2023 HSC Biology Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 21 (a)

Criteria	Marks
• Identifies sugar, phosphate and a base	1

Sample answer:

Sugar, phosphate and base

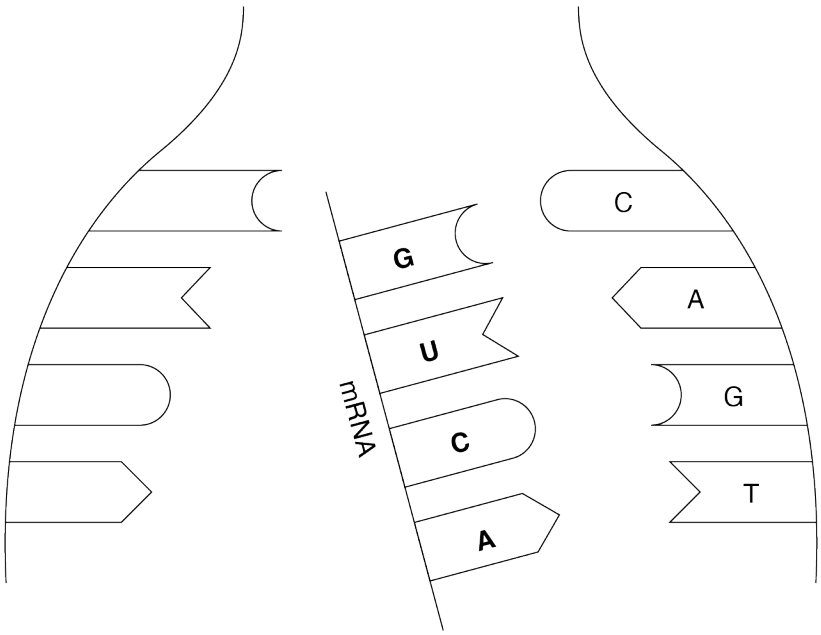
Answers could include:

Adenine, thymine, cytosine or guanine.

Question 21 (b)

Criteria	Marks
• Completes the diagram with the correct mRNA sequence	2
• Identifies uracil as a replacement for thymine for the mRNA sequence OR • Completes the diagram with the complimentary DNA sequence	1

Sample answer:



Question 22 (a)

Criteria	Marks
• Provides a clear description of how phagocytes help protect against pathogens	2
• Provides some relevant information	1

Sample answer:

They engulf or enclose a pathogen/antigen as it can identify non-self-substances. Once the pathogen is engulfed, the phagocyte breaks down the pathogen or antigen.

Question 22 (b)

Criteria	Marks
• Demonstrates a thorough understanding of the immune response to the entry of a pathogen	4
• Demonstrates a sound understanding of the immune response to the entry of a pathogen	3
• Demonstrates some understanding of the immune response to the entry of a pathogen	2
• Provides some relevant information	1

Sample answer:

Pathogens carry protein markers (antigens), so that when it enters a body, it is recognised as non-self. The immune response is then activated to destroy the pathogen.

The antigen of the pathogen binds to the receptor of a B cell and activates it. This specific B cell replicates to form plasma cells. Plasma cells produce an antibody that is specific to the antigen.

Question 23

Criteria	Marks
• Demonstrates a sound understanding of the function of TWO hormones in pregnancy and identifies the trimester in which each hormone secretion peaks	4
• Demonstrates a sound understanding of the function of at least ONE hormone in pregnancy and identifies the trimester in which each hormone secretions peaks	3
• Demonstrates some understanding of the function of a hormone OR • Identifies the trimester in which each hormone secretion peaks	2
• Provides some relevant information	1

Sample answer:

Hormone name	*Function in pregnancy*	*Trimester where peak occurs*
hCG	It thickens the lining of the placenta and stops menstruation	First trimester/10 weeks
Progesterone	Maintains uterus lining, helps the uterus grow and triggers hormones responsible for developing the babies' organs	Third trimester/38 weeks

Any of the hormones shown on the graph can be used to complete the table.

Question 24 (a)

Criteria	Marks
• Names a visual disorder • Relates problems with eye structure and function to the visual disorder	3
• Names a visual disorder • Sketches in general terms the cause of a visual disorder in relation to structure and/or function	2
• Provides some relevant information	1

Sample answer:

The lens of the eye refracts light from the environment on the retina. Cataracts are a visual disorder caused by the clouding of the lens which is normally clear. Clouding stops light passing through the lens leading to blurry vision.

Question 24 (b)

Criteria	Marks
• Provides characteristics and features of a technology that is used to assist with the effects of a visual disorder	3
• Outlines a technology that assists with the effects of a visual disorder	2
• Provides some relevant information	1

Sample answer:

A technology that assists with the effects of a visual disorder is laser surgery. One type of laser surgery is LASIK. It is used to correct myopia, hyperopia and astigmatism which are caused by refraction errors in the eye which can be caused by problems with the shape of the cornea. In LASIK surgery a thin flap is opened on the surface of the cornea a laser then reshapes the cornea to provide the correct refraction and the flap is laid back into place.

Question 25 (a)

Criteria	Marks
• Justifies the correct genotype of individual *H* with reference to *H's* offspring	3
• Identifies possible genotypes of autosomal dominant inheritance	2
• Provides some relevant information	1

Sample answer:

Individual '*H*' must be heterozygous for the Huntington's disease gene (genotype Hh). This is because she has children that do not have Huntington's disease (*J* and *L*) and children that do have Huntington's disease (*I* and *K*). Therefore she must carry both the allele for Huntington's disease (*H*) and the normal allele (h) because she has both normal and affected children.

Answers could include:

Punnet squares

Question 25 (b)

Criteria	Marks
• Identifies the correct amino acid	1

Sample answer:

Glutamine

Question 25 (c)

Criteria	Marks
• Explains the relationship between the age of onset of Huntington's disease and CAG repeats • Makes relevant reference to data on graph OR the effect of increased repeats on the protein structure	2
• Makes evident the relationship between the age of onset of Huntington's disease and CAG repeats OR • Makes some relevant reference to data on the graph	1

Sample answer:

As the number of repeats increases, the age of onset of Huntington's disease decreases eg when there are 60 CAG repeats the age of onset of Huntington's disease is 20 years of age. CAG repeats lead to the alteration of the protein responsible for the disease at an earlier age.

Answer could include:

CAG repeats lead to the change in the structure of the protein responsible for the disease at an earlier stage.

Question 25 (d)

Criteria	Marks
• Predicts the outcome for both individuals *S* and *U*, including age of onset • Provides suitable justification using data from the diagrams	3
• Predicts the outcome for one of the individuals, including age of onset OR • Makes some interpretation of data from the diagrams and how it relates to Huntington's disease	2
• Provides some relevant information	1

Sample answer:

Individual *S* is not predicted to be affected by Huntington's disease. The gel electrophoresis shows a band at approximately 15 repeats this is the same as his father (*P*) who does not have the disease. Individual *U* will most likely get Huntington's disease at around age 45. Individual *U* has the same number of repeats as her mother (*Q*) around 38 repeats.

Question 26 (a)

Criteria	Marks
• Identifies the dependent variable AND a controlled variable	2
• Identifies a controlled variable OR • Identifies the dependent variable	1

Sample answer:

Dependent variable: the number of mosquitoes that land on the clothing

Controlled variable: any reasonable controlled variable eg size of container, number of mosquitoes in each container.

Question 26 (b)

Criteria	Marks
• Justifies an appropriate conclusion for the investigation	3
• Provides a relevant conclusion with limited justification	2
• Provides some relevant information	1

Sample answer:

Wearing clean clothing would reduce the transmission of malaria as mosquitoes land on clean clothing on average fewer times than on worn clothing. Infected mosquitoes landed on clothing three times as often as uninfected mosquitoes. Infected mosquitoes can only pass on infection if they land on a host and bite them.

Question 27

Criteria	Marks
• Demonstrates a thorough understanding of the characteristics and features of a valid epidemiological study • Provides a comprehensive analysis of the air pollution study • Makes an informed judgement	7
• Demonstrates a sound understanding of the characteristics and features of a valid epidemiological study • Provides an analysis of the air pollution study • Makes a suitable judgement	5–6
• Demonstrates some understanding of the characteristics and features of a valid epidemiological study • Supports answer with reference to the study	3–4
• Identifies features of an epidemiological study	2
• Provides some relevant information	1

Answers could include:

- The epidemiological study conducted was not a valid study and a statistically significant relationship between cause and effect is not shown
- The risk factors that might contribute to the occurrence of the disease include age, sex, ethnic group, occupation
- Different ethnic groups are not indicated in the sample
- The time period of 12 months may not be long enough for symptoms to develop
- The occupation of individuals is not taken into account, this may impact health giving similar symptoms
- There is no indication of the locality within each city and whether those surveyed are near industry or not
- No indication of the degree of symptoms
- The study must be done on a very large population, with large range in terms of socioeconomic status and geography, for trends to be reliable
- Some subjects may be affected by other factors
- Subjects should also have varying levels of exposure to air pollution. Greater exposure to the air pollution should correspond to greater incidence of the symptoms.

Question 28 (a)

Criteria	Marks
• Provides a feature that can be used to distinguish a bacterium from a virus	2
• Provides some relevant information	1

Sample answer:

The size of a bacterium is 1–10μm, a virus is 0.05–0.1μm so a bacterium is much larger than a virus.

Answers could include:

- Bacteria is a prokaryotic cellular organism; Viruses are comprised of nucleic acids and a protein coat and are not cellular
- Bacteria are living organisms; Viruses are usually considered non-living
- Bacteria can reproduce by binary fission; Viruses use host cells to replicate.

Question 28 (b)

Criteria	Marks
• Sketches in general terms a method that can be used to distinguish between bacterial and viral pathogens	2
• Provides some relevant information	1

Sample answer:

The presence of a bacterial pathogen could be identified by using an agar culture. A viral pathogen cannot be cultured on agar. A bacterial pathogen can be observed using a high-powered light microscope, but a viral pathogen would not be able to be observed as it is too small.

Answers could include:

Subjecting the pathogen to antibiotics will cause bacteria to die, but not affect the virus.

Question 29 (a)

Criteria	Marks
• Sketches in general terms a physiological adaptation in endotherms	2
• Provides some relevant information	1

Sample answer:

Endotherms can undergo vasoconstriction to decrease blood flow and volume. This reduces heat loss through the skin.

Answers could include:

- Vasodilation will expand blood vessels to increase blood flow to skin to promote cooling
- Water balance is maintained by the kidneys extracting water from urine.

Question 29 (b)

Criteria	Marks
• Explains TWO adaptations in plants that help maintain water balance	4
• Relates ONE adaptation to the maintenance of water balance in plants and identifies a second adaptation OR • Outlines TWO adaptations in plants that help maintain water balance	3
• Relates ONE adaptation to the maintenance of water balance in plants OR • Identifies adaptations in plants to maintain water balance	2
• Provides some relevant information	1

Sample answer:

Sunken stomates	Stomata may be sunken in pits in the epidermis. Moist air is trapped over the top of the stomate. The saturated air above the stomates reduces the evaporation rate.
Thick waxy cuticle	A thick waxy cuticle makes the leaf watertight, it acts as a barrier to evaporation and also the shiny surface reflects heat and so lowers the leaf temperature.

Question 30

Criteria	Marks
• Demonstrates a comprehensive understanding of the use of vaccines and the vaccination schedule, with reference to the graph and provided information • Makes a judgement about the value of the vaccination schedule	5
• Demonstrates a sound understanding of the use of vaccines and the vaccination schedule, with some reference to the graph or provided information • Makes a relevant judgement	4
• Demonstrates some understanding of the use of vaccines and the vaccination schedule	3
• Demonstrates understanding of vaccination and/or vaccination schedules	2
• Provides some relevant information	1

Sample answer:

Vaccinations are used to initiate an immune response using a form of the pathogen/antigen that will not result in infection. From the graph, the more booster shots, the longer the period of time the person is considered immune. Cases occurring in people aged over 65 would be the result of not having a booster for a long time. The reduction in numbers of tetanus cases would suggest that vaccinations are effective while the recurring schedule ensures a person maintains immunity.

Question 31

Criteria	Marks
• Provides a comprehensive description of a named genetic technology and its use in a medical application	4
• Provides a sound description of a genetic technology and its use in a medical application	3
• Identifies and outlines a genetic technology and its use in a medical application	2
• Provides some relevant information	1

Sample answer:

Human insulin is produced by recombinant DNA technology to help diabetics.

Restriction enzymes are used to cut the insulin gene from a human cell. The same restriction enzyme is used to cut a section from a plasmid of *E.coli* to ensure the sticky ends are complimentary. The plasmid is then resealed with the insulin gene inserted. The recombined plasmid is then inserted into a host to produce human insulin.

The insulin is then used by patients to manage diabetes.

Question 32

Criteria	Marks
• Demonstrates an extensive understanding of the relationships between bushfires and introducing males on the population size and gene pool of the Mt Buller pygmy possum population • Makes an informed judgement about factors affecting the Mt Buller pygmy possum population	7
• Demonstrates a sound understanding of the relationships between bushfires and introducing males on the population size and gene pool of the Mt Buller pygmy possum population • Makes a suitable judgement about factors affecting the Mt Buller pygmy possum population	5–6
• Demonstrates an understanding of the relationships between bushfires or introducing males on the population size and/or gene pool of the Mt Buller pygmy possum population	3–4
• Identifies the relationship between bushfires or introducing males on the population size or gene pool of the Mt Buller pygmy possum population	2
• Provides some relevant information	1

Answers could include:

- Bushfires and the introduction of mating males have had an impact on the gene pool and population size of the Mt Buller pygmy possum population
- Bushfires in general reduce the population size as individuals die. The introduction of mating males from a distant population will bring new genes and increase the gene pool
- The size of the population of pygmy possums at Mt Buller was low in 1996, at about 90 individuals. This means that the diversity of alleles in the gene pool was low
- Fires in 1998, 2000 and 2002 further reduced the population size and further restricted the alleles present in the gene pool
- The remaining population following three different fires made up the new gene pool where the frequency of certain alleles may disappear or become more frequent depending on the population that remained
- This may have led to genetic drift (bottleneck effect) in this population where the low diversity of alleles in the population led to a further reduction in the population between 2002–2007
- In 2007 and 2012, 6 males from Mt Bogong were introduced. Their genes may have been different as their populations are a long way apart and isolated from one another
- This could have produced gene flow from the Mt Bogong pygmy possum population to the Mt Buller population increasing genetic diversity, the number of suitable adaptations and leading to an increase in population from about eight individuals in 2007 to 150 in 2016
- The improved diversity of this population and conserving the population with greater variation amongst the population has enabled the Mt Buller sub-population to improve its capacity to adapt to changing conditions as a direct result of this gene pool mixing.

May also discuss:

- Genetic diversity and the cause of bottlenecks, gene flow, genetic drift and long-term health of the local gene pool.

Question 33

Criteria	Marks
• Interprets the stimulus to provide similarities and differences between the reproduction of fungi and humans	4
• Interprets the stimulus to provide a similarity and a difference between the reproduction of fungi and humans	3
• Provides a similarity and/or a difference in the reproduction of fungi and humans	2
• Provides some relevant information	1

Sample answer:

The reproduction of fungi and humans has some similarities. Both use meiosis in their reproduction to produce gametes in humans and spores in fungi. Both involve the fusion of genetic material to produce a zygote. However, there are also differences in their reproduction. In humans all reproduction is sexual. Fungi have both sexual and asexual reproduction. In humans, fertilisation produces a diploid zygote. In fungi, after the mycelium fuse there is a stage where there are two nuclei present in the cytoplasm.

Answer could include:

Other correct information from the stimulus.

Question 34

Criteria	Marks
• Demonstrates an extensive understanding of the biotechnologies applied to cattle with relevant references to the table • Makes an informed judgement of the effect of biotechnologies on the biodiversity of cattle	5
• Demonstrates a sound understanding of the biotechnologies applied to cattle with some references to the table • Makes a suitable judgement of the effect of biotechnologies on the biodiversity of cattle	4
• Demonstrates an understanding of the effect of biotechnologies on biodiversity of cattle	3
• Identifies an effect of a biotechnology	2
• Provides some relevant information	1

Sample answer:

Biotechnologies can increase, maintain and decrease biodiversity in cattle. Artificial insemination generally reduces biodiversity as one male can be used to sire many offspring. This reduces the number bulls that pass on their genetics reducing the biodiversity in the species. Selective breeding reduces biodiversity as only individuals with desired characteristics are allowed to breed and pass on their genes. Producing transgenic organisms may increase the genetic diversity in cattle by introducing genes not originally present, but as it is not widely used it is not currently having a large impact on biodiversity. Whole organism cloning will also reduce biodiversity as cloned organisms are genetically identical to the parent organism. However, this is not used commercially in cattle so will not have a large effect on biodiversity. These biotechnologies used in the farming of cattle have the overall effect of decreasing the biodiversity in cattle.

Answer could include:

Hybridisation will increase the biodiversity within cattle as new gene combinations will be produced. It may also reduce biodiversity if the hybridised cattle are bred in preference to the original breeds.

Question 35 (a)

Criteria	Marks
• Identifies the type of mutation caused by bU	1

Sample answer:

Point or substitution mutation

Question 35 (b)

Criteria	Marks
• Demonstrates a comprehensive understanding of the possible ways the mutation could alter the DNA sequence that determines the amino acid sequence • Relates how a changed amino acid sequence could change the structure of the protein and implications for protein function	4
• Demonstrates a sound understanding of a possible way the mutation could alter the DNA sequence that determines the amino acid sequence • Relates how a changed amino acid sequence could change the structure of the protein or implications for protein function	3
• Identifies a possible way the mutation could alter the DNA sequence or the amino acid sequence and resulting protein	2
• Provides some relevant information	1

Sample answer:

Polypeptide synthesis is the process of creating an mRNA strand based on the DNA strand. The sequence of bases along the mRNA strand that codes for specific amino acids found in organisms.

One strand will have the original adenine and replicate the same sequence. The mutated strand will contain guanine and continue to reproduce the mutated gene.

If a new mutated codon is for the same amino acid as the non-mutated codon, there will be no change to the protein.

If the new codon codes for a different amino acid, a different polypeptide chain will form. This could result in different folding which could result in a non-functioning protein being produced. If a stop codon is formed as a result of the mutation, the chain will not form after that point and if it occurs on the AUG START, then it will not start.

2023 HSC Biology
Mapping Grid

Section I

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

Section II

Question	Marks	Content	Syllabus outcomes
21 (a)	1	Mod 5 Cell Replication	12-12
21 (b)	2	Mod 5 DNA and Polypeptide Synthesis	12-6, 12-12
22 (a)	2	Mod 7 Responses to Pathogens	12-14
22 (b)	4	Mod 7 Responses to Pathogens	12-14
23	4	Mod 5 Reproduction	12-4, 12-12
24 (a)	3	Mod 8 Technologies and Disorders	12-15
24 (b)	3	Mod 8 Technologies and Disorders	12-15
25 (a)	3	Mod 5 Genetic Variation	12-5, 12-12
25 (b)	1	Mod 5 DNA and Polypeptide Synthesis	12-12
25 (c)	2	Mod 8 Causes and Effects	12-6, 12-15
25 (d)	3	Mod 5 Genetic Variation	12-6, 12-12
26 (a)	2	Mod 7 Prevention, Treatment and Control	12-2, 12-5, 12-14

Question	Marks	Content	Syllabus outcomes
26 (b)	3	Mod 7 Prevention, Treatment and Control	12-2, 12-5, 12-6, 12-7, 12-14
27	7	Mod 8 Epidemiology	12-5, 12-15
28 (a)	2	Mod 7 Cause of Infectious Disease	12-14
28 (b)	2	Mod 7 Cause of Infectious Disease	12-14
29 (a)	2	Mod 8 Homeostasis	12-15
29 (b)	4	Mod 8 Homeostasis	12-15
30	5	Mod 7 Prevention, Treatment and Control	12-5, 12-14
31	4	Mod 6 Genetic Technologies	12-13
32	7	Mod 6 Mutation	12-13
33	4	Mod 5 Reproduction	12-12
34	5	Mod 6 Biotechnology	12-13
35 (a)	1	Mod 6 Mutation	12-4, 12-13
35 (b)	4	Mod 6 Mutation	12–4, 12–13