

HSC Trial Examination 2005

# Biology

**Solutions and marking guidelines**

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## Section I

## Part A

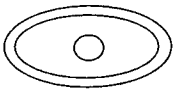


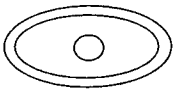


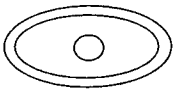


Answer and explanation	Syllabus content and course outcomes	
<b>Question 1</b> <b>A</b> Cells need to maintain a constant internal environment so that water is not lost or gained by osmosis.	9.2.3	H6
<b>Question 2</b> <b>C</b> Salts travel in the blood in the form of ions.	9.2.2	H6
<b>Question 3</b> <b>D</b> The tubule or loop of Henle is where substances are reabsorbed against a concentration gradient by active transport.	9.2.3	H2, H6
<b>Question 4</b> <b>B</b> pH is the only factor in the list that can effect enzyme activity.	9.2.1	H3, H6
<b>Question 5</b> <b>D</b> All other flow diagrams are either out of order or flow the incorrect way.	9.2.1	H2
<b>Question 6</b> <b>D</b> The diagram shows animals from two different evolutionary branches that have both adapted to suit their ecological niches as large predators in the marine environment. These adaptations have led the two animals to develop similar structural features evident in the diagram.	9.3.1	H10
<b>Question 7</b> <b>D</b> Black must be dominant to white as all of the offspring are black. In addition, it is likely that the male is heterozygous as all of the offspring are black. If he was heterozygous, approximately half of the offspring would be white.	9.3.2	H9
<b>Question 8</b> <b>C</b> Individual 11 must be homozygous recessive (aa) as the individual exhibits albinism, which is recessive to normal pigmentation. Individuals 3 and 4 must be heterozygous (Aa) as each contributes a recessive allele to their offspring 11, but neither exhibits the disease, so they must also have a dominant, normal allele.	9.3.2	H9
<b>Question 9</b> <b>B</b> When the mRNA leaves the nucleus, it binds to a ribosome, the site of the translation from nucleic acid to polypeptide.	9.3.4	H6, H9
<b>Question 10</b> <b>A</b> Since the cloned sheep shows the genetic characteristics of the Finn Dorset ewe and not of either the surrogate or the donor egg ewes, A must be the donor nucleus and B must then be the enucleated unfertilised egg.	9.3.5	H9, H10
<b>Question 11</b> <b>D</b> Koch's Postulates are a list of guidelines for identification of the organism causing a particular disease.	9.4.3	H1, H4
<b>Question 12</b> <b>B</b> As bacteria rarely spread from dead bodies to living people, the most likely means of transmission would be in water or food contaminated with human faeces.	9.4.2	H8
<b>Question 13</b> <b>A</b> The immune response occurs as a result of the introduction of antigens into the body, which are foreign or 'non-self'. In this case, protein molecules in the transplant act as antigens.	9.4.4	H6

**Part A (Continued)**

<b>Answer and explanation</b>	<b>Syllabus content and course outcomes</b>
<b>Question 14</b> <b>C</b> An antibody is a protein produced by B cells and an antibiotic is a substance, which may be used in the treatment of a bacterial disease.	9.4.3, 9.4.4, 9.4.5      H6
<b>Question 15</b> <b>B</b> Mitosis is the only process that involves this sequence of chromosomal movements. Rapid division and lack of differentiation may result in the formation of a tumour. Crossing over does not occur in mitosis.	9.4.1      H6

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**Part B**

Sample answer	Syllabus content, course outcomes and marking guide												
<b>Question 16</b>													
Prior to passing through the lungs, the blood is oxygen poor. The high concentration of oxygen in the lungs causes oxygen to move into the bloodstream. The blood is also carbon dioxide rich and so there is a net movement of carbon dioxide out of the blood and into the lungs.	<p>9.2.2 <span style="float: right;">H6</span></p> <ul style="list-style-type: none"> <li>• States the composition of blood prior to lungs.</li> <li>• States composition of blood after lungs.</li> <li>• Outlines the net movement of materials. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• States the composition of blood prior to lungs.</li> </ul> <p>AND</p> <ul style="list-style-type: none"> <li>• States composition of blood after lungs.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• Outlines the net movement of materials . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Identifies a net movement of materials. . . 1</li> </ul>												
<b>Question 17</b>													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><i>Blood vessel</i></th> <th style="text-align: center;"><i>Diagram</i></th> <th style="text-align: center;"><i>Description of structure</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Artery</td> <td style="text-align: center;"></td> <td>Thick elastic walls made of three layers, smooth muscle and connective tissue.</td> </tr> <tr> <td style="text-align: center;">Vein</td> <td style="text-align: center;"></td> <td>Same three layers but not as thick, inner diameter is larger.</td> </tr> <tr> <td style="text-align: center;">Capillary</td> <td style="text-align: center;"></td> <td>Walls one cell thick.</td> </tr> </tbody> </table>	<i>Blood vessel</i>	<i>Diagram</i>	<i>Description of structure</i>	Artery		Thick elastic walls made of three layers, smooth muscle and connective tissue.	Vein		Same three layers but not as thick, inner diameter is larger.	Capillary		Walls one cell thick.	<p>9.2.2 <span style="float: right;">H6, H13</span></p> <ul style="list-style-type: none"> <li>• Diagrams correctly drawn and labelled for each blood vessel.</li> <li>• Diagrams show structure of each blood vessel.</li> <li>• Two correct features described for each blood vessel. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Diagrams mostly correctly drawn and labelled for each blood vessel.</li> <li>• Diagrams show some structure of each blood vessel.</li> <li>• One correct feature described for two blood vessels. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• One diagram correctly drawn.</li> <li>• One correct feature described for any blood vessel. . . . . 1</li> </ul>
<i>Blood vessel</i>	<i>Diagram</i>	<i>Description of structure</i>											
Artery		Thick elastic walls made of three layers, smooth muscle and connective tissue.											
Vein		Same three layers but not as thick, inner diameter is larger.											
Capillary		Walls one cell thick.											
<b>Question 18</b>													
A pulse oximeter is used to measure saturation of oxygen in the blood in patients undergoing many different types of procedures. This device is a peg that is placed on the finger and measures the transmission of light through the tissues.	<p>9.2.2 <span style="float: right;">H3, H5</span></p> <ul style="list-style-type: none"> <li>• Names a correct technology.</li> <li>• Explains when it might be used.</li> <li>• Outlines the way the device operates. . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Names a correct technology.</li> <li>• Outlines the way it operates. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Names a correct technology. . . . . 1</li> </ul>												

Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide						
<p><b>Question 19</b></p>							
<p><b>Hypothesis:</b> To compare the optimum pH conditions for two enzymes.</p> <p><b>Materials:</b> Ten test tubes, test tube rack, solutions of acid of pH 4 and 6, solutions of NaOH of pH 8 and 10, enzyme A and B, distilled water, starch solution, stop watch, tes tape.</p> <p><b>Risk assessment:</b></p> <table border="1" data-bbox="175 548 917 694"> <thead> <tr> <th>Risk</th> <th>Safe practice</th> </tr> </thead> <tbody> <tr> <td>Acid and NaOH</td> <td>Wear protective clothing and safety goggles</td> </tr> <tr> <td>Glassware</td> <td>Clean up breakages immediately</td> </tr> </tbody> </table>	Risk	Safe practice	Acid and NaOH	Wear protective clothing and safety goggles	Glassware	Clean up breakages immediately	<p>9.2.1 H6, H11, H13, H14</p> <ul style="list-style-type: none"> <li>Hypothesis is appropriately worded.</li> <li>Logical hypothesis.</li> <li>A brief risk assessment is provided.</li> <li>Method is appropriate.</li> <li>Method is <b>logical</b> and numbered in sequence.</li> <li>Method reflects what is being investigated.</li> <li>Conclusion is appropriately worded.</li> <li>Conclusion reflects the hypothesis provided. .... 8</li> </ul>
Risk	Safe practice						
Acid and NaOH	Wear protective clothing and safety goggles						
Glassware	Clean up breakages immediately						
<p><b>Method:</b></p> <ol style="list-style-type: none"> <li>Set two test tubes of each level of pH and two with distilled water as a control.</li> <li>Add 5 mL of starch solution to each test tube.</li> <li>Add 5 mL of Enzyme A to one of each of the pH test tubes.</li> <li>Add 5mL of Enzyme B to each of the other pH text tubes.</li> <li>Allow the reactions to take place for five minutes and then test for the amount of sugar in each test tube using tes tape.</li> <li>Record results in table.</li> </ol>	<ul style="list-style-type: none"> <li>Hypothesis is appropriately worded.</li> <li>Logical hypothesis.</li> <li>A brief risk assessment is provided.</li> <li>Method is appropriate.</li> <li>Method is numbered <b>and in sequence</b>.</li> <li>Method generally reflects what is being investigated.</li> <li>Conclusion is appropriately worded.</li> <li>Conclusion reflects the hypothesis provided. .... 7</li> </ul>						
<p><b>Conclusion:</b> The optimum pH for both Enzyme A and B was quite different. Enzyme A produced most product in a pH range around 6 whereas Enzyme B produced most product at a pH of 4, indicating that the enzymes have different optimum conditions in relation to pH.</p>	<ul style="list-style-type: none"> <li>Hypothesis is <b>appropriate</b>.</li> <li>Logical hypothesis.</li> <li>A brief risk assessment is provided.</li> <li>Method is appropriate.</li> <li>Method is numbered.</li> <li>Method generally reflects what is being investigated.</li> <li>Conclusion is appropriately worded.</li> <li>Conclusion generally reflects the hypothesis provided. .... 6</li> </ul>						
	<ul style="list-style-type: none"> <li>Hypothesis is adequate.</li> <li><b>Somewhat</b> logical hypothesis.</li> <li>A brief risk assessment is provided.</li> <li>Method is appropriate.</li> <li>Method is numbered.</li> <li>Method reflects what is being investigated, with <b>some imperfections</b>.</li> <li>Conclusion is <b>adequately</b> worded. .... 5</li> </ul>						

## Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide
	<ul style="list-style-type: none"> <li>• Hypothesis is adequate.</li> <li>• Somewhat logical hypothesis.</li> <li>• A risk assessment is provided.</li> <li>• Method is appropriate.</li> <li>• Method reflects what is being investigated with some imperfections.</li> <li>• Conclusion is adequately worded. . . . . 4</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Hypothesis is poor.</li> <li>• A risk assessment is provided.</li> <li>• Method is adequate.</li> <li>• Method reflects what is being investigated with many imperfections.</li> <li>• Conclusion is adequately worded. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Hypothesis is provided yet not worded well.</li> <li>• A risk assessment is provided.</li> <li>• Method is in numbered steps. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Hypothesis is provided yet not worded well.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• A risk assessment is provided.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• Method is in numbered steps. . . . . 1</li> </ul>
<p><b>Question 20</b></p> <p>The cell is constantly producing wastes as a product of metabolic activity. If these wastes are not removed from the cell and are allowed to accumulate, they can slow down the metabolism of the cell and ultimately poison it. For example, ammonia is extremely toxic to cells and must be either excreted or transformed into a less harmful substance.</p>	<p>9.2.3 H4, H6</p> <ul style="list-style-type: none"> <li>• Outlines that cells produce wastes.</li> <li>• Outlines why cells must remove such wastes.</li> <li>• Gives an example of a metabolic waste material. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Outlines that cells produce wastes.</li> <li>• Outlines why cells must remove such wastes. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Outlines that cells produce wastes.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• Outlines why cells must remove such wastes. . . . . 1</li> </ul>
<p><b>Question 21</b></p> <p>(a) DNA hybridisation can be a useful tool in determining the genetic distance between two species. If two species show a high degree of complementarity in their DNA, they are more closely related than two species that show a lower degree of complementarity. The more closely related species will have more similar DNA, and will therefore have a higher degree of complementarity: a correspondence or similarity between nucleotides of DNA or RNA molecules that allows precise pairing of bases</p> <p>(b) One other way biochemistry can be used in support of evolutionary theory is by comparing proteins found in common among different species. One such example is <i>cytochrome c</i>. This protein is found in many different living things and has been studied extensively to develop a 'molecular clock'.</p>	<p>9.3.1 H4, H10</p> <ul style="list-style-type: none"> <li>• Clear explanation given, linking degree of DNA hybridisation with genetic distance between two species. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Minimal explanation given; weak or poor link between degree of hybridisation and genetic distance between species. . . . . 1</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Outlines one other way biochemistry can be used in support of evolutionary theory. . . 1</li> </ul>

## Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide
<b>Question 22</b>	
<p>(a) Chargaff's research clearly indicates that there exists a regular pattern of ratios between the nucleotides of A and T and likewise between C and G. This is due to the fact that within the DNA molecule A always binds with T and, likewise, C always binds with G. When a sequence of DNA is sampled, the parts that bind together will always be found in similar ratios.</p>	<p>9.3.3 H9, H14</p> <ul style="list-style-type: none"> <li>• Correctly identifies ratios of A-T and C-G. AND</li> <li>• Provides correct reasons for the linkage in the ratios. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Correctly identifies ratios of A-T and C-G. OR</li> <li>• Provides correct reasons for the linkage in the ratios. . . . . 1</li> </ul>
<p>(b) From Chargaff's results, researchers knew that the DNA molecule must be a double-stranded molecule, since complementary base pairs were always found in almost matching ratios. Also, the fact that the base pairs were joined in the middle of the molecule makes sense in light of the findings of Chargaff's research.</p>	<p>9.3.4 H9</p> <ul style="list-style-type: none"> <li>• Clear explanation linking Chargaff's ratios of nucleotides to the discovery of the structure of DNA, including the binding of complementary base pairs and the double-stranded nature of the DNA molecule. . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Limited linking between Chargaff's research and the structure of the DNA molecule. OR</li> <li>• Identifies that DNA is a double-stranded molecule. . . . . 1</li> </ul>
<p>(c) The double-stranded and anti-parallel nature of the DNA molecule ensures that it is well-suited to self-replicate. Once enzymes have unzipped the molecule, each exposed DNA single strand acts as a template from which a new strand will be formed. Spare nucleotides are simply added onto the template DNA strand until the whole length of the DNA strand has been accurately copied.</p>	<p>9.3.4 H6, H9</p> <ul style="list-style-type: none"> <li>• Outlines DNA replication with reference to the double-stranded nature of the molecule. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Mentions a facet of DNA replication. OR</li> <li>• Mentions the double-stranded nature of the DNA molecule. . . . . 1</li> </ul>

**Question 23**

<p>(a) Theodor Boveri’s research with sea urchin larvae was instrumental in determining the role of the nucleus in inheritance. Prior to his work, it was unknown what part of the cell was responsible for the transmission of heritable traits. Boveri crossed two species of sea urchins with the important preparatory step of removing the nucleus from the egg. The resultant sea urchin larva only exhibited genetic traits of the sperm, whose nucleus had remained intact for the experiment. Boveri’s experiments clearly indicated that it was the nucleus of the cell that carried the important role of inheritance.</p>	<p>9.3.3 H1, H6, H9</p> <ul style="list-style-type: none"> <li>Clearly describes Boveri’s main contributions to understanding of genetics and inheritance, including a reference to his research subject. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Minimal description of Boveri’s contributions, including a reference to his research subject.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Describes main contributions of Boveri without reference to his research subject. . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Mentions a facet of Boveri’s work.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Names Boveri’s research subject. . . . . 1</li> </ul>
<p>(b) T. H. Morgan was researching genetic traits in the fruit fly <i>Drosophila</i> when he made a chance discovery. He observed that one of the males had white eyes as opposed to the usual red eyes. With careful test crosses with the white-eyed fly, Morgan described a new form of inheritance for the first time: sex-linked genes. These sex-linked traits do not follow the usual patterns of Mendelian ratios since the gene is located on the sex chromosome X.</p>	<p>9.3.3 H1, H6, H9</p> <ul style="list-style-type: none"> <li>Clearly describes main contributions of Morgan to understanding of genetics and inheritance, including a reference to his research subject. . . . . 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Minimal description of Morgan’s contributions, including a reference to his research subject.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Describes main contributions of Morgan without reference to his research subject . . . . . 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Mentions a facet of Morgan’s work.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Names Morgan’s research subject . . . . . 1</li> </ul>

**Question 24**

<p>An example of a transgenic species that has been produced and is grown on a wide scale is ‘Ingard’ cotton. This variety of cotton is resistant to insect pests because it produces a toxin from the bacteria <i>Bacillus thuringiensis</i> (Bt). This cotton variety was produced to reduce the amount of crop loss due to insects. As a result of the introduction of this gene into the cotton, farmers do not need to use as much chemical spray to keep the pests from destroying their plant. The Ingard cotton was produced by identifying the Bt gene in the bacterium, excising it from the bacterial DNA and then inserting it into the cotton DNA using recombinant DNA techniques. Since the Bt gene is now part of the cotton DNA, as the plant grows it automatically produces the Bt toxin, protecting itself from pests.</p>	<p>9.3.5 H3, H4, H6</p> <ul style="list-style-type: none"> <li>Describes a process used to produce a transgenic species.</li> <li>Provides reasons for the use of the transgenic species.</li> <li>Names the transgenic species. . . . . 4–5</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Describes a process used to produce a transgenic species.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Provides reasons for the use of the transgenic species.</li> </ul> <p>AND</p> <ul style="list-style-type: none"> <li>Names the transgenic species. . . . . 2–3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Names the transgenic species. . . . . 1</li> </ul>
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**Question 25**

(a) Malaria or other correct example.	9.4.3 H7 • Identifies disease caused by a protozoan. 1
(b) A protozoan has membrane-bound organelles and no cell wall, whereas a bacterium has no membrane-bound organelles but does have a cell wall.	• Outlines two structural differences between a protozoan and a bacterium. . . . . 2 • Outlines one structural difference between a protozoan and a bacterium. . . . . 1

**Question 26**

(a) Incidence of Melanoma in NSW 93-02	9.4.6 H13,14 • Constructs two line graphs on one set of axes including a title and key to identify graphs. • Labelled axes with units on y-axis. • Suitable scales on both axes and adequate size. • Correctly plotted points. . . . . 5
<p>rate per 100 000 population</p> <p>year</p> <p>males</p> <p>females</p>	• Constructs two line graphs on same set of axes. • Axes labelled with units. • Scales adequate. . . . . 4
	• Constructs a line graph. • Axes labelled. • Scale adequate. . . . . 3
	• Axes labelled. • Scale adequate. . . . . 2
	• Axes labelled. . . . . 1
	(b) The incidence of melanoma fluctuates throughout the period of the study for both sexes. There is no identifiable trend so it is difficult to extrapolate for 2005. (It is possible the incidence could continue to increase for men.)

**Question 27**

Two types of T cells are killer (cytotoxic) T cells and helper T cells. Killer T cells secrete substances that destroy infected body cells containing viruses, inhibiting viral replication, whereas helper T cells stimulate B cells to reproduce and form plasma cells. They also secrete proteins that stimulate other T cells and B cells.	9.4.3, 9.4.5 H6 • Correctly names two types of T cells and contrasts their roles. . . . . 3 • Correctly names two types of T cells and assigns a correct role to one of them. . . . . 2 • Correctly names two types of T cells. . . . . 1
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**Question 28**

Infectious diseases can cause illness, disability and death in individuals as well as disrupting whole populations and economies. National borders offer little resistance to the transmission of infectious diseases, especially as people are now able to travel so easily and quickly from one country to another.

Australia is fortunate in being an island continent away from large centres of population where the spread of disease is more likely. Quarantine regulations with respect to entry of animals, plants and materials that may be likely sources of pathogens have resulted in Australia being free of diseases such as rabies and ‘foot and mouth’, which are common in other parts of the world. Public health programs, the use of pesticides and immunisation programs also help to prevent the spread of infectious disease. However, the continuing increase in resistance of microbes to antibiotics has become pervasive in Australia and worldwide, diminishing the capacity of the country to respond to microbial threats.

9.4.3, 9.4.5, 9.4.7	H1, H4
<ul style="list-style-type: none"> <li>Identifies the issues in the statement in question and provides points for and against including relevant examples. . . . . 4</li> </ul>	
<ul style="list-style-type: none"> <li>Identifies the issues in the statement in question and provides points for or against. . . . . 2–3</li> </ul>	
<ul style="list-style-type: none"> <li>Identifies the issues in the statement. . . . 1</li> </ul>	

**Question 29**

(a) *Colletotrichum lupini*.

(b) Treat seeds for seven days at 65–70°C.

(c) The experiment included a control group, large numbers of seeds of the same species and repetition, so the results are likely to be reliable. However, the effect of heat on seed germination would need to be determined.

The results are important as they suggest a method by which seeds can be treated so that yield of this plant (used for stockfood) can be increased.

9.4.2, 9.4.7	H12, H14
<ul style="list-style-type: none"> <li>Identifies correct organism. . . . . 1</li> </ul>	
<ul style="list-style-type: none"> <li>Identifies correct time interval and temperature range. . . . . 1</li> </ul>	
<ul style="list-style-type: none"> <li>Makes a judgment with evidence about the reliability or otherwise of the data.</li> </ul>	
AND	
<ul style="list-style-type: none"> <li>A judgment about the importance of the data. . . . . 2</li> </ul>	
<ul style="list-style-type: none"> <li>Makes a judgment with evidence about the reliability or otherwise of the data.</li> </ul>	
OR	
<ul style="list-style-type: none"> <li>A judgment about the importance of the data. . . . . 1</li> </ul>	

**Section II**

**Question 30 Communication**

Sample answer		Syllabus content, course outcomes and marking guide								
(a)	(i) The pitch of a sound depends on the frequency of the vibration producing the note. As frequency increases, the pitch of a sound increases.	9.5.5	H13 <ul style="list-style-type: none"> <li>Identifies the relationship between frequency and pitch. .... 1</li> </ul>							
(ii)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;"><i>Structures used by grasshoppers to produce sound</i></th> <th style="width: 50%; text-align: center;"><i>Structures used by humans to produce sound</i></th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Comb-like row of pegs on inner surfaces of hind legs scraped against hard edges of front legs. Or, crickets rub their wings together. Or, in cicadas, muscles attached to tymbals contract, causing them to buckle, which produces a pulse of sound.</td> <td style="padding: 5px;">Lungs and associated muscles, larynx in throat housing vocal cords, tongue, teeth, lips, cheeks, palates and nasal cavity.</td> </tr> <tr> <td style="padding: 5px;">Body parts rubbed together, such as legs against wings.</td> <td style="padding: 5px;">Air passes from lungs through vocal cords in the larynx; tightness of vocal cords determines pitch; movements of mouth, lips and tongue form sounds.</td> </tr> <tr> <td colspan="2" style="padding: 5px; text-align: center;">Both sets of structures produce vibrations.</td> </tr> </tbody> </table>	<i>Structures used by grasshoppers to produce sound</i>	<i>Structures used by humans to produce sound</i>	Comb-like row of pegs on inner surfaces of hind legs scraped against hard edges of front legs. Or, crickets rub their wings together. Or, in cicadas, muscles attached to tymbals contract, causing them to buckle, which produces a pulse of sound.	Lungs and associated muscles, larynx in throat housing vocal cords, tongue, teeth, lips, cheeks, palates and nasal cavity.	Body parts rubbed together, such as legs against wings.	Air passes from lungs through vocal cords in the larynx; tightness of vocal cords determines pitch; movements of mouth, lips and tongue form sounds.	Both sets of structures produce vibrations.		H3, H13 <ul style="list-style-type: none"> <li>Identifies the structures used to produce sound in humans and one other animal</li> <li>Clearly shows how they are similar and/or different. .... 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Identifies some of the structures used to produce sound in humans and one other animal</li> <li>Shows how they are similar and/or different. .... 2</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Identifies the structures used to produce sound in humans and one other animal. .... 1</li> </ul>
<i>Structures used by grasshoppers to produce sound</i>	<i>Structures used by humans to produce sound</i>									
Comb-like row of pegs on inner surfaces of hind legs scraped against hard edges of front legs. Or, crickets rub their wings together. Or, in cicadas, muscles attached to tymbals contract, causing them to buckle, which produces a pulse of sound.	Lungs and associated muscles, larynx in throat housing vocal cords, tongue, teeth, lips, cheeks, palates and nasal cavity.									
Body parts rubbed together, such as legs against wings.	Air passes from lungs through vocal cords in the larynx; tightness of vocal cords determines pitch; movements of mouth, lips and tongue form sounds.									
Both sets of structures produce vibrations.										
(b)	(i) After examining the exterior of the eye and removing excess fat and muscle, a scalpel was used to pierce the sclera beyond the cornea. Once an incision was made, The cut was completed with scissors to reduce the risk of slippage. The scissors were used to cut around the eyeball separating the front part of the eye from the back. The structures found inside the eye were identified and the lens was removed from the vitreous humor. After demonstrating the converging power of the lens, the layers inside the eyeball were investigated.  If using a scalpel due to the toughness of the sclera, slippage of the scalpel and consequent cuts would be risks. Inserting and removing scalpel blades is best done by a teacher.  Goggles and gloves were worn to protect the body from bacterial transmission. All waste from the dissection was wrapped in newspaper then sealed in a plastic bag before disposal.	9.5.2	H11, H12, H13 <ul style="list-style-type: none"> <li>Describes the method used to investigate the interior of the eye, including the means by which hazards were minimised and waste materials disposed of. .... 4</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Identifies the method used to investigate the interior of the eye and the means by which hazards were minimised and waste materials disposed of. .... 3</li> </ul> <hr/> <ul style="list-style-type: none"> <li>Identifies the method used to investigate the interior of the eye.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>The means by which hazards were minimised and waste materials disposed of. .... 1-2</li> </ul>							

Question 30 Communication (Continued)

Sample answer		Syllabus content, course outcomes and marking guide						
(ii)	<table border="1"> <thead> <tr> <th>Structure</th> <th>Relationship between anatomy and function</th> </tr> </thead> <tbody> <tr> <td>Lens</td> <td>Clear, crystalline, biconvex body, which transmits and refracts light, focusing an image on the retinal surface.</td> </tr> <tr> <td>Vitreous humor</td> <td>Clear, jelly-like fluid between the lens and the retina which transmits and refracts light and helps to maintain the shape of the eyeball.</td> </tr> </tbody> </table>	Structure	Relationship between anatomy and function	Lens	Clear, crystalline, biconvex body, which transmits and refracts light, focusing an image on the retinal surface.	Vitreous humor	Clear, jelly-like fluid between the lens and the retina which transmits and refracts light and helps to maintain the shape of the eyeball.	<ul style="list-style-type: none"> <li>Identifies two structures in the eye's interior and relates the anatomy of each structure to its function. .... 2</li> <li>Identifies one structure in the eye's interior and relates its anatomy to its function.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Identifies two structures in the eye's interior..... 1</li> </ul>
Structure	Relationship between anatomy and function							
Lens	Clear, crystalline, biconvex body, which transmits and refracts light, focusing an image on the retinal surface.							
Vitreous humor	Clear, jelly-like fluid between the lens and the retina which transmits and refracts light and helps to maintain the shape of the eyeball.							
(c)	<p>Two technologies designed to improve human hearing are the hearing aid and the cochlear implant.</p> <p>A hearing aid is a battery-operated device attached to a part of the ear to make sounds louder. It amplifies vibrations so that they can physically stimulate the nerves of the cochlea. Hearing aids benefit people who have some residual hearing but who may have damage to a part of the outer or middle ear resulting in conduction deafness. They are relatively inexpensive and do not require any surgery. The limitations of this technology include the fact they are not useful for people with damage to the inner ear or auditory nerve and that they have an effective distance limited to three metres. Users can also experience sounds that are painfully loud and background noise can be a problem.</p> <p>A cochlear implant substitutes for part of the ear by stimulating nerve fibres in the inner ear, bypassing the normal auditory pathway. It does not make the sound louder but enables a user to detect a wider range of sounds than a hearing aid. It is useful for profoundly deaf people who would receive no help from a hearing aid. A cochlear implant can be inserted in childhood and programmed to an individual's requirements, resulting in significant gains in sound awareness, speech understanding and speech production over a period of time.</p> <p>Limitations of the cochlear implant include the expense of surgery and possible post-operative side effects. The quality of the sound varies (tends to be 'robotic') and it needs to be programmed to suit the wearer's hearing needs and adjusted for different situations. It gathers sound from only one side so there are limitations in determining direction of sound. Extensive training will be required to be able to recognise sounds and decode what is heard, such as speech. The small size of the device means it cannot take rechargeable batteries so there are ongoing costs.</p>	<p>9.5.6 H3, H4, H13</p> <ul style="list-style-type: none"> <li>Discusses the benefits and limitations of each of two named technologies that have been designed to improve human hearing. .... 6-7</li> <li>Describes a benefit and limitation of each of two named technologies designed to improve human hearing. .... 4-5</li> <li>Describes a benefit.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>Limitation of each of two named technologies designed to improve human hearing. .... 2-3</li> <li>Identifies two technologies designed to improve human hearing. .... 1</li> </ul>						
(d)	(i)	<p>An action potential is a nerve impulse generated when the cell membrane of a neurone is depolarised by a stimulus. If the depolarisation is strong enough to reach the threshold level, a change in permeability of the membrane occurs and a flow of ions is the result. The change in polarity passes along the axon and across the gap between neurones by means of a neurotransmitter.</p>	<p>9.5.7 H12, H13, H14, H6</p> <ul style="list-style-type: none"> <li>Describes at least two characteristics and/or features of an 'action potential'. .... 2</li> <li>Describes a characteristic or feature of an 'action potential'..... 1</li> </ul>					

Question 30	Communication (Continued)	Syllabus content, course outcomes and marking guide
	Sample answer	H2
		<ul style="list-style-type: none"> <li>• Both values and units correct. . . . . 2</li> </ul>
(ii) Resting potential = $-70$ mV Time taken to reach threshold = $0.70 - 0.75$ ms.		<ul style="list-style-type: none"> <li>• One value and unit correct.</li> </ul>
		OR <ul style="list-style-type: none"> <li>• Both values correct without units. . . . . 1</li> </ul>
(iii) Photoreceptor cells (rods and cones) located in the retina, at the back of the eye, are stimulated by light energy. These cells contain light sensitive pigments that absorb light and convert it into electrochemical signals. If the amount of light falling on a photoreceptor cell does not reach the threshold level of intensity, no impulse will be generated as the depolarisation of the cell's membrane is not great enough and an action potential does not occur. Each stimulus produces either a full action potential or none at all. If no action potential is generated no nerve impulse is sent to the brain.		H2, H6
		<ul style="list-style-type: none"> <li>• Explains, using a clear cause and effect relationship and some detail of the structure of the retina, why the stimulus of light does not always generate an action potential in the photoreceptor cells of the eye. Identifies the consequences of this. . . . . 4</li> </ul>
		<ul style="list-style-type: none"> <li>• Explains, using a clear cause and effect relationship, why the stimulus of light does not always generate an action potential in the photoreceptor cells of the eye. Identifies a consequence. . . . . 3</li> </ul>
		<ul style="list-style-type: none"> <li>• Describes why the stimulus of light does not always generate an action potential in the photoreceptor cells of the eye. . . . . 2</li> </ul>
		<ul style="list-style-type: none"> <li>• Identifies why an action potential is not always generated. . . . . 1</li> </ul>

Question 31	Biotechnology	Syllabus content, course outcomes and marking guide	
Sample answer			
(a)	(i) DNA is a double-stranded molecule while RNA is only single-stranded.	9.6.4,	H9
		<ul style="list-style-type: none"> <li>• Correctly identify the major structural difference between DNA and RNA. . . . . 1</li> </ul>	
	(ii) The polymerase chain reaction (PCR) process involves the use of the enzyme DNA polymerase, whose role is to copy strands of DNA. The DNA is heated to a point where the double-stranded structure breaks down. Then the DNA polymerase builds new complementary strands of DNA on the exposed single strands of DNA. This cycle is repeated many times over to amplify the number of DNA sequences to millions of copies. This process is of great value in forensic science, where even the smallest sample of tissue or blood can reveal a full complement of DNA for identification, but the process is also widely used for creating many copies of a gene that might be inserted into cells in recombinant DNA techniques.	9.65	H9
		<ul style="list-style-type: none"> <li>• Describes the process of the polymerase chain reaction with reference to its application in biotechnology..... 3</li> </ul>	
		<ul style="list-style-type: none"> <li>• Outlines the process of the polymerase chain reaction. . . . . 2</li> </ul>	
		<ul style="list-style-type: none"> <li>• Lists some steps of the polymerase chain reaction. . . . . 1</li> </ul>	
(b)	(i) We set up a simple apparatus to demonstrate the process of fermentation by yeast to produce alcohol: 1. Add sugar solution with a small amount of citric acid to a flask. 2. Add one spoonful of dried yeast. 3. Stopper flask with a two-holed stopper. In one hole insert glass U-tube. 4. Insert end of glass U-tube in a test tube of limewater. 5. Observe appearance of limewater at beginning of fermentation. 6. In second hole of stopper insert carbon dioxide sensor for datalogger. 7. Set up datalogger to record carbon dioxide levels and leave apparatus for 48 hours. 8. Observe limewater to see if carbon dioxide has been given off. 9. Download and analyse data from datalogger. 10. Distill flask contents and test by combustion to determine if alcohol has been produced. Note: simpler answers should be accepted, but marked to the same standard as outlined in the marking guide.	9.6.2	H11, H15
		<ul style="list-style-type: none"> <li>• Method of fermentation clearly outlined in step-wise fashion.</li> <li>• Indication of how results/measurements were obtained.</li> <li>• Indication of tests that were performed to determine that fermentation had occurred. . . . . 4</li> </ul>	
		<ul style="list-style-type: none"> <li>• Method of fermentation outlined in steps.</li> <li>• Indication of how results/measurements were obtained. . . . . 3</li> </ul>	
		<ul style="list-style-type: none"> <li>• Method of fermentation outlined. . . . . 2</li> </ul>	
		<ul style="list-style-type: none"> <li>• Some steps in method of fermentation given. . . . . 1</li> </ul>	