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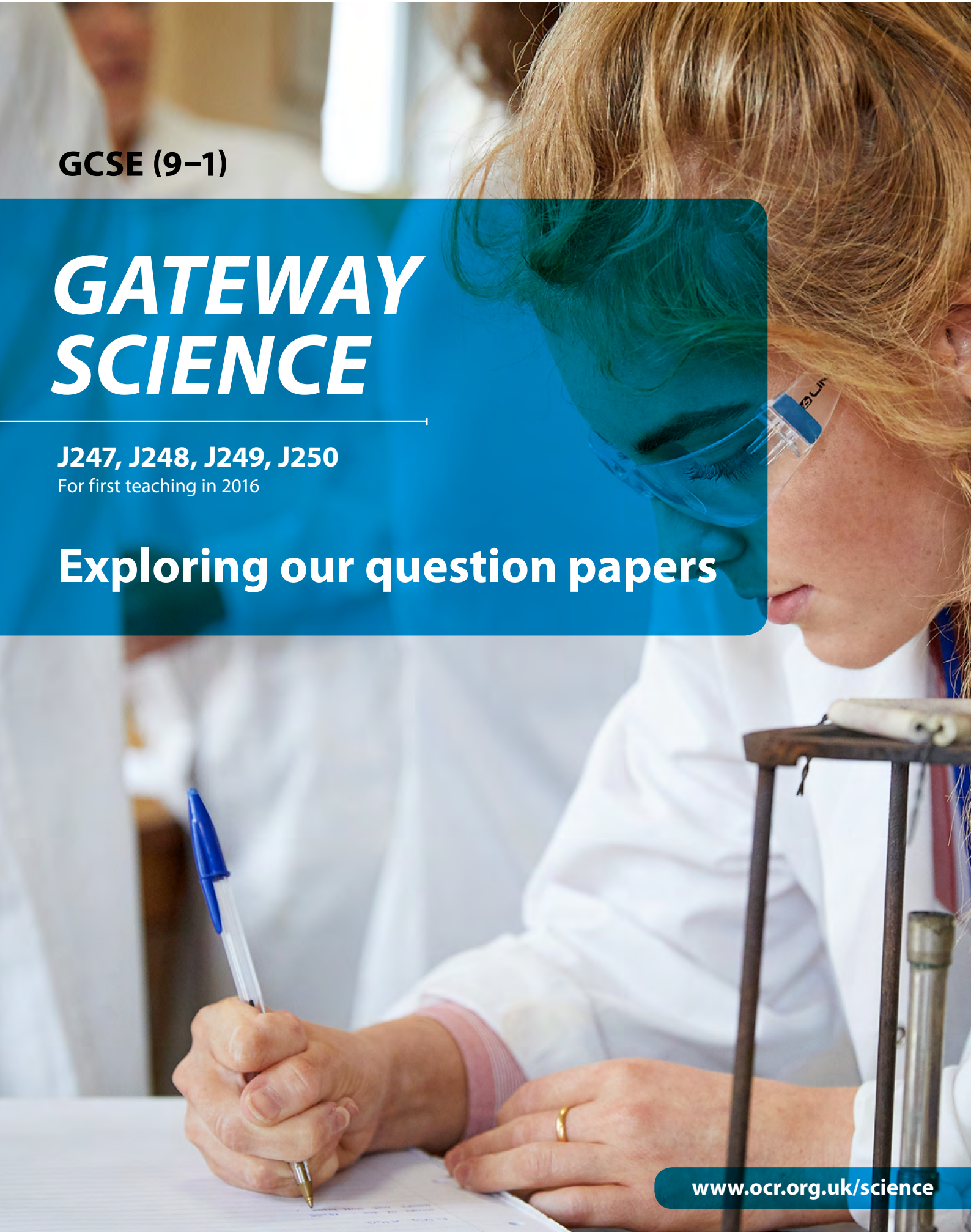


GCSE (9–1)

GATEWAY SCIENCE

J247, J248, J249, J250
For first teaching in 2016

Exploring our question papers

www.ocr.org.uk/science

EXPLORING OUR QUESTION PAPERS

We redeveloped our GCSE (9–1) Science qualifications for first teaching from September 2016. Ahead of the first assessments in June 2018, we have produced this guide to share the story of our assessment approach and explore our question papers with you.

During the development, we talked to a wide range of teachers to influence the structure of our question papers. Underlying principles for us were to:

- **keep presentation clear** (font style, space for working)
- **ensure we're always assessing** understanding of the science (without letting the language of our questions be an obstacle to understanding what is needed)
- **be clear** on Command Word usage.

1. BASIC QUESTION PAPER STRUCTURE

(a) Separate sciences (Biology, Chemistry, Physics)

Assessment for each science is through two exams and can be taken at Higher or Foundation tier.

- Paper 1/3 only tests content from **topics 1 to 3 and topic 7** (practical).
- Paper 2/4 tests content from **topics 4 to 6 and topic 7** (practical) with assumed knowledge of topics 1 to 3.

Foundation tier

Paper	Marks	Duration	Weighting
Paper 1 Foundation	90	1 hour 45 mins	50%
Paper 2 Foundation	90	1 hour 45 mins	50%

Higher tier

Paper	Marks	Duration	Weighting
Paper 3 Higher	90	1 hour 45 mins	50%
Paper 4 Higher	90	1 hour 45 mins	50%

The two exams in each tier will each comprise the following range of question types:

Section A (only assesses Assessment Objectives 1 and 2)

- ***15 Multiple Choice Questions (MCQs) (1 mark each)***

  The MCQs are in a discrete section of the paper as research shows that students find MCQs more accessible when they are grouped together in this way. We use MCQs as a powerful way of allowing us to assess a wide range of content, especially underpinning common misconceptions, whilst keeping the overall assessments as short as possible. We recommend that students spend no more than 30 minutes on the MCQ section of the paper. To ensure that the MCQs are not too demanding for the one mark apportioned per question we only assess Assessment Objectives 1 and 2 using this question type.

Section B (assesses Assessment Objectives 1, 2 and 3)

- Up to 69 marks for short answer response questions (1–3 marks each)
- One 6 mark level of response question (flagged with an asterisk, *, in the question paper). This question tests the ability of the student to construct and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. We use a level of response mark scheme to mark this question as to obtain maximum credit the student needs to demonstrate how they have structured their response in a meaningful way. There may be a small number of longer answer response questions (4–6 marks) which are not marked by level of response depending on the context and content being assessed in a particular exam series. There will only ever be one level of response question per paper per series.

In addition, Paper 2/4 will test students' ability to pull together their knowledge, skills and understanding from across the full course of study (so called 'synoptic assessment'). Synoptic questions will require students to use knowledge, skills and understanding from a number of parts of the specification to construct their answer. Synoptic questions will draw on material learnt in topics 1–3 (tested in Paper 1/3). We have limited the synoptic assessment to Paper 2/4 to aid in exam preparation.

(b) Combined Science

Assessment is through six exams (two for each of the sciences) and can be taken at Higher or Foundation tier.

- All papers are 1 h 10 minutes and 60 marks.
- All papers start with a section of 10 MCQs, students are advised to spend no more than 20 minutes on this section.
- The approach to Sections A and B is as for separate sciences with slightly different mark weightings, see the following table.
- A minimum of 12 marks for synoptic assessment.

Mark weightings

Biology	Chemistry	Physics
Paper 01/07 Biology Topics (B1–B3, B7) 10 marks MCQ Up to 44 marks short answer 1 x 6-mark level of response	**Paper 03/09** Chemistry Topics (C1–C3, C7) 10 marks MCQ Up to 44 marks short answer 1 x 6-mark level of response	**Paper 05/11** Physics Topics (P1–P3, P7) 10 marks MCQ Up to 44 marks short answer 1 x 6-mark level of response
Paper 02/08 Biology Topics (B4–B6, B7) and assumed knowledge (B1–B3) 10 marks MCQ 44 marks short answer and practical questions 1 x 6-mark level of response	**Paper 04/10** Chemistry Topics (C4–C6, C7) and assumed knowledge (C1–C3) 10 marks MCQ 44 marks short answer and practical questions 1 x 6-mark level of response	**Paper 06/12** Physics Topics (P4–P6, P7) and assumed knowledge (P1–P3) 10 marks MCQ 44 marks short answer and practical questions 1 x 6-mark level of response

2. ASSESSMENT

(a) Our basic assessment principles

The principles and rationale underpinning our test construction approach for GCSE (9–1) Gateway Science are outlined below.

Group	No.	Accessibility Principle	Why?
Look and feel of the paper	1	**Layout (clear for all)** • Arial font. • Adequate space for responses and room for working in calculations.	To make it easy for students to add their responses/do their working.
	2	**Tone (assessing good understanding of science without letting the language of our questions be an obstacle to understanding what is needed)** • The use of overly complicated language and grammatical constructions will be avoided. • Contexts and vocabulary will be considered for currency and appropriateness to students, e.g. glasses not spectacles. • Language used throughout the question will be consistent. For example, usage in the stem of a question matches that throughout the rest of the question and any titles given to any diagrams. • Technical words will be used appropriately to underpin the science being assessed.	To make it as clear as possible what response is expected.
Assessment approach	3	Negative questions will be kept to a minimum.	Used well, negative questions can be a good way of testing understanding but can also easily lead to confusion. We will only ever use negatives where it is the most appropriate approach.
	4	Where there is a large context provided, e.g. an experiment, sentences will be grouped by content rather than be lots of separate sentences. Bulleted lists or numbering will be used where it helps indicate stages in a process/practical method.	To ensure information is presented in the clearest possible way.
	5	Names will not be used unless avoidance of names leads to a complicated question layout.	To avoid imparting cultural/gender bias into questions through choice of name or confusing students through choices of names they are unfamiliar with.

Group	No.	Accessibility Principle	Why?
Question formatting style	6	Where possible, brackets rather than commas will be used to separate abbreviations/acronyms from the body of the text. For example, measurement abbreviations will be put into brackets not separated by commas.	Brackets are a much clearer way of signposting such clarification within sentences than commas.
	7	All text will be left aligned (text in table headings will be centred except for row headings which will be left aligned).	To align with the principles applied to our modified question papers (left alignment is easier to understand for a range of visual impairments).
	8	Multiple choice answer options will be in alphabetical order/numerical order (Unless doing so would provide a prompt for the correct answer or if listing elements in the order of the Periodic Table).	To avoid an order that might indicate to the student the correct response.
Calculations	9	If a question requires an answer to a certain number of decimal places or significant figures, for example, we will always ensure this is clearly stated.	To avoid confusing students. Genuine scientific scenarios will be used wherever possible for authenticity and validity. This may mean numbers in calculations will not be whole integers.
Scientific conventions	10	Units will always, • be separated by a solidus, e.g. mol/dm^3 rather than mol dm^{-3}. The latter notation will be used at A level. • be in brackets for tables/graphs.	To align notation with common usage at this level. The more technically correct notation, e.g. mol dm^{-3} with graph axes labelled as concentration/mol dm^{-3} etc., will be used at AS/A level to support progression to HE and in line with accepted educational practice post-16.
	11	Atomic masses will always be used as published on our Periodic Table, included on the OCR Data Sheet.	Masses used represent up-to-date IUPAC practice and align with usage at AS/A level to avoid students having to learn new values as they move on to further study. The non-integer, real, data also better underpin concepts such as isotopes.
	12	Italics will not be used in questions (unless scientifically justified, e.g. for genus species nomenclature). Generally italicised latin abbreviations such as i.e., e.g. and etc. will not be used. English terms will be used instead.	Italics can be hard to read if overused but we have retained their use where this is the correct scientific approach to avoid establishing bad practices for students who progress to AS/A level. Latin abbreviations can be easily misunderstood.

Group	No.	Accessibility Principle	Why?
Images, diagrams, data	13	Images, diagrams and data will only be used where they genuinely support what is required in the question. We will avoid students needing to turn pages by aiming to always have images, diagrams and questions on facing pages.	To avoid unnecessary page turning and distracting images for the students that do not help them understand what is required in the question.
	14	All tables, graphs, images, diagrams and equations will be left aligned.	To align with the principles applied to our modified question papers (left alignment is easier to understand for a range of visual impairments).
	15	Text will not be wrapped around images/diagrams/graphs.	To retain clarity.
	16	If students are required to do something with an image/diagram/graph, it will be centred with sufficient space around it for them to do their working.	To avoid students struggling to fit in their response.

(b) Assessment Objectives

Every question tests one or more Assessment Objective (see earlier for a summary of question types). Each Assessment Objective is split into a number of elements (see below). Each Assessment Objective and their accompanying elements, are defined by Ofqual with associated required weightings. To aid your analysis of published question papers, all of our mark schemes indicate the precise Assessment Objective, and elements, targeted in each question.

There is an Ofqual defined maximum of 15% of AO1 marks that can be used to test knowledge in isolation. For example, for GCSE (9–1) Chemistry, there are 72/180 marks testing AO1 (40%), of these only a maximum of 11 marks (15% of the AO1 marks) can be used to test knowledge in isolation. Knowledge in isolation is not just recall, therefore it is not limited to the command words e.g. identify, state, recall etc.

Marks which reward demonstrating knowledge in isolation are those instances where marks are awarded solely for recalling facts or other knowledge that is part of the specification. It does not include marks awarded for selecting appropriate knowledge (for example, to evidence an argument), or for applying knowledge to a particular context.

HIGH LEVEL ASSESSMENT OBJECTIVES AND WEIGHTINGS

Assessment Objectives		Weighting	
		Higher	Foundation
AO1	**Demonstrate knowledge and understanding of:** • Scientific ideas • Scientific techniques and procedures	40%	40%
AO2	**Apply knowledge and understanding of:** • Scientific ideas • Scientific enquiry, techniques and procedures	40%	40%
AO3	**Analyse information and ideas to:** • Interpret and evaluate • Make judgements and draw conclusions • Develop and improve experimental procedures	20%	20%

ASSESSMENT OBJECTIVE ELEMENTS

	Assessment Objective elements
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

(c) Demand through the paper

For both tiers (Foundation and Higher) we ease students into the paper by starting with a lower demand question and then slowly ramping up difficulty, i.e. the most difficult questions should come towards the end of the paper. Similarly, within a multi-part question we aim to start with an easier lead in building through successive parts of the question.

There will be at least 20% of the marks available in the assessments for each tier that are common to both tiers (overlap questions) and targeting a level of demand consistent with grades 4 and 5. Overlap questions will be whole questions and there will be a maximum of two MCQs shared between Higher and Foundation as overlap. We use overlap questions to help ensure awarding of common grades between the two tiers are comparable.

- For Foundation tier, higher demand overlap questions should be towards the end of the paper.
- For Higher tier, overlap questions should be near the beginning of the paper . 50% of the marks for the paper are targeted at grades 4–6 and 50% at grades 7–9.

(d) Mathematical requirements

All GCSE (9–1) sciences are required by Ofqual to test mathematical skills (in the context of the appropriate science) at the weightings and level of demand shown below. It is important to note that the mathematical skills will always be tested in the context of science and questions testing mathematical skills can test any of the three assessment objectives, AO1 to AO3. A question testing mathematical skills could also be testing, for instance, understanding of practical.

Each OCR science specification includes an Appendix summarising the generic mathematical skills requirements (e.g. use of ratios, percentages, etc.). Additionally, the subject content section of the specification indicates where there are opportunities to incorporate the skills requirements into teaching and where there are content specific mathematical learning outcomes (e.g. CM3.1i, arithmetic computation and ratio when determining empirical formulae).

		Level of demand	
Subject	**Weighting**	**Foundation**	**Higher**
Biology	10%	Not lower than that which is expected of students at Key Stage 3, as outlined in the Department for Education's document *Mathematics programme of study: key stage 3*.	Not lower than that of questions and tasks in the assessment for the Foundation Tier in a GCSE qualification in Mathematics, see *OCR GCSE (9–1) Mathematics*.
Chemistry	20%		
Physics	30%		
Combined Science*	20%		

* Allocated to questions related to biology, chemistry and physics in a ratio of 1:2:3, respectively.

(e) Calculation questions

Where there is a calculation we will always leave space for any working you may need. The examiner guidance for marking of calculation questions is that if the answer on the answer line is correct, full marks would be awarded (unless the question has specifically said that working must be shown). Remember that if you get the answer wrong but have shown working you can gain marks for the correct working. On that basis it is good practice to show working to ensure that if you make an error it is still possible for you to score some marks.

(f) Practical skills assessment

It is an Ofqual requirement that an overall minimum of 15% of the marks in our science question papers involve assessment of practical skills. This matches the requirements for AS/A level Sciences. Practical skills will be assessed across all components and all assessment objectives.

Each OCR Gateway specification includes a topic section summarising the requirements for practical work. We have collated the apparatus and techniques that students need to be familiar with into a series of Practical Activity Groups (PAGs). The question papers will test students understanding of the apparatus and techniques which has been acquired through the completion of the PAGs. The examination is testing their understanding of the principles and apparatus, not of the specific PAG that they may have completed. The specification indicates sections of content where PAGs could most conveniently be incorporated into teaching and learning.

For more information on practicals, please see the practical activity resources on our website.

(g) Working Scientifically

Each OCR Gateway specification includes an Appendix covering the skills associated with working scientifically that will be tested. All Working Scientifically statements can be tested across the three Assessment Objectives, AO1 to AO3.

(g) Command words

The key list of common command words used in our exams is listed below. The definitions are intended to provide guidance to teachers and students as to what a student will be expected to do when these words are used in examinations.

The exact response expected to a command word will be dependent on the context. At all times, we advise students to read the full question carefully to be sure of what they are being asked to do.

Command word	Definition
analyse	Separate information into components and identify their characteristics. Discuss the pros and cons of a topic or argument and make reasoned comment.
calculate	Generate a numerical answer, with workings shown.
choose	Select from a list or a number of alternatives.
classify	Assign to a category or group.
compare and contrast	Identify similarities and differences.
complete	Add words, numbers, labels or plots to complete a sentence, table, diagram or graph.
conclude	Make a decision after reasoning something out.
construct	Write out or draw the requested item, e.g. '…Construct a dot and cross diagram for sodium chloride…' or '…Construct a balanced equation for a specific reaction…'
convert	Change a defined item to another defined item, e.g. '…Convert your calculated answer in g to an answer in moles…'
deduce	Use your knowledge and/or supplied data to work something out, e.g. '…Deduce the empirical formula of compound X (using supplied data)…'
define	Use your knowledge to state the meaning of a given term, e.g. '…Define the term specific heat capacity…' or '…Define the term momentum…'
describe	Set out the facts or characteristics. The description of a process should address what happens, and when and/or where it happens. (Compare with 'Explain') For example, when asked to describe the change in rate of reaction seen on a graph, the expected response might be to describe whether the rate of reaction remains constant, or decreases or increases over time.
design	Plan and present ideas to show a layout / function / workings / object / system / process.
determine	To find a solution by following a set of procedures. Obtain a numerical value by carrying out a series of calculations.
discuss	Give an account that addresses a range of ideas and arguments.
draw	Produce a diagram with sufficient detail and labels to illustrate the answer. (Compare with 'Sketch')

Command word	Definition
estimate	Assign an approximate value.
evaluate	Make a qualitative judgement taking into account different factors and using available knowledge / experience / evidence.
explain	Set out reasons and/or mechanisms to address why and/or how something happens. (Compare with 'Describe') For example, when asked to explain the change in rate of reaction seen on a graph, the expected response would suggest scientific reasons for any change seen, for example in terms of molecular collisions or enzymatic action.
give	A short answer is required without explanation (unless separately requested).
how	In what way?
identify	Recognise, list, name or otherwise characterise.
illustrate	Make clear by using examples or providing diagrams.
justify	Present a reasoned case for actions or decisions made.
label	Add names or other identifying words or symbols to a diagram.
measure	Establish a value using a suitable measuring instrument or technique.
name	Provide appropriate word(s) or term(s).
outline	Provide a description setting out the main characteristics / points.
plan	Consider, set out and communicate what is to be done.
plot	Translate data into a suitable graph or chart, with labelled axes.
predict	Make a judgement of an event or action that will or would happen in the future, as a result of knowledge, experience or evidence.
recall	Use your knowledge of the specification to remember a relevant key fact which needs to be used in the question.
select	Carefully choose as being the most suitable for a task or purpose.
show	Write down details, steps or calculations to prove a fact or answer.
sketch	Produce a simple, freehand drawing to illustrate the general point being conveyed. Detail is not required. (Compare with 'Draw') In the context of a graph, the general shape of the curve would be sufficient without plotting precise points. (Compare with 'Plot')
state or define	Express in precise terms the nature, state or meaning
suggest	Give possible alternatives, produce an idea, put forward (for example) an idea or a plan for consideration.
use / using	The answer must be based on information given in the question.
what	A request for information, clarified by the context or question in which it is contained.
which	Identify an object, word or explanation.
why	For what reason?
write down	Present the required information, e.g. '…Write balanced equations that represent the radioactive decay of...'

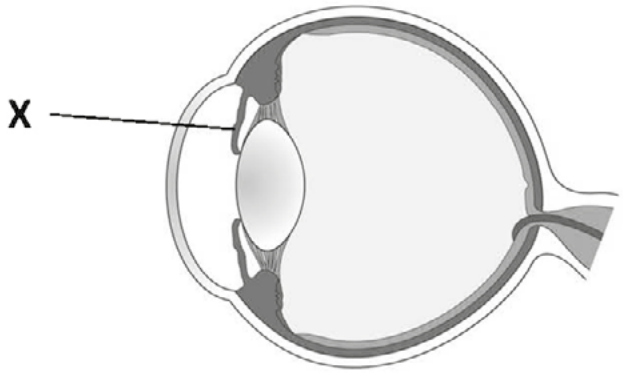
3. QUESTION TYPE EXAMPLES AND COMMENTS

(a) Multiple Choice Questions (MCQs)

In all Gateway question papers, the first section will be multiple choice questions.

- There will always be four options
- All options will either be directly from the specification, cover understanding from a previous key stage or test understanding of common misconceptions/ errors. For example, a calculation MCQ might include a distractor where the student has forgotten to double the value. Whilst not an exhaustive list, OCR Gateway specifications include a summary of common misconceptions at the start of each topic area
- Options will always be in alphabetical/numerical order unless doing so prompts the correct option
- MCQs will never test AO3
- There is a box at the end of the options for students to indicate their answer .

3 The diagram shows the eye.



What is the name of part **X**?

A Cornea

B Iris

C Lens

D Pupil

Your answer ☐

[1]

A straightforward example of an MCQ testing knowledge and understanding of an idea, AO1.1. There will never be more than 15% of marks available for questions like this which just test knowledge in isolation.

Specification reference	Mark allocation	AO target	Specimen assessment material question
3.1d	1	AO1.1	J247/01 Question 3

(b) Short answer questions

These question types can assess any assessment objective and will include:

- 3 mark objective style questions
- 1, 2 or 3 mark free-response questions
- 1, 2 or 3 mark calculations.

We use short answer questions because they allow broad specification coverage helping us keep our examinations at a manageable length.

(b) Their teacher prefers the method used by student **A**.

Suggest **one** reason why.

……

……

[1]

The question requires analysis of information and ideas to make a judgement (AO3.2a) as well as an ability to evaluate methods (Working Scientifically WS1.2e).

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question
P4.1c	1	AO3.2a	WS1.2e	J249/01 Question 17(b)

(b) One student suggests that they measure the length of more nettle leaves in each area.

Why will taking more measurements improve their results?

……

……

[1]

The question needs knowledge and understanding of a practical procedure (AO1.2) and the ability to interpret observations/data (Working Scientifically WS1.3e)

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question
4.1e	1	AO1.2	WS1.3e	J250/02 Q12b

(c) (i) Calculate the percentage change in the length of the chip in the **1.0 M solution**.

Calculation requiring application of knowledge and understanding of a scientific idea (AO2.1) knowledge of percentages (Maths skill, M1c) and ability to translate data from one form to another (WS1.3b)

Answer = ...%

[2]

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question	Maths reference
2.1a	2	AO2.1 x 2	1.3b	J247/03 Q20ci	M1c

17 Two students, **A** and **B**, use different methods to see magnetic field patterns.

(a) (i) Describe how student **A** could use a compass to plot a magnetic field pattern.

You may draw a diagram to help you answer this question.

Knowledge and understanding of scientific techniques and procedures (AO1.2) alongside the ability to plan or devise experiments (Working Scientifically, WS1.2b)

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..... **[3]**

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question
P4.1c	3	AO1.2 x 3	WS1.2b	J249/01 Q17a(i)

(b) The equation shows the reaction between sodium hydroxide and dilute sulfuric acid.

Required relative atomic masses are available on the OCR Data Sheet

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

sodium hydroxide + sulfuric acid → sodium sulfate + water

Calculate the mass of sodium hydroxide needed to make 30.0 g of sodium sulfate.

Give your answer to **3** significant figures.

For full credit the calculation needs to be completed to a specific number of significant figures so we have made that clear in the question.

Answer = ... g **[3]**

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question	Maths reference
3.1l	3	AO1.1 x 1 AO2.1 x 2	WS1.3b,c,e	J248/03 19b	CM3.1iv

(c) Long answer/extended response questions

We class long answer/extended response questions in science as anything over 3 marks. We use these questions to assess across all three Assessment Objectives (AO1, 2 and 3).

These question types include:

- open-ended, essay-style questions
- synoptic questions linking concepts from across the specification
- data interpretation questions
- questions on experimental design
- questions assessing the application of knowledge in novel contexts
- multi-step calculations.

Additionally, we use the term level of response (often abbreviated to LOR by teachers and examiners) to cover a specific 6 mark question type that tests students on their ability to form and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically presented. As these questions are testing the organisation as well as the substance of the response they are marked using a levels of response mark scheme. All level of response questions are flagged with an asterisk in the question paper so it is clear to the student what is being assessed. The cover of science question papers testing level of response also include a sentence to remind students that such items will be flagged with an asterisk.

MARKING APPROACH FOR LEVEL OF RESPONSE QUESTIONS

Level of response questions are always marked in the same basic way, see below, with the six marks split into three bands using generic communication descriptors.

Level 3 (5–6 marks)

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated

Level 2 (3–4 marks)

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks
No response or no response worthy of credit.

Our examiners are given the following guidance to aid their marking of level of response questions (this information is repeated in our published mark schemes including our specimen assessment materials).

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for students' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.
The communication statement determines the mark within a level.

See later for a specific example of a level of response question, and mark scheme, from our specimen assessment materials.

(c) Particle **C** has the electronic structure 2.8.7.

What does this electronic structure tell you about the position of particle **C** in the periodic table?

Explain your answer.

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..... **[4]**

A long answer response question requiring:

- application of knowledge and understanding of scientific ideas (AO2.1)
- use of theories and terminology (WS1.2a, 1.4a)

There is no asterisk as this question is not assessing using the level of response approach. A bulleted answer could score maximum marks for this example.

Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question
2.2c	4	AO2.1 x 4	1.4a, 1.2a	J248/03 Q16c

(c)* The student investigates the effect of changing pressure and changing temperature on this reaction.

Asterisk indicates this question is assessed through level of response.

carbon dioxide + hydrogen ⇌ methane + water

The table shows the percentage yield of methane in the equilibrium mixture under different conditions.

A level of response question testing the ability to develop a sustained line of reasoning which is coherent, relevant, substantiated and logically presented.

		Pressure (in atmospheres)			
		100	200	300	400
Temperature (in °C)	300	35%	52%	65%	80%
	600	30%	46%	58%	74%
	900	23%	37%	47%	62%
	1200	14%	25%	36%	48%

Describe what happens to the percentage yield as the pressure and temperature change and explain the effect of increasing the pressure on the rate of reaction.

Remember, the basic approach to testing level of response is always the same, see later.

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Specification reference	Mark allocation	AO target	Working Scientifically reference	Specimen assessment material question
5.3b, 5.2c, 5.2d	6	AO1.1 x 4 AO3.1a x 2	1.4a, 1.3f	J248/02 Q19c

A typical level of response mark scheme

Qu.	Answer	Marks	AO element	Guidance
(c)*	**Level 3 (5–6 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table and includes clear explanations on the effect of increasing the pressure on the rate of reaction** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table and either describes the effect of increasing the pressure on the rate of reaction or explains the effect increasing the pressure on the rate of reaction** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table or describes the effect of increasing the pressure on the rate of reaction** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* *No response or no response worthy of credit.*	**6**	**4 x 1.1** **2 x 3.1a**	**AO1.1: Knowledge of pressure on rate of reaction** • Increasing the pressure increases the rate of reaction. • Increasing the pressure means particles are closer together. • Increasing the pressure means more crowded particles / more particles in the same space. • Increasing the pressure means more collisions between particles. • More collisions the quicker the reaction. More collisions more percentage yield. **AO3.1a: Analyse information in the table to interpret percentage yield** • As temperature increases the percentage yield decreases. • As pressure increases the percentage yield increases. • The highest yield is when the temperature is low and the pressure is high.

Generic level of response marking descriptors

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The small print

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