

**2019**  
**Higher School Certificate**  
**Trial Examination**

# Biology

## General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- Write your student number and/or name at the top of every page

**Total marks – 100**

### **Section I – Pages 2–10** **20 marks**

- Attempt Questions 1–20
- Allow about 35 minutes for this section

### **Section II – Pages 11–28** **80 marks**

- Attempt Questions 21–38
- Allow about 2 hours and 25 minutes for this section

**This paper MUST NOT be removed from the examination room**

STUDENT NUMBER/NAME: .....

1 An infectious disease can be which of the following?

- (A) Transposed
- (B) Transmitted
- (C) Translated
- (D) Transcribed

Refer to the following information to answer Questions 2 and 3.

In 2018, health workers conducted a year-long study of 20 000 people to examine the incidence, prevalence and mortality rates of a particular non-infectious disease.

1200 people were identified with the disease at the beginning of the study and 165 new cases of the disease were diagnosed over the course of the year. There were 35 deaths from the disease recorded throughout the duration of the study.

2 What is the prevalence rate of the disease in the study population?

- (A) 175 per 100 000 persons
- (B) 1330 per 100 000 persons
- (C) 1365 per 100 000 persons
- (D) 6650 per 100 000 persons

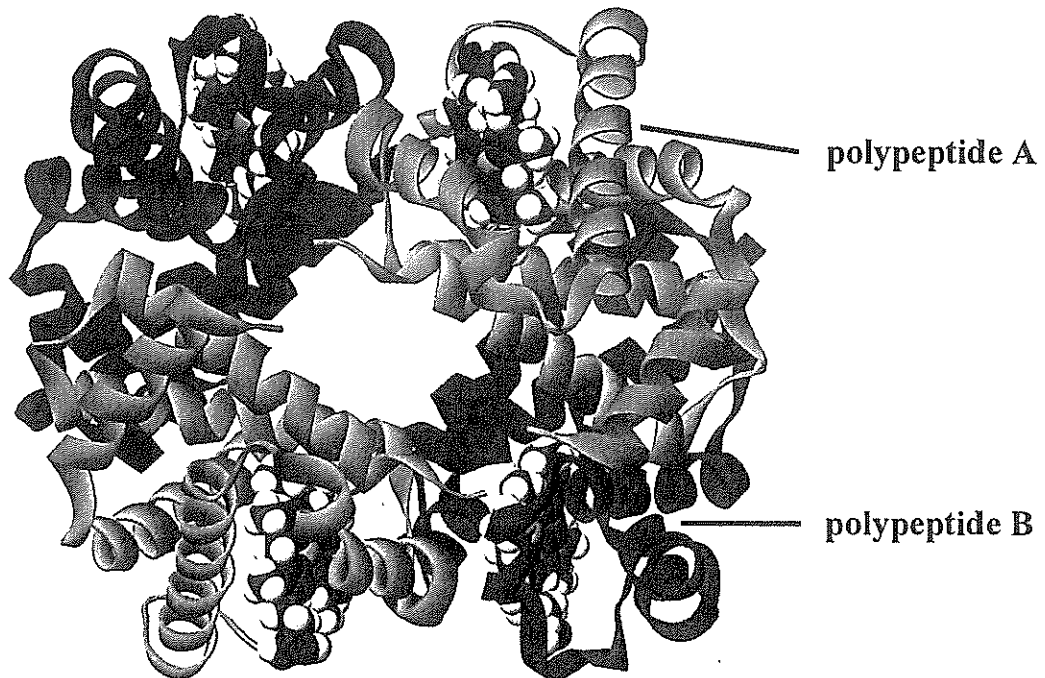
3 What is the mortality rate of the disease for the study population?

- (A) 175 per 100 000 persons
- (B) 6825 per 100 000 persons
- (C) 825 per 100 000 persons
- (D) 878 per 100 000 persons

4 Which identifies an advantage of artificial insemination?

- (A) Improves the reproductive rate of endangered species
- (B) Increases variability through genetic modification
- (C) Transfers pollen a great distance from one plant to another
- (D) Produces multiple genetically identical offspring

- 5 The diagram below represents a molecule of the protein haemoglobin.



**The protein haemoglobin**

Which level of protein structure is represented by this model?

- (A) Primary
  - (B) Secondary
  - (C) Tertiary
  - (D) Quaternary
- 6 Spores are an asexual method of reproduction in which multicellular organisms produce large amounts of single reproductive cells which are then dispersed over large distances. If these spores reach a location with favourable conditions they will begin to divide, producing a new organism.

Which of the following organisms is most likely to reproduce using spores?

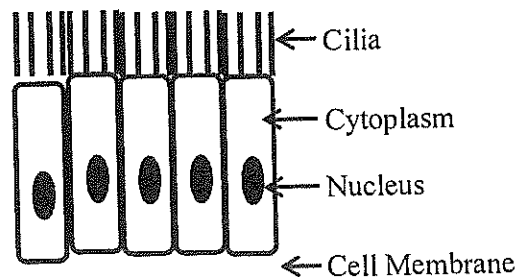
- (A) Amphibians
- (B) Bacteria
- (C) Fungi
- (D) Protists

STUDENT NUMBER/NAME: .....

- 7 Which of the following is a common physiological adaptation that helps endotherms to maintain a stable body temperature?
- (A) Seeking shade and sweating
  - (B) Vasoconstriction and vasodilation
  - (C) A high or low surface-area-to-volume ratio
  - (D) Licking paws to induce evaporative cooling
- 8 Which of the following correctly describes the function of the hormone progesterone?
- (A) Progesterone kills sperm that enters the vagina.
  - (B) Progesterone causes the ovaries to release an ovum.
  - (C) Progesterone prepares and maintains the uterus for pregnancy.
  - (D) Progesterone produces the female sexual characteristics, such as breasts.

Refer to the following information to answer Questions 9 and 10.

The diagram below illustrates the cells found in the lining of the human respiratory system.



- 9 What is the role of these cells in the immune system?
- (A) To move back and forward to increase gas exchange
  - (B) To exchange oxygen and carbon dioxide
  - (C) To trap foreign material before entering the body
  - (D) To phagocytose foreign material once it has entered the body
- 10 The cilia on the surface are part of which immune system?
- (A) The innate immune system
  - (B) The acquired immune system
  - (C) The adaptive immune system
  - (D) The active immune system

11 Which of the following biotechnologies would lead to an INCREASE in genetic diversity?

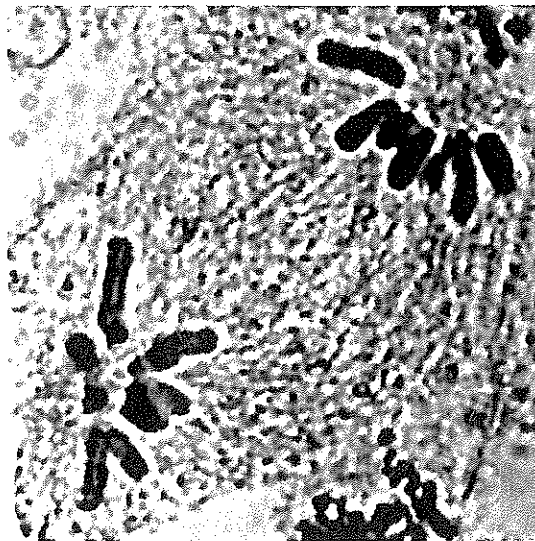
- (A) Artificially inseminating a number of female heifers (cows) from one desirable bull
- (B) Grafting two or more fruit trees together
- (C) Artificially pollinating an endangered plant species to increase seed production
- (D) Producing a transgenic organism

12 The production of chemicals by cells or tissues of animals is often in response to a pathogen. One of those chemicals is histamine.

What is the purpose of producing histamine in response to invasion by a pathogen?

- (A) Vasoconstriction and triggering an itching response
- (B) Vasoconstriction and regulating production and function of lymphocytes
- (C) Vasodilation and preventing blood from clotting
- (D) Vasodilation and influencing the movement of white blood cells

13 The electron micrograph below shows chromosomes in one cell during mitosis.



Which stage is this most likely to be?

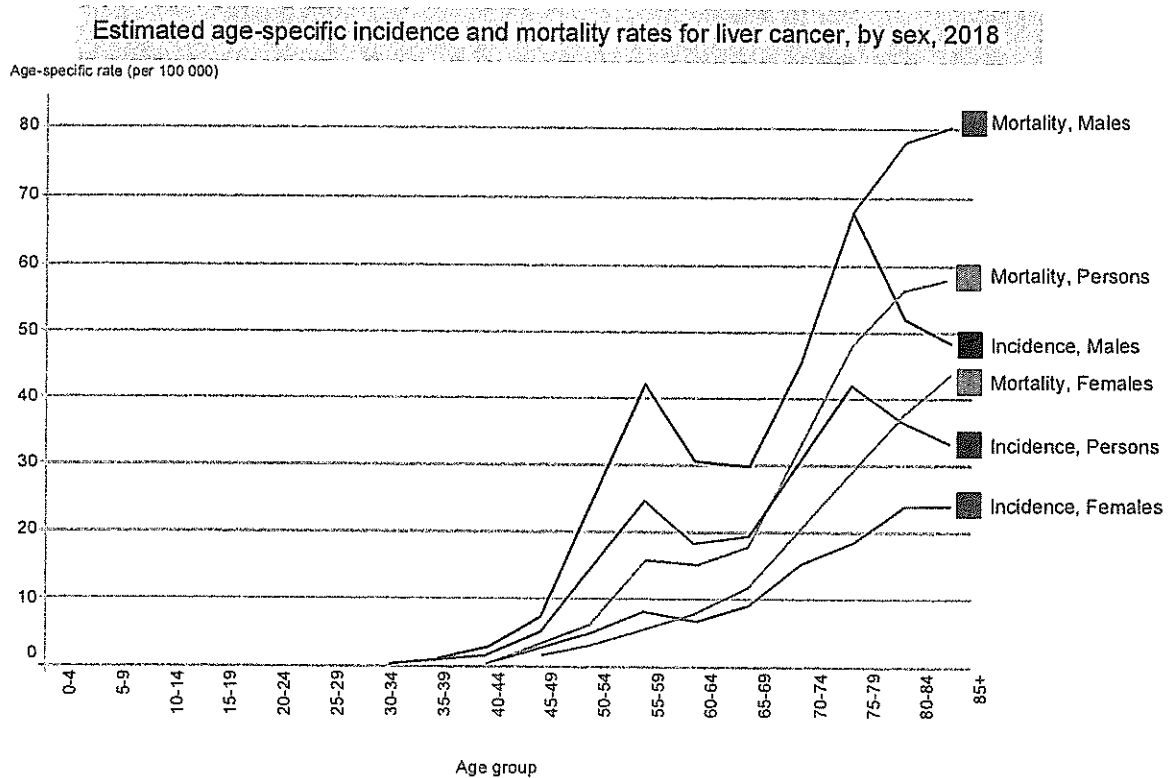
- (A) Prophase
- (B) Metaphase
- (C) Anaphase
- (D) Cytokinesis

STUDENT NUMBER/NAME: .....

14 Which of the following best describes a single nucleotide polymorphism (SNP)?

- (A) One characteristic being changed due to multiple mutations.
- (B) One nucleotide being changed in section of DNA.
- (C) Many proteins within a section of DNA being changed.
- (D) Many changed characteristics from mutations in a section of DNA.

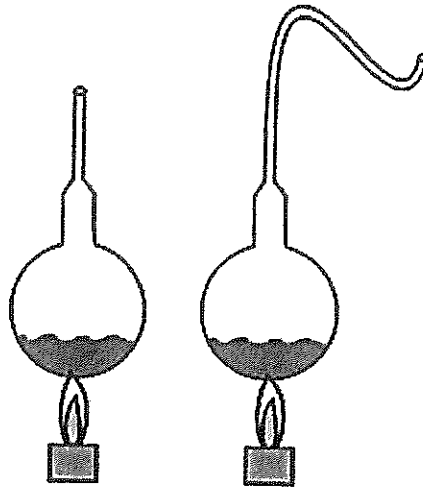
15 Observe the graph below.



What conclusion is most correct from the graph about liver cancer?

- (A) Females who are diagnosed with liver cancer are just as likely to die from the disease as males who are diagnosed with it.
- (B) The likelihood of dying from liver cancer increases steadily with age.
- (C) Males are more likely to be diagnosed with liver cancer than females.
- (D) The prevalence of males diagnosed with liver cancer increases with age.

- 16 The diagram shows Louis Pasteur's famous swan neck flask experiment.



Which of the following was used as a control in his method?

- (A) Boiling of the broth
  - (B) The swan shape of the flask
  - (C) The measure of cloudiness
  - (D) Particles in the air outside the flask
- 17 In 1856, the Austrian monk, Gregor Mendel began his now famous research using pea plants, which led to a proposed model for inheritance. His success was based on precise experimentation and careful observations.

Which of the following techniques ensured that the data he obtained was reliable? .

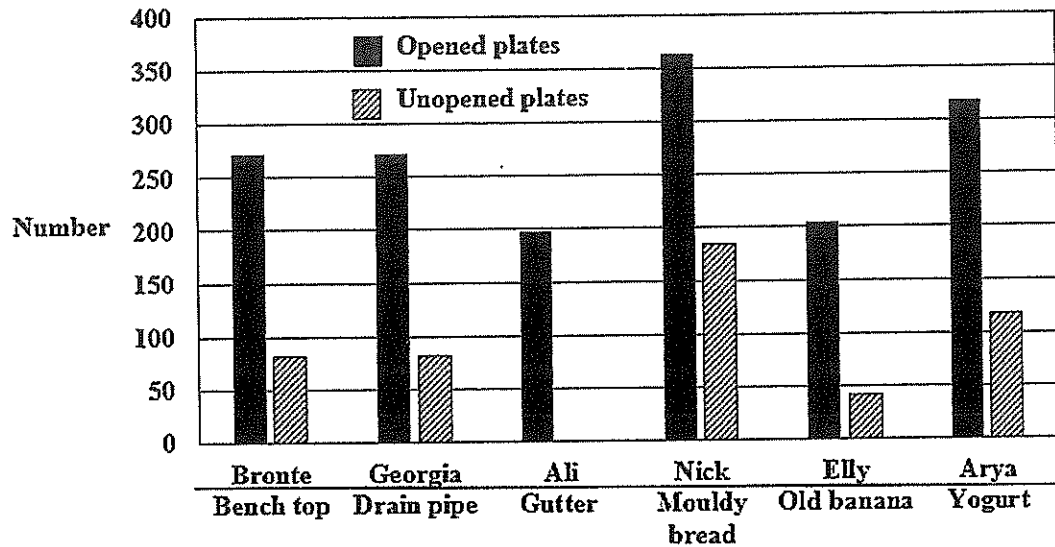
- (A) Bred plants hundreds of times and tabulated each outcome
- (B) Ensured pure-breeding lines by previously breeding each variety for 2 years
- (C) Kept plants isolated in a greenhouse, to prevent accidental cross-pollination
- (D) Ensured all plants self-pollinated by covering them with bags

STUDENT NUMBER/NAME: .....

- 18 When seeking to establish the cause of a particular non-infectious disease, which of the following must epidemiologists first consider?
- (A) Mortality rates, if the disease is not diagnosed and addressed with appropriate treatment
  - (B) The preventative and control measures to be implemented as part of the intervention
  - (C) Evidence that exposure to a pathogen, virus or prion has not occurred before the disease appeared
  - (D) The correlation between exposure to the suspected cause and the prevalence of the disease
- 19 Which of the following statements is correct of DNA in eukaryotes and prokaryotes?
- (A) DNA in eukaryotes and prokaryotes is located on chromosomes.
  - (B) There is less DNA in eukaryote cells arranged in a simple structure whereas prokaryotes have a more complex helix structure.
  - (C) DNA in eukaryotes is free to move around the cytoplasm of the cell whereas DNA in prokaryotes is contained within a membrane.
  - (D) DNA in eukaryotes is composed of adenine, guanine, cytosine and thymine, whereas DNA in prokaryotes uses uracil instead of thymine.



- 20 Six students each prepared ten agar petri dishes using sterile techniques. Eight of the plates were exposed and the other two left unopen. All plates were placed in a particular location for twenty minutes at the same time of day. After incubation, the total numbers of microbes (bacteria and fungi) in all opened plates were counted and the results tabulated. The total number of microbes in unopened plates were also counted.



Which of the following would be true from the data presented above?

- (A) All of the student's data is valid because they each used a control.
- (B) All of the student's data is valid because they each used multiple petri dishes.
- (C) Only Bronte's and Georgia's data are valid because their results were identical.
- (D) Only Ali's data is valid because his unopened plates had no microbes present.

## Section II

80 marks

Attempt Questions 21–38

Allow about 2 hours and 25 minutes for this section

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

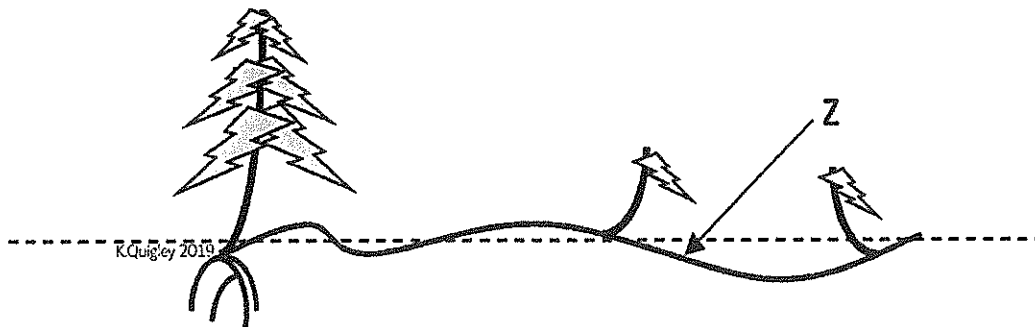
Show all relevant working in questions involving calculations.

Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

### Question 21 (3 marks)

Marks

The diagram below shows a method of reproduction used by many native species of Australian ferns. The parent plant on the left, grows a specialised horizontal stem called a runner (Z) along the ground and new plants emerge from this stem.



- (a) Identify whether this method of reproduction is sexual or asexual. 1

.....

- (b) Outline an advantage and limitation of the type of reproduction identified in (a). 2

.....

.....

.....

.....

.....

STUDENT NUMBER/NAME: .....

**Question 22 (4 marks)**

**Marks**

‘Golden Rice’ is the name given to a number of varieties of rice that have been genetically modified to produce beta-carotene.

- (a) Explain why Golden Rice is considered to be a biotechnology. 2

.....

.....

.....

.....

.....

- (b) Outline ONE social implication of Golden Rice becoming widely used. 1

.....

.....

.....

- (c) Outline ONE ethical consideration of Golden Rice becoming widely used. 1

.....

.....

.....

STUDENT NUMBER/NAME: .....

**Question 23 (4 marks)**

**Marks**

A group of university researchers are responsible for 5 families of pandas in different zoos. Each family has been isolated from other families for generations. As the cubs reach sexual maturity, a mating program aims to improve the genetics of the worldwide panda population.

- (a) Explain how the mating program may affect gene flow. 2

.....

.....

.....

.....

.....

- (b) Explain how the mating program may affect genetic drift. 2

.....

.....

.....

.....

.....

STUDENT NUMBER/NAME: .....

**Question 24 (3 marks)**

**Marks**

A student designed the following first-hand investigation to determine how one factor in the environment can effect phenotypic expression. The plants used were grown from seed.

<i>Feature</i>	<i>Group A</i>	<i>Group B</i>
<i>Type of seedling</i>	Bean	Bean
<i>Number of seedlings</i>	100	100
<i>Temperature (°C)</i>	10	30
<i>Light (hours/day)</i>	12	12
<i>Water (mL/day)</i>	20	20
<i>Soil</i>	Potting medium	Potting medium

- (a) Identify the independent variable in this investigation.

1

.....

- (b) Evaluate the validity of this investigation.

2

.....

.....

.....

.....

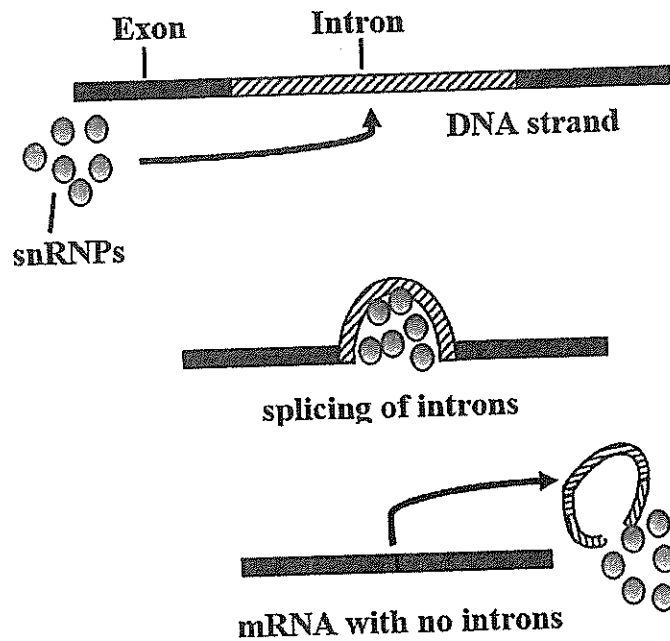
.....

STUDENT NUMBER/NAME: .....

Marks

**Question 25 (3 marks)**

The diagram below shows the process of how an intron is removed from a section of DNA to form a strand of mature messenger RNA (mRNA).



- (a) Explain the difference between an exon and an intron.

1

.....

.....

.....

- (b) Identify a specific type of electromagnetic radiation that is known to cause mutations and describe how this mutagen causes the mutation.

2

.....

.....

.....

.....

**Question 26 (6 marks)****Marks**

DNA replication is a biological process by which DNA is copied. The model below represents a section of DNA that has replicated into two identical strands.

- (a) Using the same shapes and symbols in this model, complete the missing STAGE 2, showing the main features of DNA replication.

**3**

- (b) Explain why scientists use models to represent the process of DNA replication.

**3**

.....

.....

.....

.....

.....

.....

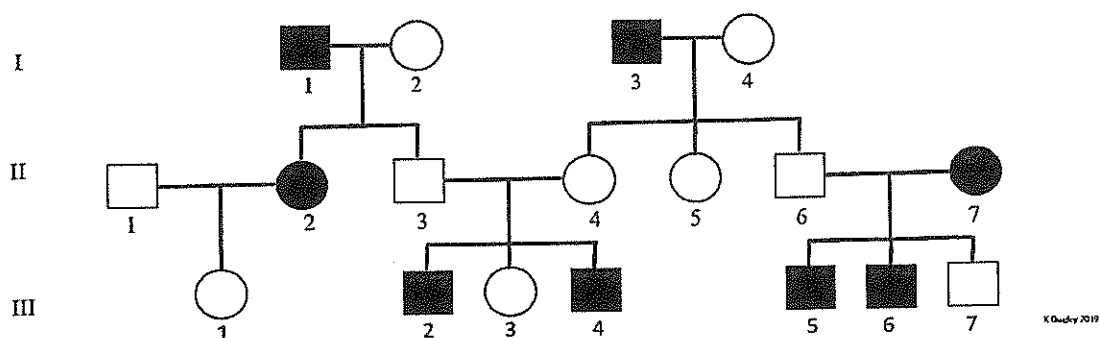
.....

STUDENT NUMBER/NAME: .....

**Question 27 (6 marks)**

**Marks**

The pedigree below shows the inheritance of a genetic disease in a family through three generations.



- (a) What is the relationship of I2 to II3?

1

.....

.....

.....

- (b) Explain if this genetic disease is dominant or recessive.

2

.....

.....

.....

.....

.....

- (c) Assess if it is possible to determine if this disease is sex-linked from the information given in the pedigree.

3

.....

.....

.....

.....

.....

.....

.....



**Question 28 (5 marks)****Marks**

Tay-Sachs Disease is a rare genetic disorder that destroys the nerve cells in the brain and spinal cord in humans. It is caused by a mutation on the HEXA gene, found on Chromosome 15.

A section of a normal HEXA gene is shown below:

CGTATATCCTATGCCCCCTGAC

The same section of the HEXA gene, with the Tay-Sachs mutation is shown below:

CGTATATCTCTATGCCCCCTGAC

- (a) Name the type of mutations causing Tay-Sachs disease.

**1**

.....

**Question 28 continues on the next page**

## Question 28 (continued)

Marks

- (b) The table provided shows the base triples in mRNA for amino acids.

4

		Second Base of mRNA Codon									
		U		C		A		G			
First Base of mRNA Codon	U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U	Third Base of mRNA Codon
		UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys	C	
		UUA	Leu	UCA	Ser	UAA	STOP	UGA	STOP	A	
		UUG	Leu	UCG	Ser	UAG	STOP	UGG	Trp	G	
	C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U	
		CUC	Leu	CCC	Pro	CAC	His	CGC	Arg	C	
		CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg	A	
		CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg	G	
	A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U	
		AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser	C	
		AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg	A	
		AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg	G	
	G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U	
		GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly	C	
		GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly	A	
		GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly	G	

Using the codon table attached, explain the effect this mutation has on the production of a polypeptide from the HEXA sequence.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 28

STUDENT NUMBER/NAME: .....

**Question 29 (8 marks)**

**Marks**

Describe how recombinant DNA technology has been used to genetically modify an organism important in a medical, agricultural or industrial application. **8**

In your answer, evaluate the impact of this modified organism.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

STUDENT NUMBER/NAME: .....

**Question 30 (3 marks)**

### Marks

Complete the table below to identify an animal disease caused by each pathogen and the mode of transmission.

3

<i>Pathogen</i>	<i>Diseased caused by pathogen</i>	<i>Mode of transmission</i>
<i>Bacteria</i>		
<i>Fungal</i>		
<i>Prion</i>		

**Question 31 (3 marks)**

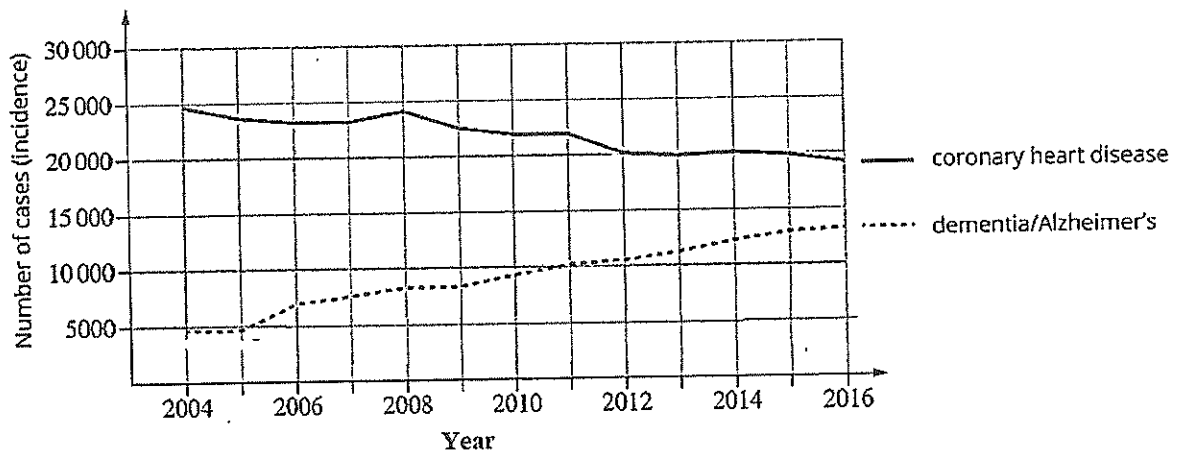
Maintaining a stable internal environment is crucial for cells to function and organisms to survive.

Using a specific example, construct a negative feedback loop that demonstrates how hormones and neural pathways are used to maintain homeostasis in humans.

3

**Question 32 (4 marks)****Marks**

The graph below shows the **incidence of coronary heart disease and dementia** in the Australian population from 2004 to 2016.



- (a) In 2011 what was the approximate incidence of:

**2**

- (i) Coronary heart disease? .....
- (ii) Dementia/Alzheimer's? .....

- (b) Suggest likely explanations to account for the decrease in the incidence of coronary heart disease from 2006 to 2016.

**2**

.....

.....

.....

.....

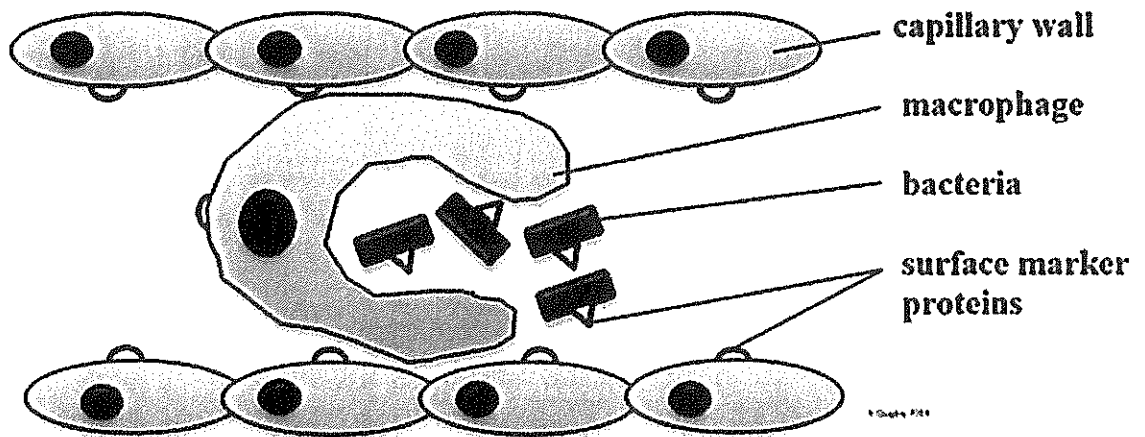
.....

**Question 33** (3 marks)

**Marks**

The diagram below models how macrophages recognise potential foreign pathogens in the body.

**3**



Describe the process represented by the macrophage model.

.....

.....

.....

.....

.....

.....

.....

**Question 34 (4 marks)****Marks**

Read the article below to answer the following questions.

**Curing SCID**

SCID stands for 'Severe Combined Immunodeficiency'. It is a group of disorders that is caused by a mutation in a gene that codes for the development of immune cells in newborn babies. This mutation makes babies highly susceptible to infections and even a simple common cold could kill them. For this reason, these babies cannot have any contact with the outside world and must be isolated.

Recently, researchers at St. Jude Children's Research Hospital in America, used a new gene therapy program in clinical trials. Their findings have been published in the New England Journal of Medicine [April 18, 2019].

The trials used a disabled virus as a vector and a special drug to reduce side effects. They injected gene-corrected stem cells into the bone marrow of eight infants and found that the transplanted stem cells produced all three types of immune cells, helper T cells, killer T cells and B cells in the infants.

After monitoring the babies for over 16 months, the authors reported that all babies are healthy, show consistent levels of immune cells, and are developing well. One of the research doctors has reported that as the immune system in these children is consistently stable in their follow-up beyond a year, she believes that this treatment is a cure for SCID but that; "only time will say whether this will be a durable lifelong cure."

The babies have now been sent home to their families.

- (a) Describe the cause of SCID.

**1**

.....

.....

.....

- (b) Assess the reliability and validity of this article and suggest ways that these could be improved.

**3**

.....

.....

.....

.....

.....

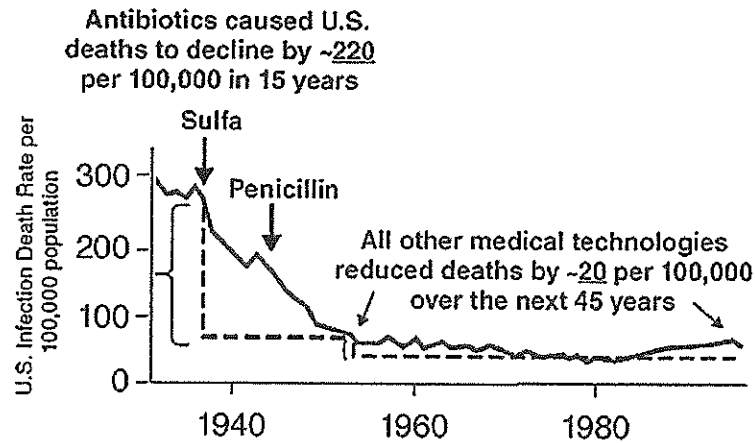
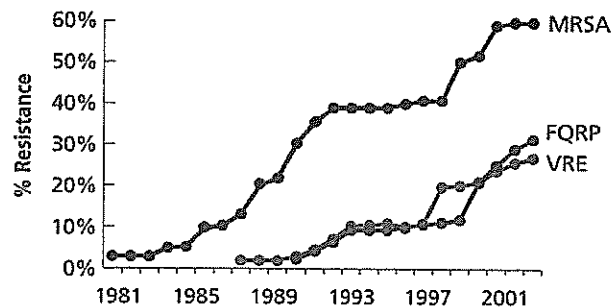
.....

.....

.....

**Question 35 (5 marks)****Marks**

The graphs below show different information about the effectiveness of antibiotics as a treatment strategy for infectious diseases.

**5****INCREASE IN ANTIBIOTIC RESISTANCE (NNIS 1999)**

Using the information provided in the graphs and your own knowledge, discuss the effectiveness of antibiotics as a treatment strategy for infectious diseases.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



**Question 36 (5 marks)****Marks**

As part of your Biology course, you had to design and conduct a practical investigation relating to the microbial testing of water and food samples.

- (a) State the hypothesis that was tested. 1
- .....
- .....
- .....
- (b) Describe the safe work practices employed during the investigation. 2
- .....
- .....
- .....
- .....
- .....
- (c) Explain the choice of data collection method when collecting the results of this investigation. 2
- .....
- .....
- .....
- .....
- .....

STUDENT NUMBER/NAME: .....

**Question 37 (4 marks)**

**Marks**

Non-infectious diseases account for all of the top 5 leading causes of death for Australians over 45 years of age (*Australian Institute of Health & Welfare, 2018*).

- (a) Describe the cause and effects of a NAMED disease related to environmental exposure OR nutrition.

**2**

.....

.....

.....

.....

.....

- (b) Discuss the treatment/management options available for the disease you identified in part (a).

**2**

.....

.....

.....

.....

.....

**Question 38 (7 marks)**

**Marks**

The term '*disorder*' can be used to describe something that alters or disrupts the normal functioning of the body.

**7**

Explain the cause of a specific disorder that affects the human body and evaluate the use of a technology implemented to manage the effects of this disorder.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**End of paper**

**NSW INDEPENDENT TRIAL EXAMS – 2019  
BIOLOGY TRIAL HSC EXAMINATION  
MARKING GUIDELINES**

**Section I**

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

**Section II**

**Question 21(a)**

Criteria	Mark
• Correctly identifies method of reproduction	1

*Answer may include:* Asexual reproduction

**Question 21(b)**

Criteria	Mark
• Correctly outlines an advantage and limitation of the reproduction identified in (a)	2
• Correctly outlines an advantage OR limitation of the reproduction identified in (a)	1

*Answer may include:* The advantage of asexual reproduction is that it requires only one parent, so numbers are increased quickly as no other parent is required. The disadvantage of asexual reproduction is all the offspring are genetically identical (lack of genetic variation) and if there is an unsuitable change in the environment the population may all die.

**Question 22(a)**

Criteria	Mark
• Provides a definition for <i>biotechnology</i>	2
• Explains why Golden Rice is considered a biotechnology	
• Provides some relevant information	1

*Answer may include:* Golden Rice is a biotechnology as we are genetically manipulating the rice to make it higher in beta-carotene. We are doing this so we can improve the health of people with Vitamin A deficiency.

**Question 22(b)**

Criteria	Mark
• Describes ONE social implication of Golden Rice	1

*Answer may include:* Accessibility, privacy, health, safety or nutritional benefit

**Question 22(c)**

Criteria	Mark
• Describes ONE ethical consideration of Golden Rice becoming widely used	1

*Answer may include:* Conflict with cultural/religious views, genetic proliferation in the wild, corporate control of the technology, loss of biodiversity if it becomes a monoculture

**Question 23(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>States that a mating program would increase the gene flow</li> <li>Explains why the mating program would increase gene flow</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

*Answer may include:* A mating program would cause an increase in gene flow, because it would allow genes to be exchanged between populations.

**Question 23(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>States that a mating program would decrease the genetic drift</li> <li>Explains why the mating program would decrease genetic drift</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

*Answer may include:* Genetic drift refers to the variation and possible disappearance of alleles in a small population, often due to organisms not having an opportunity to mate. By introducing a mating program, certain alleles are less likely to disappear as organisms now have opportunity to pass them on to offspring. As the variation is less likely between populations involved in a mating program, genetic drift has been decreased.

**Question 24(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly identifies the independent variable</li> </ul>	1

*Answer may include:* Temperature

**Question 24(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Makes a correct judgement about the validity of the investigation</li> <li>Explains an aspect relevant to the validity of the investigation</li> </ul>	2
<ul style="list-style-type: none"> <li>Makes a correct judgement about the validity of the investigation</li> </ul> OR <ul style="list-style-type: none"> <li>Describes an aspect relevant to the validity of the investigation</li> </ul>	1

*Answer may include:* The test appears to be valid, since all items in the table are identical with the exception of the independent variable. All items considered in the table seem to have been controlled, but crucially the specimens being tested were grown from seed, which introduces variability. This investigation is therefore invalid as it does not answer the aim. Changing the temperature should be the only variable that will affect the height of the plants, but seedlings were used instead of cuttings and therefore are genetically different to each other. This genetic variation within the bean seedlings will also produce a variation in height and thusly the temperature will not be the factor affecting plant growth.

**Question 25(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly defines an <i>exon</i> and <i>intron</i></li> </ul>	1

*Answer may include:* Introns and exons are nucleotide sequences within a gene. Exons code for proteins, whereas introns do not, they are non-coding.

**Question 25(b)**

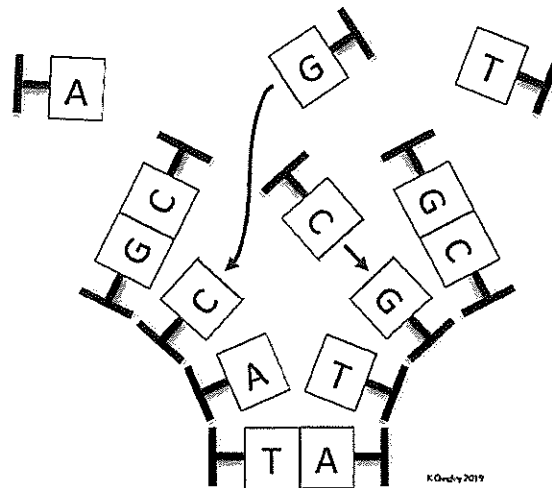
Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly identifies a specific type of electromagnetic radiation that causes mutations and describes how this radiation causes the mutation</li> </ul>	2
<ul style="list-style-type: none"> <li>Correctly identifies a specific type of electromagnetic radiation that causes mutations</li> </ul> OR describes how this radiation causes the mutation	1

*Answer may include:* High frequency electromagnetic radiation has enough energy to ionise (remove electrons from) atoms and molecules. This causes these atoms or molecules to become charged and this can break chemical bonds. Breaking the chemical bonds in DNA can alter its function and cause a mutation.

**Question 26(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Provides a clear diagram that illustrates ALL the following features of DNA replication:               <ul style="list-style-type: none"> <li>Double strand unzipping</li> <li>Nucleotides exposed</li> <li>Free nucleotides join to exposed nucleotides</li> <li>Free nucleotides join to corresponding base pair</li> </ul> </li> </ul>	3
<ul style="list-style-type: none"> <li>Provides a clear diagram that illustrates at least THREE of the features listed</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides a diagram that illustrates at least ONE of the features listed</li> </ul>	1

*Answer may include:*

**Question 26(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Explains why scientists use models</li> <li>Outlines benefits of using models for DNA replication</li> </ul>	3
<ul style="list-style-type: none"> <li>Describes reasons for using models</li> <li>Outlines a benefit of using models for DNA replication</li> </ul>	2
<ul style="list-style-type: none"> <li>Identifies reasons for using models</li> </ul> OR <ul style="list-style-type: none"> <li>Identifies a benefit of using models for DNA replication</li> </ul>	1

*Answer may include:* Scientists use models to explain DNA replication as is too small to be seen with a microscope. Models of DNA replication allow students to visualise and simplify the process and therefore help them understand how it occurs within cells.

**Question 27(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly identifies the relationship</li> </ul>	1

*Answer may include:* I2 is II3's mother OR II3 is I2's son.

**Question 27(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Explains why the disease is recessive with reference to relevant features of the pedigree</li> </ul>	2
<ul style="list-style-type: none"> <li>Identifies a correct feature of the pedigree to determine the disease is recessive</li> </ul> OR	1
<ul style="list-style-type: none"> <li>Identifies the disease is recessive</li> </ul>	

*Answer may include:* The disease is recessive because parents II3 and II4 produce children III2 and III4. II3 and II4 must both be heterozygous, that is they both carry the recessive allele but do not suffer from the disease as they both also have the dominant allele. III2 and III3 have both recessive alleles, one from each parent. (Students could also explain this using a Punnett square to get full marks).

**Question 27(c)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Provides an assessment for the determination of sex-linkage</li> <li>Determines sex-linkage with reference to relevant features of the pedigree</li> </ul>	3
<ul style="list-style-type: none"> <li>Provides an assessment for the determination of sex-linkage with reference to a correct feature</li> </ul> OR	2
<ul style="list-style-type: none"> <li>Determines the sex-linkage with reference to relevant features of the pedigree</li> </ul>	
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

*Answer may include:* Yes, it is possible to determine the disease is not sex-linked from the pedigree. If the disease is sex-linked, Parent II7 has the recessive genetic disease and therefore carries both recessive alleles on each X chromosome. When II6 and II7 have children, all the boys will have the disease because they get their X chromosome from their mother which would have the recessive allele and their Y chromosome from their father which would have no allele. From the pedigree, it can be seen, that III7 does not have the disease and therefore it is not sex-linked.

**Question 28(a)**

Criteria	Mark
• Identifies the mutation as a(n) insertion mutation, or frameshift mutation	1

*Answer may include:* The mutation is an insertion mutation.

**Question 28(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Provides a detailed response which includes the following:               <ul style="list-style-type: none"> <li>Shows the correct mRNA sequence from each DNA sequence</li> <li>Shows the correct amino acid sequence from each mRNA sequence</li> <li>Describes the difference between the two amino acid sequences</li> <li>Suggests a possible outcome because of this difference. E.g. the resulting polypeptide may be dysfunctional</li> </ul> </li> </ul>	4
• Provides a detailed response with at least THREE of the above	3
• Provides a response with at least TWO of the above	2
• Provides some relevant information	1

*Answers may include:*

Normal DNA sequence	CGTATATCCTATGCCCTGAC
Normal mRNA sequence	GCAUAUAGGAUACGGGGACUG
Normal amino acid sequence	ALA-TYR-ARG-ILE-ARG-GLY-LEU
Tay-Sachs DNA sequence	CGTATATCTCTATGCCCTGAC
Tay-Sachs mRNA sequence	GCAUAUAGAGAUACGGGGACUG
Tay-Sachs amino acid sequence	ALA-TYR-ARG-ASP-THR-GLY-THR

The mutation in the Tay-Sachs DNA sequence changes the amino acid sequence after the ARG. Because it is a different amino acid sequence, it is likely to be a dysfunctional polypeptide.



**Question 29**

Criteria	Mark
<ul style="list-style-type: none"> <li>Shows thorough understanding of recombinant DNA technologies used to manufacture a NAMED genetically modified organism</li> <li>Shows thorough understanding of a NAMED genetically modified organism and its medical, agricultural or industrial application</li> <li>Provides a detailed assessment for the application of the NAMED genetically modified organism</li> </ul>	8
<ul style="list-style-type: none"> <li>Shows sound understanding of recombinant DNA technologies used to manufacture a NAMED genetically modified organism</li> <li>Shows sound understanding of a NAMED genetically modified organism and its medical, agricultural or industrial application</li> <li>Provides an assessment for the application of the NAMED genetically modified organism</li> </ul>	6–7
<ul style="list-style-type: none"> <li>Outlines some features of recombinant DNA technologies in the manufacture of genetically modified organisms</li> <li>Outlines some features of genetically modified organisms and their medical, agricultural or industrial application</li> </ul>	4–5
<ul style="list-style-type: none"> <li>Identifies some features of the manufacture of genetically modified organisms AND/OR their medical, agricultural or industrial application</li> </ul>	2–3
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

*Answer may include:* Bt Cotton is created by inserting a gene from a bacterium (*Bacillus thuringiensis*) into a cell from a cotton plant. First, the bacterial gene is inserted into a plasmid, then the plasmid is injected into the nucleus of a cotton plant cell. This genetically modified cotton cell is then grown using tissue culture to produce the genetically modified Bt Cotton plant. When it was first introduced, Bt cotton was a successful agricultural application to improve cotton yields in areas where borers were a problem. The cotton, once genetically modified, could produce its own pesticide. This reduced the need for farmers to spray these crops, thus saving money and improving crop yield and farmer profits. After some time, Bt Cotton faced problems with insect resistance to the Bt Cotton. Therefore Bt Cotton has initially been very successful, but less so recently.

**Question 30**

Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly states a disease and transmission mode for THREE pathogens</li> </ul>	3
<ul style="list-style-type: none"> <li>Correctly states a disease and transmission mode for TWO pathogens</li> </ul>	2
<ul style="list-style-type: none"> <li>Correctly states a disease and transmission mode for ONE pathogen</li> </ul>	1

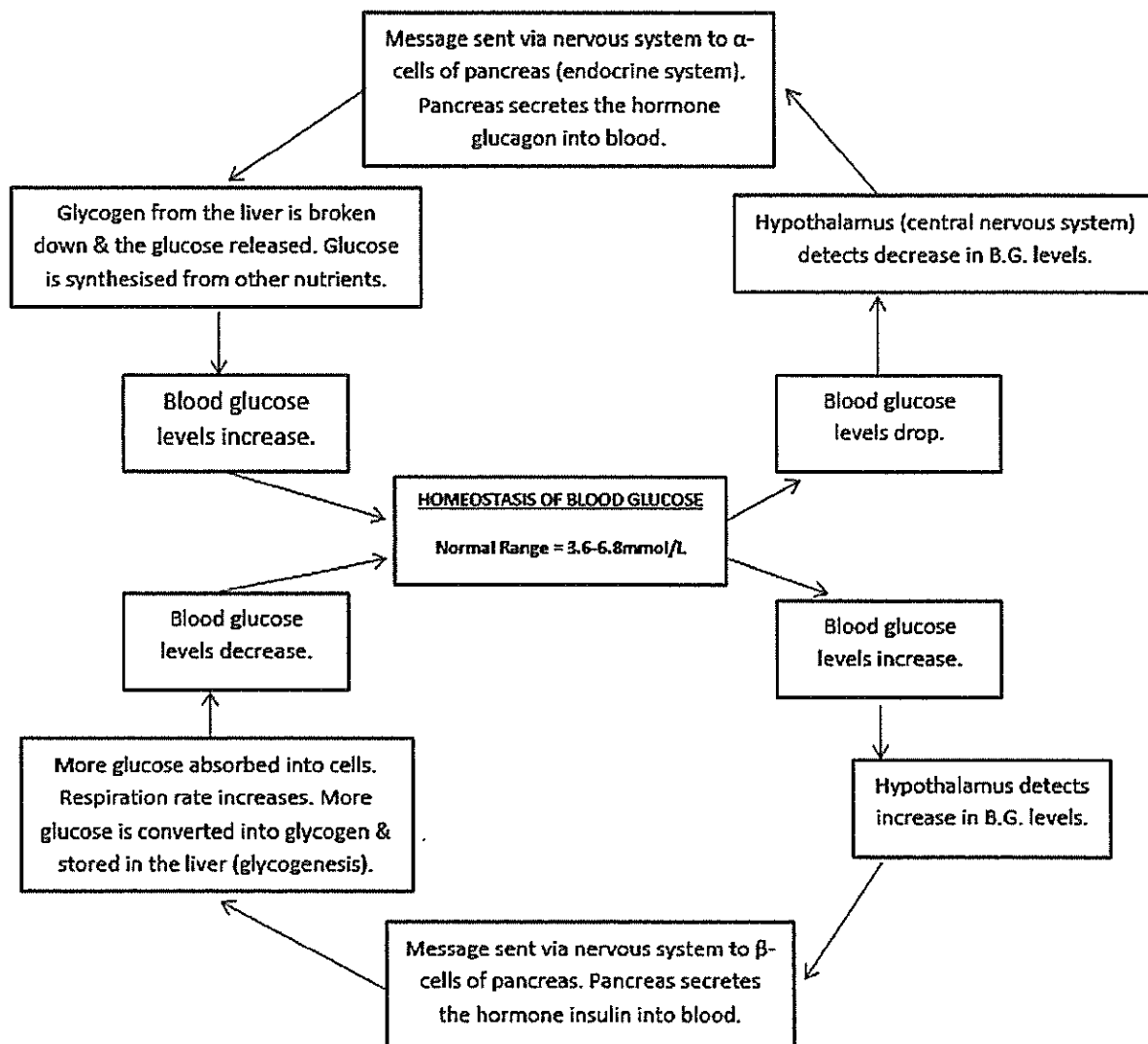
*Answer may include:*

Pathogen	Diseased caused by pathogen	Mode of transmission
Bacteria	Tetanus	Indirect contact
Fungal	Tinea pedis	Direct or indirect contact
Prion	Creutzfeldt-Jakob disease	Indirect contact

### Question 31

Criteria	Mark
<ul style="list-style-type: none"> <li>Provides a clear diagram/response that includes the following features: <ul style="list-style-type: none"> <li>Accurately constructs a negative feedback loop</li> <li>Outlines how homeostasis is achieved in the example given</li> <li>Feedback loop clearly identifies the role of both nervous and endocrine elements</li> </ul> </li> </ul>	3
<ul style="list-style-type: none"> <li>Provides a clear diagram/response that includes TWO features listed</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides a diagram/response that includes ONE feature listed</li> </ul>	1

Answer may include:



**Question 32(a)(i)**

Criteria	Mark
• States an approximate answer of 22 000 for coronary heart disease	1

*Answer may include: 22 000*

**Question 32(a)(ii)**

Criteria	Mark
• States an approximate answer of 10 000 for dementia/Alzheimer's	1

*Answer may include: 10 000*

**Question 32(b)**

Criteria	Mark
• Provides TWO logical explanations to account for the decrease in the incidence of coronary heart disease from 2006 to 2016	2
• Provides a logical explanation to account for the decrease in the incidence of coronary heart disease from 2006 to 2016	1

*Answer may include:* A range of logical responses may be accepted. Education programs (e.g. Heart Foundation) and public advertising (e.g. heart healthy) campaigns to increase awareness of the benefits of good nutrition and a healthy lifestyle may contribute to a decrease in the incidence of coronary heart disease. Increased awareness and participation in fitness programs. Decrease in percentage of people regularly smoking.

**Question 33**

Criteria	Mark
• Identifies and describes the process of the macrophage model	3
• Identifies and outlines the process of the macrophage model	2
• Provides some relevant information	1

*Answer may include:* The process shown is phagocytosis. The surface marker proteins on the bacteria are identified as foreign and as such antigenic. The macrophage surrounds the bacteria, ingests the bacteria by a process of endocytosis and breaks down the bacterial cell.

**Question 34(a)**

Criteria	Mark
• Correctly describes the cause of SCID by referring to a gene mutation	1

*Answer may include:* SCID is caused by a mutation in a gene that codes for the development of immune cells in newborn babies. This mutation interferes with the normal production of T cells and B cells so that normal immunity is severely reduced.

**Question 34(b)**

Criteria	Mark
• Correctly assesses the reliability and validity of this article and suggests ways that these could be improved	3
• Correctly assesses the reliability OR validity of this article and suggests ways that it could be improved	2
• Provides some relevant information	1

*Answer may include:* This article is written recently, in scientific language and in a way that is intended to convey information. The trials were carried out at a research facility and hospital and performed under clinical conditions, or conditions where a diagnosis can be properly performed, by doctors. Outcomes were clearly described. These processes indicate that controlled and accurate assessments were made. Findings were published in a recognised medical journal and properly cited. Articles published in medical journals allow for peer review and evaluation. Although the article appears to be accurate, improvements could be made to remove any uncertainty about their validity. The article's author, publisher and source are not cited and limitations are not stated so that information cannot be easily compared to other sources for verification. Improvements could be made evident from increasing sample size and longer term study.

**Question 35**

Criteria	Mark
<ul style="list-style-type: none"> <li>Gives detailed description of antibiotics, describes initial effectiveness with link to graph and describes the development of antibiotic resistance with link to second graph</li> </ul>	5
<ul style="list-style-type: none"> <li>Gives detailed description of antibiotics, describes initial effectiveness with link to graph and identifies antibiotic resistance with link to second graph</li> </ul>	4
<ul style="list-style-type: none"> <li>Gives detailed description of antibiotics, describes initial effectiveness and identifies antibiotic resistance with link to second graph</li> </ul>	3
<ul style="list-style-type: none"> <li>Gives an outline of antibiotics, describes initial effectiveness and identifies antibiotic resistance</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

*Answer may include:* Antibiotics are chemicals produced by microorganisms that inhibit the growth of bacterial cells. These pharmaceuticals have been extremely effective in controlling infectious bacterial diseases in humans. Antibiotics only act on prokaryotic cells, so they can inhibit the growth of pathogenic bacteria in humans without damaging human cells. This effectiveness can be seen on the first graph where the impact of antibiotics is more than 10 times more effective over 15 years than all other treatment over a period of 45 years. Unfortunately, over the last 20 years there has been a decrease in the effectiveness of these antibiotics. Due to the over prescription and misuse of antibiotics, the process of natural selection has increased the number of bacterial cells with a genetic resistance to the most common antibiotics. This is seen in the upward trend in the second graph showing an increasing number of pathogenic bacteria that can no longer be controlled by currently available antibiotics.

**Question 36(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Correctly states a valid hypothesis</li> </ul>	1

*Answer may include:* Microorganisms can be transferred into hosts via food and water.

**Question 36(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Identifies TWO hazards and describes practice to minimise the risk of EACH</li> </ul>	2
<ul style="list-style-type: none"> <li>Identifies TWO hazards and describes practice to minimise the risk of ONE</li> </ul> OR	1
<ul style="list-style-type: none"> <li>Identifies ONE hazard and describes practice to minimise the risk</li> </ul>	

*Answer may include:* Eye injury due to heating inoculation loop in Bunsen flame; use of safety glasses protects against airborne particles. Infection transfer of pathogenic material; incubation of agar plates at 30°C reduces growth of human pathogenic organisms.

**Question 36(c)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Describes an appropriate method of data collection</li> <li>Provides rationale to relevance and accuracy of data collected</li> </ul>	2
<ul style="list-style-type: none"> <li>Identifies an appropriate method of data collection</li> </ul>	1

*Answer may include:* Clear mm grid sheets were used to collect data. By counting then calculating the area of the agar plate covered by colonies, this produces a quantitative estimate of the number and types of microorganisms present in the food and water samples tested. This provides an accurate measurement that can be used to compare samples.

**Question 37(a)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Describes the cause of a NAMED non-infectious disease and outlines the effects of the disease</li> </ul>	2
<ul style="list-style-type: none"> <li>Describes the cause of a named non-infectious disease</li> </ul> OR <ul style="list-style-type: none"> <li>Outlines the effects of the disease</li> </ul>	1

*Answer may include:* Osteoporosis is severe loss of bone density that results from a combination of insufficient calcium intake, particularly in the first few decades of life and lack of weight-bearing exercise. A lack of calcium in the diet results in low calcium levels in the blood. Calcium will be absorbed from bone tissue to boost blood calcium levels, but this means that bone density is compromised. Osteoporosis makes a person prone to fractures (particularly of the hip), which limit mobility and can lead to chronic pain. A loss of height and physical function can occur. These all impact on a person's quality of life and reduce their life expectancy.

**Question 37(b)**

Criteria	Mark
<ul style="list-style-type: none"> <li>Describes AT LEAST ONE specific treatment/management option</li> <li>Identifies the advantages and limitations of this treatment/management option</li> </ul>	2
<ul style="list-style-type: none"> <li>Describes AT LEAST ONE treatment/management option</li> </ul>	1

*Answer may include:* Some medications for osteoporosis have a limited ability to restore some bone density, but the main focus of treatment/management is on preventing further bone density loss in people identified as having a low bone density T-score and people who have already sustained a bone-density related fracture. Medication such as Bisphosphonate tablets are given daily to inhibit bone resorption, but these must be taken in tandem with the patient maintaining appropriate calcium, vitamin D and exercise levels to be most effective.

**Question 38**

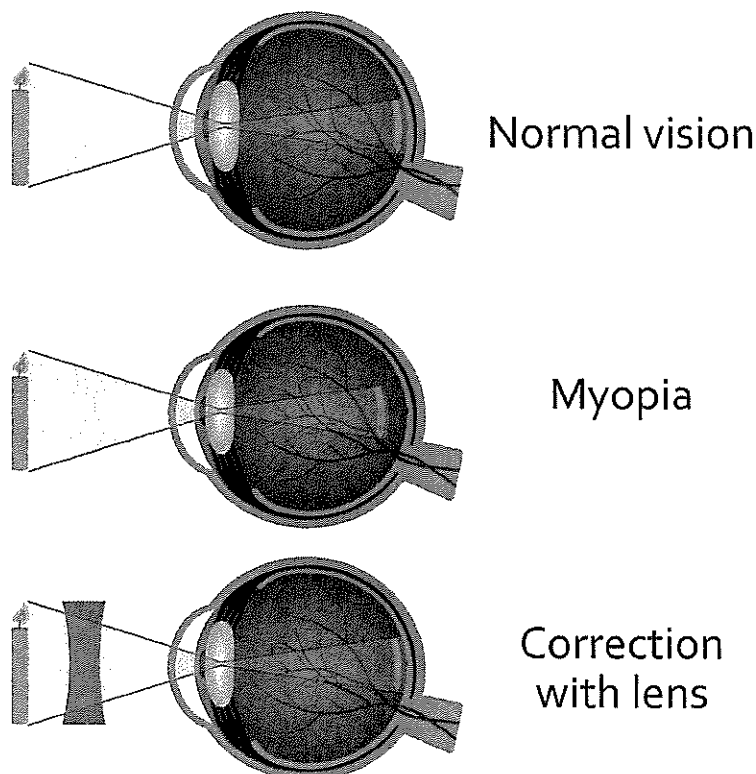
Criteria	Mark
<ul style="list-style-type: none"> <li>Shows thorough understanding of the causes of a NAMED disorder and its effect upon the human body</li> <li>Shows thorough understanding of the technologies available to manage the effect of a NAMED disorder</li> <li>Provides a detailed assessment of the technology implemented on its effectiveness to manage this disorder</li> </ul>	7
<ul style="list-style-type: none"> <li>Shows sound understanding of the causes of a NAMED disorder and its effect upon the human body</li> <li>Shows sound understanding of the technologies available to manage the effect of a NAMED disorder</li> <li>Provides an assessment of the technological implemented on its effectiveness to manage this disorder</li> </ul>	5–6
<ul style="list-style-type: none"> <li>Outlines some features of a disorder and its effect upon the human body</li> </ul> AND/OR <ul style="list-style-type: none"> <li>Outlines some technologies available to manage a disorder</li> </ul>	3–4
<ul style="list-style-type: none"> <li>Identifies some features of disorders that affect the human body</li> </ul> AND/OR <ul style="list-style-type: none"> <li>Identifies some technologies available to manage disorders</li> </ul>	1–2

*Question 38 continues on the next page*

*Question 38 continued*

*Answer may include:* Short sightedness/myopia is a condition where light entering a person's eye does not focus properly on the retina, leaving a person's vision of distant objects blurred. To see, light reflects off objects and refracts through the cornea, aqueous humour, biconvex lens and vitreous humour of the eye, landing (upside down) on the retina. The retina contains photoreceptor cells that, when stimulated by light, send messages to the brain via the optic nerve so that the brain can process what the eye sees.

The thickness of the biconvex lens of the eye is adjusted to increase or decrease its refractive power, allowing objects of different distances to be seen clearly. In a person with myopia, the eyeball is elongated OR the lens is unable to adjust itself to the right thickness. The effect of this is that light from far away objects is not able to be focused onto the retina, focusing in front of it instead. This results in an inability to see distant objects clearly.



Contact lenses and glasses can both be used to correct myopia. Glasses and contact lenses involve placing a concave lens in front of the eye. A concave lens refracts light rays outwards, changing the angle at which they pass through a person's eye, so that as the light is refracted through the eye, it focuses correctly on the retina. The concave lens helps to overcome the elongated shape of the eyeball or the inability of the lens to achieve the necessary thickness.

Some benefits of using these technologies are that they are generally painless (contact lenses can become uncomfortable) and effectively allow the person with myopia to achieve a more normal vision of distant objects. Both of these technologies can be tailored to the specific vision needs of each person and each eye (as a person may have different vision issues in each eye). They can also be adjusted throughout a person's lifetime to suit their changing vision needs.

An obvious limitation of these technologies is that they do not correct the problem and their use will need to be ongoing, which will involve ongoing cost to the person. Contact lenses also carry a risk of infection of the eye if proper hygiene is not maintained when handling the lenses and the lenses are not cleaned properly. Both of these technologies are extremely important for people with myopia because they allow them to participate more fully and independently in society. If these were not available to correct myopia, people may be limited in their ability to read, recognise people (e.g. find people in a crowd), drive, spot potential dangers and play sport.

**NSW INDEPENDENT TRIAL EXAMS – 2019**  
**BIOLOGY TRIAL HSC EXAMINATION**  
**MAPPING GRID**

Question	Marks	Content	Syllabus outcomes	Target performance bands
<b>Section I</b>				
1	1	Mod 7 Causes of Infectious Disease 1	BIO12-14	1-2
2	1	Mod 8 Causes and Effects 2	BIO12-6, BIO12-15	1-2
3	1	Mod 8 Causes and Effects 2	BIO12-6, BIO12-15	1-2
4	1	Mod 6 Genetic Technologies 2	BIO12-13	2-3
5	1	Mod 5 DNA and Polypeptide Synthesis 3	BIO12-6, BIO12-12	2-3
6	1	Mod 5 Reproduction 1	BIO12-12	2-4
7	1	Mod 8 Homeostasis 2	BIO12-15	2-3
8	1	Mod 5 Reproduction 2	BIO12-12	2-4
9	1	Mod 7 Immunity 1	BIO12-14	2-3
10	1	Mod 7 Immunity 1	BIO12-14	3-5
11	1	Mod 6 Biotechnology	BIO12-13	2-3
12	1	Mod 7 Response to Pathogens 2	BIO12-14	3-4
13	1	Mod 6 Mutation 5	BIO12-5, BIO12-13	3-4
14	1	Mod 5 Genetic Variation 1	BIO12-12	3-5
15	1	Mod 8 Epidemiology 2	BIO12-5, BIO12-15	4-5
16	1	Mod 7 Causes of Infectious Disease 2	BIO12-2, BIO12-15	4-5
17	1	Mod 5 Reproduction 3	BIO12-3, BIO12-12	4-6
18	1	Mod 8 Epidemiology 3	BIO12-15	4-6
19	1	Mod 5 DNA and Polypeptide Synthesis 1	BIO12-12	5-6
20	1	Mod 7 Causes of Infectious Disease 1	BIO12-2, BIO12-12	5-6

**NSW INDEPENDENT TRIAL EXAMS – 2019**  
**BIOLOGY TRIAL HSC EXAMINATION**  
**MAPPING GRID - cont'd**

<b>Section II</b>				
<b>Question</b>	<b>Marks</b>	<b>Content</b>	<b>Syllabus outcomes</b>	<b>Target performance bands</b>
<b>21(a)</b>	1	Mod 5 Reproduction 1	BIO12-12	2-3
<b>21(b)</b>	2	Mod 5 Reproduction 1	BIO12-12	2-3
<b>22(a)</b>	2	Mod 6 Biotechnology	BIO12-13	3-5
<b>22(b)</b>	1	Mod 6 Biotechnology	BIO12-13	2-3
<b>22(c)</b>	1	Mod 6 Biotechnology	BIO12-13	2-3
<b>23(a)</b>	2	Mod 6 Mutation 6	BIO12-13	3-4
<b>23(b)</b>	2	Mod 6 Mutation 6	BIO12-13	3-4
<b>24(a)</b>	1	Mod 5 DNA and Polypeptide Synthesis 2	BIO12-2, BIO12-5, BIO12-12	2-3
<b>24(b)</b>	2	Mod 5 DNA and Polypeptide Synthesis 2	BIO12-2, BIO12-5, BIO12-12	3-6
<b>25(a)</b>	1	Mod 6 Mutation 1	BIO12-13	2-4
<b>25(b)</b>	2	Mod 6 Mutation 1	BIO12-7, BIO12-13	2-4
<b>26(a)</b>	3	Mod 5 Cell Replication 1	BIO12-5, BIO12-5, BIO12-12	2-5
<b>26(b)</b>	3	Mod 5 Cell Replication 1	BIO12-5, BIO12-5, BIO12-12	2-5
<b>27(a)</b>	1	Mod 5 Genetic Variation 2	BIO12-6, BIO12-7, BIO12-12	2-3
<b>27(b)</b>	2	Mod 5 Genetic Variation 2	BIO12-6, BIO12-7, BIO12-12	3-5
<b>27(c)</b>	3	Mod 5 Genetic Variation 2	BIO12-6, BIO12-7, BIO12-12	3-6
<b>28(a)</b>	1	Mod 6 Mutation 2	BIO12-5, BIO12-6, BIO12-13	3-5
<b>28(b)</b>	4	Mod 6 Mutation 2	BIO12-5, BIO12-6, BIO12-13	4-6
<b>29</b>	8	Mod 6 Genetic Technologies 1 Mod 6 Genetic Technologies 4 Mod 6 Genetic Technologies 5	BIO12-4, BIO12-6, BIO12-13	4-6
<b>30</b>	3	Mod 7 Causes of Infectious Disease 1	BIO12-14	2-3
<b>31</b>	3	Mod 8 Homeostasis 1 Mod 8 Homeostasis 2	BIO12-7, BIO12-15	3-5
<b>32(a)(i)</b>	1	Mod 8 Epidemiology 1	BIO12-4, BIO12-15	2-3
<b>32(a)(ii)</b>	1	Mod 8 Epidemiology 1	BIO12-4, BIO12-15	2-3
<b>32(b)</b>	2	Mod 8 Epidemiology 4	BIO12-6, BIO12-15	2-4



**NSW INDEPENDENT TRIAL EXAMS – 2019**  
**BIOLOGY TRIAL HSC EXAMINATION**  
**MAPPING GRID - cont'd**

<b>Question</b>	<b>Marks</b>	<b>Content</b>	<b>Syllabus outcomes</b>	<b>Target performance bands</b>
<b>33</b>	3	Mod 7 Immunity 1 Mod 7 Immunity 2	BIO12-4, BIO12-7, BIO12-14	3-5
<b>34(a)</b>	1	Mod 6 Mutation 3 Mod 7 Immunity 2	BIO12-14, BIO12-15	2-3
<b>34(b)</b>	3	Mod 6 Mutation 3 Mod 7 Immunity 2	BIO12-5, BIO12-14, BIO12-15	4-5
<b>35</b>	5	Mod 7 Prevention, Treatment and Control 2 Mod 7 Prevention, Treatment and Control 3	BIO12-5, BIO12-6, BIO12-14	2-6
<b>36(a)</b>	1	Mod 7 Causes of Infectious Disease 1	BIO12-1, BIO12-14	2-4
<b>36(b)</b>	2	Mod 7 Causes of Infectious Disease 1	BIO12-2, BIO12-4, BIO12-14	2-4
<b>36(c)</b>	2	Mod 7 Causes of Infectious Disease 1	BIO12-2, BIO12-4, BIO12-14	3-5
<b>37(a)</b>	2	Mod 8 Causes and Effects 1	BIO12-15	3-5
<b>37(b)</b>	2	Mod 8 Epidemiology 2	BIO12-15	3-4
<b>38</b>	7	Mod 8 Technologies and Disorders 1 Mod 8 Technologies and Disorders 2 Mod 8 Technologies and Disorders 3	BIO12-4, BIO12-7, BIO12-15,	4-6