

Student Number



Pymble Ladies' College

2022 HIGHER SCHOOL CERTIFICATE
TRIAL EXAMINATION

BIOLOGY

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Board-approved calculators may be used

Total marks – 100

This paper has two parts, Part A and Part B

Part A – 20 marks

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

Part B – 80 marks

- Attempt Questions 21–32
- Allow about 2 hours and 25 minutes for this part

Part A – 20 marks

Attempt Questions 1–20

Allow about 35 minutes for this part

Use the separate multiple-choice answer sheet for Questions 1–20.

1. Prions and viruses are both non-cellular pathogens.

Which row of the table correctly identifies the characteristics of viruses and prions?

	Prion	Virus
(A)	eukaryotic	prokaryotic
(B)	chain of amino acids that has folded into an incorrect form	chain of nucleotides
(C)	chain of polypeptides folded correctly	bases that have folded incorrectly
(D)	macroscopic	microscopic

2. Robert Koch developed postulates for disease.

Which of the following statements best describes the purpose of Koch's postulates?

- (A) The microorganism that causes a specific disease can be identified.
- (B) Healthy organisms can become sick when infected with a microorganism.
- (C) Microbes from the air were wrapped in glass tubing during Koch's famous experiments.
- (D) Cultures of a disease-causing pathogen can always be grown from samples of unhealthy animals.

3. What are the features of passive immunity?

- (A) A long-term effective period, memory cells and antibodies produced.
- (B) A short-term effective period, memory cells and antibodies produced.
- (C) A long-term effective period, no memory cells and no antibodies produced.
- (D) A short-term effective period, no memory cells and no antibodies produced.

4. Which response identifies two chemical barriers to the transmission of pathogens?

- (A) Skin and urine.
- (B) Stomach acid and tears.
- (C) Mucus and white blood cells.
- (D) Stomach acid and cilia in the respiratory tract.

5. Bush medicine is an exciting area of disease treatment because:
- (A) There is little risk when using native plants.
 - (B) Intellectual property is not a consideration when exploiting these plants.
 - (C) There is little need for rigorous scientific testing before their use in patients.
 - (D) Some properties of plants may be useful in managing modern infectious diseases.
6. A germ-line mutation is one which:
- (A) affects sex cells.
 - (B) affects somatic cells.
 - (C) is acquired from a virus.
 - (D) changes the virulence of a pathogen.
7. In order to investigate the microbes present in a range of water samples, a group of students carried out the following procedure:
1. 12 identical agar plates were made in sterile petri dishes.
 2. Samples of tap water, rain water and dam water were collected.
 3. 3 agar plates were sealed.
 4. An inoculation loop was heated in a Bunsen Burner flame, cooled, inserted into the tap water sample then swiped over the surface of one of the remaining agar plates.
 5. The agar plate was then sealed.
 6. Steps 4-5 were repeated twice
 7. Steps 4-6 were repeated with the rain water sample and then the dam water sample.
 8. All plates were incubated for 3 days at 35⁰C.
 9. Each plate was observed, and the number, appearance, size and shape of each colony was recorded.
 10. The agar plates were heated and then disposed of.

Which response correctly identifies the purpose of the step outlined?

- (A) Step 1 is important for ensuring validity.
 - (B) Step 4 is important for ensuring reliability.
 - (C) Step 3 is important for ensuring variables are controlled.
 - (D) Step 8 is important for ensuring a safe working environment.
8. Rickets is a disease that is caused by a mutation on the X chromosome. It can be passed on to offspring.

What type of disease is rickets?

- (A) Cancer.
- (B) Genetic.
- (C) Nutritional.
- (D) Environmental.

9. External fertilisation:

- (A) mainly occurs in terrestrial animals.
- (B) only occurs in aquatic environments.
- (C) involves a small number of female gametes produced.
- (D) involves a great deal of parental care for subsequent offspring.

10. Consider the following definition.

It makes up over 90% of the human genome, most of it lies between genes on the chromosomes and it has few known functions.

Which of the following is referred to by the definition?

- (A) Coding DNA
- (B) Autosomal DNA
- (C) Non-coding DNA
- (D) Messenger RNA (mRNA)

11. Endotherms possess adaptations to maintain their body temperature within tolerable limits. Adaptations can be behavioural, structural and physiological.

The following are adaptations of endotherms to a hot environment.

- i. Counter-current heat exchange to increase heat loss from extremities
- ii. Decreased metabolic rate to reduce the amount of heat produced
- iii. Vasodilation of blood vessels to increase heat loss by radiation
- iv. Sweating to increase heat lost from skin
- v. Move into the shade

Which of the following responses correctly classifies the type of adaptation shown by the options identified?

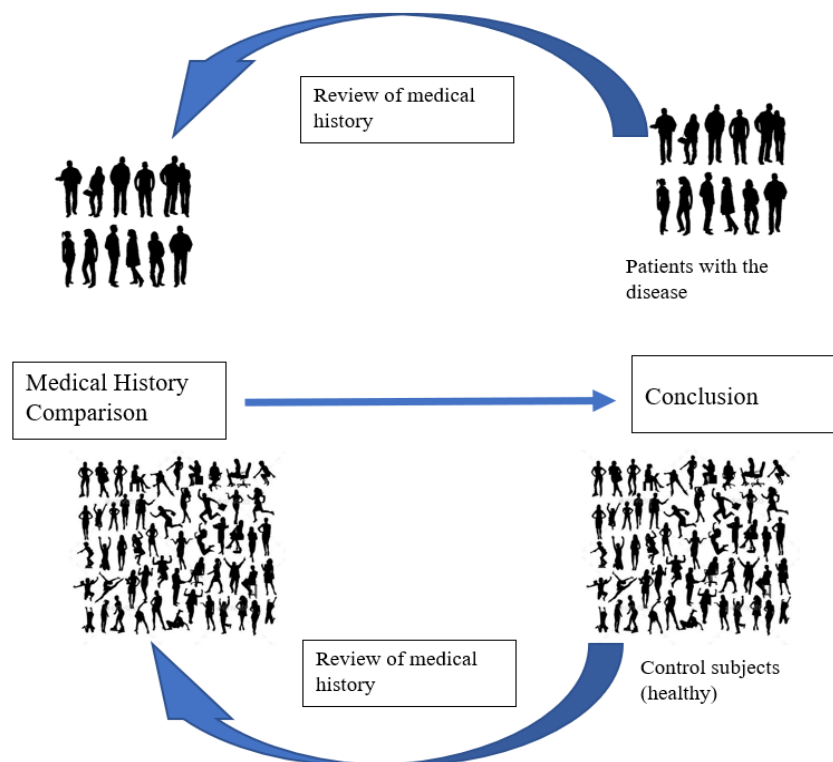
	Adaptation	Type of Adaptation
(A)	ii, iii, iv	Physiological
(B)	ii, iv, v	Behavioural
(C)	ii, iv	Structural
(D)	i, v	Physiological

12. Governments invest in education programs to reduce the incidence of childhood obesity, as a rise in childhood obesity has been linked to higher rates of type 2 diabetes in children.

The purpose of these education programs is to:

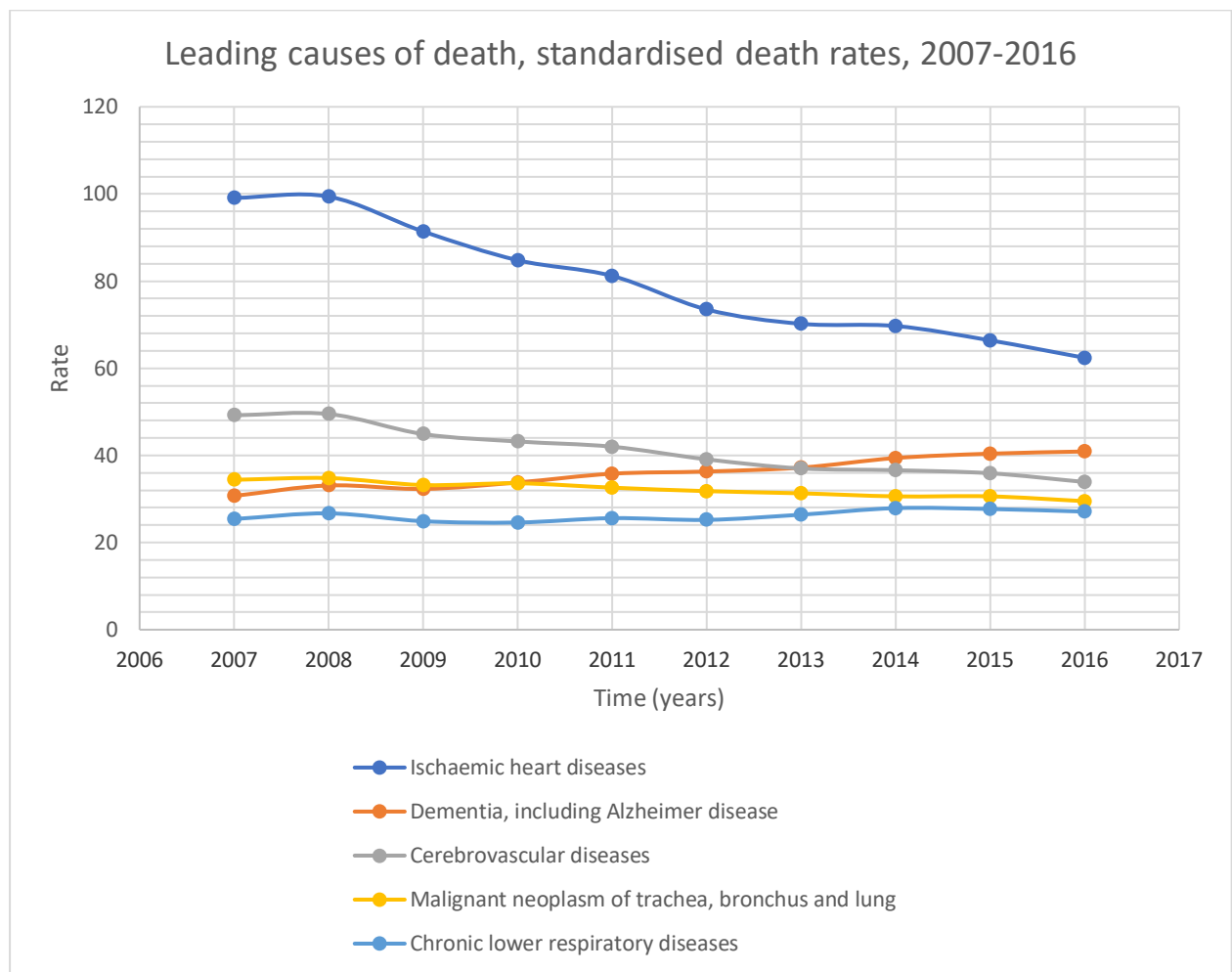
- (A) Prevent the occurrence of obesity.
- (B) Cure children with type 2 diabetes.
- (C) Make children aware of the treatments for diabetes.
- (D) Prevent discrimination against children who are overweight or obese.

13. The diagram below represents which of the following types of epidemiological studies?



- (A) Cohort study.
- (B) Descriptive study.
- (C) Intervention study.
- (D) Case-control study.

The following graph shows the leading causes of death in Australia between 2007 and 2016. Use this graph to answer Q14 and Q15.



14. What is the death rate per 100,000 population for Ischaemic heart diseases in 2016?
- (A) 30
(B) 34
(C) 40
(D) 62
15. Which of the following is the best description of the trend shown on the graph for the death rate per 100,000 from 2007-2016 for cerebrovascular diseases?
- (A) Decreases from 50 per 100,000 in 2007 to 35 per 100,000 in 2016.
(B) Shows a very gradual decrease from 34 per 100,000 in 2007 to 30 per 100,000 in 2016.
(C) Remains constant at 50 per 100,000 in 2007 and 2008, after which it decreases at a generally constant rate until it reaches 35 per 100,000 in 2016.
(D) Remains constant at 100 per 100,000 in 2007 and 2008, after which it decreases at a generally constant rate until it reaches 62 per 100,000 in 2016.

16. The Australian Budgerigar is a small Australian parrot which has 26 chromosomes in a general body cell. One easy way for the vet to determine a bird's gender is to analyse the bird's DNA using a PCR-based test. This test identifies a bird's gender based on its chromosome pair (ZW in females and ZZ in males).

What is the total number of autosomes that occur in a general body cell in a female budgerigar?

- (A) 13
- (B) 24
- (C) 26
- (D) 52

17. The table shows the changes in the human body when an individual begins exercising.

Internal coordination systems in response to breathing				
Rate of cellular respiration	Concentration of carbon dioxide in the blood	Concentration of oxygen in the blood	pH of blood	Rate of breathing
increase	increase	decrease	decrease	increase

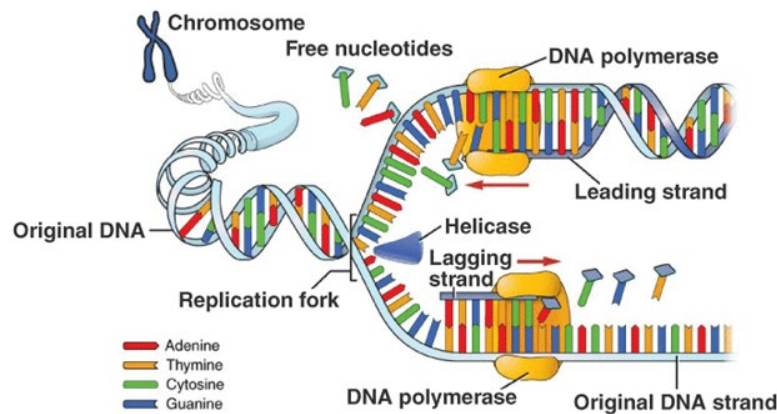
The following steps are processes in the stimulus response pathway.

- I Nerves send a signal to an effector.
- II Chemoreceptors detect a decrease in blood pH.
- III Nerves send a signal about lower blood pH to the brain.
- IV Muscles in the pulmonary system (diaphragm) contract and relax at a faster rate, returning oxygen and carbon dioxide to optimum levels.

What is the correct order of steps to explain the changes in the human body when an individual begins exercising?

- (A) II, IV, I, III.
- (B) I, II, III, IV.
- (C) II, III, I, IV.
- (D) II, I, IV, III.

18. Which of the following describes DNA polymerase.



An enzyme that:

- (A) splices DNA at specific recognition sites.
- (B) adds nucleotides to a newly forming DNA strand.
- (C) joins together fragments of newly synthesised DNA.
- (D) uncoils DNA by breaking the hydrogen bond between base pairs.

19. Which of the following is an example of how the environment might affect the expression of a gene in an individual?

- (A) Many people with red hair also have freckles and green eyes.
- (B) Identical twins brought up in different areas show many physical similarities.
- (C) Black fur develops under a cold pack placed on the white fur of a Himalayan rabbit.
- (D) Homozygous snapdragon plants have red or white flowers, but hybrids have pink flowers.

20. Which of the following correctly identifies the reproduction methods of the different organisms?

	Fungi	Bacteria	Protists
(A)	Budding and spores	Binary fission only	Binary fission
(B)	Spores only	Binary fission only	Binary fission and budding
(C)	Binary fission only	Spores only	Budding and spores
(D)	Binary fission and budding	Budding and spores	Spores only

Part B – 80 marks

Attempt Questions 21–32

Allow about 2 hours and 25 minutes for this part

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

Question 21 (7 marks)

Proteins are the most abundant organic compound in organisms, formed through the process of polypeptide synthesis.

- a) Describe the process of translation in polypeptide synthesis. 3

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- b) Justify this statement using TWO specific named examples of proteins you have studied in this subject. 4

“It is essential that the correct proteins are synthesised to maintain structure and function in the human body.”

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Question 22 (8 marks)

Huntington's Disease (HD) is an autosomal genetic condition.

Matt and his wife Ella do not have the disease but are concerned that their daughter Leah may be affected. Both of Matt's parents and his brother Bill all have Huntington's disease.

- a) Using the information provided, draw a pedigree for this family in the space below. **3**

- b) Determine whether Huntington's disease is caused by a dominant or recessive allele. Justify your answer using the pedigree. **2**

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- c) Bill is heterozygous and marries a woman who does not have Huntington's disease. Use a punnett square to determine the genotypic ratio of any future children they may have. **3**

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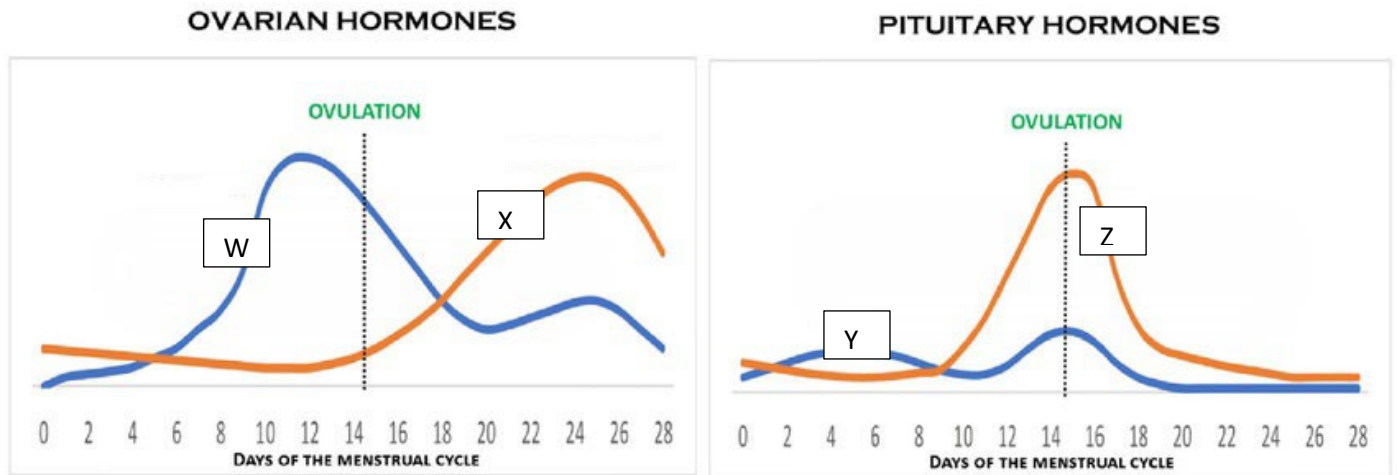
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Question 23 (4 marks)

Diagram 1 shows the levels of two hormones released from the ovaries and two hormones released from the pituitary gland over a menstrual cycle.

Diagram 1



- a) Identify ONE of the hormones W, X, Y or Z and explain the changes in levels of this hormone over the menstrual cycle. 3

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Diagram 2 shows the menstrual cycle of a woman during the month of January.

Diagram 2

Menstruation
 Ovulation

2022 JANUARY						
SUN	MON	TUE	WED	THU	FRI	SAT
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

- b) Using the graphs in Diagram 1, state which date in January her oestrogen levels will be at their highest? 1

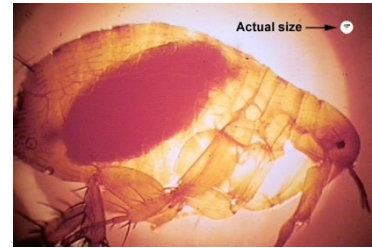
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Question 24 (3 marks)

*“Ring a ring o’ roses
A pocket full of posies.
Atishoo! Atishoo!
We all fall down.”*



Medieval pomander



Rat flea showing dark mass of bacteria in gut

This children’s rhyme originated as a description of the Black Death, the plague that killed some 40% of the population during the 14th century. The ‘pocket full of posies’ refers to the pomanders of sweet smelling herbs that people carried or wore around their neck to ward off the bad air that they believed caused the disease. We now know that the plague is caused by the bacterium *Yersinia pestis* carried in the gut of biting fleas on rodents (primarily rats).

With reference to the information above and your knowledge of disease transmission, evaluate the effectiveness of the pomander in controlling this plague.

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Question 25 (8 marks)

Varroa mites (*Varroa destructor* and *Varroa jacobsoni*) are parasites that feed on adult honey bees and their larvae. They weaken and kill honey bee colonies and can also transmit honey bee viruses such as deformed wing virus which affects bees' ability to fly.



Varroa mites were detected in biosecurity surveillance hives in Newcastle in late June 2022 and in hives on the Central Coast of NSW within a few days of this finding. The pest affects every other major beekeeping area in the world. Concerns have been raised about it becoming established in Australia.

- a) Outline TWO methods that could be used to prevent the spread of varroa mite within Australia. 3

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- b) Assess the potential impacts of the varroa mite on agricultural production in Australia. 5

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Question 26 (9 marks)

Monkeypox is a rare disease caused by infection with the monkeypox virus. Monkeypox virus belongs to the *Orthopoxvirus* genus. The *Orthopoxvirus* genus also includes variola virus (which causes smallpox), vaccinia virus (used in the smallpox vaccine), and cowpox virus. Monkeypox is not related to chickenpox.

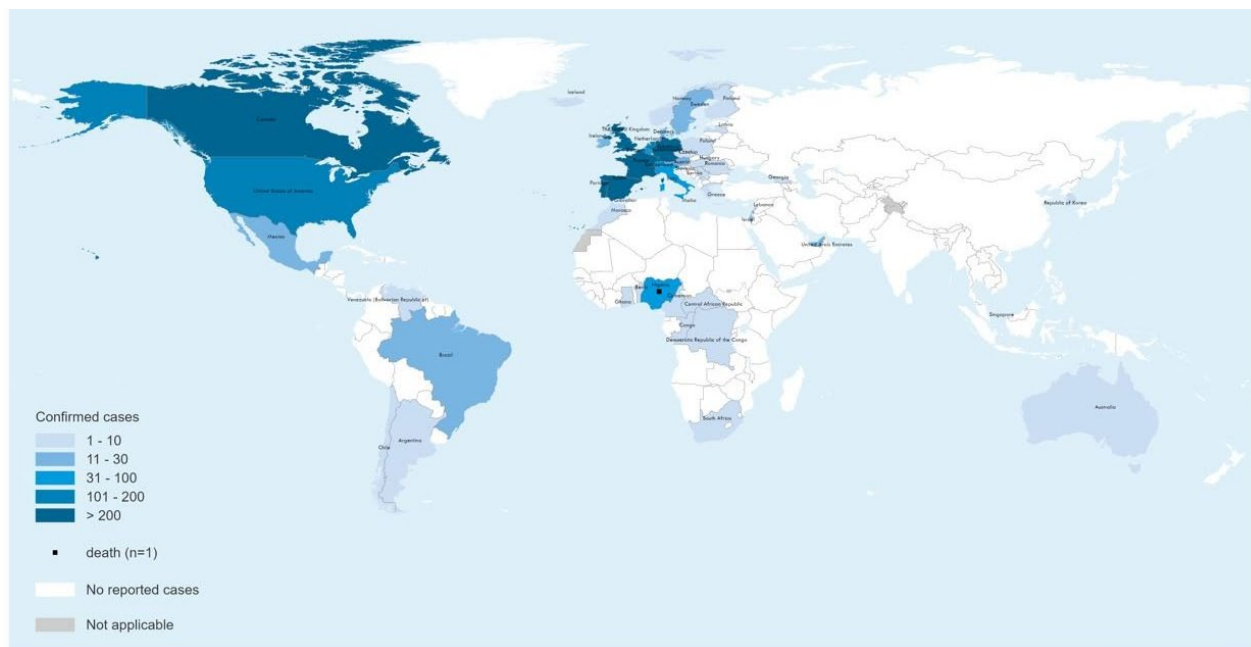
Multi-country monkeypox outbreak: situation update from the World Health Organisation (WHO)

27 June 2022 <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON396U>

This Disease Outbreak News on the current monkeypox outbreak is an update to the previously published editions. It is based on outcomes of the International Health Regulations Emergency Committee regarding the multi-country monkeypox outbreak held on 23 June.

Outbreak at a glance: Since 1 January and as of 22 June 2022, 3413 laboratory confirmed cases and one death have been reported to WHO from 50 countries/territories in five WHO Regions. In the period 17 June to 22 June, 1310 new cases have been reported and eight new countries have reported cases. The majority of laboratory confirmed cases (86%) were reported from the WHO European Region.

The figure below shows the Geographic distribution of confirmed cases of monkeypox reported to or identified by WHO from official public sources, 1 January to 22 June 2022



The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: WHO Health Emergencies Programme
Map Date: 27 June 2022

 **World Health Organization**
© WHO 2022. All rights reserved.

a) Evaluate the validity and accuracy of the data provided in the article.

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- b) Tecorivimat is an antiviral drug with recent regulatory approval from the European Medicines Agency for orthopoxvirus-associated infections, including monkeypox. Describe how this drug may be helpful in treating patients with monkeypox. **2**

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- c) Vaccines made from the variola and vaccinia viruses are also effective against monkeypox virus. Explain how these vaccines provide immunity against this disease. **3**

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Question 27 (10 marks)

You are an ophthalmologist (eye specialist) who has had a visit from a 25-year-old patient. She is an avid netball player and reader. She is having trouble viewing text on her laptop and in books, describing the letters as looking blurry.

- a) Identify the condition she has and describe the causes.

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- b) In a table, discuss the TWO best treatment options available to this patient that will assist with this vision impairment.

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Question 28 (3 marks)

Read the information in the story board below.



Identify the process occurring in the storyboard and describe the effect on the future gene pool of the new seal population.

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Question 29 (8 marks)

A link between high levels of cholesterol in the blood and coronary heart disease has long been recognised by doctors. The Scandinavian Simvastatin Survival Study followed a group of 4444 people with high levels of blood cholesterol who were all on cholesterol lowering diets. The patients were randomly divided into two equal sized groups. One group was treated with a medication containing the cholesterol lowering drug *Simvastatin*, while the other received a placebo – an identical tablet, but without *Simvastatin*. Patients were not aware of which group they were in. The health of the patients was then closely monitored, and the table below shows some of the data obtained after six years.

	Simvastatin Group (SG) (2222 patients)	Placebo Group (PG) (2222 patients)
Patients who had 1 or more major cardiac events	431 (19%)	622 (28%)
Patients who died from cardiac arrest (heart attack)	111 (5%)	189 (8.5%)
Patients who died from non-cardio causes	46 (2%)	49 (2.2%)

Information taken from: Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). Lancet. 1994 Nov 19;344(8934):1383-9. PMID: 7968073.

a) Outline why a placebo group is necessary.

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b) Analyse the results shown in the table.

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One factor which can affect blood cholesterol levels is heredity. The PCSK9 gene found on chromosome 1 codes for a polypeptide which plays a role in the regulation of blood cholesterol levels by cells in the liver. Some alleles of this gene lead to higher blood cholesterol levels and others can lead to lower levels. People with the C679X allele of the gene have much lower cholesterol levels.

The C679X allele is found almost exclusively in African populations. The allele frequency has been found to vary from 0% to 6.9% in populations across West Africa.

- c) Explain TWO processes which may have contributed to the rise of the C679X allele frequency in the Europe gene pool over the last 50 years. 4

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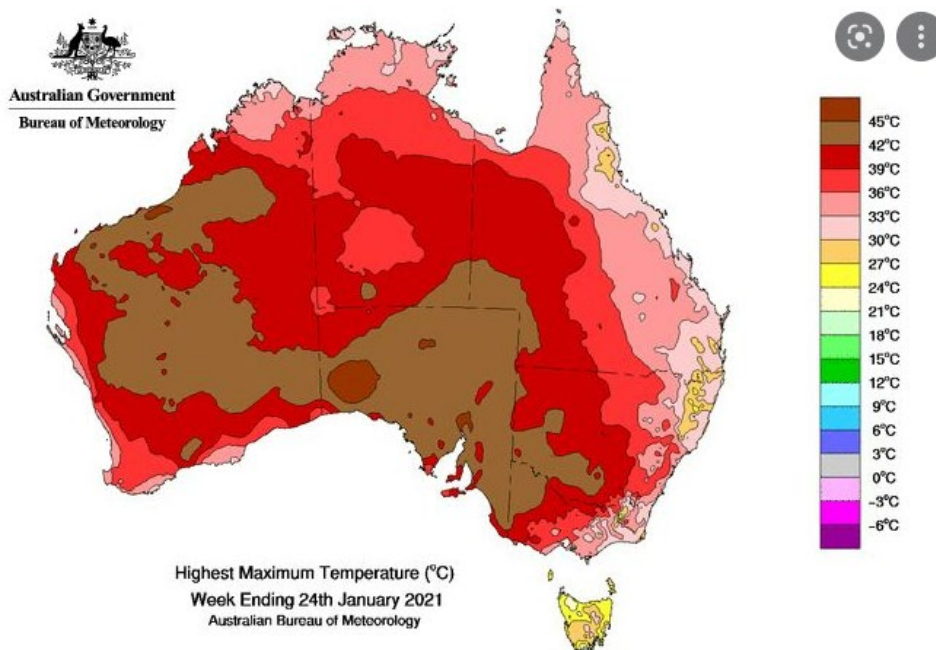
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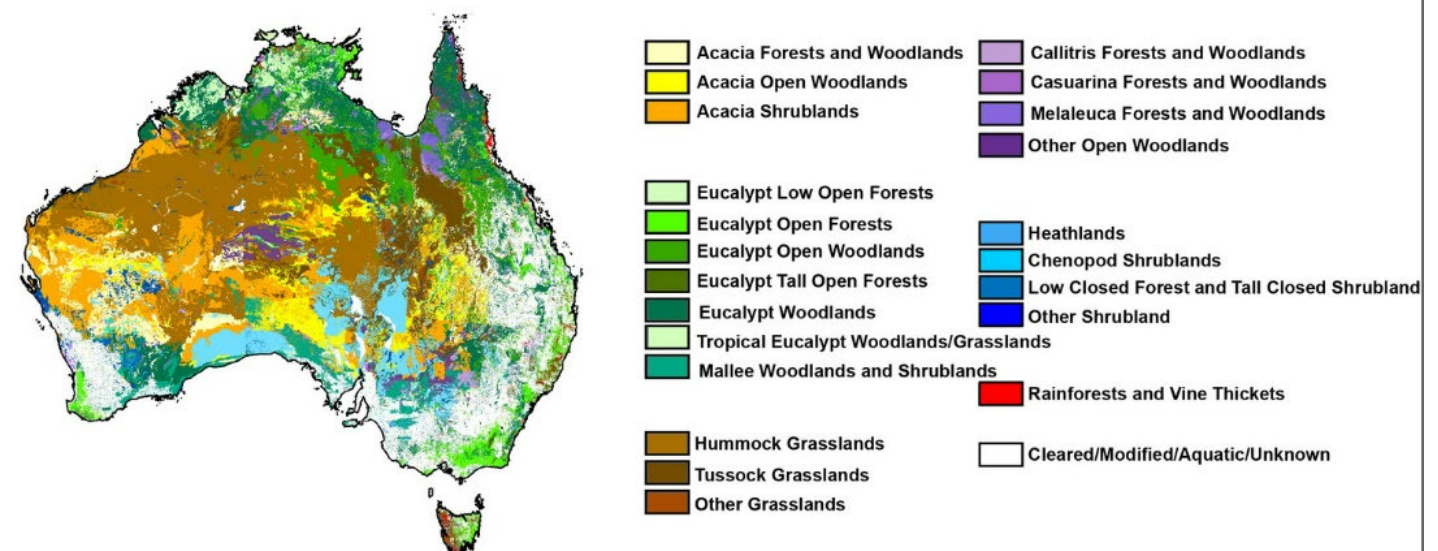
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Question 30 (5 marks)

Plant species in Australia have adaptations designed to maintain water balance in hot dry conditions. Below are two maps produced in January 2021. Map 1 shows the highest maximum temperature and Map 2 shows the distribution of the major vegetation groups.



Map 1: www.bom.com.au



Map 2: <https://onlinelibrary.wiley.com/doi/full/10.1111/ddi.13265>

With reference to the maps, explain how adaptations of Australian plants enable them to survive these hot dry conditions.

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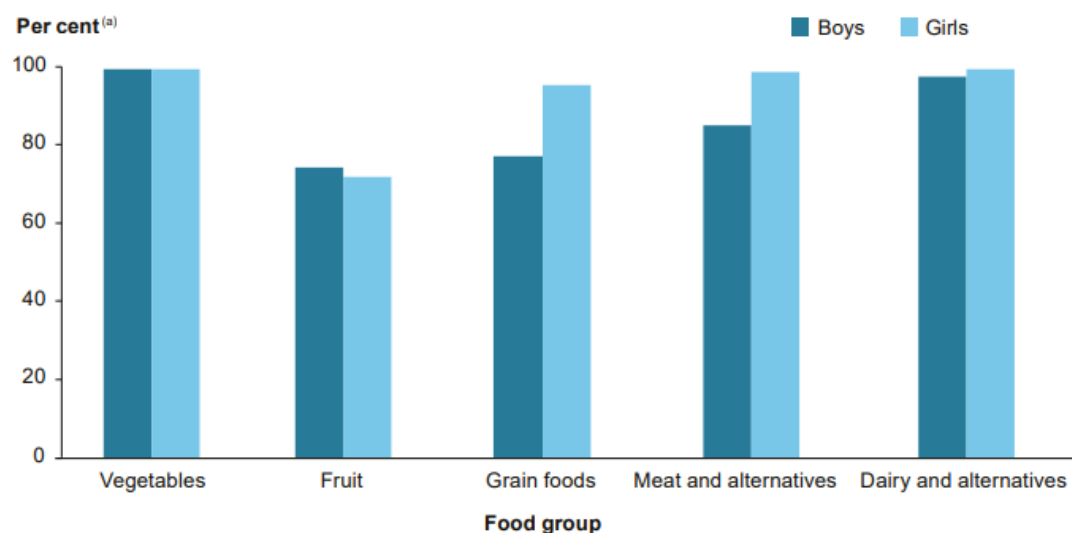
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Question 31 (7 marks)

The Australian Institute of Health and Welfare investigated the adequacy of the Australian diet across various life stages to help inform their understanding of nutrition-related health determinants for chronic conditions. The following two graphs were published in their 2018 report. ADGs refers to the Australian Dietary Guidelines.

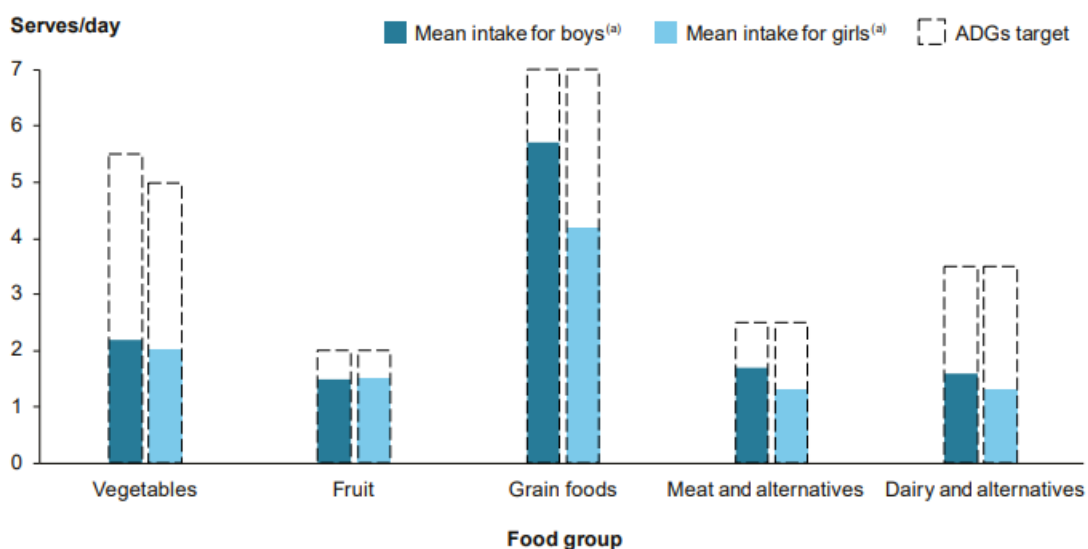
Figure 5.32: Proportion of the population with food group intakes below the recommended serves, by sex, aged 14–18, 2011–12



(a) Based on usual intakes (see Appendix A) and includes non-discretionary foods only.

Source: ABS 2016d; Table S5.

Figure 5.31: Mean intake of food groups compared with the ADGs target, by sex, aged 14–18, 2011–12



(a) Based on intake from Day 1 (see Appendix A) and includes non-discretionary foods only.

Source: AIHW analysis of ABS 2013d; Table S5.

a) Are diseases caused from incorrect nutrition termed infectious or non-infectious? Why? **1**

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b) Draw ONE conclusion from the graphs provided and justify using data. **3**

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c) To obtain the data for these graphs an epidemiological study would have been undertaken. Describe the features of a study that could have produced the data above. **3**

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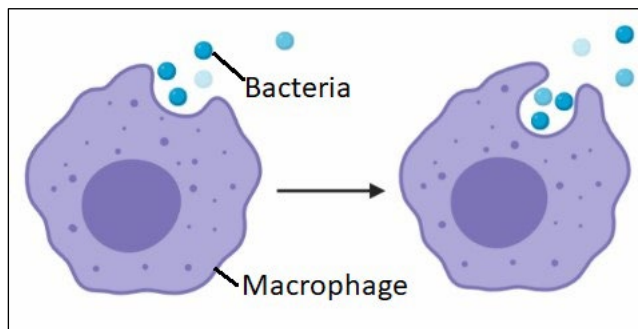
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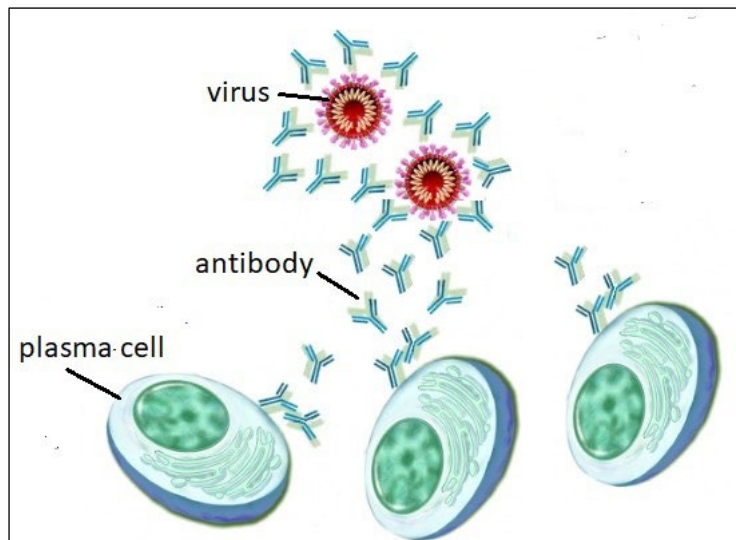
Question 32 (8 marks)

Below are two models that each represent a different aspect of the immune response in humans.

Model 1



Model 2



Describe both processes and assess the effectiveness of each model in representing the process.

8

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no margins, text, or other markings.

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Pymble Ladies' College

Student Number

2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

BIOLOGY

ANSWER SHEET

General Instructions

- Write your Student Number at the top of this page.
- Answer ALL multiple choice questions on this Answer Sheet.
- Use a pencil to fill in the circle indicating your answer.

PART A

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

Yr 12 Biology 2021 Task 4 – Trial Marking Guidelines with Markers Comments

Catch up paper in Red

Part A – Multiple Choice

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	A	D	B	D	A	A	B	B	C	A	A	D	D	C	B	C	B	C	A
C	A	B	D	D	B	A	D	B	C	A	D	A	D	C	B	C	B	C	A

Part B

	Marking Guidelines		Sample Answer	Markers Comments
21a	Describes translation process including the action of mRNA, tRNA on ribosome and joining of amino acids to form a polypeptide	3	Translation takes place at the ribosome in the cytoplasm. mRNA moves through the ribosome. Amino acids are carried to the ribosome by tRNA. tRNA anticodon match with mRNA codon so the amino acids are placed in the correct order and they join with peptide bonds. Once a stop codon is reached, the polypeptide is released.	Mostly answered well.
	Outlines translation process including the action of mRNA, tRNA on ribosome and joining of amino acids to form a polypeptide	2		No need to mention codon on mRNA and anti-codon on tRNA specifically but need to state their matching pairs/complementary with each other.
	Any relevant information	1		Chain of amino acids to make a polypeptide chain. 1 mark deducted if did not state chain of amino acids or amino acids joining to form a polypeptide
				Do not mix up with other processes like DNA replication and transcription
21b	Justifies statement by explaining essential function of two proteins in human body with	4	Two examples of proteins which are essential to the functioning of the human body are enzymes and hormones.	Mostly answered well.

	<table><tr><td>reference to specific named proteins in correct detail.</td><td></td></tr><tr><td>Justifies statement by explaining essential function of two named proteins in human body</td><td>3</td></tr><tr><td>Justifies statement by explaining essential function of one protein in human body OR Outlines function of two groups of proteins in human body</td><td>2</td></tr><tr><td>Identifies two proteins in human body OR Any relevant information</td><td>1</td></tr></table>	reference to specific named proteins in correct detail.		Justifies statement by explaining essential function of two named proteins in human body	3	Justifies statement by explaining essential function of one protein in human body OR Outlines function of two groups of proteins in human body	2	Identifies two proteins in human body OR Any relevant information	1	Helicase enzyme is needed to split DNA into single strands at the start of DNA replication which takes place in the cell replication processes of mitosis and meiosis. Hormones play a role in homeostasis. E.g., Insulin is released from the pancreas when blood sugar levels (BSL) are increased. Insulin helps convert glucose into glycogen and body cells to use more glucose up, thus reducing the level of glucose in blood. It is therefore essential for proteins to be correctly synthesised to maintain glucose levels, thus homeostasis and proper bodily function like carrying out respiration	Two named proteins instead of what the protein does. Specific details on the function of the named proteins						
reference to specific named proteins in correct detail.																	
Justifies statement by explaining essential function of two named proteins in human body	3																
Justifies statement by explaining essential function of one protein in human body OR Outlines function of two groups of proteins in human body	2																
Identifies two proteins in human body OR Any relevant information	1																
22a	<table><tr><td>Pedigree with key, correct formatting and specific shading</td><td>3</td></tr><tr><td>Pedigree with one error in key, correct formatting and specific shading</td><td>2</td></tr><tr><td>Pedigree with two errors in key, correct formatting and specific shading</td><td>1</td></tr></table>	Pedigree with key, correct formatting and specific shading	3	Pedigree with one error in key, correct formatting and specific shading	2	Pedigree with two errors in key, correct formatting and specific shading	1	I II III Key <table><tr><td></td><td>HD male</td></tr><tr><td></td><td>HD female</td></tr><tr><td></td><td>Unaffected male</td></tr><tr><td></td><td>Unaffected female</td></tr></table>		HD male		HD female		Unaffected male		Unaffected female	Marked Generously. Marks were not deducted this time for missing labelling of persons/generations. Careful with formatting (e.g.: twins, half-shading means carriers which is found in sex-linked pedigrees)
Pedigree with key, correct formatting and specific shading	3																
Pedigree with one error in key, correct formatting and specific shading	2																
Pedigree with two errors in key, correct formatting and specific shading	1																
	HD male																
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22b	<table><tr><td>Describes pattern (with reference to pedigree) which shows disease is due to dominant allele AND parents are heterozygous</td><td>2</td></tr><tr><td>Outlines pattern (with reference to pedigree) which shows disease is due to dominant allele OR parents are heterozygous</td><td>1</td></tr></table>	Describes pattern (with reference to pedigree) which shows disease is due to dominant allele AND parents are heterozygous	2	Outlines pattern (with reference to pedigree) which shows disease is due to dominant allele OR parents are heterozygous	1	Both of Matt's parents in Generation I have HD but Matt doesn't so both his parents must be heterozygous. Matt has inherited two recessive alleles which means he does not have the disease. His parents have the dominant allele which shows in their phenotype.	No marks awarded for guessing dominant. Deducted for identifying HD as recessive. Marks deducted for missing reference to pedigree. If refer to names or generations, they must be in pedigree to be awarded the mark.										
Describes pattern (with reference to pedigree) which shows disease is due to dominant allele AND parents are heterozygous	2																
Outlines pattern (with reference to pedigree) which shows disease is due to dominant allele OR parents are heterozygous	1																

22c	Calculates genotypic ratio with correct punnett square, genotype of parents and allele key	3	Key – H – Huntington’s disease allele, h – normal allele Hh x hh Woman <table><tr><td></td><td colspan="2">Bill</td></tr><tr><td></td><td>H</td><td>h</td></tr><tr><td>h</td><td>Hh</td><td>hh</td></tr><tr><td>h</td><td>Hh</td><td>hh</td></tr></table> Genotypic ratio – 1 Hh: 1 hh OR 50% Hh, 50% hh		Bill			H	h	h	Hh	hh	h	Hh	hh	Error carried forward if identified Huntington’s as recessive in 22b. Accepted fractions. Note: -For Allele key: Need to specify H-Huntington’s allele, h-normal allele. - Should state the disease in full form but no mark deducted for this. -Accepted: H-Huntington’s, h-normal OR H-disease, h-no disease OR H – affected, h – unaffected.
		Bill														
		H		h												
	h	Hh		hh												
h	Hh	hh														
Provides the details above without one of the aspects	2															
Provides the details above without two of the aspects OR A relevant punnett square or correct genotype of parents or genotypic ratio with error carried forward	1															
23a	Explains more than 1 change of the correct hormone and its associated graph identified	3	W – oestrogen Oestrogen is released from the ovary in response to FSH and LH which causes development of the follicles. There is a surge of oestrogen before ovulation then it is still released from the corpus luteum after ovulation to build up the lining of the uterus. Oestrogen levels drop just before menstruation as the corpus luteum disintegrates X – progesterone Progesterone is released from the ovary after ovulation. After ovulation the follicle forms the corpus luteum. There is a rise in progesterone as this causes the retention of the uterus lining. Progesterone levels drop just before menstruation as the corpus luteum disintegrates causing menstruation. Y – FSH FSH is released from the pituitary gland at the start of the menstrual cycle after GnRH stimulates the pituitary. It causes the follicles to	Need to specifically say 2 changes for 3 marks i.e. increasing level and decreasing level with explanation Any relevant information – wrong hormone and graph but correct information about the named hormone												
	Explains 1 change of the correct hormone and its associated graph identified	2														
	Any relevant information	1														

			develop and the ovary to release oestrogen. After ovulation release of FSH is suppressed. Z – LH LH is released from the pituitary gland at the start of the menstrual cycle after GnRH stimulates the pituitary. It causes the follicles to develop and the ovary to release oestrogen. The rise in oestrogen causes a peak in LH at ovulation. After ovulation release of LH is suppressed.	
23b	Identifies date of peak oestrogen correctly according to January calendar	1	12 th January (oestrogen levels peak three days before ovulation according to graph in Diagram 1)	Accept 11-13 th Jan
24	Makes a judgement supported with reference to disease transmission of plague pathogen and stimulus	3	Pomanders were ineffective against plague transmission as the disease is the result of invasion of the body by the bacterium <i>Yersinia pestis</i> not bad air. Herbs will neither prevent entry into the body nor destroy pathogens. Transmission of this bacterium was by being bitten by a rat flea (vector) which delivered the bacterium into the bite from its gut.	Need to specifically say fleas bite humans (or exchange of bodily fluids) for transmission.
	Makes a judgement supported with reference to disease transmission or stimulus or references both with no judgment	2		
	Some relevant information	1		
25a	Outlines two relevant methods for preventing spread of varroa mite	3	To reduce the risk of spread of the mite within Australia, infected hives need to be destroyed immediately. In addition, all hives within a set eradication zone (even if uninfected) must also be destroyed. No hives can be transported out of the zone. Other responses could include: • Insecticides are used to kill wild bees within the area. • All bee-keeping equipment in the zone must be burnt (or fumigated) • Hives cannot be re-established in the area for a set time period to prevent re-infection. I also accepted the following: • Isolation of infected hives • Development of selective insecticides that will kill mites but not bees (although this is not currently available) • Sterilisation of clothes, equipment used with infected hives	Responses needed to be as relevant as possible. Separating bees with mites from bees without mites is not possible – infected hives must be destroyed completely. However, this may have been accepted if additional information provided a realistic method. Note that all insecticides will currently kill both bees and mites. There was some confusion about mites vs viruses. Antivirals will not kill mites. Focus needed to be on methods used within Australia, rather
	Outlines one relevant method OR identifies two methods	2		
	Identifies a relevant method	1		

			than on methods to prevent entry as the mites are already here.										
25b	<table><tr><td>Makes a judgement supported by description of impacts of the mite on at least two different agricultural products</td><td>5</td></tr><tr><td>Makes a judgment supported by description of the impact of the mite on one agricultural product and identification of a second product OR describes impacts on two products but judgement not clear</td><td>4</td></tr><tr><td>Makes a judgment supported by description of the impact on one agricultural product OR describes one product impacted and identifies a second without a judgment</td><td>3</td></tr><tr><td>Makes a judgment supported by identification of one agricultural product impacted OR identifies two products impacted without a judgement</td><td>2</td></tr><tr><td>Some relevant information</td><td>1</td></tr></table>	Makes a judgement supported by description of impacts of the mite on at least two different agricultural products	5	Makes a judgment supported by description of the impact of the mite on one agricultural product and identification of a second product OR describes impacts on two products but judgement not clear	4	Makes a judgment supported by description of the impact on one agricultural product OR describes one product impacted and identifies a second without a judgment	3	Makes a judgment supported by identification of one agricultural product impacted OR identifies two products impacted without a judgement	2	Some relevant information	1	Varroa mite will have a very significant effect on agricultural production within Australia if the mite becomes established. Because the mite feeds on both adult bees and larvae it has the ability to destroy entire colonies and its presence means that all hives within a large area must be destroyed. This will reduce the production of honey and other bee related products such as beeswax and royal jelly which is used in medicinal products. In addition, there may be flow-on effects to other agricultural industries as bees are vital for the pollination of crops such as fruit trees. Both the destruction of hives plus viral diseases such as deformed wing virus transmitted by the mites that prevent bees from flying may severely reduce rate of pollination and decrease production of fruit and other crops.	The question asked for impacts of the mite ON agricultural production. Many students provided the social and economic impacts OF reduced production which is not specifically what the question was asking. While this may have added to the information provided, without at least two agricultural products impacted, it was not possible to receive more than 3 marks. Always read questions very carefully. ‘Other crops’ did not have to be specific. Judgment must be clear and explicit. Impacts may be positive or negative so you must clarify this in your judgment.
Makes a judgement supported by description of impacts of the mite on at least two different agricultural products	5												
Makes a judgment supported by description of the impact of the mite on one agricultural product and identification of a second product OR describes impacts on two products but judgement not clear	4												
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26a	<table><tr><td>Makes a judgement of both validity and accuracy with three supporting statements from stimulus</td><td>4</td></tr><tr><td>Makes a judgement of validity and accuracy with two supporting statements from stimulus or three statements but not all from stimulus</td><td>3</td></tr><tr><td>Makes a judgment of validity or accuracy with supporting statements</td><td>2</td></tr><tr><td>Some relevant information</td><td>1</td></tr></table>	Makes a judgement of both validity and accuracy with three supporting statements from stimulus	4	Makes a judgement of validity and accuracy with two supporting statements from stimulus or three statements but not all from stimulus	3	Makes a judgment of validity or accuracy with supporting statements	2	Some relevant information	1	The information is valid as it is provided by the World Health Organisation, a highly reputable source, and is directly addressing questions related to the outbreak of monkeypox virus. The information is up to date and comes from the outcomes of the International Health Regulations Emergency Committee specifically regarding the outbreak of monkeypox. The number of cases reported have been laboratory confirmed and either identified by WHO or reported to WHO from official sources and so would be considered to be accurate.	Accuracy includes where information comes from and information has been reviewed so includes validity and reliability.		
Makes a judgement of both validity and accuracy with three supporting statements from stimulus	4												
Makes a judgement of validity and accuracy with two supporting statements from stimulus or three statements but not all from stimulus	3												
Makes a judgment of validity or accuracy with supporting statements	2												
Some relevant information	1												
26b	<table><tr><td>Describes that drug may slow progress of disease by preventing the virus from invading and reproducing in cells</td><td>2</td></tr></table>	Describes that drug may slow progress of disease by preventing the virus from invading and reproducing in cells	2	Antiviral drugs such as tecovirimat may slow down the progress of monkeypox by inhibiting the invasion and reproduction of the virus	Antivirals do not kill viruses.								
Describes that drug may slow progress of disease by preventing the virus from invading and reproducing in cells	2												

	Identifies that drug prevents virus from invading cells	1	inside infected cells, so the immune system can take over to destroy the pathogen.	
26c	Provides a thorough explanation of how the vaccine results in active immunity and links same antigen to all three viruses	3	Vaccines contain an antigen which triggers a specific immune response by B and T lymphocytes that match the antigen. Once the antigen is destroyed, memory B and T cells for the antigen remain, providing active immunity that allows for a rapid future response. In this case, the antigen of the vaccinia and variola viruses must be the same as that for monkeypox, ensuring that the memory cells from the vaccine will be activated by the monkeypox virus.	Must say all 3 viruses have the same/similar antigens which is why the vaccine will work on monkeypox. Need to explain how vaccines work.
	Provides a sound explanation of how the vaccine results in active immunity and attempts to link the three viruses	2		
	Some relevant information	1		
27a	Correctly identifies the condition and outlines 2 causes	3	The patient is long/far sighted/has hyperopia. Several factors can contribute to this condition including: - An eyeball being too short (from front to back) or too rounded. - A lens that is too flat or has lost its elasticity and cannot be elongated enough to focus objects close to the eye onto the retina. - Refractive power of the cornea is too weak for the shape of the eye. Catch up – myopia - Eyeball too elongated - Lens too round	Students should revise the difference between myopia and hyperopia. Marks were given if condition was incorrect, but causes were correct. No error carried forward if the entire answer was related to myopia.
	Identifies the condition and outlines 1 cause	2		
	Identifies the condition or states a cause	1		

27b

Correctly tabulates details of two appropriate technologies to allow for a comprehensive discussion (positives and negatives for both) of their role in correcting hyperopia/myopia in this patient. Correctly tabulates details of two appropriate technologies to allow for a comprehensive discussion (positives and negatives for both) of their role in correcting myopia in this patient.	7
Correctly tabulates details of two technologies to allow for a thorough discussion (positives and/or negatives for both) of their role in correcting hyperopia/myopia in this patient.	5-6
Describes the details of two technologies allowing for a discussion (a positive and a negative for either) of their role in correcting vision.	3-4
Identifies a technology and provides a positive or negative in correcting vision. Or Describes a vision technology used to correct vision.	2
Any relevant information	1

Technology	Contact Lenses	LASIK
Description	A convex lens (can be made from a range of materials) is placed on the cornea. It will suit the curvature of your eyeball. It will increase the refraction of light so objects up close will be viewed more clearly. A concave lens is placed on the cornea. It will suit the curvature of your eyeball. It will reduce the refraction of light so objects at the distance will be viewed more clearly.	This involves the use of lasers to increase the curvature of the cornea to increase its refractive power. This involves cutting and lifting a flap of the cornea, leaving it partly intact. The surgeon to use a laser to sculpt and shape the middle layers of the cornea before replacing the flap and flattening it against the newly shaped surface. This bends the light more so it will land on the retina producing a clear image. ...decrease the curvature of the cornea to decrease the refractive power...this bends the light less so it will land on the retina producing a clear image.
Positives	- Corrects vision reliably. - Doesn't change your appearance - Can be worn easily for netball games.	- Appropriate for someone whose vision is stable (over 21) - vision corrected so no glasses or contacts needed - lasts up to 20 years - quick, painless procedure - good for active people like you.

Most students lost marks for not including a specific description of each technology.

Two positives and two negatives were needed

D – description for each (2 marks)

Px2 – two positives for each (2 marks)

Nx2 – two negatives fr each (2 marks)

In a table (1 mark)

Note: Glasses/spectacles not the BEST treatment option as patient plays netball. One mark deducted from full marks.

			<table><tr><td>Negatives</td><td> - Reduces cleansing effect of tears - Blood vessels may swell - Uncomfortable - Carefully cleaned & sterilised to avoid infection </td><td> - expensive - invasive – eye infection/damage - one week recovery - dry eyes - glasses in future when vision changes due to aging (long sighted) </td></tr></table>	Negatives	- Reduces cleansing effect of tears - Blood vessels may swell - Uncomfortable - Carefully cleaned & sterilised to avoid infection	- expensive - invasive – eye infection/damage - one week recovery - dry eyes - glasses in future when vision changes due to aging (long sighted)	
Negatives	- Reduces cleansing effect of tears - Blood vessels may swell - Uncomfortable - Carefully cleaned & sterilised to avoid infection	- expensive - invasive – eye infection/damage - one week recovery - dry eyes - glasses in future when vision changes due to aging (long sighted)					
28	<table><tr><td>Identifies process -genetic drift and founder effect and describes change in allele frequency in gene pool in new population</td><td>3</td></tr><tr><td>Identifies process -genetic drift or founder effect and describes change in allele frequency in gene pool in new population OR</td><td>2</td></tr></table>	Identifies process -genetic drift and founder effect and describes change in allele frequency in gene pool in new population	3	Identifies process -genetic drift or founder effect and describes change in allele frequency in gene pool in new population OR	2	The process in the storyboard is genetic drift – the founder effect. Some members of the seal population have formed a new population to escape the whale predator. The effect on the gene pool will be that the new population will have a reduced variety of alleles to the original population as the new population is smaller and so the members of the new population may not have the full diversity of alleles in their gene pool compared to the original population.	Many failed to mention founder effect as the cause for genetic drift. Some incorrectly identified natural selection as the process in the storyboard. Genetic drift-
Identifies process -genetic drift and founder effect and describes change in allele frequency in gene pool in new population	3						
Identifies process -genetic drift or founder effect and describes change in allele frequency in gene pool in new population OR	2						

	<table><tr><td>Identifies process -genetic drift and founder effect and outlines change in allele frequency in gene pool in new population</td><td></td></tr><tr><td>Identifies process -genetic drift or founder effect OR outlines change in allele frequency in gene pool in new population</td><td>1</td></tr></table>	Identifies process -genetic drift and founder effect and outlines change in allele frequency in gene pool in new population		Identifies process -genetic drift or founder effect OR outlines change in allele frequency in gene pool in new population	1		random change, natural selection- prolonged change.		
Identifies process -genetic drift and founder effect and outlines change in allele frequency in gene pool in new population									
Identifies process -genetic drift or founder effect OR outlines change in allele frequency in gene pool in new population	1								
29a	<table><tr><td>Outlines the need for a control group</td><td>1</td></tr></table>	Outlines the need for a control group	1	The placebo group provides a comparison/control group. As the placebo group does not contain the active ingredient any difference in outcome must be due to whether the subjects are taking simvastatin.	Marked generously. Did not accept an answer that was entirely dependent on incorrectly identifying the placebo as a control variable.				
Outlines the need for a control group	1								
29b	<table><tr><td>Groups examined for each dependent variable with reference to data. Conclusions reached about significance of each result.</td><td>3</td></tr><tr><td>Groups examined for two dependent variables with reference to data. Conclusions reached about significance of each result. OR Groups compared for each dependent variable with no reference to data. Conclusions reached about significance of each result. OR Groups examined for one dependent variable with reference to data and compared for two variables with no reference to data. Conclusions reached about significance of each result.</td><td>2</td></tr><tr><td>Some comparison between groups outlined</td><td>1</td></tr></table>	Groups examined for each dependent variable with reference to data. Conclusions reached about significance of each result.	3	Groups examined for two dependent variables with reference to data. Conclusions reached about significance of each result. OR Groups compared for each dependent variable with no reference to data. Conclusions reached about significance of each result. OR Groups examined for one dependent variable with reference to data and compared for two variables with no reference to data. Conclusions reached about significance of each result.	2	Some comparison between groups outlined	1	The SG group showed a 9% lower incidence of major cardiac events, and a 3.5% lower incidence of death from cardiac arrest. These data indicates that members of the Placebo group are 1.7 times as likely to have a serious cardiac event and 1.5 times as likely to die from cardiac arrest than members of the SG group. Thus, Simvastatin appears to be an effective Simvastatin is an effective preventative drug for cardiac disease. The number of individuals dying from no cardiac events was similar in both groups (2%-2.2%). This is an insignificant difference and indicates Simvastatin has no other effect on life span.	Many failed to analyse all three dependent variables – major cardiac events, death from cardiac events AND death from non-cardiac events. Double check your calculations when manipulating the data. Non-cardiac deaths - 0.2% difference is not significant (46 vs 49 individuals out of 2222).
Groups examined for each dependent variable with reference to data. Conclusions reached about significance of each result.	3								
Groups examined for two dependent variables with reference to data. Conclusions reached about significance of each result. OR Groups compared for each dependent variable with no reference to data. Conclusions reached about significance of each result. OR Groups examined for one dependent variable with reference to data and compared for two variables with no reference to data. Conclusions reached about significance of each result.	2								
Some comparison between groups outlined	1								
29c	<table><tr><td>Detailed explanation of how both natural selection and gene flow increase C679X allele frequency</td><td>4</td></tr></table>	Detailed explanation of how both natural selection and gene flow increase C679X allele frequency	4	The allele frequency of C679X allele the gene pool has increased in the last 50 years in Europe due to the processes of gene flow and natural selection.	Genetic drift and mutation were not accepted as processes. Drift – chance events are very unlikely				
Detailed explanation of how both natural selection and gene flow increase C679X allele frequency	4								

	<table><tr><td>Explanation of how both natural selection and gene flow increase C679X allele frequency</td><td>3</td></tr><tr><td>Outlines the process of natural selection or gene flow without applying to the stimulus OR Detailed explanation of how natural selection OR gene flow increase C679X allele frequency</td><td>2</td></tr><tr><td>Some relevant information</td><td>1</td></tr></table>	Explanation of how both natural selection and gene flow increase C679X allele frequency	3	Outlines the process of natural selection or gene flow without applying to the stimulus OR Detailed explanation of how natural selection OR gene flow increase C679X allele frequency	2	Some relevant information	1	By the process of natural selection, there would be variation in the population – some with the C679X allele and some not. Having this C679X allele provides a survival advantage, those individuals with this allele are more likely to survive and reproduce and pass on this allele to their offspring, hence, the allele frequency of C679X increases in the gene pool. Gene flow is the process by which alleles present in one population will spread to other populations as they interbreed. Migration from individuals from West Africa to Europe would have increased the allele frequency in the European population and contributed to an increase in the C679X the allele frequency in offspring over the last 50 years.	to result in an increase in an allele. Mutations do not occur frequently enough in one location in 50 years to produce a significant increase in a specific allele. Full mark answer required specific and correct reference to change in allele frequency in Europe.				
Explanation of how both natural selection and gene flow increase C679X allele frequency	3												
Outlines the process of natural selection or gene flow without applying to the stimulus OR Detailed explanation of how natural selection OR gene flow increase C679X allele frequency	2												
Some relevant information	1												
30	<table><tr><td>With appropriate reference to the maps, the response explains the relationship between adaptations/mechanisms held by Australian plants for hot conditions to water conservation.</td><td>5</td></tr><tr><td>With some reference to the maps, the response explains the relationship between adaptations/mechanisms held by Australian plants for hot conditions to water conservation.</td><td>4</td></tr><tr><td>With some reference to the maps, sketches in general terms adaptations of Australian plants for hot conditions and a mechanism for water conservation. OR With some reference to the maps, explains the relationship between one adaptation of an Australian plant for hot conditions and a mechanism for water conservation.</td><td>3</td></tr><tr><td>Outlines the adaptations of Australian plants to hot conditions OR effectively uses stimulus to correlate variables with reference to adaptations</td><td>2</td></tr><tr><td>Some relevant information</td><td>1</td></tr></table>	With appropriate reference to the maps, the response explains the relationship between adaptations/mechanisms held by Australian plants for hot conditions to water conservation.	5	With some reference to the maps, the response explains the relationship between adaptations/mechanisms held by Australian plants for hot conditions to water conservation.	4	With some reference to the maps, sketches in general terms adaptations of Australian plants for hot conditions and a mechanism for water conservation. OR With some reference to the maps, explains the relationship between one adaptation of an Australian plant for hot conditions and a mechanism for water conservation.	3	Outlines the adaptations of Australian plants to hot conditions OR effectively uses stimulus to correlate variables with reference to adaptations	2	Some relevant information	1	In January 2021 temperatures up to 42oC were experienced by large parts of SA and WA, as seen in the map coloured brown. Matching the brown areas in map 1 with the plant types in map 2, the main types of plants found are acacias and grasses with some small areas of eucalypts and shrubland varieties. These plants have survived due to their adaptations for conserving water. For example, the reduced surface area of leaves in grassland plants reduces heat absorption. The leaves may be reduced in size or curled to achieve this. E.g. hummock and tussock grasses. The reduced surface area to limits water lost via transpiration due to fewer stomata. Reduced leaf surface area is an adaptation utilised by the acacia. True leaves are very small. The plant has flattened leaf stalks that can photosynthesis but are small in surface area, with minimal stomates so transpiration is reduced and therefore water is maintained. The leaves of Eucalyptus trees hang vertically in hot conditions to reduce the surface area exposed to the sun’s rays. Small hairs on the surface of some species or sunken stomates to trap evaporating water, increasing humidity, and limiting transpiration. Their shiny	At least two adaptations required (sample answer gives many eggs). Stimulus had to be used effectively to achieve full marks. Be careful using the stimulus, many only talked to eucalypts and ignored grasslands and acacia that are the most predominant in the hotter regions. Note: hot arid conditions are a selection pressure that means only plants with certain adaptations can grow – the arid weather does not ‘cause’ these adaptations (not penalised but important in understanding of evolution)
With appropriate reference to the maps, the response explains the relationship between adaptations/mechanisms held by Australian plants for hot conditions to water conservation.	5												
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Outlines the adaptations of Australian plants to hot conditions OR effectively uses stimulus to correlate variables with reference to adaptations	2												
Some relevant information	1												

			cuticle helps to reflect light and reduce the temperature of the plant so evaporative cooling can be reduced.	
31a	Give a correct reason for why disease caused by nutritional imbalance are non-infectious	1	Diseases caused by nutritional imbalance are non-infectious as they are not caused by pathogens.	Well answered.
31b	Uses data from one of the graphs to justify a correct conclusion. Provides a correct conclusion with no data or incorrectly interpreted data OR provides data for an incomplete conclusion. Provides some relevant information	3 2 1	For all categories of non-discretionary foods, individuals aged between 14-18 are not consuming the recommended daily serves. For example, it is recommended that girls of this age group consume 5 serves of vegetables. However, the mean intake is 2. For boys the recommended serves is 5.5, whereas their mean intake is around 2.3 serves. For non-discretionary foods, individuals aged between 9-11 are not consuming the recommended daily serves for vegetables, fruits, meat and dairy. For example, it is recommended that girls and boys of this age group consume 5 serves of vegetables per day. However, both girls and boys are only consuming 2 serves per day.	The conclusion must be based specifically on the data presented. Some students went beyond the scope of the data in graphs, drawing conclusions related to nutritional diseases, which is not within the data presented.
31c	Describes two relevant features of an epidemiological study that would produce the data in the graphs. Describes one relevant feature of an epidemiological study and identifies a second Identifies a relevant feature of an epidemiological study	3 2 1	To obtain the data needed for these graphs the epidemiological study would have needed to have the following features: - Large sample size of 14-18 year old/9-11 boys and girls - Undertaking a survey during 2011 to 2012 (extended time frame) - Included boys and girls from a range of geographical locations in Australia, range of ethnicities, range of socioeconomic backgrounds - Survey to include questions regarding the quantities and types of foods consumed - Survey included a food diary to be completed - Data collected would be analysed and checked for reliability and validity	The question asked for features of the study to be described . Many students outlined aspects such as the type of study or the order you would conduct studies or linked it to looking for cause of disease, or gave general information about epidemiology. Very few of these responses answered the question.
32	Provides a full description of both named processes, makes a judgement about the effectiveness of both models supported by a thorough understanding of the aspects of the model that are effective and those that could be improved Provides the details above but with one or two aspects in a limited way. Provides the details above but with three or four aspects in a limited way.	8 6-7 4-5	Model 1 shows the process of phagocytosis with a macrophage engulfing bacteria. Phagocytosis is part of the innate immune response in which white blood cells such as macrophages engulf and destroy invading pathogens, subsequently displaying the antigen on MHC markers on their cell membrane and releasing Interleukin-1 to activate specific helper T-cells (adaptive immune response). This will activate both the humoral and cell-mediated immune response specific to the antigen.	Marking key: D₁ – Description of the process for model 1 J₁ – Judgement for model 1 P₁ – Positives for model 1 N₁ – Negatives for model 1 D₂ – Description of the process for model 2

	Provides the details above but with five or six aspects in a limited way.	2-3	The model effectively represents the phagocyte engulfing the bacterium, but it does not provide any information about what attracts phagocytes to the bacteria. It also does not show what happens next, how the white blood cells display the antigenic part of the pathogen, which in turn activates other parts of the immune system. Model 2 represents the humoral immune response, showing plasma B cells releasing antibodies specific to the invading virus which will bind to and form an antigen-antibody complex to destroy the virus. The formation of the complex can result in neutralisation of binding sites or agglutination of microbes (which enhance phagocytosis to destroy pathogens) or activation of the complement system which causes cell lysis. The model effectively shows the production of antibodies and how they attach to the virus. It does not provide any information about the activation of plasma B cells, how antibodies work, the fact that antibodies are specific, or the production of memory B cells. While both models illustrate aspects of the immune response to invading pathogens, neither clearly shows how each process is activated nor how they work together to destroy pathogens and as such, are not effective in representing the entire process.	J₂ – Judgement for model 2 P₂ – Positives for model 2 N₂ – Negatives for model 2 Essential details for model 1 description: - phagocytosis, - white blood cell/macrophage engulfs a pathogen/bacteria - destroys/kills/ digests it. Essential details for model 2 description: - Humoral response/antibody mediated response - plasma b cells produce antibodies - target specific pathogen/virus to help destroy it Judgement needed to be clear. A judgement for one aspect of the model with a different judgement for another aspect of the model wasn't accepted. You needed a final over judgement for each model. Positives and negatives needed to be specifically applied to the model. You needed to identify which parts of the model were benefits and which parts were limitations.
	Some relevant information	1		