

Student Number

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***PEM***

**2014**

**TRIAL HIGHER SCHOOL CERTIFICATE  
EXAMINATION**

# Biology

## General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen  
Black pen is preferred
- Draw diagrams using pencil
- Board-approved calculators  
may be used
- Write your Student Number  
where required

**Total Marks – 100**

## Section I

**75 marks**

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1 – 20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21 – 33
- Allow about 1 hour and 40 minutes for  
this part

## Section II

**25 marks**

Attempt ONE question from Questions 34 – 38  
Allow about 45 minutes for this section

### Directions to School or College

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**Section 1**  
**75 Marks**

**Part A - 20 marks**

**Attempt Questions 1 – 20**

**Allow about 35 minutes for this part**

Use the multiple choice answer sheet provided for Questions 1 – 20

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- 1 A student made the following description of a cell undergoing meiosis that she observed in some diagrams “The homologous pairs of chromosomes are separating towards the poles on the spindle”.

The student was describing which phase of meiosis?

- (A) Telophase I
  - (B) Metaphase I
  - (C) Prophase I
  - (D) Anaphase I
- 2 An organism was found to lie out in the sun in the morning to raise its body temperature above that of the ambient temperature in order to increase its metabolism and then it moves under the shade in the middle of the day to reduce its body temperature below that of the surrounds. This organism is most likely an:
- (A) exotherm.
  - (B) endotherm.
  - (C) ectotherm.
  - (D) homeotherm.
- 3 Which of the following, matches the structures correctly with their characteristics?

	<b>Artery</b>	<b>Vein</b>	<b>Capillary</b>
(A)	Carries oxygenated blood	Carries deoxygenated blood	Carries oxygenated and deoxygenated blood
(B)	Has thin muscular walls and one way valves	Has thick elastic muscular walls	Has thin one cell thick walls
(C)	Carries deoxygenated blood	Carries oxygenated blood	Carries oxygenated and deoxygenated blood
(D)	Has thick elastic muscular walls	Has thin muscular walls and one way valves	Has thin one cell thick walls

4 Match the substances and the best answer as to how they are carried in the body.

	<b>Oxygen</b>	<b>Carbon dioxide</b>	<b>Urea</b>	<b>Glucose</b>
(A)	Dissolved in plasma	Dissolved in plasma	Bound to haemoglobin	Dissolved plasma ions and bound to haemoglobin
(B)	Dissolved plasma ions and bound to haemoglobin	Dissolved in plasma	Dissolved in plasma	Bound to haemoglobin
(C)	Bound to haemoglobin	Dissolved plasma ions and bound to haemoglobin	Dissolved in plasma	Dissolved in plasma
(D)	Bound to haemoglobin	Dissolved in plasma	Dissolved plasma ions and bound to haemoglobin	Dissolved in plasma

5 The pulse oximeter is used in hospitals to measure the blood concentration of:

- (A) carbon dioxide levels.
- (B) oxygen and carbon dioxide levels.
- (C) oxygen levels.
- (D) oxygen, carbon dioxide and nitrogen levels.

6 The hormone released by the adrenal gland to control salt levels in the kidney is:

- (A) aldosterone.
- (B) anti-diuretic hormone.
- (C) adrenalin.
- (D) insulin.

7 Which of the following characteristics would be an adaptation an Australian plant would possess to minimize water loss?

- (A) Large flat leaf shape.
- (B) Sunken stomates.
- (C) Large air spaces in the mesophyll tissue.
- (D) Many stomates on the upper and lower leaf surface.

- 8** It has been noted after using high levels of pesticides on farms for many years, that the pesticides seem to have less effect on the insects. Darwin would explain this as being most likely due to:
- (A) Some insects individually developing resistance, surviving and passing the resistance on to the offspring.
  - (B) Some insects individually possessing resistance, surviving and passing the resistance on to the offspring.
  - (C) The pesticides causing the insects to metamorphose into “Super Bugs”.
  - (D) The pesticides are past their “use by” date.
- 9** A bushwalker was hiking in the bush and ran out of clean drinking water. He obtained some water from a local stream but was unsure as to its purity. The best way to make the water safe to drink would be to:
- (A) Filter the water through clean socks.
  - (B) Mix it with salt.
  - (C) Boil the water for ten minutes.
  - (D) Let the water stand for an hour.
- 10** A new species of snake has been found in Borneo which has 3 varietal colours; yellow, brown and patchy yellow and brown. If a yellow snake and a brown snake are mated then all the offspring are patchy yellow and brown. If two of the patchy yellow and brown snakes are mated the ratio of colours in the offspring are 1 yellow: 2 patchy yellow and brown: 1 brown.
- This ratio can be best explained by:
- (A) dominant recessive inheritance.
  - (B) co-dominant inheritance.
  - (C) sex-linked dominant inheritance.
  - (D) sex-linked recessive inheritance.
- 11** For which of the following is Thomas Hunt Morgan remembered?
- (A) The chromosomal theory of inheritance.
  - (B) The discovery of DNA hybridisation techniques.
  - (C) The “one gene – one protein” hypothesis.
  - (D) The discovery of genes on the sex chromosomes.

- 12 A sample of DNA was found to contain 30% guanine. The percentage of adenine would therefore be:
- (A) 20%.
  - (B) 30%.
  - (C) 40%.
  - (D) 70%.
- 13 Which of the following best describes how mitosis assists in the maintenance of health?
- (A) The formation of gametes.
  - (B) The growth of new hair cells.
  - (C) The differentiation of the zygote.
  - (D) The growth of new skin cells repairing a cut in the skin.
- 14 Malaria is caused by:
- (A) the *Anopheles* mosquito.
  - (B) the protozoan *Malaria sp.*
  - (C) the protozoan *Plasmodium sp.*
  - (D) the bacterium *Plasmodium sp.*
- 15 In defence against disease in the human body, cilia and mucous membranes are considered to be part of the:
- (A) first line of defence and non-specific to the disease.
  - (B) first line of defence and specific to the disease.
  - (C) second line of defence and non-specific to the disease.
  - (D) second line of defence and specific to the disease.
- 16 In order to maintain water balance, freshwater fish survive by:
- (A) drinking water, producing large quantities of dilute urine and actively excreting salt through their gills.
  - (B) drinking water, producing little amounts of concentrated urine and actively excreting salt through their gills.
  - (C) not drinking water, producing little amounts of concentrated urine and actively absorbing salt through their gills.
  - (D) not drinking water, producing large quantities of dilute urine and actively absorbing salt through their gills.

- 17** The scientists Watson, Crick, Franklin and Wilkins were responsible for:
- (A) the discovery of recombinant DNA technology.
  - (B) the discovery of restriction enzymes to cut DNA.
  - (C) founding the laws of segregation and independent assortment.
  - (D) using modelling and X-ray crystallography to help determine the structure of DNA.
- 18** A mutation occurred causing a significant change of several bases in the DNA sequence of a section of DNA. This would most likely lead to:
- (A) no change in the polypeptide created causing no change in the cell functioning.
  - (B) a change in the polypeptide created causing a change in the cell functioning.
  - (C) no change in the amino acid sequence created causing a change in the cell functioning.
  - (D) a change in the peptide bonds causing a change in the cell functioning.
- 19** An example of the effect of the environment on the phenotype of an organism is:
- (A) skin cells forming extra melanin on exposure to the sun.
  - (B) two brothers having different eye colour.
  - (C) brown hair due to two brown hair alleles.
  - (D) two twins growing to the same height when being brought up in different countries.
- 20** Antibodies are produced by:
- (A) Plasma B-lymphocytes
  - (B) Memory B-lymphocytes
  - (C) Helper T-lymphocytes
  - (D) Cytotoxic T-lymphocytes

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Student Number

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**Section 1 (continued)**

**Part B – 55 marks**

**Attempt Questions 21 - 33**

**Allow about 1 hour and 40 minutes for this part.**

Answer the questions in the spaces provided.

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**Question 21 (4 marks)**

(a) Gregor Mendel is often considered as the “father of genetics”. Outline two of the aspects of his experimental techniques that made his experiments so successful.

**2**

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(b) Why were his results ignored for so long?

**2**

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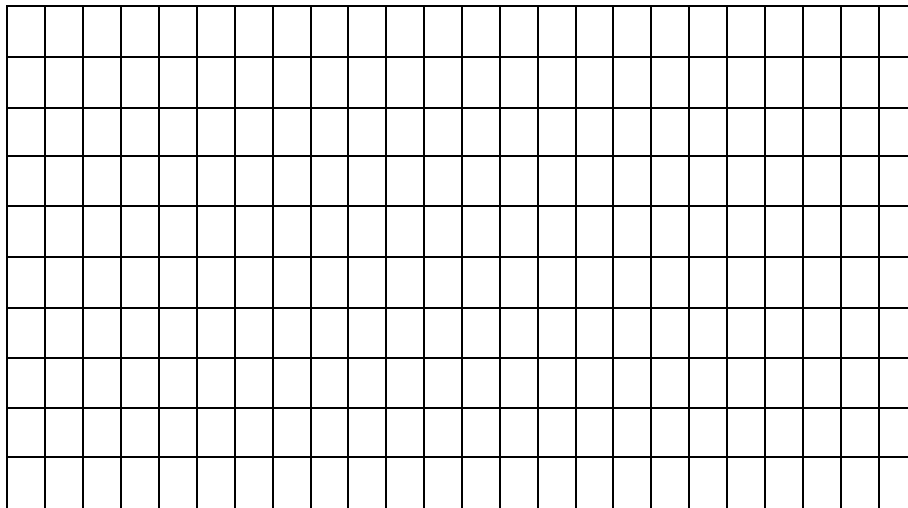
**Question 22** (4 marks)

Some students performed an experiment to test the effect of pH on enzyme activity. They prepared test tubes of hydrogen peroxide at different pH's and added 1cm<sup>3</sup> of potato containing the enzyme catalase to the hydrogen peroxide. They measured the height of bubbles of oxygen produced by the reaction as a measure of the activity of the enzyme. The experiment ran for 10 minutes.

(a) Use the results they obtained in the following table to draw an appropriate graph on the grid provided below.

**3**

pH	Height of Bubbles (cm)
2	1.8
4	3.2
6	4.5
7	4.7
9	4.4
11	3.1



(b) Describe the relationship between pH and enzyme activity as shown in the above results.

**1**

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**Question 23** (6 marks)

(a) Draw and label a longitudinal section of a plant vascular bundle to show the xylem, phloem and cambium tissues.

**3**

(b) Describe a current theory that explains how plants transport water throughout the plant.

**3**

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**Question 24** (5 marks)

During your course you performed an experiment to test the effect of carbon dioxide on the pH of water.

(a) Describe how you performed this experiment and the results you obtained.

**3**

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(b) Explain why it is necessary for the removal of carbon dioxide from the blood.

**2**

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**Question 25** (3 marks)

Describe how the neo-Darwinism concept of punctuated equilibrium differs from the original process proposed by Darwin with evidence to support the change in ideas.

**3**

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**Question 26** (4 marks)

Compare, in table form, the similarities and differences between the human kidney and a renal dialysis machine.

**4**

**Question 27** (2 marks)

Palaeontology is one area used as evidence to support the theory of evolution. Describe with specific examples, how two other areas of study are used to support the theory of evolution.

**2**

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**Question 28** (6 marks)

The use of transgenic species or genetically modified organisms (GMO's) in food is a hotly contested topic in some areas of the media.

**6**

Analyse and evaluate the increased use of GMO's in agriculture discussing the ethics involved using named examples.

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**Question 29** (3 marks)

Sexually reproductive species are theoretically more likely to survive in a changing environment due to increased variation in the species, than asexually reproductive species. Explain how sexual reproduction increases variation.

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**Question 30** (4 marks)

Complete the following table.

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<b>Pathogen type</b>	<b>Structure</b>	<b>Example of disease caused</b>
<b>Prion</b>		
	<b>DNA or RNA enclosed in protein coat</b>	
		<b>Cholera</b>
<b>Protozoan</b>		

**Question 31** (4 marks)

Some of the people living in Gropertown on the Bay of Crabs have started to develop symptoms of itching, skin discolouration, and swelling and in some cases sensory impairment (vision, hearing, and speech), disturbed sensation and a lack of coordination. The town’s major industry is fishing although a new chemical factory has started up on the far side of the bay. Many of the townspeople are dependent on fish for their major food source although some prefer to eat the meat of the surrounding cattle farms and these people do not seem to be affected by the symptoms.

4

Design an epidemiological study to investigate the origin of the disease.

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**Question 32** (2 marks)

Discuss how a named disease results from an imbalance of microflora in humans.

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**Question 33** (8 marks)

Discuss using named examples how our increased understanding of the causes and transmission of disease and the immune system have led to modern methods of treatment, control and prevention of disease. Evaluate the methods discussed.

**8**

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## Section II

**25 Marks**

**Attempt ONE question from Questions 34 – 38**

**Allow about 45 minutes for this section**

Answer the question in the Section II Answer Booklets.

Extra writing booklets are available.

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	Page
Question 34    Communication.....	17
Question 35    Biotechnology .....	18
Question 36    Genetics: The Code Broken? .....	20
Question 37    The Human Story.....	22
<i>Question 38    Biochemistry (Not included in this paper)</i>	



**Question 34 - Communication (25 marks)**

Answer the question in the Section II Answer Booklets.

- (a) Draw a table in your answer book to indicate the type of receptor used for the following senses: touch, taste, hearing and sight. Eg: Smell: chemoreceptor. **2**
- (b) Draw a table to compare the wavelengths of the electromagnetic spectrum detected by humans and two other organisms giving reasons for the differences in the ranges. **3**
- (c) As people get older more layers of crystallin protein fibres are replaced in the lens of the eye, enlarging it and causing it to become denser and less elastic. **4**  
Describe the effect of this on the person's ability to focus on objects and assess two technologies that can be used to correct the problem.
- (d) Describe the nature and functioning of photoreceptor cells in mammals, insects and one other animal **3**
- (e) Draw a table to compare the structures used by three named animals, other than humans, to produce sound. **3**
- (f) Outline, in table form, how insects, fish and mammals detect vibrations. **4**
- (g) Discuss and evaluate how our increased understanding of the brain, the nervous system, the ear and the eye have led to technologies that have the potential to help the profoundly deaf and possibly blind people. **6**

**End of Question 34**

**Question 35 - Biotechnology** (25 marks)

Answer the question in the Section II Answer Booklets.

(a) Describe an example of the use of biotechnology by an early society. **3**

(b) Prior to the 18<sup>th</sup> century biotechnological processes had been in use for centuries. Fermentation processes have expanded since the early 18<sup>th</sup> century.

(i) Outline an early fermentation process used prior to the 18<sup>th</sup> century. **1**

(ii) Explain how the use of a named organic compound produced by a fermentation process developed since the early 18<sup>th</sup> century impacted on society on its introduction. **3**

(c) Consider the following DNA sequence: TAC CAT TAG GGC TGG

In your answer booklet give the complementary sequences of the nucleic acids that would result from the following processes:

(i) Transcription **2**

(ii) Translation **1**

(iii) The following information gives the anticodons on the transfer RNA and their corresponding amino acids. In order, list the five amino acids that would be coded for by the 'read' or 'leading' strand of the DNA sequence above. **2**

Alanine – CGA	Isoleucine – UAG	Threonine – UGG
Arginine – GCA	Methionine – UAC	Tryptophan – ACC
Glycine – CCG	Proline – GGC	Tyrosine – AUG
Histidine – GUA	Stop – AUC	Valine – CAU

(d) Describe the steps used in the polymerase chain reaction (PCR) and discuss its uses. **4**

(e) Genetically modified cows have been developed in the United Kingdom to have larger rumps and shoulders in order to supply more meat for the market. In order to maintain the desired traits, animal cloning is needed to produce the herd. There was a large uproar when it was found that some of these animals had made it into food supplies as the government had yet to approve the use of these organisms for human consumption.

(i) Name with reference to a specific example, other than that described above, a transgenic organism and the reason why the organism was created. **1**

**Question 35 continues on page 19**

Question 35 (continued)

- (ii) Discuss and evaluate with the use of examples, the ethical and/or social issues associated with the use of biotechnology and analyse how realistic it is to compare artificial selection and DNA technology. 4
- (f) Describe and evaluate one example in detail of the application of biotechnology in medicine. 4

**End of Question 35**

**Question 36 - Genetics: The Code Broken? (25 marks)**

Answer the question in the Section II Answer Booklets.

(a) Fred has blood type A and his sister Cindy has blood type O but their father is blood type B. **3**

Indicating the type of inheritance involved, explain with the use of diagrams to support your answer, how Fred has blood type A, whilst Cindy has blood type O yet the father is blood type B.

(b) (i) In a species of plant, purple flowers (P) are dominant to white flowers (p) and round seeds (R) are dominant to wrinkled seeds (r). **2**

Using your knowledge of Mendel's work predict the phenotypic ratios of a cross between two plants that are heterozygous for both purple flowers and round seeds assuming independent inheritance. No Punnett square required.

(ii) If the genes for flower colour and seed shape were linked in that purple (P) was linked with wrinkled (r) and white (p) was linked with round (R) predict the difference in the genotypic and phenotypic ratios for the above cross showing all working. **3**

(c) Consider the following DNA sequence: TAC CAT TAG GGC TGG

In your answer booklet give the complementary sequences of the nucleic acids that would result from the following processes:

(i) Transcription **1**

(ii) Translation **1**

**Question 36 continues on page 20**

Question 36 (continued)

(iii) The following information gives the anticodons on the transfer RNA and their corresponding amino acids. In order, list the five amino acids that would be coded for by the 'read' or 'leading' strand of the DNA sequence above. **1**

Alanine – CGA	Isoleucine – UAG	Threonine – UGG
Arginine – GCA	Methionine – UAC	Tryptophan – ACC
Glycine – CCG	Proline – GGC	Tyrosine – AUG
Histidine – GUA	Stop – AUC	Valine – CAU

(iv) A mutation occurred changing the DNA sequence to:

TAG CAT TAG GGC TGG

Name this type of mutation and describe an example of a genetic disorder that is caused by this type of mutation? **3**

(d) Discuss some of the benefits and limitations of the Human Genome Project. **4**

(e) Describe and evaluate the use of gene therapy for an identified disease. **4**

(f) Draw a flow diagram to outline the sequence of events used in 'gene cloning' with an example of its use. **3**

**End of Question 36**

**Question 37 - The Human Story (25 marks)**

Answer the question in the Section II Answer Booklets.

- (a) Describe some of the characteristics that differentiate humans from one group of either prosimians, monkeys or apes. **3**
- (b) In the past the theories of human evolution and relationships with other primates were largely based on the fossil record and analysis of anatomical structures. However as technologies have improved and new techniques have been devised new conclusions are being drawn.
- (i) Outline the method of obtaining information from fossils and assess the use of fossils in studying the evolution of primates. **3**
- (ii) Discuss the new technologies and analyse how they may be used in determining human evolution and relationships with other primates. **7**
- (c) Explain the difference between polymorphism and clinal gradations with examples. **3**
- (d) Describe the cultural changes that occurred as humans developed into efficient hunters in organised co-operative groups and the possible impacts of this cultural development. **5**
- (e) Outline the purpose of the Human Genome Project and discuss its implications. **4**

**End of Question 37**

***Question 38 - Biochemistry – Not included in this paper.***

**End of Paper**



**2014 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION**

**BIOLOGY**

**Solutions and Marking Guidelines**

## Section 1 – Part A

1 mark each

Question	Answer	Syllabus Reference	Outcome(s) H
1	D	9.3.3 C2 D4	9
2	C	9.2.1 C2 D4 D8	6
3	D	9.2.2 C2 D3	6
4	C	9.2.2 C2 D1	6
5	C	9.2.2 C2 D2	3
6	A	9.2.3 C2 D7	6
7	B	9.2.3 C2 D9	6
8	B	9.3.1 C2 D1 C3 D2 9.3.4 C3 D4	7, 8, 10
9	C	9.4.2 C2 D1 C3 D2	3, 4
10	B	9.3.3 C2 D6	6, 9
11	D	9.3.3 C2 D6	1, 4, 9
12	A	9.3.3 C2 D3	2, 9
13	D	9.4.1 C2 D2	6
14	C	9.4.3 C3 D2	1, 4
15	A	9.4.4 C2 D1	6
16	D	9.2.3 C2 D3 C3 D4	6
17	D	9.3.4 C3 D5	1, 2, 4
18	B	9.3.4 C2 D5 C3 D3	1, 6, 10
19	A	9.3.3 C2 D9	6, 8
20	A	9.4.5 C2 D1 D2	6



## Section 1 – Part B

### Question 21 (a)

Syllabus Reference, Outcomes, Marking guide	Marks
9.3.2 C2 D1 D2 H2 H4	
<ul style="list-style-type: none"><li>• Outlines 2 aspects of Mendel’s work contributing to his success.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Outlines 1 aspect of Mendel’s work contributing to his success.</li></ul>	<b>1</b>
<b>Sample answer</b> Mendel used pure breeding lines and studied a large number of characteristics, one at a time so he was able to form conclusions about heredity. (Also could use large sample size, exact counts producing quantitative data)	

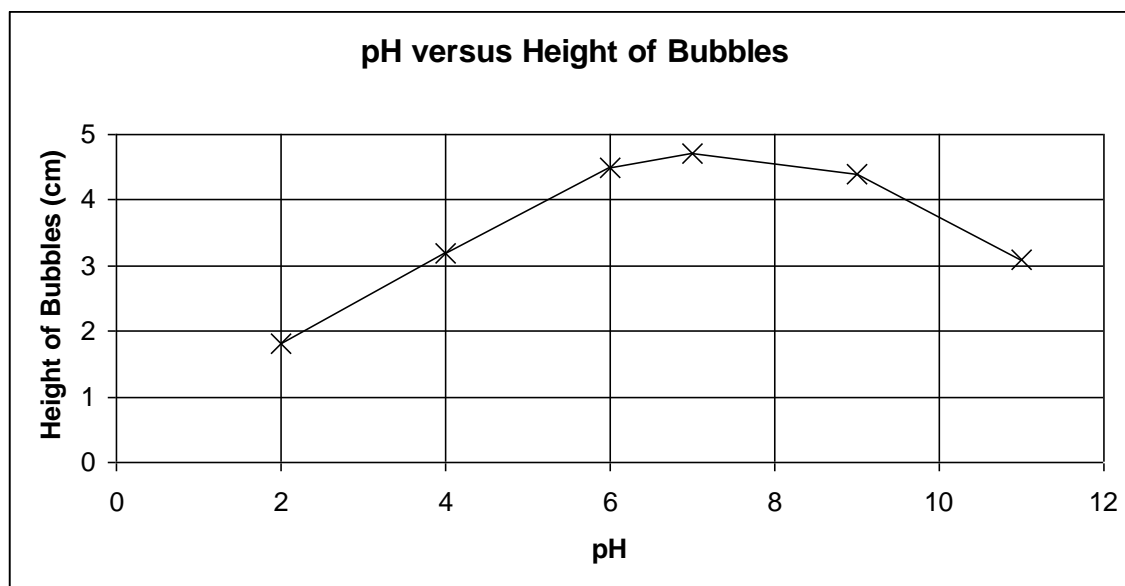
### Question 21 (b)

Syllabus Reference, Outcomes, Marking guide	Marks
9.3.2 C2 D1 D2 H2 H4	
<ul style="list-style-type: none"><li>• Outlines 2 aspects of why Mendel’s results were ignored</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Outlines 1 aspect of why Mendel’s results were ignored</li></ul>	<b>1</b>
<b>Sample answer</b> His paper and results were presented to only a small group of scientists; people did not really understand his results; he was not a recognised scientist.	

**Question 22 (a)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.2.1 C3 D1 H13	
<ul style="list-style-type: none"> <li>Correctly labels axes with pH on X-axis and height of bubbles on Y-axis with correct units, numbers and appropriate divisions. Correctly plots data and draws a line of best fit. Includes title.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Labels axes with pH on X-axis and height of bubbles on Y-axis with either correct units or numbers and appropriate divisions. Correctly plots data and draws a line of best fit.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Draws some form of line graph with some labels or numbers.</li> </ul>	<b>1</b>

**Sample answer**



**Question 22 (b)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.2.1 C3 D1 H14	
<ul style="list-style-type: none"> <li>Correctly describes relationship between pH and enzyme activity as shown in the results.</li> </ul>	<b>1</b>

**Sample answer**

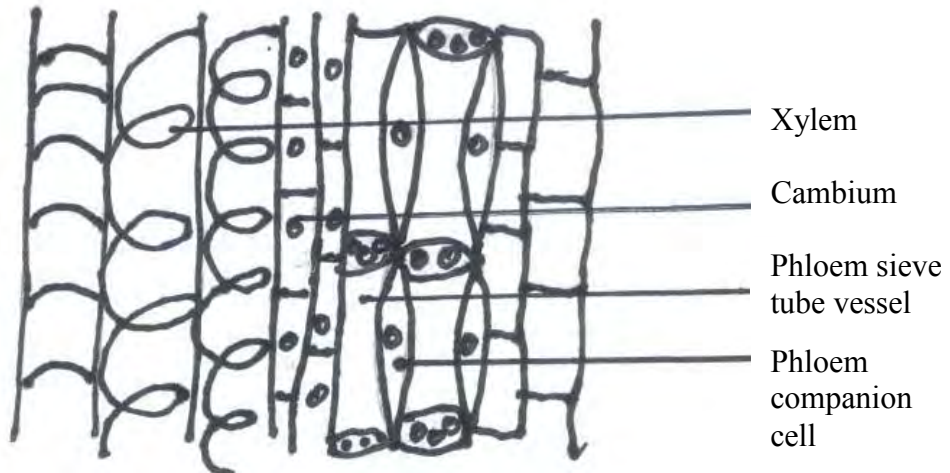
As the pH increased to 7 the enzyme activity increased and then it decreased as the pH rose above 7.

**Question 23 (a)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.2.2 C3 D6 H6 H13	
<ul style="list-style-type: none"> <li>Correctly draws a scientific diagram of the longitudinal section of the tissues in pencil and correctly labels the xylem, phloem (sieve tube vessel and companion cells) and cambium tissues.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Correctly draws a scientific diagram of the longitudinal section of the tissues with some of the xylem, phloem and cambium labelled.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Makes some diagram of the longitudinal section of the tissues and labels one of the xylem, phloem and cambium.</li> </ul>	<b>1</b>

**Sample answer**

Longitudinal section of plant vascular bundle



**Question 23 (b)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.2.2 C2 D6 H6 H13	
<ul style="list-style-type: none"> <li>Explains transpiration stream theory including the 3 major areas of transpiration pull, capillary action and root pressure including the terms xylem, transpiration, cohesion, adhesion, capillary action, root pressure and osmosis of water and movement of water through xylem from roots to leaves.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Explains transpiration stream theory including at least 2 of the major areas of transpiration pull, capillary action and root pressure including some of the terms xylem, transpiration, cohesion, adhesion, capillary action, root pressure and osmosis of water and movement of water through xylem from roots to leaves.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Describes some of transpiration stream theory through xylem from roots to leaves.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>Plants transport water from the roots to the leaves through the transpiration stream. Root pressure occurs as water moving into the roots by osmosis pushes the water molecules in front of the incoming water a little way up the xylem. Water moves a little way up the xylem also due to capillary action where the water molecules are attracted to each other (known as cohesion) and to the walls of the xylem (known as adhesion). The major force is the transpiration pull when water evaporates out of the leaves (transpiration) causing a pull on the water molecules behind in the xylem due to cohesion. This force pulls the water up the xylem.</p>	

**Question 24 (a)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.2.2 C2 D1 D5 C3 D1 H6 H11 H13 H14 H15	
<ul style="list-style-type: none"> <li>Detailed description of experiment including variables, control and result, safety precautions.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Brief description of experiment including 2 of either variables, control or result.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Brief description of experiment with some mention of either variables, control or result.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <ol style="list-style-type: none"> <li>Wear safety goggles in case of splashing (and gloves if using HCl). Work in pairs as it is easier to set up the experiment and have several groups for repetition.</li> <li>Pour 20mls of water into 2 test tubes.</li> <li>Test the water with universal indicator paper and record the pH.</li> <li>Blow through a straw into the water of one test tube (the other is the control) for 2 minutes.</li> <li>Test the pH again with universal indicator paper and record the pH.</li> </ol> <p>The pH of the control was 7 and the experimental test tube was 4.</p> <p>Other methods may include using <math>\text{CaCO}_3 + \text{HCl}</math> bubbled through a delivery tube.</p>	

### Question 24 (b)

Syllabus Reference, Outcomes, Marking guide	Marks
9.2.2 C2D1 D5 H6 H13	
<ul style="list-style-type: none"><li>Links excess carbon dioxide in the blood to an increase in carbonic acid and therefore a lower pH which lowers the oxygen carrying capacity of haemoglobin and enzyme activity.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>Links excess carbon dioxide in the blood to an increase in carbonic acid and therefore a lower pH.</li></ul>	<b>1</b>
<b>Sample answer</b> Carbon dioxide needs to be removed from the blood in the lungs as excess carbon dioxide in the blood leads to an increase in carbonic acid and therefore a lower pH which lowers the oxygen carrying capacity of haemoglobin and also may lower enzyme activity.	

### Question 25

Syllabus Reference, Outcomes, Marking guide	Marks
9.3.4 C2 D7 H1 H2 H10	
<ul style="list-style-type: none"><li>Describes with evidence/examples the difference between the concepts of gradualism and punctuated equilibrium.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>Describes the difference between the concepts of gradualism and punctuated equilibrium.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>Describes either the concept of gradualism or punctuated equilibrium.</li></ul>	<b>1</b>
<b>Sample answer</b> Darwin proposed a sequence of gradual change in organisms over time due to the process of natural selection, however the fossil record does not support this but rather shows periods of relative stability punctuated by periods of extinctions and rapid changes in the organisms. An example of this might be when the dinosaurs dominated the earth and then suddenly became extinct followed by the rise of the mammals.	

### Question 26

Syllabus Reference, Outcomes, Marking guide		Marks
9.2.3 C3 D2 H3 H4 H6 H13		
<ul style="list-style-type: none"> <li>Answers in a table to compare 2 similarities and 2 differences</li> </ul>		<b>4</b>
<ul style="list-style-type: none"> <li>Answers in a table to compare 2 similarities and 1 difference or 1 similarity and 2 differences OR compares 2 similarities and 2 differences with no table</li> </ul>		<b>3</b>
<ul style="list-style-type: none"> <li>Answers in table to compare 1 similarity and 1 difference OR compares 2 similarities and 1 difference or 1 similarity and 2 differences with no table</li> </ul>		<b>2</b>
<ul style="list-style-type: none"> <li>Some comparison or difference or table format</li> </ul>		<b>1</b>
<b>Sample answer</b>		
	Similarities	Differences
Kidney	Filtration occurs. Urea removed from blood. Glucose, salts and water levels are balanced.	Reabsorption occurs. Active transport and/or hormones are involved in reabsorption and balancing of substances.
Dialysis machine	Filtration occurs. Urea removed form blood. Glucose, salts and water levels are balanced.	No reabsorption occurs. Balancing relies on diffusion due to solution concentrations in dialysis fluids.

### Question 27

Syllabus Reference, Outcomes, Marking guide		Marks
9.3.1 C2 D2 H1 H2 H10		
<ul style="list-style-type: none"> <li>Describes with examples how two other areas of study are used to support the theory of evolution eg Comparative anatomy, comparative embryology, biogeography or biochemistry.</li> </ul>		<b>2</b>
<ul style="list-style-type: none"> <li>Describes how one other area of study is used to support the theory of evolution OR names 2 other areas.</li> </ul>		<b>1</b>
<b>Sample answer</b>		
Two other areas of study that support the theory of evolution are comparative anatomy and comparative embryology. Comparative anatomy such as the pentadactyl limb, an homologous structure has been used to show common ancestry as has comparative embryology showing common ancestry between the chordates.		

## Question 28

Syllabus Reference, Outcomes, Marking guide	Marks
9.3.5 C2 D2 D3 C3 D2 H1 H3 H4 H5 H6 H7 H8 H10 H16	
<ul style="list-style-type: none"> <li>• Gives a definition of transgenic species/genetically modified organism (GMO).</li> <li>• Explains how transgenic species/GMO's are made.</li> <li>• Analyses and evaluates the use of GMO's in agriculture using named examples discussing at least two areas of ethics, for and against.</li> </ul>	<b>6</b>
<ul style="list-style-type: none"> <li>• Gives a definition of transgenic species/genetically modified organism.</li> <li>• Explains how transgenic species/GMO's are made.</li> <li>• Discusses the use of GMO's in agriculture using named examples discussing ethics, for and against.</li> </ul>	<b>4-5</b>
<ul style="list-style-type: none"> <li>• Provides two or three of the following:</li> <li>• Gives a definition of transgenic species/genetically modified organism.</li> <li>• Explains how transgenic species/GMO's are made.</li> <li>• Discusses the use of GMO's in agriculture with either some discussion of ethics OR gives some examples.</li> </ul>	<b>2-3</b>
<ul style="list-style-type: none"> <li>• Mentions some area of transgenic species/genetically modified organisms.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>A genetically modified organism (GMO) is one which has had its DNA altered. A transgenic species is one that has had a gene from another species incorporated into its genome.</p> <p>This can be done by cutting the required gene from a species using a restriction enzyme and cutting the DNA of the species the gene is going into with the same restriction enzyme as it will cut at the same DNA sequence. The enzyme ligase will join the inserted gene to the existing DNA. This is known as recombinant DNA. The recombined DNA can then be inserted into the host species using techniques such as a biolistic gene gun, microinjection or using a virus or bacteria as a vector.</p> <p>GMO's are being widely used in agriculture due to the benefits associated with them such as increased crop production which is an economic benefit to the farmers and cheaper prices to the consumer. Other benefits include providing more food to starving populations and increased nutritional value such as in the case of Golden rice with Vitamin A.</p> <p>Some of the benefits are longer shelf life (Flavr Savr tomatoes), herbicide resistance (GMO corn), and pest resistance (BT cotton).</p> <p>Farmed salmon are being grown with a bovine growth hormone which causes the salmon to grow larger and quicker.</p> <p>However even though there appear to be many benefits, there are also concerns. The full effects of GMO's are not fully known and many people want products to be labelled so they can decide if they want to consume them.</p> <p>Also if all farmers in the world are using one type of crop the other species may disappear which will result in decreasing biodiversity which may result in the destruction of the crops if a disease were to attack it, due to lack of variation. <i>(continued overleaf)</i></p>	

Also there is concern the transgene may move into the wild populations causing problems for example if the herbicide resistance gene were to get into the weed populations, the target weeds would be resistant to the herbicides used.

### Question 29

Syllabus Reference, Outcomes, Marking guide	Marks
9.3.3 C2 D4 D5 H6 H9	
<ul style="list-style-type: none"> <li>Correctly explains 3 sources of variation in sexual reproduction</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Correctly explains 2 sources of variation in sexual reproduction</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Correctly explains 1 source of variation in sexual reproduction</li> </ul>	<b>1</b>
<b>Sample answer</b> Sexual reproduction increases variation due to one or more of the following. As a result of the Law of Independent Assortment (or random segregation) during meiosis in gamete formation, many different combinations of parental chromosomes are possible in the gametes. Crossing over may also occur during meiosis thereby increasing the possible combinations of alleles in the gametes. Finally the combining of gametes from different parents in fertilisation further increases different combinations of characteristics.	

### Question 30

Syllabus Reference, Outcomes, Marking guide	Marks															
9.4.3 C2 D2 H7																
<ul style="list-style-type: none"> <li>Answers all 8 parts correctly</li> </ul>	<b>4</b>															
<ul style="list-style-type: none"> <li>Answers 6 - 7 parts correctly</li> </ul>	<b>3</b>															
<ul style="list-style-type: none"> <li>Answers 4 - 5 parts correctly</li> </ul>	<b>2</b>															
<ul style="list-style-type: none"> <li>Answers 2 - 3 parts correctly</li> </ul>	<b>1</b>															
<b>Sample answer</b>																
<table border="1"> <thead> <tr> <th>Pathogen Type</th> <th>Structure</th> <th>Example of disease caused</th> </tr> </thead> <tbody> <tr> <td><b>Prion</b></td> <td>Protein</td> <td>Bovine Spongiform Encephalitis (Mad Cow Disease)</td> </tr> <tr> <td>Virus</td> <td><b>DNA or RNA enclosed in protein coat</b></td> <td>Influenza</td> </tr> <tr> <td>Bacteria</td> <td>Prokaryotic cell eg Cell wall, cell membrane, no membrane bound organelles</td> <td><b>Cholera</b></td> </tr> <tr> <td><b>Protozoan</b></td> <td>Unicellular eucaryotic cell eg Cell membrane, membrane bound organelles</td> <td>Giardia</td> </tr> </tbody> </table>	Pathogen Type	Structure	Example of disease caused	<b>Prion</b>	Protein	Bovine Spongiform Encephalitis (Mad Cow Disease)	Virus	<b>DNA or RNA enclosed in protein coat</b>	Influenza	Bacteria	Prokaryotic cell eg Cell wall, cell membrane, no membrane bound organelles	<b>Cholera</b>	<b>Protozoan</b>	Unicellular eucaryotic cell eg Cell membrane, membrane bound organelles	Giardia	
Pathogen Type	Structure	Example of disease caused														
<b>Prion</b>	Protein	Bovine Spongiform Encephalitis (Mad Cow Disease)														
Virus	<b>DNA or RNA enclosed in protein coat</b>	Influenza														
Bacteria	Prokaryotic cell eg Cell wall, cell membrane, no membrane bound organelles	<b>Cholera</b>														
<b>Protozoan</b>	Unicellular eucaryotic cell eg Cell membrane, membrane bound organelles	Giardia														



### Question 31

Syllabus Reference, Outcomes, Marking guide	Marks
9.4.6 C2 D2 C3 D2 H2 H4 H5 H6 H11 H12 H13	
<ul style="list-style-type: none"> <li>Includes all 4 points below in detail with reference to 2 sample groups, collection of a wide range of data, possibility of chemical testing, statistical analysis and possible treatment, controls or prevention.</li> </ul>	4
<ul style="list-style-type: none"> <li>Includes 3 of the points below in some detail.</li> </ul>	3
<ul style="list-style-type: none"> <li>Includes 2 of the points below in some detail.</li> </ul>	2
<ul style="list-style-type: none"> <li>Mentions 1 or 2 of the points below.</li> </ul>	1
<p><b>Sample answer</b></p> <p>1. Interview 2 major groups of people:</p> <p>a. those that have been affected by the disease and</p> <p>b. those that have not been affected by the disease.</p> <p>2. For each group a similar sample of a large number of people of all ages need to be interviewed and the same data should be collected from each group. This information should include age, sex, race, diet, occupation, lifestyle, where they live and when symptoms if any started to appear.</p> <p>If possible blood tests of the two groups could be taken looking for similarities and differences. Also fish and meat samples from the area could also be tested for abnormal levels of chemicals.</p> <p>3. The data needs to be analysed statistically for comparisons between the two groups and chemical tests, looking for similarities and differences and any patterns or trends.</p> <p>4. A cause for the disease may then be identified and possible treatments, preventative strategies and controls can be put into place to minimise the possibility of future outbreaks occurring. Periodic monitoring should be carried out.</p>	

### Question 32

Syllabus Reference, Outcomes, Marking guide	Marks
9.4.4 C3 D1 H6 H7	
<ul style="list-style-type: none"> <li>Discusses how a named disease results from an imbalance of microflora in humans.</li> </ul>	2
<ul style="list-style-type: none"> <li>Discusses how a disease results from an imbalance of microflora in humans OR names a disease from an imbalance of microflora in humans.</li> </ul>	1
<p><b>Sample answer</b></p> <p>Candidiasis or thrush is a fungal infection due to any species from the genus <i>Candida</i> (one genus of yeasts). It is often caused in the vagina of women by a disruption to the normal balance of microflora in the vagina consisting of lactic acid bacteria such as lactobacilli, and results in an overgrowth of <i>Candida</i> cells, causing symptoms of infection, such as local inflammation.</p>	

### Question 33

Syllabus Reference, Outcomes, Marking guide	Marks
9.4.2 C2D2 9.4.3 C2D1D3 C3D2 9.4.5 C2D1 C3D1 9.4.7 C2D1D2 C3D2 H1 H2 H3 H4 H5 H6 H8 H13 H16	
<ul style="list-style-type: none"> <li>Detailed discussion using named examples of how our increased understanding of the causes and transmission of disease and the immune system have led to modern methods of treatment, control and prevention of disease.</li> <li>Should include 6 – 7 areas of increased understanding and evaluations of the methods discussed.</li> </ul>	<b>8</b>
<ul style="list-style-type: none"> <li>Discusses using named examples how our increased understanding of the causes and transmission of disease and the immune system have led to modern methods of treatment, control and prevention of disease.</li> <li>Includes 5 – 6 areas of increased understanding and an evaluation of some areas.</li> </ul>	<b>6-7</b>
<ul style="list-style-type: none"> <li>Discusses with some named examples how our increased understanding of the causes and transmission of disease and the immune system have led to modern methods of treatment, control and prevention of disease.</li> <li>Includes 3 – 4 areas of increased understanding and an evaluation of some areas.</li> </ul>	<b>4-5</b>
<ul style="list-style-type: none"> <li>Discusses two to three areas how our increased understanding of the causes and transmission of disease and the immune system has led to some methods of treatment, control and prevention of disease OR</li> <li>Discusses one to two areas of how our increased understanding of the causes and transmission of disease and the immune system has led to some methods of treatment, control and prevention of disease with some evaluation.</li> </ul>	<b>2-3</b>
<ul style="list-style-type: none"> <li>Identifies an area of how our increased understanding of the causes and transmission of disease and the immune system have led to modern methods of treatment, control and prevention of disease OR evaluates an area.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>The Chinese and Hebrews advocated cleanliness in food, water and personal hygiene practices which we now know helps reduce the possibility of pathogens entering the body and therefore clean food preparation, water purification and hygiene procedures have been adopted today leading to the reduction in the transmission of diseases.</p> <p>Pasteur disproved “spontaneous generation” and showed how microbes caused decay and could be spread in the air or on hands and clothes leading to pasteurisation used in food preparation and more sterile procedures in hospitals resulting in fewer deaths in hospitals.</p> <p>Koch’s postulates methodology led to the procedure for identification of a particular microbe causing a particular disease allowing for better treatments knowing the cause of a particular disease.</p> <p>Both Pasteur and Koch also worked on vaccination techniques with <i>Anthrax</i> as did Jenner</p>	

with smallpox, paving the way for immunisation programs which has led to the reduction of diseases and the eradication of some such as smallpox, which is considered to be a great success.

MacFarlane Burnett's work on the immune system and immunisation furthered advances in this field and also in the area of organ transplants as the immune system and the function and interaction of T and B Lymphocytes became better understood.

Ross and Laveran helped in the identification of the malarial parasite protozoan *Plasmodium sp.* and its vector the *Anopheles* mosquito which led to methods of prevention and control including the destruction of vector habitats, as no cure or vaccination has yet been found.

As different pathogens were identified eg macro-parasites, fungi, protozoans, bacteria and eventually viruses and prions, better treatments could be determined and eventually better methods of control and prevention were established.

Fleming's discovery of penicillin led to the development of antibiotics which has radically reduced sickness and death from bacterial infections, saving many lives.

Quarantine procedures have been introduced to isolate and prevent the entry of pathogens into areas. In Australia this has been reasonably successful as shown by the prevention of some diseases entering the country such as foot and mouth disease and "mad cow disease" or Bovine Spongiform Encephalitis which would have dire agricultural and economic consequences.

An increase in public health programs has led to better awareness and in some cases successful reduction in some diseases such as skin cancer and lifestyle diseases such as heart disease which has led to more research into methods of prevention and control as opposed to treatment.

## Section II

### Question 34 - Communication

#### Question 34 (a)

Syllabus Reference, Outcomes, Marking guide	Marks										
9.5.1 C1 D1 D2 H6 H13											
<ul style="list-style-type: none"> <li>Correctly identifies all four receptors and correctly draws a table</li> </ul>	<b>2</b>										
<ul style="list-style-type: none"> <li>Correctly identifies at least two receptors with some sort of table.</li> </ul>	<b>1</b>										
<b>Sample answer</b>											
<table border="1"> <thead> <tr> <th>Sense</th> <th>Type of Receptor</th> </tr> </thead> <tbody> <tr> <td>Touch</td> <td>Mechanoreceptor</td> </tr> <tr> <td>Taste</td> <td>Chemoreceptor</td> </tr> <tr> <td>Hearing</td> <td>Mechanoreceptor</td> </tr> <tr> <td>Sight</td> <td>Photoreceptor</td> </tr> </tbody> </table>	Sense	Type of Receptor	Touch	Mechanoreceptor	Taste	Chemoreceptor	Hearing	Mechanoreceptor	Sight	Photoreceptor	
Sense	Type of Receptor										
Touch	Mechanoreceptor										
Taste	Chemoreceptor										
Hearing	Mechanoreceptor										
Sight	Photoreceptor										

#### Question 34 (b)

Syllabus Reference, Outcomes, Marking guide	Marks												
9.5.2 C2 D2 C3 D2 H6 H13													
<ul style="list-style-type: none"> <li>Correctly draws a table and correctly compares humans and two other organism's wavelengths of electromagnetic spectrum detected with reasons.</li> </ul>	<b>3</b>												
<ul style="list-style-type: none"> <li>Correctly draws a table and correctly compares humans and one other organism's wavelengths of electromagnetic spectrum detected with reasons OR correctly compares humans and two other organisms with no table.</li> </ul>	<b>2</b>												
<ul style="list-style-type: none"> <li>Draws some sort of table or has some of information correct.</li> </ul>	<b>1</b>												
<b>Sample answer</b>													
<table border="1"> <thead> <tr> <th>Organism</th> <th>Wavelengths of electromagnetic spectrum detected</th> <th>Reason for wavelengths detected</th> </tr> </thead> <tbody> <tr> <td>Humans</td> <td>Visible light (400-700 nm)</td> <td>Sight is a major sense</td> </tr> <tr> <td>Bees</td> <td>Visible and ultraviolet light (100-700nm)</td> <td>Find food using flower petal markings detected by UV light</td> </tr> <tr> <td>Snakes</td> <td>Visible and infra-red light (480nm-1000nm)</td> <td>Detect endothermic prey at night</td> </tr> </tbody> </table>	Organism	Wavelengths of electromagnetic spectrum detected	Reason for wavelengths detected	Humans	Visible light (400-700 nm)	Sight is a major sense	Bees	Visible and ultraviolet light (100-700nm)	Find food using flower petal markings detected by UV light	Snakes	Visible and infra-red light (480nm-1000nm)	Detect endothermic prey at night	
Organism	Wavelengths of electromagnetic spectrum detected	Reason for wavelengths detected											
Humans	Visible light (400-700 nm)	Sight is a major sense											
Bees	Visible and ultraviolet light (100-700nm)	Find food using flower petal markings detected by UV light											
Snakes	Visible and infra-red light (480nm-1000nm)	Detect endothermic prey at night											

**Question 34 (c)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.5.3 C1 D3 D4 D5 C3 D2 H1 H3 H4 H5	
<ul style="list-style-type: none"><li>• Correctly describes the effect resulting in hyperopia and two technologies used to correct it and makes an assessment.</li></ul>	<b>4</b>
<ul style="list-style-type: none"><li>• Correctly describes hyperopia and two technologies used to correct it.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>• Describes hyperopia and one technology or mentions two technologies with little description.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Describes either hyperopia or one technology or mentions two technologies with little description.</li></ul>	<b>1</b>
<b>Sample answer</b> In accommodation, when focussing on close objects the ciliary muscles contract and the tension in the suspensory ligaments is reduced causing the lens to become more rounded due to its elasticity. The refractive power of the lens increases, shortening the focal length to focus on the retina. As people get older more layers of crystallin protein fibres are replaced in the lens of the eye, enlarging it and causing it to become denser and less elastic. Therefore it becomes more difficult to focus on close objects as the lens is unable to become round enough due to the decrease in elasticity. This poor accommodation ability therefore results in hyperopia or “long-sightedness” as the focal point is now behind the retina. To correct this problem spectacles or contact lenses with a convex lens are required to converge the light rays before the eye to allow for the focal point to be brought forward onto the retina. Alternatively refractive surgery can be used. A thin flap of the cornea is cut and folded back and then the cornea is reshaped using laser technology. Although the laser method has had some success and permanently corrects vision, if problems arise it may be hard to reconfirm. Using spectacles or contact lenses may be annoying to the wearer but if problems occur they can be corrected.	

**Question 34 (d)**

<b>Syllabus Reference, Outcomes, Marking guide</b>		<b>Marks</b>
9.5.4 C2 D1 C3 D1 H6 H13		
<ul style="list-style-type: none"> <li>Describe the nature and functioning of photoreceptor cells in mammals, insects and one other animal. May present answer in table or sentence form.</li> </ul>		<b>3</b>
<ul style="list-style-type: none"> <li>Describe the nature and functioning of photoreceptor cells in two of mammals, insects or one other animal. May present answer in table or sentence form.</li> </ul>		<b>2</b>
<ul style="list-style-type: none"> <li>Describe the nature and functioning of photoreceptor cells in one of mammals, insects or other animal.</li> </ul>		<b>1</b>
<b>Sample answer</b>		
<b>Organism</b>	<b>Nature and functioning of photoreceptor cells</b>	
Human	<p>Rods and cones are located in the retina. They are modified neurones that convert light into electrochemical signals that the brain can interpret.</p> <p>Rods are long rod shaped cells and contain the pigment rhodopsin which is photosensitive to lower wavelengths of light (blue-green) and are therefore are more useful in dim light or at night.</p> <p>There are three types of cones that can detect different wavelengths of light, blue, green or red and are therefore used in detecting colour. The cones are mostly used during daylight for visual acuity and colour vision.</p>	
Insect	<p>Compound eyes that have hundreds of photoreceptor units called ommatidia containing pigment cells and visual cells. Some insects can detect colour and even ultra-violet light.</p>	
Planarian worm	<p>Groups of light sensitive cells organised into eye cups to detect light sources. Helps to move away from light sources and predators.</p>	

**Question 34 (e)**

<b>Syllabus Reference, Outcomes, Marking guide</b>		<b>Marks</b>
9.5.5 C2 D2 H6 H13		
<ul style="list-style-type: none"> <li>Correctly draws a table and compares the structures used by three named animals, other than humans, to produce sound.</li> </ul>		<b>3</b>
<ul style="list-style-type: none"> <li>Correctly either draws a table and compares the structures used by two named animals, other than humans, to produce sound OR compare three animals but no table.</li> </ul>		<b>2</b>
<ul style="list-style-type: none"> <li>Either draws a table and lists the structures used by one named animal, other than humans, to produce sound OR has some information about named animals and their sound production structures.</li> </ul>		<b>1</b>
<b>Sample answer</b>		
<b>Animal</b>	<b>Structures used to produce sound</b>	
Cicada	A vibrating membrane, or tymbal, is moved, held in place by rigid exoskeletal structures and moved by a muscle attached directly to the membrane.	
Grasshopper	Rub their back legs together or against their forewing (stridulation).	
Fish	Vibrate their swim bladder using sonic muscles to make drumming sounds.	

**Question 34 (f)**

<b>Syllabus Reference, Outcomes, Marking guide</b>		<b>Marks</b>
9.5.6 C2 D1 D2 D4 D5 H6 H13		
<ul style="list-style-type: none"> <li>• Correctly draws a table and outlines the structures used by insects, fish and mammals to detect vibrations.</li> </ul>		<b>4</b>
<ul style="list-style-type: none"> <li>• Correctly either draws a table and outlines the structures used by two of insects, fish and mammals to detect vibrations OR outlines the structures used by insects, fish and mammals to detect vibrations but no table.</li> </ul>		<b>3</b>
<ul style="list-style-type: none"> <li>• Correctly either draws a table and outlines the structures used by one of insects, fish and mammals to detect vibrations OR outlines the structures used by two of insects, fish and mammals to detect vibrations but no table.</li> </ul>		<b>2</b>
<ul style="list-style-type: none"> <li>• Outlines the structures used by one of insects, fish or mammals to detect vibrations.</li> </ul>		<b>1</b>
<b>Sample answer</b>		
<b>Animal</b>	<b>Structures used to detect vibrations</b>	
Insects	A membrane or tymbal vibrates when sound waves contact it stimulating mechanoreceptor cells which send a message to the brain. Some also have sensory hairs on the exterior of their bodies which vibrate when sound waves of certain frequencies stimulate them.	
Fish	Internal ears near the brain have semicircular canals which contain hair cells that pick up vibrations that are transmitted through the skeleton of the head from soundwaves in the water. These hair cells send a message to the brain. Neuromast hairs in the lateral line system pick up sound vibrations in the water and transmit to the brain. Sounds vibrate their swim bladder.	
Mammals	Sound vibrations vibrate the eardrum which in turn vibrates the ear ossicles which passes the vibrations into the cochlea. Different hair cells (mechanoreceptors) in the organ of Corti in the cochlea are stimulated by different frequencies and send a message to the brain through the auditory nerve.	



**Question 34 (g)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.5.2 C2 D1 9.5.4 C2 D1D2 9.5.6 C2 D2 D4 D5 C3 D2 D3 9.5.7 C2 D2 D4 H1 H3 H4 H5 H6 H8 H16	
<ul style="list-style-type: none"> <li>• Discusses and evaluates how our increased understanding of the brain, the nervous system, the ear and the eye have led to technologies that have the potential to help the profoundly deaf and possibly blind people including:</li> <li>• Increased understanding of the neurone structure and impulse generation and transmission leading to new technology.</li> <li>• Better understanding of the areas of the brain.</li> <li>• Increased understanding of the structures and functions of the structures in the ear and the eye and have allowed us to try and develop technology to aid or replace parts that do not function properly.</li> <li>• Relates technology to specific parts and workings of the ear and eye.</li> <li>• Cochlear implant and how it works and an evaluation.</li> <li>• Possible development of the bionic eye and an evaluation.</li> </ul>	<b>6</b>
<ul style="list-style-type: none"> <li>• Some discussion and evaluation of how our increased understanding of the brain, the nervous system, the ear and the eye have led to technologies that have the potential to help the profoundly deaf and possibly blind people including some of:</li> <li>• Increased understanding of the neurone structure and impulse generation and transmission leading to new technology.</li> <li>• Better understanding of the areas of the brain.</li> <li>• Increased understanding of the structures and functions of the structures in the ear and the eye and have allowed us to try and develop technology to aid or replace parts that do not function properly.</li> <li>• Relates technology to specific parts and workings of the ear and eye.</li> <li>• Cochlear implant and how it works and an evaluation OR possible development of the bionic eye and an evaluation.</li> </ul>	<b>4-5</b>
<ul style="list-style-type: none"> <li>• Some discussion of how our increased understanding of the brain, the nervous system, the ear and the eye have led to technologies that have the potential to help the profoundly deaf and possibly blind people including two or three of:</li> <li>• Increased understanding of the neurone structure and impulse generation and transmission leading to new technology.</li> <li>• Better understanding of the areas of the brain.</li> <li>• Increased understanding of the structures and functions of the structures in the ear and the eye and have allowed us to try and develop technology to aid or replace parts that do not function properly.</li> <li>• Relates technology to specific parts and workings of the ear and eye.</li> </ul>	<b>2-3</b>

<ul style="list-style-type: none"> <li>• Cochlear implant and how it works OR possible development of the bionic eye.</li> </ul>	
<ul style="list-style-type: none"> <li>• Some mention of the brain OR the nervous system OR the ear OR the eye OR technologies that have the potential to help the profoundly deaf OR possibly blind people.</li> </ul>	<b>1</b>

**Sample answer**

As neurone structure and impulse generation and transmission have become better understood we have developed technology to stimulate the nerves to transmit impulses so where parts of the body are not stimulating the nerves those parts can be replaced with technology to do so.

As we have determined the areas of the brain's cerebrum that are responsible for receiving the information of sound, the auditory area in the temporal lobe and sight, the visual cortex in the occipital lobe we can develop technologies that can stimulate the areas to simulate sound in the case of the cochlear implant and possibly sight in the case of the bionic eye.

The increased understanding of the structures and functions of the structures in the ear and the eye and have allowed us to try and develop technology to aid or replace parts that do not function properly.

In the case of profoundly deaf people the understanding of the hair cell mechanoreceptors in the organ of Corti in the cochlea have allowed for the development of the cochlear implant which is an electronic device that is surgically implanted and gives hearing to profoundly deaf people. It consists of a microphone that picks up the sound, a speech processor which filters the sound and converts the sounds to electronic signals which are sent to the transmitter which sends radio waves across the skin to the receiver/stimulator which converts the radio waves to electrical impulses that are sent to electrodes implanted in the cochlea which then sends electrical impulses through the auditory nerve to the brain.

Whilst the implant can give auditory perception to profoundly deaf people and compensates for non working parts of the inner ear, it does not create normal hearing and transmits sounds different to those in reality so that the person needs to learn to interpret the sounds received. It is also expensive.

In the case of the eye and blind people, the understanding of the retina and the photoreceptors, the rods and cones has resulted in technology presently being developed to create a bionic eye which is looking at ways to place an implant in the retina or a camera in the eye to process light rays and send electrical impulses to the brain. Again the images are most likely to be of light and dark areas only and not exact images as in normal vision.

## Question 35 – Biotechnology

### Question 35 (a)

Syllabus Reference, Outcomes, Marking guide	Marks
9.6.1 C2 D1 D2 H1 H10	
<ul style="list-style-type: none"><li>Provides characteristics and features of an example of the use of biotechnology by an early society with some detail and a named example.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>Provides characteristics and features of an example of the use of biotechnology by an early society with some detail.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>Provides some characteristics and features of an example of the use of biotechnology by an early society.</li></ul>	<b>1</b>
<b>Sample answer</b> Approximately 10 000 years ago in the Middle East early societies collected wild seeds and wild animals and selected those with the characteristics that were favourable to them for food and grew these which lead to a more settled form of life. For example some seeds produced better quality and quantity of crops than others and so these were selected and grown. Wheat domestication has been traced back to the Middle East in around 9600BC probably from wild einkorn wheat ( <i>Triticum boeoticum</i> ) and emmer wheat ( <i>Triticum dicoccoides</i> ) and ( <i>Triticum dicoccum</i> ). Cultivation and repeated harvesting of these wild varieties led to the creation of domestic strains as various traits, such as grains that were larger and seeds which were attached to the ear better and therefore did not disperse as easily, were selected for. This led to wheat that produced higher yields.	

**Question 35 (b) (i)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.6.2 C2 D1 H1 H3 H4	
<ul style="list-style-type: none"> <li>• Outlines an early fermentation process used prior to the 18<sup>th</sup> century such as yeast and fermentation in alcohol production.</li> </ul>	<b>1</b>
<b>Sample answer</b> Yeast is used in the production of alcohol where glucose is converted to carbon dioxide and ethanol (alcohol).	

**Question 35 (b) (ii)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.6.3 C2 D1 C3 D1 H1 H3 H4	
<ul style="list-style-type: none"> <li>• Explains how a named organic compound is produced by a fermentation process developed since the early 18<sup>th</sup> century and how the use impacted on society on its introduction in detail.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>• Briefly explains how a named organic compound is produced by a fermentation process developed since the early 18<sup>th</sup> century and how the use impacted on society on its introduction.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>• Makes some sort of outline of how the use of a named organic compound produced by a fermentation process developed since the early 18<sup>th</sup> century impacted on society</li> </ul>	<b>1</b>
<b>Sample answer</b> Lactic acid is produced by bacteria (and animal cells) through anaerobic fermentation of glucose, sucrose or lactose and is used throughout the world to produce foods that cannot be produced by other methods such as yoghurt (by <i>Lactobacillus</i> and <i>Streptococcus</i> ), sauerkraut (by <i>Leuconostoc</i> ), kimchi and sour beer. Its use in food production is valued as it decreases the pH thereby making the environment inhospitable for many other pathogenic bacteria and can be used as a food preservative. Yoghurt also helps our normal gut bacteria to function more efficiently. It is also used in medicine and the pharmaceutical industry, cosmetics, textiles (it helps fabrics accept dyes), leather tanning and detergents. Due to its wide use in many areas it had a major impact on society as it can be used in such a large variety of applications and therefore has a major economic significance.	

**Question 35 (c) (i)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.4 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>• Correctly transcribes the DNA sequence to provide the mRNA codon sequence.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>• Transcribes at least half of the DNA sequence correctly to provide the mRNA codon sequence.</li> </ul>	<b>1</b>
<b>Sample answer</b> AUG GUA AUC CCG ACC (mRNA)	

**Question 35 (c) (ii)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.4 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>• Correctly translates the DNA sequence to provide the tRNA anticodon sequence.</li> </ul>	<b>1</b>
<b>Sample answer</b> UAC CAU UAG GGC UGG (tRNA)	

**Question 35 (c) (iii)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.4 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>• Correctly translates the tRNA anticodons to provide the amino acid sequence.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>• Translates the tRNA anticodons to provide at least three of the amino acid sequence correctly.</li> </ul>	<b>1</b>
<b>Sample answer</b> Methionine, valine, isoleucine, proline, threonine	

**Question 35 (d)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.5 C2 D2 C3 D4 H3 H4 H13	
<ul style="list-style-type: none"><li>• Correctly describes the steps used in polymerase chain reaction (PCR) and discuss its uses with an example.</li></ul>	<b>4</b>
<ul style="list-style-type: none"><li>• Correctly describes the steps used in polymerase chain reaction (PCR) OR describes some of the steps used in polymerase chain reaction (PCR) and discusses its use.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>• Describes some of the steps used in polymerase chain reaction (PCR) OR mentions some of the steps and its use.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Partially outlines some of polymerase chain reaction (PCR)</li></ul>	<b>1</b>
<b>Sample answer</b> Polymerase chain reaction (PCR) can be performed in a test tube using the DNA sample required to be copied, DNA primers, DNA polymerase and DNA nucleotides to produce many copies of the required DNA. It maybe used when only a small sample of DNA is present and more copies are needed for tests to be performed. For example this may be in forensic science cases where only a small sample of DNA has been found at the crime scene or where medical testing is needed. The steps involved include: 1. Denaturation: the required DNA is heated to approximately 94–96°C to denature the DNA into single strands. 2. Annealing: the temperature is dropped to approximately 50–65°C to allow the complementary DNA primers to bind to the single stranded template using DNA polymerase and start DNA formation. 3. Elongation: DNA polymerase synthesises new strands complementary to the original strands to create two identical copies. The above three steps are repeated, doubling the copies of DNA each cycle.	

**Question 35 (e) (i)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.5 C3 D3 H3 H4	
<ul style="list-style-type: none"> <li>Names with reference to a specific example other than given in the question, a transgenic organism and the reason why the organism was created.</li> </ul>	<b>1</b>
<b>Sample answer</b> Bt cotton – more resistant to pests OR strawberry with salmon gene so can grow in cold OR other example.	

**Question 35 (e) (ii)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.7 C2 D2 C3 D1 H3 H4 H7 H16	
<ul style="list-style-type: none"> <li>Discusses and provides an evaluation with two ethical and/or social issues for and two ethical and/or social issues against the use of biotechnology with examples.</li> <li>Provides comparison between artificial selection and DNA technology.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>Discusses one ethical and/or social issue for and one ethical and/or social issue against the use of biotechnology with examples.</li> <li>Provides comparison between artificial selection and DNA technology OR</li> <li>Discusses and provides an evaluation with two ethical issues and/or social issues for and two ethical and/or social issues against the use of biotechnology with examples with no comparison between artificial selection and DNA technology</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Discusses one ethical and/or social issue.</li> <li>Provides comparison between artificial selection and DNA technology OR</li> <li>Discusses two ethical and/or social issues and no comparison between artificial selection and DNA technology</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Discusses one ethical and/or social issue OR</li> <li>Provides comparison between artificial selection and DNA technology</li> </ul>	<b>1</b>
<b>Sample answer</b> Transgenic organisms have been created for a number of reasons which include some positive areas such as: higher yield of crops which provides better economic benefit to the farmers eg strawberry with salmon gene; a greater production of more nutritious food to help feed the starving populations eg golden rice; less pesticide sprays being used on pesticide resistant crops which is better for the environment eg Bt cotton and gene therapy to help benefit suffering people eg cystic fibrosis. On the other hand concerns have been raised such as: the long term effects are not fully understood especially as many of the transgenic	

organisms are foods eg GMO corn, golden rice; “playing God” as in what gives humans the right to manipulate genes especially in the case of animals where their health has been compromised eg pigs engineered to grow faster that cannot walk properly and have heart problems keeping up with the faster growth rate and are therefore in pain; patent rights to genes and therefore the genetically modified organism which may therefore see farmers being manipulated by big companies.

Cloning of organisms has also come under fire as animal cloning is considered unnatural and may result in the reduction of biodiversity as farmers resort to using the cloned organism only which may result in the destruction of the crops if a disease were to attack it due to lack of variation.

Although artificial selection has been practised for thousands of years and has changed characteristics in groups of organisms, it has not included gene manipulation and therefore is often considered as a more natural way of gaining desirable characteristics in farming stocks whereas gene manipulation is more direct and produces more exact outcomes, however many people are concerned many of the issues associated with GMO have not been fully addressed.



**Question 35 (f)**

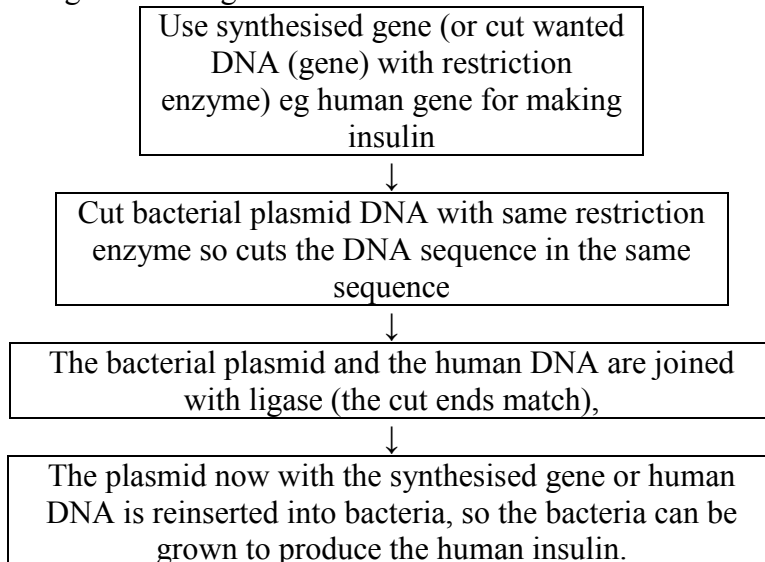
<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.6.6 C2 D2 C3 D1 H1 H3 H4 H6	
<ul style="list-style-type: none"> <li>Describes in detail and evaluates one example of the application of biotechnology in medicine. May describe tissue engineering, gene delivery by nasal sprays or production of synthetic hormones.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>Describes and evaluates one example of the application of biotechnology in medicine OR describes in detail one example of the application of biotechnology in medicine with no evaluation. May describe tissue engineering, gene delivery by nasal sprays or production of synthetic hormones.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Describes in some detail one example of the application of biotechnology in medicine with no evaluation. May describe tissue engineering, gene delivery by nasal sprays or production of synthetic hormones.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Makes some description of one example of the application of biotechnology in medicine. May describe tissue engineering, gene delivery by nasal sprays or production of synthetic hormones.</li> </ul>	<b>1</b>

**Sample answer**

Insulin is a hormone made in the pancreas to regulate blood sugar levels. People with Diabetes Type 1 cannot produce enough insulin.

Insulin used to be extracted from the pancreas of pigs or cows however this sometimes caused allergic reactions in some patients.

In 1978 a synthetic version of the human insulin gene was constructed by determining the amino acid sequence of the protein insulin and then from that determining and synthesising the DNA sequence of the gene. This synthesised gene was then inserted into the bacterium *Escherichia coli* using the following process of DNA recombination and the bacteria is then grown in large fermentation vessels and then the insulin is harvested.



This process was used commercially since 1983 to produce insulin and has provided a great benefit to people with diabetes around the world.

### Question 36 - Genetics: The Code Broken?

#### Question 36 (a)

Syllabus Reference, Outcomes, Marking guide	Marks
9.7.2 C3 D1 H6 H9	
<ul style="list-style-type: none"> <li>Explains the genotypes of Fred, Cindy, the mother and the father with the use of diagrams to show the inheritance pattern of multiple alleles allowing for all the different blood types.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Explains the genotypes of Fred, Cindy, the mother and the father and the inheritance pattern of multiple alleles allowing for all the different blood types OR uses diagrams to show the genotypes of Fred, Cindy, the mother and the father and the inheritance pattern of multiple alleles allowing for all the different blood types.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Makes some explanation of multiple alleles and the genotypes of some of the family.</li> </ul>	<b>1</b>

#### Sample answer

This is a form of multiple alleles. As Fred is blood type A he must have the allele  $I^A$  and as Cindy is blood type O her genotype must be  $ii$ . Therefore both the parents must contain the allele  $i$ . Therefore the genotypes of their mother and father must be  $I^A i$  and  $I^B i$  respectively in order for Fred to be blood type A and Cindy to be blood type O. This is shown in the Punnett square below.

Parent gametes	Mother	
Father	$I^A$	$i$
$I^B$	$I^A I^B$	$I^B i$
$i$	$I^A i$ (Fred)	$ii$ (Cindy)

**Question 36(b) (i)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.7.3 C2 D2 C3 D1 H6 H9	
<ul style="list-style-type: none"> <li>Indicates the parent's genotypes are PpRr and it is Mendel's dihybrid heterozygous cross phenotype ratio. Predicts correct ratio 9:3:3:1 of the correct characteristics.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Indicates the parent's genotypes are PpRr and it is Mendel's dihybrid heterozygous cross phenotype ratio OR Predicts correct ratio 9:3:3:1 of the correct characteristics.</li> </ul>	<b>1</b>
<p><b>Sample answer</b>                      The genotypes of the two plants are PpRr and due to a dihybrid cross this will result in Mendel's dihybrid phenotype ratio of 9 purple and round: 3 purple and wrinkled: 3 white and round: 1 white and wrinkled.</p>	

**Question 36 (b) (ii)**

Syllabus Reference, Outcomes, Marking guide	Marks									
9.7.3 C2 D3 C3 D1 H9										
<ul style="list-style-type: none"> <li>Draws punnet square showing correct gametes and crosses and correctly states phenotype and genotype ratios.</li> </ul>	<b>3</b>									
<ul style="list-style-type: none"> <li>Draws punnet square showing correct gametes and crosses and correctly states either phenotype or genotype ratios OR correctly states phenotype and genotype ratios with no punnet square.</li> </ul>	<b>2</b>									
<ul style="list-style-type: none"> <li>Either draws punnet square showing correct gametes OR correctly states either phenotype OR genotype ratios.</li> </ul>	<b>1</b>									
<p><b>Sample answer</b>                      Parents: PpRr x PpRr                      Gametes: Pr and pR x Pr and pR</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Parents gametes</td> <td>Pr</td> <td>pR</td> </tr> <tr> <td>Pr</td> <td>PPrr</td> <td>PpRr</td> </tr> <tr> <td>pR</td> <td>PpRr</td> <td>ppRR</td> </tr> </tbody> </table> <p>Genotype ratios: 1 PPrr: 2 PpRr: 1 ppRR                      Phenotype ratios: 1 purple and wrinkled: 2 purple and round: 1 white and round</p>		Parents gametes	Pr	pR	Pr	PPrr	PpRr	pR	PpRr	ppRR
Parents gametes	Pr	pR								
Pr	PPrr	PpRr								
pR	PpRr	ppRR								

**Question 36 (c) (i)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.1 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>Correctly transcribes the DNA sequence to provide the mRNA codon sequence.</li> </ul>	<b>1</b>
<b>Sample answer</b> AUG GUA AUC CCG ACC (mRNA)	

**Question 36 (c) (ii)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.1 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>Correctly translates the DNA sequence to provide the tRNA anticodon sequence.</li> </ul>	<b>1</b>
<b>Sample answer</b> UAC CAU UAG GGC UGG (tRNA)	

**Question 36 (c) (iii)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.1 C2 D1 H6 H9	
<ul style="list-style-type: none"> <li>Correctly translates the tRNA anticodons to provide the amino acid sequence.</li> </ul>	<b>1</b>
<b>Sample answer</b> Methionine, valine, isoleucine, proline, threonine	

**Question 36 (c) (iv)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.1 C2 D1 9.7.6 C2 D1 C3 D1 H6 H9	
<ul style="list-style-type: none"> <li>Correctly states the mutation is a base substitution mutation and correctly describes an example of a genetic disorder caused by this mutation.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Correctly states the mutation is a base substitution mutation and correctly states an example of a genetic disorder caused by this mutation.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Correctly states either the mutation is a base substitution mutation OR gives an example of a genetic disorder caused by this mutation.</li> </ul>	<b>1</b>
<b>Sample answer</b> This is a base substitution mutation. An example of a genetic disorder caused by a recessive base substitution mutation is sickle-cell anaemia. Due to the base substitution, the polypeptide chain of the haemoglobin molecule differs by one amino acid resulting in the red blood cells to be crescent or sickle shaped. The sickle-shaped cells block capillaries and therefore tissues may be starved of oxygen.	

**Question 36 (d)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.4 C2 D1 D2 9.7.8 C2 D1 D2 C3 D1 H3 H4 H9	
<ul style="list-style-type: none"> <li>Briefly describes the Human Genome Project and discusses 2 benefits and 2 limitations of the Human Genome Project.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>Discusses 3 of the benefits and limitations of the Human Genome Project.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Discusses 2 of the benefits and limitations of the Human Genome Project.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Makes some statement about either the benefits or limitations of the Human Genome Project.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>The Human Genome Project (HGP) was implemented to identify and determine the position of all the genes in the human chromosomes and to determine the base sequences for the genes to create a database of the information for use in medicine, a better understanding of genetics and evolution and DNA forensics.</p> <p>Some of the benefits include:</p> <p>Improved diagnosis and earlier detection of hereditary diseases allowing for genetic counselling and possible gene therapy techniques.</p> <p>A better understanding of how genes interact. For example the switching on and off of genes in mitosis and differentiation and also gene cascades in embryonic development. Also the effect of non protein coding introns.</p> <p>A better understanding of evolutionary pathways through comparison with genomes of other species.</p> <p>Some of the limitations of the data obtained include:</p> <p>Even though we have mapped the genes, the full expression of the genes may be affected by other factors such as chemicals in the environment, also the final characteristics may be more than the sum of the genes together, such as in brain function, which means that even though we know the genes involved it may not be enough to give the full picture.</p> <p>Another concern is the ethical, legal and social implications such as how the genetic information will be used. For example people may be refused jobs or life insurance if they have a genetic deficiency or disorder which may lead to a tiered society.</p>	

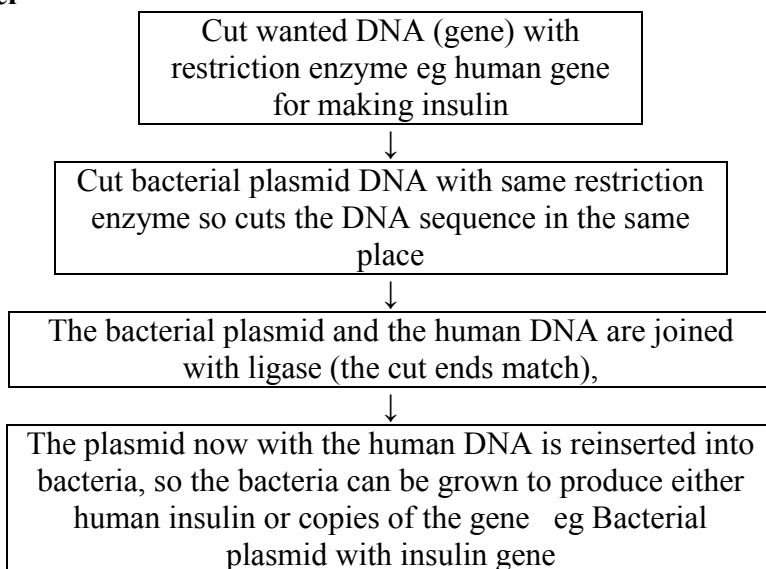
**Question 36 (e)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.7.5 C2 D1 C3 D1 H3 H4 H6	
<ul style="list-style-type: none"> <li>• Describes gene therapy and how the genes are inserted into cells using vectors. Identifies a disease, describes the cause and symptoms and explains how using gene cloning of a healthy gene and inserting the gene through a vector the disease is treated. Makes an evaluation of the therapy and its effectiveness.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>• Identifies a disease, describes the cause and symptoms and explains how using gene cloning of a healthy gene and inserting the gene through a vector the disease is treated. Makes an evaluation of the therapy and its effectiveness.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>• Identifies a disease, describes the cause and symptoms and explains how using gene cloning of a healthy gene and inserting the gene through a vector the disease is treated.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>• Identifies and briefly describes a disease and discusses some points of gene therapy and how it is used to treat the disease OR discusses gene therapy and makes some evaluation.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>Gene therapy is the process of replacing defective genes with normal genes by cutting genes from DNA of healthy cells and inserting them into the DNA of defective cells and tissues. To insert the DNA, vectors such as viruses or liposomes are used to transport the wanted DNA across cell membranes into the defective cells.</p> <p>Cystic fibrosis is a genetic disease caused by a recessive gene that does not produce the protein needed to transport chloride ions across the cell membrane. This results in mucus build up in the lungs causing lung infections and tissue destruction resulting in the death of most patients before 30 years of age.</p> <p>The gene therapy replaces the defective genes causing cystic fibrosis with healthy ones in the somatic cells. First the healthy gene is cloned using bacteria and then the healthy genes are inserted into a harmless adeno-virus which is put into solution and dripped into the patient's lungs through a thin tube. The virus then infects the lung tissue taking the healthy gene into the DNA of the nucleus of the lung cells and these cells should then function normally.</p> <p>Gene therapy is proving beneficial in those patients that it is managing to help however there have been some detrimental cases where the virus was not harmless and caused infection. As gene therapy improves it should be able to be more beneficial in the treatment of disease.</p> <p>Can do any of a genetic disease, a named form of cancer or AIDS</p>	

**Question 36 (f)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.7.7 C2 D2 H6 H13	
<ul style="list-style-type: none"> <li>Correctly draws a flow diagram to outline the sequence of events used in ‘gene cloning’ (recombinant DNA) with an example of its use.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Correctly draws a flow diagram to outline the sequence of events used in ‘gene cloning’ (recombinant DNA) with no example OR draws a flow diagram to partially outline the sequence of events used in ‘gene cloning’ (recombinant DNA) with an example of its use.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Partially outlines some of the sequence of events used in ‘gene cloning’ (recombinant DNA) OR gives some information and an example of its use.</li> </ul>	<b>1</b>

**Sample answer**



## Question 37 - The Human Story

### Question 37 (a)

Syllabus Reference, Outcomes, Marking guide	Marks
9.8.1 C2 D6 C3 D2 H7	
<ul style="list-style-type: none"><li>Describes any three correct characteristics that differentiate humans from one of prosimians, monkeys or apes giving the characteristics of the two groups discussed.</li></ul>	3
<ul style="list-style-type: none"><li>Describes any two different characteristics of each group.</li></ul>	2
<ul style="list-style-type: none"><li>Describes a different characteristic of each group.</li></ul>	1
<b>Sample answer</b> Humans have an upright stance and bipedal locomotion, an S shaped spine and the legs are longer than the arms. Apes on the other hand are usually quadrupedal, have a slightly curved spine (i.e. J shaped) and the arms are longer than the legs.  Other primates and characteristics are also suitable.	

### Question 37 (b) (i)

Syllabus Reference, Outcomes, Marking guide	Marks
9.8.2 C2 D1 D5 H2 H11 H12 H14	
<ul style="list-style-type: none"><li>Outlines how the method of obtaining information from fossils works in detail.</li><li>Assesses the usefulness of fossils in studying the evolution of primates.</li></ul>	3
<ul style="list-style-type: none"><li>Outlines how the method works in detail with some assessment OR</li><li>Assesses the usefulness of fossils in studying the evolution of primates.</li></ul>	2
<ul style="list-style-type: none"><li>Briefly outlines how the method works.</li></ul>	1
<b>Sample answer</b> The use of fossil evidence is based on the discovery of fossil remains which is most often restricted to hard parts such as teeth, bones and shells. For fossils to form it requires quick burial to prevent decay and therefore this is more likely to occur in aquatic environments, tar pits, bogs, volcanic ash flows or where freezing occurs due to ice formation and burial. Unfortunately this occurrence for terrestrial organisms can be quite rare resulting in little fossilisation of land based organisms. Also the chance of finding fossils decreases the availability of fossil evidence that can be used. Primate fossils are generally of the teeth, jaws and sometimes other skeletal parts and therefore often incomplete and the number of fossils found is quite rare often giving an incomplete picture especially when trying to determine the sequential nature of evolution. Therefore interpreting such incomplete data can lead to different interpretations and not be conclusive and as a result is not always highly accurate so other techniques maybe more useful or better if used in conjunction with fossil evidence.	



**Question 37 (b) (ii)**

Syllabus Reference, Outcomes, Marking guide	Marks
9.8.1 C3D3 9.8.2 C2D5D6 C3D2D3 9.8.3 C3D3 H1 H2 H3 H6 H9 H10 H13 H14	
<ul style="list-style-type: none"> <li>Discusses five new technologies in detail and analyses how they may be used in determining human evolution and relationships with other primates.</li> </ul>	<b>7</b>
<ul style="list-style-type: none"> <li>Discusses four new technologies in detail and analyses how they may be used in determining human evolution and relationships with other primates OR discusses five new technologies in detail with little analysis.</li> </ul>	<b>6</b>
<ul style="list-style-type: none"> <li>Discusses three new technologies in detail and analyses how they may be used in determining human evolution and relationships with other primates OR discusses four new technologies in detail with little analysis.</li> </ul>	<b>5</b>
<ul style="list-style-type: none"> <li>Discusses two new technologies in detail and analyses how they may be used in determining human evolution and relationships with other primates OR discusses three new technologies in detail with little analysis.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>Discusses one new technology in detail and analyses how it may be used in determining human evolution and relationships with other primates OR discusses two new technologies in detail with little analysis.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>Discusses one new technology and analyses how it may be used in determining human evolution or relationships with other primates OR discusses two new technologies with no or little analysis.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>Makes some mention of a new technology or analysis.</li> </ul>	<b>1</b>
<p><b>Sample answer</b></p> <p>New technologies in biochemical analysis have been recently devised providing more information in the comparison of organisms. This new information can be used in conjunction with fossil evidence and analysis of anatomical structures to provide a clearer picture of human evolution and relationships between primates.</p> <p>These techniques include the following:</p> <p><i>Karyotype analysis:</i> A picture of the pairs of chromosomes can be used to make comparisons between different species by observing the number, size, shape and banding patterns on the chromosomes of the species. This can be used to determine the closeness of the relationship depending on how similar or different they are. For example scientists have concluded that humans appear to be more closely related to chimpanzees than to gorillas and orangutans using karyotype analysis.</p> <p><i>Comparison of haemoglobins:</i> Haemoglobin is an oxygen carrying protein in the blood. As it is a protein it is coded for by the DNA and therefore is a method of indirectly comparing the closeness of the DNA of two organisms. It can be examined by immune response testing using reactions to antibodies. The greater the reaction to the antibodies of the species being compared to, the closer the relationship. It can also be studied by looking at the amino acid sequence. Chimpanzees have haemoglobin identical to humans whereas gorilla haemoglobin differs by two amino acids from humans and chimpanzees</p>	

indicating humans and chimpanzees have been separated for less time, since fewer changes have occurred.

*DNA Hybridisation:* DNA – DNA hybridisation uses the DNA of the two species being compared to be heated to separate the strands of DNA. Restriction enzymes are used to cut the DNA into smaller pieces and the DNA of the two different species is mixed together. As the DNA cools bonds will be formed between the two species where there is complementarity depending on the similarity of the sequences of the DNA. The more similarity the more bonds form. The mixture is then heated and the temperature required to separate the two strands ( $T_m$ ) again indicates how closely related the two species are. This technique is highly accurate but requires samples of DNA and therefore is useful in comparing present day organisms but becomes more problematic when comparing organisms that are extinct especially as good samples of DNA are not always readily available especially if trying to obtain it from fossil remains which are often incomplete or have been altered.

*DNA sequencing:* This process uses biochemical and genetic methods to determine the order or sequence of nitrogenous bases in a strand of DNA. The sequences of different species can then be compared for similarities and differences, again the more similarities in the base sequence, the more closely the species are related. Humans and chimpanzees differ by about 1-2% indicating 98-99% of our DNA is the same indicating a shorter period since divergence when compared to other primates.

*Mitochondrial DNA as a molecular clock:* DNA found in the mitochondria is passed on through the female and is believed to have a predictable mutation rate like a molecular clock. Therefore by looking at the number of differences in sequences between species, indicating the number of mutations and knowing the mutation rate, it can be used to determine the length of time two organisms have been diverging.

Studies of mitochondrial DNA of modern humans show more variation in the African populations indicating a longer human history in Africa than other areas and populations of the world which lends support to the Out of Africa model of human evolution over the theory of regional continuity.

DNA analysis of *Homo neanderthalensis* has shown it to be distinct from *Homo sapiens* supporting Neanderthals to be a separate species and did not interbreed with modern humans even though coexisting and supports modern humans eventually replacing *Homo neanderthalensis*.

Biochemical analyses have also been used to change the classification of humans from hominids to hominin as relationships between humans, chimpanzees, gorillas and orangutans are being revised due to biochemical evidence.

**Question 37 (c)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.8.4 C2 D2 H7	
<ul style="list-style-type: none"><li>• Correctly defines polymorphism and clinal gradation and gives examples of each.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>• Correctly defines polymorphism and clinal gradation with no examples OR</li><li>• Correctly defines polymorphism or clinal gradation and gives examples of each.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Either defines one of polymorphism or clinal gradation OR gives examples of each.</li></ul>	<b>1</b>
<b>Sample answer</b> Polymorphism is when two or more clearly different phenotypic characteristics exist in the same population of a species such as skin colour or blood groups in humans. A clinal gradation is a gradual change in gene frequency resulting in a gradual change in the phenotype in a population from one geographic area to another. This can be seen in skin colour moving from the equator where darker skin is more advantageous in the high UV radiation areas to higher latitudes where the skin becomes fairer such as in the northern European populations. The areas in between show a gradual change.	

**Question 37 (d)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.8.5 C2 D1 D2 H1 H8 H10 H13 H14	
<ul style="list-style-type: none"> <li>• Describes cultural development with examples.</li> <li>• Describes several cultural changes that occurred as humans developed into efficient hunters in organised co-operative groups and the possible impacts of this cultural development.</li> </ul>	<b>5</b>
<ul style="list-style-type: none"> <li>• Describes cultural development.</li> <li>• Describes several cultural changes that occurred as humans developed into efficient hunters in organised co-operative groups and the possible impacts of this cultural development.</li> </ul>	<b>4</b>
<ul style="list-style-type: none"> <li>• Describes several cultural changes that occurred as humans developed into efficient hunters in organised co-operative groups and the possible impacts of this cultural development.</li> </ul>	<b>3</b>
<ul style="list-style-type: none"> <li>• Describes some cultural changes that occurred as humans developed into efficient hunters in organised co-operative groups and a possible impact of this cultural development.</li> </ul>	<b>2</b>
<ul style="list-style-type: none"> <li>• Mentions a cultural change that occurred as humans developed into efficient hunters OR mentions a possible impact of this cultural development.</li> </ul>	<b>1</b>

**Sample answer**

Cultural development started to appear as humans evolved and passed on information such as skills and ways of life onto future generations by communication and traditions. The use of language, customs, religion, rituals, tools and weapons are all examples of culture.

As early humans started to use tools they were able to hunt better and as they started to hunt more they needed to develop methods of communication. It is thought that as hunter gatherers, the males would go off in groups and hunt whilst the women would collect plant material such as nuts and seeds. The group as a whole would then share the food hunted and gathered during the day, leading to changed social structures of early humans. They would have functioned more as a social group having to communicate better leading to language development and other ways of passing on information such as rituals and perhaps ceremonies. The younger members of the group would have learned from watching and participating in the activities.

Humans started making their own tools somewhere between 400 000 and 100 000 years ago and would have resulted from better communication between the members of the social groups.

The existence of evidence of bone sewing needles, bone fishhooks, stone chisels, hand axes and eventually bows, arrows and spears indicates a higher level of communication needed to share ideas. The appearance of clothes, necklaces and cave paintings shows more cultural development over time.

Around 10 000 years ago humans started to settle more permanently from the nomadic lifestyle and started farming crops and domesticating animals.

As a result of organised co-operative groups we have seen the rise of more complex social structures, changes in diets, better communication and the development of verbal and written languages, permanent settlements and agriculture, industrial and technological revolutions amongst many other impacts.

**Question 37 (e)**

<b>Syllabus Reference, Outcomes, Marking guide</b>	<b>Marks</b>
9.8.6 C3 D2 H1 H3 H4 H5 H9	
<ul style="list-style-type: none"><li>• Outlines the Human Genome Project and discusses three of its implications.</li></ul>	<b>4</b>
<ul style="list-style-type: none"><li>• Outlines the Human Genome Project and discusses two of its implications.</li></ul>	<b>3</b>
<ul style="list-style-type: none"><li>• Outlines the Human Genome Project and discusses an implication.</li></ul>	<b>2</b>
<ul style="list-style-type: none"><li>• Makes some statement about the Human Genome Project.</li></ul>	<b>1</b>
<b>Sample answer</b> The Human Genome Project (HGP) was implemented to identify and determine the position of all the genes in the human chromosomes and to determine the base sequences for the genes to create a database of the information for use in medicine, a better understanding of genetics and evolution and DNA forensics. Some of the positive implications include: Improved diagnosis and earlier detection of hereditary diseases allowing for genetic counselling and possible gene therapy techniques. A better understanding of how genes interact. For example the switching on and off of genes in mitosis and differentiation and also gene cascades in embryonic development. Also the effect of non protein coding introns. A better understanding of evolutionary pathways through comparison with genomes of other species. Some of the negative implications of the data obtained include: Concerns over the ethical, legal and social implications such as how the genetic information will be used. Who owns or has access to the information therefore needs to be considered and perhaps protected. For example people may be refused jobs or life insurance if they have a genetic deficiency or disorder which may lead to a tiered society. Parents could design the children they have or countries may design armies of cloned soldiers.	

***Question 38 - Biochemistry – Not included in this paper.***