

Synoptic Essays – Mark schemes

Q1.

21 – 25	<p>Extended abstract</p> <p>Generalised beyond specific context</p>	<p>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.</p> <p>Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.</p> <p>No significant errors or irrelevant material.</p> <p>For top marks in the band, the answer shows evidence of reading beyond specification requirements.</p>
16 – 20	<p>Relational</p> <p>Integrated into a whole</p>	<p>Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained.</p> <p>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.</p> <p>Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.</p>
11 – 15	<p>Multistructural</p> <p>Several aspects covered but they are unrelated</p>	<p>Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.</p> <p>Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology.</p> <p>Some significant errors and, or, more than one irrelevant topic.</p>
6 – 10	<p>Unistructural</p> <p>Only one or few aspects covered</p>	<p>Response predominantly deals with only one or two topics that relate to the question.</p> <p>Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology.</p> <p>May contain a number of significant errors and, or, irrelevant topics.</p>
1 – 5	<p>Unfocused</p>	<p>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.</p> <p>Content and terminology is generally below A-level.</p>

		May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Please note that to obtain full credit, students must use information to show **the importance of nitrogen-containing substances in biological systems**. 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.

Specification Reference	Topic Area
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
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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.

[25]

Q2.

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.

Please note that to obtain full credit, students must use information to show **the importance of diffusion in organisms**. 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.

Specification Reference	Topic Area
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

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.

[25]

Q3.

21–25	Extended Abstract Generalised beyond specific context	<p>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.</p> <p>Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.</p> <p>No significant errors or irrelevant material.</p> <p>For top marks in the band, the answer shows evidence of reading beyond specification requirements.</p>
16–20	Relational Integrated into a whole	<p>Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained.</p> <p>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.</p> <p>Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.</p>
11–15	Multistructural Several aspects covered but they are unrelated	<p>Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.</p> <p>Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology.</p> <p>Some significant errors and, or, more than one irrelevant topic.</p>
6–10	Unistructural Only one or few aspects covered	<p>Response predominantly deals with only one or two topics that relate to the question.</p> <p>Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology.</p> <p>May contain a number of significant errors and, or, irrelevant topics.</p>
1–5	Unfocused	<p>Response only indirectly addresses the theme of the question and merely presents a series of</p>

		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.

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

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

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

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

[25]

Q4.

21–25	<p>Extended Abstract</p> <p>Generalised beyond specific context</p>	<p>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.</p> <p>Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.</p> <p>No significant errors or irrelevant material.</p> <p>For top marks in the band, the answer shows evidence of reading beyond specification requirements.</p>
16–20	<p>Relational</p> <p>Integrated into a whole</p>	<p>Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained.</p> <p>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.</p> <p>Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.</p>
11–15	<p>Multistructural</p> <p>Several aspects covered but they are unrelated</p>	<p>Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.</p> <p>Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology.</p> <p>Some significant errors and, or, more than one irrelevant topic.</p>
6–10	<p>Unistructural</p> <p>Only one or few aspects covered</p>	<p>Response predominantly deals with only one or two topics that relate to the question.</p> <p>Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology.</p> <p>May contain a number of significant errors and, or, irrelevant topics.</p>

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.

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

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

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

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

[25]

Q5.

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16 – 20	<p>Relational</p> <p>Integrated into a whole</p>	<p>Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained.</p> <p>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.</p> <p>Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.</p>
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1 – 5	<p>Unfocused</p>	<p>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.</p> <p>Content and terminology is generally below A-level.</p> <p>May contain a large number of errors and, or, irrelevant topics.</p>
0		<p>Nothing of relevance or no response.</p>

Please note that to obtain full credit, students must use information to show **the**

importance of movement, not just write about topics that include movement. In order to fully address the question and reach the highest mark bands students must also include at least **five topics** in their answer, to demonstrate a synoptic approach to the essay.

Specification Reference	Topic Area
3.1.4.2	Enzyme-catalysed reactions
3.1.5.2	DNA replication
3.1.6	ATP
3.2.2	Cell division
3.2.3	Transport across membranes
3.2.4	Immune response
3.2.2	Gas exchange
3.3.3	Digestion and absorption
3.3.4.1, 4.2	Mass transport
3.4.2	DNA and protein synthesis
3.4.3	Meiosis
3.5.1	Photosynthesis
3.5.2	Respiration
3.6.1	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	Synapses
3.6.2.2	Synaptic transmission
3.6.3	Skeletal muscle
3.6.4.2	Control of blood glucose concentration
3.6.4.3	Control of blood water potential
3.7.3	Evolution (population isolation and movement between)
3.8.2.2	Regulation of transcription and translation

3.8.2.3	Gene expression and cancer
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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.

[25]

Q6.

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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.

Please note that to obtain full credit, students must use information to show **the importance of receptors**, not just write about topics that include receptors. In order to fully address the question and reach the highest mark bands students must also include at least **five topics** in their answer, to demonstrate a synoptic approach to the essay.

Specification Reference	Topic Area
3.1.4.2	Enzymes
3.2.1.2	Structure of prokaryotic cells and of viruses
3.2.3	Transport across cell membranes
3.2.4	Cell recognition and the immune system
3.3.4.1	Mass transport in animals
3.4.2	DNA and protein synthesis
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	Nerve impulses
3.6.2.2	Synaptic transmission
3.6.3	Skeletal muscles
3.6.4.1	Principles of homeostasis
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

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.

[25]

Q7.

The control of processes in cells and the importance of these controls.

- O** 3.1.3. and 3.2.4. Organelles and processes
- T** 3.1.3. Transport across membranes
3.1.3. Cholera
- I** 3.1.5. Immune response
- M** 3.2.2. Meiosis
- C** 3.2.5. Mitosis and cell cycle and DNA replication
- Tr** 3.2.7. Passage of water through plant
- E** 3.4.2. ATP
3.4.3. Photosynthesis
3.4.4. Respiration
- G** 3.2.10. Antibiotics and genetic variation
3.4.8. Inheritance
- N** 3.5.1. Receptors
3.5.2. Nerve impulses and synapses
- Mc** 3.5.3. Muscle contraction
- H** 3.5.4. Control of blood glucose concentration – hormones – plant growth substances
- Cd** 3.2.6. Cell differentiation
3.5.6. Polypeptide synthesis and gene mutations
- Gt** 3.5.7. Gene expression
3.5.8. Gene therapy

H If a candidate writes at great length about plant growth substances and hormones, then the topic can be split to allow more credit

[25]

Q8.

The importance of ions in biology.

- P** 3.1.3, 3.2.2. Phosphate in structure of phospholipids, structure of membranes, nucleotides, DNA and RNA
- T** 3.1.3. Water potentials and osmosis, chloride ions and cholera
3.1.3. Co-transport involving sodium ions
- H** 3.2.4. Haemoglobin and iron
- Tr** 3.2.7. Passage of water through plants, symplast and root pressure
- Ph** 3.4.1. ATP and ADP
3.4.3. Protons in photosynthesis, including reduced NADP and phosphorylated intermediates
- R** 3.4.4. Protons in respiration, reduced NADS and FAD and phosphorylated intermediates
3.4.4. Glycolysis and lactate
- F** 3.4.5. Use of (NPK) fertilisers
3.4.6. Nitrogen cycle
- N** 3.5.1. Chemoreceptors, heart rate and Pacinian function
3.5.2. Nerve impulses and synapses
- M** 3.5.3. Calcium ions and muscle contraction, and phosphate from ATP
- G** 3.5.8. Genetic fingerprinting, electrophoresis

[25]

Q9.

Topic areas

- T** - 3.1.3 Transport in and out of cells (of specific substances)
- I** - 3.1.6 Immune response
- Hb** - 3.2.4 Haemoglobin
- Tr** - 3.2.7 Transpiration – response to environmental factors – gas exchange in plants
- B** - 3.2.9 Behaviour
- A** - 3.2.10 Adaptation and selection
- P** - 3.4.8 Changes in populations – selection pressures
- R** - 3.5.1 Responses to stimuli – plants and tropisms – control of heart rate
- Tk** - 3.5.1 Taxes and kineses
- Rc** - 3.5.1 Receptors
- H** – 3.5.2 Control of Heart Rate
- Sn** - 3.5.1 and 2 Simple reflexes and neurones and synapses

Hr - 3.5.2 and 5.4 Hormones and responses

C – 3.5.2 Chemical mediators

Ho - 3.5.4 Homeostasis – response to changes in internal environment

F - 3.5.5 Feedback

G - 3.5.7 Gene expression as part of response

[25]

Q10.

Topic areas

A - 3.1.1 Pathogens (and invasion of human tissues) and 3.2.10 Antibiotic resistance – control of bacterial growth

Ch - 3.1.3 Cholera

I - 3.1.6 Immune response and vaccination (to control growth of pathogens)

B - 3.2.11 Human influence on biodiversity

Hp - 3.4.1 Human populations

Hf - 3.4.5 Humans and farming practices – and 3.2.3 selective breeding

F - 3.4.6 Use of fertilisers and pesticides

S - 3.4.7 Succession – control of

G - 3.4.8 Genetics – prediction of inherited conditions

Ge - 3.5.7 Control of gene expression – stem cells

C - 3.5.7 Regulation of gene expression – prevention, treatment and cure of cancer – and 3.2.5 Mitosis and cancer

Gc - 3.5.8 Gene cloning and transfer

Gt - 3.5.8 Gene therapy

[25]

Q11.

Cells and organisms carry out exchanges with their external environment to maintain their internal environment.

Topic areas

H - Homeostasis (concept of)

D - Digestion and absorption

C - Cells

- L - Lung function
- G - Gas exchange
- W - Passage of water through plant
- Nc - Nutrient cycles
- R - Response to stimuli
- N - Neurones
- T - Temperature control
- Tf - tissue fluid and its formation
- B - Control of blood glucose concentration
- Nf - Negative feedback
- Gn - Gene expression

The topics listed contain material that could be made relevant to the title. Writing about these topics in a general sense may not address the question.

Candidates may make correct use of material from other topics.

A includes where candidates use information about a topic in the specification but go beyond what is expected for our A level*

[25]

Q12.

How energy is transferred within and between organisms.

Topic areas

- P - Photosynthesis
- Ec - Energy transfer through ecosystems
- F - Food production
- D – Digestion (as in fuel)
- Ab - Absorption (by cells)
- Mt - Mass transport
- R - Respiration
- A - ATP
- Sr - Stimuli and responses
- Mc - Muscle contraction

N - Nerve impulses

The topics listed contain material that could be made relevant to the title. Writing about these topics in a general sense may not address the question.

Candidates may make correct use of material from other topics.

A includes where candidates use information about a topic in the specification but go beyond what is expected for our A level.*

[25]

Q13.

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be. In fact, extra credit is given for those who show evidence of a greater breadth of study. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally come from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Essay – The importance of shapes fitting together in cells and organisms

Proteins & Enzymes

3.1.2 Enzyme properties and digestion

3.1.2 Protein structure

3.1.3 Plasma membrane structure and cell transport

3.1.6 Antigens, antibodies, B cells & T cells

3.1.6 Vaccines

Nucleic Acids

3.2.2 Structure of DNA

3.2.5 DNA Replication (not PCR)

3.5.7 Transcription & translation

3.5.8 Transcriptional factors, oestrogen, siRNA

3.5.8 Restriction enzymes

Physiology

3.2.4 Haemoglobin

3.5.2 Action potentials & synaptic transmission

3.5.3 Muscle contraction

3.5.4 Control of blood glucose concentration

Q14.

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be. In fact, extra credit is given for those who show evidence of a greater breadth of study. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

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Essay – How bacteria can affect the lives of humans and other organisms

Bacteria & Disease

3.1.1 Pathogens

3.2.10 Resistance to antibiotics

Ecological Importance

3.4.6 Nitrogen cycle

3.4.6 Eutrophication

Making Use of Bacteria

3.5.8 Use of bacterial enzymes

e.g. restriction endonuclease, DNA polymerase for PCR

3.5.8 Use of bacterial plasmids

e.g. *in vivo* gene cloning, genetically-modified crops, gene therapy

3.5.8 Use of bacteria to produce useful chemicals

Q15.

Essay A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next. Write an essay about cycles in biology.

Section

Ecological cycles

4.6 Nutrient cycles

Nitrogen cycle

Biochemical cycles

1.2 Enzyme action

4.2 Synthesis of ATP from ADP

4.3 Light-independent reaction

4.4 The Krebs cycle

Physiological and genetic cycles

1.4 The mechanism of breathing

1.5 The cardiac cycle

2.5 The cell cycle

5.3 Muscle contraction

Q16.

Introduction

The essay is intended to assess a candidate's ability to bring together principles and concepts from different areas of biology, express ideas clearly and logically and use appropriate specialist vocabulary. It also provides an opportunity for candidates to demonstrate that they have met the ideals of stretch and challenge required to gain an A* grade. Because of this, essays are deliberately worded such that they allow candidates the freedom to respond in a variety of ways. Candidates are offered a choice of essay and it is important that the final mark reflects the quality of work, not the choice of essay.

The marking scheme considers four skill areas

S	Scientific content
B	Breadth of knowledge
R	Relevance
Q	Quality of written communication

In practice, this means that we are looking for

- evidence of knowledge and understanding in keeping with an A-level course of study
- selection of material relevant to the title, and drawn from different areas of the specification
- the ability to present an argument coherently and logically, using appropriate biological language.

Each of the skill areas is considered and matched against a series of descriptors to

give the total mark. Notes are provided to assist in the application of the mark scheme to specific essay titles. Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will. The notes must therefore be seen as no more than guidelines providing an indication of areas of the specification from which suitable factual material may be drawn.

Plans should be considered in awarding marks. Examiners are instructed to ignore the plan when reading the essay. They should then return to the plan. If further credit can be awarded because of material contained in the plan, this is done. Under no circumstances can a candidate lose credit for incorrect information contained in the plan.

Assessing scientific content

In assessing this area, note the following

- The maximum mark is 16
- Only even marks are awarded (16, 14, 12 etc). Intermediate marks (15, 13, 11 etc) cannot be used. This restricts examiners' choice and increases the reliability of the marking.
- Descriptors are given for 16, 12, 8, 4 and 0 marks. Work is matched to these descriptors. If a particular essay is considered to fall between the criteria for two descriptors an intermediate even mark (14, 10, 6 etc) is awarded.
- Candidates have approximately 40 minutes to plan and write their essays. It is important that candidates who allocate their time wisely should be able to gain maximum marks for what it is possible to write in this time. In practice, this amounts to between three and four sides of normal handwriting.
- Essays do not have to be perfect to gain higher marks. The amount of detail required by the specification should always be born in mind. Average A-grade candidates should be able to achieve 12 marks so it would not be unreasonable to expect around 15% of candidates to achieve such a mark.

Category	Mark	Descriptor
Exceptional	16	Material accurate and of a high standard throughout, reflecting a sound understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. In addition, there are some significant references to material that indicates greater depth or breadth of study.
	14	
Good	12	Most of the material is of a high standard reflecting a sound understanding of the principles involved and a knowledge of factual detail generally in keeping with an A-level course of study. Material accurate and free from fundamental errors, but there may be minor errors that detract from the overall accuracy.

	10	
Average	8	A significant amount of the content is of appropriate depth. Shows a sound understanding of most of the principles involved and knowledge of factual detail generally in keeping with a programme of A-level study. Most of the content is accurate with few fundamental errors.
	6	
Poor	4	Material presented is largely superficial with only occasional content of appropriate depth. Shows some understanding of some of the basic principles involved. If greater depth of knowledge is demonstrated, then there are fundamental errors.
	2	
Unacceptable	0	Such material as is relevant is both superficial and inaccurate. Fails to demonstrate evidence of knowledge in keeping with a programme of A-level study.

In marking scientific content, the first decision to be made is the category into which the essay falls. Examiners will discuss a range of specimen scripts at the standardising meeting that help them to make this decision. In general:

An exceptional essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout
- includes two or more paragraphs of material that indicates greater depth or breadth of study

A good essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout

An average essay

- contains a significant amount of material that reflects the detail that could be expected from a knowledge and understanding of relevant parts of the specification. In practice this will amount to about half the essay.
- is likely to reflect limited knowledge of some areas and to be patchy in quality
- demonstrates a good understanding of basic principles but will contain some errors and evidence of misunderstanding

A poor essay

- contains much material which is below the level expected of a candidate who has completed an A-level Biology course although there will be occasional valid points
- Contains fundamental errors reflecting a poor grasp of basic principles and concepts

Having decided on the basic category, examiners may award the mark above or below this according to whether the candidate has exceeded the requirements or just failed to meet them.

Assessing breadth

In assessing this area, note the following

- The maximum mark is 3
- The mark scheme will include notes which indicate how the marks for breadth should be awarded for individual essays. In determining the mark awarded for breadth, content should ideally be taken from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is only taken from a single area, one mark should be awarded. However, this should only serve as a guide. The list is not exhaustive and examiners are prepared to offer credit for the incorporation of relevant material from other areas of study.
- Marks are awarded independently. Therefore it is possible for a candidate to gain full credit for breadth even though much of the essay is below the standard expected.

The general descriptors in the table below form the basis for awarding the mark for breadth.

Mark	Descriptor
3	A balanced account making reference to most of the areas that might realistically be covered in an A-level course of study
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with almost all material based on a single aspect
0	Material entirely irrelevant

The descriptors should be interpreted using these guidelines.

Essay	Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects.
Section	
	Carbon dioxide affects the physiology of organisms

1.4	Pulmonary ventilation and the mechanism of breathing
4.3	Light-independent reaction of photosynthesis. Limiting factors
5.1	Role of chemoreceptors in controlling heart rate
4.6	<p>The direct effects of increasing carbon dioxide concentration</p> <p>Respiration, photosynthesis and human activity giving rise to short-term fluctuations and long-term change.</p> <p>Yield of crop plants</p>
4.6 1.2	<p>Indirect effects of increasing carbon dioxide concentration</p> <p>Distribution of animals and plants;</p> <p>Effect of temperature on enzymes;</p>

[25]

Q17.

Introduction

The essay is intended to assess a candidate's ability to bring together principles and concepts from different areas of biology, express ideas clearly and logically and use appropriate specialist vocabulary. It also provides an opportunity for candidates to demonstrate that they have met the ideals of stretch and challenge required to gain an A* grade. Because of this, essays are deliberately worded such that they allow candidates the freedom to respond in a variety of ways. Candidates are offered a choice of essay and it is important that the final mark reflects the quality of work, not the choice of essay.

The marking scheme considers four skill areas

- S** Scientific content
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In practice, this means that we are looking for

- evidence of knowledge and understanding in keeping with an A-level course of study
- selection of material relevant to the title, and drawn from different areas of the specification
- the ability to present an argument coherently and logically, using appropriate biological language.

Each of the skill areas is considered and matched against a series of descriptors to give the total mark. Notes are provided to assist in the application of the mark scheme to specific essay titles. Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in

keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will. The notes must therefore be seen as no more than guidelines providing an indication of areas of the specification from which suitable factual material may be drawn.

Plans should be considered in awarding marks. Examiners are instructed to ignore the plan when reading the essay. They should then return to the plan. If further credit can be awarded because of material contained in the plan, this is done. Under no circumstances can a candidate lose credit for incorrect information contained in the plan.

Assessing scientific content

In assessing this area, note the following

- The maximum mark is 16
- Only even marks are awarded (16, 14, 12 etc). Intermediate marks (15, 13, 11 etc) cannot be used. This restricts examiners' choice and increases the reliability of the marking.
- Descriptors are given for 16, 12, 8, 4 and 0 marks. Work is matched to these descriptors. If a particular essay is considered to fall between the criteria for two descriptors an intermediate even mark (14, 10, 6 etc) is awarded.
- Candidates have approximately 40 minutes to plan and write their essays. It is important that candidates who allocate their time wisely should be able to gain maximum marks for what it is possible to write in this time. In practice, this amounts to between three and four sides of normal handwriting.
- Essays do not have to be perfect to gain higher marks. The amount of detail required by the specification should always be born in mind. Average A-grade candidates should be able to achieve 12 marks so it would not be unreasonable to expect around 15% of candidates to achieve such a mark.

Category	Mark	Descriptor
Exceptional	16	Material accurate and of a high standard throughout, reflecting a sound understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. In addition, there are some significant references to material that indicates greater depth or breadth of study.
	14	
Good	12	Most of the material is of a high standard reflecting a sound understanding of the principles involved and a knowledge of factual detail generally in keeping with an A-level course of study. Material accurate and free from fundamental errors, but there may be minor errors that detract from the overall accuracy.
	10	
Average	8	A significant amount of the content is of appropriate depth. Shows a sound understanding of most of the principles

		involved and knowledge of factual detail generally in keeping with a programme of A-level study. Most of the content is accurate with few fundamental errors.
	6	
Poor	4	Material presented is largely superficial with only occasional content of appropriate depth. Shows some understanding of some of the basic principles involved. If greater depth of knowledge is demonstrated, then there are fundamental errors.
	2	
Unacceptable	0	Such material as is relevant is both superficial and inaccurate. Fails to demonstrate evidence of knowledge in keeping with a programme of A-level study.

In marking scientific content, the first decision to be made is the category into which the essay falls. Examiners will discuss a range of specimen scripts at the standardising meeting that help them to make this decision. In general:

An exceptional essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout
- includes two or more paragraphs of material that indicates greater depth or breadth of study

A good essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout

An average essay

- contains a significant amount of material that reflects the detail that could be expected from a knowledge and understanding of relevant parts of the specification. In practice this will amount to about half the essay.
- is likely to reflect limited knowledge of some areas and to be patchy in quality
- demonstrates a good understanding of basic principles but will contain some errors and evidence of misunderstanding

A poor essay

- contains much material which is below the level expected of a candidate who

has completed an A-level Biology course although there will be occasional valid points

- Contains fundamental errors reflecting a poor grasp of basic principles and concepts

Having decided on the basic category, examiners may award the mark above or below this according to whether the candidate has exceeded the requirements or just failed to meet them.

Assessing breadth

In assessing this area, note the following

- The maximum mark is 3
- The mark scheme will include notes which indicate how the marks for breadth should be awarded for individual essays. In determining the mark awarded for breadth, content should ideally be taken from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is only taken from a single area, one mark should be awarded. However, this should only serve as a guide. The list is not exhaustive and examiners are prepared to offer credit for the incorporation of relevant material from other areas of study.
- Marks are awarded independently. Therefore it is possible for a candidate to gain full credit for breadth even though much of the essay is below the standard expected.

The general descriptors in the table below form the basis for awarding the mark for breadth.

Mark	Descriptor
3	A balanced account making reference to most of the areas that might realistically be covered in an A-level course of study
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with almost all material based on a single aspect
0	Material entirely irrelevant

The descriptors should be interpreted using these guidelines.

Essay	The causes of disease in humans
Section	
1.1	<p>Pathogens</p> <p>Pathogens include bacteria, viruses and fungi</p> <p>Pathogens cause disease by damaging cells and producing toxins</p>

1.1	Lifestyle Risk factors associated with cancer and coronary heart disease
2.2	Genetics Differences in bases may lead to non-functional enzymes
2.5	Relationship between the cell cycle and cancer
5.6	Proto-oncogenes and tumour suppressor genes Gene mutations

[25]

Q18.

General principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific content (maximum 16 marks)

Category	Mark	Descriptor
	16	
Good	14	Most of the material of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	12	
	10	
Average	8	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any fundamental errors. Shows a sound understanding of most of the principles involved.
	6	
	4	
Poor	2	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	0	

Topics

3.1.1 Monomers and polymers

3.1.2 Carbohydrates

3.1.4 Proteins

3.1.5 Nucleic acids

3.2.3 transport across membranes

3.2.4 Cell recognition and the immune system

3.3.3 Digestion and absorption

3.4.1 DNA, genes and chromosomes

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most if not all areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect
0	Material entirely irrelevant.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking this question

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is

likely that it will be.

These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally come from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Q19.

General principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific content (maximum 16 marks)

Category	Mark	Descriptor
	16	
Good	14	Most of the material of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	12	
	10	
Average	8	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any fundamental errors. Shows a sound understanding of most of the principles involved.
	6	
	4	
Poor	2	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	0	

Topics

- 3.1.7 Water
- 3.2.3 Transport across cell membranes
- 3.3.1 Surface area to volume ratio
- 3.3.2 Gas exchange
- 3.3.3 Digestion and absorption
- 3.3.4 Mass transport
- 3.5.3 Energy and ecosystems
- 3.5.4 Nutrient cycles

3.6.4 Homeostasis is the maintenance of a stable internal environment

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most if not all areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect
0	Material entirely irrelevant.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking this question

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be.

These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally come from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Q20.**General principles for marking the Essay:**

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific content (maximum 16 marks)

Category	Mark	Descriptor
	16	
Good	14	Most of the material of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	12	
	10	
Average	8	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any fundamental errors. Shows a sound understanding of most of the principles involved.
	6	
	4	
Poor	2	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	0	

Topics

3.1.3 Lipids

3.1.5 Nucleic acids are important information-carrying molecules

3.1.6 ATP

3.2.3 Transport across cell membranes

3.5.1 Photosynthesis

3.5.2 Respiration

3.5.4 Nutrient cycles

3.6.2 Nervous coordination

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most if not all areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect
0	Material entirely irrelevant.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally be drawn from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Q21.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
Poor	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
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3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking this question

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally be from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

The transfer of energy between different organisms and between these organisms and their environment.

Biology		Human Biology
	Photosynthesis	
14.6	Photosynthesis uses energy from sunlight to synthesis organic molecules from inorganic sources	14.6
	Ecology	
14.7	Energy is transferred through food chains and food webs in a community	14.7
	Energy loss	
14.8	Respiration produces ATP which is the immediate form of energy for many cell activities	14.8
15.9	Receptors convert stimuli into electrical impulses in nerve cells	16.8

Q22.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material,
	14	

	12	however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
Average	10 8 6	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
Poor	4 2 0	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.

Topics

3.2.1 Cell structure

3.2.4 Cell recognition and the immune system

3.3.2 Gas exchange

3.3.3 Digestion and absorption

3.3.4 Mass transport

3.6.1 Stimuli, both internal and external, are detected and lead to a response

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.

0	Material entirely irrelevant or too limited in quantity to judge.
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Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in

a particular way, but where a high level of understanding is shown a high mark may be justified.)

- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate
- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

Breadth of Knowledge

3 marks	five topics - at least two from each set of examples
2 marks	five from one set of topics
	four topics - at least one from each set
1 mark	three topics

Q23.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
Poor	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Topic areas for assessment of scientific content:

- (1) principle of destabilising effect of rising temperature on metabolic systems within organisms and on balance in ecosystems. (P)
- (2) effect on rate of diffusion / gaseous exchange; possible consequences, e.g. increased evaporation, more rapid uptake of ions by plants. (D)
- (3) effect on proteins; possible increased rate of denaturation of tertiary structure. Increased rate of enzyme activity; possible increased dislocation of metabolic pathways. (E)
- (4) effect on photosynthesis (light independent reaction); increased rate with small increases, disruption with larger; increased rate of growth of (some) plants; possible increased rate of crop growth; effect of other limiting factors. (PS)
- (5) effect on transpiration; increased rate of water loss and hence wilting / dehydration; reduced stomatal opening may affect photosynthesis; possible consequences of drought on ecosystems. (T)

- (6) effect on respiration and metabolism; increased effect on growth and activity, especially of ectotherms. (M)
- (7) ecological effects of disruption of food webs and the dynamics of ecosystems, with changes in niches and hence communities. (EC)
- (8) effect on species; extinction of species that are unable to adapt, especially ones with specialised requirements; limited opportunity for plants and some animals to spread to more suitable conditions as climate changes. (S)
- (9) effect on agriculture; increased growth of some crops and loss of others, and effect on productivity; possible redistribution to different parts of the world, and overall loss of agricultural land. (A)
- (10) ecological effect of increased rates of growth and reproduction, especially of bacteria, insects and pests; possible increased incidence of disease. (R)
- (11) role of natural selection in adaptation to change. (N)

There are many possible alternative approaches to this essay and any biologically sensible effect of increasing change in temperature on living organisms should be credited. In a good essay the specific effects of rising temperature will be explained and explicitly linked to their possible effects on physiology or ecology. A good candidate will also recognise the complex interactions involved and avoid giving simplistic explanations and doomsday scenarios.

Assessment of breadth of knowledge:

- 3 marks: includes descriptions of at least 5 different areas, including both physiological and ecological effects.
- 2 marks: refers to 3 different areas, including at least one physiological and one ecological.
- 1 mark: refers to 2 different areas

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title

- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas are indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also be given credit where appropriate.

Q24.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate
	8	

	6	with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
Poor	4 2 0	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level

- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate

- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

How microscopes have contributed to our understanding of living organisms

- (1) reference to both light and electron microscopes (M)
e.g. resolution, magnification, techniques.

good candidates e.g. clear distinction of advantages disadvantages of each, historical developments, reference to wavelengths employed and limitations.

- (2) cell structures (typically) visible with each (CS)

good candidates - how observation of structures can inform about function; viewing isolated organelles and their internal structure.

- (3) tissue structure (T)
e.g. histology of digestive system related to function, muscle structure, kidney tubules, leaf structure.

good candidates - explanation linking appearance of features to understanding function

- (4) observation of processes (P)
e.g. cell division, fertilisation, capillary circulation.

good candidates - appreciation of using microscopes to observe dynamic processes, use of tracers.

- (5) observation of organisms; classification (O)
e.g. bacteria and viruses, taxonomic differences in small organisms.

good candidates - importance in understanding of disease.

- (6) other uses (U)
e.g. understanding effects of disease / cancer, opportunities to improve / alter / etc living organisms.

Breadth of Knowledge

3 marks	4 areas covered to significant extent
2 marks	3 areas covered to significant extent
1 mark	2 areas covered to significant extent

Q25.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
Poor	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
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[25]

Guidelines for marking the essay**Introduction**

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- coverage of the main concepts and principles that might be reasonably expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A

level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate
- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
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- includes several errors, including some major ones

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Marking the essay

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- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also be given credit where appropriate.

Enzymes and their importance in plants and animals

- (1) principles of enzyme action (A)
e.g. catalysis, protein structure, active site, activation energy, enzyme-substrate complex, specificity.

good candidates relate protein structure to specificity / active site, catalysis to activation energy.

- (2) factors affecting enzyme action (F)
e.g. temperature, pH, enzyme / substrate concentration, inhibition.

good candidates – relate changes in activity to denaturing / tertiary structure; effects of concentration to active site availability, distinguish competitive / non-competitive inhibition.

- (3) enzyme synthesis (S)
reference to protein synthesis; link to genes, gene expression, effects of mutation.

good candidates – appreciation of connection between genes and enzyme production, e.g. 'one gene, one enzyme'.

roles and functions of enzymes in different processes. In each case good candidates should specify enzyme and its function.

- (4) digestion (D)
enzymes involved in mammalian digestive system, breakdown of polymers in other circumstances, e.g. saprophytic digestion / mobilisation of storage compounds.

good candidates – range of enzymes giving source and action in sequence in mammalian digestion; reference to other breakdown.

2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Guidelines for marking the essay

Introduction

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- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories:
Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0).
Only even scores can be awarded, i.e. not 15, 13, etc.
Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate
- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

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- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

The process of osmosis and its importance to living organisms

(1) definition (D)

(2) effects on cells (C)

turgity and support
plasmolysis (idea)
lysis

(3) importance in animals (A)

role in relationship between plasma and tissue fluid
role in medulla of kidney
reabsorption in gut
sweat production neutral

(4) importance in plants (P)

role in movement of water from soil to leaves in plants
role in mass flow hypothesis for movement in plants

Breadth of knowledge

3 marks	reference to all 4 areas
2 marks	definition + 2 other areas
1 mark	any 2 areas

(b) Energy transfers which take place in living organisms

(1) ATP (A)
synthesis from ADP and P

role as an energy source

- (2) photosynthesis (P)
excitation of electrons
generation of ATP and reduced NADP
photolysis
reduction of glycerate phosphate to carbohydrate
structure of chloroplast in relation to energy transfers
- (3) respiration (R)
net gain of ATP in glycolysis
production of ATP in Krebs cycle
synthesis of ATP associated with electron transfer chain
ATP production in anaerobic respiration
structure of mitochondrion in relation to energy transfers
- (4) uses of energy in biological processes (B)

active transport
muscle contraction
nerve transmission
synthesis
translocation
kidney function
nitrogen fixation
receptors

Breadth of knowledge

3 marks	reference to all 4 areas
2 marks	ATP + 2 other areas
1 mark	any 2 areas

Q27.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key
	8	

	6	principles involved.
Poor	4 2 0	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification

- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.

Descriptors are divided into 3 categories:

Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0).

Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas will be indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of C / D / E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate

- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

Energy transfers which take place in living organisms

- (1) ATP (A)
synthesis from ADP and P
role as an energy source
- (2) photosynthesis (P)
excitation of electrons
generation of ATP and reduced NADP
photolysis
reduction of glycerate phosphate to carbohydrate
structure of chloroplast in relation to energy transfers
- (3) respiration (R)
net gain of ATP in glycolysis
production of ATP in Krebs cycle
synthesis of ATP associated with electron transfer chain
ATP production in anaerobic respiration
structure of mitochondrion in relation to energy transfers

(4) uses of energy in biological processes (B)

active transport
 muscle contraction
 nerve transmission
 synthesis
 translocation
 kidney function
 nitrogen fixation
 receptors

Breadth of knowledge

3 marks reference to all 4 areas
 2 marks ATP + 2 other areas
 1 mark any 2 areas

Q28.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
Poor	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics

	essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays.

In both essays, topics either from the option modules or beyond the scope of the specification were also given credit where appropriate.

How the structure of proteins in relation to their functions.

1. Structure (S)
 primary structure – peptide bond
 secondary structure
 tertiary structure. Globular - bonds between R groups give spherical shape – shape determines function – active sites and receptor sites
(allow quaternary structure – haemoglobin incorporates ions for oxygen transport)

2. Structural proteins (ST)
fibrous – regular pattern of hydrogen bonds – coiling,
(e.g. *keratin coils twist together to form rope-like structures – flexible and strong*)
(e.g. *collagen – coils more tightly bound – more rigid*)
3. Transport (T)
channel – complementary shape – charges – gated
carrier – complementary shape – can change shape
active transport – phosphate group attached by energy from
ATP – can change shape
4. Enzymes (E)
active site, enzyme-substrate complex
activation energy reduction - explanation e.g. brings molecules closer
5. Receptors (R)
synapse
insulin / glucagon
ADH
rhodopsin
6. Muscle (M)
actin thin – binding site
myosin thick - cross bridges
tropomyosin – block binding sites

Breadth of knowledge

- 3 marks Four or more of the above 6 areas
2 marks Three of the above 6 areas
1 mark Two of the above 6 areas

Q29.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
Poor	4	Material presented is largely superficial and fails to

	2	reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays.

In both essays, topics either from the option modules or beyond the scope of the specification were also given credit where appropriate.

The causes of variation and its biological importance

1. Gene mutation (G)
 - addition
 - deletion
 - substitution
 - effect on alleles
 - effect on polypeptide / protein

2. Sexual reproduction (S)
 - crossing over
 - independent assortment
 - random fusion
 - (allow chromosome mutation)*

3. Environmental (E)
 - nutrients
 - disease
 - light
 - temperature

4. Biological importance (B)
 - enables adaptation
 - natural selection
 - speciation
 - evolution

Breadth of knowledge

- 3 marks Three of the above four areas including cause and importance
- 2 marks Two of the above four areas including cause and importance
- 1 mark Two of the above four areas

Q30.

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
Average	10	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level

	8	study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	6	
Poor	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking this question

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally be from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Ways in which different species of organisms differ from each other

Biology		Human Biology
Molecular differences		
10.4	Large molecules are important in the structure and functioning of Cells (proteins)	10.4
Genetic differences		
11.3	Genes incorporate coded information which determines the metabolism of organisms	12.5
14.2	Genes and environmental factors influence variation between individuals	14.2
14.3	Selection can influence the frequency of alleles in a population	14.3
14.4	Evolution has resulted in different species of organisms	14.4
Other aspects of biology		
10.1	The cell is the basic unit of structure in prokaryotic and eukaryotic organisms	
14.5	The concept of ecosystem (niches)	14.5
15.5	Different organisms possess different types of haemoglobin with different oxygen transporting properties	
15.4	Limitation of water loss in xerophytic plants	
15.6	Digestion of cellulose	
	Bacteria as examples of pathogenic microorganisms	12.1 /
	Principles of immunology	12.9
		12.3

Examiner reports

Q1.

The essay is a synoptic exercise. Students are expected to bring to bear factual recall of different parts of the specification, and use what they know to illustrate and explain an important theme in the title of the essay. The essay is (approximately) half AO1, factual recall with understanding, and half AO2, application of knowledge. It is the use of what they know to address the theme of the essay title that constitutes the AO2 component.

The essay was marked using a *levels* mark scheme. The statements in each level were based on the *descriptors* used for marking the essay in the previous specification. This suggests that the outcomes for the essay should be similar to those in the previous specification. In the event, the mean mark this year was up slightly on last year's BIOL5 mean, and the standard deviation was also up. As in the previous specification, the essay discriminated well. It should be noted that significant errors and irrelevant passages have significant impacts with regard to the level to which any essay can be assigned. The quality of handwriting, spelling and grammar is not as important as the scientific content of the essay and the use of appropriate terminology. An introduction and a conclusion are not required. We appreciate that students are writing this piece of prose in a limited time and under exam conditions.

Relatively few students included material from beyond the specification (at A-level standard). This was a little surprising since A-level textbooks use many examples, that were in the previous specification, to illustrate important concepts.

Common topic areas for 'nitrogen' included the nitrogen cycle, proteins, enzymes, nucleic acids, ATP, DNA replication, protein synthesis, peptide hormones, haemoglobin, photosynthesis and respiration, and muscle contraction. The types of comment made with regard to the 'diffusion' essay all apply here. Some students wrote almost entirely (or even entirely) about one topic, often the nitrogen cycle, and scored poorly. Others identified processes such as respiration and photosynthesis as depending on nitrogen-containing molecules, but didn't identify what they are, or what their specific roles are; they just wrote everything they could remember about the process. Better attempts identified NADP and NAD (and FAD) as nitrogen-containing coenzymes and gave their roles. Others wrote about ATP synthase as a nitrogen-containing protein in chemiosmosis. It was surprising how many wrote about DNA replication, transcription and translation, without making a major point of the importance of complementary base pairing between nitrogen-containing bases. As with the other title, it was the links to the importance that were often weak. To give an example from the nitrogen cycle, students often wrote in some (A-level) detail about stages in the production of the inorganic ions. They would then end by saying that nitrates are taken up by plants and this is important; they might go on to say that it was important to make proteins. Relatively few wrote about a number of nitrogen-containing biological molecules that plants are able to make from the products of photosynthesis (and respiration) after taking up these nitrate ions, which is, of course, a main reason why they are important to us as primary producers.

Q2.

The essay is a synoptic exercise. Students are expected to bring to bear factual recall of different parts of the specification, and use what they know to illustrate and explain an important theme in the title of the essay. The essay is (approximately) half AO1, factual recall with understanding, and half AO2, application of knowledge. It is the use of what they know to address the theme of the essay title that constitutes the AO2 component.

The essay was marked using a *levels* mark scheme. The statements in each level were

based on the *descriptors* used for marking the essay in the previous specification. This suggests that the outcomes for the essay should be similar to those in the previous specification. In the event, the mean mark this year was up slightly on last year's BIOL5 mean, and the standard deviation was also up. As in the previous specification, the essay discriminated well. It should be noted that significant errors and irrelevant passages have significant impacts with regard to the level to which any essay can be assigned. The quality of handwriting, spelling and grammar is not as important as the scientific content of the essay and the use of appropriate terminology. An introduction and a conclusion are not required. We appreciate that students are writing this piece of prose in a limited time and under exam conditions.

Relatively few students included material from beyond the specification (at A-level standard). This was a little surprising since A-level textbooks use many examples, that were in the previous specification, to illustrate important concepts.

Common topic areas for 'diffusion' included all of those listed in the mark scheme. The vast majority of students did appreciate the need to write about a number of topic areas. A few wrote at great length about one or two topic areas, frequently gas exchange. This approach is not synoptic in the context of this exercise. The levels scheme defines such essays as *unistructural* and limits them to a mark within the range 6 to 10 (as a maximum). Quite a large number of students wrote essays that were largely at GCSE level and did not score well. Some of the more commonly seen errors related to descriptions of active transport as diffusion, ventilation of the lungs as diffusion and ultrafiltration in the kidneys as depending on diffusion. If written about at length (several lines), these would also constitute irrelevant passages. It was not uncommon to see answers from students who had written about respiration, photosynthesis or transpiration at length, but with no real reference to the role of diffusion in the process.

To obtain more than 15 marks, a student had to discuss the *importance* of the process involving diffusion. Many students just wrote what they knew about processes involving diffusion. The attempts at explaining importance generally ranged from GCSE level upwards. To give an example from one topic area, many wrote about gas exchange in the lungs and then simply said that people would die if they didn't breathe. At the other end of the spectrum, there were students who gave the importance of gas exchange in the lungs in terms of the requirement for oxygen as the terminal electron acceptor in oxidative phosphorylation, which is the major source of ATP that supplies energy for all vital functions. In essence, to obtain good credit the factual content and the explanation of importance had to be at A-level standard.

Q7.

The essay produced the greatest discrimination of any question on the paper. The essay titles were not equally popular, with far more attempting title (b). The examiners' opinion was that the better essays were produced in response to title (b).

Many students wrote about relevant topics but failed to explain the biological importance of what they wrote about. The essay has roughly equal AO1 and AO2 weighting, with AO1 being factual recall and AO2 being application of knowledge; in this case, AO2 being the biological importance of the factual content. If a student failed to address importance at all then, according to the descriptors for the essay, they could only achieve a maximum of 8 marks for content. They could still get 3 for each of breadth, relevance and quality of written communication (judged mainly on use of terminology). This would give them a maximum mark of 17 for the essay.

The vast majority of students appeared to understand that this is a synoptic exercise, where they have to draw on a range of examples to obtain a high mark. Examiners reported that substantive attempts at extension material were relatively uncommon.

Extension material has to be at least of A-level standard and accurately described using appropriate scientific terminology.

Appropriate terminology was often poorly used or absent. The essay is supposed to be written using appropriate terminology, at a level to be expected after two years of A-level study.

The marking annotation of the essay this year was the same as last year. Where an AS or A2 topic was included, a vertical line should appear in the right-hand margin of candidates' scripts. If a paragraph (or substantial piece of text) was irrelevant, a vertical line should appear in the left-hand margin. Any notable errors should be underlined. The vertical lines do not give any information about the quality of the content. That was assessed by the examiners as they read the essay.

This report will mainly consider the topics identified on the mark scheme as relevant to the title and which were frequently used by students.

(a) The control of processes in cells and the importance of these controls.

Some weaker essays included very long and rambling discussions of the importance of control but little relevant detail to illustrate the points being discussed. A minority of students ignored 'in cells' and wrote at length about systems in organisms; for example, homeostatic control systems in mammals.

Cholera was a popular example used to illustrate the importance of control of movement across membranes. Unfortunately, many included confused or wrong details of, for example, co-transport and how ORS works. Some students included cystic fibrosis in this topic area and this could contribute towards A*. Quite a large number of students wrote about movement of ions into roots and how this related to the control of water uptake by plants. These students often went on to discuss control of water loss by plants; again, this was appropriate, if they considered control at the cellular level. Some used potential A* material relating to the opening and closing of stomata by guard cells.

Some students included enzymes and wrote about factors controlling their activity. Better accounts included their roles in controlling reactions and metabolic pathways.

Many wrote about transcriptional factors, proto-oncogenes and tumour suppressor genes, possibly triggered by questions in this paper. The degree of success depended on their ability to recall correct detail. There were also accounts of the use of gene therapy to try and control, or alter, the production of proteins and treat conditions.

There were some discussions of the control of DNA replication and cell division.

Some students wrote about the control of protein synthesis but, in reality, often simply gave accounts of the process. There were some good accounts of the role of small interfering RNA in the control of protein synthesis.

The inclusion of oestrogen in accounts of transcriptional control then frequently resulted in a discussion of the role of hormones in control; usually insulin and glucagon. This was appropriate, as long as the student stayed at the cellular level. Some students showed poor recollection of the control of blood glucose concentration and many failed to discuss its importance. There was considerable confusion about the different cellular mechanisms involved in the actions of oestrogen, insulin, glucagon and adrenaline. There were some potentially A* accounts of ADH in control of water uptake in the kidney. Some of the better attempts to discuss control were associated with accounts of the roles of IAA in controlling tropisms.

Accounts of various processes in the nervous system were very common. The best

accounts included consideration of the importance of unidirectional transfer of information across synapses, the control of propagation of a nerve impulse and the importance of the refractory period. Students often moved from this topic area to the control of muscle contraction; frequently using movement of calcium ions as a link. As with other topic areas, many accounts were heavy on facts but with limited consideration of control.

There were many accounts of ATP, respiration and photosynthesis but these were frequently little more than statements of fact, with few references to control.

Q8.

The essay produced the greatest discrimination of any question on the paper. The essay titles were not equally popular, with far more attempting title (b). The examiners' opinion was that the better essays were produced in response to title (b).

Many students wrote about relevant topics but failed to explain the biological importance of what they wrote about. The essay has roughly equal AO1 and AO2 weighting, with AO1 being factual recall and AO2 being application of knowledge; in this case, AO2 being the biological importance of the factual content. If a student failed to address importance at all then, according to the descriptors for the essay, they could only achieve a maximum of 8 marks for content. They could still get 3 for each of breadth, relevance and quality of written communication (judged mainly on use of terminology). This would give them a maximum mark of 17 for the essay.

The vast majority of students appeared to understand that this is a synoptic exercise, where they have to draw on a range of examples to obtain a high mark. Examiners reported that substantive attempts at extension material were relatively uncommon. Extension material has to be at least of A-level standard and accurately described using appropriate scientific terminology.

Appropriate terminology was often poorly used or absent. The essay is supposed to be written using appropriate terminology, at a level to be expected after two years of A-level study.

The marking annotation of the essay this year was the same as last year. Where an AS or A2 topic was included, a vertical line should appear in the right-hand margin of candidates' scripts. If a paragraph (or substantial piece of text) was irrelevant, a vertical line should appear in the left-hand margin. Any notable errors should be underlined. The vertical lines do not give any information about the quality of the content. That was assessed by the examiners as they read the essay.

This report will mainly consider the topics identified on the mark scheme as relevant to the title and which were frequently used by students.

(b) The importance of ions in biology.

A very large number of students wrote very fact-filled essays about ions in Biology but with little or no consideration of their importance. There were several topic areas that were common to the other essay title but with factual content relevant in a different way.

Surprisingly few wrote about ions in biological molecules and cellular structures, or pH. There were attempts to discuss the role of iron ions in haemoglobin but these were frequently rather superficial. There were some accounts of the importance of charge on DNA fragments in electrophoresis and genetic fingerprinting.

The nitrogen cycle was a popular topic and there were good accounts of the facts. Relatively few linked the cycle to amino acid and nucleotide synthesis. Quite a few

students produced confused and factually incorrect accounts of the relationships between the various ions in the nitrogen cycle. Some students gave quite good accounts of the use of fertilisers and potential problems with eutrophication.

The role of ions in water potential gradients was often discussed, frequently in the context of cholera. There were many incorrect accounts of co-transport of glucose. Cystic fibrosis was used by some students in this context and offered an opportunity for A* content. Uptake of ions by root hairs was commonly used as an example and some went on to discuss the role of the endodermis in the generation of root pressure. Some students included potential A* content with a discussion of the role of sodium ion gradients in the re-absorption of water in the kidney.

Very many students wrote about aspects of ion movements and gradients in the nervous system. Some wrote at very great length about many different aspects of this one topic area, sometimes to the detriment of their content and breadth marks. This was a topic area that frequently brought out poor understanding and use of terminology. Some examples included, the movement of 'signals' or 'messages' along neurons, the use of 'channel' proteins in active transport, 'movement' instead of 'diffusion', and nerve impulses moving across synapses. Some students obtained A* credit with a discussion of the role of chloride ions in inhibitory synapses.

Respiration and photosynthesis were also commonly discussed, with the emphasis on the role of protons. There were good accounts of how proton gradients are generated and then used to produce ATP and/ or reduced NADP (in photosynthesis). Once again, students often failed to follow up with the importance of these processes; for example the use of reduced NADP in the synthesis of sugars that can then be used for respiration or in the synthesis of other biological molecules. Poor expression often marred students' accounts. For example, it was quite common to see references to H⁺ being used in/passing down the electron transfer chain. There were some attempts to discuss uses of ATP that involved the transfer of phosphate groups but these tended to be vague.

Q9.

Most wrote about thermoregulation and the control of blood glucose concentration. Many accounts of thermoregulation were at GCSE level, or below, and did not include details of receptors, their location, the coordinator or the effectors. There were unfortunate references to blood vessels migrating to and from the surface of the skin and capillaries dilating or contracting. There were also many signals and messages. Most did identify the importance of thermoregulation in terms of enzyme activity.

Control of blood glucose concentration was somewhat better done. There were some very good accounts that included the mechanisms of action of insulin, glucagon and adrenaline. These also got credit for the role of hormones in responses to changes. Weaker students wrote about levels a great deal, confused insulin with glucagon, alpha cells with beta cells and glucagon with glycogen.

Feedback and homeostasis were frequently mentioned by students in various contexts, including the two just discussed. However, very few went beyond a mention and moved into explanation. Some did use feedback control to justify the inclusion of the role of hormones in the oestrous cycle.

Control of heart rate was also popular, in terms of control of blood pressure and blood carbon dioxide concentration / pH. There were good answers that included the role of baro / pressure receptors and chemoreceptors in control of heart rate, the medulla, sympathetic and parasympathetic systems and the SAN. Weaker answers confused the medulla and hypothalamus and often missed out parts of the story. Only better answers included why the changes produced were important; for example, in terms of pH and

enzyme activity. Those who considered blood carbon dioxide concentration sometimes included haemoglobin and the Bohr effect, together with its importance in supplying oxygen to rapidly respiring tissues.

Taxis and kinesis were frequently written about but often superficially, with incorrect examples and little regard to details of the importance of these responses. Tropism was also frequently written about but with problems similar to those with taxis and kinesis. In these three topics, many answers were given at GCSE level. Behaviour was also mentioned by many, usually when discussing thermoregulation in ectotherms. Other examples were rare, such as courtship behaviour and its importance.

Reflexes were discussed and some students showed understanding of the three neurones in a simple reflex arc and its importance in producing a rapid response, without involvement of the brain. However, many just wrote about fast responses and often included the brain. Receptors were also commonly written about, mainly rods, cones and Pacinian corpuscles. Levels of detail varied, as did attempts to explain their importance in responses.

Transpiration and control of gas exchange in plants were used as examples by many students. Some good accounts were seen that related changes in response to environmental stimuli. However, quite a few drifted into accounts of uptake by roots, without any link to the title. Some wrote that plants close their stomata at night, when they switch from photosynthesis to respiration.

Many students wrote about the responses of populations to changing environments. Some of these included excellent accounts of the processes involved, resulting changes in allele frequencies and, sometimes, speciation. Weaker students slipped into organisms 'having to', or 'needing to' evolve.

The immune response was also chosen by many. Those who knew the detail gave good accounts of the response and its importance in defending the body both now and in the future.

Q10.

This essay title produced a higher proportion of thoughtful essays and essays with suitable extension material.

Almost all students wrote about farming and how humans attempt to control growth, reproduction and development. The better students wrote about net productivity and the impact on this of various farming practices. They also often wrote about simplifying food webs and ways of removing competition for resources. In this context, fertilisers and pesticides were often mentioned. Some students went on to give good detail about how these affected productivity of producers and energy flows through food webs and chains. Selective breeding was also mentioned a great deal but rarely explained beyond 'choosing the best animals to breed'. Weak answers wrote about all of the above but without any detail of biological concepts or appropriate terminology. There were some very good accounts of the control of succession to maintain certain habitats and thus conserve certain species.

Control of human populations was discussed by some. More usually, students wrote about controlling populations of other organisms. This resulted in many writing about control of pathogens. How well they fared depended on how much they knew about the topic. Better students frequently included accounts of vaccination programmes and resulting herd immunity as ways of controlling pathogen populations and their growth. Not surprisingly, many who wrote about pathogens wrote about problems controlling populations of antibiotic-resistant bacteria.

Accounts of various aspects of regulation of gene expression featured in many good essays. This was also a topic area that produced quite a lot of extension material; including some references to epigenetics. Control of cell differentiation and division were often written about and often in relation to cancer. Some weaker students simply wrote about mitosis and / or meiosis but without relating what they wrote to the title. Students who wrote about control of gene expression often went on to write about gene therapy and attempts to control the development of inherited conditions. This was sometimes followed by accounts of genetic counselling, as a way of controlling reproduction to affect inheritance of such conditions.

There were some accounts of genetic engineering to affect the development of organisms and as a way of controlling pests in farming. These accounts were not as frequent as expected. There were few references to using genetic engineering to alter the development of organisms so that they produced substances useful to humans.

Q11.

The marking annotation of the essay this year was the same as last year. Where an AS or A2 topic was included, a vertical line should appear in the right margin. If a paragraph (or substantial piece of text) was irrelevant, a vertical line should appear in the left margin. Any notable errors should be underlined. The vertical lines do not give any information about the quality of the content. This was assessed by the examiner as they read the essay.

This report will mainly consider the topics identified on the mark scheme as relevant to the title and which were frequently used by students.

How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

Students were usually able to identify exchanges carried out by cells and organisms and often described them quite well. They often failed to explain how these exchanges maintained any factor in an internal environment, or to indicate why this was important.

Homeostasis was often mentioned but rarely defined or discussed well. Many students defined it as thermoregulation. Very few students wrote about opposing mechanisms or processes that work to maintain internal factors within a narrow range for optimum functioning. Exchange of heat with the environment to maintain a (relatively) constant internal temperature was a popular topic. There were good descriptions of how heat loss can be controlled in mammals and in ectotherms. Factual errors were also common, such as getting endotherms and ectotherms the wrong way round, writing about blood vessels moving nearer to the skin and capillaries dilating. Relatively few students wrote about maintaining a constant, optimum temperature for enzyme activity and metabolic processes generally.

Students who wrote about thermoregulation quite often wrote about how this involved responses to stimuli, involving thermoreceptors, the hypothalamus and effectors. This is a separate topic area that relates to the title. Other students chose different stimuli and response pathways, including some in plants that maintain water uptake. Many students wrote about ion exchanges carried out by neurones. This was appropriate and should have been linked to maintaining the ion gradients required for an action potential to take place. Factual errors were not uncommon; for example, sodium or potassium ions moving in the wrong direction at the wrong time and by the wrong mechanisms.

Water uptake in plants was another popular topic and there were good accounts of how plant roots take up water and plants lose water via stomata. The best answers linked this to water potentials, maintaining the water content of cells and the importance of this.

Gas exchange mechanisms and lung function were very often written about. Some of the commoner extension material content related to stomatal opening and closure mechanisms. These often went into some detail about changes in turgor of guard cells and how stomatal aperture size relates to maintaining gradients for gas exchange and regulating water loss. Quite a few of the descriptions of lung function were little beyond GCSE level. Few accounts of gas exchange referred directly to maintaining internal oxygen concentrations for respiration, or removing carbon dioxide that can lower pH and thus affect enzyme activity.

Control of the body's blood glucose concentration was frequently written about, including the roles and mechanisms of action of insulin and glucagon. Properly phrased, this was also used by some students as an example of responses to stimuli and negative feedback. It was comparatively rare for students to refer to the importance of a (relatively) constant blood glucose concentration to maintain the water potential of blood plasma and a diffusion gradient for entry of glucose into cells for respiration. Some students wrote about the related topic of tissue fluid and how exchanges in capillaries maintain the composition of this fluid. A few also wrote about the importance of this as providing a constant external environment for cells.

Negative feedback, like homeostasis, was frequently mentioned but rarely expanded upon by students.

Exchanges by individual cells were often described, in terms of movements across membranes. Only the best accounts made reference to maintaining some aspect of the internal environment of cells. Some good accounts were given of the importance of these exchanges in maintaining the water potential and content of cells, to avoid shrinkage or bursting. Many of the exchange mechanisms used in this topic area were also described in relation to digestion and absorption and this was a valid topic area. Few wrote about how this maintained internal concentrations of essential nutrients.

Nutrients were often written about in the context of nutrient cycles. The problem was that few students could tie down the parts of what they knew to the title of the essay. In essence, they just wrote everything they knew about, for example, the nitrogen cycle, with no indication of how this related to exchanges with the environment and maintaining a constant internal environment.

Q12.

The marking annotation of the essay this year was the same as last year. Where an AS or A2 topic was included, a vertical line should appear in the right margin. If a paragraph (or substantial piece of text) was irrelevant, a vertical line should appear in the left margin. Any notable errors should be underlined. The vertical lines do not give any information about the quality of the content. This was assessed by the examiner as they read the essay.

This report will mainly consider the topics identified on the mark scheme as relevant to the title and which were frequently used by students.

How energy is transferred within and between organisms.

Students were usually able to write about a range of topics involving energy. Only better essays included descriptions or explanations of forms of energy transfer. Quite a few included irrelevant paragraphs about transfer of energy between organisms and their abiotic environment.

Photosynthesis was the most common starting point for students. Some just wrote everything they knew about the process. Others were more selective and wrote about how

energy in photons is conserved in chemical bonds during the process. These students addressed the main theme of the essay and scored more highly. It was a similar story with another very popular topic, respiration.

There were many references to ATP and its formation from ADP. It was much rarer to see references to how it is involved in transfers of energy. Some good accounts did include phosphorylation of glucose at the start of glycolysis, to make it more reactive/less stable. Others wrote about the role of ATP in muscle contraction and covered two topics at once. Muscle contraction was a popular topic in itself. Again, many accounts contained a lot of factual recall but did not make a real point about chemical energy in ATP being conserved/used in movement, or being transduced/transformed into kinetic energy. Some good accounts did point this out and linked it to functions of ATP.

Almost all students wrote about transfer of energy between organisms in food chains and webs. Many wrote about feeding relationships but without any real references to energy. Better responses made reference to the energy in food and to the various ways in which energy is not transferred to other organisms, explaining the limited number of trophic levels in any food chain.

The discussion of food chains led to many going on to farming practices used to increase productivity. This was a valid approach and many described, at length, practices such as raising animals in pens to reduce movement, and heat loss. Many failed to make the point that almost all farming practices are there to try to increase energy transfers to humans.

Quite a number of students wrote about digestion and absorption in relation to obtaining energy, often after, or whilst, discussing food chains. This often included extracellular digestion by bacteria and fungi.

A large number of students attempted to use nutrient cycles in this essay. The impression was that many effectively wandered into the topic after writing about food chains and webs. It was very difficult for them to make this topic area relevant to the title.

A stimulus is a change in energy and many students used responses to stimuli as examples of energy transfers. The Pacinian corpuscle was the commonest example used and quite often produced statements about mechanical stress forces leading to ion flows and electrical impulses. This topic area also produced quite a few accounts involving extension material; most notably the photo-chemical reactions in rods and cones in the retina and how these are linked to formation of nerve impulses. A related topic area was the generation of resting and action potentials in nerve cells. These accounts sometimes included references to the use of chemical energy from ATP to transport ions across membranes, leading to the subsequent generation of electrical impulses.

Digestion and absorption were acceptable topics but had to be made relevant to the title. Absorption by cells of glucose as a respiratory substrate was relevant. This could involve the use of chemical energy from ATP to *move* sodium ions across a membrane against the concentration gradient. This could then be linked to the *movement* of glucose by facilitated diffusion.

Some students wrote about mass transport systems as examples involving energy transfers. For example, chemical energy from ATP being used by heart muscles that generate force and thus cause movement of blood. Another example used was that of the transpiration stream in plants. Students who wrote about these topics were often the ones who focused clearly on the theme of transfers of energy.

Q13.

In general, the standard of essays was better than last year with a greater proportion of

scripts achieving a mark of 12 or more for scientific content and 3 for quality of written communication. It was also pleasing to see that many scripts showed evidence of a useful plan. This clearly helped to order students' thoughts before starting, gave the essay a better flow and reducing the possibility of missing out important points. However, a number of misconceptions were seen by weaker students for the essay title and these are described below.

Although there was no evidence of misreading the essay title, a minority of weaker students simply described the shapes of different molecules or cells, without relating this to 'fitting together'. Similarly, some students included examples of how the shapes or structures of different cells, such as palisade cells, red blood cells and myelinated neurons, are suited to their function.

Proteins & Enzymes

Students often started the essay with an account of enzymes. Many students stated that the active site and substrate have complementary shapes and this naturally led on to descriptions of the lock and key model and denaturation. Better students were able to also describe the induced fit model and could explain how both types of enzyme inhibitor reduce the rate of reaction. Similarly, there were some excellent, detailed accounts of protein structure and how a mutation can lead to the production of a non-functional enzyme. Unfortunately, some weaker students attributed the properties of enzymes to their quaternary structure and a minority placed the active site on the substrate. Surprisingly few students wrote about protein channels in the plasma membrane in the context of cell transport. However, in terms of awarding extra credit for material beyond the specification, there were some truly excellent accounts of how faulty chloride ion channels cause the production of thicker mucus in cystic fibrosis sufferers. The immune system was also frequently covered. However, responses were usually superficial. It was usually only better students who described the consequence of antigens and antibodies fitting together. Weaker students often let themselves down due to poor expression e.g. 'antibodies fight disease' and 'memory cells remember the pathogen'. There was also confusion between the terms 'antigen', 'antibody' and 'antibiotic'. Very few students mentioned vaccines.

Nucleic acids

Most students had no trouble in giving the complementary base pairings in DNA. However, only better students went on to explain their importance in terms of DNA replication, transcription or translation. Weaker students were often uncertain of the role of DNA polymerase. They thought that this enzyme is responsible for complementary base pairing during DNA replication, rather than joining nucleotides on the newly formed strand. Similarly, a minority thought that DNA polymerase is involved in transcription. Many students appreciated the role of restriction enzymes in isolating genes, cutting plasmids and producing sticky ends. However, it was usually only better students who went further in terms of the production of complementary sticky ends, the role of DNA ligase and how bacteria can be made to take up recombinant plasmids. It was pleasing to see that many students understood the role of oestrogen in controlling transcription. However, references to siRNA were seen less frequently. A minority of students wrote about the polymerase chain reaction (PCR) and DNA hybridisation. These were not classed as relevant as they do not occur 'in cells and organisms'.

Physiology

The most popular topic in this section was the role of acetylcholine at a synapse. This was usually described well. However, weaker students often gave vague accounts of what happened after acetylcholine had bound to its complementary receptor. Similarly, some confused the roles of calcium and sodium ions. The best students had clearly done some

independent study in this area and were well versed in the effects of a variety of drugs at a synapse. The control of blood glucose concentration was also frequently covered, with the best students including reference to cAMP or making the link to diabetes. However, other hormones, including those involved in controlling the mammalian oestrous cycle, were rarely mentioned. There were some excellent accounts of muscle contraction. Most students appreciated the importance of myosin heads fitting into binding sites on actin. However, better students were able to complete the story in terms of the 'power stroke' and detachment of the myosin heads. The best students described the role of calcium ions in removing tropomyosin from the actin binding sites to allow cross bridges to form. Haemoglobin was occasionally covered but this was usually superficial. Only the best students were able to link the partial pressure of oxygen or carbon dioxide to a change in shape of the molecule and relate this to its affinity for oxygen at the lungs or tissues.

Q14.

In general, the standard of essays was better than last year with a greater proportion of scripts achieving a mark of 12 or more for scientific content and 3 for quality of written communication. It was also pleasing to see that many scripts showed evidence of a useful plan. This clearly helped to order students' thoughts before starting, gave the essay a better flow and reducing the possibility of missing out important points. However, a number of misconceptions were seen by weaker students for the essay title and these are described below.

Bacteria and disease

Cholera was frequently covered and there were some truly excellent explanations of how the cholera toxin causes diarrhoea. Weaker students often stated that water moves into the intestine but the mechanism was often vague or confused. Unfortunately, some students wrote in unnecessary detail about the worldwide distribution of cholera and how the disease can be treated or avoided. Tuberculosis was less frequently covered and responses typically lacked detail. They amounted to little more than lung tissue being destroyed or the formation of scar tissue. Only the best students referred to the two phases of infection or the role of the immune response. Indeed, some students confused tuberculosis with emphysema. Antibiotic resistance was well covered and proved to be a good discriminator. Better students were able to describe horizontal gene transmission in detail and often went on to include how natural selection allows the proportion of resistant bacteria to increase. A common misconception seen by weaker students is that vertical gene transmission in bacteria is the same as mitosis. Similarly, some students gave long, unnecessary descriptions of how the immune system responds to a pathogen, without any context regarding how bacteria affect the lives of humans. Very few students mentioned vaccines.

Ecological importance

Most students appreciated the role of bacteria in the carbon cycle, although some weaker students described saprobiotic bacteria 'returning carbon to the soil', rather than returning carbon dioxide to the air by respiration. The nitrogen cycle proved to be a better discriminator. Better students had no trouble in giving full, accurate, detailed accounts. They then often linked this to eutrophication. However, weaker students often focused on one part of the cycle or gave a muddled account. Such responses typically referred to plants taking up nitrogen, rather than nitrates. There was also the usual confusion regarding nitrogen fixation and nitrification. A common misconception that was seen is that nitrogen fixation is the first stage in nitrification, rather than a separate process in its own right. Similarly, a minority of students thought that bacteria can colonise bare rock and are therefore responsible for primary succession. These responses sometimes referred to lichens as bacteria.

Making use of bacteria

Many students focused primarily on how bacterial plasmids can be manipulated to produce genetically modified bacteria containing the human insulin gene. Weaker students appreciated the role of restriction enzymes to isolate the gene and cut the plasmid. However, it was usually only better students who explained the importance of producing complementary sticky ends and the role of DNA ligase in sealing the gene into the plasmid. They could usually also describe how bacteria can be treated in order to take up the recombinant plasmid. A number of misconceptions were seen in the work of weaker students. They included injecting bacteria containing the human insulin gene into diabetics and placing the plasmid into a virus. Indeed, some students thought that a bacteriophage and a bacterium are the same thing. Regarding gene therapy, there were some excellent accounts by the best students of how plasmids can be attached to liposomes in order to alleviate the symptoms of cystic fibrosis. These were awarded extra credit. Similarly, the roles of bacteria in producing vitamin K in the human digestive system, producing cellulase in the digestive system of cattle and breaking down oil spills were also seen. Finally, a number of weaker students confused bacteria with yeast and made references to the routine uses of bacteria in the brewing and baking industries.

Q15.

Cycles in biology

Most of the candidates who attempted this essay were able to write about appropriate biochemical, physiological and ecological cycles. Despite the help given in the title, some of the less able candidates sought to redefine a cycle as any process that leads to another process and hence justified the inclusion of much irrelevant discussion of such topics as protein synthesis. Accounts were, on the whole, sound but there was much confusion between the detail of the Krebs and Calvin cycles, while the nitrogen cycle produced some extremely confused accounts often resulting from the need to “start” and “end” the cycle with nitrogen gas. The cardiac cycle was often introduced as an example of a physiological cycle but descriptions seldom reflected the detail of control that is a key feature of the relevant part of this specification.

Q16.

There were occasional essays that were a pleasure to read. They had accurate and detailed content and presented the underlying argument lucidly and coherently. Many of the essays seen, however, were of poor quality. The following comments could often be applied to these essays.

- There was no evidence of planning. This inevitably led to much repetition and to the liberal use of footnotes and asterisks which detracted from overall coherence and allowed only limited marks to be awarded for skill Q.
- They were frequently based on content that was superficial and rarely reflected the detail expected at the end of an A-level course.
- There were many fundamental errors and misconceptions. Such phrases as “plants respire by photosynthesis”, “carbon dioxide creates the diffusion gradient for oxygen” and “carbon dioxide makes a hole in the O-zone layer” were frequent.
- Much of the content was clearly irrelevant. Examiners were left with the impression that once candidates had identified a topic that they considered to be of some relevance, they were determined to extend it far beyond any link with the essay title. There was the occasional suspicion that some candidates were attempting to recall essays that they had written earlier. Thus the effects of carbon dioxide not

infrequently became the importance of carbon-containing compounds or even the importance of oxygen while the causes of disease became the immune response or DNA and mutation. While examiners are fully prepared to give credit to any relevant biology that relates, even, distantly to the title, irrelevance inevitable results in withholding marks, not only for skill R but also for scientific content.

Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects.

Most of the candidates who attempted this essay, introduced the topic with a reference to the light-independent reaction of photosynthesis. Where they progressed beyond a general equation, their knowledge of biochemical detail was often sound, even though there was often a disturbing degree of confusion between respiration and photosynthesis. The physiological role of carbon dioxide in regulating heart beat and the Bohr shift usually received mention but accounts were often spoiled by confusion between haemoglobin and red blood cells or between carbon dioxide and carbon monoxide. From this point, detail usually fell away. References to the carbon cycle were often followed by superficial and long-winded accounts of climate change. Given the relevance of this topic to the future lives of these students and the emphasis that is placed on it in Unit 4, it was indeed depressing to see that so few could progress beyond the melting of ice caps and the demise of polar bears. Such phrases as “insects would have to migrate to find new niches” raised concerns about fundamental understanding of ecological concepts.

Q17.

The causes of disease in humans

Most of the candidates who attempted this essay were able to write about pathogens, lifestyle diseases and genetic disease. The section on pathogens was usually based on the diseases considered in Unit 1 and marks awarded were closely linked to the accuracy with which candidates recalled basic facts. Fundamental errors were numerous. The terms virus and bacterium appeared freely interchangeable and while understanding of the part played by the cholera toxin was sound, knowledge of tuberculosis was less convincing. Many, indeed, attempted to link tuberculosis with smoking or even with a high fat diet. Many candidates introduced material that was clearly irrelevant at this stage and digressed at great length on the topic of immunology. Better candidates considered genetic disease in considerable detail linking it to cystic fibrosis and sickle-cell anaemia. Others were inclined to produce a lengthy account of DNA structure and mutation finally ending with a phrase along the lines that, if “this goes wrong then you will get a disease.” The section on lifestyle disease, was by far the most poorly answered. Generalisation and inaccuracy were frequently compounded by poor expression such as tar “clogging up” lungs or fats similarly “clogging up veins.”

Q18.

Unit 8

It is difficult to comment meaningfully on the standard of the essays this year compared to that in previous years. Essays ranged from the outstanding to the extremely weak and their quality appeared at times to be independent of the quality of the responses to the other questions in the paper. Thus, there were some excellent answers to questions 1 and 2 which were followed by extremely limited essays and, at the other extreme, papers whose sole redeeming feature was a competent essay. Particularly apparent this year were the many essays which showed no evidence whatsoever of a plan. They were often poorly organised and lacked coherence, with timing often presenting an additional problem. Many candidates still see length in itself as a virtue. Such candidates often produced scripts with two or three extra sheets attached. They often started with some

promise but frequently incorporated much that at best could only be regarded as being of marginal relevance.

There were some outstanding essays on this topic where the detail throughout was fully in keeping with what might be expected of an A-level candidate, and which did not stray from the theme of the relationship between structure and function. Such essays were a pleasure to read and mark. Others, although sound and attracting considerable credit, tended to belabour particular aspects unnecessarily. A frequent example of this was in protein structure where the concept of shape and fit was illustrated at considerable length with enzymes, hormones, carriers, and antibodies. All were correct and each was relevant but, taken together, they contributed little more than could be provided by considering one example. This approach not infrequently led to candidates discussing one particular polymer at great length at the expense of others, thus affecting the overall balance of the essay. At the other end of the spectrum, it was apparent that some candidates were uncertain as to the meaning of the term 'polymer'. It was not unusual to see substantial paragraphs written about lipids, and there were also frequent references to "small polymers such as glucose and maltose". Apart from this, errors often arose from a poor understanding of technical terminology. Thus α - and β -glucose were regularly confused; cellulose molecules were described as consisting of β -pleated sheets, and there was considerable uncertainty over the relationship between amino acids and DNA, the latter all too frequently being described as a polymer of the former.

Unit 9

The essays varied greatly in length and biological content, but less so in breadth and relevance. Many essays showed good evidence of planning in a way which would clearly be useful to the author, and which kept their work relevant. Some candidates failed to plan at all.

The competence with which the scientific terminology was used was pleasing, with many technical terms being used in the majority of essays. Weaker candidates tended to relate their work in everyday language, dwelling on the distribution of large surface areas rather than on the link with transfer processes.

Many of the candidates who chose to write this essay showed themselves to be competent biochemists. They understood the nature of a polymer, and frequently opened their essay with a definition. Some of the best candidates were at pains to point out that lipids were not polymers, and so would not be discussing them. Sadly, some thought they were, and included as much on this group of substances as they did on the relevant ones.

The most frequently discussed polymers were proteins and carbohydrates. Extensive and detailed knowledge of the structure of proteins was included, with descriptions of peptide bonds, primary to quaternary structures, and the bonds which hold them together. Weaker candidates were somewhat haphazard in their descriptions, but the better ones were not only capable of demonstrating a lot of detail but their approach was highly logical. The links with function were less competent. Some simply offered a selection of proteins, while the best essays discussed the differences, for example, between those with a simple secondary structure compared with the globular examples. Frequent choices were enzymes and haemoglobin. Other interesting additions included keratin, antibodies and hormones; although most felt there was no need to comment on the fact that not all hormones are proteins. As a consequence a few lipids were mentioned. The work on the structure was in far more detail than the function in many cases, leaving candidates missing the opportunity to demonstrate detailed knowledge of the control of blood glucose, the principles of immunology, and the transport of blood gases. This was a route which could have been exploited by those capable biologists whose biochemistry is perhaps a little sketchy.

The work on the structure of carbohydrates was equally detailed by a lot of candidates who chose this essay. However, it was much more often that the function of the molecule was linked very closely to its structure. Starch and glycogen were described as large, compact molecules while the work on cellulose reflected its role in the structure of a plant. There was some confusion over the solubility of some of these molecules.

Candidates who moved on to discuss the nucleic acids were less frequently seen. Those that did gave good descriptions of their structure, but a number went on to give huge amounts of detail about the processes in which they play a part, rather than making the more careful links to their function. Full details of protein synthesis, DNA replication, and genetic engineering, were inappropriate. Weaker candidates confused nucleic acids with proteins.

It was easy for candidates to use this essay to show their A-level knowledge. Some candidates tried to use the outline of an essay they may have written earlier on a single polymer. There was a wide range of marks, with a good number of the better candidates gaining full or close to full marks.

Q19.

The essays varied greatly in length and biological content, but less so in breadth and relevance. Many essays showed good evidence of planning in a way which would clearly be useful to the author, and which kept their work relevant. Some candidates failed to plan at all.

The competence with which the scientific terminology was used was pleasing, with many technical terms being used in the majority of essays. Weaker candidates tended to relate their work in everyday language, dwelling on the distribution of large surface areas rather than on the link with transfer processes.

This essay was chosen by a large number of candidates, some of whom used it effectively to demonstrate their A-level knowledge. Sadly, a large number submitted essays of a very general nature, with much of the work being at GCSE level. Candidates were very clear on what is meant by a large surface area, and often quoted Fick's Law to illustrate the point. This led on to discussions of the lungs, the placenta and the digestive system in most cases. Unfortunately this did not include the expected A-level detail regarding the large numbers of alveoli, the microvilli of the placenta and small intestine, and the presence of increased numbers of transport proteins in folded membranes. There was confusion over villi and microvilli, both being cited as found in the mouth, lungs, stomach and large intestine. In the placenta work, there was confusion over the umbilical cord as a site of transfer. Descriptions of the shape of the alveoli were often of a culinary rather than a biological nature. Weaker candidates tended to stray on to other aspects illustrated by Fick's Law, and introduced irrelevant material on concentration gradients and the shortness of the diffusion pathway.

The understanding of the difference between surface area, and surface area to volume ratios was apparent on a lot of good quality scripts. Other candidates happily compared the large surface area of a mouse with the small surface area of an elephant with little thought of what they are actually saying! Confusion was rife when the descriptions of surface area to volume ratios were added, with a lot of erroneous links being made to men of different shapes. Some discussions of BMR were competent, but sadly this was rarely the case. Some candidates failed to write about heat transfer despite this being in the title. Those who did were able to describe the vasodilation/vasoconstriction processes quite well but were often unclear as to the exact nature of the blood vessels involved. Little comment was found on the way in which sweating cools the body. Heat transfer was often mentioned in the context of pregnant mothers, but weaker candidates seemed to think this was by radiation, conduction and convection.

When the essay moved onto cells there were some good comments on the significance of the shape of red blood cells, but these were often confused with haemoglobin. The work on the chloroplasts, mitochondria and endoplasmic reticula was welcome but rare.

Candidates who chose this essay found it harder to display their A-level knowledge, and marks were often fairly meagre for scientific content. A disappointingly large number were of GCSE standard. This title needed a more thoughtful approach, with care taken to include sufficient depth to the answer rather than being fairly repetitious around the theme.

Q20.

Essays remain extremely variable in quality. For some candidates they provided the saving grace and did much to redeem the limited quality of the two structured questions. Others proved themselves unable to recall basic A-level knowledge, and produced superficial and poorly constructed accounts. The biggest single factor in limiting the marks awarded was undoubtedly the ability to base the essay on appropriate, detailed biology. Thus, for example, many of the essays on bacteria ignored the detail of genetic engineering, nutrient cycles and cellulose digestion which form a major part of the A-level specification and, instead, centred their essays around such topics as yoghurt and cheese production. Essays generally met the requirements for breadth although some devoted so much time to scene setting and significance that they left themselves little time to consider more fundamental issues. There is little doubt that plans would have helped here but these were often conspicuous by their absence. Given the pressure of writing under examination conditions, the quality of written communication was usually sound, often better than that displayed by the same candidates in **Questions 1 and 2**. The use of technical language, however, was less impressive and a lack of understanding of the terms "ion" and "bacteria" provided an obvious handicap.

Certain topics lent themselves to excellent accounts of how inorganic ions are used physiologically - nerve impulses, nephron function, absorption in the intestine, root pressure and guard cell activity. These topics enabled candidates to demonstrate what they knew and how well they understood the processes concerned. There were many detailed and accurate accounts concerning the roles of sodium and potassium ions in the transmission of nerve impulses and of calcium ions in synaptic transmission. Less able candidates sometimes confused the roles of the ions or the parts played by diffusion and active transport. The movement of ions in the counter-current mechanism of the loop of Henle also appeared frequently, but here confusion over detail was more apparent.

The identity of inorganic ions and their names produced problems for some in describing the role of ions in the synthesis of biologically important molecules. Phosphorus, for example, was commonly identified as the ion important in the synthesis of ATP and phospholipid. This lack of understanding occasionally led to much irrelevance, especially where discussing hydrogen bonding in DNA, or the importance of carbon, oxygen and hydrogen in macromolecules.

The role of hydrogen ions gave scope for some sound biological detail in descriptions of the role of reduced coenzymes in photosynthesis and respiration. Few candidates considered the importance of hydrogen ions in changing the pH environment of enzymes, but many discussed the buffering effect of haemoglobin when describing the transport of carbon dioxide as hydrogencarbonate in the blood.

Q21.

BYA8

Correlation between performance on the first two questions and on the essay was by no

means clear-cut. For some candidates, the essay proved the saving grace; for others, who had gained substantial credit for questions 1 and 2, it contained little of merit. The two essays offered a genuine choice, emphasising the themes of ecology and genetics which were largely untested in the first part of the paper. As in previous years, the examiners took care to consider and credit any valid interpretation of the titles offered, such that no candidate should have been penalised for the choice made.

It was quite clear that many candidates were well prepared for the task. The importance of planning cannot be overemphasised and it was noticeable how frequently the better answers were accompanied by a carefully structured plan. Candidates who produced an adequate plan then usually progressed to write succinctly and clearly about the topics they had identified as being relevant. On the other hand, some candidates possibly panicked by the seeming enormity of the task in hand, launched straight into an account which sacrificed quality for quantity. Others did produce plans, but the educational value of producing one centred solely on the inclusion of something from each module must be questioned.

The guidelines for marking the essay have been altered somewhat this year and centres should note that areas of the specification are now indicated in the mark scheme. Candidates need to draw from each of these areas to gain full credit for breadth.

The transfer of energy between different organisms and between these organisms and their environment

Good essays were often introduced by a summary of the processes by which energy is transferred from the environment and passes along a food chain before being ultimately dissipated as heat. Such essays then progressed to consider relevant aspects of photosynthesis, respiration and ecology, occasionally making reference to the physiology of temperature control and sense organs. The weaker essays tended to focus on food chains becoming, perhaps inevitably, somewhat repetitive. There was a marked lack of detail in such accounts with examples seldom involving anything other than food chains involving grass, rabbits and foxes, and failing to emphasise the quantitative aspects of energy transfer. Where the topics of photosynthesis and respiration were introduced, there was either a wealth of irrelevant detail or much biochemical inaccuracy. In addition to omissions, there were a number of significant misconceptions. It was apparent that many candidates were of the opinion that energy is recycled and returns to the producer again when taken in as carbon dioxide or nitrates released by decomposers. Others considered photosynthesis as being simply the reverse of respiration and a process whereby plants could generate all the ATP required. Energy was obviously considered to be a discrete substance by some and there was much made of “making” and “using up” energy in some accounts.

BYA9

The essays varied greatly in length, depth of knowledge and relevance of content. There was plentiful evidence of careful and logical planning, and good use of scientific style in the average to good work. Candidates were occasionally inclined to include diagrams, mostly of food chains or pyramids and these were credited. The most common failing was the inclusion of irrelevant material, especially in essay B. The full range of marks was used on essay A, which was also the more popular choice. Essay B proved to be more problematic for those who chose it as they struggled to restrict their answers to differences between species. This essay stimulated the inclusion of large amounts of material from outside the specification, frequently treated at a very basic level. However, many candidates endeavoured to ensure that material for both essays was selected from different areas of the specification.

The transfer of energy between different organisms and between these organisms

and their environment.

Excellent candidates wrote well structured, readable essays which included detailed reference to the energy exchanges involved in photosynthesis, food chains, respiration and temperature control. Such essays linked the detailed biochemistry of photosynthesis and respiration to energy transfer, then set these two important processes in the context of food chains in which losses of energy were described and quantified. Heat loss was regarded as a major source of energy loss, and mechanisms to achieve this were described.

Many of the best candidates were able to demonstrate a sound knowledge of the light-dependent reaction of photosynthesis, but were not always so confident in transferring the energy into the Calvin cycle. Some confusion arose as to the origins of the electrons, and the role of reduced NADP. A few candidates had clearly learnt diagrams for both photosynthesis and respiration.

Respiration was treated similarly. There was detailed knowledge of the biochemistry of the process, but was more often than not confined to descriptions of glycolysis. The best candidates referred to energy losses during oxidative phosphorylation. Digestion was often included, in detail, although the relevance of this was sometimes marginal.

Food chains formed the backbone of most essays, regardless of standard and, in the case of some weaker candidates, were the sole topic discussed. Examples were frequently included, but equally frequently were confined to the feeding habits of rabbits and foxes. Almost without exception, an essay on energy transfer included reference to food chains, but the quality lay in the references made to the ways in which energy was lost between each trophic level, and the quantification thereof. It was good to see the better candidates quoting figures as percentages, but some were unrealistically high. Weaker candidates included pyramids of all types, most frequently of numbers or biomass. It was disappointing to see so many candidates unable to differentiate between energy transfer and nutrient cycling, so there were frequent sections including details of either the carbon or the nitrogen cycle, or both. Sadly, there was too much cycling of energy, and indeed making of energy, to give full marks for quality of language.

Temperature control was frequently mentioned, but infrequently described in detail. Those who chose to do so referred most frequently to vasodilation, arterioles, and sweating, setting these responses in the context of overall control by the hypothalamus.

Q22.

The full range of marks was seen for this essay. To obtain high marks, candidates had to use scientific terminology and use it correctly.

This essay title proved quite challenging, since it required candidates to think about the shape of cells related to their functions, rather than the shape of the molecules the cells comprise, or functions not directly related to shape. A significant number of candidates did include irrelevant sections about spare enzymes, DNA and other molecules. However, the vast majority of these candidates also produced examples of how the shape of cells related to function. This suggested that most candidates understood what was required but were unable to think of enough relevant examples. The best essays clearly related the shapes of cells to their functions. The most commonly used examples were; red blood cells, neurones, epithelial cells of various types, receptor cells, root hair cells, xylem and phloem cells, stomatal guard cells and bacterial cells. There was a rather alarming number of candidates who thought that mitochondria, chloroplasts, villi, microvilli and viruses were cells. It was not uncommon to find statements about cells having thin membranes, or villi to assist in exchange. There were many references to epithelial cells lining blood vessels. Many related the shape of red blood cells to an ability to hold more

haemoglobin, rather than providing an increased surface area for exchange of oxygen. Weaker candidates frequently made no reference to plant cells, or other non-human examples.

Q23.

A roughly equal proportion of candidates attempted each essay, although this varied from centre to centre. On the whole, less able candidates were more likely to embark on the essay about rising temperatures. The majority did follow the requirement to write in continuous prose, and most displayed a reasonable ability to communicate adequately. However, a significant number adopted an unscientific style and failed to use appropriate terminology. References to 'messages' passing along nerves, heat evaporating and lungs contracting were common. Candidates undertaking the global warming essay often adopted an unsuitably exaggerated journalistic style in which all effects resulted in death and extinction. Most candidates produced some sort of plan, but these were frequently sketchy and not well used to organise the structure of the essay. In particular candidates often embarked on the global warming essay without adequate preparation and consequently kept flitting between topics and revisiting similar areas.

Only a small proportion of the candidates embarking on this essay were able to apply their biological knowledge and understanding to the issue of rising temperatures and to appreciate the complexity of possible effects. Surprisingly few seemed to have thought about the consequences of global warming before, and the great majority offered simplistic and often grossly exaggerated descriptions. On the whole this essay appeared to attract the weaker candidates, who often demonstrated a rather poor grasp of basic principles. There was much evidence of poor planning, and it was clear that many candidates were developing their thoughts as they went along. The better candidates often recognised relevant areas but then skimmed across a range of topics without clearly describing the effects and consequences. Weaker candidates gave lengthy irrelevant accounts of the causes of global warming (not infrequently invoking damage to the ozone layer as the main factor) and lurid descriptions of the consequences of rising sea levels.

Few considered the simple effects of rising temperatures on basic processes, such as increased rates of reaction and faster diffusion. Only a small minority mentioned that small rises in temperature could increase rates of photosynthesis and raise the rate of other metabolic processes in plants and ectotherms. Most assumed catastrophic increases resulting in more or less immediately lethal consequences, and the majority focused largely on humans. There were, for example, many accounts of thermoregulation in humans which were irrelevant since they failed to relate to an effect of rising temperature because they merely described the processes regularly involved in maintaining body temperature. Often the effects of cooling were also given. The most appropriate effect that was commonly discussed was the possible impact on enzymes. This, however, was almost always in the context of humans, or at least mammals. A small number did recognise that initially the rate of enzyme activity would increase, but most simply launched into descriptions of the denaturing of enzymes. Often particular processes, such as digestion or respiration, were selected and then were followed by naive statements along the lines that 'we would be unable to digest our food so we would die'. Only a handful of good candidates pointed out that the effects would be greatest for plants and ectotherms, and that their metabolism would be liable to be destabilised by rising temperatures.

When addressing ecological effects candidates were again inclined to present doomsday scenarios. There were few well argued accounts of disruption to food webs and the dynamics of ecosystems. A remarkably large number of candidates focused on the plight of polar bears and penguins resulting from the melting of icecaps, but few could provide

informed explanations of the broader consequences and many suggested some very unlikely descriptions of the communities living in polar regions. Some did go on to discuss extinction, although there was much careless expression in which the distinction between deaths of individuals and extinction of species was not made clear. A disturbingly common misunderstanding was to suggest that species 'would have to adapt'. In particular it was often stated that plants would have to become xerophytes. This idea was then used as an excuse to give an account of the features of xerophytes. Only the better candidates gave good descriptions of the possibility of changes in species resulting from natural selection.

Q24.

The great majority of candidates chose to tackle the essay on enzymes and their importance rather than the one on the contributions of microscopy. Most of those who did select the latter topic appeared to be weaker candidates, and as a result very few good, or even reasonably good, essays about microscopy were seen. On the other hand, the full range of marks was awarded for the enzyme essay and there was a significant proportion of good essays, although the proportion of superficial and poor essays was even greater. It is surprising that many candidates apparently fail to formulate any plan, or produce only a cursory attempt at a plan, and consequently present an essay which lacks coherence and which keeps returning to different aspects of the same theme. There are also some who adopt an inappropriate chatty approach that does not match up to the criterion of being in a scientific style using technical terminology.

It was clear that most of the candidates that embarked on this essay had a very limited understanding of the biological structures that could only be detected by microscopy, such as for example the cell components listed in Module 1. Many omitted to make any reference to electron microscopes, and few were able to distinguish the ultrastructure that could only be distinguished with an electron microscope. A small number did give a summary of the differences between light and electron microscopes in terms of magnification, resolution and procedures required in the preparation of material for viewing. Many, however, were totally unrealistic in suggesting what had been discovered with microscopes, particularly with reference to, for example, various metabolic reactions, the movement of molecules and the replication of DNA. Many weaker candidates merely suggested a short list of what they considered to be important biological processes, such as photosynthesis, reproduction and digestion, and then stressed the importance of knowledge of these. Few described how observation of cell structures could make it possible to understand something of the functions of different organelles, and even fewer referred to the observation of different tissues and the elucidation of their functions. A small number mentioned the importance of microscopes in discovering microorganisms and hence in understanding the causes of disease, and a few made reference to techniques such as *in vitro* fertilisation that had been made possible by the use of microscopes. A small number attempted to treat the topic from a historical perspective, but most had insufficient background knowledge to sustain this.

Q25.

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The best candidates were able to give good accounts of how enzymes work, factors that affect their activity and a range of examples to illustrate their importance in plants and animals. There were some impressive essays in which the mode of action was clearly linked to the protein structure of enzymes, as were explanations of the effects of factors such as high temperature and pH. The examples given were sensibly related to the role and importance of the processes catalysed. On the other hand, a considerable number of weaker candidates demonstrated only a very superficial knowledge and often there was confusion with the roles of hormones, haemoglobin, chlorophyll, ATP, muscle proteins and almost any other substance that occurs in living organisms. Frequently essays were unbalanced, with by far the greater part being devoted to the mode of action and factors affecting it and very little to the importance of enzymes.

Overall, the best part of the essay was the account of the structure of enzyme molecules and an explanation of how the active site is involved in the formation of an enzyme-substrate complex. Many, however, failed to explain what happens after the formation of this complex. It was also common for candidates to imply that the only role of enzymes is to break down substances. The better candidates referred to specificity, related it to the tertiary protein structure, and explained activation energy. A common example of careless expression was to describe enzymes 'breaking down substances by the lock and key hypothesis'. Quite a few candidates failed to gain credit for relevance by including unnecessary detail about protein structure, for example by including diagrams of amino acid molecules and peptide bond formation as well as the quaternary structure of haemoglobin.

There was considerable variation with respect to which factors candidates decided to include. Not surprisingly, most referred to the effect of temperature, and there were some good accounts of the effect of increasing temperature in terms of kinetic energy and of denaturation. Quite often, however, it was suggested that enzymes were denatured at both high and low temperatures. Few of the candidates who referred to pH were able to give convincing explanations of how it affects enzyme molecules, but there were many good accounts of competitive and non-competitive inhibition.

Most candidates had greater difficulty when it came to discussing the importance of enzymes. Some simply resorted to listing a number of important processes, such as photosynthesis, respiration and digestion, and included, some such as reproduction, where the role of enzymes would be hard to pinpoint. Often, they merely stated that enzymes were needed for these processes and then emphasized the importance of each process. Many could only conceive of importance in terms of what would happen in the event of enzymes not existing for a particular process, often leading to the absurd notion that, for example, 'if we did not have the enzymes for respiration we would die'. The examples most often quoted were digestion, photosynthesis, respiration and synapses. Descriptions of digestive enzymes were often disappointing with surprisingly large numbers resorting to GCSE level detail and only referring to proteases, carbohydrases and lipase. There was much confusion about where different enzymes are produced and their roles. Those who did mention endopeptidases and exopeptidases frequently got their functions the wrong way round. A good proportion described the role of rubisco, but the majority appeared to believe that this is the only enzyme involved in photosynthesis. Similarly, very few recognised that respiration involves many enzymes, each catalysing one reaction within the metabolic pathway. By far the commonest reference was to acetyl coenzyme A, with the great majority failing to make any distinction between a coenzyme and an enzyme. There were some good explanations of the part played by acetylcholinesterase in synaptic transmission, but there were also many erroneous and half-understood ideas, as well as vague statements about it being vitally important in preventing paralysis and irrelevant comments about snake venoms for example. Because of the superficial nature of many of the references to particular enzymes or processes, the examiners looked for a significant description when assessing the contribution to the criteria for breadth.

Q26.

Three times as many candidates attempted the essay on osmosis as on the energy transfers inside living organisms. Most candidates provided some form of plan, although these varied greatly in length and detail. A few candidates spent a disproportionate amount of their time on a plan to the detriment of the essay itself. There was some evidence to support the view that candidates were better prepared for the essays, particularly in terms of providing relevant information and breadth of knowledge, although many candidates are under the impression that full marks will only be awarded if they include material, from most of the modules in the specification. Consequently, these candidates give a shallow treatment of many areas, rarely explaining concepts in depth. Most examiners commented on a general improvement from last year although quality of written communication and poor handwriting remains a problem for a significant number of candidates. It was pleasing to note that a significant number of candidates obtained full marks for the essay.

Most candidates scored well on breadth and relevance, because they were able to identify suitable material. Where they failed to gain marks on breadth it tended to be because of failure to consider cellular aspects such as turgor. Candidate commonly failed to gain relevance marks where they drifted into considerations of organisms living either in water, or in conditions where water is very scarce. This did not in itself debar them from marks but it tended to be the weaker candidates who took this approach.

Scientific content produced the expected range of responses in terms of both knowledge and use of terminology. Most candidates had memorised reasonable definitions of osmosis, though a significant number gave definitions in terms of 'concentration' rather than water potential. The most common error was failure to discuss the role of partially permeable membranes.

There were significant differences in the amount and accuracy of detail given relating to the roles of osmosis in the kidney, transpiration and translocation. Relatively few candidates referred to osmosis in the proximal tubules, a majority suggesting that most water reabsorption occurs in the loop of Henle. There was widespread confusion about the relative permeability of the ascending and descending limbs of the loop of Henle to water and ions.

Descriptions of the role of osmosis in plants were often superficial and frequently suggested that transport of water through xylem vessels is by osmosis. Whilst there were many excellent accounts of translocation, many failed to refer to the role of osmosis-induced hydrostatic pressure in the process.

Many candidates successfully referred to the role of osmosis in maintaining a suitable viscosity of mucus in the respiratory tracts.

Q27.

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marks for the essay.

Whilst this essay was chosen by a smaller number of candidates, it was often the choice of the more able candidates who were able successfully to use their detailed knowledge and understanding of respiration and photosynthesis. Although the essay title specified 'energy transfers that take place inside living organisms', many weaker candidates wrote extensively about food chains. Many good candidates also included at least a paragraph on that topic.

Candidates often wrote about the role of ATP whilst writing about one of the other topic areas, usually photosynthesis or respiration. Most candidates knew how ATP is formed but many fewer made any true attempt to discuss how it is used.

There were some very detailed accounts of photosynthesis with the main stages recognised, good descriptions of excitation of electrons and the generation of ATP and reduced NADP. Very few were able to link the structure of chloroplasts to energy transfer.

Respiration was described in sufficient detail although there were some who omitted the synthesis of ATP in association with the electron transfer chain. Hardly any attempted to link the structure of the mitochondrion with energy transfer, although mitochondrial involvement with energy release was described, often in association with the examples used to explain uses of energy.

The best candidates wrote about ATP being used to phosphorylate substances to make them more reactive. Weaker candidates often failed to gain credit in other parts of the essay because they would identify a suitable topic, e.g. active transport, but not be able to explain how any energy transfer is involved. Most candidates referred to the role of ATP in muscle contraction, but were hazy about exactly how ATP is involved. The best candidates did address the concept of energy transfers throughout.

Q28.

More candidates attempted the essay on proteins than that on variation. The majority of candidates provided a plan, but these varied greatly in their usefulness. Most candidates attempted to provide essays with a reasonable breadth of knowledge and understanding, but many included irrelevant material. The quality of written communication was generally poor, as was the quality of much of the handwriting.

Most candidates had obviously prepared an essay on proteins, but attempts at relating structure to function were generally weak except for enzymes.

Most essays began with a detailed account of the structure of proteins, but relation to function generally only began with tertiary structure and proteins. Only the best candidates were able to give good accounts relating structure to function in structural proteins. Although the 'lock and key' and 'induced fit' models of enzyme action are generally well understood, only the very best candidates related enzyme structure to reduction of activation energy.

Most candidates stated that proteins were used in transporting substances across membranes, but very few gave structural details of these proteins. Usually, there was very little difference between descriptions of membrane proteins and enzymes, the term 'active sites' being used in both. It was rare to see descriptions of both channel and carrier proteins, and even more rare to see explanations of active transport.

Most candidates included material on receptor proteins from module four, usually describing blood sugar control or synaptic transmission, but rarely relating relevant protein structure to function.

Surprisingly few candidates made any real attempt to describe the proteins used in muscle contraction. Whereas most candidates can describe muscle contraction in answers to module four questions, relating the structures of actin, myosin and tropomyosin to their functions was beyond most candidates.

Q29.

More candidates attempted the essay on proteins than that on variation. The majority of candidates provided a plan, but these varied greatly in their usefulness. Most candidates attempted to provide essays with a reasonable breadth of knowledge and understanding, but many included irrelevant material. The quality of written communication was generally poor, as was the quality of much of the handwriting.

Most candidates were able to include material from both module two and module four in their essays, but command of module two material was generally much stronger than that of module four.

A majority of candidates were able to describe gene mutation, but only the better candidates went on to describe the effects of mutation on alleles and polypeptides.

Most candidates attempted to relate meiosis to variation, but although there were frequent references to chiasmata and independent assortment, there was widespread misunderstanding of how these resulted in variation.

It was relatively rare to see accounts of the effects of environmental factors on variation; where these were seen only nutrients were mentioned.

The majority of candidates attempted to explain the relationship between variation and evolution, but only the best candidates could relate these satisfactorily. Average and weaker candidates generally spoke in terms of organisms 'realising that they had to change to adapt' and 'producing variations to adapt', rather than explaining the effect of natural selection on 'natural' variation. Many candidates gave long descriptions of speciation without a single reference to variation.

Q30.

BYA8

Correlation between performance on the first two questions and on the essay was by no means clear-cut. For some candidates, the essay proved the saving grace; for others, who had gained substantial credit for questions 1 and 2, it contained little of merit. The two essays offered a genuine choice, emphasising the themes of ecology and genetics which were largely untested in the first part of the paper. As in previous years, the examiners took care to consider and credit any valid interpretation of the titles offered, such that no candidate should have been penalised for the choice made.

It was quite clear that many candidates were well prepared for the task. The importance of planning cannot be overemphasised and it was noticeable how frequently the better answers were accompanied by a carefully structured plan. Candidates who produced an adequate plan then usually progressed to write succinctly and clearly about the topics they had identified as being relevant. On the other hand, some candidates possibly panicked by the seeming enormity of the task in hand, launched straight into an account which sacrificed quality for quantity. Others did produce plans, but the educational value of producing one centred solely on the inclusion of something from each module must be questioned.

The guidelines for marking the essay have been altered somewhat this year and centres

should note that areas of the specification are now indicated in the mark scheme. Candidates need to draw from each of these areas to gain full credit for breadth.

Ways in which different species of organisms differ from each other

The examiners took an extremely broad view as to what constituted relevance in this essay. They had originally anticipated that good essays would include a discussion of the genetic, molecular, physiological and ecological differences between species. Instead they were frequently confronted with accounts of speciation, and of differences between organisms at the level of kingdom. Such accounts were accepted. However, those which judged such topics as meiosis, and emphasised intraspecific variation as relevant, failed to gain credit for this material. Good essays frequently incorporated accounts of speciation and, moreover, illustrated these with appropriate examples. They then progressed to consider some contrasts in physiological systems and there was some particularly good material relating to haemoglobin, cereal plants and gas exchange mechanisms. Few seemed at ease with developing genetic aspects, but there were some good accounts of molecular differences related to the structure of enzymes, carrier proteins and haemoglobin. Less convincing essays generally focused on lists of characteristics possessed by selected organisms. Thus it was not infrequent to read such comments as "elephants have trunks while sharks are marine and have a streamlined shape." Such accounts failed to draw on material from the specification and gained little credit. Where speciation was introduced, examples were often confined to birds with long beaks and fat beaks, and frequently revealed an alarmingly naive understanding of natural selection with most new species considered to arise as the immediate consequence of a single mutation occurring in an individual in the previous generation.

BYA9

The essays varied greatly in length, depth of knowledge and relevance of content. There was plentiful evidence of careful and logical planning, and good use of scientific style in the average to good work. Candidates were occasionally inclined to include diagrams, mostly of food chains or pyramids and these were credited. The most common failing was the inclusion of irrelevant material, especially in essay B. The full range of marks was used on essay A, which was also the more popular choice. Essay B proved to be more problematic for those who chose it as they struggled to restrict their answers to differences between species. This essay stimulated the inclusion of large amounts of material from outside the specification, frequently treated at a very basic level. However, many candidates endeavoured to ensure that material for both essays was selected from different areas of the specification.

Ways in which different species of organisms differ from each other

Approximately a quarter of the candidates chose this essay. Well planned, high quality essays showed a sound understanding of the term species, and illustrated this understanding by reference to a range of examples of speciation and natural selection. Some candidates widened the net further by considering differences between species to be differences between kingdoms, and so included not only a list of the five kingdoms, but also details about the characteristics of each group. This was carried out with varying degrees of success. Better work included descriptions of prokaryotic and eukaryotic cells, and these were sometimes illustrated with diagrams. Many candidates listed the taxa into which organisms are classified. Speciation was referred to in almost all pieces of work; allopatric was better treated than sympatric, which was often referred to as little more than 'reproductive isolation'. Examples were often included, and while those based on the work of Darwin were often suitable, those 'made-up' under examination conditions were less than helpful and seldom of A level standard.

While some attempt was made to discuss differences in anatomy and physiology, few

attempted to use their knowledge of the biology of microorganisms, and such features as the nature of antigens and differences in the structure of bacterial cells was rarely discussed.

In a positive attempt to be more synoptic in their approach, a number of candidates chose to include details of the changes in DNA which occur during meiosis. This was unacceptable as such differences would be intraspecific. Others diverted into excessive detail on mutations, which, while it could be deemed relevant, did not need so much attention.

Disappointingly, there was very little reference made to the difference between species at molecular level, other than the rare reference to different proteins being synthesised.

This essay title could have been interpreted in a number of ways, using material from several different areas of the specification. It would seem that of those who chose this option, too many were insecure in their definition of species, and were therefore unable to select appropriate material. That which was included was too often of a general nature, rather than reflecting the work they had been taught during their A level course.