A-LEVEL
BIOLOGY

7402/3

Mark scheme

7402

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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	1. (Nerve impulse/depolarisation of membrane) causes Ca^{2+} channel (proteins) to open; 2. Ca^{2+} enter by (facilitated) diffusion; 3. Causes (synaptic) vesicles to fuse with (presynaptic) membrane;	3	Accept single reference to ions to cover 1 and 2 Penalise once for no reference to ions 1. Reject carrier proteins 3. Reject ref to release of vesicles 3. Ignore vesicles bind to membrane (but accept merge with)
01.2	1. Myosin head attaches to actin **and** bends/performs powerstroke; 2. (This) pulls mitochondria past/along the actin; 3. Other/next myosin head attaches to actin (and bends/performs powerstroke);	2 max	1. Accept change shape/change angle 2. Ignore pulls actin along 2. Ignore refs to cytoskeleon Accept plural or singular statements
01.3	1. (Mitochondria) supply (additional) ATP/energy; 2. To move vesicles/for active transport of ions/for myosin to move past actin OR Re-synthesis/reabsorption of neurotransmitter/named neurotransmitter;	2	1. Reject produces energy 2. Ignore ref. to ATP for opening calcium ion channels/making vesicles fuse with membrane

Question	Marking Guidance	Mark	Comments
02.1	The bacteriophage has a capsid and the bacterium has a cell-surface membrane; Third box down ✓	1	Reject if more than one box with tick. Ignore crossed-out ticks Accept tick to right or left of correct box
02.2	Correct number of times between 13.0/12.96 **and** 13.9/13.92 scores 2 marks;; One mark if correct sizes in ranges of 150.7nm to 154.4nm/ 0.151µm to 0.154µm **and** 1953.5nm to 2097.6nm/ 1.954µm to 2.098µm;	2	**Both** lengths required for 1 mark credit Accept refs to150/0.15 and 2000/2 Ignore number of sig fig
02.3	The bacteriophage makes no difference to the number of (living) bacteria/there will be no difference in the number of (live) bacteria in treated and untreated mice/ there will be no difference in the number of (live) bacteria in A and B;	1	Ignore no difference between mice

02.4	1. Log scale (on graph) shows big range in number of bacteria OR Use of suitable data from log scale to give the range in number of bacteria; 2. Some samples too many to count (so dilute) but some countable (so don't dilute) **OR** Use of figures from graph relating to ease (or otherwise) of counting Example. 631 000 000 bacteria would be too big to count (without serial dilution), 100 000 bacteria is small enough to count;	2	1 and 2 **Do not** accept simple statements of $\log_{10}$ values from graph Look for answers in standard form **Group A** Mean between 79 million and 100 million Range 4 million to 631 million **Group B** Mean between 100 thousand and 126 thousand Range 3.98/4 up to 251 thousand
02.5	1. (Bacteriophage) reduces number of bacteria; 2. (In all cases/mice because) ranges don't overlap; 3. But big range of effect/some mice a big reduction/a few mice with big falls in number OR Doesn't bring bacteria down to 0 in any/works for some (mice) but not for all;	3	Do not accept just quotes of $\log_{10}$ figures direct from graph Ignore refs to significance 2. Reject ref to SD / SE

Question	Marking Guidance	Mark	Comments
03.1	Two suitable examples;; Examples 1. amino acid/protein/ polypeptide/peptide; 2. nucleic acid/nucleotide/base; 3. DNA; 4. RNA; 5. ATP/ADP; 6. NAD/NADP (reduced or not); 7. Cyclic AMP/cAMP; 8. Chlorophyll;	2 max	**List rule applies** Reject for either point nitrates/nitrites/ammonia/ammonium/urea 4. Accept pre-mRNA/mRNA/rRNA/tRNA
03.2	Correct answer in the range 90 to 133.2 scores 2 marks;; 1 mark for answers where yield calculated correctly for 1970 **OR** 2005; (1970 in range) 170.8 to 176.4 **OR** (2005 in range) 266.4 to 304.0;	2	Accept positive or negative values
03.3	1. Using more but getting less response over time; 2. The graph shows correlation but doesn't prove changes in yield due to fertiliser/but there could be other factors; 3. Becomes less cost effective with time;	2 max	**Idea of over time is important** 1. accept fertiliser becomes less effective over time 1. Accept use of figures from graph 1. Accept the idea of less grain/crop over time 2.Ignore whether correlation is positive or negative

Question	Marking Guidance	Mark	Comments
04.1	Correct answer of 4.92, 2 marks;; If N(N-1) = 3540, **OR** ∑n(n-1) = 720, then award 1 mark	2	Accept 4.916/4.917/4.9
04.2	1. A method of selecting sampling sites at random; 2. Use of quadrat; 3. Identify (plant) species (at site/in each quadrat) OR Count number of (different plant) species (at site/in each quadrat);	3	1. Eg grid with coordinates selected using random number table 2. Frame or point 3. Reject refs to % cover, or counting individuals
04.3	1. Significant increase in species richness on Islay and Colonsay **and** (significant) fall on Harris; 2. Change in diversity on Islay not significant; 3. Greater than 0.05/5% probability of getting this change/difference by chance (on Islay) OR (For other differences) less than 0.001/0.1% probability of getting this change/difference by chance (for species richness on Colonsay, Harris, Islay) OR Less than 0.01/1% probability of getting this change/difference by chance (for diversity index on Colonsay, Harris);	3	2. Accept converse about significance of differences in other cases 3. Reject **results** are due/not due to chance 3. Ignore refs to P unqualified

Question	Marking Guidance	Mark	Comments
05.1	1. (DNA) helicase; 2. (DNA) polymerase;	2	**List Rule Applies** Accept (DNA) ligase/ Primase/telomerase/ Topoisomerase/DNA gyrase Reject RNA Accept phonetic spellings
05.2	1. Changes tertiary structure of the enzyme; 2. (Enzyme) active site formed/able to be formed/active site becomes complementary;	2	1. Accept tertiary symbol 3^{o} 1. Ignore 3D 2. Reject refs to inhibition/inhibitors 2. Ignore refs to E-S complexes form 2. Ignore refs to substrate phosphorylation
05.3	(Phosphorylation/phosphate) makes substrates more reactive/raises their energy level(s)/lowers activation energy for the reaction;	1	Ignore provides energy unqualified Ignore refs to kinetic energy unqualified
05.4	1. ATM will not bind to (broken) DNA; 2. DNA not repaired/ cell still has broken DNA; 3. Cell division continues/tumour forms; 4. Tumour suppressor (gene) not effective/ not activated; 5. May have no effect in diploid/heterozygous (organism); 6. (Which) still has a functional ATM/ATM gene;	3 max	

Question	Marking Guidance	Mark	Comments
06.1	Correct answer 23.55 – 24 two marks;; For one mark 5.9 OR 94.2;	2	
06.2	1. Method for measuring area; eg draw round (each) leaf on graph paper and count squares; 2. Of both sides of (each) leaf; 3. Divide rate (of water loss/uptake from potometer) by (total) surface area (of leaves);	3	
06.3	Plant has roots OR xylem cells very narrow;	1	Ignore references to air bubbles/mass flow/photosynthesis Accept xylem damaged when cut
06.4	1. Both small/similar size (so fit channel); 2. Have a similar shape (so bind to/fit channel);	2	1. Accept same height and width Ignore refs to polar/non-polar 2.Accept Aquaporin complementary to oxygen(s)
06.5	1. Single-stranded RNA (has base sequence) complementary to PIP1 mRNA; 2. Binds to mRNA (of PIP1)/leads to destruction of mRNA; 3. Prevents/reduces translation (of *PIP1*); 4. Reduces photosynthesis/named process that uses water;	3 max	3. Less made is insufficient

06.6	Not all of mRNA bound to single-stranded RNA/there is more mRNA than interfering RNA OR Not all mRNA destroyed/disabled;	1	Accept mutations in transgene, Accept not all cells with transgenes
06.7	1. Loss of PIP reduces water **and** carbon dioxide movement; 2. Differences significant because SDs don't overlap **OR** Need stats test to see whether significant differences (or not); 3. Greater (proportional) effect on carbon dioxide transport; 4. Not all movement through PIP;	3 max	1. Accept converse for wild type 2. Reject references to results significant or not significant 2. Accept error bars for SDs

Question 7 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. i.e. 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.

Question	Marking Guidance	Mark	Comments
07.1	The importance of nitrogen-containing substances in biological systems • 3.1.4 and 3.1.4.2 proteins and enzymes • 3.1.5 nucleic acids • 3.1.5.2 DNA replication • 3.1.6 ATP • 3.2.1.1 ribosomes • 3.2.2 cell division • 3.2.3 transport across membranes • 3.2.4 immune response • 3.3.3 digestion and absorption • 3.3.4.1 haemoglobin • 3.4.1 genes and chromosomes • 3.4.2 protein synthesis • 3.4.3 mutation • 3.4.7 investigating diversity • 3..5.1 photosynthesis • 3.5.2 respiration • 3.5.4 nitrogen cycle • 3.6.2 nervous coordination • 3.6.3 muscles • 3.6.4.2 control of blood glucose (and peptide/protein hormones) • 3.7.1 inheritance • 3.8.1 alteration of DNA sequences • 3.8.2.2 regulation of transcription and translation	25	

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.

07.2	The importance of diffusion in organisms 3.1.7 and 3.1.8 water and inorganic ions • 3.2.3 transport across membranes • 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 • 3.5.1 photosynthesis • 3.5.2 respiration • 3.5.4 nutrient cycles • 3.6.1.1 plant responses to stimuli • 3.6.1.2 receptors • 3.6.2.1 nerve impulses • 3.6.2.2 synaptic transmission • 3.6.3 muscle contraction • 3.6.4.1 and 4.2 control of blood glucose concentration • 3.6.4.3 control of blood water potential	25	

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.