ASE 2018

Ready for AQA science GCSEs 2018?

Making the most of AQA assessment resources

January 2018

Contents

Slides

Ready for AQA science GCSEs 2018?

Elise Reece
Science Curriculum Manager

Making the most of AQA assessment resources

- Lessons learnt from summer 2017 series and end of Year 10 tests
- How to make the most of the two sets of specimen papers
- Intervention resources

Executive summaries and example student responses

Exam techniques
- command words
- key terms
- scientific calculators

Maths skills
- graphs – plotting, describing, gradients of the curve, lines of best fit, using a pencil
- significant figures
- standard form
- unit conversion

Working scientifically
- variables
- what is a conclusion?
- improving accuracy
- identifying types of errors
- identifying hazards and risks

Executive summaries and example student responses

Use of language
- extended answers
- planning
- use bullet points with care
- logical order
- words with specific scientific meaning

Subject content and misconceptions

Similar points seen on end of Year 10 test
- may have carried out the practical work but learning is not embedded
- importance of the apparatus and techniques is being missed
- not using equations given

Using specimen papers

First set of specimen papers:
- Now on Exampro.
- Use in training to familiarise teachers with style of questions and the assessment model.
- Use in lessons to exemplify style of questions with students.
- As with the live papers, any part of the specification can be assessed.

Year 10 test:
- Introduce students to the types of questions in the new exams.
- Give students a feel for the challenge of the new exams.
- Identify areas of weakness for individual students that may need intervention.
- Appropriate length to fit school timetable.
- Assesses topics that teachers said they would have covered by Easter of Year 10.
- Written by examiners who were writing the live exams.

Using specimen papers

Second set specimen papers:
- Full set of papers and mark schemes.
- Metadata.
- Analysis tool from Exampro – MERiT.
- Written by the examiners in parallel with live summer 2018 papers.
- Any part of the specification can be assessed.
- Same balance of AOs etc as the live papers.
- No grade boundaries – level of demand will give an indication of progress.
- Use as mock exams – due to increase in assessment time many schools are doing staged mocks with Paper 1 Dec/Jan, Paper 2 Feb/March when course completed.
- By doing some level of analysis teachers and students can identify areas of weakness and can then plan appropriate intervention to address these gaps.
- Webinar recording

Intervention

- AO1 knowledge in isolation is only 15%, therefore opportunities for application, analysis and evaluation are important.
- 15% practical skills.
- Maths skills - 10% biology, 20% chemistry, 30% physics.
- Teachit lessons using the required practicals as a starting point.
- Teachit equation flash cards
- Subject specific vocabulary.
- Command words document.

How did we do?

- Please rate this session on the **Sched Conference app**.
- Using the post-its provided, please write:
  - one thing you enjoyed about our session or will take away for your teaching
  - one thing you feel could be improved.
- Stick these on the feedback poster as you leave.

Get in touch

Contact us
aqa.org.uk/contact-us

Customer Support Team
01483 477756
gcsescience@aqa.org.uk

Events Team
0161 696 5994
events@aqa.org.uk
aqa.org.uk/professional-development

Thank you

Executive summaries

Summaries covering Science A (route 1), Additional Science (route 1), Biology, Chemistry and Physics

Lessons from summer 2017

Grade boundaries

To view grade boundaries, visit aqa.org.uk/gradeboundaries

For results statistics, visit aqa.org.uk/exams-administration/results-days/results-statistics

Qualification summary

There are some key overarching points which are relevant to all science disciplines. Unlike in previous years, we have referred to all the sciences within the key heading, as in the new GCSEs these assessment points will be valid for all.

It is important to note that the assessment structure, weighting of AOs, maths skills and practical skills, including working scientifically, are different in the new GCSE papers. However, there are some very useful lessons which can be carried over from the previous assessments.

To exemplify some of these key assessments points we have put together a number of student responses with commentaries to illustrate good answers. These can be used in conjunction with this document and the detailed examiners report.

General remarks

Students appeared to be able to complete the papers in the time available, and most attempted all parts.

Response to some of the practical and working scientifically questions suggest students are getting practical experience, but some of the finer details are being missed in responses to questions. Some were hindered by following a whole school/college approach/structure which did not always elicit the best responses. Students need to carefully read the questions and ensure they are addressing any bullet points which are given to guide their response.

Exam technique

There is increasing evidence of students highlighting what they consider to be key words in the question –both the command word and important scientific terms. This is excellent practice and should be encouraged.

Small changes to how students approach a question paper can help them demonstrate their knowledge and understanding better:

- **command words** – know what they mean, particularly the difference between describe and explain. For example:
    - in BLH16aii, 7bi, 8a many students described rather than explained and vice versa
    - in CH1FP 7 many students wrote an advantages/disadvantages response to a question asking for explanations about environmental impact
    - in PH3FP 2e asked students to state the power output of a transformer, given the power input and assuming it is 100% efficient. Many tried to calculate the output
- understand **key terms** and their precise use,(eg precision and accuracy) validity, repeatability, reproducibility and anomalies. For example, in PH2HP 6cii students wrote about anomalies and reliability when the question was about the validity of the conclusion
- express ideas **clearly and unambiguously**
- be familiar with the **name, spelling and uses** of common experimental apparatus. This was particularly evident in CH3FP 4bi
- the **inclusion of extra, incorrect information** in addition to the correct answer **can cancel a potential mark**. For example, in BLF1Ciii students added incorrect information eg 'vitamins' which disqualified any credit already gained
- **use a pencil to plot graphs** or complete dot-cross diagrams so that mistakes can be corrected easily. This was particularly evident in CH2FP 4div
- ensure students have **scientific calculators** and are comfortable using them. This was particularly evident in PH1FP and PH3HP 4d
- **don't just repeat information** from the stem of a question. For example:
    - in CH3FP 3aiii when asked to describe how ammonia is separated from natural gas, many simply quoted 'it turns into liquid,' which was given in the diagram in the stem
    - in PH2HP 1a when asked for manmade sources of radiation, many students gave examples of natural radiation shown in the graph in the question
- simply **rephrasing the question** will rarely score marks. For example, in PH1FP 3cii students wrote that a burglar blocking light caused the alarm to sound, when this was given in the stem
- **read the whole question carefully** and answer what it asked. For example:
    - in BL1F 9b, students restricted their marks as they didn't address the bullet points in the question, ie didn't 'name one type of receptor and the stimulus that the receptor detects' as asked. Other examples were seen in BLH1 3b,4 and 7
    - in CH1FP 6cii and 6ciii, when asked about the relationship between number of carbon atoms and boiling point of alkanes, many compared the boiling points of alkanes and alkenes, which was actually the next question
    - in CH1HP 4aiii, the intention was for students to suggest what might have changed to cause a difference in a trend, but many students described differences in the trend instead
- **scan for marks** to ensure they don't miss any questions and look at the number of marks for the question to ensure they **give enough detail** in their answers – one short phrase is rarely enough for two marks.

Maths skills

Calculations have been generally well done in Chemistry but there are some weaknesses with skills such as analysing trends, Reassuringly in Physics, a large proportion of students showed their working with calculation questions. This is a good way to ensure marks can still be gained if a mistake is made. There were very limited maths skills assessed in Biology which will be a notable change in the 2018 papers.

Areas for attention/note:

- **practice plotting and describing graphs**, including those that are not a straight line
- more practice is needed with **calculations that involve significant figures and standard form**
- many Biology candidates were unable to calculate the **percentage increase in the rate of photosynthesis**. This was particularly evident in BL2HP4bii
- students found interpreting the **amylase activity graph** and applying this knowledge in an unfamiliar way quite difficult. Many reversed the colours and some invented new colours. This was particularly evident in BL2FP8bii
- when asked to describe a curved graph, many made no reference to **the gradient of the curve** (and hence the rate of reaction) decreasing as time increased. This was particularly evident in CH2FP 5aiv
- students need to be familiar with **drawing lines of best fit** for data sets that have anomalies and where the line may be a curve. This was particularly evident in CH2FP 5ai and CH3FP 3cii
- students need to remember to **exclude anomalies before calculating means**. This was particularly evident in CH3FP 4ci
- students wrote about a **general trend** but did not notice that it was not the same for the **whole range of the data**. This was particularly evident in CH1HP 4aii and CH2HP 2eiii
- students trying to **rearrange equations** when they don't have to, which was particularly evident in PH1FP 1c, or not rearranging correctly when they do need to, which was particularly evident in PH2FP 6b
- poor performance in questions that ask for use of **significant figures** in the final answer. For example, in PH1HP 1b and PH3HP 5b many students did not give an answer to two significant figures despite being asked to
- there was some evidence that students did not have **calculators to work out standard form**. For example, in PH2HP 6ci students confused 3×10^{-3} with 3×10^{3}, entering the number into their calculators incorrectly
- **calculations involving unit conversions** were not always done well. For example:
  - in PH1HP 6b and PH2HP 4bii not converting kJ,
  - in PH2HP 5aii very few managed to convert 40 milli watts
  - in PH1FP 4d - not converting pounds into pence
- not realising the need to **halve numbers** for things like ultrasound reflections. For example:
  - PH3FP 4c dealt with a reflected pulse of ultrasound
  - PH2HP 4bi dealt with the area of a triangle
- using the **correct figures** and **thinking about what they mean**. For example:
  - in PH2HP 7b, many used an acceleration of 2500 m/s2 as the velocity when calculating a momentum
  - PH2FP 3ai included three numbers to choose from
  - a pertinent example from our IGCSEs saw students estimating the distance between Saturn and the Earth. Answers in terms of µm probably should have raised doubts.

Working scientifically

Students are generally able to access questions assessing practical skills; however vague language often limited marks. Good understanding of the basic principles of scientific investigation will enable students to access marks in questions even if they are not familiar with the practical.

- students appeared to have difficulty recognising or suggesting **control variables**. For example:
    - in1BL1FP4ci, the frequent response of 'repeating the experiment' illustrates students misunderstanding of controlling factors to make the investigation valid
    - in CH3FP 6ci students made vague references like 'ensuring the same people do the experiment' or used 'amount' instead of a measurable quantity such as 'volume'
    - in PH3FP 7a and PH3HP 1ai, very few gave two correct control variables
- when asked to **evaluate the validity of the method used and the evidence for** the scientists' conclusion, students needed to make points both for and against the method and the conclusion. Many students simply addressed one side of the argument. Others, while making both positive and negative points, did not make it clear whether the point they were addressing supported or refuted the argument. This was particularly evident in BL2H 5bi
- greater understanding is needed of what a **conclusion** is. For example:
    - in BLF15bii, when asked for the reason why a given student's conclusion might not be correct they referred to methodology like 'experimental errors', not being' fair' having different strengths of antibiotic or different disc size rather than the scientific knowledge in the given conclusion
    - in CH1HP 5ai, when asked to give a conclusion for a table of data, many students described the data instead students were given a flawed conclusion but were not able to answer why it was not valid
- greater understanding is needed that **one theory is chosen over another because there is evidence to support it**. This was particularly evident in PH2FP 8c
- understanding **why apparatus is used to improve accuracy**. For example:
    - in CH2FP 4ci,many made reference to insulation conducting heat or made vague references to reliability and accuracy with no reference to reduction of loss of thermal energy from a beaker
    - in CH2HP 1biii, simply saying you would get 'better readings' is insufficient
- it is a common misconception that a **data logger** or **digital thermometer** will **give more accurate results**. This was particularly evident in CH3FP 6cii
- suggesting two improvements to the **amylase investigation** was problematic although nearly half were able to suggest one. This was particularly evident in BL2F8bii
- students usually volunteer **suggestions for hazards and risks**, but need to ensure any precautions are valid. For example, in PH3FP 9b suggestions that breathing masks and goggles should be worn if having a CT scan.

Use of language

Some of the better quality of written communication answers tended to include some indication that the students had planned what they were going to write – either using sub-headings to ensure the student attempted each part of the question, or something as simple as a list at the top of their answer and using this as a basis to structure their answer.

There were good responses to some of the quality of written communication questions, with students able to write concisely without irrelevant detail, for example in CH2HP 2. Sometimes students give vague answers, or perhaps don't realise the significance of the words they choose:

- plan **extended response answers** before writing them – perhaps a bullet point list to help think about structure before the full answer
- precise use of **definitions and language**. For example:
  - in BL2F6 diffusion does not occur 'along' or 'across' a concentration gradient but down the gradient
  - many students missed marks because they did not define a hydrocarbon consisting of carbon and hydrogen only in CH1FP 6b and CH1HP 2b
  - in CH1FP 7, when asked about pollution of quarrying, many wrote 'drilling or quarrying cause pollution' but did not state how
  - in PH1FP 9, 'black attracts heat' or 'metals are good insulators', in reference to 'storing/trapping heat' and 'attracting heat' limited access to level 3
- some extended response questions include discussion about **methods**, for which the **order of events** is important. Some responses lacked structure and mixed stages, which can limit marks. This was particularly evident in CH1HP 5c
- students need to recognise that many **common terms** such as 'power' and 'energy' have **specific meaning in science**. This was particularly evident in PH1HP 6c.

Subject content and misconceptions

Some topics will naturally be more challenging for students than others:

Biology:

- there was a widespread misconception that neurones rather than impulses travel (BLFP9b)
- students mistakenly wrote that 'chemicals/hormones/pulses pass through neurones (BL1FP9)
- Students did not know the function of ribosomes (BL2HP6b)
- Students found the application of sampling technique question challenging many having very little idea how the investigation should be carried out. As one of the required practicals is on sampling it would be useful to look again at this question (BL2H7)

Chemistry

- Although chemical formulae are generally acceptable as alternatives to the names of substances, they need to be correct, for example CO_2 is an acceptable alternative to carbon dioxide but CO^2 is not.
- students should know that catalysts increase the rate of reaction but do not necessarily change the yield (CH2FP 5c)
- questions requiring an understanding of bonding were not well answered (CH2HP 3aiii, 3c)
- evidence some students had no experience of making copper sulfate crystals, with limited understanding of steps such as filtration (CH2FP 4a)
- many thought a higher pH meant a stronger acid, there is also lack of precision with words with 'less acidic' being used in place of 'weaker acid'(CH3HP 3eii)

- questions involving reversible reactions and equilibrium – many thought a higher temperature would increase the yield in an exothermic reaction (CH3HP 5ai, 5aii)
- negative temperatures are not well understood with many thinking -260 °C is a greater temperature than -33 °C (CH3HP 6aii)

Physics:

- practice rearranging equations so students understand how to use them
- students continue to find convection currents difficult to explain (PH1HP 8a)
- similarly, states of matter questions see answers such as 'water vapour particles turning into liquid' (PH1HP 8c)
- smaller parts of the specification tend to be answered less well. A question about pumped storage generation saw lots of detail about hydroelectric power stations, but little about the pumping part (PH1HP 7bi)
- thinking, braking and stopping distances are often confused, with many students using 'reaction time' to mean the time taken to stop the car (PH2FP 2bi).
- students thought that increased reaction time meant you could react faster (PH2FP 2bii)

Find more observations from the first series in the full examiner reports available at [aqa.org.uk/log-in](aqa.org.uk/log-in)

Example student responses

These example student responses are taken from the summer 2017 series. The students scripts show good answers and can be used with teachers and students to highlight good practice when answering exam questions.

The types of questions although different from the reformed GCSEs science papers to be sat in summer 2018 reflect some of the structures found in the new question types.

The full set of example responses, can be found in our Autumn Hubs accompanying materials: aqa.org.uk/subjects/science/hub-schools-network

- Biology
  - quality of written communication
  - Practical method QWC
  - photosynthesis practical
  - practical investigation involving enzymes
- Chemistry
  - quality of written communication
  - analysing trends
  - practical method in a quality of written communication question
  - titration method
  - titration calculation
- Physics
  - quality of written communication
  - calculation with unit conversion
  - calculation involving reflection
  - describing differences between two lines on a graph
  - calculation with standard form and significant figures

PH3HP 5b – calculation with standard form and significant figures

2 marks awarded out of 3

5 (b) The pressure in the liquid in the hydraulic system in the jaws is 5.2×10^8 Pa
The cross-sectional area of the load piston in the jaws is 4.1×10^{-4} m^2

Calculate the force at the load piston.

Use the correct equation from the Physics Equations Sheet.

Give your answer to two significant figures.

[3 marks]

$P = \frac{F}{A}$ $F = P \times A$

$(4.1 \times 10^{-4}) \times (5.2 \times 10^8) =$

213200

Force = 213200 newtons

Commentary

Again the student has underlined figures and has correctly worked with standard form. Unfortunately, they did not follow the instruction to give an answer to 2 significant figures. 29% of responses scored full marks for this question, with marks being dropped invariably for incorrect rounding or mistakes in working with figures in standard form.

Mark scheme

5(b)	2.1×10^5	accept 210 000 for **3** marks allow **1** mark for correct substitution ie $5.2 \times 10^8 = F / 4.1 \times 10^{-4}$ allow **2** marks for an answer of 213200 **or** one that rounds to 2.1×10^5	3	AO2 3.2.3c

PH1HP Q6b – calculation with unit conversion

4 marks – full marks awarded

6 (b) The mobile phone battery can store 36 kJ of energy and was initially uncharged.

Calculate the minimum time, in hours, it would take to fully charge the mobile phone battery using these solar cells.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Energy = Power x time

36kJ = 2.5W x time

36000 = 2.5 x time

$\frac{36000}{2.5} = \frac{14400}{60}$ sec $= \frac{240 \text{ mins}}{60} = 4$

Time = 4 hours

Commentary

Here the student has underlined and circled important information in the question to ensure they understand what is being asked of them. They have also shown detailed working, which means that if they had made a simple mistake with their calculator, they could still have been awarded compensation marks.

Mark scheme

6(b)	4 (hours)	allow **2** marks for an answer of 14 400 (seconds) **or** allow **2** marks for an answer of 240 (minutes) allow **1** mark for correct substitution ie 36 000 = 2.5 x t allow **2** marks for an answer of 0.004 allow **1** mark for an answer of 14.4 for a student who uses 6.3 W or 6.25 W allow **2** marks for an answer of 1.6 hours allow **1** mark for an answer of 5714 or 5760 or 5.71 or 5.76	3	AO2 1.3.1c

BL2FP Q8 / BL2HP Q3 – practical investigation involving enzymes

8 marks – full marks awarded

3 Amylase is an enzyme that breaks down starch.

3 (a) Complete the equation to show the breakdown of starch.

[1 mark]

Starch $\xrightarrow{\text{amylase}}$ Sugar

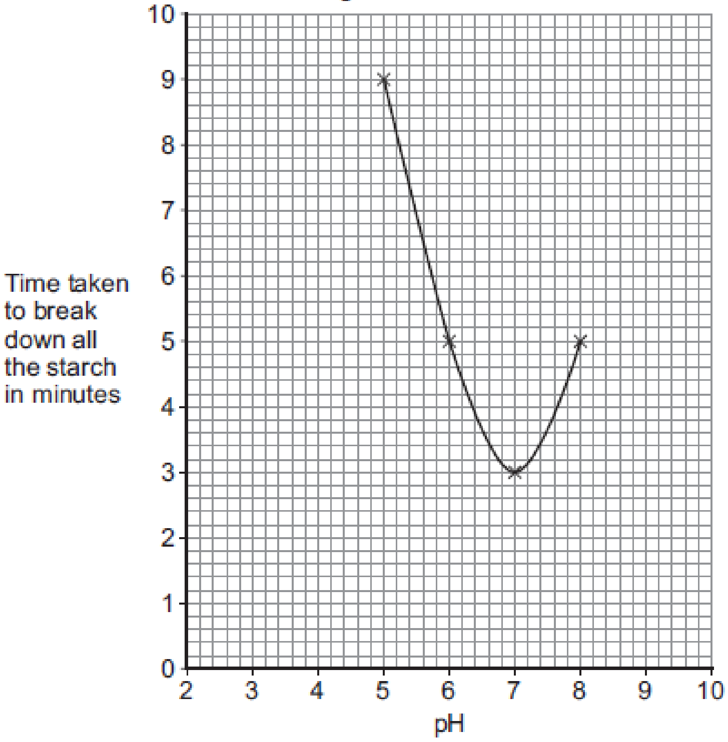
3 (b) Some students investigated the effect of pH on the activity of amylase.

The students:

- put 5 cm^3 of pH5 solution + 1 cm^3 of amylase solution into a test tube
- put 4 cm^3 of starch suspension into a second test tube
- left both test tubes at room temperature for 5 minutes
- mixed the contents of the two test tubes
- removed a small sample of the mixture at 1-minute intervals
- tested each sample for starch
- timed how long it took to break down all the starch
- repeated each of the above steps at pH6, pH7 and pH8.

Figure 4 shows the students' results.

Figure 4



3 (b) (i) Give **two** variables which were controlled in this investigation.

[2 marks]

1 the volume of pH solution

2 the volume of amylase solution.

3 (b) (ii) The students tested samples of the reaction mixture for starch. In each test, they added one drop of the reaction mixture to one drop of iodine solution on a white tile.

- Iodine solution = light brown colour
- Iodine solution + starch = dark blue colour

Predict the colour seen in the iodine test on the samples of the pH6 reaction mixture at 4 minutes and at 6 minutes.

[1 mark]

4 minutes dark blue

6 minutes light brown

3 (b) (iii) The students concluded that amylase works best at pH7. This may **not** be a valid conclusion.

Suggest **two** improvements to the investigation that would increase the validity of the students' conclusion.

[2 marks]

1 repeated each PH solution more than once

2 used smaller interval than 1 minute

3 (b) (iv) The students repeated the investigation at pH3.

What result would you expect at pH3?

Give a reason for your answer.

[2 marks]

I wouldn't expect the stach to break down at all, no matter how much time it has been left, as I think that at pH3 it would be so acidic that the enzyme amylase would denature and not work, so it couldn't break down the starch.

Commentary

Another practical question, but this time the students are given a method. Many students fail to identify more than one control variable, or spoil their answers by using vague terms like 'amount of solution'. It is important that students are conversant in terminology such as 'valid conclusion'. In this case, students need to understand what makes a valid conclusion and what should be done with this method to ensure that one is given.

In the final response, students could have scored full marks for a response as short as 'no reaction because the enzyme is denatured'.

Mark scheme

3(a)	sugar(s) / glucose	allow maltose do not allow if extra incorrect answers	1	AO1 2.5.2d Prac
3(b)(i)	any **two** from: • volume of pH solution • volume of amylase / enzyme solution • volume of starch / suspension / substrate • time left (before mixing)	allow amount for volume if neither mark given allow 1 mark for volume(s) of solution(s) ignore time between samples ignore ref. to (room) temperature ignore ref. to concentration	2	AO2 2.5.2b Prac

3(b)(ii)	4 minutes: (dark) blue **and** 6 minutes: (light) brown	allow black ignore purple do **not** allow light blue allow yellow / orange	1	AO3 2.5.2b Prac

3(b)(iii)	any **two** from: • take each reading more than once • use colour standards for deciding end-point • test more pH values between 6 and 8 **or** test at smaller pH intervals • test at shorter intervals • same temperature (in a water bath)	ignore take more readings allow compare with another group allow use a colorimeter ignore wider range of pH unqualified allow example – e.g. every half min	2	AO3 2.5.2b Prac

3(b)(iv)	no reaction **or** stays (dark) blue **or** takes >9 minutes enzyme denatured	allow takes longer allow description of denaturing, i.e. shape change allow description of trend on graph	1 1	AO2/3 2.5.2a/b

BL1HP Q8 – photosynthesis practical

9 marks – full marks awarded

8 Students investigated the sensitivity of plants to different stimuli.

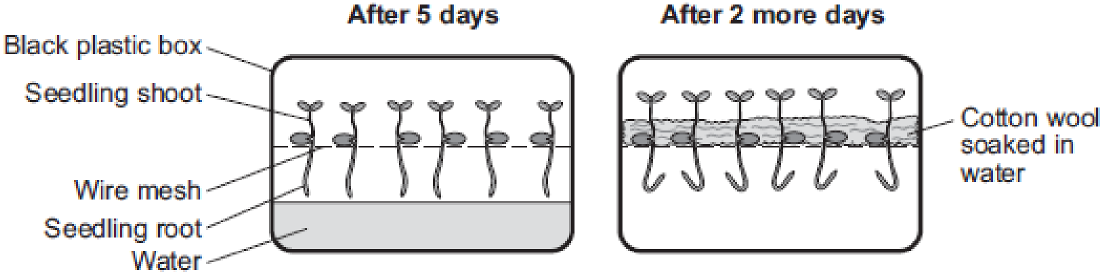
The students:

- put cress seeds onto wire mesh above some water in a black plastic box which did not allow light to enter
- left the seeds to grow in darkness for 5 days
- poured out the water after the 5 days
- then put cotton wool soaked in water on top of the wire mesh
- left the seedlings for 2 more days.

Figure 7 and **Figure 8** show the results of the investigation.

Figure 7 **Figure 8**

After 5 days **After 2 more days**



8 (a) Shoots are sensitive to light and gravity.

What conclusions can you make about the growth of the seedling shoots in response to light **and** gravity from the results shown in **Figure 7**?

Explain why you made these conclusions.

[3 marks]

A conclusion can be made that the shoots grow away from gravity, because they have grown upwards. However, no conclusion can be made for how the shoots grow towards light as there was no light let into the box.

8 (b) One student said:

"Roots are sensitive to the stimuli of gravity and moisture."

Explain which of these two stimuli is more important to the growth of roots.

Refer to the results shown in **Figure 7** and **Figure 8**.

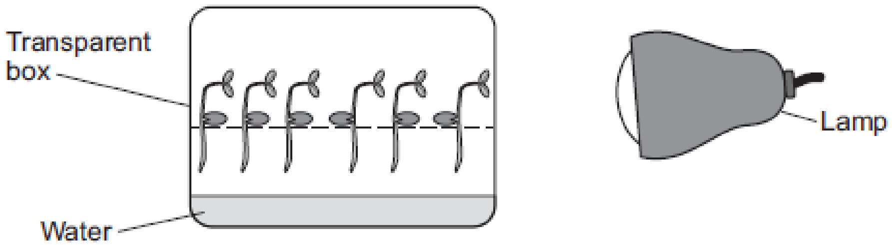
[2 marks]

I think that moisture is a more important stimuli because in figure 7, the root goes in the direction of water and gravity. Whereas, in figure 8 it only goes in the direction of water and away from gravity.

8 (c) In a different investigation students grew cress seeds in a transparent box. The students directed light from a lamp on to one side of the box.

Figure 9 shows the results after 7 days.

Figure 9



8 (c) (i) Explain what caused the seedling shoots to grow in the way shown in **Figure 9**.

[2 marks]

Plant growth hormones called Auxins gather on the shady side of the shoot and cause that side to grow faster which causes the shoot to curve towards the light.

8 (c) (ii) What is the advantage to the cress seedlings of the response to light shown in **Figure 9**?

[2 marks]

They are able to absorb more light for photosynthesis as the leaves at their tips are now facing the light.

Commentary

These questions covers an investigation into photosynthesis, requiring students to use their own knowledge of plant growth hormones and the data presented to make a number of conclusions/explanations.

In these responses, students have made reference to all of the relevant information, and have done so concisely. Part 8(b) refers to information earlier in the stem. Often, student responses indicate that they have not read question stems fully. Students should be reminded to read this information clearly as it can have an impact on how they answer the question.

Mark scheme

8(a)		ignore ref to roots / moisture		AO2/AO3
	(shoots) grow against (the force / direction of) gravity	allow negative geotropism / gravitropism	1	1.2.3a
	(gravity is down and) shoots are growing upwards		1	
	cannot conclude anything about light / phototropism as growth is in the dark		1	

8(b)		ignore shoots no mark for moisture unqualified max **1** mark if moisture not stated as more important **or** if gravity given as more important		AO3 1.2.3a
	(after 5 days / Figure 7) when gravity and moisture are in the same direction / down the roots grow towards both / down	allow (after 5 days / Figure 7) roots grow towards moisture and gravity	1	
	(after 2 more days / Figure 8) when moisture and gravity are in opposite directions, the roots grow towards water	allow (after 2 more days / Figure 8) roots grow towards moisture and away from gravity	1	

8(c)(i)	unequal distribution of hormone / auxin (so there is) unequal growth rates	allow more hormone / auxin on darker side **or** converse allow more / faster growth on darker side **or** converse	1 1	AO1 1.2.3b/c

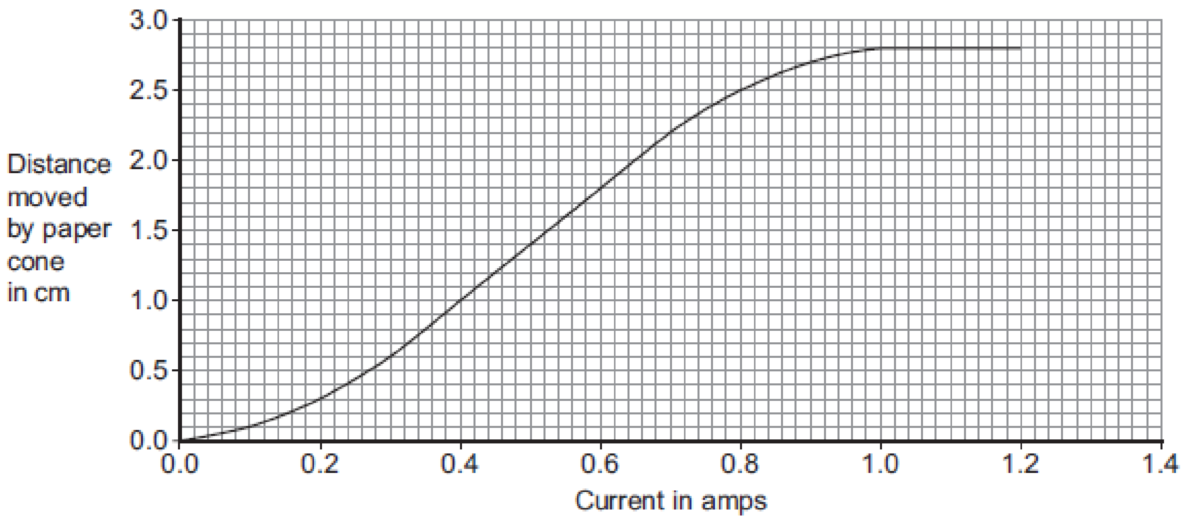
8(c)(ii)	more surface area exposed to light **or** more light absorbed (by leaves / plant) more photosynthesis	allow more glucose / carbohydrate / biomass produced for **2** marks there must be a reference to 'more' at least once	1 1	AO2 1.5.1a

PH3HP Q1bii –Elicit conclusions from a graph

2 marks – full marks awarded

1 (b) The results of the student's investigation are shown in **Figure 2**.

Figure 2



1 (b) (ii) State **two** conclusions that can be made from the graph.

[2 marks]

1 As the current increases, so does the distance moved by the paper cone

2 After 1 amps, the cone cannot move beyond 2.8 cm (it's the maximum it can move)

Commentary

There are three conclusions that could be given for this graph. Students need to be familiar with describing how the nature of the line changes over the range of data, which this student has done. This student has referred to the variables by name and has linked to points on the graph.

1(b)(ii)	any **two** from: • (Below 1A) as the current increases the distance increases • Above 1A the distance does not change (with current) • Between 0.3A and 0.7A the relationship is linear	accept the maximum distance (that the cone can move) is 2.8 cm accept between 0.6 cm and 2.2 cm the relationship is linear ignore references to positive correlation and direct proportionality a description of the shape of the graph is insufficient eg the line levels off after 1A	2	AO3 3.3.1c

Biology

BL1FP Q9b/BL1HP Q3b – quality of written communication

6 marks awarded – full marks

3 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Reflexes allow humans to respond to stimuli (changes in the environment).

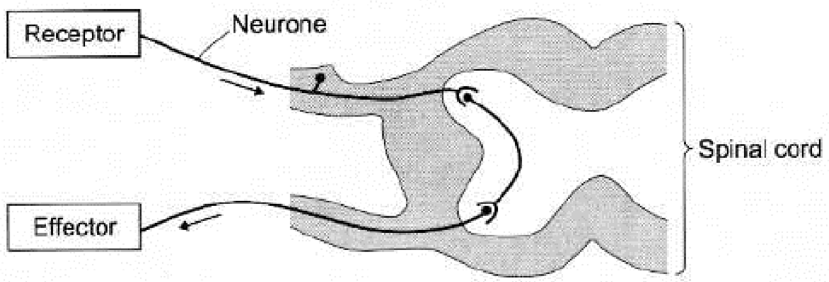
One example of a reflex is when a finger touches a hot kettle and the arm is pulled away.

Sense organs contain receptors that detect stimuli.

Effectors are muscles or glands which respond.

Figure 2 is a diagram of a simple reflex pathway.

Figure 2



Describe how a simple reflex works.

Your answer should include:

- one type of receptor and the stimulus that the receptor detects
- how information is passed from the receptor to the effector.

[6 marks]

Starting at the receptor, this detects the stimuli, change in the environment, such as heat, pain, light or sound. Different sensory organs such as the eye, detect light, but the skin detects pressure, pain, and the tongue and nose detect chemical. Once the receptor has detected the stimuli, it transmits an electrical impulse, to the sensory neurone (a nerve cell), which carries the electrical impulse to the CNS (central nervous system) in the spinal chord, to the relay neurone. the electrical impulse changes to a chemical form, and diffuses across the

Extra space Synapse (gaps between 2 neurones), then carries on the electrical impulse to the motor neurone, where the impulse will be chemically diffused to the next neurone. At the end of the motor neurone, the impulse reaches the effector. once it has chemically diffused to the effector via the synapse.

Commentary

This response scored full marks and includes a good amount of detail, including definitions of terms such as ‘neurone’. The question asks for one type of receptor, but the student has listed several. The student could have saved themselves time by referring only to one type of receptor and there was a risk the excess information they gave could have contradicted or confused their answer.

3(b)				6	AO1 1.2.1a/b/c/d/e
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.					

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content	identifies one type of receptor **or** the stimulus it detects **or** refers to at least one type of neurone **or** refers to passage of information **or** at least one response by an effector	identifies at least one link between: one type of receptor **and** the stimulus it detects **and / or** refers to at least one type of neurone **and / or** refers to passage of information **and / or** at least one response by an effector	identifies one type of receptor **and** the stimulus it detects **and** refers to different types of neurone **and** refers to passage of information **or** at least one response by an effector

examples of biology points made in the response:	**extra information:**
• *(R & S)* (receptors in) skin detects pressure / pain / change in temperature	*(R & S)* = receptor and stimulus
• *(R & S)* (receptors in) eyes detect light	*(P)* = passage of information
• *(R & S)* (receptors in) ears detect sound	*(N)* = type of neurone
• *(R& S)* (receptors in) ears detect changes in position	*(E)* = response by effector
• *(R& S)* (receptors on) tongue detects chemicals / taste	
• *(R & S)* (receptors in) nose detects chemicals / smell	
• *(N)* sensory / relay / motor neurone	
• *(P)* neurones carry impulses / electrical information	allow electrical signals ignore messages
• *(P)* ref to synapse	
• *(P)* (release of) chemical information at / across synapse	allow neurotransmitter or named neurotransmitter
• *(E)* muscle contracts	
• *(E)* gland releases hormone / chemical / enzyme	

Chemistry

CH1FP Q7/CH1HP Q3 – quality of written communication

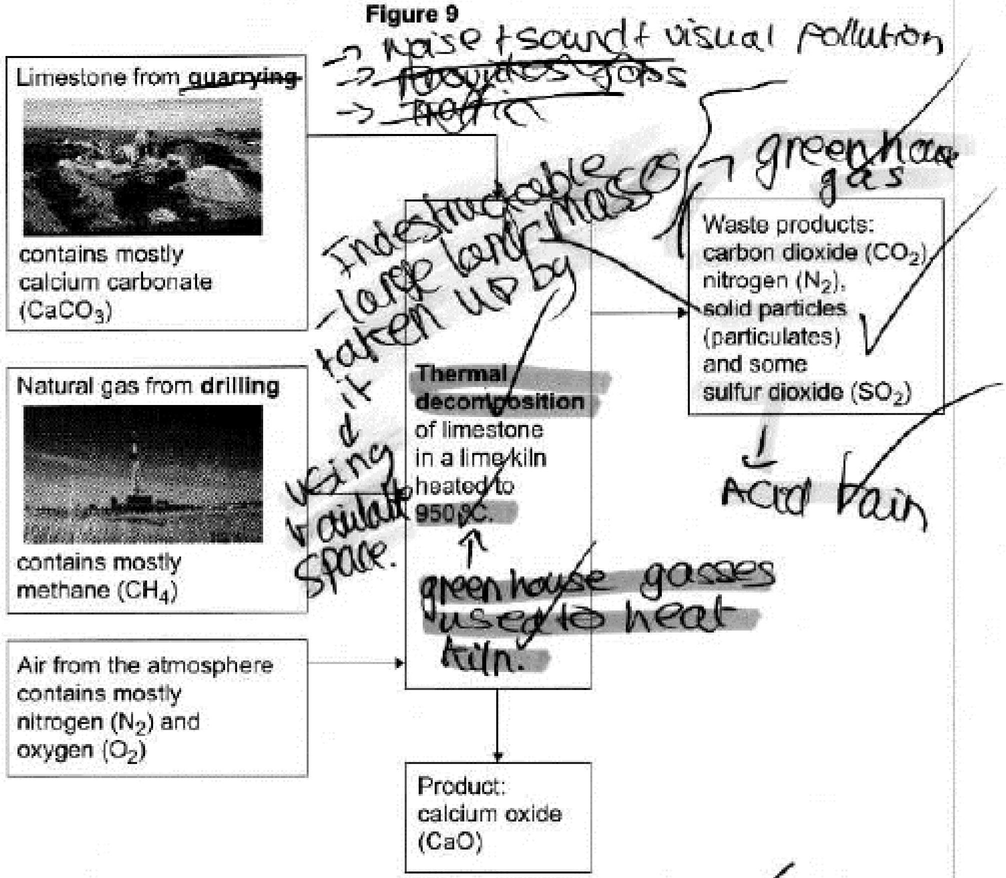
Second response 6 marks – full marks

7 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Limestone is heated in a lime kiln to produce calcium oxide.

Figure 9 shows the reactants used and the products made in a lime kiln.

Figure 9



Use information from **Figure 9** to explain the potential environmental impacts of quarrying, drilling and the thermal decomposition of limestone used in the production of calcium oxide.

[6 marks]

Commentary

Many students erroneously answered this question as an ‘advantages and disadvantages’ question, because they may have seen past paper questions like this.

In this first excerpt, the student has highlighted information in the question as well as annotating the environmental impacts. Each point has been ticked off as it is written about. In the full response (which has not been included here) the student filled all of the available answer space and continued onto additional pages. The next example shows it is possible – and expected – that students can score full marks with a more concise answer to this question.

Use information from **Figure 4** to explain the potential environmental impacts of quarrying, drilling and the thermal decomposition of limestone used in the production of calcium oxide.

[6 marks]

Quarrying can destroy habitats as quarries take up a large space and so, reduces biodiversity. Drilling may create noise pollution as well as the land pollution created from quarrying. Also, the thermal decomposition ~~from~~ of the limestone produces carbon dioxide which contributes to global warming, affecting climate and causing sea levels to rise. Thermal decomposition also produces particulates which contribute to global dimming and sulfur dioxide which contributes to acid rain, destroying buildings made of materials like limestone and acidifying

Extra space soil.

<table>
<tr><td>3</td><td></td><td></td><td>6</td><td rowspan="5">AO2
AO3
1.2.1a;b
1.4.2a
1.4.3a;b;c
1.7.2a;i</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.</td></tr>
<tr><td>0 marks</td><td>Level 1 (1–2 marks)</td><td>Level 2 (3–4 marks)</td><td>Level 3 (5–6 marks)</td></tr>
<tr><td>no relevant information given</td><td>discrete relevant points made about types of pollution or problematic effects or environmental impacts</td><td>an explanation of how an environmental impact is caused by the pollution from or the problematic effect of a linked process</td><td>detailed explanations of how environmental impacts are caused by the pollutions from or the problematic effects of linked processes</td></tr>
<tr><td colspan="4">Examples of chemistry points made in the response could include:
Processes
• quarrying
• drilling
• thermal decomposition
• combustion of fossil fuel
• use of explosives

Types of pollution and problematic effects:
• visual pollution
• noise pollution
• dust pollution
• destruction of land
• air / atmospheric pollution (methane, carbon dioxide, sulfur dioxide, NO_x, particulates)
• water (rivers / lakes / seas) pollution
• earth tremors

Environmental impacts:
• destruction of areas of natural beauty
• disturbance of people and animals
• breathing problems or asthmatic attacks
• destruction of habitats or biodiversity or kills wildlife and plants
• (CH_4 ; CO_2) greenhouse gases → global warming → consequences
• (particulates) global dimming → consequences including breathing problems
• (SO_2 ; NO_x) acidic gas / rain → consequences including breathing problems
• damage to buildings / infrastructure</td></tr>
<tr><td>Total</td><td></td><td></td><td>6</td><td></td></tr>
</table>

Physics

PH1HP Q2 – quality of written communication

6 marks – full marks awarded

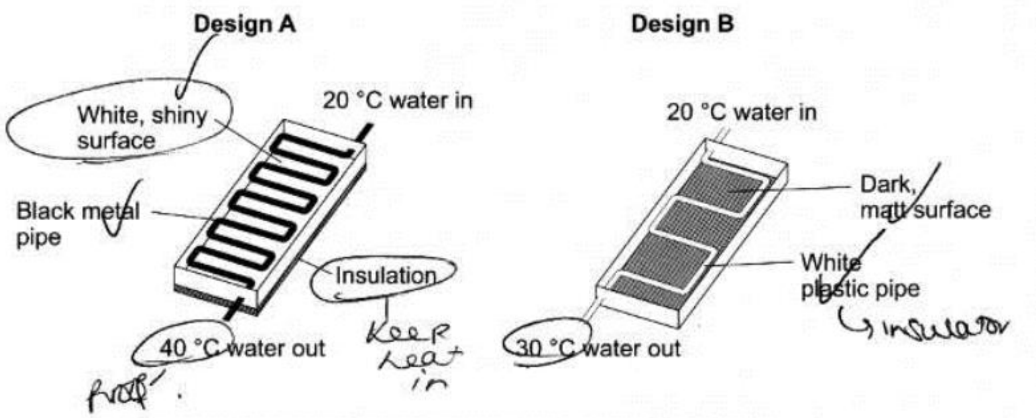
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Solar panels use energy from the Sun to heat water.

Two different designs of solar panel are shown in **Figure 1**.

Both designs have the same water flow rate.

Figure 1



Explain why **Design A** is better than **Design B** at heating water.

[6 marks]

Design A, firstly, uses ~~a~~ ~~B~~ black metal pipes in comparison with white plastic pipes in design B. This makes it better at heating water as ~~Black~~ ~~Dark~~, Dark surfaces are good absorbes and therefore will absorb ~~more~~ lots of heat from the sun. As well as this, it is made out of metal which is a good conductor, allowing heat to travel through the ~~mater~~ pipes quickly, heating up the water. Design B uses plastic which is an insulator and therefore heat from the ~~sung~~ sun would take longer to get

Extra space through to the water. The white, shiny surface below the pipes, in design A, is better that the ~~Bar~~ dark matt surface in design B, as the heat that passes beyond the pipes is reflected back allowing extra absorbtion of heat. Contrasting, the dark, matt surface would absorb the heat taking it away from the pipes.

Turn over for the next question

Commentary

In this example, the student has highlighted features they want to include in their answer and ticked them off as they have written about them. For this type of question it can really help students if they spend a little time thinking about what they will write about and how they can structure it before they begin writing. This kind of approach can really help with questions about practical methods, where the order of steps would be important.

Mark scheme

2	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.	6	AO1 AO2 AO3 1.1.1cde

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	A description of how at least **one** feature makes design A better than design B.	A basic explanation in terms of physical processes of how some features of design A make it better than design B.	A clear and correct explanation in terms of physical processes, including direct comparisons, of how most features of design A make it better than design B.

examples of physics points made in the response	extra information
colour of pipe: • black (pipe) surface is a good absorber of IR radiation / energy **material of pipe:** • metal pipes are good conductors **or** • metal pipes are better conductors than plastic pipes • higher rate of energy transfer through metal pipe **colour of surface:** • (inside of solar panel is) white / shiny surface which is a good reflector of IR radiation to the pipe • (inside of solar panel is) white / shiny surface which is a poor absorber of IR radiation **Insulation:** • layer of insulation reduces conduction through base of solar panel **length of pipe / surface area of pipe:** • water is in solar panel for longer time • water absorbs more energy • pipe absorbs more IR design A has a greater water temperature increase (could be linked to any feature)	accept converse answers in terms of why design B is worse than design A allow heat / radiation for IR throughout

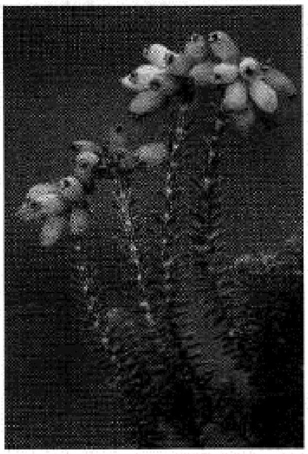
BL2FP Q7/BL2HP Q2 – Practical method QWC

6 marks – full marks awarded

7 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 7 shows part of a plant called cross-leaved heath.

Figure 7



A student noticed that some areas of marshland contained cross-leaved heath plants and some areas did not.

The student made the following hypothesis:

'Soil pH affects the amount of cross-leaved heath plants that grow in an area.'

How could the student use apparatus, including the quadrat and pH meter shown in **Figure 8**, to find the range of pHs where the cross-leaved heath plants grew best?

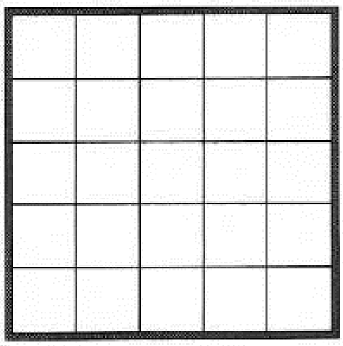
You should include details of how the student could make sure the results are valid.

[6 marks]

Figure 8

1 m x 1 m quadrat

Soil pH meter



Not to scale

Step 1, use a ~~tape~~ mesure and
Sp Line it across the Marshland.
Step 2, Place your quadrat ~~along~~ at the
one end of the line.
Step 3, Count the amount of Cross-
Leaved heath inside the quadrat
Step 4, ~~use~~ Place the Soil PH meter
in the Square in the ~~exact~~ center of the
quadrat,
Step 5, ~~Rec~~ Record ~~your~~ the PH of the soil and the amount of cross leaved heath
Step6, Repeat Steps 3-5, whilst
Moving the quadrat along the Line
1 meter at ~~a~~ a time,
Step 7, ~~Put~~ Plot your Results on a bar Chart

Extra space

Commentary

In this example, students are given some apparatus and a hypothesis and are asked to produce a method. Students are also asked how they could ensure the results are valid. The student here has underlined a few key words to help them. Their response is organised into steps in order and they have been able to score full marks without using any extra space. For this question, students could either use a transect or place their quadrat randomly. The mark scheme credited both approaches.

Here the student has made reference to using a bar chart, which has enabled them to score full marks in the top level. Students should be reminded to check they have answered the question fully as it is quite common that this kind of detail is missed in their responses.

Mark scheme

7			6	AO1/2/3 2.4 2.4.1a/b Prac

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	A simple correct statement is made about the investigation, e.g. counting plants in a quadrat **or** measuring pH **or** random placement of a quadrat.	There is a description of how a quadrat could be used to collect data at different locations. **or** how a pH meter could be used to collect data at different locations. **For four marks** an additional point is made e.g. reference to randomness **or** compare to other's results.	There is a description of how a quadrat **and** pH meter could be used to collect data at different locations. **For full marks** an additional point to ensure validity is made e.g. repeat in a different marshland **or** randomness **or** measure pH at the same depth each time **or** large number of repeats **or** graph or correlate results.

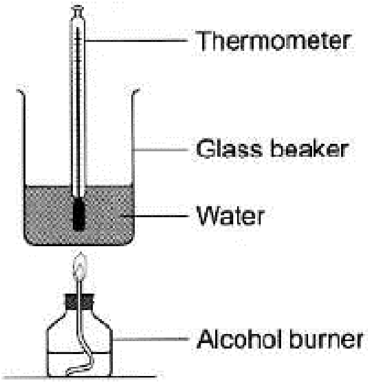
examples of points made in the response:	extra information
• placing of quadrat and measuring plants	
• randomly in area where plant is growing • randomly in area where plant is not growing	allow • regular intervals along a transect • from an area where plants are growing to an area where plants are not growing
• many times	
• score number **or** % cover **or** dry mass or heights of plants per quadrat	allow presence / absence
• measure soil pH in each quadrat	
• control variables such as measurements at same depth	
• repetition of pH measurements in a quadrat	
• calculate mean pH for each quadrat	
• relate quantity of plants to soil pH – e.g. graph	

CH3FP Q6ci – practical method in a quality of written communication question

6 marks – full marks awarded

6 (c) **Figure 9** shows apparatus used to measure the energy released when an alcohol is burned.

Figure 9



6 (c) (i) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe how a student could use the apparatus in **Figure 9** to compare the energy released when methanol and ethanol are burned.

You should include any measurements the student would need to make.

Do **not** describe how to do any calculations.

Do **not** describe any improvements to the apparatus.

[6 marks]

Firstly you Should measure out 50cm³ of water and pour that into your beaker. Now you should record the mass of the alcohol burner. Place your beaker above the alcohol burner. Make sure you have a thermometer in the beaker, and record the temperature. Now light the burner. Once the water has reached 60°C put out the burner and record the mass of the alcohol burner. Repeat the method with the two types of alcohols. Now you have the before and after masses of the burners. You Should work out the differerte in wieghts. The one that has lost the least amount of wieght is the more

Extra space effiant burner.

Commentary

The student has given a response worth 6 marks in 13 lines, with minimal use of the extra space. The answer has been well written with a logical flow. The small number of corrections indicates that the student may have planned what to write before beginning. Often, responses are seen which contain jumbled methods with events out of order. Students should be encouraged to think about their response before they begin writing.

CH3HP 4c – titration calculation

First response 1 mark, second response 3 marks

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

Calculate the concentration of the nitric acid.

[3 marks]

$\frac{0.2}{1000} \times 25 = \frac{5\times10^{-3}}{26.25} = 0.000190476 \times 1000 = 0.190476$

Concentration of nitric acid = 0.19 moles per dm^3

Commentary

This final answer was quite commonly seen and is because the student has mixed up the ratios. In the next response, the student has created a table to help them arrive at the final answer. This approach helps minimise the type of mistake seen in the first response as well as giving evidence of working.

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

n
C V
0.0,0,5, 25

Calculate the concentration of the nitric acid.

[3 marks]

	KOH	HNO_3	
C	0.2		26.25 ÷ 1000 = 0.02625 25 ÷ 1000 = 0.025
n	0.00525	0.00525	n = 0.2 × 0.02625 = 0.00525
V	0.02625	0.025	C = 0.00525 / 0.025 = 0.21

Concentration of nitric acid = 0.21 moles per dm^3

Mark scheme

4(c)	0.21	if incorrect, 26.25 x 0.2/1000 or 0.00525 for 1 mark their moles x 1000/25.00 or their moles x 40 for 1 mark correct evaluation for 1 mark 0.19(0476…) gains only 1 mark with or without working	3	**AO2** 3.4.1h

Subject specific vocabulary

The following subject specific vocabulary provides definitions of key terms used in our GCSE Science specifications.

Wherever possible we have used the definitions derived from a booklet created in a joint project of the Association for Science Education and the Nuffield Foundation, *The Language of Measurement: Terminology used in school science investigation,* ISBN 978 0 86357 424 5, Association for Science Education (ASE), 2010.

Accuracy

A measurement result is considered accurate if it is judged to be close to the true value.

Calibration

Marking a scale on a measuring instrument. This involves establishing the relationship between indications of a measuring instrument and standard or reference quantity values, which must be applied. For example, placing a thermometer in melting ice to see whether it reads zero, in order to check if it has been calibrated correctly.

Data

Information, either qualitative or quantitative, that has been collected.

Error

See also uncertainty.

Measurement error

The difference between a measured value and the true value.

Anomalies

These are values in a set of results which are judged not to be part of the variation caused by random uncertainty.

Random error

These cause readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next. Random errors are present when any measurement is made, and cannot be corrected. The effect of random errors can be reduced by making more measurements and calculating a new mean.

Systematic error

These cause readings to differ from the true value by a consistent amount each time a measurement is made. Sources of systematic error can include the environment, methods of observation or instruments used. Systematic errors cannot be dealt with by simple repeats. If a systematic error is suspected, the data collection should be repeated using a different technique or a different set of equipment, and the results compared.

Zero error

Any indication that a measuring system gives a false reading when the true value of a measured quantity is zero, eg the needle on an ammeter failing to return to zero when no current flows. A zero error may result in a systematic uncertainty.

Evidence

Data which has been shown to be valid.

Fair test

A fair test is one in which only the independent variable has been allowed to affect the dependent variable.

Hypothesis

A proposal intended to explain certain facts or observations.

Interval

The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres.

Precision

Precise measurements are ones in which there is very little spread about the mean value. Precision depends only on the extent of random errors – it gives no indication of how close results are to the true value.

Prediction

A prediction is a statement suggesting what will happen in the future, based on observation, experience or a hypothesis.

Range

The maximum and minimum values of the independent or dependent variables; important in ensuring that any pattern is detected. For example a range of distances may be quoted as either: 'From 10 cm to 50 cm' or 'From 50 cm to 10 cm'.

Repeatable

A measurement is repeatable if the original experimenter repeats the investigation using same method and equipment and obtains the same results. Previously known as reliable.

Reproducible

A measurement is reproducible if the investigation is repeated by another person, or by using different equipment or techniques, and the same results are obtained. Previously known as reliable.

Resolution

This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.

Sketch graph

A line graph, not necessarily on a grid, that shows the general shape of the relationship between two variables. It will not have any points plotted and although the axes should be labelled they may not be scaled.

True value

This is the value that would be obtained in an ideal measurement.

Uncertainty

The interval within which the true value can be expected to lie, with a given level of confidence or probability, eg 'the temperature is 20 °C ± 2 °C, at a level of confidence of 95%'.

Validity

Suitability of the investigative procedure to answer the question being asked. For example, an investigation to find out if the rate of a chemical reaction depended upon the concentration of one of the reactants would not be a valid procedure if the temperature of the reactants was not controlled.

Valid conclusion

A conclusion supported by valid data, obtained from an appropriate experimental design and based on sound reasoning.

Variables

These are physical, chemical or biological quantities or characteristics.

Categoric

Categoric variables have values that are labels, eg names of plants or types of material.

Continuous

Continuous variables can have values (called a quantity) that can be given a magnitude either by counting (as in the case of the number of shrimp) or by measurement (eg light intensity, flow rate etc). Previously known as discrete variable.

Control

Control variable is one which may, in addition to the independent variable, affect the outcome of the investigation and therefore has to be kept constant or at least monitored.

Dependent

Dependent variable is the variable of which the value is measured for each and every change in the independent variable.

Independent

Independent variable is the variable for which values are changed or selected by the investigator.

Command words (Science)

Command words are the words and phrases used in exams that tell students how they should answer a question.

The following command words are taken from Ofqual's official list of command words and their meanings that are relevant to this subject. In addition, where necessary, we have included our own command words and their meanings to complement Ofqual's list.

Command words marked * are new for teaching from 2016.

Calculate

Students should use numbers given in the question to work out the answer.

Choose*

Select from a range of alternatives.

Compare

This requires the student to describe the similarities and/or differences between things, not just write about one.

Complete

Answers should be written in the space provided, for example on a diagram, in spaces in a sentence, or in a table.

Define*

Specify the meaning of something.

Describe

Students may be asked to recall some facts, events or process in an accurate way.

Design*

Set out how something will be done.

Determine*

Use given data or information to obtain and answer.

Draw

To produce, or add to, a diagram.

Estimate

Assign an approximate value.

Evaluate

Students should use the information supplied, as well as their knowledge and understanding, to consider evidence for and against.

Explain

Students should make something clear, or state the reasons for something happening.

Give

Only a short answer is required, not an explanation or a description.

Identify*

Name or otherwise characterise.

Justify

Use evidence from the information supplied to support an answer.

Label

Provide appropriate names on a diagram.

Measure*

Find an item of data for a given quantity.

Name

Only a short answer is required, not an explanation or a description. Often it can be answered with a single word, phrase or sentence.

Plan*

Write a method.

Plot*

Mark on a graph using data given.

Predict*

Give a plausible outcome.

Show*

Provide structured evidence to reach a conclusion.

Sketch*

Draw approximately.

Suggest

This term is used in questions where students need to apply their knowledge and understanding to a new situation.

Use

The answer must be based on the information given in the question. Unless the information given in the question is used, no marks can be given. In some cases students might be asked to use their own knowledge and understanding.

Write

Only a short answer is required, not an explanation or a description.

Notes

Contact us

T: 01483 477756
E: gcsescience@aqa.org.uk

aqa.org.uk