

## Essay titles

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This resource lists essay titles and the indicative content from the mark schemes, featured in the previous specifications. It prepares students for the essay in A-level Biology Paper 3.

### Biology 2410 (BIOL5)

Year	Question	Title
2013	10 a	The membranes of different types of cells are involved in many different functions
2013	10 b	There are many different types of relationships and interactions between organisms
2014	10 a	Cells and organisms carry out exchanges with their external environment to maintain their internal environment
2014	10 b	How energy is transferred within and between organisms
2012	10 a	The importance of shapes fitting together in cells and organisms
2012	10 b	How bacteria can affect the lives of humans and other organisms
2011	10 a	Using DNA in science and technology
2011	10 b	A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next. Write an essay about cycles in biology
2010	10 a	Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects
2010	10 b	The causes of disease in humans

### Legacy Biology Spec B

Year	Question	Title
2010	4 a	The movement of substances within living organisms
2010	4 b	Cycles in Biology
2009	4 a	Ions and organisms
2009	4 b	DNA and the transfer of information

2008	A	The part played by the movement of substances across cell membranes in the functioning of different organs and organ systems
2008	B	The part played by enzymes in the functioning of different cells, tissues and organs
2007	A	Movements inside cells
2007	B	Transfers through ecosystems

## Legacy Biology Spec A

Year	Question	Title
2010	A	Carbon dioxide in organisms and ecosystems
2010	B	Why the offspring produced by the same parents are different in appearance
2009	A	The uses of water in living organisms
2009	B	The transfer of energy within and between organisms
2008	A	Hydrogen bonds and their importance in living organisms
2008	B	How nitrogen-containing substances are made available to and are used
2007	A	Carbon dioxide in organisms and ecosystems
2007	B	Why the offspring produced by the same parents are different in appearance

## BIOL5 2013

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:

- Scientific content: 16
- Breadth of knowledge: 3
- Relevance: 3
- Quality of written communication: 3.

Write an essay on one of the following topics.

10 (a) The membranes of different types of cells are involved in many different functions

(25 marks)

Marking guidance	Mark	Comments
<p>1. Membrane function as selectively permeable barrier</p> <p>1. Transport mechanisms across membranes</p> <p>1. Absorption and co-transport of sodium ions and glucose</p> <p>2. Photosynthesis, chloroplast, thylakoids</p> <p>2. Respiration, mitochondrion and cristae</p> <p>2. Protein secretion, RER, SER and Golgi</p> <p>3. Surface receptors/antigen and immune response</p> <p>3. Cell division</p> <p>3. Vertical and horizontal transmission – membranes and bacteria</p> <p>3. Pacinian corpuscle</p> <p>4. Tropisms – movement of IAA</p> <p>4. Nerve impulses/action potentials</p> <p>4. Synaptic transmission</p> <p>4. Muscle contraction, calcium ion movement/storage</p> <p>4. Hormones - eg Blood glucose regulation – insulin and glucagon</p> <p>4. Osmosis, including water movement in plants</p>	<p>25</p>	<p>The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves.</p> <p>Breadth, one mark for use of an example from each of the following approaches:</p> <ol style="list-style-type: none"> <li>1. Membranes – basic functions</li> <li>2. Organelle membranes</li> <li>3. Cell surface membranes</li> <li>4. Processes – eg protein secretion, synaptic transmission, cell division</li> </ol>

10 (b) There are many different types of relationships and interactions between organisms

(25 marks)

Marking guidance	Mark	Comments
<p>1. Pathogens and effects on host</p> <p>1. Cholera</p> <p>1. TB</p> <p>2. Taxonomy</p> <p>2. Classification and evolution</p> <p>2. Inheritance and evolution</p> <p>2. Genetic code, universal</p> <p>2. Behaviour</p> <p>2. Populations and evolution, variation between individuals within a species</p> <p>3. Relationships within ecosystems – eg predator/prey</p> <p>3. Energy transfer in ecosystems</p> <p>3. Nutrient cycles, the organisms involved</p> <p>3. Succession, biodiversity, species and individuals in a community</p> <p>4. Human impacts on the environment and its effect on relationships between organisms – including farming</p> <p>4. Gene technology and GMO and selective breeding</p> <p>4. Antibiotic resistance</p>	<p>25</p>	<p>The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves.</p> <p>Breadth, one mark for use of an example from each of the following approaches – 3 max:</p> <p>1. Pathogen and host</p> <p>2. Evolution (related topics)</p> <p>3. Ecological</p> <p>4. Human intervention in relationships</p>

## BIOL5 June 2014

### 10 (a) Cells and organisms carry out exchanges with their external environment to maintain their internal environment

(25 marks)

Marking guidance	Mark	Comments
<p>Cells and organisms carry out exchanges with their external environment to maintain their internal environment.</p> <p>Topic areas:</p> <ul style="list-style-type: none"><li>• Homeostasis (concept of)</li><li>• Digestion and absorption</li><li>• Cells</li><li>• Lung function</li><li>• Gas exchange</li><li>• Passage of water through plant</li><li>• Nutrient cycles</li><li>• Response to stimuli</li><li>• Neurones</li><li>• Temperature control</li><li>• Tissue fluid and its formation</li><li>• Control of blood glucose concentration</li><li>• Negative feedback</li><li>• Gene expression</li></ul>		<p>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.</p> <p>Candidates may make correct use of material from other topics.</p> <p>A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A level.</p>

## 10 (b) How energy is transferred within and between organisms

Marking guidance	Mark	Comments
<p>How energy is transferred within and between organisms.</p> <p>Topic areas:</p> <ul style="list-style-type: none"><li>• Photosynthesis</li><li>• Energy transfer through ecosystems</li><li>• Food production</li><li>• Digestion (as in fuel)</li><li>• Absorption (by cells)</li><li>• Mass transport</li><li>• Respiration</li><li>• ATP</li><li>• Stimuli and responses</li><li>• Muscle contraction</li><li>• Nerve impulses</li></ul>		<p>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.</p> <p>Candidates may make correct use of material from other topics.</p> <p>A* includes where candidates use information about a topic in the specification but go beyond what is expected for our A level.</p>

## BIOL5 June 2012

### 10 (a) The importance of shapes fitting together in cells and organisms

Marking guidance	Mark	Comments
<p>Proteins &amp; Enzymes:</p> <ul style="list-style-type: none"><li>• 3.1.2 Enzyme properties and digestion</li><li>• 3.1.2 Protein structure</li><li>• 3.1.3 Plasma membrane structure and cell transport</li><li>• 3.1.6 Antigens, antibodies, B cells &amp; T cells</li><li>• 3.1.6 Vaccines</li></ul> <p>Nucleic Acids:</p> <ul style="list-style-type: none"><li>• 3.2.2 Structure of DNA</li><li>• 3.2.5 DNA Replication (not PCR)</li><li>• 3.5.7 Transcription &amp; translation</li><li>• 3.5.8 Transcriptional factors, oestrogen, siRNA</li><li>• 3.5.8 Restriction enzymes</li></ul> <p>Physiology:</p> <ul style="list-style-type: none"><li>• 3.2.4 Haemoglobin</li><li>• 3.5.2 Action potentials &amp; synaptic transmission</li><li>• 3.5.3 Muscle contraction</li><li>• 3.5.4 Control of blood glucose concentration</li><li>• 3.5.5 Control of mammalian oestrous cycle</li></ul>	25	

## 10 (b) How bacteria can affect the lives of humans and other organisms

Marking guidance	Mark	Comments
<p>Bacteria &amp; Disease:</p> <ul style="list-style-type: none"><li>• 3.1.1 Pathogens</li><li>• 3.1.2 Lactose intolerance</li><li>• 3.1.3 Cholera</li><li>• 3.1.4 Tuberculosis</li><li>• 3.2.10 Resistance to antibiotics</li></ul> <p>Ecological Importance:</p> <ul style="list-style-type: none"><li>• 3.4.6 Carbon cycle</li><li>• 3.4.6 Nitrogen cycle</li><li>• 3.4.6 Eutrophication</li></ul> <p>Making Use of Bacteria:</p> <ul style="list-style-type: none"><li>• 3.5.8 Use of bacterial enzymes eg restriction endonuclease, DNA polymerase for PCR</li><li>• 3.5.8 Use of bacterial plasmids eg in vivo gene cloning, genetically-modified crops, gene therapy</li><li>• 3.5.8 Use of bacteria to produce useful chemicals</li></ul>	25	



## BIOL5 June 2011

Write an essay on one of the following topics.

### Essay A. 10 (a) Using DNA in science and technology

Marking guidance	Mark	Comments
<p>DNA and classification:</p> <ul style="list-style-type: none"><li>• Structure of DNA</li><li>• Differences in DNA lead to genetic diversity</li><li>• Comparison of DNA base sequences</li><li>• DNA hybridisation</li></ul> <p>Genetic engineering and making useful substances:</p> <ul style="list-style-type: none"><li>• Plasmids</li><li>• The use of recombinant DNA to produce transformed organisms that benefit humans</li></ul> <p>Other uses of DNA:</p> <ul style="list-style-type: none"><li>• Cell cycle and treatment of cancer</li><li>• Gene therapy</li><li>• Medical diagnosis and the treatment of human disease</li><li>• The use of DNA probes to screen patients for clinically important genes</li></ul>	25	

Essay B. 10 (b) A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next.  
Write an essay about cycles in biology

Marking guidance	Mark	Comments
Ecological cycles	25	
Nutrient cycles		
Carbon cycle		
Nitrogen cycle		
Biochemical cycles		
Enzyme action		
Synthesis of ATP from ADP		
Light-independent reaction		
The Krebs cycle		
Physiological and genetic cycles		
The mechanism of breathing		
The cardiac cycle		
The cell cycle		
Muscle contraction		
Oestrous cycle		

## BIOL5 June 2010

Write an essay on one of the following topics.

Essay A. A carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects

Marking guidance	Mark	Comments
<p>Carbon dioxide affects the physiology of organisms:</p> <ul style="list-style-type: none"><li>• Pulmonary ventilation and the mechanism of breathing</li><li>• Light-independent reaction of photosynthesis. Limiting factors</li><li>• Role of chemoreceptors in controlling heart rate</li></ul> <p>The direct effects of increasing carbon dioxide concentration:</p> <ul style="list-style-type: none"><li>• Respiration, photosynthesis and human activity giving rise to short-term fluctuations and long-term change.</li><li>• Yield of crop plants</li><li>• Carbon cycle</li></ul> <p>Indirect effects of increasing carbon dioxide concentration:</p> <ul style="list-style-type: none"><li>• Role of carbon dioxide in producing global warming</li><li>• Life cycles and number of insect pests</li><li>• Distribution of animals and plants</li><li>• Effect of temperature on enzymes</li></ul>	25	

## Essay B. The causes of disease in humans

Marking guidance	Mark	Comments
<p>Pathogens:</p> <ul style="list-style-type: none"><li>• Pathogens include bacteria, viruses and fungi</li><li>• Pathogens cause disease by damaging cells and producing toxins</li><li>• Cholera bacteria produce toxins resulting in diarrhoea</li><li>• Symptoms and transmission of pulmonary tuberculosis</li><li>• Horizontal gene transmission and MRSA</li></ul> <p>Lifestyle:</p> <ul style="list-style-type: none"><li>• Risk factors associated with cancer and coronary heart disease</li><li>• The effects of fibrosis, asthma and emphysema on lung function</li><li>• The biological basis of heart disease</li></ul> <p>Genetics:</p> <ul style="list-style-type: none"><li>• Differences in bases may lead to non-functional enzymes</li><li>• Relationship between the cell cycle and cancer</li><li>• Proto-oncogenes and tumour suppressor genes</li><li>• Gene mutations</li></ul>	25	

## Spec B Jan 2010 Unit 6/7/8

Write an essay on one of the topics below. In the answer to this question you should bring together relevant principles and concepts from different parts of the specification.

Your essay will be marked not only for its scientific accuracy, but also for the selection of relevant material.

The essay should be written in continuous prose.

### 4 a The movement of substances within living organisms

Marking guidance	Mark	Comments
Osmosis Across cell membranes Movement of water/mineral ions in plants Enzymes, kinetic energy and reactions Gut and absorption DNA Transcription and translation Mitosis and Meiosis Sperm and fertilisation Blood vessels and heart Exchange in capillaries Electron transport Nerve impulses/action potential Synapses Muscle contraction Alveolar gas exchange Translocation Photosynthesis Kidneys	25	

## 4 b Cycles in Biology

Marking guidance	Mark	Comments
<ol style="list-style-type: none"><li>1. Large and small biological molecules, condensation and hydrolysis</li><li>2. Enzymes</li><li>3. Cell cycle – Mitosis and meiosis</li><li>4. PCR</li><li>5. Mammalian blood circulation</li><li>6. Calvin cycle</li><li>7. Krebs cycle</li><li>8. ATP and ADP</li><li>9. Negative feedback</li><li>10. Nitrogen cycle</li><li>11. Carbon cycle</li><li>12. Menstrual cycle</li><li>13. Muscle contraction</li><li>14. Nerve impulses</li><li>15. Predator prey</li><li>16. Electron transport chain</li></ol>	25	

## Spec B June 2009 Unit 6/7/8

### 4 (a) Ions and organisms

Marking guidance	Mark	Comments
Topic areas for assessment of scientific content: 1 Osmosis and turgor 2 Haemoglobin dissociation, pH and carbon dioxide 3 Uptake/movement of water/mineral ions by/in plants 4 Ions in biological molecules 5 Hydrogen, photosynthesis and respiration 6 Anaerobic respiration and lactate 7 Nerve impulses and synaptic transmission 8 Regulation of blood water potential/kidney function 9 Muscle contraction 10 Nitrogen cycle 11 Eutrophication 12 Movement across membranes 13 Cystic fibrosis	25	

#### 4 (b) DNA and the transfer of information

Marking guidance	Mark	Comments
1 Genes/how information is carried on DNA 2 Replication of DNA 3 Cell division - Mitosis and meiosis 4 Transcription and translation 5 Mutation 6 Genetic engineering 7 Gene therapy 8 Genetically modified organisms 9 Variation (in populations) 10 Evolution 11 Inheritance	25	Any other sensible example of the transfer of information involving DNA should be credited.



## Spec B June 2008 Unit 6/7/8

(25 marks)

Essay A. The part played by the movement of substances across cell membranes in the functioning of different organs and organ systems

Marking guidance	Mark	Comments
1 Plasma membranes and movement across 2 Gaseous exchange system/lungs 3 Digestive system/small intestine 4 Blood vascular system 5 Transpiration/root/stem 6 Mass flow/leaf/stem 7 Nervous system/eye 8 Excretory system/kidney 9 Muscle systems 12 Liver, blood glucose 11 Root mineral ions 10 Lungs cystic fibrosis	25	Any other sensible example of the movement of substances across cell membranes in the functioning of different organs and organ systems should be credited.

Essay B. The part played by enzymes in the functioning of different cells, tissues and organs

Marking guidance	Mark	Comments
1 Action of enzymes 2 Enzyme properties 3 Extracellular digestion 4 Nutrient cycles 5 Digestion in humans 6 Replication of DNA 7 Protein and enzyme synthesis 8 Metabolic pathways 9 Mutations 10 Coenzymes and enzyme action	25	Any other sensible example of the part played by enzymes in the functioning of different cells, tissues and organs should be credited.

11 Homeostasis		
12 Neurone/synapse		
13 Muscle contraction		
14 Pesticide toxicity		

## Spec B June 2007 Unit 6/7/8

### Essay A. Movements inside cells

Marking guidance	Mark	Comments
1 Plasma membranes and movement across	25	
2 Protein synthesis		
3 Movement through ER and Golgi		
4 Cell division and chromosome movement		
5 Water movement in plants/xylem		
6 Translocation		
7 Neurones and synaptic vesicles		
8 Actin and myosin		
9 DNA replication and mutation		
10 Electron transport chains		
11 Molecular/atomic/ionic movement		

### Essay B. Transfers through ecosystems

Marking guidance	Mark	Comments
1 Photosynthesis – energy transfer	25	
2 Respiration – energy transfer		
3 Carbon cycle		
4 Nitrogen cycle		
5 Food chains		
6 Ecological pyramids		
7 Pesticide toxicity/bioaccumulation		
8 Eutrophication		

9 Digestion and absorption		
10 Transfer of genetic material		
11 Water cycle		

## Spec A Jan 2010 Unit 8

### Essay A. Carbon dioxide in organisms and ecosystems

Marking guidance	Mark	Comments
<p>Biochemistry:</p> <ul style="list-style-type: none"> <li>• 14.6 The biochemistry of photosynthesis</li> <li>• 14.8 The biochemistry of respiration</li> <li>• 11.6 C4 photosynthesis in maize</li> </ul> <p>Physiology:</p> <ul style="list-style-type: none"> <li>• 15.4 Gas exchange surfaces</li> <li>• 10.8 Changes in cardiac output and pulmonary ventilation with exercise</li> <li>• 15.5 The transport of respiratory gases</li> </ul> <p>Ecology:</p> <ul style="list-style-type: none"> <li>• 11.6 The effect of carbon dioxide on productivity</li> <li>• 14.9 Decomposition and recycling maintain the balance of nutrients in an ecosystem</li> <li>• The greenhouse effect is not specifically mentioned but should be credited here if discussed.</li> </ul>	25	

## Essay B. Why the offspring produced by the same parents are different in appearance

Marking guidance	Mark	Comments
<p>Genes:</p> <ul style="list-style-type: none"> <li>• 11.3 Genes incorporate coded information which influence phenotype</li> <li>• 14.2 Gene mutation</li> </ul> <p>Environment:</p> <ul style="list-style-type: none"> <li>• 14.2 Environment variation</li> <li>• 15.7 Dietary requirements of insects</li> </ul> <p>Chromosomes and cells:</p> <ul style="list-style-type: none"> <li>• 11.2 and 14.1 Meiosis</li> <li>• 14.1 Principles of Mendelian inheritance</li> <li>• 14.2 Polygenetic inheritance</li> <li>• Gametes and gamete formation. Fertilisation 16.1</li> </ul>	25	

## Spec A Biology and Human Biology June 2009 Paper 8/9

### Essay A. The uses of water in living organisms

Marking guidance	Mark	Comments
<p>Water in chemical reactions:</p> <ul style="list-style-type: none"> <li>• 10.4 Condensation and hydrolysis</li> <li>• 14.6 Photolysis</li> <li>• 16.4 Digestion and absorption</li> </ul> <p>Water and physiology:</p> <ul style="list-style-type: none"> <li>• 10.7 Circulation</li> <li>• Tissue fluid and its circulation</li> <li>• 16.11 Temperature control</li> <li>• 16.2 The fetus in its uterine environment</li> </ul>	25	

<p>Water and Osmosis:</p> <ul style="list-style-type: none"> <li>• 10.3 Water potential and osmosis</li> <li>• 10.2 Cell walls and support in plants</li> <li>• 16.11 Urine formation (Biology only)</li> </ul>		
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### Essay B. The transfer of energy within and between organisms

Marking guidance	Mark	Comments
<p>Autotrophic nutrition:</p> <ul style="list-style-type: none"> <li>• 14.6 Photosynthesis</li> <li>• 11.6 Factors that limit the rate of photosynthesis</li> </ul> <p>Energy transfer:</p> <ul style="list-style-type: none"> <li>• 14.9 Carbon cycle</li> <li>• 14.10 The influence of deforestation of carbon cycling</li> <li>• 14.7 Ecological pyramids and the transfer of energy</li> <li>• 16.4 Digestion and absorption</li> </ul> <p>Energy loss:</p> <ul style="list-style-type: none"> <li>• 14.8 Respiration and ATP</li> <li>• 10.3 Active transport</li> <li>• 15.9 Receptors convert stimuli into nerve impulses</li> </ul>	25	

## Spec A Biology and Human Biology June 2008 Paper 8/9

### Essay A. Hydrogen bonds and their importance in living organisms

Marking guidance	Mark	Comments
<p>Hydrogen bonds associated with the properties of water:</p> <p>15.1 The passage of water through a plant and cohesion tension</p> <p>Hydrogen bonds associated with secondary and tertiary structure:</p> <ul style="list-style-type: none"><li>• 10.4 The structure of proteins, starch and cellulose</li><li>• 10.5 Enzymes</li></ul> <p>Hydrogen bonds associated with nucleic acids:</p> <ul style="list-style-type: none"><li>• 11.3 DNA as genetic material, structure of nucleic acids</li><li>• 11.4 Gene technology</li></ul>	25	

### Essay B. How nitrogen-containing substances are made available to and are used

Marking guidance	Mark	Comments
<p>Nutrient cycling:</p> <ul style="list-style-type: none"><li>• Nitrogen cycle</li><li>• The influence of deforestation of nitrogen cycling</li></ul> <p>The uses of proteins:</p> <ul style="list-style-type: none"><li>• Proteins as biological molecules</li><li>• Enzymes and enzyme action</li><li>• Haemoglobin and the exchange of respiratory gases</li><li>• The use of membrane proteins in the nervous system</li></ul> <p>The uses of nucleic acids and other nitrogen-containing substances:</p>	25	

<ul style="list-style-type: none"> <li>• DNA and protein synthesis</li> <li>• Chlorophyll, NADP and photosynthesis</li> <li>• ATP and respiration</li> </ul>		
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## Spec A Biology and Human Biology June 2007 Paper 8/9

Write an essay on one of the following topics. You should select and use information from different parts of the specification. Credit will be given not only for the biological content, but also for the selection and use of relevant information and for the organisation and presentation of the essay.

### Essay A. Carbon dioxide in organisms and ecosystems

Marking guidance	Mark	Comments
<p>Biochemistry:</p> <ul style="list-style-type: none"> <li>• The biochemistry of photosynthesis 14.6</li> <li>• The biochemistry of respiration 14.8</li> <li>• C4 photosynthesis in maize 11.6</li> </ul> <p>Physiology:</p> <ul style="list-style-type: none"> <li>• Gas exchange surfaces 15.4</li> <li>• Changes in cardiac output and pulmonary ventilation with exercise 10.8</li> <li>• The transport of respiratory gases 15.5</li> </ul> <p>Ecology:</p> <ul style="list-style-type: none"> <li>• The effect of carbon dioxide on productivity 11.6</li> <li>• Decomposition and recycling maintain the balance of nutrients in an ecosystem 14.9</li> <li>• The greenhouse effect is not specifically mentioned but should be credited here if discussed</li> </ul>	25	

## Essay B. Why the offspring produced by the same parents are different in appearance

Marking guidance	Mark	Comments
<p>Genes:</p> <ul style="list-style-type: none"><li>• Genes incorporate coded information which influences phenotype 11.3</li><li>• Gene mutation 14.2</li></ul> <p>Environment:</p> <ul style="list-style-type: none"><li>• Environment variation 14.2</li><li>• Dietary requirements of insects 15.7</li></ul> <p>Chromosomes and cells:</p> <ul style="list-style-type: none"><li>• Meiosis 11.2 and 14.1</li><li>• Principles of Mendelian inheritance 14.1</li><li>• Polygenetic inheritance 14.2</li><li>• Gametes and gamete formation. Fertilisation 16.1</li></ul>	25	