

2024 HSC Biology Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 21 (a)

Criteria	Marks
• Identifies BOTH structures correctly	2
• Provides some relevant information	1

Sample answer:

Pollen – anther
Ovule – ovary

Question 21 (b)

Criteria	Marks
• Correctly compares all features of sexual and asexual reproduction	3
• Compares most features of sexual and asexual reproduction correctly	2
• Provides some relevant information	1

Sample answer:

Feature	Sexual	Asexual
Genetic variability	Yes	No
Number of parents required	2	1
Example of an organism which uses this type of reproduction	Humans	Bacteria

Question 22 (a)

Criteria	Marks
• Justifies a safety precaution used to prevent infection	2
• Provides some relevant information	1

Sample answer:

The wearing of gloves to prevent contact with skin and the subsequent entry of pathogens into skin/mouth

Answers could include:

Keeping the petri dish closed and wiping down the benchtop with an antiseptic after viewing the microbes – this will kill any pathogens that may have escaped the petri dish and could be transferred to the student.

Question 22 (b)

Criteria	Marks
• Explains how to ensure the investigation is reliable	2
• Provides some relevant information	1

Sample answer:

The student could repeat the experiment by using five plates to culture the same sample of food or water. This would mean the student could check that the results are similar in each test.

Question 23

Criteria	Marks
• Outlines how a named type of electromagnetic radiation can cause a DNA mutation	2
• Provides some relevant information	1

Sample answer:

X-rays are a type of electromagnetic radiation that damages the structure of DNA. If this damage occurs to the DNA in gametes (sex cells) then it is a germline mutation.

Question 24 (a)

Criteria	Marks
• Outlines a cause of a disease relating to environmental exposure	2
• Provides some relevant information	1

Sample answer:

Lung cancer can be caused by exposure to inhalation of smoke from cigarettes.

Question 24 (b)

Criteria	Marks
• Explains how a program/campaign will help to decrease the incidence of the disease	3
• Outlines features of a relevant program/campaign	2
• Provides some relevant information	1

Sample answer:

An educational program in schools could teach students that UV exposure causes skin cancer, and that to protect from this, they should wear hats and sunscreen when outside. This will help to increase student's understanding of the risk and therefore increase compliance, and help to prevent the cause of skin cancer (UV rays damaging DNA in cells).

Question 25 (a)

Criteria	Marks
• Explains the relationship between the cloning of the dog and being born with both eyes	2
• Provides some relevant information	1

Sample answer:

The rescue dog had been injured and lost an eye but it still had the genetic code for two eyes which the clone inherited.

Question 25 (b)

Criteria	Marks
• Describes how animals can be cloned	4
• Outlines how animals can be cloned	3
• Demonstrates some understanding of the cloning of animals	2
• Provides some relevant information	1

Sample answer:

The egg of a host animal is enucleated (nucleus removed). The nucleus of a body cell of the animal to be cloned is removed. The nucleus of the animal to be cloned is inserted into the enucleated host animal's egg to produce a zygote. The zygote is stimulated to divide via electric charge. The zygote is then transplanted into the surrogate mother's uterus. After a period of time, a cloned animal is born.

Question 26

Criteria	Marks
• Describes a named plant disease and its effects on agriculture	4
• Outlines a plant disease and its effect on agriculture	3
• Demonstrates some understanding of a plant disease or its effects on agriculture	2
• Provides some relevant information	1

Sample answer:

Stone fruit scab

This is a fungal disease that affects stone fruit such as plums, peaches and nectarines. It starts as small dark spots on the fruit which later become scabby and may cause the fruit to crack, shrivel and fall off the plant.

It causes downgrading of fruit quality and decreased fruit yield, leading to economic losses.

Question 27

Criteria	Marks
• Demonstrates a thorough understanding of the trends observed in the graph and the role of Pasteur's work	5
• Demonstrates a sound understanding of the trends observed in the graph and the role of Pasteur's work	4
• Demonstrates some understanding of Pasteur's work with reference to trend(s) in the graph	3
• Demonstrates some understanding of Pasteur's work or a trend in the graph	2
• Provides some relevant information	1

Sample answer:

Pasteur's work involved disproving spontaneous generation. This understanding of microbes explains that organisms in the milk could be causing the disease outbreaks.

Pasteur's work also showed that heating substances to high temperatures causes microbes to be killed. Similarly, increasing the temperature of the milk to 70°C kills many bacteria in milk.

The knowledge that there are microbes in milk and that heating the milk would kill the microbes explains why pasteurised milk would reduce the likelihood of disease outbreaks. This is seen with the number of outbreaks due to pasteurised milk generally being much lower compared to raw milk – it can be seen that after 1945 the number of raw milk disease outbreaks decreased significantly.

The low number of outbreaks after 1945 may also be due to fewer people drinking raw milk. There were some outbreaks due to pasteurised milk – this could be due to problems during the pasteurisation, storage or transport of the pasteurised milk.

Question 28 (a)

Criteria	Marks
<ul style="list-style-type: none"> Provides the correct parental genotypes and suitable working with a Punnett square Provides the correct probability of the second child having cystic fibrosis 	3
<ul style="list-style-type: none"> Provides the correct probability with some correct working OR <ul style="list-style-type: none"> Provides the correct parental genotypes with suitable working 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

	<i>R</i>	<i>r</i>
<i>R</i>	<i>RR</i>	<i>Rr</i>
<i>r</i>	<i>Rr</i>	<i>rr</i>

There is a 25% chance of the second child having cystic fibrosis.

Question 28 (b)

Criteria	Marks
<ul style="list-style-type: none"> Provides a thorough explanation of how the deletion removes only one amino acid Refers to isoleucine, phenylalanine and the final amino acid sequence 	4
<ul style="list-style-type: none"> Provides a sound explanation of the deletion of one amino acid Refers to appropriate amino acids or the effects of deletions 	3
<ul style="list-style-type: none"> Demonstrates some understanding of how mRNA codes for amino acids or of the effects of deletions 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

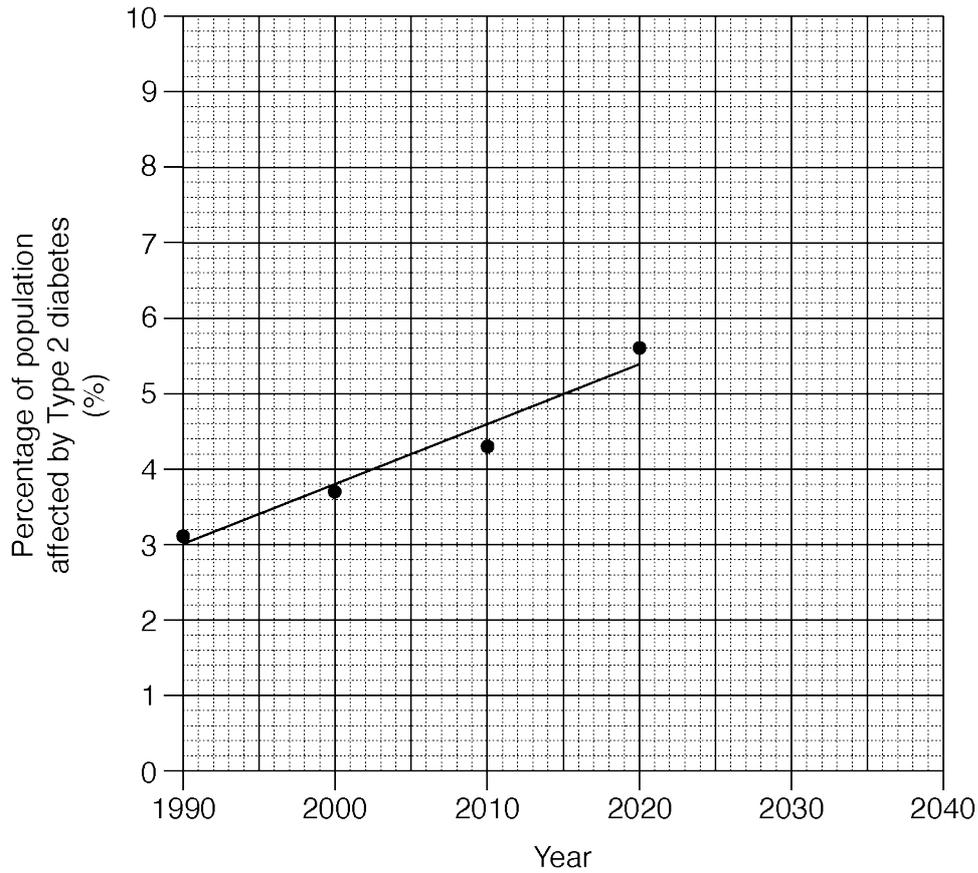
Sample answer:

A triplet of mRNA nucleotides codes for one amino acid, however, the three nucleotides that are removed span across two triplet codons – the codon for isoleucine and the codon for phenylalanine. Therefore, it would be expected that both amino acids are affected. However, isoleucine can be coded for by a number of different triplet nucleotide combinations. The correct coding is AUC, but after the deletion of the three nucleotides, the code left is AUU, which also codes for isoleucine. Thus, only the phenylalanine amino acid is removed.

Question 29 (a)

Criteria	Marks
<ul style="list-style-type: none"> All points plotted correctly Appropriate line of best fit drawn 	2
<ul style="list-style-type: none"> Some points plotted correctly OR <ul style="list-style-type: none"> Line of best fit attempted 	1

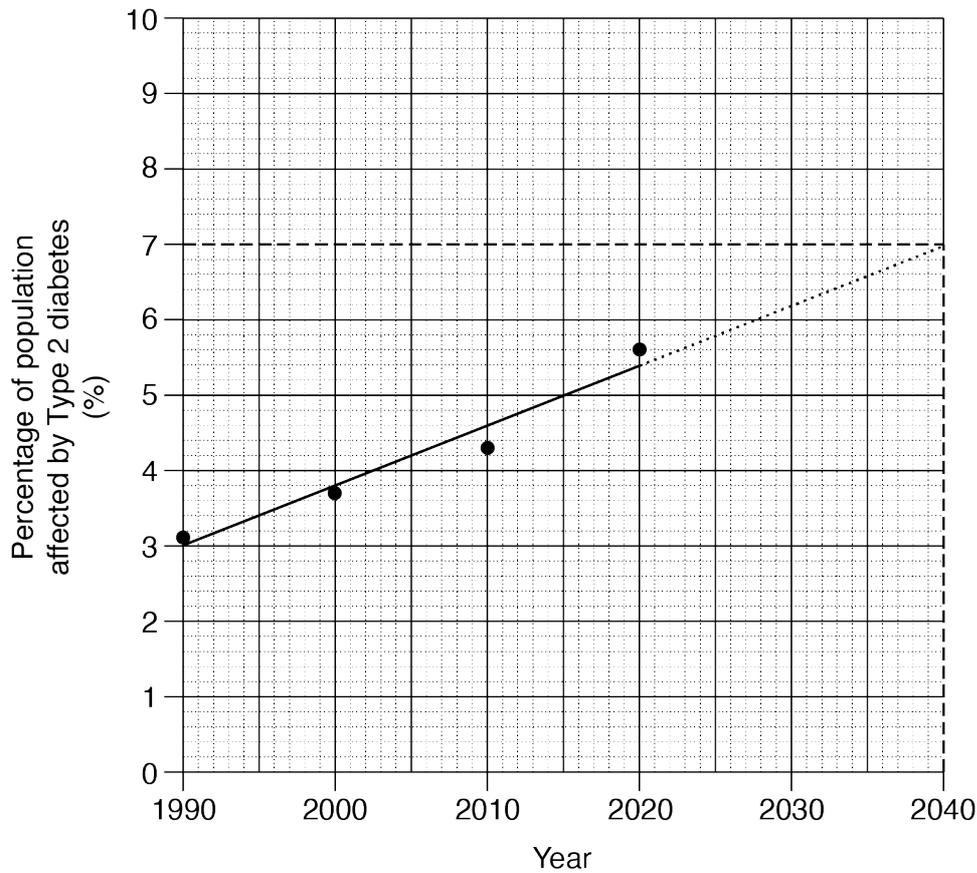
Sample answer:



Question 29 (b)

Criteria	Marks
<ul style="list-style-type: none"> • Extrapolates the line of best fit • States the percentage value from y-axis • Calculates the number of people with type 2 diabetes in 2040 based on 9 billion people 	3
<ul style="list-style-type: none"> • Demonstrates some understanding of how to determine the number of people with type 2 diabetes in 2040 	2
<ul style="list-style-type: none"> • Provides some relevant detail 	1

Sample answer:



7% of the population

$$\frac{7}{100} \times 9 \text{ billion} = 0.63 \text{ billion or } 630 \text{ million}$$

Question 30 (a)

Criteria	Marks
• Provides a sound comparison of the processes of transcription and DNA replication	3
• Demonstrates some understanding of the process of transcription and DNA replication	2
• Provides some relevant information	1

Sample answer:

Both process A (transcription) and DNA replication involve unwinding of DNA double strand to produce complementary strand. In replication, DNA is copied to produce two identical strands of DNA whereas in transcription, DNA is copied to produce single strand mRNA.

Question 30 (b)

Criteria	Marks
• Provides a thorough explanation of the importance of mRNA and tRNA in polypeptide synthesis	5
• Provides a sound explanation of the importance of mRNA and tRNA in polypeptide synthesis	4
• Demonstrates some understanding of the importance of mRNA and tRNA in polypeptide synthesis	3
• Demonstrates an understanding of mRNA or tRNA	2
• Provides some relevant information	1

Sample answer:

mRNA is synthesised from the DNA template in the nucleus during transcription. This mRNA carries the genetic instructions (codon) from the DNA in the nucleus to the ribosomes in the cytoplasm. Once the mRNA reaches the ribosome, the process of translation begins. Each tRNA molecule has an anticodon that pairs with a complementary codon on the mRNA strand. The mRNA codons are read in sequence, and as each tRNA brings its specific amino acid to the ribosome, the polypeptide is assembled.

Question 31 (a)

Criteria	Marks
<ul style="list-style-type: none"> Identifies the correct time 	1

Sample answer:

4 am

Question 31 (b)

Criteria	Marks
<ul style="list-style-type: none"> Provides a sound explanation of whether torpor is present in the human and kookaburra with reference to the graph 	3
<ul style="list-style-type: none"> Provides a sound explanation of whether torpor is present in the kookaburra with reference to the graph 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

The human did not display torpor, since their body temperature remained fairly constant throughout the time period. This did not indicate a decrease in physiological functioning.

The kookaburra did display torpor, since they had a decrease in body temperature between 5 pm and 4 am, which indicates a decrease in physiological functioning.

Question 31 (c)

Criteria	Marks
<ul style="list-style-type: none"> Outlines an adaptation leading to heat generation or retention 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

The kookaburra can raise its temperature by fluffing up feathers which traps a layer of warm air between the feathers and the body. This retains heat.

Question 32

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates an extensive understanding of the innate and adaptive immune response including phagocytosis, inflammatory response, stimulation and role of B and T cells • Relates body's responses to innate and adaptive immunity against <i>H.pylori</i> 	7
<ul style="list-style-type: none"> • Demonstrates a thorough understanding of the innate and adaptive immune response including phagocytosis, inflammatory response, stimulation and role of B and T cells 	5–6
<ul style="list-style-type: none"> • Demonstrates a sound understanding of the innate and adaptive immune response 	3–4
<ul style="list-style-type: none"> • Demonstrates some understanding of the immune response 	2
<ul style="list-style-type: none"> • Provides some relevant information 	1

Sample answer:

Damaged cells cause chemicals to be released, causing inflammation. Dilation of blood vessels as a part of inflammatory response increases blood flow which facilitates movement of phagocytes including macrophages and neutrophils into the infected area. Phagocytes process bacterial antigens and present them to the helper T-cells which triggers the adaptive immune response through release of cytokines. This results in activation of T and B cells. Cytotoxic T-cells specific to *H.pylori* directly attack the bacteria while the memory T-cells stay in the system to induce a rapid secondary immune response. Suppressor T-cells help with the regulation of the immune response. Plasma B-cells produce antibodies specific to *H.pylori* while memory B-cells remain in the system for secondary immune response. The antibodies can neutralise the antigens directly or tag it for destruction by phagocytes.

Both innate and adaptive immune responses work together to eliminate *H.pylori*. Innate response is rapid and provides immediate defence against *H.pylori* whereas adaptive response is slow but provides lifelong immunity through specific memory cells.

Question 33 (a)

Criteria	Marks
• Outlines clearly the significance of crossing over in meiosis	2
• Provides some relevant information	1

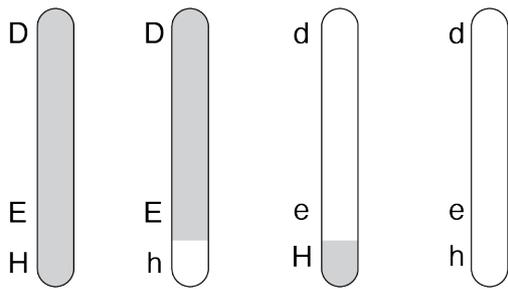
Sample answer:

Increasing genetic variation, which gives the Jack Jumper ant a better chance to survive environmental change.

Question 33 (b)

Criteria	Marks
• Draws all four possible chromosomes correctly for the gametes	2
• Provides some relevant information	1

Sample answer:



Question 34

Criteria	Marks
<ul style="list-style-type: none"> Provides an extensive discussion of the ethical implications and impacts for society of the use of two biotechnologies 	7
<ul style="list-style-type: none"> Provides a thorough discussion of the ethical implications and impacts for society of the use of two biotechnologies 	5–6
<ul style="list-style-type: none"> Provides a sound discussion of the ethical implication(s) and/or impact(s) for society of the use of biotechnology/biotechnologies 	3–4
<ul style="list-style-type: none"> Demonstrates some understanding of the ethical implication or benefit of the use of a biotechnology 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

A plant biotechnology that is of benefit to society is recombinant DNA technology eg when used to produce Bt corn or Bt cotton.

Recombinant DNA technology has many ethical implications. For example, Bt corn seeds cost money to purchase each season, while farmers using normal corn seeds can regrow their crops each year from their own seeds. This leads to inequalities in who has access to these GM seeds, and thus access to markets to sell their products.

The use of selective breeding/hybridisation is a type of biotechnology used in animals eg hybridisation of dairy cows to produce greater milk yielding cows. This has ethical implications for example, the side-effect of continuously selecting for greater milk yield has been a decrease in fertility amongst these cows, and may affect quality of life for cows. However, there are also many benefits to society of the use of recombinant DNA technology or selective breeding/hybridisation. For example:

- the production of more food like Bt corn which can allow the human population to continue to grow, or greater milk availability for consumers in society
- greater yields for farmers, leading to increased profits and quality of life for farmers.

Question 35

Criteria	Marks
<ul style="list-style-type: none"> Demonstrates an extensive understanding of how cochlear implants work and how they affect communication in children with reference to the data 	5
<ul style="list-style-type: none"> Demonstrates a thorough understanding of how cochlear implants work and how they affect communication in children with reference to the data 	4
<ul style="list-style-type: none"> Demonstrates a sound understanding of how cochlear implants work and how they affect communications in children with some reference to the data OR <ul style="list-style-type: none"> Demonstrates a thorough understanding of how cochlear implants affect communication in children with reference to the data 	3
<ul style="list-style-type: none"> Demonstrates some understanding of how cochlear implants work or how they affect communication in children 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

Cochlear implants are electronic devices that are surgically inserted into the cochlear to improve hearing when the cochlear is damaged. They directly stimulate the auditory nerve and help carry the sound signals directly to the brain.

If a child is implanted at a young age they reduce their use of sign language as a mode of communication over the following five years so that approximately 10% of children are using sign language five years after implantation. If children are implanted when they are older (> 5 years old) they continue to use sign language and don't change their mode of communication. If children are implanted when they are between three and five years of age they decrease their use of sign language, but not as much as when they are implanted younger. The data suggest that cochlear implants change communication when implanted at a younger age.

2024 HSC Biology

Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	Mod 7 Causes of Infectious Disease	12-14
2	1	Mod 6 Biotechnology	12-13
3	1	Mod 6 Mutation	12-4, 12-13
4	1	Mod 5 DNA and Polypeptide Synthesis	12-12
5	1	Mod 5 Reproduction	12-4, 12-12
6	1	Mod 5 Inheritance Patterns in a Population	12-6, 12-12
7	1	Mod 8 Homeostasis	12-15
8	1	Mod 7 Causes of Infectious Disease	12-5, 12-14
9	1	Mod 6 Mutation	12-6, 12-13
10	1	Mod 7 Causes of Infectious Disease	12-5, 12-14
11	1	Mod 8 Epidemiology	12-5, 12-15
12	1	Mod 7 Causes of Infectious Disease	12-14
13	1	Mod 7 Responses to Pathogens	12-14
14	1	Mod 5 Cell Replication	12-6, 12-12
15	1	Mod 7 Prevention, Treatment and Control	12-5, 12-14
16	1	Mod 8 Technologies and Disorders	12-4, 12-15
17	1	Mod 8 Epidemiology	12-15
18	1	Mod 6 Mutation	12-4, 12-13
19	1	Mod 6 Genetic Technologies	12-4, 12-13
20	1	Mod 5 Genetic Variation	12-6, 12-12

Section II

Question	Marks	Content	Syllabus outcomes
21 (a)	2	Mod 5 Reproduction	12-4, 12-12
21 (b)	3	Mod 5 Genetic Variation	12-12
22 (a)	2	Mod 7 Prevention, Treatment and Control	12-2, 12-14
22 (b)	2	Mod 7 Prevention, Treatment and Control	12-2, 12-14
23	2	Mod 6 Mutation	12-13
24 (a)	2	Mod 8 Causes and Effects	12-15
24 (b)	3	Mod 8 Prevention	12-7, 12-15
25 (a)	2	Mod 6 Genetic Technologies	12-13
25 (b)	4	Mod 6 Biotechnology	12-13
26	4	Mod 7 Causes of Infectious Disease	12-14
27	5	Mod 7 Prevention, Treatment and Control	12-5, 12-14
28 (a)	3	Mod 5 Inheritance Patterns in a Population	12-6, 12-7, 12-12
28 (b)	4	Mod 6 Mutation	12-4, 12-6, 12-13

Question	Marks	Content	Syllabus outcomes
29 (a)	2	Mod 8 Causes and Effects	12-4, 12-7, 12-15
29 (b)	3	Mod 8 Epidemiology	12-5, 12-6, 12-15
30 (a)	3	Mod 5 DNA and Polypeptide Synthesis	12-4, 12-12
30 (b)	5	Mod 5 DNA and Polypeptide Synthesis	12-12
31 (a)	1	Mod 8 Homeostasis	12-5, 12-15
31 (b)	3	Mod 8 Homeostasis	12-5, 12-6, 12-15
31 (c)	2	Mod 8 Homeostasis	12-15
32	7	Mod 7 Immunity	12-4, 12-14
33 (a)	2	Mod 5 Genetic Variation	12-4, 12-12
33 (b)	2	Mod 5 Genetic Variation	12-4, 12-6, 12-12
34	7	Mod 6 Biotechnology	12-13
35	5	Mod 8 Technologies and Disorders	12-5, 12-6, 12-15