Question 33 (c) (i)

Criteria	Marks
• Constructs a correct Punnett square	2
• Constructs a recognisable Punnett square OR • 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
• 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
• 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
• Provides any relevant information regarding linkage OR • 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
• 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
• Identifies ways in which genetic change occurs • Identifies some genetic technologies • Relates the genetic technologies to influence on society	4–5
• Provides some information regarding an example of genetic change • Provides some information on genetic technologies	2–3
• Provides some information about an example of genetic change OR • 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
• 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
• 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
• Demonstrates a logical progression of ideas AND • Outlines the nature of the HGP • Provides ONE benefit and ONE limitation of gene therapy for society OR • Provides only benefits for society OR • Provides only limitations for society	4–5
• Outlines the nature of the HGP or gene therapy • States a benefit or a limitation for society	2–3
• 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
• 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
• Identifies the main features of evolution • Identifies cultural changes in human populations • Relates cultural changes to changes in evolution	4–5
• Provides some information about cultural development or biological evolution in humans	2–3
• 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 an 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
• Identifies the correct order of hominid skulls	1

Sample answer:

C, A, B

Question 34 (e) (ii)

Criteria	Marks
• 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
• Outlines traditional techniques of classification using relevant examples OR • Outlines modern techniques with implications for primate classification using relevant examples	5
• Identifies traditional techniques of classification using relevant examples OR • Identifies modern techniques with implications for primate classification using relevant examples	4
• Identifies traditional or modern techniques with a connection linked to primate classification	3
• Identifies a traditional or a modern technique • Names a relevant example of a primate	2
• 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 then 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
• Identifies the coenzymes involved in the light reactions and their role • Identifies the conversion ADP ➔ ATP and NADP ➔ NADPH	3
• 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
• Identifies one of the coenzymes involved in the light reaction OR • 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
• Provides the characteristics and features of an appropriate experiment in a logical sequence: – Method for pigment extraction – Means to separate/isolate pigments – Means of identification	4
• Provides some characteristics and features of an appropriate experiment: – Method for pigment extraction – Means to separate/isolate pigments – Means of identification OR logical sequence	3
• Provides method for pigment extraction • Provides means to separate/isolate pigments OR means of identification	2
• 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 CO_2 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 CO_2, 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 lead to the idea of antennae chlorophylls.

Question 35 (d)

Criteria	Marks
• 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
• Demonstrates a knowledge of isotopes in the context of biochemistry • Provides an example of an isotope used to trace a biochemical pathway OR • Provides an example of isotopes used to trace biochemical pathways • Indicates a specific scientist associated with this research	4–5
• 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
• Provides some information about an isotope OR • Provides some information about a biochemical pathway OR • 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. ^{3}H 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 $^{11}CO_2$ 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
• Names the products of photosynthesis	1

Sample answer:

Glucose and oxygen

Question 35 (e) (ii)

Criteria	Marks
• 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
• Names three environmental issues AND • Relates how use of photosynthesis can help solve two of the named problems OR • 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
• Names three environmental issues • Links photosynthesis to some aspect of these issues OR • Names at least two environmental issues and provides some information on how these issues can be addressed	2–3
• Provides some relevant information	1

Sample answer:

Burning of fossil fuels is increasing CO_2 levels and this is causing global warming and rising sea levels. By increasing forest areas we can use photosynthesis to absorb more CO_2 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 CO_2 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