3 is being assessed here (including an aspect of 'making judgements and drawing conclusions'). The question and data is all on a double page spread, so students did not have to flip pages.

Make judgements and draw conclusions

Chemistry 2F Question 5.3

The question also assesses aspects of working scientifically 3.5.

Students should interpret the information given in the simple chromatogram to conclude which substances are present. The closed nature of the question keeps the demand low. Compare with the next much more open question, which targets a higher level of demand.

Trilogy Biology 2F Question 6.7

The question assesses an aspect of working scientifically 3.5.

Students should interpret the information in the bottom row of the table that indicates light intensity increases with distance from the tree and the information about percentage cover of the different species with distance from the tree to conclude that the daisy is the correct species. Interpretation of tabular data can be more demanding than interpreting a graph or diagram, but the numbers in the table are all whole numbers, and clearly show the differences in light intensity and plant cover, so it is a relatively straightforward task.

Chemistry 2H Question 4.2

Uses the same chromatograph the previous example, but the question is much more open. It's actually targeted at standard to high demand, so students are still steered slightly towards what is required.

Develop and improve experimental procedures

Chemistry 2F Question 5.2

This question assesses aspects of Working scientifically 2.3 and 2.7.

This question is based on a required practical activity, so students should be familiar with the basic experimental set-up. Students need to use the information given in the stem and in the diagram to identify which two of the options given are the errors. Compare this question with the next more open, high-demand question.

Chemistry 2H Question 4.1

This question assesses aspects of Working scientifically 2.6 and 2.7.

It assesses the same skills as the previous example, but the level of demand is higher as students are not given options to choose from. No clues or prompts are given. Also, as well as being asked to identify the errors, an extra aspect is brought in because they are being asked to identify the problem that each error would cause.

Notes

Notes

Notes

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