**Q1.**          (a)     Discs of carrot were placed in a solution containing potassium ions (K+). The concentration of oxygen in air bubbled through the solution was changed and the rates of respiration and uptake of potassium ions were measured. The results are shown in the table.

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Concentration of oxygen / %** | **Rate of respiration / arbitrary units** | **Rate of uptake of potassium ions / arbitrary units** |
|   | 2.7 | 31 | 29 |
|   | 12.2 | 69 | 72 |
|   | 20.8 | 90 | 80 |

Describe and explain the link between oxygen concentration, rate of respiration and rate of uptake of potassium ions.

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**(4)**

(b)     Cylinders of potato were cut using a cork borer. Their initial lengths were measured.  Each cylinder was then put in a different concentration of sucrose solution for 12 hours. The graph shows the changes in length of the potato cylinders in the different sugar solutions.



(i)      In what concentration of sucrose did the length of the potato cylinder remain the same?

.............................................................................................................

**(1)**

(ii)     The initial length of the potato cylinder in the solution of concentration 0.1 mol dm–3 was 90 mm. Calculate its final length. Show your working.

Final length = .................................... mm

**(2)**

(iii)     Explain the change in length which occurs in a sucrose solution of concentration 0.5 mol dm–3.

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**(2)**

**(Total 9 marks)**

**Q2.Essay**

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy.

It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

|  |  |  |
| --- | --- | --- |
|   | ScientificBreadth of knowledgeRelevanceQuality of written communication | 16333 |

Write an essay on the following topic:

Inorganic ions include those of sodium, phosphorus and hydrogen. Describe how these and other inorganic ions are used in living organisms.

**(Total 25 marks)**

**M1.**          (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]**

**M2.*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.

**E1.**          (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.

**E2.**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.