AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.1.8 INORGANIC IONS

SCORE	PERCENTAGE
/43	%

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Q1.

(a) 1. Polar molecule;

2. Acts as a (universal) solvent;

OR

3. (Universal) solvent;

4. (Metabolic) reactions occur faster in solution;

OR

5. Reactive;

6. Takes place in hydrolysis / condensation / named reaction;

Polar molecule so acts as (universal) solvent so (metabolic reactions are faster = 3 marks

4

(b) Name of ion;

Correct function within cell;

Ions other than sodium in specification are H^+, Fe^{2+} and PO_4^{3-} but accept any correct ion (other than sodium) plus relevant function = 2.

Allow ion to be named in words but not as element, e.g, iron ion but not iron.

2

(c) 1. Comparison: both move down concentration gradient;

2. Comparison: both move through (protein) channels in membrane;

Accept aquaporins (for water) and ion channels

3. Contrast: ions can move against a concentration gradient by active transport

3

[9]

Q2.

(a) greater rate of oxygen consumption / leads to greater rate of respiration and greater rate of uptake;

(allow this mark even if spread through account but cause and effect must be within the correct context)

oxygen required for respiration;
respiration produces ATP / releases energy;
(ignore ref to producing or making energy)
potassium ions taken up by active transport / against concentration gradient;

4

(b) (i) 0.25 (mol dm^{-3});

1

(ii) 1 mark Incorrect answer but derived from ratio of 1.2 and initial length of 90 mm
2 marks Correct answer of 108 mm;

2

(iii) water potential inside potato higher / less negative than in solution;
water moves out by osmosis;

2

[9]

Q3.

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

		content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

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

Levels mark scheme word/statement	**Definition**
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. ‘Several’ here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting

	and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at A-level standard.

Inorganic ions include those of sodium, phosphorus and hydrogen.

Please note that to obtain full credit, students must use information to **describe how these and other inorganic ions are used in living organisms**.

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

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

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

Note, other topics from beyond the specification can be used, providing they relate to the

title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q2.

(a) There were many candidates sitting this unit who displayed an excellent knowledge of the facts and principles contained in the module, but who revealed an inability to describe and interpret the data presented in the table in this part of the question. The descriptions revealed that such candidates often failed to appreciate that the experimenters had changed the concentration of oxygen bubbled through the mixture. They also occasionally referred to a decrease in the rate of uptake of potassium ions from 90 to 80 arbitrary units at a 20.8 % concentration of oxygen, further suggesting unfamiliarity with tabulated data. Candidates who recognised the table as relating to active transport, were generally able to produce a convincing interpretation of the figures. Others frequently suggested that potassium ions were used as a respiratory substrate, or combined with ADP to produce ATP.

(b) An understanding of water potential should have resulted in candidates being able to interpret the graph, even if they experienced difficulties with understanding the ratio on the y-axis. They should also have appreciated that the x-axis represented sucrose concentration, not time.

(i) Evidence that this was not the case came from the many who suggested that the length of the potato remained the same at a concentration of 0.5 mol dm^{-3}, presumably identifying the point where the graph levelled out.

(ii) An understanding of ratio was required. Answers based on 180 presumably reflected those who thought that 1.2 represented a ration of 1:2 but other responses suggested incorrect reading of the graph, or the inability to calculate the required length from the correct ratio.

(iii) Answers need reference to water potential. Responses based simply on concentration were unable to gain maximum credit.

Q3.

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.