A-level
BIOLOGY
7402/3

Paper 3

Mark scheme

June 2021

Version: 1.0 Final

2 1 6 A 7 4 0 2 / 3 / M S

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 Examiner.

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. Answer of 12/13 = **2 marks**;; 2. 0.36(48)/0.365/0.37 **= 1 mark** **OR** 36(.48)/36.5/37% = **1 mark** **OR** q^2= 0.06/0.059/0.0588 = **1 mark** **OR** or q = 0.2/0.24/0.243 = **1 mark;**	2	For 1 mark accept q^2 = 6%/5.9%/5.88%

Question	Marking Guidance	Mark	Comments
01.2	0.71	1	

Question	Marking Guidance	Mark	Comments
01.3	Second box ticked/answer key: B: The mutation that caused black fur happened in a common ancestor of *S. carolinensis* and other closely related species.	1	

Question	Marking Guidance	Mark	Comments
01.4	1. 2.55% **= 2 marks**;; 2. 2.61% **= 1 mark** (question misread ie 8/306x100) **OR** Evidence of dividing by 314 or 942 **= 1 mark** **OR** Answers **not** given to three significant figures **= 1 mark;**	2	

Question	Marking Guidance	Mark	Comments
01.5	1. Mutation/lack of glutamic acid leads to (permanent) activation of the receptor/protein; 2. (Because) the receptor/protein does not require the binding/leaving of αMSH (to become activated); 3. ASIP (might) not (be) able to bind to the receptor/protein; 4. (Only) the dark <u>pigment</u> is produced	3 max	2. Answer must convey the idea that binding/leaving is not required

Question	Marking Guidance	Mark	Comments
02.1	1. RNA converted into DNA using reverse transcriptase; 2. DNA incorporated/inserted into (helper T cell) DNA/chromosome/genome/nucleus; 3. DNA transcribed into (HIV m)RNA; 4. (HIV mRNA) translated into (new) HIV/viral proteins (for assembly into viral particles);	4	1. Reject 'messenger' or 'm' before RNA 3. Accept descriptions of transcription 4. Accept descriptions of translation 4. Accept named viral protein, eg capsid 4. Reject viral cells

Question	Marking Guidance	Mark	Comments
02.2	For 1. (There appears to be) no virus/ HIV(-1)/RNA/DNA, so could be a cure/effective; 2. No CCR5/receptor, so not get HIV(-1) in the future **OR** No CCR5/receptor, so nothing for HIV(-1) to bind to; 3. Only one transplant/BSCT needed (shown by patient **Q**) 4. Would not need (daily) ART (16 months after BSCT); Against 5. Don't know if chemotherapy/radiotherapy is needed **OR** Do not know if BSCT alone would be effective; **OR** Do not know which treatment is having the effect **OR** Could be due to chemotherapy/radiotherapy; 6. Only for HIV-1; 7. Don't know if it would work in all people **OR** Only worked/tried in 2 cases; 8. Might not be long term **OR** Only 18 months; 9. HIV-1 may mutate and be able to bind to a different receptor (on T_H cells); 10. Might be a lack of (suitable stem cell/BSCT) donors;	5 max	Max 4 for reasons for or against 1. Ignore virus is killed 2. Reject less CCR5/less HIV(-1) bind 5. Accept: chemotherapy/radiotherapy is toxic/harmful/has side-effects 6. Accept: Might not work in other types of HIV 10. Accept stem cells/BSCT (might be) rejected

Question	Marking Guidance	Mark	Comments
03.1	Behaviour 1. (Positive photo) taxis; Advantage 2. Accept any suitable suggestion, eg to avoid competition, to find a mate, increase dispersal, to avoid predators;	2	1. Reject negative (photo) taxis 2. Neutral – to move into the open or to move out of the tree bark

Question	Marking Guidance	Mark	Comments
03.2	1. No stats test, so do not know if change (in movement away from light) is significant; 2. Between 35 °C and 36.5 °C more than half of beetles are still found on the light side; 3. (At higher temperatures/above 35 °C) beetles might be flying (not walking) **OR** (Y-axis) states speed of movement, might not just be walking speed; 4. Slowing of movement happens before 35 °C; 5. Slowing of movement could be due to beetles preparing to fly (and not temperature); 6. Speed (of movement) not recorded above 35 °C/ between 35 and 37.5 °C/between 35 and 40 °C; **OR** Speed (of movement) not recorded at 37.5 °C 7. (Mean speed could mean) some might walk very quickly **and** others stay still/not move;	3 max	

Question	Marking Guidance	Mark	Comments
04.1	1. Low respiration; 2. More growth/biomass/colonisation;	2	1. Accept less energy lost in respiration 2. Allow examples of more carbon-containing molecules eg glucose

Question	Marking Guidance	Mark	Comments
04.2	1. Less nitrification **OR** Fewer/less active nitrifying bacteria; **OR** Nitrification/nitrifying bacteria require oxygen/aerobic conditions; 2. (Less) oxidation/conversion of ammonium (ions) to nitrite (ions) and to nitrate (ions); 3. More denitrification **OR** More/more active denitrifying bacteria **OR** Denitrification/denitrifying bacteria do not require oxygen **OR** Denitrification/denitrifying bacteria require anaerobic conditions; 4. (So more) nitrate (ions) reduced/converted to nitrogen (gas);	2 max	2. Order must be nitrite then nitrate 2. Accept ammonia for ammonium ions 2. Accept correct chemical formulae for ions, eg there will be little oxidation/conversion of $NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$ 2. Ignore 'breakdown' for oxidation/conversion 4. Accept correct chemical formulae eg So more NO_3^- reduced/converted to N_2;

Question	Marking Guidance	Mark	Comments
04.3	1. Assumed that height is (directly) proportional to biomass; 2. (Plants may put biomass into) other named aspect of growth (other than height) **OR** Height does not include the roots **OR** Some increase in height results from water gain;	2	1. Accept descriptions of 'is proportional to', eg correlates to, is equivalent to 2. Examples of other named aspects of growth could include root growth, flower/seed/fruit formation, lateral growth, wider leaves

Question	Marking Guidance	Mark	Comments
04.4	1. Answer of 12 days = **2 marks**;; 2. 12.16 (12.15774433) **= 1 mark** **OR** 4 days (used 387 and 268, ie not calculated starting length) **= 1 mark;**	2	

Question	Marking Guidance	Mark	Comments
05.1	1. Exopeptidases hydrolyse peptide bonds at the ends of a polypeptide/protein **AND** endopeptidases hydrolyse internal peptide bonds within a polypeptide/protein; 2. More 'ends' **OR** More surface area;	2	1. Reference to 'hydrolyse' required at least once 2. Accept even if via action of incorrect enzyme

Question	Marking Guidance	Mark	Comments
05.2	1. Actin/myosin/tropomyosin; 2. Antibodies;	2	1. Accept troponin 1. Accept ATP synthase/hydrolase 2. Accept immunoglobulins 2. Accept lysozyme

Question	Marking Guidance	Mark	Comments
05.3	Whey (no mark) as it: 1. Is absorbed quicker **OR** It has a faster/higher/greater/the highest/the greatest/the fastest rate of absorption; 2. Still stimulates/increases protein synthesis (even if lower than casein); 3. Prevents/inhibits/limits breakdown of body proteins; 4. **Significantly** more becomes body protein;	3 max	If student selects casein allow 1 mark **only** for 'as it stimulates a higher rate of protein synthesis' 1. and 4. Accept use of data to show differences

Question	Marking Guidance	Mark	Comments
06.1	1. Extract DNA and add restriction endonucleases/restriction enzymes; 2. Separate fragments using electrophoresis; 3. (Treat DNA to) form single strands **OR** (Treat DNA to) expose bases; 4. The probe will bind to/hybridise/base pair with the *SUT1*/gene; 5. Use autoradiography (to show the bound probe);	4 max	3. Ignore method used to separate strands 5. Accept use photographic or X ray film (to show the bound probe) 5. X rays alone is not sufficient

Question	Marking Guidance	Mark	Comments
06.2	1. Antisense mRNA is <u>complementary</u> to 'sense' mRNA; 2. Antisense mRNA would bind/base pair to (sense) mRNA; **OR** Double stranded (m)RNA forms; 3. Ribosomes would not be able to bind; 4. Preventing/less translation (of mRNA) **OR** Preventing/less production of SUT1 (protein);	4	4. Accept descriptions of translation

Question	Marking Guidance	Mark	Comments
06.3	$0.4\ (3\dot{1}\dot{8})$:1;	1	Accept any suitable rounding

Question	Marking Guidance	Mark	Comments
06.4	1. Some ($^{14}CO_2$) used to make cellulose/cell walls; 2. Some ($^{14}CO_2$) converted into starch (which remains in the leaf); 3. Not all ($^{14}CO_2$) fixed/used in photosynthesis; **OR** Not enough RuBP (to combine with all of the $^{14}CO_2$); 4. Some used to reform RuBP **OR** Some (is still) in glycerate 3-phosphate/GP/triose phosphate/in the Calvin cycle;	2 max	1. Accept some becomes lipids/ proteins/DNA/RNA/ nucleotides 2. Accept some ($^{14}CO_2$) converted into glucose 3. Accept descriptions of this

Question	Marking Guidance	Mark	Comments
06.5	1. Reduced *SUT1* expression/less SUT 1 (protein) means less sucrose exported (so concentration increases in leaves); 2. (Increased sucrose in leaves) inhibits rubisco, so less $^{14}CO_2$ fixed into GP; **OR** (Increased sucrose in leaves) inhibits rubisco, so less $^{14}CO_2$ combines with RuBP; **OR** (Increased sucrose in leaves) inhibits rubisco, so less Calvin cycle/light independent reaction/s; 3. Less sucrose transported to roots, so roots do not develop/grow (as shown by larger shoot to root dry mass ratio); 4. Roots less developed so fewer minerals available for growth 5. Less growth means less dry mass;	4 max	2. Accept less rubisco or less active rubisco for 'inhibits rubisco' 4. Accept: roots less developed so less water available for photosynthesis 5. Accept: less photosynthesis/light independent reaction/s means less dry mass;

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 complementary shapes of molecules in organisms** • 3.1.4.2 Many proteins are enzymes • 3.1.5.1 Structure of DNA and RNA • 3.1.5.2 DNA replication • 3.1.6 ATP • 3.2.2 All cells arise from other cells • 3.2.3 Transport across cell membranes • 3.2.4 Cell recognition and the immune system • 3.3.3 Digestion and absorption • 3.4.1 DNA, genes and chromosomes • 3.4.2 DNA and protein synthesis • 3.4.3 Genetic diversity can arise as a result of mutation or during meiosis • 3.5.1 Photosynthesis • 3.5.2 Respiration • 3.6.1.2 Receptors • 3.6.2.1 Nerve impulses • 3.6.2.2 Synaptic transmission • 3.6.3 Skeletal muscles are stimulated to contract by nerves and act as effectors • 3.6.4.2 Control of blood glucose concentration • 3.6.4.3 Control of blood water potential • 3.8.1 Alteration of the sequence of bases in DNA can alter the structure of proteins • 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 ions in metabolic processes** • 3.1.4.2 Many proteins are enzymes (H and denaturation) • 3.1.5.2 DNA replication • 3.1.6 ATP • 3.1.8 Inorganic ions • 3.2.3 Transport across cell membranes • 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 Survival and response • 3.6.1.2 Receptors • 3.6.2.1 Nerve impulses • 3.6.2.2 Synaptic transmission • 3.6.3 Skeletal muscles are stimulated to contract by nerves and act as effectors • 3.6.4.3 Control of blood water potential • 3.8.4.3 Genetic fingerprinting	**[25 marks]**	

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