2021 HSC Biology Marking Guidelines

Section I

Multiple-choice Answer Key

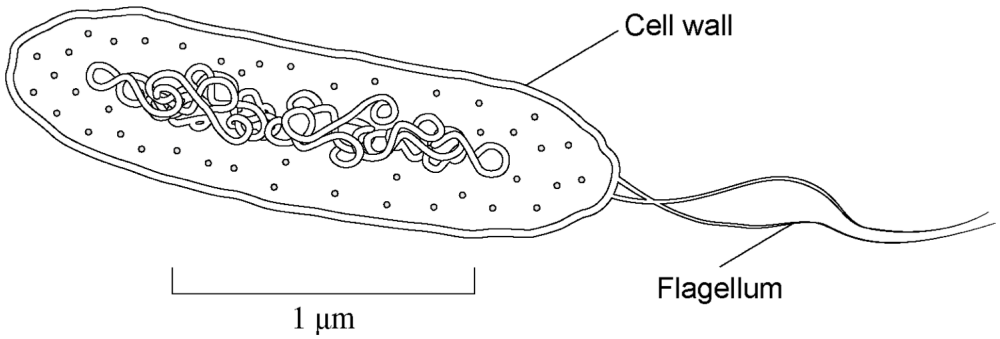
Question	Answer
1	C
2	D
3	B
4	B
5	C
6	A
7	C
8	D
9	D
10	A
11	B
12	C
13	A
14	A
15	B
16	C
17	B
18	D
19	C
20	B

Section II

Question 21 (a)

Criteria	Marks
• Correctly labels TWO features of the diagram	2
• Correctly labels ONE feature on the diagram	1

Sample answer:



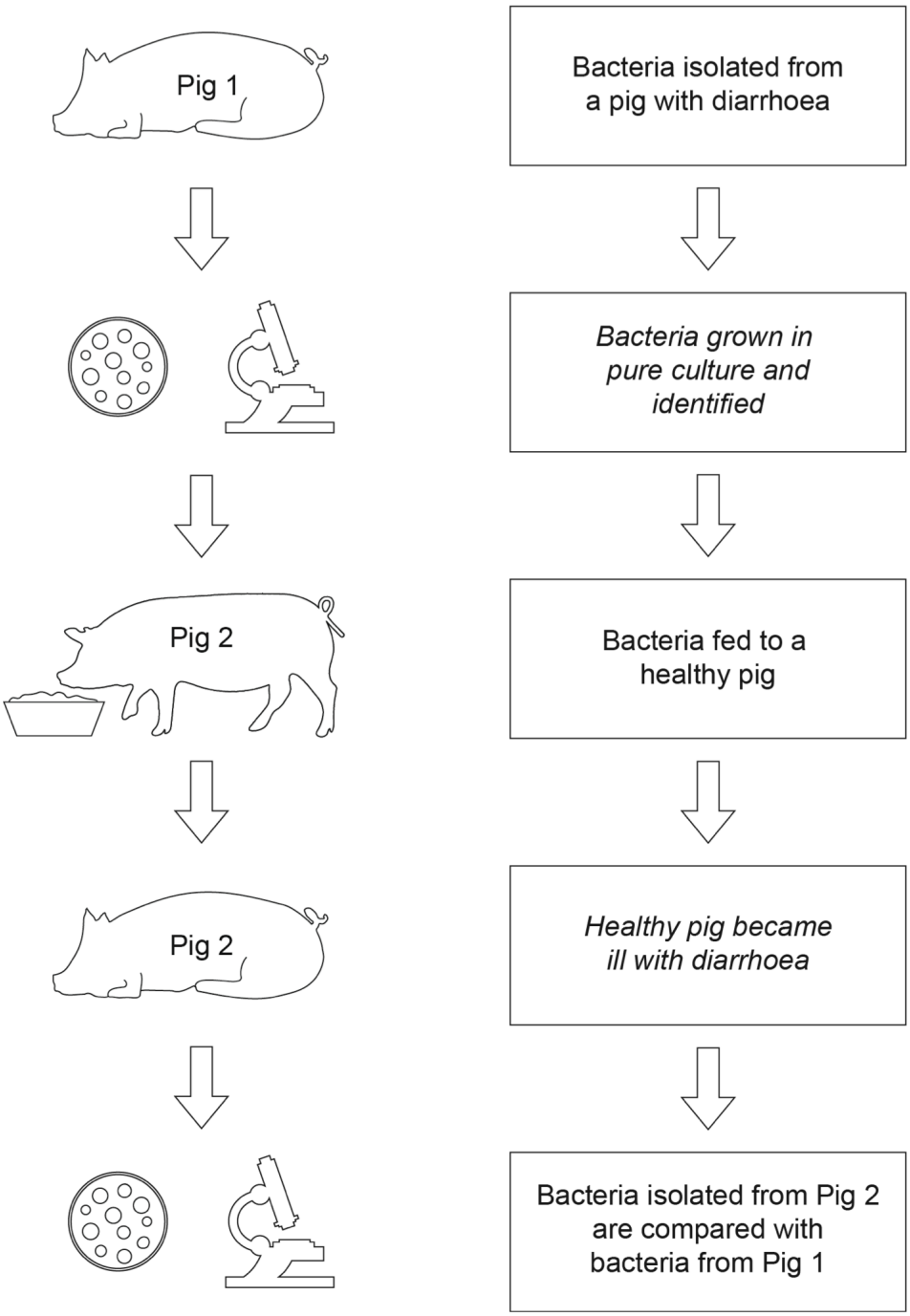
Answers could include:

- Plasma membrane
- Absence of membrane bound organelles
- DNA.

Question 21 (b)

Criteria	Marks
• Completes TWO boxes in the flowchart correctly	2
• Provides some relevant information	1

Sample answer:



Question 21 (c)

Criteria	Marks
• Outlines a benefit and a limitation of the strategies	3
• Outlines a benefit or limitation OR • Identifies a benefit and a limitation OR • Identifies benefits or limitations	2
• Provides some relevant information	1

Sample answer:

The use of antibiotics on Farm 1 eliminates the disease quickly but may induce resistance in the bacteria with longer term use so the strategy will become less effective.

On Farm 2, improved hygiene including removal of rats and mice is slow to eliminate the disease but provides a long-term solution that will prevent future outbreaks.

Question 22

Criteria	Marks
• Predicts the correct phenotypic ratio of the offspring • Provides parental genotypes and suitable working out	3
• Predicts the correct phenotypic ratio of the offspring • Provides some correct working OR • Identifies correct parental genotypes • Provides appropriate working out OR • Provides parental genotypes • Provides appropriate working out and relevant phenotypic ratio	2
• Provides some relevant information	1

Sample answer:

Bb $\times$ bb

	b	b
B	Bb	Bb
b	bb	bb

Ratio — Black : White
1 : 1

Question 23

Criteria	Marks
• Correctly identifies the valid result • Provides a suitable justification • Includes reference to test line and control line	3
• Correctly identifies a negative result • Provides a justification	2
• Provides relevant information about the test	1

Sample answer:

Strip 2 is the only valid negative result. The control line is present therefore indicating that the test itself has worked. No LH surge line has been detected in strip 2 therefore it is a negative result (unlike test 3 and 4 which have no control line, making those results invalid). Ovulation is not occurring according to test 2.

Question 24 (a)

Criteria	Marks
• Identifies the type of mutation • Justifies the type of mutation with reference to the information provided	3
• Identifies the type of mutation • Provides a reason for the type of mutation	2
• Provides some relevant information	1

Sample answer:

It is a somatic mutation because it is a dominant trait but not present in the parents or the offspring of the affected male. If it were a germ-line mutation which occurs in the cells that form gametes, it is most likely it would be seen in the offspring.

Question 24 (b)

Criteria	Marks
• Explains the effects of the mutations on the twins and their offspring	4
• Explains some effects of the mutations on the twins and/or their offspring	3
• Demonstrates some understanding of the effect(s) of the mutation(s)	2
• Provides some relevant information	1

Sample answer:

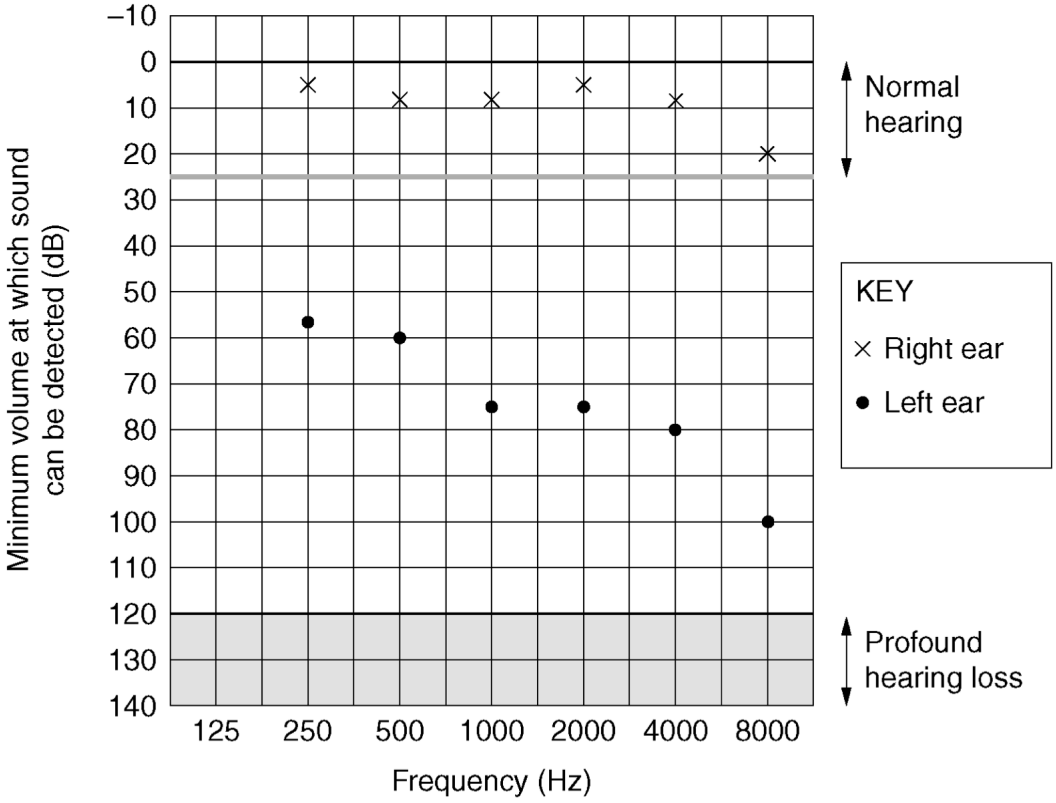
Mutation *B* occurred after twin formation, therefore affecting only Twin 1. Because it occurred prior to formation of the germ cells it will be evident in both the germ cells and the somatic cells of Twin 1 and through the germ cells may be passed to the offspring.

Because Mutation *C* occurs in the cells leading to somatic cells in Twin 2 only, it will be evident in the somatic cells of Twin 2 but not in the germline cells and can't be passed on to offspring.

Question 25 (a)

Criteria	Marks
• Data for right and left ear plotted correctly • Appropriate key provided	3
• All data plotted accurately OR • Most data plotted correctly and includes an appropriate key	2
• Plots some data	1

Sample answer:



Question 25 (b)

Criteria	Marks
• Draws correct conclusions about the hearing level in both left and right ears	2
• Provides some appropriate information about the hearing	1

Sample answer:

Right ear has normal hearing.
Left ear has a deficit/cannot hear at a normal level.

Question 25 (c)

Criteria	Marks
• Justifies the use of a suitable technology to assist hearing	3
• Outlines a relevant hearing technology	2
• Provides relevant information on any hearing technology	1

Sample answer:

Bone conduction implants would be the most suitable technology for this patient. The blocked outer ear needs to be completely bypassed, and bone conduction works by detecting sound waves via a microphone, and relaying it to a sound processor that converts the waves into vibrations. These vibrations are transferred directly to the cochlea in order to hear the sound and so improve the patient's hearing.

Question 26

Criteria	Marks
• Explains reasons for the changing phenotypes with reference to recessive alleles and gene pools in populations • Relates concentration of recessive alleles to offspring being different to parents	4
• Explains a reason for the changing phenotypes showing a sound knowledge of gene pools in populations	3
• Demonstrates some understanding of inheritance in populations	2
• Provides some relevant information	1

Sample answer:

A reduction in gene flow occurs as populations become smaller and more isolated. This results in inbreeding, a reduction in the gene pool and the accumulation of mutations. Many mutations are recessive and when offspring receive two copies of a mutation it is expressed (and offspring will appear different to their parents). Inbreeding with close relatives results in increased risk of phenotype being affected by mutations.

Question 27

Criteria	Marks
• Provides correct phenotype for Child 3 • Justifies it using the DNA profile	3
• Provides correct phenotype for Child 3 • Provides some justification	2
• Provides some relevant information	1

Sample answer:

The third child will have sickle cell anaemia because the mother, father and child two are all heterozygous/unaffected (Aa) and this is depicted by the 2 bands on the DNA profile. Child one is unaffected and displays only 1 band therefore must be homozygous normal (AA). Child 3 displays one band in a different location to child one but is a common band to the heterozygous family member therefore must be (aa) recessive and will have sickle cell anaemia.

Question 28 (a)

Criteria	Marks
• Demonstrates a thorough knowledge of the role of mRNA	3
• Describes a feature of the role of mRNA OR • Identifies features of the role of mRNA	2
• Provides some relevant information	1

Sample answer:

mRNA carries a complementary copy of a section of DNA that codes for a polypeptide to the ribosomes. At the ribosomes mRNA provides a template. Each codon (three nucleotides) on the mRNA results in the addition of a correct amino acid to form a polypeptide chain.

Question 28 (b)

Criteria	Marks
• Provides a comprehensive explanation of how the vaccine results in active immunity • Applies knowledge of mRNA and protein to the production of active immunity	5
• Provides a sound explanation of how the vaccine results in active immunity • Links mRNA and protein to the production of active immunity	4
• Demonstrates a sound knowledge of vaccination and the development of active immunity OR • Links mRNA and protein to the production of active immunity	3
• Outlines how a vaccine could provide immunity OR • Demonstrates an understanding of active immunity	2
• Provides some relevant information	1

Sample answer:

The vaccine's mRNA enters cells and provides instructions for the production of the spike protein. The mRNA is translated at the ribosomes and the viral spike protein is produced and released into the body.

The protein will be an antigen in the body as it is foreign (not coded for by the human genome). This will trigger a specific response by B and T lymphocytes that match the antigen. Once the viral protein has been removed, memory B and T cells for the spike protein will remain, providing active immunity that allows for a rapid future response.

If the person is later exposed to the virus, the spike protein molecules on the virus's surface will trigger a rapid, large response by the memory cells.

Question 29

Criteria	Marks
• Demonstrates a thorough understanding of adaptations to maintain stable body temperature • Relates the answer to the stimulus provided • Explains the relevant adaptations in the koala	4
• Demonstrates a sound understanding of adaptations to maintain stable body temperature • Links the answer to the stimulus provided • Describes adaptations in the koala	3
• Describes an adaptation to maintain stable body temperature • Refers to the stimulus provided	2
• Provides some relevant information	1

Sample answer:

The posture of the koala on the tree is associated with the category of hot or mild air temperatures. Posture is a behavioural adaptation that changes the surface area of the skin exposed to the air. In mild conditions koalas were sometimes observed to curl up, minimising the surface area exposed and therefore minimising heat loss, a behaviour which was never observed in hot conditions. Maximising the surface area of ventral skin exposed by leaning back on a branch occurred much more frequently in hot conditions than in mild.

Hugging of tree trunks was observed more often in hot conditions. Since the tree trunk temperatures have been shown to be lower than air temperatures in hot conditions, this is also a behavioural adaptation by the koala to expose its ventral surface to the cool trunk and use it as a heat sink.

Answers could include:

Reference to physiological adaptation of directing blood flow to the koala's belly to make contact with the tree trunk.

Question 30

Criteria	Marks
• Provides a comprehensive analysis and interpretation of scientific data reference to the statement • Provides arguments for and against the statement	7
• Provides a sound analysis and interpretation of scientific data • Provides argument(s) for and against the statement	6
• Interprets scientific data to support arguments for and/or against the statement	4–5
Demonstrates some understanding of the information provided and/or the role of vaccines in the control of infectious disease	2–3
• Provides some relevant information	1

Sample answer:

The measles vaccine protects children against contracting measles. The graph shows that the incidence of measles in vaccinated children is very low, sometimes zero, compared with unvaccinated children. Since these children are matched for age and other social factors, it is likely that the vaccine is responsible for the differences. The table supports this conclusion in that only two vaccinated children died of measles compared with 40 in the unvaccinated group. Therefore the data supports the statement that the measles vaccine protected the community against measles.

The table provides data that suggests the measles vaccine protects children against dying from diseases other than measles and therefore contradicts the statement that a vaccine targets a specific disease. Children vaccinated against measles died at about half the rate of unvaccinated children from diarrhoea and dysentery, and less than one third the rate from oedema. However, numbers dying of oedema are small so this conclusion needs further study. If all other variables were taken into account then the vaccine appears to have non-specific beneficial effects, especially for diarrhoea. However, only small differences between the groups with respect to fever suggest that the protection of the vaccine is for selected diseases only. Since it is likely the vaccine targeted specific antigens for the measles virus, the mechanism for this wider protection is not clear.

Overall the vaccinated group showed about half the mortality of the unvaccinated group supporting the conclusion that the vaccine was protective in a more general way. The results in the table question the specificity of the measles vaccine and therefore the statement requires qualification.

Question 31

Criteria	Marks
• Evaluates the validity of the design of the study • Provides a suitable interpretation of the data • Provides a suitable judgement	6
• Demonstrates an understanding of the validity of the study • Provides an interpretation of the data • Provides a judgement	5
• Outlines suitable points about the validity of the study and/or the data	3–4
• Identifies several suitable points about the study and/or the data OR • Outlines one suitable point about the study or the data	2
• Provides relevant information	1

Sample answer:

The study results show that when patients were in the 'no tablet' period they still displayed the symptoms of side effects (score 8). Taking placebo tablets doubled the severity of side effects (from 8 to 15.4) even though no active ingredients were present. Statin tablets and placebo tablets had very similar results (16.3 and 15.4). These data seem to indicate that side effects in patients taking statins may not be due to the active ingredients in statins but other factors.

However these results cannot be regarded as valid as only 60 patients were involved (millions of people take statins). Also, symptoms were monitored and recorded by the patients themselves in a qualitative way and cannot be regarded as reliable measurements. The study should also have included a control group that could be used for comparison.

The study and its results cannot be regarded as valid. However, it is valuable as it indicates it would be worthwhile following this up with a large randomised control trial to confirm that statins do not cause side effects in most people.

Question 32

Criteria	Marks
• Explains changes that would occur in the testes in response to anabolic steroids • Demonstrates a comprehensive knowledge and understanding of negative feedback loops • Correctly interprets the diagram	5
• Describes changes that would occur and provides a reason for the proposed changes • Demonstrates an understanding of negative feedback loops • Correctly interprets some steps in the diagram	4
• Identifies change(s) that would occur and/or provides a reason for the proposed change(s) • Demonstrates some understanding of negative feedback loops and/or relates answer to the diagram	2–3
• Provides some relevant information	1

Sample answer:

In a normal male as shown in the diagram, the hypothalamus releases Releasing Hormone which stimulates the anterior pituitary to produce hormones that stimulate the testes to produce sperm and the hormones testosterone and inhibin. Testosterone stimulates sperm production also. When a large dose of an anabolic steroid that is like testosterone is taken, while this may initially increase sperm production and the associated hormone inhibin, the testosterone effect of negative feedback on both the hypothalamus and the anterior pituitary cause less stimulatory hormones to be released so that the testes produce less sperm and less inhibin and less testosterone. Although less inhibin would mean a smaller negative feedback on the anterior pituitary caused by this hormone, the ongoing dose of testosterone would ensure a large overall negative feedback effect. In time, the testes would lose their normal function.

Question 33 (a)

Criteria	Marks
• Explains the processes in the steps	3
• Outlines the process of gene cloning	2
• Provides relevant information	1

Sample answer:

The transgene is inserted into a plasmid by using enzymes. The plasmid is then placed into a bacterial host. As the host reproduces the plasmid is copied and so is the transgene (gene cloning). This is done in order to produce multiple copies of the gene.

Question 33 (b)

Criteria	Marks
• Explains a benefit of the use of transgenic salmon in aquaculture • Links answer to data in the graph	3
• Describes a benefit of the transgenic species OR • Identifies a benefit of the transgenic salmon and links it to the data	2
• Provides relevant information	1

Sample answer:

Transgenic salmon has a higher rate of growth in the first two years than standard salmon. Transgenic salmon reaches market size in the second year whereas the standard salmon takes five months longer. This saves money in producing the fish for market as there are lower feed and maintenance costs.

Question 33 (c)

Criteria	Marks
• Demonstrates extensive knowledge and understanding of biotechnology, reproduction and biodiversity • Provides scientific analyses for the techniques used • Relates analyses to protecting and preserving biodiversity	9
• Demonstrates thorough knowledge of biotechnology, reproduction and biodiversity • Provides scientific analyses for the main techniques used • Links techniques to maintaining biodiversity	7–8
• Demonstrates sound knowledge of biotechnology and reproduction • Applies knowledge to explain technique(s) used • Links technique(s) to effect(s) on biodiversity	5–6
• Demonstrates a sound knowledge of biotechnology/techniques and/or reproduction and/or biodiversity OR • Demonstrates basic knowledge of biotechnology/techniques and makes a link to biodiversity	3–4
• Provides relevant information	1–2

Sample answer:

Biodiversity is the variety in gene pools of species as well as the variety of species in ecosystems. Transgenic salmon carries the risk of reducing biodiversity and has the potential to do great harm.

Physical isolation techniques 1 and 5 prevent transgenic salmon from escaping into the environment. They may have a survival advantage, and pass the transgene onto offspring. This may reduce biodiversity as wild-type fish become less common and the gene pool is reduced. Transgenic salmon could outcompete other species, potentially reducing species biodiversity.

Reproductive techniques such as the hormone treatment in technique 2 allow sperm to be produced that only carries X chromosomes as the parents are genetically female. This sperm is used to fertilise eggs from wild-type salmon, and all offspring are female as none of the sperm have a Y chromosome. They will all have a copy of T from the sperm – only one T is needed as it is dominant. Technique 4 prevents meiosis II and results in diploid eggs being fertilised by haploid sperm. This produces infertile, triploid offspring that have three copies of each type of chromosome. These techniques prevent the transgene from being passed on.

Using eggs from wild-type salmon is crucial to preserving biodiversity as it prevents inbreeding of transgenic fish stock and ensures hybrid vigour in the offspring, preventing the accumulation of mutations.

Physical isolation, reproductive technologies and the introduction of hybrid vigour are crucial in protecting biodiversity in ecosystems as well as within the transgenic salmon population.

2021 HSC Biology
Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	Mod 8 Causes and Effects	BIO12-15
2	1	Mod 5 Reproduction	BIO12-12
3	1	Mod 6 Biotechnology	BIO12-13
4	1	Mod 8 Epidemiology	BIO12-15
5	1	Mod 8 Homeostasis	BIO12-15
6	1	Mod 6 Mutation	BIO12-13
7	1	Mod 5 Cell Replication	BIO12-12
8	1	Mod 7 Prevention, Treatment and Control	BIO12-5, BIO12-14
9	1	Mod 7 Prevention, Treatment and Control	BIO12-14
10	1	Mod 5 Genetic Variation	BIO12-15, BIO12-12
11	1	Mod 6 Biotechnology	BIO12-13
12	1	Mod 5 Reproduction	BIO12-5, BIO12-12
13	1	Mod 8 Homeostasis	BIO12-5, BIO12-15
14	1	Mod 7 Causes of Infectious Disease	BIO12-14
15	1	Mod 6 Mutation	BIO12-13
16	1	Mod 7 Causes of Infectious Disease	BIO12-5, BIO12-14
17	1	Mod 5 Cell Replication	BIO12-4, BIO12-12
18	1	Mod 5 Genetic Variation	BIO12-5, BIO12-12
19	1	Mod 8 Causes and Effects	BIO12-5, BIO12-15
20	1	Mod 8 Causes and Effects	BIO12-5, BIO12-15

Section II

Question	Marks	Content	Syllabus outcomes
21 (a)	2	Mod 7 Causes of Infectious Disease	BIO12-14
21 (b)	2	Mod 7 Causes of Infectious Disease	BIO12-14
21 (c)	3	Mod 7 Prevention, Treatment and Control	BIO12-6, BIO12-14
22	3	Mod 5 Genetic Variation	BIO12-6, BIO12-12
23	3	Mod 5 Reproduction	BIO12-2, BIO12-12
24 (a)	3	Mod 5 Genetic Variation	BIO12-5, BIO12-12
24 (b)	4	Mod 6 Mutation	BIO12-6, BIO12-13
25 (a)	3	Mod 8 Technologies and Disorders	BIO12-4, BIO12-7, BIO12-15
25 (b)	2	Mod 8 Technologies and Disorders	BIO12-5, BIO12-15
25 (c)	3	Mod 8 Technologies and Disorders	BIO12-15
26	4	Mod 5 Genetic Variation	BIO12-12
27	3	Mod 5 Inheritance Patterns in Populations	BIO12-12

Question	Marks	Content	Syllabus outcomes
28 (a)	3	Mod 5 DNA and Polypeptide Synthesis	BIO12-12
28 (b)	5	Mod 7 Immunity	BIO12-14
29	4	Mod 8 Homeostasis	BIO12-5, BIO12-15
30	7	Mod 7 Prevention, Treatment and Control	BIO12-5, BIO12-6, BIO12-14
31	6	Mod 8 Epidemiology	BIO12-2, BIO12-5, BIO12-15
32	5	Mod 8 Homeostasis	BIO12-5, BIO12-6, BIO12-15
33 (a)	3	Mod 6 Genetic Technologies	BIO12-5, BIO12-13
33 (b)	3	Mod 6 Genetic Technologies	BIO12-5, BIO12-6, BIO12-13
33 (c)	9	Mod 6 Biotechnology	BIO12-5, BIO12-6, BIO12-7, BIO12-13