A-level
BIOLOGY
7402/3

Paper 3

Mark scheme

June 2025

Version: 1.0 Final

256A7402/3/MS

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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

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Mark scheme instructions to examiners

7. 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 <u>not</u> 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. Replication of (circular) <u>DNA</u>; 2. Replication of <u>plasmids</u>; 3. (New) membrane forms (dividing cell) **OR** Division of cytoplasm (to produce daughter cells);	3 (3 x AO1)	1. and 2. Accept doubling for replication 1. Reject chromosome 1. Reject mitosis 1. Reject single strand of DNA 2. Ignore (named) organelles replicate 3. Accept descriptions of either alternative 3. Accept cytokinesis (occurs)

Question	Marking Guidance	Mark	Comments
01.2	Correct answer of 1159 = **2 marks**;; Evidence of 1158 (incorrect rounding) = **1 mark** **OR** Evidence of 1158 followed by any number of decimal places (not to nearest whole number) = **1 mark** **OR** Evidence of 1259 (answer that failed to subtract 100) = **1 mark** **OR** Evidence of 12 (not multiplied by 100) = **1 mark** **OR** Evidence of 145 900(.0651) (calculation of increase in number of bacteria) = **1 mark** **OR** Evidence of 92 (dividing by $10^{5.2}$ instead of $10^{4.1}$) = **1 mark** **OR** Evidence of 27 (percentage increase of log values read from graph) = **1 mark** **OR** Evidence of the following working (calculation method including correct powers of 10) = **1 mark;** $\frac{10^{5.2} - 10^{4.1}}{10^{4.1}} \times 100$ **OR** $(\frac{10^{5.2}}{10^{4.1}} \times 100) - 100$ **OR** $\frac{158489(.32) - 12589(.25)}{12589(.25)} \times 100$ **OR** $\frac{145900(.07)}{12589(.25)} \times 100$ **OR** $\frac{158489(.32)}{12589(.25)} \times 100) - 100$	2 (2 x AO2)	

Question	Marking Guidance	Mark	Comments
01.3	1. Fewer/no protons/hydrogen ions/H^+ diffuse/move through ATP synthase; 2. Less/no **energy** to add phosphate to ADP **OR** Less/no **energy** for phosphorylation of ADP **OR** Less/no **energy** to form ATP **OR** Less/no oxidative phosphorylation; 3. (Bacteria die due to) less/no ATP/energy for cellular/metabolic processes;	3 (3 x AO2)	1. Accept no/less chemiosmosis 1. Reject reference to protons/hydrogen ions/H^+ diffusing if in mitochondrion 1. Accept hydrogen/H for protons/hydrogen ions/H^+ (as told hydrogen ion in stem of question) 2. or 3. Reject less/no energy produced once 2. Accept (P), P_i or PO_4^{3-} for phosphate 2. Reject phosphorous/P 3. Accept named process e.g. synthesis of an organic molecule, binary fission, DNA replication, active transport, etc. 3. Reject 'less/no energy/ATP for respiration' unless qualified e.g. glucose to glucose phosphate 3. Reject incorrect metabolic process for a bacterium, e.g. muscle contraction

<table>
<tr><th>Question</th><th>Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>02.1</td><td>All four rows correct = 2 marks;;

3 or 2 rows correct = 1 mark;

<table>
<tr><th rowspan="2">Statement</th><th colspan="4">Part of the nephron</th></tr>
<tr><th>Glomerulus</th><th>Proximal convoluted tubule</th><th>Distal convoluted tubule</th><th>Collecting duct</th></tr>
<tr><td>ADH receptors are present</td><td></td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Water can be absorbed from the filtrate</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Blood is under high pressure</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Glucose is absorbed from the filtrate</td><td></td><td>✓</td><td></td><td></td></tr>
</table>
</td><td>2
(2 x AO1)</td><td></td></tr>
</table>

<table>
<tr><th>Question</th><th>Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>02.2</td><td>1. (Plasma) proteins are (too) large;

2. To filter/pass through <u>basement membrane</u>;</td><td>2
(2 x AO1)</td><td>2. Ignore any other structures</td></tr>
</table>

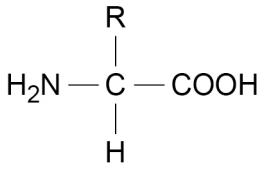
Question	Marking Guidance	Mark	Comments
02.3	**Max 4 for MP3-7** **(Yes – no mark)** 1. Probability of **less** than 0.01 that the increase (in GS) is due to chance **OR** Increase (in GS) is significant; 2. Rats and humans are both mammals, **so** similar; **(No – no mark)** 3. (Investigation only) done on rats **OR** (Investigation) not done on humans; 4. Do not know if (160-day-old) rats are adults; 5. Small sample size, **so** not representative; 6. Only two (different) quantities of protein (used) **OR** Only high and normal protein (milk/s) **OR** Protein content (of milk/s) not known **OR** Types of protein (in the milk/s) not known; 7. Only GS studied **OR** Other kidney damage (can) occur/s;	5 max (5 x AO3)	1. Accept probability of **less** than 1%/0.05/5% that the increase is due to chance 1. Accept probability of **more** than 99%/0.99/95%/0.95 that the increase is **not** due to chance 1. Accept P for probability 1. Accept difference for increase 1. Ignore correlation is significant 1. Ignore results are significant unqualified 4. Ignore long terms effects unknown 5. Accept only 14/28 (rats), **so** not representative 6. Ignore answers relating to protein content of solid food diet 7. Accept other named factors (can cause kidney damage) e.g. genetic factors

Question	Marking Guidance	Mark	Comments
03.1	2/two;	1 (1 x AO2)	If no number is present, accept *Gastrophysa* **and** *Chrysolina* alone

Question	Marking Guidance	Mark	Comments
03.2	**Max 2 marks for MP1-5 and Max 1 mark for MP6-8** **Reasons for capture** 1. (So beetles) have emerged (from the soil) **OR** (So beetles) are not still in burrows **OR** (So beetles) are not under the soil/ground; 2. (To allow beetles to) evenly/randomly distribute (before they burrow underground); 3. To allow **time** for (re)capture (before they burrow underground); 4. To not disturb mating/egg laying (in April); 5. To ensure no population changes/increase (due to production of eggs/larvae); **Reason for identification** 6. (All three beetles are) same colour/green; 7. (All three beetles are a) similar length; 8. Only *C. graminis*/tansy beetle (population size being) investigated **OR** Only investigated one/correct species **OR** Did not investigate (the) other/wrong species;	3 max (3 x AO3)	7. Accept size

Question	Marking Guidance	Mark	Comments
03.3	Correct answer of 1215 = **2 marks**;; Evidence of 810 (not calculated total number in 2nd sample) = **1 mark** **OR** Evidence of 608 (divided by unmarked rather than marked) = **1 mark** **OR** Evidence of $\frac{150\,660}{124}$ (correct working but incorrect or no answer) = **1 mark** **OR** Evidence of $\frac{405 \times 372}{124}$ (correct working but incorrect or no answer) = **1 mark** **OR** Evidence of $\frac{405}{n} \times \frac{124}{372}$ (correct working but incorrect or no answer) = **1 mark**;	2 (2 x AO2)	

Question	Marking Guidance	Mark	Comments
03.4	1. Collected samples during the second week of August **OR** Collected samples at the same time of year; 2. Collected samples from the same location/area/habitat; 3. Used the same method; 4. Used a different mark (each year); 5. Marking does not affect survival/predation/ behaviour/recapture **OR** Mark is not toxic **OR** Mark is not removed (before second capture);	2 max (2 x AO3)	3. Accept any correct named part of the method used being the same

Question	Marking Guidance	Mark	Comments
04.1		1 (1 x AO1)	Accept other correct representations

Question	Marking Guidance	Mark	Comments
04.2	The primary structure of a protein is the sequence of amino acids joined by peptide bonds.	1 (1 x AO1)	

Question	Marking Guidance	Mark	Comments
04.3	Correct answer of 128 000 000/1.28×10^8/ 1.3×10^8 /1×10^8 = **2 marks**;; Answer shows 128 (ignore position of decimal point and preceding/subsequent zeroes, incorrect order of magnitude) = **1 mark** **OR** Evidence of 691 200 000 000/6.912×10^{11}/ 6.9×10^{11} (total number produced in 24 hours in 5.4 dm^3) = **1 mark** **OR** Evidence of 4000 × 2000 × 60 × 60 × 24 (total number produced in 24 hours in 5.4 dm^3) = **1 mark** **OR** Evidence of 5 333 333.333/5.3×10^6/5×10^6 (total number produced in one hour per cm^3 of blood) = **1 mark** **OR** Evidence of 32 000/3.2×10^4 (number produced from one plasma cell per cm^3 of blood) = **1 mark**;	2 (2 x AO2)	Accept any correct rounding

Question	Marking Guidance	Mark	Comments
04.4	1. Only measuring the number of B cells **OR** Only provides data for the humoral response **OR** No data provided for the T cell/cellular response; 2. Only looking at (immune response in) the lungs; 3. Only (measured response to) influenza (virus) **OR** Only (measured response to) one virus; 4. Day 9 results do not fit the pattern **OR** Day 9 results are anomalous; 5. Cannot predict if there would be fluctuations between days 11–15/15–19 **OR** More data needed between days 11–15/15–19 **OR** Do not know what happens (to the number of B cells) after 19 days; 6. Do not know age (range) of young and old (mice);	3 max (3 x AO3)	2. Accept not looked at other organs 3. Accept need to investigate other viruses/pathogens 3. Accept 'flu' for 'influenza' 5. Accept long term response/effects unknown 5. Accept investigation/ 19 days is too short

Question	Marking Guidance	Mark	Comments
05.1	1. Not caused by one gene; 2. (Hardy-Weinberg) cannot predict (the effect of) environmental factors **OR** Environmental factors involved; 3. (Various genetic factors suggests) mutations occur; 4. Human populations migrate/emigrate/ immigrate;	2 max (2 x AO2)	Ignore any references to random mating 1. Ignore ideas relating to not knowing about dominant/ recessive 2. Accept 'methylation/ epigenetic factors' for 'environmental factors' 4. Accept descriptions of human migration 4. Accept human populations are not isolated 4. Ignore population size changes due to births/deaths

Question	Marking Guidance	Mark	Comments
05.2	1. Reduce/prevent expression/transcription (of *CDH1*/the gene); 2. Prevent transcription factor binding **OR** Prevent binding to promotor (of gene); 3. Reduce/prevent production of CDH1/protein;	1 max (1 x AO1)	Reject (methylation) causes mutation 1. Accept reduce/prevent production of messenger RNA/ mRNA 1. Ignore 'switching off' 2. Accept prevent binding/activation of <u>RNA</u> polymerase

Question	Marking Guidance	Mark	Comments
05.3	1. Inflammation (alone) may be the cause **as** both (types of) treated cells have increased methylation; 2. Loss of *CDH1/*gene function might not have an effect **as** (both) untreated cells have similar (percentage) methylation; 3. Drug used to cause inflammation, **so** might not be the same as infection/diabetes; 4. Cells grown *in vitro*, **so** does not represent a living organism/human/body/fetus **OR** Cells grown *in vitro*, **so** might not respond in the same way as a living organism/human/body/fetus; 5. Cells not (allowed to) develop into lip/mouth/baby, **so** do not know any would develop CLP **OR** Cells not (allowed to) develop into lip/mouth/baby, **so** do not know what percentage (*CDH1*) methylation leads to CLP;	3 max (3 x AO3)	2. Accept loss of *CDH1/gene* function might not have an effect as 36% and 40% are similar 3. Accept 'normal environmental conditions' for 'infection/diabetes' 3. Accept 'artificial conditions' for 'drug 4. Accept '*in vivo'* **OR** '*in utero'* **OR** 'pregnancy' for 'living organism' 4. Accept only cells grown, not a whole organism/human/body/ fetus, **so** might not respond in the same way

Question	Marking Guidance	Mark	Comments
06.1	1. Remove shading/hatching; 2. Have the same number of ribs on each side **OR** Make the sizes of the muscles/ribs more accurate on each side; 3. Use single/continuous/joined line **OR** Do not use sketching **OR** No crossing or hanging lines; 4. Not have the label line (for **B**) crossing/ obscuring the drawing; 5. (Add a) scale (bar); 6. Simplify the trachea/bronchus/bronchioles/ alveoli/structure **OR** Draw (only) the outline of tissues;	2 max (2 x AO3)	5. Ignore (add) magnification 6. Accept reduce the amount of detail

Question	Marking Guidance	Mark	Comments
06.2	1. **A** contracts **and** pulls ribs up/out; 2. **B** contracts **and** moves down;	2 (2 x AO1)	If 'contracts' is not mentioned, allow 1 mark for correct movement of both structures 1. For **A** accept (external) intercostal muscle 1. For **A** reject internal intercostal muscle 2. For **B** accept diaphragm 2. For moves down accept 'flattens'

Question	Marking Guidance	Mark	Comments
06.3	Answer of 5(.347883598) = **2 marks**;; Evidence of correct answer but incorrect rounding e.g. 5.34 = **1 mark** **OR** Evidence of 5347.883598 (answer in cm^3) = **1 mark** **OR** Evidence of numbers 5347883598 (ignore position of decimal point, incorrect order of magnitude) = **1mark** **OR** Evidence of 20 215/20.215 (calculated the numerator) = **1 mark**;	2 (2 x AO2)	Accept any correct rounding

Question	Marking Guidance	Mark	Comments
06.4	1. (Known) contact with asbestos; 2. A latency period of 15–40 years **OR** A long latency period **OR** (Diagnosis) at least 15 years after;	2 (2 x AO3)	1. Accept descriptions of contact with e.g. exposure to 1. Accept '(fibrous) mineral' for 'asbestos' 2. Accept a long time between exposure and symptoms 2. Accept any number of given years between 15 and 40 for latency period/diagnosis

Question	Marking Guidance	Mark	Comments
06.5	1. Less painful/invasive; 2. Less (risk of further) lung damage **OR** Less (risk of more) scar tissue; 3. Less risk of infection/death; 4. Cheaper; 5. Quicker (procedure/results/recovery);	2 max (2 x AO3)	Accept converse for all mark points in the context of a biopsy 1. Accept no surgery (needed)

Question	Marking Guidance	Mark	Comments
06.6	Unethical not to treat (control group);	1 (1 x AO3)	

Question	Marking Guidance	Mark	Comments
06.7	**Max 3 for reasons FOR or AGAINST** **FOR (no mark)** 1. Both (diseases) involve the formation of scar tissue **OR** Both (diseases) have similar symptoms **OR** (Drug/s) can slow the formation of scar tissue **OR** (Drug/s) can slow the symptoms/progression; 2. Both drugs equally as effective; 3. (Investigated) in humans/people; 4. Long-term effects are known **OR** (It is) a long-term investigation; **AGAINST (no mark)** 5. Is not a cure **OR** Only reduces the formation of scar tissue; 6. Neither drug affects the cause/DNA damage; 7. Formation of scar tissue might not be the same (for asbestosis) **OR** (Only) investigated in IPF **OR** Not investigated in asbestosis **OR** Needs investigating in asbestosis; 8. No control (group) to compare with **OR** No group without treatment/drugs to compare with	4 max (4 x AO3)	Ignore answers relating to sample size 9. Accept any reference to side effects for or against for 1 mark 2. Must be clearly stated and not inferred 8. Accept descriptions of this, e.g. do not know percentage of patients still alive without treatment.

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 condensation and hydrolysis reactions in biological systems.** • 3.1.1 Monomers and polymers • 3.1.2 Carbohydrates • 3.1.3 Lipids • 3.1.4.1 General properties of proteins • 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 • 3.1.7 Water • 3.2.3 Transport across cell membranes • 3.2.4 Cell recognition and the immune system • 3.3.3 Digestion and absorption • 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 • 3.6.2.1 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 • 3.8.2.2 Regulation of transcription and translation (RNAi) • 3.8.4.1 Recombinant DNA technology • 3.8.4.3 Genetic fingerprinting	**[25 marks]** (13 x AO1, 12 x AO2)	

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 responses to changes in the internal and external environment of organisms.** • 3.1.4.2 Many proteins are enzymes • 3.2.2 All cells arise from other cells (Many cancer treatments are directed at controlling the rate of cell division) • 3.2.3 Transport across cell membranes • 3.2.4 Cell recognition and the immune system • 3.3.1 Surface area to volume ratio • 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 • 3.4.3 Genetic diversity can arise as a result of mutation or during meiosis • 3.4.4 Genetic diversity and adaptation • 3.4.5 Species and taxonomy • 3.4.6 Biodiversity within a community • 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 • 3.6.1.3 Control of heart rate • 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 • 3.6.4.1 Principles of homeostasis and negative feedback • 3.6.4.2 Control of blood glucose concentration • 3.6.4.3 Control of blood water potential • 3.7.3 Evolution may lead to speciation • 3.7.4 Populations in ecosystems • 3.8.1 Alteration of the sequence of bases in DNA can alter the structure of proteins • 3.8.2.1 Most of a cell's DNA is not translated • 3.8.2.2 Regulation of transcription and translation • 3.8.2.3 Gene expression and cancer	**[25 marks]** (13 x AO1, 12 x AO2)	

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.