

BOARD OF STUDIES
NEW SOUTH WALES

2013 HSC Biology Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

Question	Answer
1	C
2	B
3	A
4	B
5	C
6	A
7	B
8	A
9	A
10	B
11	D
12	C
13	D
14	A
15	D
16	D
17	C
18	C
19	D
20	B

Section I, Part B

Question 21

Criteria	Marks
<ul style="list-style-type: none">Names two types of T cellsProvides characteristics and features of the roles of each of the T cells, in the immune response in humans	4
<ul style="list-style-type: none">Names two types of T cellsProvides the characteristics and features of the roles of one of the T cells	3
<ul style="list-style-type: none">Provides the characteristics and features of the role of one named T cell OR	2
<ul style="list-style-type: none">Names two types of T cells	
<ul style="list-style-type: none">Provides some relevant information about T cells	1

Sample answer:

The T helper cell is part of an initial response to an antigen, releasing chemicals to stimulate growth of B cells that respond to the antigen. A T memory cell responds differently, interacting initially with an antigen but remaining dormant until the next time the body is infected, when it is quickly activated so that there is a faster response to the antigen.

Question 22

Criteria	Marks
<ul style="list-style-type: none">• Sketches in general terms the sex-linked inheritance experiments conducted by Morgan• Notes the different frequencies of occurrence of the sex-linked trait in males and females	3
<ul style="list-style-type: none">• Indicates some of the features of Morgan's work with fruit fly AND <ul style="list-style-type: none">• Notes the difference in ratios between males and females of a trait that includes sex linkage OR identifies that the trait showed non-Mendelian ratios	2
<ul style="list-style-type: none">• Provides some relevant information concerning Morgan's work with fruit flies	1

Sample answer:

Morgan bred fruit flies and observed that the eye colour was not inherited in normal Mendelian ratios. The white eye colour was common in males and rare in females.

Question 23

Criteria	Mark
<ul style="list-style-type: none">Identifies two relevant adaptations and provides how each relates to the survival of Spinifex	4
<ul style="list-style-type: none">Identifies two adaptations and relates information about survival of Spinifex to one of these adaptations	3
<ul style="list-style-type: none">Identifies two adaptations OR <ul style="list-style-type: none">Identifies an adaptation and relates it to information about survival of Spinifex OR <ul style="list-style-type: none">Provides two pieces of information about survival of Spinifex in a hot dry environment	2
<ul style="list-style-type: none">Names one adaptation OR <ul style="list-style-type: none">Provides some information about survival of Spinifex	1

Sample answer:

Curling the leaves reduces water loss from the stomates.
The roots grow deep to access water.

Question 24 (b)

Criteria	Marks
<ul style="list-style-type: none">• Makes evident the relationship between the use of controls and microbial experiments, including the importance to increasing the validity	3
<ul style="list-style-type: none">• Provides a reason for using controls and identifies a control for a microbial experiment OR <ul style="list-style-type: none">• Provides a reason for using a relevant control and indicates its importance to increasing validity OR <ul style="list-style-type: none">• Provides two reasons for using controls OR <ul style="list-style-type: none">• Provides a relevant control and indicates its importance to increasing validity	2
<ul style="list-style-type: none">• Identifies a relevant control for a microbial experiment OR <ul style="list-style-type: none">• Provides a reason for using a relevant control OR <ul style="list-style-type: none">• Indicates the importance of using controls to increase validity	1

Sample answer:

Controls in microbial experiments allow us to validate the results. The control ensures that the microbial growth is a result of experimental conditions rather than contamination. For example, when testing the presence of microbes in food, the control agar plate is left unopened / unexposed. No growth in the control culture plate will make sure the microbial growth in experimental plates is from food rather than from the contamination of nutrient agar.

Question 25 (a)

Criteria	Marks
<ul style="list-style-type: none"> Identifies a variable 	1

Answers could include:

pH OR enzyme concentration OR substrate concentration

Question 25 (b)

Criteria	Marks
<ul style="list-style-type: none"> States an appropriate temperature range 	1

Sample answer:

Temperature range is 89–93°C

Question 25 (c)

Criteria	Marks
<ul style="list-style-type: none"> States a reason for the shape of the curve at each of the temperature ranges: A, B, C and D 	4
<ul style="list-style-type: none"> States reasons for the shape of the curve at THREE of the temperature ranges 	3
<ul style="list-style-type: none"> States reasons for the shape of the curve at TWO of the temperature ranges OR <ul style="list-style-type: none"> States a reason for the shape of the curve at ONE of the temperature ranges and provides some relevant information about enzyme function 	2
<ul style="list-style-type: none"> States a reason for the shape of the curve at ONE of the temperature ranges OR <ul style="list-style-type: none"> Provides some relevant information about enzyme function 	1

Sample answer:

A = constant gradient indicating a constant increasing rate of enzyme activity as temperature increases.

B = graph level at a maximum (10 $\mu\text{mol} / \text{s}$). Enzyme-substrate complex operating at maximum even though temperature is increasing.

C = graph decreasing indicating a reduction in enzyme efficiency due to increasing temperature denaturing enzyme.

D = graph rapidly goes to 0 indicating enzyme activity stops because the enzyme is denatured.

Question 25 (d)

Criteria	Marks
<ul style="list-style-type: none">• Suggests a suitable type of environment for those bacteria to survive, based on the information in the graph	1

Sample answer:

Bacteria could survive in hot geothermal springs or geysers where temperatures may be up to 90°C.

Question 26

Criteria	Marks
<ul style="list-style-type: none">Relates the general principles of Darwin/Wallace's theory of evolution to survival and recovery of rabbits	3
<ul style="list-style-type: none">Sketches in general terms Darwin/Wallace's theory of evolution but does not relate it to rabbit population recovery OR <ul style="list-style-type: none">Relates some of the principles of Darwin/Wallace's theory of evolution to survival and recovery of rabbits	2
<ul style="list-style-type: none">Gives a reason for rabbit survival OR <ul style="list-style-type: none">Provides some information about Darwin/Wallace's theory of evolution	1

Sample answer:

Darwin/Wallace's theory of evolution suggests variation in a population and the fittest survive to pass on their characteristics. Individuals in a rabbit population vary. The virus, a change in the environment, killed most rabbits. A few that were resistant survived. The survivors reproduced and passed this characteristic (resistance) on to their offspring. Over time the population increased with most rabbits resistant to the virus.

Question 27

Criteria	Marks
<ul style="list-style-type: none">Clearly explains how one advance in technology has provided support for the theory of evolution	4
<ul style="list-style-type: none">Provides a relationship between an advance in technology and the theory of evolution	3
<ul style="list-style-type: none">Outlines some information of the theory of evolution AND names a relevant technology	2
<ul style="list-style-type: none">Names a relevant technology <p>OR</p> <ul style="list-style-type: none">Provides some information about the theory of evolution	1

Sample answer:

The theory of evolution suggests variation in a population and the fittest survive to pass on their characteristics. With the use of DNA sequencing, we now know that genetic variations are caused by a difference in the DNA of the members of the population. It can be shown that certain genes are chosen for in the population by outside pressures, and this leads to change in species.

DNA sequencing is used to find the exact order of bases in the gene of one individual species and to compare them with the sequences from individuals of another species.

From this data, although differences occur in individuals, closely related species are similar in their DNA sequence and the sequences have slowly changed. This provides evidence that these species have diverged more recently from a common ancestor, which supports the theory of evolution.

Question 28 (a)

Criteria	Marks
<ul style="list-style-type: none"> Lists two correct and relevant observations 	2
<ul style="list-style-type: none"> Lists one correct and relevant observation 	1

Answers could include:

Black spots on leaves; appearance of ‘fur’ (mould) on the leaf; white spots/growth on shoots; presence of abnormal tissue growth on/in leaves/shoots.

Question 28 (b)

Criteria	Marks
<ul style="list-style-type: none"> Names TWO relevant methods Provides characteristics and features of the two methods and of how the methods have changed the way disease and/or insect pests are managed 	5
<ul style="list-style-type: none"> Names TWO relevant methods AND <ul style="list-style-type: none"> Provides characteristics and features of the two methods and how a method has changed the way disease or insect pests are managed OR provides a characteristic and feature of a method and of how methods have changed the way disease and/or insect pests are managed 	4
<ul style="list-style-type: none"> Identifies TWO relevant methods and outlines how one of these methods is used 	3
<ul style="list-style-type: none"> Identifies TWO relevant methods OR <ul style="list-style-type: none"> Identifies ONE relevant method and outlines how the method is used 	2
<ul style="list-style-type: none"> Identifies ONE method OR <ul style="list-style-type: none"> Provides some information about the prevention of plant disease / insect pests 	1

Sample answer:

Genetic engineering of plants with particular characteristics: The findings that a combination of certain genetic characteristics can provide insect resistant crops have led to the insertion of genes for desirable characteristics into plants to produce insect resistant plants. This has produced less need for insecticides.

Quarantine restrictions: Based on our understanding of disease transmission, the isolation of diseases plants has prevented the spread of plant diseases into and around Australia. This has led to a change from the treatment of diseased plants to preventing the disease spread.

Question 29 (a)

Criteria	Marks
• Identifies at least two chemicals that are filtered	2
• Identifies one chemical that is filtered	1

Sample answer:

Filters glucose and NaCl

Question 29 (b)

Criteria	Marks
• Identifies at least two chemicals that are reabsorbed	2
• Identifies one chemical that is reabsorbed	1

Sample answer:

Reabsorbs water and glucose

Question 29 (c)

Criteria	Marks
• Relates characteristic features of each region of the nephron to an appropriate function • Includes an indication of the selective nature at the glomerulus and Bowman's capsule complex • Identifies role of a named hormone	4
• Provides the main features and functions of the nephron	3
• Provides at least ONE feature and function of the nephron	2
• Provides some information about urine formation	1

Sample answer:

Blood is filtered at the glomerulus through Bowman's capsule. Blood cells and large molecules remain in the blood and small molecules, salts and water enter the proximal tubule. Glucose is actively taken back to the blood through the wall of the proximal tubule. The filtrate then enters the loop of Henle where a countercurrent mechanism uses active transport (ascending limb) and osmosis causes a concentration gradient of ions down the loop of Henle (towards the medulla). The filtrate then enters the distal tubule where its other ions are removed. The urine can be made more acidic here. It then enters the collecting tubule which is not permeable to water unless stimulated by ADH. ADH causes it to be permeable to water as it descends past the loop of Henle in the medulla. This then leads to a concentration of the urine by osmosis.

Question 30

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates thorough knowledge of the structure of chromosomes • Clearly states the relationship between chromosome structure and inheritance • Links appropriate reproduction technologies to the nature of inheritance and chromosomes • Relates using these technologies to possible impacts on evolution 	8
<ul style="list-style-type: none"> • Provides some information about chromosome structure • Clearly states the relationship between chromosome structure and inheritance • Outlines a reproductive technology • Relates this technology to possible impact on evolution 	6–7
<ul style="list-style-type: none"> • Provides some information about chromosomes • States a relationship between chromosomes and inheritance AND <ul style="list-style-type: none"> • Outlines a reproductive technology OR links chromosomes to evolution 	4–5
<ul style="list-style-type: none"> • Provides some information about chromosome structure OR <ul style="list-style-type: none"> • Shows a relationship between chromosomes and inheritance OR <ul style="list-style-type: none"> • Outlines a reproductive technology OR <ul style="list-style-type: none"> • Relates chromosomes to evolution 	2–3
<ul style="list-style-type: none"> • Provides some information about chromosomes or evolution OR <ul style="list-style-type: none"> • Identifies a reproductive technology 	1

Sample answer:

Chromosomes contain DNA that provides the genetic code for an organism. Genes in this DNA code for proteins and eventually phenotypes. In sexual reproduction pairs of homologous chromosomes are separated during meiosis into gametes. These pairs are then brought back together during fertilisation, with genetic information from both parents. Some of the characteristics will be dominant, and revealed in the phenotypes and others will be recessive, not revealed unless both of the chromosome pair are recessive. Knowing the sperm have the characteristics of the father artificial insemination can be used from one father to fertilise many females, such as is done in racehorses. If this is done then genetic variation will be limited and so limiting variations in the population and hence controlling evolution. Cloning techniques have also been developed where the chromosomes of a normal cell are placed in an egg, or parts of a plant are grown into a new plant. These then develop into copies of the parent organism and there is no variation because all the chromosomes and genetic information is the same as the parent. This would lead to a population with no genetic variation, hence stopping evolution.

Section II

Communication

Question 31 (a)

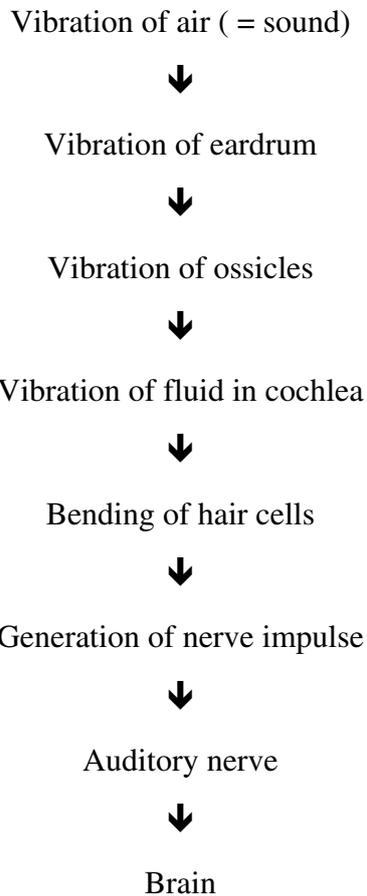
Criteria	Marks
<ul style="list-style-type: none">Identifies the structures and mechanisms for the larynx producing high and low pitched sounds	3
<ul style="list-style-type: none">Identifies the mechanism for producing high and low pitched sounds OR <ul style="list-style-type: none">Identifies the structures and mechanism for producing high pitched sounds OR <ul style="list-style-type: none">Identifies the structures and mechanism for producing low pitched sounds	2
<ul style="list-style-type: none">Provides some information about sound production	1

Sample answer:

The tension of the vocal chords can be altered by the muscles of the larynx as air moves between them. Tight (stretched) gives high pitch (frequency) and loose (relaxed) gives low notes as the chords vibrate.

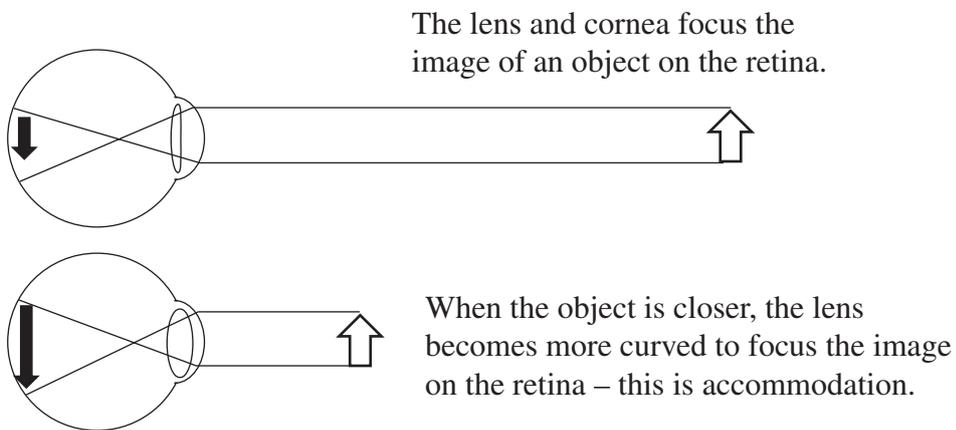
Question 31 (b)

Criteria	Marks
• Sketches in general terms how sound is transmitted to the brain	4
• Sketches in general terms some features of how sound is transmitted to the brain	3
• Provides some steps in sound being transmitted to the brain	2
• Provides some information about hearing pathway	1

Sample answer:

Question 31 (c) (i)

Criteria	Marks
<ul style="list-style-type: none"> Provides characteristics and features of the process of accommodation. Diagrams may be included 	4
<ul style="list-style-type: none"> Sketches in general terms the process of accommodation. Diagrams may be included 	3
<ul style="list-style-type: none"> Identifies some features of the process of accommodation 	2
<ul style="list-style-type: none"> Provides some relevant information about accommodation 	1

Sample answer:

Question 31 (c) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Sketches in general terms how a technology is used to correct hyperopia 	1

Sample answer:

Laser surgery increases the curvature of the cornea.

Question 31 (d)

Criteria	Marks
<ul style="list-style-type: none"> Provides characteristics of distribution of rod and cone cells Identifies types of cone cells and sensitivities to red light Presents logical process from the signal reception to its conversion into an electrochemical response 	6
<ul style="list-style-type: none"> Provides characteristics of distribution of rod and cone cells Identifies types of cone cells and sensitivities to red light Identifies that the light signal is converted into a nerve impulse 	4–5
<ul style="list-style-type: none"> Identifies rod and cone cells exist Identifies a difference between rods and cones Identifies effect of red light on some cells in the retina OR <ul style="list-style-type: none"> Identifies the function of some photoreceptors Identifies that the light signal is converted into an electrochemical response 	2–3
<ul style="list-style-type: none"> Identifies rod and cone cells 	1

Sample answer:

The two main photoreceptor cell types in the retina are cone cells (colour) and rod cells (black and white).

There are 3 types of cone cells. They detect red light, blue light or green light respectively.

Cone cells are concentrated in the fovea where the image is detected in high resolution in colour. The red cone cells are most sensitive to red light (green cones slightly respond and blue cones not at all).

Red light will cause the red cones in the fovea to respond.

The red light causes the change of shape/breakup of receptor molecules in the cone cells on the back of the retina. This causes changes in the permeability of cell membranes to Na⁺ and K⁺, leading to electrochemical transmission.

Question 31 (e) (i)

Criteria	Marks
• Identifies one essential step	1

Sample answer:

An action potential must be generated in the optic nerve.

Question 31 (e) (ii)

Criteria	Marks
<ul style="list-style-type: none"> • Relates the use of the technologies to the biological problems • Outlines the use of hearing aids and cochlear implants • Describes some advantages and limitations of the aids and implants for hearing • Describes some possible advantages and limitations of the microchips for vision • Logically compares use of the devices between the senses 	6
<ul style="list-style-type: none"> • Any THREE of the first four above and compares the use of the devices between the senses 	5
Any THREE of the following: <ul style="list-style-type: none"> • Relates the use of the technology to the biological problem • Outlines the use of hearing aids and cochlear implants • Describes an advantage and a limitation of the aids and implants for hearing • Describes a possible advantage and a limitation of the microchips for vision OR <ul style="list-style-type: none"> • Any TWO of the above and compares use of devices between the senses 	4
Any THREE of the following: <ul style="list-style-type: none"> • Relates the use of the technology to the biological problem • Outlines the use of hearing aids and cochlear implants • Describes an advantage and a limitation of the aids and/or implants for hearing • Describes a possible advantage or a limitation of the microchips for vision OR <ul style="list-style-type: none"> • Any TWO of the above and compares use of devices between the senses 	3
<ul style="list-style-type: none"> • Provides some information about hearing and vision OR <ul style="list-style-type: none"> • Provides TWO pieces of information about a cochlear implant and/or a retinal implant 	2
<ul style="list-style-type: none"> • Provides some information about hearing or vision OR <ul style="list-style-type: none"> • Provides some information about a sensory implant or hearing aid 	1

Sample answer:

The retina and cochlea respond to a wide range of frequencies whereas these device implants have limited frequencies. This means that they are suitable for very blind or very deaf people. Moderately deaf people use a hearing aid to amplify the sound and similarly for the retina, an implant might be used to amplify light so you could see in the “dark” or use infra red or ultra violet light sensors and this would be an advantage. Neither the cochlear implant nor retinal implant would be useful for people with auditory nerve damage or optic nerve damage respectively, nor if they had damage to the auditory centre or visual centre in the brain. They would work better for those who previously could see or hear, but in some cases something is better than nothing. Both implants have a risk of infection with the operation, but a hearing aid does not.

Biotechnology

Question 32 (a)

Criteria	Marks
• Sketches in general terms the function of RNA	3
• Indicates some features of RNA	2
• Provides some information about RNA	1

Sample answer:

There are different specific t-RNA molecules for each amino acid.

They bring their amino acid into the ribosome (r-RNA) where they bind to specific m-RNA bases.

mRNA takes its code (order of bases) directly from DNA.

Question 32 (b)

Criteria	Marks
• Provides a specific example • Indicates traditional methods of fermentation • Indicates development of scientific idea and links it to a change in method or technology for the example	4
• Provides a specific example • Indicates traditional methods of fermentation • Indicates a change of method for the example	3
• Provides a specific example • Indicates a traditional or modern method of fermentation OR • Provides information about a scientific idea linked to a change in methodology	2
• Provides some information about fermentation	1

Sample answer:

Traditional methods of wine production used natural contamination from the environment by yeast. Pasteur discovered specific microorganisms were responsible for alcohol production. This led to using pure cultures for fermentation, so alcohol was produced.

Question 32 (c) (i)

Criteria	Marks
• Provides the main features of the extraction process of DNA from a named source	2
• Provides some information about DNA extraction	1

Sample answer:

The DNA from strawberries is extracted by blending. Make a solution of some detergent and non-iodised salt and mix with the blended strawberries. Filter the mixture through cheese cloth. Add 95% ethanol (solution). Allow to stand until the top of the solution becomes white (DNA). This is the DNA and can be picked up using a toothpick.

Question 32 (c) (ii)

Criteria	Marks
• Names a technique for identifying DNA	1

Sample answer:

Could use spectrophotometry.

Question 32 (c) (iii)

Criteria	Marks
• Names a technique for amplifying DNA • Provides features of the process	2
• Names a technique for amplifying DNA OR • Provides features of the technique	1

Sample answer:

Use complementary primer strands of the start and the finish of the gene and then use PCR (heating and cooling) and polymerase to amplify the gene.

Question 32 (d)

Criteria	Marks
<ul style="list-style-type: none"> Provides the main components of a named application Describes the contribution of this application to medicine Explains the advantage of the application to medicine Identifies a limitations of the application 	6
<ul style="list-style-type: none"> Provides the main components of a named application Describes the contribution of this application to medicine Explains the advantage of the application to medicine or identifies a limitation of the application 	5
<ul style="list-style-type: none"> Provides the main components of a named application Describes the contribution of this application to medicine 	4
<ul style="list-style-type: none"> Identifies a use of an application in medicine Identifies the advantage and a limitation of an application to medicine OR <ul style="list-style-type: none"> Identifies a use of an application in medicine Identifies an advantage or a limitation of an application to medicine <ul style="list-style-type: none"> Provides some information about the components of the named application 	3
<ul style="list-style-type: none"> Identifies a use of an application in medicine Identifies the advantage or a limitation of an application to medicine OR <ul style="list-style-type: none"> Provides some information about the components of the named application 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

An example of the production of a synthetic hormone is the production of human insulin by the use of recombinant DNA technology.

Insulin is produced in the pancreas unless the patient has type 1 diabetes. In this case insulin must be provided to allow for transport of glucose into cells (for respiration).

Recombinant DNA technology involves:

- Identifying the human gene for insulin
- Isolating this gene
- Inserting the gene into a bacterial plasmid
- Culturing the bacteria
- Extracting the human insulin

This biotechnology produces human insulin which can be taken without fear of rejection or allergic reaction.

It is cheap to produce and can be produced in quantity.

This method of insulin production does not address the issue of providing insulin to the patient when needed. This means that they may still suffer hypoglycaemic attacks.

Thus while this process is efficient and beneficial to diabetics, it has not overcome the problems of delivery of insulin into the human body.

Question 32 (e) (i)

Criteria	Marks
<ul style="list-style-type: none"> Sketches in general terms how the process relates to biotechnology 	1

Sample answer:

Noticing that a special feature of a plant is transmitted by its seeds to its offspring (bio) and then selecting seeds to take advantage of this to benefit the society (technology) is a functional biotechnology.

Question 32 (e) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Makes a judgement about at least TWO relevant ethical issues raised by the use of current biotechnology related to a named domesticated plant or animal species Provides main features of the domestication process 	6
<ul style="list-style-type: none"> Provides main features of the domestication process Provides TWO ethical issues related to the use of current biotechnology with a relevant example of a named domesticated plant or animal OR <ul style="list-style-type: none"> Provides main features of the domestication process Describes ONE relevant ethical issue AND links this to a named domesticated plant or animal species 	4–5
<ul style="list-style-type: none"> States one ethical issue and relates it to a named domesticated plant or animal 	3
<ul style="list-style-type: none"> States one ethical issue and names a domesticated plant or animal species 	2
<ul style="list-style-type: none"> Gives one example of relevant plant or animal OR <ul style="list-style-type: none"> Relates domestication to artificial selection OR <ul style="list-style-type: none"> States one ethical issue 	1

Sample answer:**Biotechnology**

Domestication of plants began with artificial selection of seeds from plants with better quality crop yields. This is early biotechnology because people used plants for their own benefit. An example is wheat. Modern wheat produces greater yields because of hybrid vigour and hybridisations.

Today, seed selection is based on yield not survival. There is little genetic variety in today's wheat. If the growing conditions for wheat changed, this would be catastrophic for wheat production. All wheat could be destroyed because there is no genetic diversity. It is an ethical issue whether to maximise yield or to maintain variation. A second ethical issue is raised by the insertion of a gene for rust resistance into wheat. This may be beneficial for the farmer but some people who eat wheat products may now change their diet because they do not want to eat food with genetic material coming from a fungus.

Genetics: The Code Broken?

Question 33 (a)

Criteria	Marks
<ul style="list-style-type: none"> Sketches in general terms the main features of polygenic inheritance, and includes an example 	3
<ul style="list-style-type: none"> Provides some information about polygenic inheritance and includes an example 	2
<ul style="list-style-type: none"> Provides an example of polygenic inheritance OR <ul style="list-style-type: none"> Provides some information about inheritance 	1

Sample answer:

Polygenic inheritance occurs when two or more genes influence a trait of the organism.

Skin colour in humans is controlled by a number of genes. These genes code for different types of melanin. Their combination provides different degrees of pigmentation.

Question 33 (b)

Criteria	Marks
<ul style="list-style-type: none"> Identifies Y as t-RNA Indicates the main features of polypeptide synthesis including the relationship between t-RNA and DNA 	4
<ul style="list-style-type: none"> Identifies Y as t-RNA Sketches in general terms some features of polypeptide synthesis including the role of t-RNA 	3
<ul style="list-style-type: none"> Includes some of the features of polypeptide synthesis 	2
<ul style="list-style-type: none"> Provides some information about translation or transcription 	1

Sample answer:

DNA carries a sequence of nitrogenous bases that holds the codes for a sequence of amino acids in codons (3 bases). The mRNA matches the DNA sequence with complementary base pairs.

The mRNA leaves the nucleus and moves to the ribosomes where tRNA (Y), which has complementary bases to codons and a specific amino acid, attaches specifically to the mRNA. The order of tRNA molecules along the mRNA determines the order of amino acids. The amino acids then form peptide bonds, which form a polypeptide.

Question 33 (c) (i)

Criteria	Marks
<ul style="list-style-type: none"> Constructs a correct Punnett square 	2
<ul style="list-style-type: none"> Constructs a recognisable Punnett square OR <ul style="list-style-type: none"> Identifies the Mendelian dihybrid phenotypic ratio 	1

Sample answer:

Purple long: purple round: red long: red round ratio 9:3:3:1

Gametes	PL	Pl	pL	pl
PL	PPLL	PPLl	PpLL	PpLl
Pl	PPLl	PPll	PpLl	Ppll
pL	PpLL	PpLl	ppLL	ppLl
pl	PpLl	Ppll	ppLl	ppll

Question 33 (c) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Draws a clear relationship between the Mendelian ratio and location of genes Relates variation of the ratio to linkage (location on the same chromosome) Relates the differences in ratio to the relative distance of genes on chromosomes 	3
<ul style="list-style-type: none"> States the relationship between the recombination ratio and the relative position of genes on the chromosome Provides any relevant information regarding linkage or relates the Mendelian ratio to location of genes on different chromosomes 	2
<ul style="list-style-type: none"> Provides any relevant information regarding linkage OR <ul style="list-style-type: none"> Relates the Mendelian ratio to location of genes on different chromosomes 	1

Sample answer:

The Mendelian ratios (of 9:3:3:1) are achieved when the genes are located on different chromosomes which are inherited independently.

The results obtained by Bateson & Punnett can be explained if the genes are located on the same chromosome (and therefore not inherited independently).

These results can be used to map the relative positions of genes on the chromosome as the closer they are located on the chromosome, the less likely crossing over (or recombination) will occur. The closer the phenotypic ratios are to 9:3:3:1, the further apart on the chromosomes the 2 genes are located.

Question 33 (d)

Criteria	Marks
<ul style="list-style-type: none"> Identifies ways in which genetic change occurs Provides named examples of some genetic changes Describes how genetic technology influences society Includes a limitation of the technologies Provides a logical sequence Relates understanding of genetic change to use of genetic technology 	6
<ul style="list-style-type: none"> Identifies ways in which genetic change occurs Identifies some genetic technologies Relates the genetic technologies to influence on society 	4–5
<ul style="list-style-type: none"> Provides some information regarding an example of genetic change Provides some information on genetic technologies 	2–3
<ul style="list-style-type: none"> Provides some information about an example of genetic change OR <ul style="list-style-type: none"> Provides some information on a genetic technology 	1

Sample answer:

Selective breeding such as cloning has been used by people in the past as a known mechanism for genetic change, well before our understanding of modern genetics. We know that the desirable traits are encompassed in genes. Mechanisms now used to change genes include recombinant DNA technology, and whole animal cloning eg Dolly the sheep.

Knowledge about recombinant DNA means that scientists are able to genetically modify plants and animals for human benefit. There are now genetic varieties of cotton resistant to fungal/insect attack saving farmers money and increasing production. There are now strawberries with an ‘anti-freeze’ gene from salmon, allowing farmers to grow strawberries in cold weather, hence increasing strawberry production. People with diabetes now use genetically modified human insulin, with little if any side effects compared with bovine insulin in the past and thus putting less strain on the health system. Several limitations include research costs (\$) and public concern about genes from ‘other organisms’ being inserted into plants/animals used for human consumption.

Question 33 (e) (i)

Criteria	Marks
<ul style="list-style-type: none"> Indicates the main features of a method used to gain the genetic profile 	1

Sample answer:

A genetic profile can be generated by using linkage maps and recombinant DNA mapping by comparing gene sequences, especially in non-coding DNA, so familial relationships can be determined.

Question 33 (e) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Outlines the nature of the HGP Provides benefits for society of knowing gene therapy Provides limitations for society of knowing gene therapy Demonstrates a logical progression of ideas 	6
<ul style="list-style-type: none"> Demonstrates a logical progression of ideas AND <ul style="list-style-type: none"> Outlines the nature of the HGP Provides ONE benefit and ONE limitation of gene therapy for society OR <ul style="list-style-type: none"> Provides only benefits for society OR <ul style="list-style-type: none"> Provides only limitations for society 	4–5
<ul style="list-style-type: none"> Outlines the nature of the HGP or gene therapy States a benefit or a limitation for society 	2–3
<ul style="list-style-type: none"> Provides some relevant information on either HGP or gene therapy 	1

Sample answer/:

The Human Genome Project involves the mapping and sequencing of all human genes. The HGP was used to identify and locate defective and healthy genes. Gene therapy involves inserting healthy genes into the individual who continues a defective gene. An example of the human disease where gene therapy is currently being used is cystic fibrosis (CF). CF occurs due to a mutation of the CFTR gene. Gene therapy is used to insert a healthy gene contained within a weakened virus cell often the common cold into the body of the affected person. The benefits of gene therapy included the ability to treat the symptoms that may lead to an early death, such as cystic fibrosis, making it a huge benefit to society. Another benefit is that gene therapy can be used to cure diseases which may reduce the cost to the health care system. A disadvantage of gene therapy is that it has had limited success and has not benefited society (eg cystic fibrosis is only effective for a short time only). Treatment is very expensive and puts a huge cost to the health system with only some individuals who could afford the treatment.

The Human Story

Question 34 (a)

Criteria	Marks
• Sketches in general terms the main features used to identify humans as the species Homo Sapiens	3
• Provides some information used to identify humans as the species Homo Sapiens	2
• Provides a piece of information used to identify human as the species Homo Sapiens	1

Sample answer:

They interbreed and produce fertile offspring.

They have a large cranial capacity, an upright stance and flat facial features.

Question 34 (b)

Criteria	Marks
• Provides another dating technique and shows how this is similar or different from ^{14}C dating and includes the time limitation from using ^{14}C dating	4
• Provides another dating technique and shows how this is similar or different to ^{14}C dating	3
• Provides another dating technique and attempts to show how it is similar or different from ^{14}C	2
• Provides some information about dating fossils	1

Sample answer:

^{14}C can be used to give an absolute age of the fossil (hence relative as well) based on radioactive decay. This can only be done to fossils less than 100 000 years old because decay is exponential and there would be little radioactivity left after this time. Stratigraphy relies on comparing fossils with the geological strata they are in and known geological events. It can relatively date fossils to much older times but not give absolute dating.

Question 34 (c) (i)

Criteria	Marks
• Identifies at least two trends relevant to the data	2
• Identifies an increasing trend OR • Identifies a future decreasing trend	1

Sample answer:

The rate of growth in the human population has increased very rapidly between 1975–1999. The rate of growth is predicted to decrease in the future.

Question 34 (c) (ii)

Criteria	Marks
• Indicates the main features of technologies that could explain the growth rate before and after 1999 • Relates each technology to the data in the table	3
• Provides TWO technologies which impact on population OR • Outlines ONE technology, relating it to the growth rate of population	2
• Provides some relevant information	1

Sample answer:

Dramatic increase in human population numbers before 1999 is associated with technologies related to more efficient food production, widespread vaccination and improved sanitation.

Increased awareness and use of contraceptives have started to slow down population growth with the prediction that this will continue for the next 20 years.

Question 34 (d)

Criteria	Marks
<ul style="list-style-type: none">• Outlines the main features of evolution• Outlines cultural changes in human populations that includes planning for the future• Relates cultural changes to changes in evolution• Demonstrates a logical progression of ideas	6
<ul style="list-style-type: none">• Identifies the main features of evolution• Identifies cultural changes in human populations• Relates cultural changes to changes in evolution	4–5
<ul style="list-style-type: none">• Provides some information about cultural development or biological evolution in humans	2–3
<ul style="list-style-type: none">• Provides a piece of information about cultural development or human evolution	1

Sample answer:

Evolution requires a variation in the genetics of a population and selective pressures to allow survival of the fittest. Human's higher intellect has led to social strategies that affect evolution. Social structures have been developed and these are used to protect against selective pressures or remove selective pressures. Communication, verbally and written, meant that useful ideas learnt by individuals could be passed onto a group and hence there was an advantage by forming groups or tribes. The group both pooled knowledge and improved ideas and allowed specialisation by individuals to enhance the overall knowledge and skills of the group. "I do not have to be good at agriculture to obtain food, just the group does." This led to sustainable ideas and preparedness for the future eg developing agricultural techniques protected against intermittent food supplies, development of protection against wild beasts allowed young to develop to maturity. In terms of evolution, this has meant that there is less selection pressure so there is overall a more defective pool of genes present eg diabetes and hence the population is weaker overall. However, it gives a wider gene pool and so if a catastrophe occurs the variance of individuals means that someone would survive. Increased communication, changes to social structure, and instant travel has also mixed the gene pool and humans occupy all of the earth. This also means that speciation is less likely because of this mixed breeding from the whole genetic pool.

Question 34 (e) (i)

Criteria	Marks
<ul style="list-style-type: none"> Identifies the correct order of hominid skulls 	1

Sample answer:

C, A, B

Question 34 (e) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Outlines traditional techniques of classifying primates Outlines modern techniques of primate classification and shows the relationship between them and classification Relates molecular analysis to implications for primate classification Provides relevant examples 	6
<ul style="list-style-type: none"> Outlines traditional techniques of classification using relevant examples OR <ul style="list-style-type: none"> Outlines modern techniques with implications for primate classification using relevant examples 	5
<ul style="list-style-type: none"> Identifies traditional techniques of classification using relevant examples OR <ul style="list-style-type: none"> Identifies modern techniques with implications for primate classification using relevant examples 	4
<ul style="list-style-type: none"> Identifies traditional or modern techniques with a connection linked to primate classification 	3
<ul style="list-style-type: none"> Identifies a traditional or a modern technique Names a relevant example of a primate 	2
<ul style="list-style-type: none"> Provides some relevant information about primate classification 	1

Sample answer:

Previous opinions were based on structural features and geographical relationships in the fossil record.

Scientists could not establish if humans were more closely related to gorillas or chimpanzees based on structural features.

Karyotype analysis using chromosome banding patterns showed we are closely related to chimpanzees.

DNA hybridisation where hybrids of single stranded DNA from species are made, indicates orangutans are more distant from humans than gorillas or chimpanzees.

More precise genetic analysis, DNA sequencing, shows that humans actually bred with Neanderthals. Micro DNA analysis has enabled tracing of modern Homo Sapiens.

Biochemistry

Question 35 (a)

Criteria	Marks
<ul style="list-style-type: none"> Identifies the coenzymes involved in the light reactions and their role Identifies the conversion $ADP \rightarrow ATP$ and $NADP \rightarrow NADPH$ 	3
<ul style="list-style-type: none"> Identifies one of the coenzymes involved in the light reactions Identifies the conversion of that coenzyme during the light reactions OR states the general role of coenzymes in assisting enzymes 	2
<ul style="list-style-type: none"> Identifies one of the coenzymes involved in the light reaction OR <ul style="list-style-type: none"> States the general state of coenzymes in assisting enzymes 	1

Sample answer:

Coenzymes assist the enzymes to catalyse some steps of the light reactions. During a light reaction coenzyme ADP is converted to ATP and NADP is reduced to NADPH.

Question 35 (b)

Criteria	Marks
<ul style="list-style-type: none"> Provides the characteristics and features of an appropriate experiment in a logical sequence: <ul style="list-style-type: none"> Method for pigment extraction Means to separate/isolate pigments Means of identification 	4
<ul style="list-style-type: none"> Provides some characteristics and features of an appropriate experiment: <ul style="list-style-type: none"> Method for pigment extraction Means to separate/isolate pigments Means of identification OR logical sequence 	3
<ul style="list-style-type: none"> Provides method for pigment extraction Provides means to separate/isolate pigments OR means of identification 	2
<ul style="list-style-type: none"> Provides any relevant detail of extraction of pigments in leaves 	1

Sample answer:

Extract chlorophyll from a leaf by:

- cutting up the leaf
- heating pieces of leaf in an organic solvent eg methylated spirits
- do a paper chromatography of the pigment solution produced
- do second hand research to identify the colour bands or use spectrophotometer to view spectrum of extracted pigment

Question 35 (c) (i)

Criteria	Marks
• Indicates correct decrease in photosynthesis per unit of light	1

Sample answer:

Photosynthesis would decrease to a yield of 4.5 per unit amount of light.

Question 35 (c) (ii)

Criteria	Marks
• Identifies the evidence for a photosynthetic unit • Indicates the experimental conclusion of Emerson and Arnold • Indicates the theoretical evidence of Gaffron and Wohl • Provides the overall impact on how photosynthesis is understood	4
• THREE of the above	3
• TWO of the above	2
• Provides some information about chlorophyll conversion of light energy	1

Sample answer:

It had been found earlier that 1 molecule of CO₂ could be converted for every 4 quanta of light absorbed by 1 chlorophyll. The graph above indicates that thousands of molecules of chlorophyll are needed per conversion of one molecule of CO₂, which led Emerson and Arnold to conclude that a photosynthetic unit containing about 2000 molecules of chlorophyll (rather than just one) existed. Gaffron and Wohl calculated the theoretical number of molecules of chlorophyll needed to be converted based on Blackman's reaction. They came up with a similar number to Emerson and Arnold. They suggested that there were special chlorophyll molecules near the centre of the unit and this led to the idea of antennae chlorophylls.

Question 35 (d)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates a knowledge of different isotopes in the context of relating specific isotopes to biochemical pathways • Provides some examples of isotopes used to trace biochemical pathways • Indicates a specific scientist associated with this research • Presents ideas in a logical sequence 	6
<ul style="list-style-type: none"> • Demonstrates a knowledge of isotopes in the context of biochemistry • Provides an example of an isotope used to trace a biochemical pathway OR <ul style="list-style-type: none"> • Provides an example of isotopes used to trace biochemical pathways • Indicates a specific scientist associated with this research 	4–5
<ul style="list-style-type: none"> • Provides some information about isotopes • Identifies a link between an isotope and a biochemical pathway or identifies a scientist who used an isotope to trace a biochemical pathway 	2–3
<ul style="list-style-type: none"> • Provides some information about an isotope OR <ul style="list-style-type: none"> • Provides some information about a biochemical pathway OR <ul style="list-style-type: none"> • Provides some information about a scientist who used an isotope in biochemistry 	1

Sample answer:

If a known substance labelled with a nuclear tracer isotope is fed to an organism, the fate of the labelled compound can be traced because the body treats it the same as an unlabelled substance. The isotope has more neutrons and so is heavier. Also any changes of position of the isotope on the molecule can be seen. ^3H can be used to track the transport of H across the thylakoid membrane, ^{14}C can be used to study the assimilation of CO_2 into glucose, and ^{32}P can be used to examine changes from ADP into ATP. Ruben used H_2^{18}O to determine that oxygen formed by plants was from H_2O . Ruben also showed that the water was not used to make glucose. However, the short lifetime of $^{11}\text{CO}_2$ did not allow determination of the fate of ^{14}C in photosynthesis. This led to the discovery of the Calvin cycle. Benson showed by similar means that the fixation of CO_2 was dependent but separate from the light reaction.

Question 35 (e) (i)

Criteria	Marks
<ul style="list-style-type: none"> Names the products of photosynthesis 	1

Sample answer:

Glucose and oxygen

Question 35 (e) (ii)

Criteria	Marks
<ul style="list-style-type: none"> Names three environmental issues Relates how use of photosynthesis could be used to solve each of the three problems Demonstrates logical progression of ideas 	6
<ul style="list-style-type: none"> Names three environmental issues AND <ul style="list-style-type: none"> Relates how use of photosynthesis can help solve two of the named problems OR <ul style="list-style-type: none"> Relates how use of photosynthesis can help solve one of the named problems and provides some information in support of the other two 	4–5
<ul style="list-style-type: none"> Names three environmental issues Links photosynthesis to some aspect of these issues OR <ul style="list-style-type: none"> Names at least two environmental issues and provides some information on how these issues can be addressed 	2–3
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

Burning of fossil fuels is increasing CO₂ levels and this is causing global warming and rising sea levels. By increasing forest areas we can use photosynthesis to absorb more CO₂ and reduce global warming.

Most electricity is made by burning fossil fuels. With further research on chloroplasts we might be able to use chloroplasts as green ‘solar cells’ to produce electricity. This will help to lower CO₂ production and therefore reduce the risk of global warming.

Humans need food and all protein and carbohydrates originate in plants. As the world’s population rises we should eat more plants.

The carbohydrates made by plants can be directly used as fuel or be converted into oil fuels.

Biology

2013 HSC Examination Mapping Grid

Section I Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.4.2.3.1, 9.4.2.3.2, 9.4.2.2.2, 9.1.12.1d, 9.1.11.3a	H3, H12, H11
2	1	9.4.4.2.2, 9.4.5.2.1	H6
3	1	9.4.5.2.3, 9.4.5.3.1, 9.4.7.1	H4
4	1	9.4.4.2.1, 9.4.4.2.4	H6
5	1	9.3.2.2.1, 9.3.2.2.3	H9
6	1	9.4.5.2.2, 9.4.5.2.4	H6
7	1	9.4.6.2.2	H4
8	1	9.3.3.2.1	H1, H9
9	1	9.2.3.3.6, 9.2.3.2.8	H6
10	1	9.2.2.2.3	H6
11	1	9.4.7.2.1, 9.4.7.3.2	H3, H4
12	1	9.2.1.2.4, 9.2.1.2.5, 9.1.14.1b	H6, H14
13	1	9.2.2.2.1, 9.2.2.2.5	H6
14	1	9.2.3.2.7, 9.2.3.3.3	H3, H6
15	1	9.2.1.2.4, 9.2.2.1.5, 9.2.1.3.2	H6
16	1	9.3.1.2.2	H10
17	1	9.2.1.2.8, 9.2.1.3.3	H6
18	1	9.1.14.1a, 9.1.14.1d, 9.3.2.2.6, 9.3.2.3.1	H9, H14
19	1	9.2.1.3.1, 9.1.13.1f, 9.1.14.1a, 9.1.14.1d, 9.1.14.3c	H6, H13, H14
20	1	9.3.4.2.6, 9.3.4.2.4	H1, H2, H9, H10

**Section I
Part B**

Question	Marks	Content	Syllabus outcomes
21	4	9.4.5.2.1, 9.4.5.2.2	H6
22	3	9.3.3.2.6, 9.3.3.2.7	H1, H2, H9
23	4	9.2.3.2.9, 9.2.1.2.9, 9.2.1.3.3, 9.1.14.1b, 9.1.14.1d, 9.1.14.1g	H6, H8, H14
24 (a)	4	9.4.3.2.1, 9.4.3.3.1, 9.1.11.3a, 9.1.13.1a, 9.1.13.1e	H1, H2, H4, H8, H11, H13
24 (b)	3	9.4.2.3.1, 9.4.3.3.1, 9.1.11.2a, 9.1.11.2b, 9.1.11.2c,	H1, H2, H11
25 (a)	1	9.2.1.3.1	H6
25 (b)	1	9.2.1.3.1, 9.1.14.1(a),	H6, H14
25 (c)	4	9.2.1.3.1, 9.1.14.1(a) 9.1.14.1(d), 9.1.14.1(g)	H6, H14
25 (d)	1	9.2.1.2.7, 9.1.14.1(b)	H6, H14
26	3	9.3.1.2.3, 9.3.1.3.2	H1, H2, H10
27	4	9.3.1.3.4, 9.3.1.2.3	H1, H2, H3, H6, H9
28 (a)	2	9.4.7.3.1	H6
28 (b)	5	9.3.5.2.2, 9.4.7.2.2, 9.4.7.3.3, 9.4.7.1	H2, H3, H4, H7, H8, H10
29 (a)	2	9.2.3.2.6	H6
29 (b)	2	9.2.3.2.6	H6
29 (c)	4	9.2.3.2.5, 9.2.3.2.6, 9.2.3.2.7	H6
30	8	9.3.4.1, 9.3.5.1	H1, H3, H4, H6, H7, H9, H10

Section II

Question	Marks	Content	Syllabus outcomes
Question 31		Communication	
(a)	3	9.5.5.2.3, 9.5.5.2.2	H6
(b)	4	9.1.13.1(a) and (e), 9.5.6.2.2, 9.5.6.2.4, 9.5.6.3.1	H6, H13
(c) (i)	4	9.5.3.2.1, 9.5.3.3.1, 9.5.3.3.2, 9.1.13.1(e), 9.5.3.2.3	H6, H13
(c) (ii)	1	9.5.3.2.5	H3
(d)	6	9.5.4.2.1, 9.5.4.2.2, 9.5.4.2.4, 9.5.1.2.1, 9.5.7.2.2	H6
(e) (i)	1	9.5.2.2.1, 9.5.7.2.3, 9.5.7.3.3	H6
(e) (ii)	6	9.5.4.2.1, 9.5.6.3.3, 9.5.7.2.4	H4, H6
Question 32		Biotechnology	
(a)	3	9.6.4.2.1	H6, H9
(b)	4	9.6.3.3.1, 9.6.3.3.2, 9.6.3.2.1	H3, H6
(c) (i)	2	9.6.5.3.1, 9.1.11.3(a)	H9, H11

Question	Marks	Content	Syllabus outcomes
(c) (ii)	1	9.6.5.3.1	H9
(c) (iii)	2	9.6.5.2.2	H9
(d)	6	9.6.6.2.2, 9.6.6.3.1	H2, H6
(e) (i)	1	9.6.1.2.1, 9.6.1.2.2	H4, H7, H8
(e) (ii)	6	9.6.1.3.1, 9.6.1.2.1, 9.6.1.2.2, 9.6.7	H3, H5, H8
Question 33		Genetics: The Code Broken?	
(a)	3	9.7.2.2.3, 9.7.2.3.2	H6, H9
(b)	4	9.7.1.2.1, 9.1.12.3 (c), 9.7.1.3.2	H6, H9, H12
(c) (i)	2	9.7.3.3.1, 9.7.3.2.2, 9.1.13.1 (e)	H9, H13
(c) (ii)	3	9.7.3.3.1, 9.7.3.2.2, 9.7.3.2.3, 9.7.3.2.4	H1, H2, H9, H14
(d)	6	9.7.4.2.1, 9.7.7.3, 9.7.6.1	H3, H4, H6, H7, H8, H9
(e) (i)	1	9.7.4.2.4	H7, H8
(e) (ii)	6	9.7.4.1, 9.7.6.1	H3, H4, H7, H8
Question 34		The Human Story	
(a)	3	9.8.3.2.2, 9.8.1.2.2, 9.8.1.3.1	H10
(b)	4	9.8.2.2.3, 9.8.2.2.4, 9.1.14.1(a)	H3, H14
(c) (i)	2	9.8.6.3.1, 9.1.14.1a,	H4, H14
(c) (ii)	3	9.8.6.3.1	H5, H12.4, H14.1
(d)	6	9.8.5.2.1, 9.8.6.1	H4, H10
(e) (i)	1	9.8.3.2.2, 9.1.12.3(c)	H10, H12.4
(e) (ii)	6	9.8.1.3.3, 9.8.2.2.6, 9.8.2.3.2	H1, H9

Question 35		Biochemistry	
(a)	3	9.9.4.2.4	H6
(b)	4	9.9.3.3.4, 9.1.11.3(a)	H6, H11
(c) (i)	1	9.9.4.3.1, 9.1.14.1(c), 9.1.14.1(d)	H6, H12, H14
(c) (ii)	4	9.9.4.2.1, 9.9.3.1, 9.1.14.1(a), 9.1.14.1(c)	H1, H2, H6, H14
(d)	6	9.9.5	H6
(e) (i)	1	9.9.1.3	H6
(e) (ii)	6	9.9.1.2.1, 9.9.1.3.1, 9.9.2.2.1, 9.9.2.2.2	H4, H5