AQA

A-LEVEL
Biology

Paper 3
Mark scheme

7402/3
Specimen Paper (set 2)

Version 1.0

Keep secure

Please be aware that centres may want to use these specimen papers as mock exams for their students. Help us to maintain the security of these papers by ensuring they are not distributed on social media or other platforms.

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Important - please note

This mark scheme has not been through the full standardisation process. As such, many of the phases described above have not been completed. The Instructions for examiners are also included as a guide to how the mark scheme will function as an operational document. The layout has been kept consistent so that future operational mark schemes do not appear different to the specimen materials.

Copyright © 2017 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Mark scheme instructions to examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information in the 'Comments' column is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

A bold **and** is used to indicate that both parts of the answer are required to award the mark.

Alternative answers acceptable for the same mark are indicated by the use of **OR**. Different terms in the mark scheme are shown by a /; eg allow smooth/free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of errors/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (often prefaced by 'Ignore' in the 'Comments' column of the mark scheme) are not penalised.

3.2 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can usually be gained by correct substitution/working and this is shown in the 'Comments' column or by each stage of a longer calculation.

3.3 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ECF or consequential in the mark scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the mark scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.6 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.7 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Question	Marking Guidance	Mark	Comments
01.1	1. Line graph with rate on y axis and temperature on x axis and linear scales; 2. Values calculated to 2 decimal places; 3. Rates correctly calculated and plotted, with ruled line connecting points and no extrapolation;	3	2. Values of 2.55, 7.17, 11.67
01.2	8 or 9;	1	
01.3	Determine the area under the curve;	1	
01.4	1. Enzymes/metabolism faster; 2. Higher rate of respiration and carbon dioxide production/release; 3. Spiracles open more often/remain open to excrete/get rid of carbon dioxide/get more oxygen;	3	Note – explanation required

Question	Marking Guidance	Mark	Comments
02.1	1. Replacement of a base by a different base (in DNA);	1	
02.2	1. (Depends on) size/mass (of protein); 2. (Depends on) charge (of protein);	2 max	Accept for 2 marks 'Smaller/more highly charged move further'
02.3	1. Each protein has a different tertiary structure; 2. (Each) antibody has a specific antigen/binding/variable region/site; 3. So, (each antibody) forms different antigen-antibody complex OR (each antibody) only binds to complementary (protein);	3	
02.4	1. Less NL3; 2. More NR2A **and** NR2B;	2	
02.5	1. Higher ratio NR2B to NR2A with mutation; 2. (Perhaps) better memory in mice with mutation;	2	1. Accept 'more' as equivalent to 'ratio'

Question	Marking Guidance	Mark	Comments
03.1	35.22 or 35.23% = 2 marks; Award 1 mark if only fresh and dry masses correct, 1335.59 and 865.13 g;	2	
03.2	(After 24 hours) 1. Record mass and reheat; 2. Until constant mass recorded;	2	1. Accept return to oven = reheat
03.3	1. Positive correlation (between diameter and biomass); 2. Not linear/geometric/exponential/gradient gets steeper;	2	
03.4	1. Calculate a mean diameter; 2. (Use this to) estimate/determine the mean fresh biomass of trees; 3. Use the percentage water content to find the dried biomass; 4. Use the dried density to calculate the mass of tree; 5. Count/estimate the number of trees in plantation and multiply by (mean) carbon content (to find total carbon);	4 max	

Question	Marking Guidance	Mark	Comments
04.1	1. Only cleared and abandoned and introduction of non-native species make (significant) difference; 2. Because only (means of) these ± 2 SDs from zero/no change; 3. About same number/4 to 3 increase or decrease (species) richness/biodiversity;	3	Accept converse for others
04.2	1. Non-native species out-competes/kills/eats/is a disease of native plants; 2. Some (populations of) native species become extinct (in the community);	2	
04.3	1. Set up grid system with coordinates; 2. Place large number of quadrats (at coordinates) selected at random; 3. Count number of/estimate percentage cover of native plant in quadrats; 4. Repeat at same time each year (for many years);	3 max	
04.4	Correct answer two marks - 0.0599; 1 mark for writing $\frac{\log_e (SR2/SR1)}{\text{Time in decades}}$	2	Award 1 mark for answer of – 5.985 or 0.290

Question	Marking Guidance	Mark	Comments
05.1	(ESCs) can replace any type of (heart) cell;	1	Accept named type of cell, eg heart muscle cell
05.2	1. Might divide out of control; 2. Leading to tumour/cancer;	2	
05.3	1. Shows the effects of surgery; 2. Allows effects of transplants/treatment to be seen;	2	Allow in either order
05.4	1. Other cell types cause some increase but most of increase due to cardiomyocytes; 2. Large SD, so some not much increase/no better than control; 3. Overlap of SDs indicates/suggests no significant difference;	3	
05.5	1. Greater blood supply (to damaged areas); 2. Bringing more oxygen/glucose for respiration; 3. Brings more amino acids for protein synthesis; 4. For cell repair/mitosis/division;	3 max	
05.6	1. Measure diameter of field of view and calculate area; 2. Using micrometer slide and eyepiece graticule; 3. Count number of capillaries in large number of fields of view and calculate mean; 4. Select fields of view randomly	4	2. Accept descriptions

Question 6 Level of response marking guidance

Level of response marking instructions

Level of response mark schemes are broken down into five levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are five marks in each level. Thus the descriptor for the level represents the mid mark in that level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level. ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 6 Level of response marking guidance

21–25	Extended Abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16–20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and/or one irrelevant topic which detracts from the overall quality of the answer.
11–15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and/or more than one irrelevant topic.
6–10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and/or irrelevant topics.
1–5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and/or irrelevant topics.
0		Nothing of relevance or no response.

Question 06.1: How nucleotides, molecules derived from nucleotides and nucleic acids are important in keeping organisms alive.

In order to fully address the question and reach the highest mark bands students must also include at least five topics in their answer, to demonstrate a synoptic approach to the essay.

Specification Reference	Topic Area
3.1.6	ATP
3.1.4.2	Enzymes – ATP, phosphorylation and activation energy
3.1.5	Nucleic acids – information carrying molecules
3.2.2	Mitosis
3.2.3	Transport across membranes – active transport and co-transport
3.3.3	Absorption
3.4.1	DNA, genes and chromosomes
3.4.2	DNA and protein synthesis – ribosomes as nucleic acids – mRNA, tRNA – etc
3.4.3	Genetic diversity – mutations
3.4.	Meiosis
3.4.4	Diversity and adaptation
3.5.1	Photosynthesis
3.5.2	Respiration
3.6.2	Nerve impulses
3.6.3	Muscle contraction
3.6.4.2	Control of blood glucose – second messenger and cAMP
3.6.4.3	Control of blood water potential
3.8.1	Control of gene expression – Mutations
3.8.2	Gene expression
3.8.2.2	Regulation transcription and translation

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

Question 06.2: The ways in which water and the regulation of water content are important to organisms.

In order to fully address the question and reach the highest mark bands students must also include at least five topics in their answer, to demonstrate a synoptic approach to the essay.

Specification Reference	Topic Area
3.1.1	Monomers and polymers – carbohydrates – lipids – proteins
3.1.7	Water
3.2.3	Transport across membranes – osmosis – water potentials
3.3.2	Gas exchange – plants
3.3.2	Gas exchange – fish
3.3.2	Gas exchange – insects
3.3.4.1	Mass transport in animals - blood – circulation
3.3.4.1	Mass transport in animals – tissue fluid and formation
3.3.4.2	Mass transport in plants – transpiration stream
3.3.4.2	Mass transport in plants – translocation
3.5.1	Photosynthesis
3.5.4	Nutrient cycles – leaching and eutrophication
3.6.1	Growth responses in plants
3.6.4	Homeostasis
3.6.4.3	Control of blood and water potential

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

Essay marking – an introduction to guidance for examiners

The essay carries about equal numbers of marks for:

- AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures
- AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:
  - in a theoretical context
  - in a practical context
  - when handling qualitative data
  - when handling quantitative data.

Application of knowledge requires a higher level of skill and ability than factual recall.

According to the Essay Descriptors, students who write a series of (correct) facts but do not apply their knowledge (AO2) to illustrate or explain the main theme or concept in an essay title should only achieve a maximum mark in the 11 to 15 range.

The essay is marked online. The guidance for examiners tells them how to construct a tick chart when marking an essay. This allows them to record decisions about content, breadth, relevance and quality of written communication as they go along. They are also given guidance on how to interpret the tick chart in relation to the Essay Descriptors.

The tick chart method was developed from annotations used in marking essays in previous specifications, when marking paper scripts. To help ensure consistency over time, and between different examiners, the essays are double-marked; two examiners mark the same essay and the marks they award are compared. The examiners do not know which essays are double-marked. AQA has rigorous procedures in place to ensure that examiners whose marking is out of tolerance with the agreed standard either have to adjust their marking or, if absolutely necessary, stop marking altogether.

The following pages show the guidance that will be used by examiners marking the essay in the new specification. It is almost identical to the guidance used when marking BIOL5 in the previous specification (2410).

Marking the Paper 3 essay: Guidance for examiners

Introduction

This guidance for marking the essay has the aim of simplifying the marking process and maintaining a consistent standard of marking across our team of examiners. Feedback from examiners and team leaders using this method has been very positive.
Furthermore, the marks for the essay in past years have shown an almost perfect normal distribution.

Initially, you may find this new method of marking a bit time consuming. However, as you get used to the method and topic areas, you will be able to mark more quickly.
When awarding marks, it is vital that you make judgements based on the core purpose of the essay, which is to assess students' synoptic skills.

The essay: a synoptic exercise

High marks should be awarded to students who demonstrate the ability:
- to organise and present relevant information to support the explanation of the concept or theme presented in the title of the essay
- to select correct examples from a breadth of topics (ideally five or six) across the specification to support their explanation.

Students should **not** be awarded all the marks available for:
- selecting only, say, two topics and writing in great depth and detail about those topics
- presenting a fact-filled essay which does not relate directly to the concept or theme in the title.

Example 1

Essay title: The importance of shapes fitting together in cells and organisms
We would expect students to select information that illustrates diverse examples of the **biological importance** of shapes fitting together.

For example, induced fit ensures that a specific enzyme only binds to its specific substrate(s). **This allows for** the construction and control of particular metabolic pathways. **It also allows** specific reactions to occur in a soup of reactants in, say, the cytoplasm of a cell.

To address the title, it is not necessary for students to expand further on the topic of protein structure. Indeed, if they only went into great depth on this one topic, they would not be addressing the title, or taking a synoptic approach.

Example 2

Essay title: Negative feedback

A student writes at degree level about how insulin and glucagon work at the cellular level. The student goes on to write at a similar factual level about three or four other topics. The fact-filled essay scores only 18 out of 25 because **no reference was made to negative feedback**, or how insulin and glucagon control their own secretion and thus action.

Instructions for marking the essay

These instructions cover how to mark the essay using CMI+ and how the essay will be standardised using OLS.
The **key feature** of this method of marking is that **you make decisions about content as you go along**, not after reading the whole essay.

There will only be **three annotations**:

- vertical line in right margin = relevant A-level content
- horizontal line under fundamental error
- vertical line in left margin = irrelevant content.

Marking sheet

The minimum you require is a piece of blank paper. If you wish, use copies of the sheet provided here. You need one copy of the sheet to understand the rest of this document.

Topic	Tick 1	Tick 2			Mark
			B	**Breadth =**	
			R	**Relevance =**	
			Q	**QWC =**	
			S	**Scientific content =**	

With a copy of the marking sheet in front of you, look at an essay then follow the procedure outlined below.

Scientific Content

The mark scheme has a list of likely topics for each essay. Next to each topic is a letter, or two letters, to identify the topic when marking; eg **A**, **B**, **C**, **D**. You will soon become familiar with these letters. Note, this list is not definitive; **students can use any valid example that is not mentioned in the specification**. If you are not familiar with an example used, please make a quick internet search and check to see whether the content of the essay is correct.

Using the marking sheet

If a student writes at least one sentence about a topic, insert the relevant letter(s) in the column headed **Topic**. After reading the essay, you will use these letters to determine breadth. (Note – breadth marks are separate from content marks)

As you read the essay, look for

- valid **A-level specification content**; this may be basic for some topics
- any correct, **relevant** and significant detail beyond the specification.

1. If a **valid A-level statement** is made about a Topic, put a tick in the **Tick 1** column, next to the topic letter on your marking sheet.
2. **On screen**, select the underline tool; once at start of each essay should be all that's needed. **Draw a vertical line in the right margin** indicating the valid content.
3. If a second A-level statement is made, another tick might be placed in the **Tick 2** column (and draw another vertical line on screen). **A second tick can only be awarded if an attempt is made to address the concept/theme of the essay.**
4. No more than two ticks can be placed next to each topic letter.
5. If **correct, relevant and significant detail** (at least a couple of sentences) **beyond the specification** is given, then use a tick with an ***** in the **Tick 1** or **Tick 2** column.

At the end, you will look at the best 4 Topics for content marks – ie those with the greatest number of double or single ticks.

Fundamental errors

1. Put a cross through one tick for each fundamental error in the factual content. This means **a big factual error**, not a spelling mistake. A cross should go through one of their 'best' ticks, that is, starting with a second tick they may have for **any** topic.
2. **On the screen**, **draw a horizontal line** under/through the fundamental error.

After going through the essay, compare your ticks against the table.

Breadth

(The guidance for this may vary slightly, depending on the number of possible topic areas for an essay title.)

- 5 relevant approaches to the title = 3 marks
- 4 approaches to the title = 2 marks
- 3 approaches to the title = 1 mark
- Fewer than 3 relevant approaches to the title = 0

Relevance

Make a note of this on your tick sheet as you go along. On the screen, draw a vertical line in the left margin that (roughly) corresponds with the non-relevant material.

Award two marks for relevance if there is a paragraph/three or four sentences about a non-relevant topic. Award one mark if there are two non-relevant paragraphs. Give 0 if the bulk of the essay is non-relevant.

- Zero non-relevant paragraphs/three or four sentences = 3
- One non-relevant paragraphs/three or four sentences = 2
- Two non-relevant paragraphs/three or four sentences = 1
- Bulk of essay is non-relevant = 0

Quality of Written Communication (QWC)

Gather your impression as you go through the essay.

- Good spelling, grammar **and (largely) correct use of terminology** = 3
- Some spelling/grammatical errors and some errors in terminology = 2
- Poor spelling/grammar and/**or little use of terminology** = 1
- Very poor spelling/grammar and/**or no use of terminology** = 0

Note – 2 should be the average mark.

How to award content marks based on topics, ticks and asterisks

The best 4 topics are considered in this table. These are represented as **A, B**, **C** and **D**. Ticks are considered **after** any have been removed by crossing through because of fundamental errors.

Content mark	Letters and ticks	*Other factors	Links to levels
0	**A**, **B**, **C**, **D**	No AS/A-level content, only GCSE – and no significant Biology at any level.	Nothing of relevance or no response.
2	**A**, **B**, **C**, **D**	GCSE content (Note, could be content with ticks crossed out for fundamental errors).	**Unfocused → Unistructural** Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect.
4	**A✓**, **B**, **C**, **D**	GCSE but **one** topic with some A-level content.	May contain a large number of errors and/or irrelevant topics. Content and terminology is generally below A-level. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and/or irrelevant topics.
6	**A✓**, **B✓**, **C**, **D**	Some A-level content in **two** topics.	**Unistructural → Multistructural** Response predominantly deals with only one or two topics that relate to the question.
8	**A✓**, **B✓**, **C✓**, **D✓**	Some A-level content in **four** topics.	Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and/or more than one irrelevant topic.

10	**A✓✓**, **B✓**, **C✓**, **D✓**	Some A-level content in **three** topics and **good content addressing theme of the essay** in **one.**	**Multistructural → Relational** Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.
12	**A✓✓**, **B✓✓**, **C✓**, **D✓**	Some A-level content in **four** topics and **good content addressing theme of the essay** in **two** topics.	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Perhaps one significant error and/or one irrelevant topic which detracts from the overall quality of the answer.
14	**A✓✓**, **B✓✓**, **C✓✓**, **D✓**	Some A-level content in **four** topics and **good content addressing theme of the essay** in **three** topics.	**Relational → Extended Abstract** Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology and is very well written and always clearly explained.
16*	**A✓✓**, **B✓✓**, **C✓✓**, **D✓***	14 for content and beyond specification content in **one** topic.	No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.

<u>Note</u>, if your tick chart indicates a certain content mark (eg 8), you can award one mark lower (ie 7) if you feel 8 is a bit strong, or one mark higher (ie 9) if you feel 8 is a bit weak.

<u>Note</u>, 16 content marks are <u>only</u> awarded if there is good A-level content up to 14 marks and one of these topics is taken beyond A-level.