**Q1.** The importance of complementary shapes of molecules in organisms

**(Total 25 marks)**

**Q2.** The importance of ions in metabolic processes

**(Total 25 marks)**

**Q3.** A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next cycle. Write an essay on cycles in biology.

**(Total 25 marks)**

**Q4.** The functions of enzymes and their importance in organisms.

**(Total 25 marks)**

**Q5.** Carbon dioxide may affect organisms directly or indirectly. Write an essay to describe and explain these effects.

**(Total 25 marks)**

**Q6.** Write an essay on the causes of variation and its biological importance.

**(Total 25 marks)**

**Q7.** Write an essay on how the structure of proteins is related to their functions.

**(Total 25 marks)**

**Q8.** Write an essay on the importance of osmosis to living organisms.

**(Total 25 marks)**

**Q9.** Write an essay on energy transfers which take place inside living organisms.

**(Total 25 marks)**

**Q10.** Write an essay on the importance of enzymes in plants and animals.

**(Total 25 marks)**

**Q11.** Write an essay on how microscopes have contributed to our understanding of living organisms.

**(Total 25 marks)**

**Q12.** Cells are easy to distinguish by their shape. Write an essay on how are the shapes of cells are related to their function.

**(Total 25 marks)**

**Q13.** Write an essay on the many different types of relationships and interactions between organisms.

**(Total 25 marks)**

**Q14.** Write an essay on the membranes of different types of cells and how they are involved in many different functions.

**(Total 25 marks)**

**Q15.** Write an essay on the importance to humans of the control of growth, reproduction and development of organisms, including themselves.

**(Total 25 marks)**

**Q16.** Write an essay on the importance of diffusion in organisms.

**(Total 25 marks)**

**Q17.** Write an essay on how energy is transferred within and between organisms.

**(Total 25 marks)**

**Q18.** Write an essay on the importance of receptors in living organisms.

**(Total 25 marks)**

**Q19.** The causes and importance of variation and diversity in organisms.

**(Total 25 marks)**

**Q20.** Write an essay on the importance of movement in living organisms

**(Total 25 marks)**

**Q21.** Write an essay on the transfer of energy between different organisms and between these organisms and their environment.

**(Total 25 marks)**

**Q22.** Inorganic ions include those of sodium, phosphorus and hydrogen. Write an essay to describe how these and other inorganic ions are used in living organisms.

**(Total 25 marks)**

**Q23.** Write an essay on the importance of nucleotides, molecules derived from nucleotides and nucleic acids in keeping organisms alive.

**(Total 25 marks)**

**Q24.** Write an essay on how bacteria can affect the lives of humans and other organisms.

**(Total 25 marks)**

**Q25.** Write an essay on the causes of disease in humans.

**(Total 25 marks)**

**Q26.** Write an essay on using DNA in science and technology.

**(Total 25 marks)**

**Q27.** Write an essay on the control of processes in cells and the importance of these controls.

**(Total 25 marks)**

**Q28.** Write an essay on the importance of shapes fitting together in cells and organisms.

**(Total 25 marks)**

**Q29.** Write an essay on how cells and organisms carry out exchanges with their external environment to maintain their internal environment.

**(Total 25 marks)**

**Q30.** Write an essay on the importance of ions in biology.

**(Total 25 marks)**

**Q31.** Write an essay on the importance of responses to changes in the internal and external environment of an organism.

**(Total 25 marks)**

**Q32.** The uses and importance of ATP in organisms.

**(Total 25 marks)**

**Q33.** Polymers have different structures. They also have different functions. Write an essay to describe how the structures of different polymers are related to their functions.

**(Total 25 marks)**

**Q34.** Heat and many different substances are transferred within the body and between the body and the environment. Write an essay to explain how surface area is linked to this transfer.

**(Total 25 marks)**

**Q35.** Write an essay on the importance of DNA as an information-carrying molecule and its use in gene technologies.

**(Total 25 marks)**

**Q36.** The importance of cycles in biology.

**(Total 25 marks)**

**Q37.** Write an essay on the ways in which different species of organisms differ from each other.

**(Total 25 marks)**

**Q38.** Write an essay on the importance of nitrogen-containing substances in biological systems.

**(Total 25 marks)**

**Q39.** Write an essay on negative feedback in living organisms.

**(Total 25 marks)**

**Q40.** Mean temperatures are rising in many parts of the world. The rising temperatures may result in physiological and ecological effects on living organisms. Write an essay to describe and explain these effects.

**(Total 25 marks)**

**Q41.** Write an essay on the importance of bonds and bonding in organisms.

**(Total 25 marks)**

**Q42.** Write an essay on the importance of interactions between cells and between organisms.

**(Total 25 marks)**

**Q43.** Write an essay on the importance of the control of movement in cells and organisms.

**(Total 25 marks)**

Mark schemes

**Q1.**

|  |  |  |
| --- | --- | --- |
| 21-25 | ExtendedAbstractGeneralised 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 | RelationalIntegrated 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 | MultistructuralSeveral 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 | UnistructuralOnly one or few aspects covered | Response predominantly deals with only one or two topics that relate to the question.Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology.May contain a number of significant errors and, or, irrelevant topics. |
| 1-5 | Unfocused | Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect.Content and terminology is generally below A-level.May contain a large number of errors and, or, irrelevant topics. |
| 0 |   | Nothing of relevance or no response. |

**Commentary on terms and statements in the levels mark scheme**

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

|  |  |
| --- | --- |
| **Levels mark scheme word/statement** | **Definition** |
| Holistic | Synoptic, drawing from different topics (usually sections of the specification) |
| A fully integrated answer which makes clear links between several different topics and the theme of the question. | All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process.When considering, for example, the importance of a process, the explanation must be at A-level standard.‘Several’ here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area. |
| Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. | Detailed and comprehensive A-level content is the specification content.Terminology is that used in the specification.Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen. |
| No significant errors or irrelevant material. | A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word.Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title. |
| For top marks in the band, the answer shows evidence of reading beyond specification requirements. | An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard. |
| Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. | Not addressing the biological theme of the essay (eg importance) at A-level standard. |

**The importance of complementary shapes of molecules in organisms**

•   3.1.4.2  Many proteins are enzymes

•   3.1.5.1  Structure of DNA and RNA

•   3.1.5.2  DNA replication

•   3.1.6  ATP

•   3.2.2  All cells arise from other cells

•   3.2.3  Transport across cell membranes

•   3.2.4  Cell recognition and the immune system

•   3.3.3  Digestion and absorption

•   3.4.1  DNA, genes and chromosomes

•   3.4.2  DNA and protein synthesis

•   3.4.3  Genetic diversity can arise as a result of mutation or during meiosis

•   3.5.1  Photosynthesis

•   3.5.2  Respiration

•   3.6.1.2    Receptors

•   3.6.2.1  Nerve impulses

•   3.6.2.2  Synaptic transmission

•   3.6.3  Skeletal muscles are stimulated to contract by nerves and act as effectors

•   3.6.4.2  Control of blood glucose concentration

•   3.6.4.3  Control of blood water potential

•   3.8.1   Alteration of the sequence of bases in DNA can alter the structure of proteins

•   3.8.2.2  Regulation of transcription and translation

•   3.8.2.3  Gene expression and cancer

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.**

**The importance of ions in metabolic processes**

•   3.1.4.2  Many proteins are enzymes (H and denaturation)

•   3.1.5.2  DNA replication

•   3.1.6  ATP

•   3.1.8  Inorganic ions

•   3.2.3  Transport across cell membranes

•   3.3.3  Digestion and absorption

•   3.3.4.1  Mass transport in animals

•   3.3.4.2  Mass transport in plants

•   3.4.2  DNA and protein synthesis

•   3.5.1  Photosynthesis

•   3.5.2  Respiration

•   3.5.4  Nutrient cycles

•   3.6.1.1  Survival and response

•   3.6.1.2  Receptors

•   3.6.2.1  Nerve impulses

•   3.6.2.2  Synaptic transmission

•   3.6.3  Skeletal muscles are stimulated to contract by nerves and act as effectors

•   3.6.4.3  Control of blood water potential

•   3.8.4.3  Genetic fingerprinting

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]**

**Q3.** A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next.

Topics

|  |
| --- |
| **Ecological cycles** |
| 4.6 | Nutrient cycles |
| **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 |

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]**

**Q4. The functions of enzymes and their importance in organisms**

•   3.1.4.2  Many proteins are enzymes

•   3.1.5.2  DNA replication

•   3.1.6  ATP

•   3.2.4  Cell recognition and the immune system (lysozyme)

•   3.3.3  Digestion and absorption

•   3.4.2  DNA and protein synthesis

•   3.4.4  Genetic diversity and adaptation (penicillinase in bacteria)

•   3.5.1  Photosynthesis

•   3.5.2  Respiration

•   3.5.4  Nutrient cycles

•   3.6.2.2 Synaptic transmission

•   3.6.3  Muscles

•   3.6.4.2 Control of blood glucose

•   3.8.4.1 Recombinant DNA technology

•   3.8.4.3 DNA fingerprinting

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]**

**Q5.** Please note that to obtain full credit, students must use information to show **the importance of how Carbon dioxide may affect organisms directly or indirectly**.

Topics

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]**

**Q6.** Please note that to obtain full credit, students must use information to show **the causes of variation and its biological importance**.

Topics

|  |  |
| --- | --- |
| **1** | Gene mutation (G)additiondeletionsubstitutioneffect on alleleseffect on polypeptide / protein |
| **2** | Sexual reproduction (S)crossing overindependent assortmentrandom fusion(*allow* c*hromosome mutation*) |
| **3** | Environmental (E)nutrientsdiseaselighttemperature |
| **4** | Biological importance (B)enables adaptationnatural selectionspeciationevolution |

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]**

**Q7.**Please note that to obtain full credit, students must use information to show **how the structure of proteins is related to their functions.**.

Topics

|  |  |
| --- | --- |
| **1** | Structure (S)primary structure – peptide bondsecondary structuretertiary 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 – gatedcarrier – complementary shape – can change shapeactive transport – phosphate group attached by energy fromATP – can change shape |
| **4** | Enzymes (E)active site, enzyme-substrate complexactivation energy reduction - explanation e.g. brings molecules closer |
| **5** | Receptors (R)synapseinsulin / glucagonADHrhodopsin |
| **6** | Muscle (M)actin thin – binding sitemyosin thick - cross bridgestropomyosin – block binding sites |

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]**

**Q8.** Please note that to obtain full credit, students must use information to show **the importance of osmosis to living organisms.**.

Topics

|  |  |
| --- | --- |
| **1** | definition (D) |
| **2** | effects on cells (C)turgity and supportplasmolysis (idea)lysis |
| **3** | importance in animals (A)role in relationship between plasma and tissue fluidrole in medulla of kidneyreabsorption in gut*sweat production neutral* |
| **4** | importance in plants (P)role in movement of water from soil to leaves in plantsrole in mass flow hypothesis for movement in plants |

|  |  |
| --- | --- |
| **1** | ATP (A)synthesis from ADP and Prole as an energy source |
| **2** | photosynthesis (P)excitation of electronsgeneration of ATP and reduced NADPphotolysisreduction of glycerate phosphate to carbohydratestructure of chloroplast in relation to energy transfers |
| **3** | respiration (R)net gain of ATP in glycolysisproduction of ATP in Krebs cyclesynthesis of ATP associated with electron transfer chainATP production in anaerobic respirationstructure of mitochondrion in relation to energy transfers |
| **4** | uses of energy in biological processes (B)active transportmuscle contractionnerve transmissionsynthesistranslocationkidney functionnitrogen fixationreceptors |

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]**

**Q9.**  Please note that to obtain full credit, students must use information to show **the importance of energy transfers which take place inside living organisms.**.

Topics

|  |  |
| --- | --- |
| **1** | definition (D) |
| **1** | ATP (A)synthesis from ADP and Prole as an energy source |
| **2** | photosynthesis (P)excitation of electronsgeneration of ATP and reduced NADPphotolysisreduction of glycerate phosphate to carbohydratestructure of chloroplast in relation to energy transfers |
| **3** | respiration (R)net gain of ATP in glycolysisproduction of ATP in Krebs cyclesynthesis of ATP associated with electron transfer chainATP production in anaerobic respirationstructure of mitochondrion in relation to energy transfers |
| **4** | uses of energy in biological processes (B)active transportmuscle contractionnerve transmissionsynthesistranslocationkidney functionnitrogen fixationreceptors |

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]**

**Q10.** Please note that to obtain full credit, students must use information to show **the importance of enzymes in plants and animals**.

Topics

|  |  |
| --- | --- |
| **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. |
| **5** | metabolic pathways - photosynthesis (Ps) and respiration (R) e.g. light independent reaction, Krebs cycle, ATP formation.good candidates - reference to specific roles e.g. in l.i.r., distribution in mitochondria / chloroplasts. |
| **6** | other specific examplese.g. in nervous system (N), such as role of acetylcholinesterase in synapses,in homeostasis (H), such as in glycogenesis,in muscle action (M), such as role of ATPase,in fertilisation (Sp), such as enzymes in acrosome,in transcription / translation (T), such as role of polymerases.other specific examples e.g. in nervous system (N), such as role of acetylcholinesterase in synapses, in homeostasis (H), such as in glycogenesis, in muscle action (M), such as role of ATPase, in fertilisation (Sp), such as enzymes in acrosome, in transcription / translation (T), such as role of polymerases. |

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]**

**Q11.**Please note that to obtain full credit, students must use information to show **how microscopes have contributed to our understanding of living organisms**.

Topics

|  |  |
| --- | --- |
| **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.  |

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]**

**Q12.**

Please note that to obtain full credit, students must use information to show **how the shapes of cells are related to their function**.

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 |

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]**

**Q13.** Please note that to obtain full credit, students must use information to show **the importance of the many different types of relationships and interactions between organisms**.

Topics

|  |  |
| --- | --- |
| **1.P** | Pathogens and effects on host |
| **2.T** | Taxonomy |
| **2.C** | Classification and evolution. |
| **2.I** | Inheritance and evolution |
| **2.Gc** | Genetic code, universal |
| **2.B** | Behaviour |
| **2.Ev** | Populations and evolution, variation between individuals within a species |
| **3.BP** | Relationships within ecosystems − eg predator / prey |
| **3.E** | Energy transfer in ecosystems |
| **3.N** | Nutrient cycles, the organisms involved |
| **3.S** | Succession, biodiversity, species and individuals in a community |
| **4.H** | Human impacts on the environment and its effect on relationships between organisms − including farming |
| **4.Gt** | Gene technology and GMO and selective breeding |
| **4.Ar** | Antibiotic resistance |

*Examiners are free to select other letters if they wish*

*The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves*

*Breadth, one mark for use of an example from each of the following approaches − 3 max:*

*1. Pathogen and host*

*2. Evolution (related topics)*

*3. Ecological*

*4. Human intervention in relationships*

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]**

**Q14.** Please note that to obtain full credit, students must use information to show **the importance of different types of cells and how they are involved in many different functions**.

Topics

|  |  |
| --- | --- |
| **1.M** | Membrane function as selectively permeable barrier |
| **1.T** | Transport mechanisms across membranes |
| **1.CT** | Absorption and co-transport of sodium ions and glucose |
| **2.P** | Photosynthesis, chloroplast, thylakoids |
| **2.R** | Respiration, mitochondrion and cristae. |
| **2.Ps** | Protein secretion, RER, SER and Golgi |
| **3.A** | Surface receptors / antigen and immune response |
| **3.CD** | Cell division |
| **3.B** | Vertical and horizontal transmission − membranes and bacteria |
| **3.Pc** | Pacinian corpuscle |
| **4.Tr** | Tropisms − movement of IAA |
| **4.N** | Nerve impulses / action potentials |
| **4.S** | Synaptic transmission |
| **4.Mc** | Muscle contraction, calcium ion movement / storage |
| **4.H** | Hormones - eg Blood glucose regulation − insulin and glucagon |
| **4.O** | Osmosis, including water movement in plants |

*Examiners are free to select other letters if they wish*

*The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves*

*Breadth, one mark for use of an example from each of the following approaches:*

*1. Membranes − basic functions*

*2. Organelle membranes*

*3. Cell surface membranes*

*4. Processes − eg protein secretion, synaptic transmission, cell division*

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]**

**Q15.**  The importance to humans of the control of growth, reproduction and development of organisms, including themselves.

Topics

|  |  |  |
| --- | --- | --- |
| **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. | 3.5.8 Gene cloning and transfer |
| **Gt** | 3.5.8. | 3.5.8 Gene therapy |

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]**

**Q16.**

 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.

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]**

**Q17.** How energy is transferred within and between organisms.

Topics

|  |  |
| --- | --- |
| **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.*

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]**

**Q18.**Please note that to obtain full credit, students must use information to show **the importance of receptors**.

|  |  |
| --- | --- |
| **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 |
| 3.8.2.3 | Gene expression and cancer |

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]**

**Q19.The causes and importance of variation and diversity in organisms**

•   3.1.4.1   Proteins have a variety of functions in all living organisms

•   3.2.4   Effect of antigen variability on disease and disease prevention

•   3.4.3   Genetic diversity from mutation

•   3.4.3   Genetic diversity from meiosis

•   3.4.4   Genetic diversity and adaptation

•   3.4.5   Courtship behaviour

•   3.4.6   Biodiversity within a community

•   3.4.7   Investigating diversity

•   3.5.3   Energy and ecosystems – farming practices

•   3.6.3   Slow and fast twitch muscles

•   3.7.1   Inheritance

•   3.7.2   Populations

•   3.7.3   Evolution leading to speciation

•   3.7.4   Populations in ecosystems

•   3.8.1   Alteration of base sequences

•   3.8.2.2   Regulation of transcription and translation

•   3.8.2.3   Gene expression and cancer

•   3.8.4.1   Recombinant DNA technology

•   3.8.4.2   Identification of heritable conditions

•   3.8.4.3   Genetic fingerprinting

**[25]**

**Q20.** Please note that to obtain full credit, students must use information to show **the importance of movement**.

|  |  |
| --- | --- |
| **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 |

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]**

**Q21.** Please note that to obtain full credit, students must use information to show **the transfer of energy between different organisms and between these organisms and their environment**.

Topics

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

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]**

**Q22.** 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]**

**Q23.** How nucleotides, molecules derived from nucleotides and nucleic acids are important in keeping organisms alive.

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 |

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]**

**Q24.** How bacteria can affect the lives of humans and other organisms.

Topics

|  |
| --- |
| **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 |

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]**

**Q25.** The causes of disease in humans.

Topics

|  |
| --- |
| **Pathogens** |
| 1.1 | Pathogens include bacteria, viruses and fungiPathogens cause disease by damaging cells and producing toxins |
| **Lifestyle** |
| 1.1 | Risk factors associated with cancer and coronary heart disease |
| **Genetics** |
| 2.2 | 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 genesGene mutations |

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]**

**Q26.** Please note that to obtain full credit, students must use information to show **the importance of Using DNA in science and technology**.

Topics

|  |
| --- |
| **DNA and classification** |
| 2.2 | Structure of DNA |
| 2.3 | Differences in DNA lead to genetic diversity |
| 2.9 | Comparison of DNA base sequences |
| **Genetic engineering and making useful substances** |
| 2.5 | Plasmids |
| 5.8 | The use of recombinant DNA to produce transformed organisms that benefit humans |
| **Other uses of DNA** |
| 2.5 | Cell cycle and treatment of cancer |
| 5.8 | Gene therapy;Medical diagnosis and the treatment of human disease;The use of DNA probes to screen patients for clinically important genes. |

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]**

**Q27.**The control of processes in cells and the importance of these controls..

Topics

|  |  |  |
| --- | --- | --- |
| **O** | 3.1.3. and 3.2.4. | Organelles and processes |
| **T** | 3.1.3.3.1.3. | Transport across membranesCholera |
| **I** | 3.1.5. | Immune response |
| **I** | 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** | 3.4.2.3.4.3.3.4.3. | ATPPhotosynthesisRespiration |
| **G** | 3.2.10.3.4.8. | Antibiotics and genetic variationInheritance |
| **N** | 3.5.1.3.5.2. | ReceptorsNerve impulses and synapses |
| **Tr** | 3.2.7. | Passage of water through plant |
| **Mc** | 3.5.3. | Muscle contraction |
| **H** | 3.5.4. | Control of blood glucose concentration – hormones – plant growth substances |
| **Cd** | 3.2.6.3.5.6. | Cell differentiationPolypeptide synthesis and gene mutations |
| **Cd** | 3.5.7.3.5.8. | Gene expressionGene 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*

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]**

**Q28.** Please note that to obtain full credit, students must use information to show **the importance of shapes fitting together in cells and organisms**.

Topics

|  |
| --- |
| **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 |
| 3.2.2 | 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 |

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.

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**[25]**

**Q29.** Cells and organisms carry out exchanges with their external environment to maintain their internal environment.

Topics

|  |  |
| --- | --- |
| **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 |

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.

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**[25]**

**Q30.** The importance of ions in biology.

Topics

|  |  |  |
| --- | --- | --- |
| **P** | 3.1.3. and 3.2.2. | Phosphate in structure of phospholipids, structure of membranes, nucleotides, DNA and RNA |
| **T** | 3.1.33.1.3 | Water potentials and osmosis, chloride ions and choleraCo-transport involving sodium ions |
| **H** | 3.2.4. | Haemoglobin and iron |
| **Tr** | 3.2.7. | Passage of water through plants, symplast and root pressure |
| **Tr** | 3.4.1.3.4.3. | ATP and ADPProtons in photosynthesis, including reduced NADP and phosphorylated intermediates |
| **R** | 3.4.4.3.4.4. | Protons in respiration, reduced NADS and FAD and phosphorylated intermediatesGlycolysis and lactate |
| **F** | 3.4.5.3.4.6. | Use of (NPK) fertilisersNitrogen cycle |
| **N** | 3.5.1.3.5.2. | Chemoreceptors, heart rate and Pacinian functionNerve impulses and synapses |
| **M** | 3.5.3. | Calcium ions and muscle contraction, and phosphate from ATP |
| **G** | 3.5.8. | Genetic fingerprinting, electrophoresis |

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]**

**Q31.** The importance of responses to changes in the internal and external environment of an organism.

Topics

|  |  |  |
| --- | --- | --- |
| **T** | 3.1.3. | Transport in and out of cells (of specific substances) |
| **I** | 3.1.6. | Immune response |
| **I** | 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 |
| **Hr** | 3.5.2 | Chemical mediators |
| **Ho** | 3.5.4 | Homeostasis − response to changes in internal environments |
| **F** | 3.5.5 | Feedback |
| **F** | 3.5.7 | Gene expression as part of response |

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]**

**Q32.The uses and importance of ATP in organisms**

•   3.1.5.2 DNA replication

•   3.1.6 ATP

•   3.2.2 All cells arise from other cells (mitosis)

•   3.2.3 Active transport

•   3.3.3 Digestion and absorption – co-transport

•   3.3.4.2 Mass transport in plants

•   3.4.2 Meiosis

•   3.5.1 Photosynthesis

•   3.5.2 Respiration

•   3.5.4 Nutrient cycles – nitrogen fixation

•   3.6.2.1 Nerve impulses – resting potential

•   3.6.2.2 Synaptic transmission

•   3.6.3 Myofibril/muscle contraction

•   3.6.4.3 Control of blood water potential

**[25]**

**Q33.** Please note that to obtain full credit, students must use information to show **the importance of how the structures of different polymers are related to their functions**.

.

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 |

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]**

**Q34.**

Heat and many different substances are transferred within the body and between the body and the environment. Please note that to obtain full credit, students must use information to **explain how surface area is linked to this transfer**.

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 |

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]**

**Q35. The importance of DNA as an information carrying molecule and its use in gene technologies**

Suitable topic areas

•   3.1.5.1  Structure of DNA

•   3.1.5.2  DNA replication

•   3.2.1.1  DNA in mitochondria (and chloroplasts)

•   3.2.1.2  Prokaryotic DNA

•   3.2.2  DNA replication in interphase and binary fission

•   3.4.1  DNA, genes and chromosomes

•   3.4.2  DNA and protein synthesis

•   3.4.3  Genetic diversity and meiosis

•   3.4.4  Genetic diversity and adaptation

•   3.4.7  Investigating diversity

•   3.7.1  Inheritance

•   3.7.3  Evolution may lead to speciation

•   3.8.1  Alteration of the sequence of bases in DNA can alter the structure of

  proteins

•   3.8.2.1  Most of a cell’s DNA is not translated

•   3.8.2.2  Regulation of transcription and translation

•   3.8.2.3  Gene expression and cancer

•   3.8.3  Using genome projects

•   3.8.4.1  Recombinant DNA technology

•   3.8.4.2  Differences in DNA between individuals of the same species can be

  exploited for identification and diagnosis of heritable conditions

•   3.8.4.3  Genetic fingerprinting

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]**

**Q36.**

**The importance of cycles in biology**

•   3.1.1 Monomers and polymers

•   3.1.4.2 Many proteins are enzymes

•   3.1.6 ATP

•   3.2.2 All cells arise from other cells

•   3.3.2 Gas exchange – mechanism of breathing

•   3.3.4.1 Cardiac cycle and blood circulation

•   3.4.3 Meiosis

•   3.5.1 Photosynthesis – light independent reaction

•   3.5.2 Respiration – Krebs cycle and electron transport chain

•   3.5.4 Nutrient cycles

•   3.6.2.1 Nerve impulses

•   3.6.2.2 Synaptic transmission

•   3.6.3 Muscle contraction

•   3.6.4.1 Negative feedback

•   3.6.4.2 Control of blood glucose concentration

•   3.7.4 Populations in ecosystems – predation

•   3.8.4.1 Recombinant DNA technology – PCR

**[25]**

**Q37.** Please note that to obtain full credit, students must use information to show **ways in which different species of organisms differ from each other**.

Topics

|  |  |  |
| --- | --- | --- |
| **Biology** |  | **Human Biology** |
| **Molecular differences** |
| 10.04 | Large molecules are important in the structure and functioning of Cells (proteins) | 10.04 |
| **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 organismsThe concept of ecosystem (niches) |   |
| 14.5 | Different organisms possess different types of haemoglobin with different oxygen transporting properties | 14.5 |
| 15.5 | Limitiation of water loss in xerophytic plantsDigestion of cellulose |   |
| 15.4 | Bacteria as examples of pathogenic microorganisms |   |
| 15.6 | Principles of immunology | 12.1 / 12.9 / 12.3 |

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

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**[25]**

**Q38.**

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

|  |  |
| --- | --- |
| **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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**[25]**

**Q39.** Please note that to obtain full credit, students must use information to show **the importance of nitrogen-containing substances in biological systems**.

Topics

|  |  |  |
| --- | --- | --- |
| **1** | principle of negative feedback – departure from a norm initiates changes which restore a system to the norm. | (p) |
| **2** | importance in homeostasis; principles of detection of change, role of receptors, corrective response, role of effectors. | (H) |
| **3** | regulation of blood glucose; roles of receptors in pancreas, secretion of insulin or glucagon; effect of insulin on surface membranereceptors / carrier proteins in stimulating uptake of glucose andglycogenesis; role of glucagon in glycogenolysis. | (G) |
| **4** | regulation of blood water potential; role of receptors in hypothalamus;secretion of ADH from pituitary; effect of ADH on permeability ofd.c.t. and collecting duct; role of loop of Henle in maintaining highion concentration in the medulla; effect on urine concentration. | (W) |
| **5** | control of ventilation; stimulation of chemoreceptors in medulla;effect on inspiration; stimulation of stretch receptors in lungs;stimulation of expiratory cells in medulla. | (B) |
| **6** | control of heartbeat; roles of chemoreceptors and pressure receptors;inhibitory and acceleratory centres in medulla; effect on SAN and rateof heartbeat; effect of change in rate on pH / pressure of blood. | (HB) |
| **7** | metabolic pathways; examples of build-up of a product in a metabolicpathway resulting in inhibition of its formation. | (M) |
| **8** | population stability; effect of increasing competition / predation onincreasing population size and restoration of balance. | (Pop) |
| **9** | (selection – stabilising selection resulting in constancy of species) | (S) |

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.

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**[25]**

**Q40.** Please note that to obtain full credit, students must use information to show **the importance of nitrogen-containing substances in biological systems**.

Topics

|  |  |  |
| --- | --- | --- |
| **1** | destabilising effect of rising temperature on metabolicsystems 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 ratewith small increases, disruption with larger; increased rate of growthof (some) plants; possible increased rate of crop growth; effect ofother limiting factors. | (PS) |
| **5** | effect on transpiration; increased rate of water loss and hencewilting / dehydration; reduced stomatal opening may affectphotosynthesis; possible consequences of drought on ecosystems. | (T) |
| **6** | effect on respiration and metabolism; increased effect on growthand activity, especially of ectotherms. | (M) |
| **7** | ecological effects of disruption of food webs and the dynamics ofecosytems, 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 opportunityfor plants and some animals to spread to more suitable conditionsas 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 ofthe 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 incidenceof disease. | (R) |
| **11** | role of natural selection in adaptation to change. | (N) |

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.

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**[25]**

**Q41. The importance of bonds and bonding in organisms.**

Suitable topic areas

•   3.1.1  Monomers and polymers

•   3.1.2  Carbohydrates

•   3.1.3  Lipids

•   3.1.4.1  General properties of proteins

•   3.1.4.2  Many proteins are enzymes

•   3.1.5.1  Structure of DNA and RNA

•   3.1.5.2  DNA replication

•   3.1.6  ATP

•   3.1.7  Water – cohesion

•   3.2.2  Mitosis

•   3.2.3  Transport across cell membranes

•   3.2.4  Cell recognition and the immune system

•   3.3.3  Digestion and absorption

•   3.3.4.1  Mass transport in animals – haemoglobin

•   3.3.4.2  Mass transport in plants

•   3.4.2  DNA and protein synthesis

•   3.4.3  Mutation and meiosis

•   3.5.1  Photosynthesis

•   3.5.2  Respiration

•   3.5.4  Nutrient cycles

•   3.6.2.2  Synaptic transmission

•   3.6.3  Skeletal muscles

•   3.6.4.2  Control of blood glucose concentration

•   3.6.4.3  Control of blood water potential

•   3.8.1  Mutations

•   3.8.2.2  Regulation of transcription and translation

•   3.8.2.3  Gene expression and cancer

•   3.8.4.1  Recombinant DNA technology

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.

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**[25]**

**Q42.** The importance of interactions **between cells** and between organisms.

Suitable topic areas

•        3.2.1.2 Viruses

•        3.2.4 Cell recognition, immune system, HIV

•        3.3.2 Gas exchange

•        3.3.4.1 Mass transport in animals

•        3.3.4.2 Mass transport in plants

•        3.4.4 Genetic diversity and adaptation

•        3.4.5 Species and taxonomy (courtship behaviour)

•        3.4.6 Biodiversity within a community

•        3.5.3 Energy and ecosystems

•        3.5.4 Nutrient cycles

•        3.6.1.1 Survival and response

•        3.6.1.2 Receptors

•        3.6.2.2 Synaptic transmission

•        3.6.3 Skeletal muscles are stimulated ...

•        3.6.4.2 Control of blood glucose

•        3.6.4.3 Control of blood water potential

•        3.7.1 Inheritance

•        3.7.2 Populations in ecosystems

•        3.7.3 Evolution and speciation

•        3.7.4 Populations in ecosystems

•        3.8.2.3 Gene expression and cancer

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.

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**[25]**

**Q43.**

The importance of the control of movement **in** cells and organisms.

Suitable topic areas

•        3.1.4.2 Enzymes and control of action

•        3.1.5.2 DNA replication

•        3.2.2 Mitosis, binary fission

•        3.2.3 Transport across membranes

•        3.2.4 Cell recognition and the immune system

•        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

•        3.4.3 Meiosis

•        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 Nervous impulses

•        3.6.2.2 Synaptic transmission

•        3.6.3 Muscle contraction

•        3.6.4.2 Control of blood glucose

•        3.6.4.3 Control of blood water potential

•        3.7.1 Inheritance

•        3.8.2.2 Regulation of transcription and translation

•        3.8.2.3 Gene expression and cancer

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.

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**[25]**