AQA

A-level
Biology

7402/3-Paper 3
Mark scheme

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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.

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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

2.1 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.

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

2.3 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	(Insulin stimulates release of osteocalcin – no mark) 1. Osteocalcin causes **more** (release of) insulin; 2. (More) insulin causes **more** (inactive) osteocalcin (release);	2	1. and 2. Idea of **more** required but other words can be used 1. and 2. Ignore ref. to further 1. and 2. Ignore ref. to more B cells / osteoblasts stimulated
01.2	1. (Change in pH) changes / breaks ionic / hydrogen bonds; 2. Changes tertiary structure;	2	1. Ignore ref. to peptide or sulfur-sulfur bonds 1. Accept polar bonds 2. Ignore changes to primary structure 2. Reject ref. to active site / enzyme 2. Accept forms binding site 2. Ignore 3D 2. Accept 3^{o}
01.3	1. (Insulin) leads to more transport proteins / channel (proteins) / carrier (proteins) for glucose; 2. More glucose (for respiration / glycolysis) enters cell;	2	Idea of more required **once** to cover both mark points 1. Ignore references to opening channels 1. Accept co-transport / GLUT 1 or 4 protein 2. Ignore references to glycogen formation / fat metabolism / enzyme activation

Question	Marking Guidance	Mark	Comments
02.1	Correlation coefficient **and** because looking for correlation / relationship / association between two variables / between B cells destroyed and CD20;	1	Accept Pearson and Spearman Accept factor for variable **Wrong test or wrong reason = 0 marks**
02.2	1. The more CD20 (on B cells), higher the percentage of / more B cells destroyed / more effective it is; 2. (At best) only destroys (about) 80% of B cells **OR** In no cases are all B cells killed; 3. Don't know % / proportion of cancer cells killed; 4. Won't cure CLL / cancer / slows but doesn't stop CLL / cancer; 5. Little effect below (about) 5 CD20 on cells;	3 max	1. Ignore ref. to 'positive correlation' unqualified Ignore ref. to correlation vs. causation Ignore ref. to effects on the immune system 5. Ignore ref. to little effect where little CD20
02.3	1.8×10^{8};; If correct difference but expressed in non-standard form, award 1 mark;	2	Award 1 mark if answer given as 1.8×10^{-8}

02.4	1. Mutation changes the tertiary structure / amino acid sequence of transcription factor; 2. Transcription factor not complementary to / cannot bind to CD20 gene / CD20 DNA; 3. Little / less / not enough / no <u>mRNA</u> for CD20 produced **OR** Little / less / not enough / no (mRNA for) CD20 translated / produced; 4. (Not enough CD20 so) nothing / little for Rituximab to bind to, **so** few / no B cells destroyed;	3 max	1. and 2. Do not accept unqualified statements about non-functional transcription factor – this is in stem of question 1. and 2. Answers must be in context of transcription factor, not CD20, or generic statements 2. Accept TF cannot bind to promoter (on DNA) 4. Accept converse for cells with a lot of CD20 4. Accept lower median percentage for fewer cells destroyed

Question	Marking Guidance	Mark	Comments
03.1	Lowercase **a** in both boxes	1	
03.2	Tick in box next to 'Crossing over';	1	
03.3	32.73 / 32.7 / 32 / 33;; Award 1 max for **either** 409 (409.2) for difference in volume (but incorrect number of mitochondria); **OR** Answer of 262 (261.9) (using diameter, rather than radius);	2	
03.4	1. Egg (created) has nucleus / DNA / genes of (affected) woman / mother; 2. It has mostly / many / lots of normal mitochondria (of unaffected woman) **OR** There are few faulty mitochondria;	2	1. Accept ref. to zygote / embryo / child for egg 1. Accept genetic information 1. Ignore references to alleles 1. Reject if nucleus from wrong egg / woman 2. Reject ref. to **production** of healthy mitochondria as result of treatment
03.5	1. Not enough / little ATP produced; 2. ATP provides **energy** for (enzyme) reactions **OR** ATP phosphorylates substrates / enzymes, **so** making them (more) reactive;	2 max	**One** reason asked for, so list rule applies 1. Ignore ref. to no ATP produced 2. Accept (leads to) lower activation energy for reaction 2. Reject if mention energy produced

Question	Marking Guidance	Mark	Comments
04.1	1. Binding of first oxygen changes tertiary / quaternary (structure) of haemoglobin; 2. Creates / leads to / uncovers second / another binding site **OR** Uncovers another iron / Fe / haem group to bind to;	2	Ignore ref. to 'positive cooperativity' unqualified Ignore ref. to named bonds 1. Accept conformational shift caused 2. Reject ref. to active site
04.2	5.6×10^6 (red blood cells per mm^3);; Award 1 max for **one of** 2.8×10^4 (standard form but ignoring dilution) **OR** 5 600 000 (correct but not standard form) **OR** $5.6 \times 10^{\mathbf{5}}$ (failure to use depth of liquid on slide);	2	
04.3	1. To avoid dealing with parts of cells; 2. To avoid counting same cells twice / more than once; 3. To be consistent / get comparable results;	2 max	3. Accept more accuracy 3. Ignore reliability / repeatability / reproducibility / precision / validity
04.4	There are fewer white cells, **so** no need to dilute (further to see enough);	1	Accept converse of too few to see if greater dilution / at 200 times Do not accept ref. to numbers of red and white cells unqualified Ignore ref. to white cells larger
04.5	White cells have a nucleus (that stains but red cells do not);	1	Accept converse for red cells

Question	Marking Guidance	Mark	Comments
05.1	1. Cell membranes made from phospholipid; 2. (Detergent) dissolves membranes / phospholipid (bilayer);	2	Note: candidates may make both mark points in once statement 2. Ignore breaks down 2. Reject hydrolysis
05.2	1. Spin (liquid / supernatant) at (very) high speed / high g; 2. Molecules / CENP-W separates depending on (molecular) mass / size / density;	2	1. Need context of high, **not** just 'faster', 'higher' in context of use of bench centrifuge 1. Accept high centrifugal force Award 1 max if ref. to organelle separation 2. Accept weight
05.3	1. siRNA binds to / destroys mRNA for CENP-W; 2. Prevents translation of CENP-W; 3. (After / as) CENP-W reduces **so** does tubulin production;	3	1. Reject if siRNA binds to gene / DNA 1. and 2. Context is important, siRNA acts on mRNA for CENP-W, **not** tubulin. 1. and 2. Ref. to CENP-W required **once** for MP1 and MP2 2. Accept reduces translation of CENP-W

Question	Marking Guidance	Mark	Comments
06.1	1. (µg because) very little ammonia (in soil); 2. (µg because) avoids use of (lots of) decimal places (in their results) / avoids the use of powers of 10 / avoids the use of standard form; 3. (g^{-1}) to allow comparisons (between samples);	2 max	2. Accept makes numbers more manageable 2. Accept makes easier to plot graph
06.2	Answer between 4.5 and 4.6 µg g^{-1} day^{-1};; Award 1 mark for correct number but wrong / no units	2	Ignore plus or minus signs Accept 'per gram' **AND / OR** 'per day'
06.3	1. pH 4.3 / B has fastest rate of breakdown (of ammonia); 2. A + B / mixture at pH 6.9 slowest / slower (than A or B); 3. Suggests (community / bacteria at) pH 4.3 / B doesn't work (well) at pH 6.9 / pH of mixture;	3	2. Not just ref. to A and then B on their own 3. Accept converse that only (community / bacteria at) pH 6.9 / A is working in the mixture
06.4	(Species **S** because) no mark 1. Species **S** change of 990,000 (per gram of soil); 2. Species **T** change of 9,900 (per gram of soil); **OR** (Species **T** because) no mark 3. Species **S** has 99% change; 4. Species **T** has 9900% change;	2	Award MP1 and 2 **OR** MP3 and 4 1. and 2. Accept standard forms 9.9 x 10^5 and 9.9 x 10^3 for either Accept for 1 mark for 100 times greater in correct context with no other calculations shown
06.5	1. They didn't count bacteria / cells / population(s);	4	Ignore ref. to other

	2. Copies / number of mRNA related to amount of enzyme / amoA produced / translated; 3. Don't know how much mRNA / amoA produced by each cell; 4. Don't know if amoA (mRNA / enzyme) is linked to cell division / growth (of population);		factors / other named factors affecting growth 3. Accept some bacteria produce more mRNA / amoA than others 4. Amount of amoA does not show cell division / growth 4. Reject references to mitosis / meiosis

06.6	1. Suitable method; eg in boiling water / steam / autoclave / wash in disinfectant / wash in alcohol 2. (Reason) to remove / kill other bacteria / organisms **that** might break down ammonia;	2	1. Ignore heat unqualified 1. Ignore flaming of bottle 1. Accept radiation 2. Ignore ref to removing bacteria that 'affect the result' 2. Accept other bacteria producing amoA 2. Accept other bacteria compete with / kill bacteria that produce amoA 2. Ignore contamination unqualified

Question 7 Level of response marking guidance

Level of response marking instructions

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

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, and 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.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	Definition
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. 'Several' here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (eg importance) at A-level standard.

Question	Marking Guidance	Mark	
07.1	The importance of the control of movement **in** cells and organisms. Suitable topic areas • 3.1.4.2 Enzymes and control of action • 3.1.5.2 DNA replication • 3.2.2 Mitosis, binary fission • 3.2.3 Transport across membranes • 3.2.4 Cell recognition and the immune system • 3.3.2 Gas exchange • 3.3.3 Digestion and absorption • 3.3.4.1 Mass transport in animals • 3.3.4.2 Mass transport in plants • 3.4.2 DNA and protein synthesis • 3.4.3 Meiosis • 3.5.1 Photosynthesis • 3.5.2 Respiration • 3.6.1.1 Survival and response • 3.6.1.2 Receptors • 3.6.1.3 Control of heart rate • 3.6.2.1 Nervous impulses • 3.6.2.2 Synaptic transmission • 3.6.3 Muscle contraction • 3.6.4.2 Control of blood glucose • 3.6.4.3 Control of blood water potential • 3.7.1 Inheritance • 3.8.2.2 Regulation of transcription and translation • 3.8.2.3 Gene expression and cancer	**[25 marks]**	

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

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	Marking Guidance	Mark
07.2	The importance of interactions **between cells** and between organisms. Suitable topic areas • 3.2.1.2 Viruses • 3.2.4 Cell recognition, immune system, HIV • 3.3.2 Gas exchange • 3.3.4.1 Mass transport in animals • 3.3.4.2 Mass transport in plants • 3.4.4 Genetic diversity and adaptation • 3.4.5 Species and taxonomy (courtship behaviour) • 3.4.6 Biodiversity within a community • 3.5.3 Energy and ecosystems • 3.5.4 Nutrient cycles • 3.6.1.1 Survival and response • 3.6.1.2 Receptors • 3.6.2.2 Synaptic transmission • 3.6.3 Skeletal muscles are stimulated ... • 3.6.4.2 Control of blood glucose • 3.6.4.3 Control of blood water potential • 3.7.1 Inheritance • 3.7.2 Populations in ecosystems • 3.7.3 Evolution and speciation • 3.7.4 Populations in ecosystems • 3.8.2.3 Gene expression and cancer	**[25 marks]**

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