

--	--	--	--	--	--	--	--

Student Number



Barker
College

2025

TRIAL HIGHER SCHOOL
CERTIFICATE EXAMINATION

Biology

ANSWER SHEET

Staff Involved:

- TKB - Mr Binet
- KIP - Mrs Prior
- ALP - Ms Pope
- DGG - Mr Giltrap
- SLC - Mrs Cormio
- VBE - Mrs Ellis

AM THURSDAY 7TH AUGUST

100 copies*

Section I - Multiple Choice

Write your Student Number at the top of this page

Choose the best response and fill in the response oval completely

Start
Here

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

BLANK PAGE

--	--	--	--	--	--	--	--

Student Number



Barker
College

2025

**TRIAL HIGHER SCHOOL
CERTIFICATE EXAMINATION**

Biology

Staff Involved:

AM THURSDAY 7TH AUGUST

- | | |
|-------------------|--------------------|
| • TKB - Mr Binet | • DGG - Mr Giltrap |
| • KIP - Mrs Prior | • SLC - Mrs Cormio |
| • ALP - Ms Pope | • VBE - Mrs Ellis |

100 copies

General

Instructions:

- Write your student number on all answer pages
- Reading time - 5 minutes
- Working time - 3 hours
- Write using black pen
- Draw diagrams using pencil
- For questions in Section II, show all relevant working in questions involving calculations
- NESA approved calculators may be used

Total marks:

100

Section I - 20 marks (pages 3 - 12)

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

Section II - 80 marks (pages 13 - 29)

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

Section I

20 marks

Attempt Questions 1 – 20

Allow about 35 minutes for this part

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

Select the alternative A, B, C or D that best answers the question.

Fill in the response oval completely.

Sample	$2 + 4 =$	A	2	B	6	C	8	D	9
		A	☐	B	☐	C	☐	D	☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A  B  C  D 

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

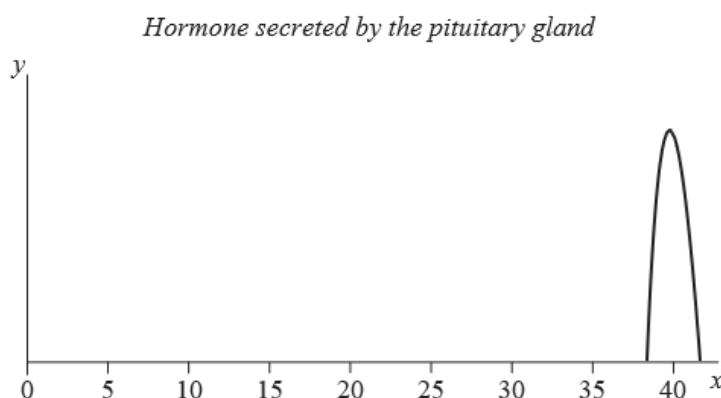
A  B  C  D 

Correct

1. What is the best definition of a mutagen?
 - A. A change in the structure of DNA
 - B. An agent that causes genetic change
 - C. The action or process of nucleotide change
 - D. The rearrangement of sections of chromosomes and genes

2. Which of the following groups contains organisms that are both eukaryotic and pathogenic?
 - A. Bacteria
 - B. Prions
 - C. Fungi
 - D. Viruses

3. The graph shows the production of a hormone during human pregnancy.



Which row of the table correctly identifies the hormone represented in the graph and the labels for each axis?

	<i>Hormone</i>	<i>x-axis label</i>	<i>y-axis label</i>
A.	oxytocin	Concentration of hormone (mg/100 mL)	Time (weeks)
B.	progesterone	Concentration of hormone (mg/100 mL)	Time (weeks)
C.	oxytocin	Time (weeks)	Concentration of hormone (mg/100 mL)
D.	progesterone	Time (weeks)	Concentration of hormone (mg/100 mL)

4. Which row of the table identifies the change in the ciliary muscle, suspensory ligaments and lens when the human eye focuses on a close object?

	<i>Ciliary muscle</i>	<i>Suspensory ligaments</i>	<i>Shape of lens</i>
A.	contracts	relax	thick
B.	relaxes	contract	thick
C.	relaxes	contract	thin
D.	contracts	relax	thin

5. Which response identifies two physical barriers to prevent entry of pathogens?
- A. Stomach acid and tears
 - B. Skin and cilia
 - C. Fever and phagocytes
 - D. Stomach acid and saliva
6. Which of the following is an example of a physiological adaptation in an endotherm that assists in maintaining homeostasis?
- A. Surface blood vessels in a human constrict on a cold day
 - B. A kangaroo moves into the shade to keep cool on a hot day
 - C. Animals in cold climates have thick fur coats
 - D. Lizards lie flat on a rock in the sun to raise their body temperature

7. The pictures below show different types of reproduction in organisms. They are not to scale.



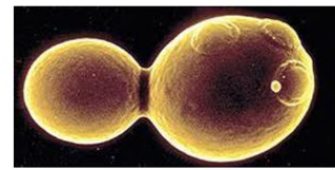
Hydra



Puffball
mushroom



Strawberry
plant with
runners



Yeast

Which of the following statements is true about the reproductive process of these organisms?

- A. They are all showing the release of eggs for fertilisation
 - B. All pictures show different forms of sexual reproduction
 - C. All pictures show different forms of asexual reproduction
 - D. Only the hydra, puffball mushroom and yeast show asexual reproduction
8. Epidemiology is the study of
- A. All types of diseases
 - B. Genetic diseases
 - C. Infectious diseases
 - D. Non-infectious diseases
9. Which of the following is an example of direct transmission of a pathogen?
- A. Ross River fever transmitted through a mosquito bite
 - B. Catching Lyssa virus walking underneath a bat colony
 - C. Infection with typhoid through the consumption of contaminated food
 - D. Catching influenza through the transfer of droplets from a kiss
10. Newborn babies receive antibodies in the milk from their mothers. This helps to protect them against pathogens. This is an example of:
- A. Active immunity
 - B. Passive immunity
 - C. Innate immunity
 - D. Autoimmunity

11. The trees of the *Hakea* genus are common in Australia. Their leaves are often reduced to spines.

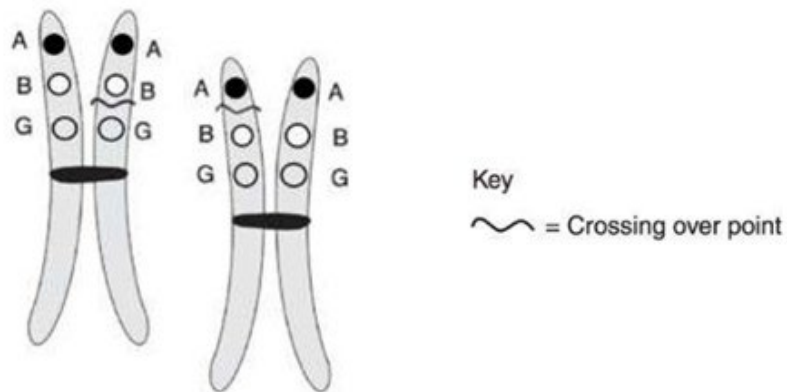
Which one of the following best explains why this is an adaptation that helps the plant survive in a dry environment.

- A. Water is the raw material in photosynthesis. Smaller leaves photosynthesise less, thus conserving water.
 - B. The spines make the stems more streamlined, causing rain which falls to run more efficiently down to the roots.
 - C. The spines break up the air flow over the stems, increasing evaporation of water from the lenticels.
 - D. The much smaller leaves mean a reduction in overall leaf surface area, reducing water loss through evaporation.
12. A school health screening was conducted in a regional town to identify students with chronic respiratory conditions. The school has 800 students, and the results showed that 56 students had been previously diagnosed with asthma.

What is the prevalence of asthma among students in this school?

- A. 0.007%
 - B. 7%
 - C. 14%
 - D. 0.07 cases per person
13. Which of the following statements about mutations is correct?
- A. Mutations in somatic cells are always passed onto offspring.
 - B. Mutations can occur naturally and can be caused by environmental factors such as high-energy electromagnetic radiation.
 - C. Mutations can occur on a large scale and cause chromosomes to be rearranged, but this usually does not cause significant changes in an organism.
 - D. Most mutations are beneficial to organisms and result in rapid evolutionary changes.

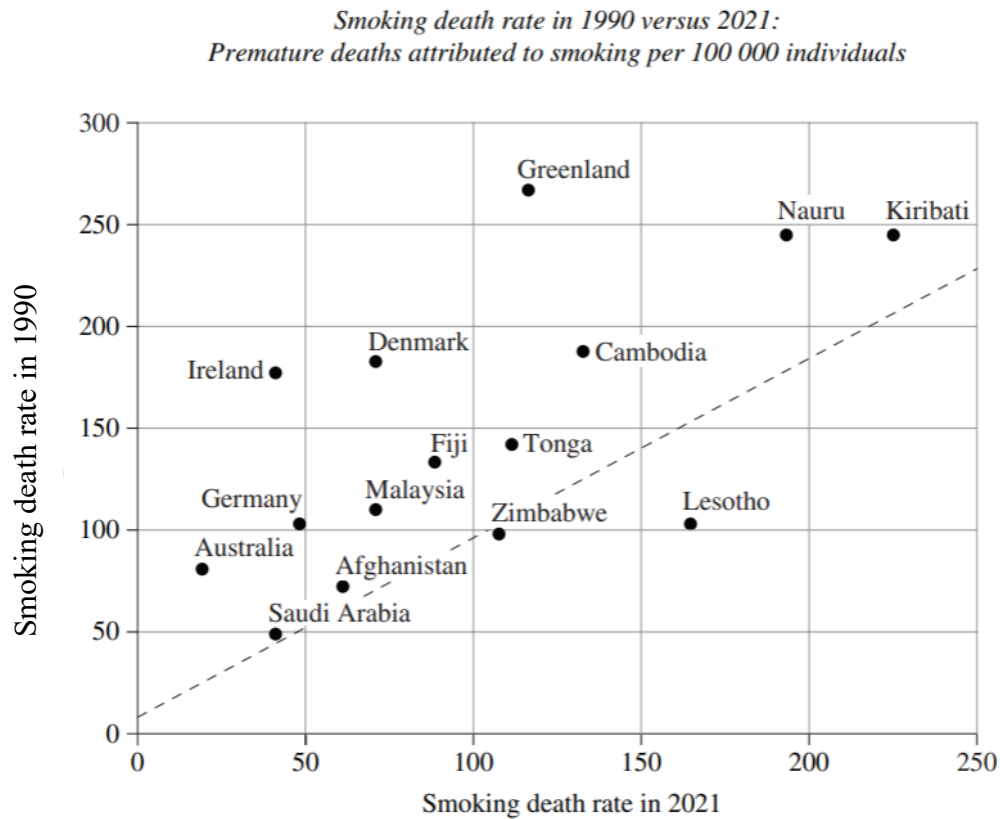
14. Which of the following statements about mutations is correct? Three genes A, B and G are arranged along a homologous pair of chromosomes. The figure below shows how the chromosomes have misaligned during meiosis and the point at which crossing over occurs.



Which mutation will result from this error?

- A. Duplication of gene A and B on one chromosome
- B. Deletion of G on one chromosome
- C. Duplication of A on one chromosome
- D. Deletion of B on one chromosome

15. The graph shows the death rate from smoking in 1990 versus 2021.

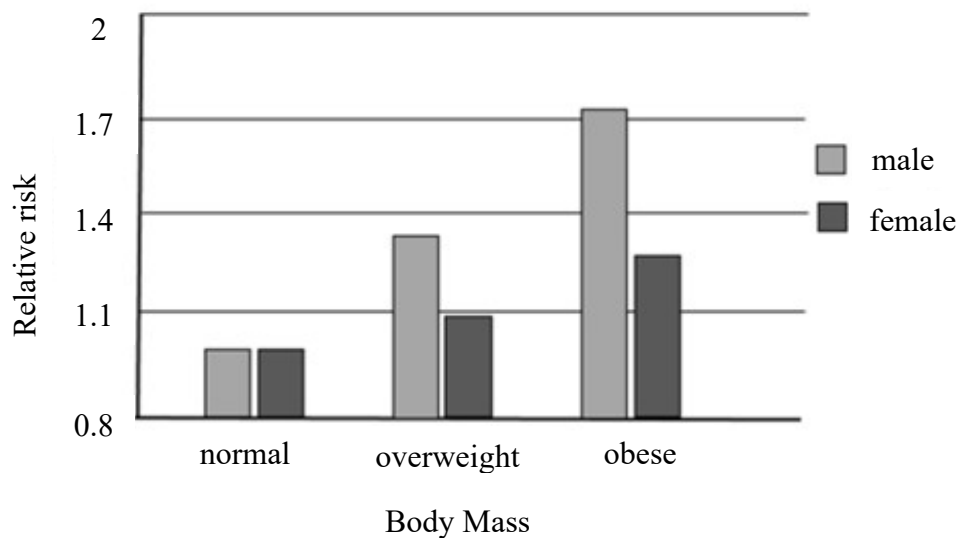


Source: Original data from IHME (2024). *Smoking death rate in 1990 vs. 2021*. Used with permission. All rights reserved. Accessed December 2024. Our World in Data website. <https://ourworldindata.org/smoking>.

Which of the following conclusions can be drawn from the graph?

- A. The smoking death rate in most countries decreased from 1990 to 2021.
- B. Lesotho showed the greatest decrease in the smoking death rate from 1990 to 2021.
- C. Nauru and Kiribati showed the highest smoking rates from 1990 to 2021.
- D. The smoking death rate in all countries increased from 1990 to 2021.

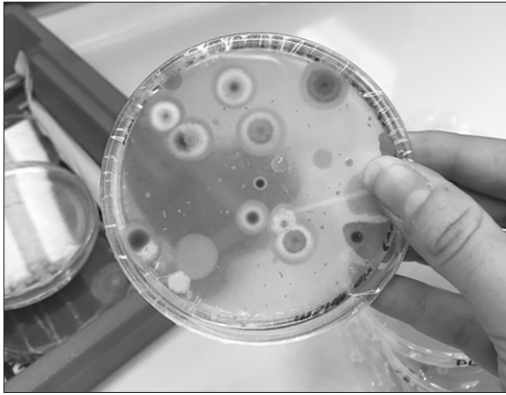
16. Colon cancer is one of the main types of cancer affecting the Australian population. The graph below shows the effect of body mass on the relative risk of contracting colon cancer for men and women.



Which of these statements is best supported by these data?

- A. Gender is not a factor which affects the relative risk of developing colon cancer.
 - B. Gaining weight increases the colon cancer risk for men more than it does for women.
 - C. The increased risk is most likely due to other health effects of obesity.
 - D. Men and women of normal weight are at no risk of developing colon cancer.
17. Throughout human history, epidemics have resulted in the deaths of many people. For example, the 'Black Death' in the 14th Century caused the death of one quarter of the population of Europe. Which of the following statements is always true of epidemics?
- A. They are caused by virulent viruses.
 - B. They occur in populations that have been immunised.
 - C. They involve infectious disease that can be transmitted easily.
 - D. They always occur in winter when a population has lowered resistance to infection.

18. A group of Biology students investigated microbes in a variety of water samples taken from a pool, a household tap and a local dam. The students added a few drops of each water sample to different agar plates, taped the lids to the plates and left them in an incubator for 48 hours. The photograph shows one of the agar plates after 48 hours.



Source: Reproduced with permission from Litchfield, Catherine (2024).

Why did the students tape the lids to the agar plates?

- A. It ensured that the students collected reliable data.
- B. It prevented the transmission of potentially pathogenic microbes.
- C. It enabled the plates to be organised more neatly in the incubator.
- D. It prevented heat loss and thus promoted the growth of microbes.

19. Which of the following best describes the transmission of a nerve impulse along a neuron?
- A nerve impulse travels along the axon and neurotransmitters carry it across the synapse.
 - Nerve impulses are carried by red blood cells through the nervous system.
 - Nerve impulses only travel towards the cell body and stop at the dendrites.
 - Electrical signals jump across the synapse from one neuron to another without chemical involvement.
20. Feather colour in some chickens is controlled by multiple alleles, as shown below.

Genotype	Phenotype
E	Black
E^R	Birchen
e^+	Wild-type
e^{Wh}	Dominant wheaten
e^b	Partridge
e^s	Speckled
e^{bc}	Buttercup
e^y	Recessive wheaten

The order of dominance of these alleles is $E > E^R > e^+ > e^{Wh} > e^b > e^s > e^{bc} > e^y$.

A rooster with black feathers and a hen with partridge feathers produce some chicks with black feathers, some chicks with partridge feathers and some chicks with buttercup feathers.

Which of the following rows identifies possible genotypes of the rooster and the hen?

	Genotype of the Rooster	Genotype of the Hen
A.	Ee^b	$e^b e^{bc}$
B.	Ee^b	$e^b e^y$
C.	Ee^{bc}	$e^b e^b$
D.	Ee^{bc}	$e^b e^y$

End of Section I

BLANK PAGE

--	--	--	--	--	--	--	--

Student Number



Barker
College

Biology

Section II Answer Booklet

80 marks*

Attempt Questions 21 - 32

Allow about 2 hours and 25 minutes for this part

Instructions:

- Write your student number at the top of every answer page.
 - 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)

50,000 years ago cheetah (*Acinonyx jubatus*) populations existed in Africa, Asia, Europe and North America. However, approximately 10,000 years ago, at the end of the last ice age, there was a mass extinction of large mammals and the North American and European populations of cheetahs died out. The number of surviving cheetahs dwindled and today the cheetah is an endangered animal with fewer than 8,000 African cheetahs living in the wild and only about 50 Asian cheetahs left.

Explain the process that occurred 10,000 years ago affecting cheetah populations and describe its effect on the gene pool of the surviving cheetahs.

3

.....

.....

.....

.....

.....

.....

Question 22 (3 marks)

Complete the table below comparing the adaptations of pathogens that assist their transmission between hosts.

3

Type of Pathogen		
Description of adaptation to assist transmission		

--	--	--	--	--	--	--	--

Student Number

Question 23 (4 marks)

In the 1860s, Louis Pasteur conducted an experiment using flasks with long, curved “swan necks”. He filled them with nutrient-rich broth, boiled them to kill any microorganisms and left them exposed to air. The broth remained free from microbial growth unless the neck of the flask was broken or tilted, allowing air-borne particles to enter.

Using the information provided, explain how Louis Pasteur’s work contributed to understanding the causes and transmission of infectious disease.

4

.....

.....

.....

.....

.....

.....

.....

.....

Question 24 (5 marks)

Opitz-Kaveggia (or FG) syndrome is a sex-linked recessive condition caused by a chromosomal mutation known as an inversion mutation on the X chromosome. People with FG syndrome have a mild intellectual disability, weak muscle tone, and developmental delays.

- (a) With the aid of a diagram explain what is meant by a chromosomal mutation. **2**

- (b) A married couple are wanting to start a family and are wondering what their chances are of having a child with FG syndrome. Neither the man or woman have FG syndrome, but the woman's father suffered from the condition.

Use a Punnett square to determine the chances of the couple having a child with FG syndrome. Show ALL working.

3

--	--	--	--	--	--	--	--

Student Number

Question 25 (5 marks)

Lactase is necessary for the digestion of lactose and without this enzyme, a person cannot tolerate lactose in their diet.

FIGURE 1: is an mRNA codon table

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

The normal lactase enzyme has the following partial DNA sequence:

C C A T A G C A C G T T A C A

This codes for the amino acid sequence: Gly, Ile, Val, Gln, Cys

(a) Complete the following table for a *mutated* partial DNA sequence for lactase.

4

DNA read strand sequence	C C A A A G C A C G T T A C A				
mRNA					
Amino acids					
Type of mutation (circle only one)	deletion duplication substitution insertion				
How did the mutation affect the amino acid sequence? (circle all that are appropriate)	Premature stop signal	1 amino acid is changed	1 amino acid is added/deleted	All the amino acids change after the mutation	

(b) Will this person be lactose intolerant? _____

1

Question 26 (7 marks)

Panama disease is considered one of the most destructive diseases of banana plants worldwide. It is caused by a soil borne fungus, *Fusarium oxysporum*. The disease enters the plants through the roots and blocks the vascular system, preventing water and nutrient transport, leading to wilting, yellowing and eventual death of the plant. The fungus survives in the soil for long periods and is spread through contaminated soil, water and plant materials.



Bananas affected by Panama disease caused by the fungus *Fusarium oxysporum*.
Source: ABC News

- (a) From the photo, identify a symptom of Panama disease in bananas. 1

.....
.....

- (b) Plants do not have complex immune systems in the same way animals do, but they have developed physical and chemical barriers in response to pathogenic infections.

Outline a response that plants have to defend themselves against disease. 2

.....
.....
.....
.....

--	--	--	--	--	--	--	--

Student Number

Question 26 (continued)

(c) Assess the effects of plant diseases on agricultural production in Australia.

4

.....

.....

.....

.....

.....

.....

.....

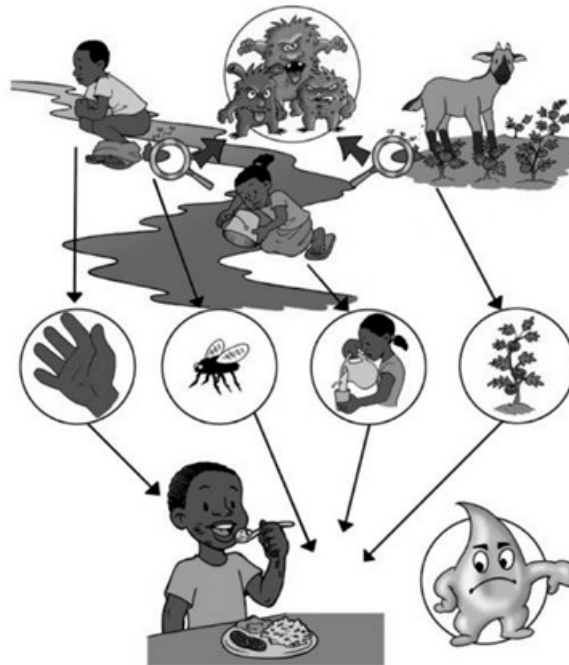
.....

.....

End of Question 26

Question 27 (11 marks)

Cholera is a bacterial disease that causes vomiting, diarrhoea, dehydration and death in humans. The diagram below shows the Five “Fs” of transmission of cholera: fluids, fingers, flies, foods, and fields.



- (a) Using the diagram, describe procedures that could be employed to prevent the spread of cholera at a local level.

6

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 27 continues on page 21

--	--	--	--	--	--	--	--

Student Number

Question 27 (continued)

- (b) Analyse the range of interrelated factors involved in limiting the regional and global spread of cholera.

5

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 27

Question 28 (5 marks)

(a) In the space below draw a flowchart to describe the process of phagocytosis.

3

(b) Explain how phagocytosis protects the body against infection.

2

.....

.....

.....

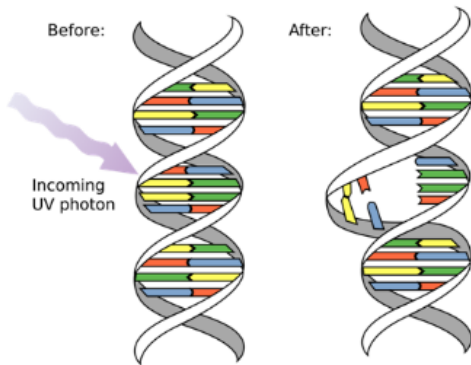
.....

--	--	--	--	--	--	--	--

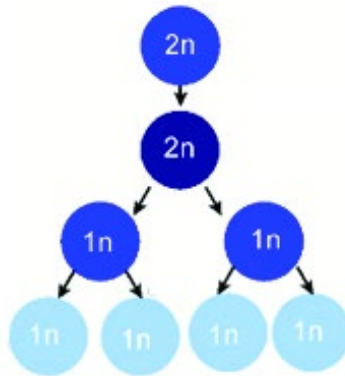
Student Number

Question 29 (8 marks)

The diagrams below show key stages in the production of gametes and their fusion during fertilisation in sexually reproducing organisms.



Mutation



Meiosis



Fertilisation

Referring to the diagrams above, explain how meiosis, fertilisation and mutation each contribute to genetic variation in sexually reproducing populations. In your answer, include specific references to the processes occurring and evaluate their relative importance in contributing to genetic diversity. **8**

[illegible]

Question 30 (13 marks)

Type 2 diabetes is a condition in which the body becomes resistant to the normal effects of insulin and gradually loses the capacity to produce enough insulin in the pancreas. Symptoms include excessive thirst, feeling tired and hungry, slow healing cuts and weight gain. There is no cure for type 2 diabetes, the condition is managed through lifestyle modifications and medication.

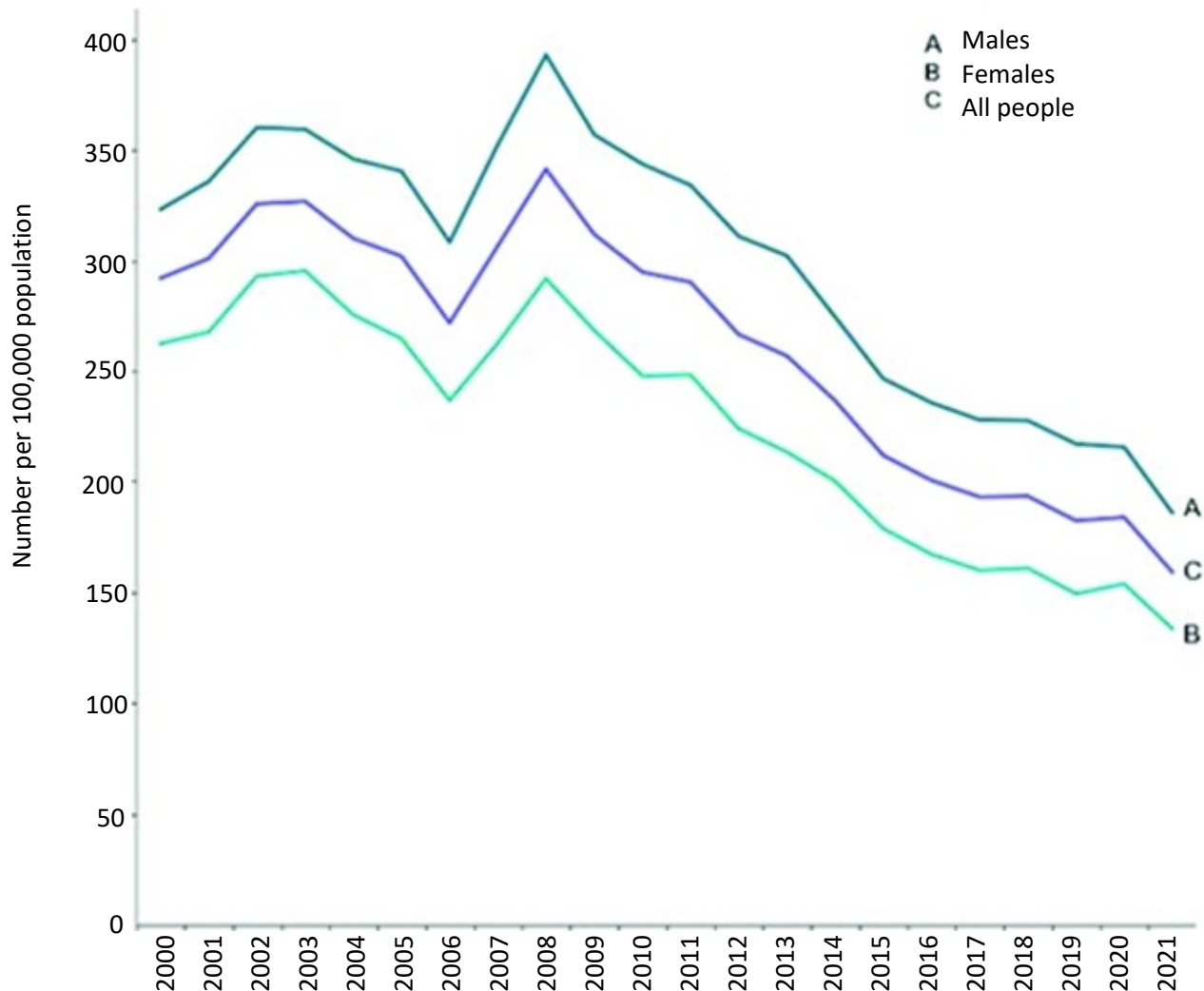


Figure 1: Incidence of type 2 diabetes, by age and sex, 2000-2021 Australia
Source: www.aihw.gov.au

Question 30 continues on page 25

Question 30 (continued)

A ■ Males **B** ■ Females **C** ■ All people

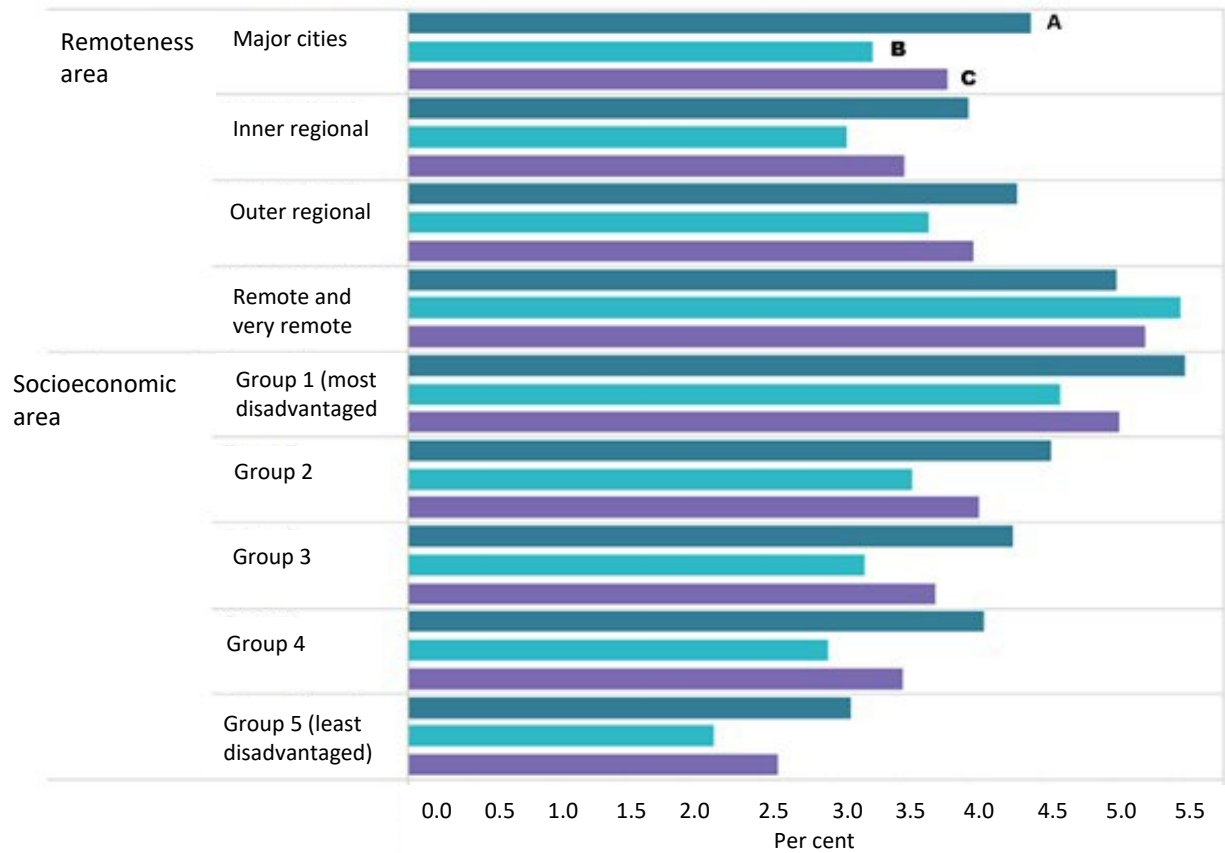


Figure 2: Prevalence of type 2 diabetes, by selected population group and sex, 2021
Source: www.aihw.gov.au

Refer to Figures 1 and 2 to answer the following questions

- (a) The “Life!” Program was introduced in Australia in 2008 and was aimed at helping Australians reduce the risk of developing type 2 diabetes through group sessions and telephone health coaching. Using data from the graphs, evaluate the effectiveness of this program.

3

.....

.....

.....

.....

.....

.....

Question 30 continues on page 26

Question 30 (continued)

- (b) Compare the prevalence of type 2 diabetes in males and females in major cities and remote and very remote areas.

4

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Suggest possible reasons for any differences observed.

2

.....

.....

.....

.....

Question 30 continues on page 27

--	--	--	--	--	--	--	--

Student Number

Question 30 (continued)

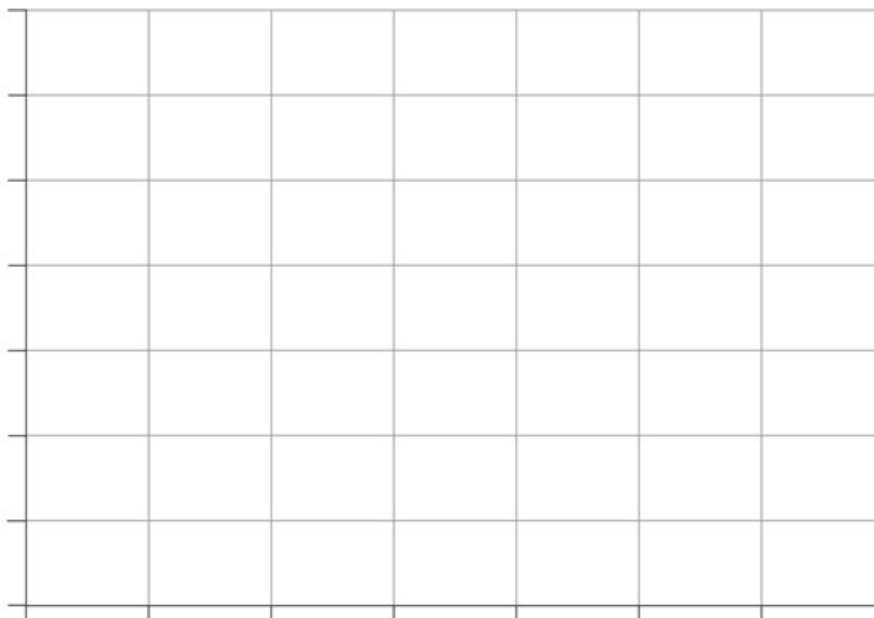
- (d) Glaucoma is a disease that damages the optic nerve in the eye. A group of researchers conducted a study to investigate a potential link between diabetes and glaucoma. The researchers selected a sample of participants who have diabetes and recorded the amount of time that had passed since each participant was diagnosed with diabetes. They also recorded the percentage of participants who had experienced glaucoma.

The results are shown in the table.

<i>Duration of diabetes (years)</i>	0	5	10	15	20	25	30	35
<i>Percentage of participants with glaucoma</i>	0	2	3	4	6	8	11	13

- (i) On the axes provided, draw and label a graph of the data.

3



- (ii) Construct a hypothesis for this investigation.

1

.....

.....

End of Question 30

Question 31 (9 marks)

- (a) Describe how a named kidney disorder affects the functioning of the kidney. **3**

.....

.....

.....

.....

.....

.....

- (b) Describe a treatment option available to a patient with kidney disease and evaluate the effectiveness of this treatment to assist with the management of this disorder. **6**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

--	--	--	--	--	--	--	--

Student Number

Question 32 (7 marks)

Tim Friede is an enthusiastic, but unusual, member of the Science community who has been “self-immunising” against different types of venom from some of the world’s deadliest snakes for nearly 20 years.

The process involves milking venom from the snakes and injecting tiny – followed by increasingly larger – doses into his body over months and years, eventually building up immunity to more than a dozen venomous snakes. Then he lets the venomous snakes bite him.

He has logged 202 snakebites in total. Without that slow buildup over 20 years, bites by most of these snakes would kill him.

Using your knowledge of the human immune response, explain how Tim's body has responded over time to this program of self-immunisation.

7

[illegible]

End of Paper

BLANK PAGE



Barker
College

--	--	--	--	--	--	--	--

Student Number

Marking Criteria

2025

TRIAL HIGHER SCHOOL
CERTIFICATE EXAMINATION

Biology

ANSWER SHEET

Staff Involved:

- TKB - Mr Binet
- KIP - Mrs Prior
- ALP - Ms Pope
- DGG - Mr Giltrap
- SLC - Mrs Cormio
- VBE - Mrs Ellis

AM THURSDAY 7TH AUGUST

Questions highlighted yellow will be covered during the Focus Day session.

100 copies*

Section I - Multiple Choice

Write your Student Number at the top of this page

Choose the best response and fill in the response oval completely

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

BLANK PAGE

--	--	--	--	--	--	--	--

Student Number



Barker
College

2025

**TRIAL HIGHER SCHOOL
CERTIFICATE EXAMINATION**

Biology

Staff Involved:

- | | |
|-------------------|--------------------|
| • TKB - Mr Binet | • DGG - Mr Giltrap |
| • KIP - Mrs Prior | • SLC - Mrs Cormio |
| • ALP - Ms Pope | • VBE - Mrs Ellis |

AM THURSDAY 7TH AUGUST

100 copies

General

Instructions:

- Write your student number on all answer pages
- Reading time - 5 minutes
- Working time - 3 hours
- Write using black pen
- Draw diagrams using pencil
- For questions in Section II, show all relevant working in questions involving calculations
- NESA approved calculators may be used

Total marks:

100

Section I - 20 marks (pages 3 - 12)

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

Section II - 80 marks (pages 13 - 29)

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

Section I

20 marks

Attempt Questions 1 – 20

Allow about 35 minutes for this part

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

Select the alternative A, B, C or D that best answers the question.

Fill in the response oval completely.

Sample	$2 + 4 =$	A	2	B	6	C	8	D	9
		A	☐	B	☐	C	☐	D	☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.

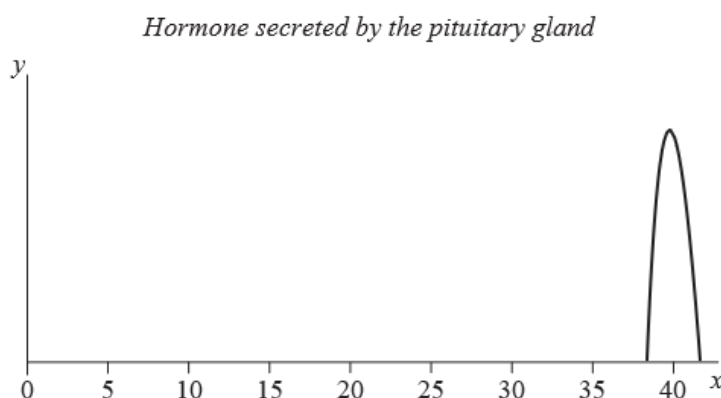
A  B  C  D 

Correct

1. What is the best definition of a mutagen?
 - A. A change in the structure of DNA
 - B. An agent that causes genetic change
 - C. The action or process of nucleotide change
 - D. The rearrangement of sections of chromosomes and genes

2. Which of the following groups contains organisms that are both eukaryotic and pathogenic?
 - A. Bacteria
 - B. Prions
 - C. Fungi
 - D. Viruses

3. The graph shows the production of a hormone during human pregnancy.



Which row of the table correctly identifies the hormone represented in the graph and the labels for each axis?

	<i>Hormone</i>	<i>x-axis label</i>	<i>y-axis label</i>
A.	oxytocin	Concentration of hormone (mg/100 mL)	Time (weeks)
B.	progesterone	Concentration of hormone (mg/100 mL)	Time (weeks)
C.	oxytocin	Time (weeks)	Concentration of hormone (mg/100 mL)
D.	progesterone	Time (weeks)	Concentration of hormone (mg/100 mL)

4. Which row of the table identifies the change in the ciliary muscle, suspensory ligaments and lens when the human eye focuses on a close object?

	<i>Ciliary muscle</i>	<i>Suspensory ligaments</i>	<i>Shape of lens</i>
A.	contracts	relax	thick
B.	relaxes	contract	thick
C.	relaxes	contract	thin
D.	contracts	relax	thin

5. Which response identifies two physical barriers to prevent entry of pathogens?
- A. Stomach acid and tears
 - B. Skin and cilia
 - C. Fever and phagocytes
 - D. Stomach acid and saliva
6. Which of the following is an example of a physiological adaptation in an endotherm that assists in maintaining homeostasis?
- A. Surface blood vessels in a human constrict on a cold day
 - B. A kangaroo moves into the shade to keep cool on a hot day
 - C. Animals in cold climates have thick fur coats
 - D. Lizards lie flat on a rock in the sun to raise their body temperature

7. The pictures below show different types of reproduction in organisms. They are not to scale.



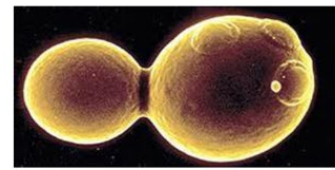
Hydra



Puffball
mushroom



Strawberry
plant with
runners



Yeast

Which of the following statements is true about the reproductive process of these organisms?

- A. They are all showing the release of eggs for fertilisation
 - B. All pictures show different forms of sexual reproduction
 - C. All pictures show different forms of asexual reproduction
 - D. Only the hydra, puffball mushroom and yeast show asexual reproduction
8. Epidemiology is the study of
- A. All types of diseases
 - B. Genetic diseases
 - C. Infectious diseases
 - D. Non-infectious diseases
9. Which of the following is an example of direct transmission of a pathogen?
- A. Ross River fever transmitted through a mosquito bite
 - B. Catching Lyssa virus walking underneath a bat colony
 - C. Infection with typhoid through the consumption of contaminated food
 - D. Catching influenza through the transfer of droplets from a kiss
10. Newborn babies receive antibodies in the milk from their mothers. This helps to protect them against pathogens. This is an example of:
- A. Active immunity
 - B. Passive immunity
 - C. Innate immunity
 - D. Autoimmunity

11. The trees of the *Hakea* genus are common in Australia. Their leaves are often reduced to spines.

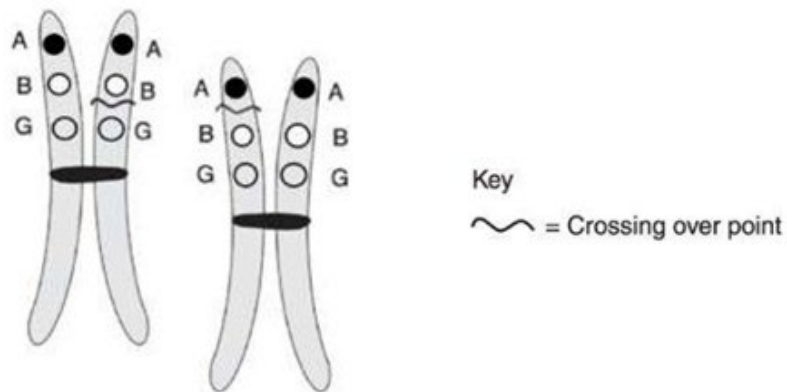
Which one of the following best explains why this is an adaptation that helps the plant survive in a dry environment.

- A. Water is the raw material in photosynthesis. Smaller leaves photosynthesise less, thus conserving water.
 - B. The spines make the stems more streamlined, causing rain which falls to run more efficiently down to the roots.
 - C. The spines break up the air flow over the stems, increasing evaporation of water from the lenticels.
 - D. The much smaller leaves mean a reduction in overall leaf surface area, reducing water loss through evaporation.
12. A school health screening was conducted in a regional town to identify students with chronic respiratory conditions. The school has 800 students, and the results showed that 56 students had been previously diagnosed with asthma.

What is the prevalence of asthma among students in this school?

- A. 0.007%
 - B. 7%
 - C. 14%
 - D. 0.07 cases per person
13. Which of the following statements about mutations is correct?
- A. Mutations in somatic cells are always passed onto offspring.
 - B. Mutations can occur naturally and can be caused by environmental factors such as high-energy electromagnetic radiation.
 - C. Mutations can occur on a large scale and cause chromosomes to be rearranged, but this usually does not cause significant changes in an organism.
 - D. Most mutations are beneficial to organisms and result in rapid evolutionary changes.

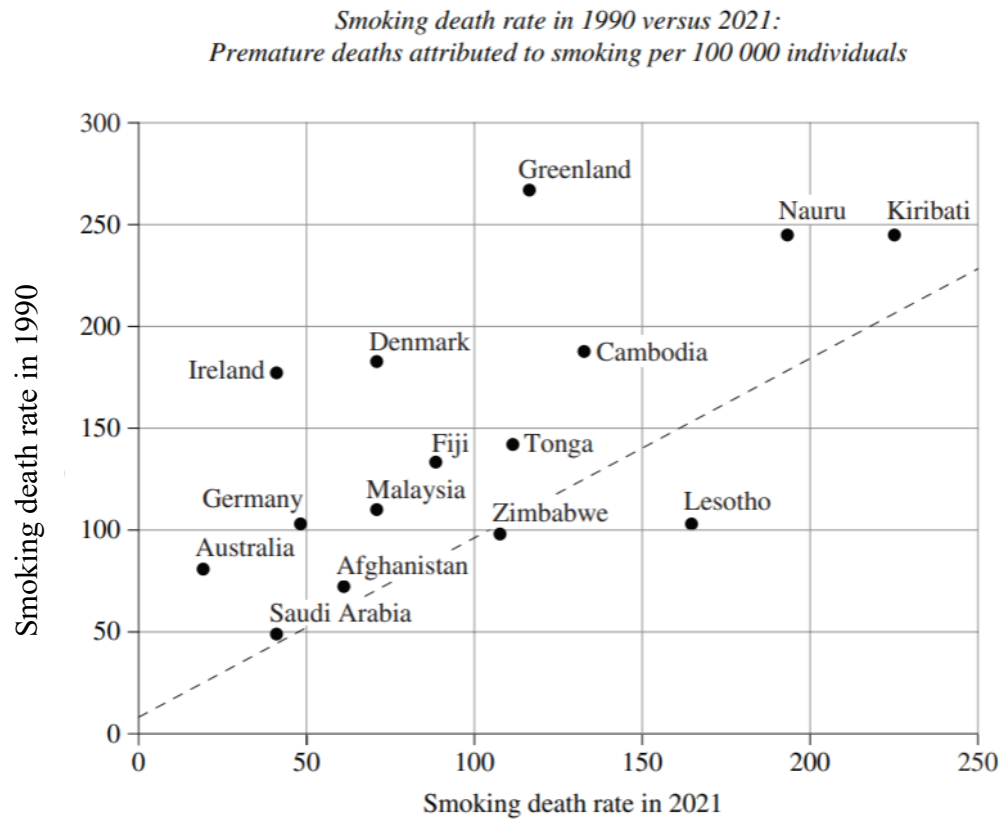
14. Which of the following statements about mutations is correct? Three genes A, B and G are arranged along a homologous pair of chromosomes. The figure below shows how the chromosomes have misaligned during meiosis and the point at which crossing over occurs.



Which mutation will result from this error?

- A. Duplication of gene A and B on one chromosome
- B. Deletion of G on one chromosome
- C. Duplication of A on one chromosome
- D. Deletion of B on one chromosome

15. The graph shows the death rate from smoking in 1990 versus 2021.

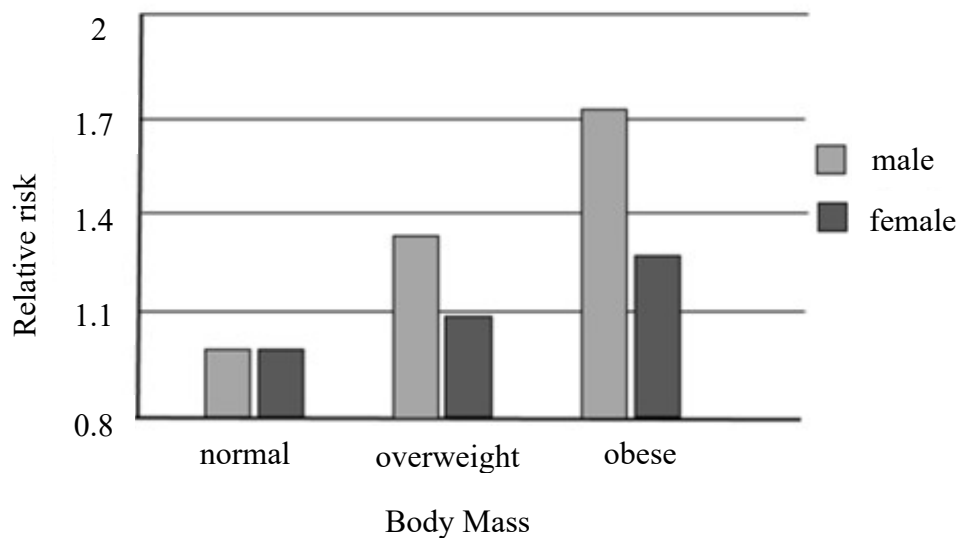


Source: Original data from IHME (2024). *Smoking death rate in 1990 vs. 2021*. Used with permission. All rights reserved. Accessed December 2024. Our World in Data website. <https://ourworldindata.org/smoking>.

Which of the following conclusions can be drawn from the graph?

- A. The smoking death rate in most countries decreased from 1990 to 2021.
- B. Lesotho showed the greatest decrease in the smoking death rate from 1990 to 2021.
- C. Nauru and Kiribati showed the highest smoking rates from 1990 to 2021.
- D. The smoking death rate in all countries increased from 1990 to 2021.

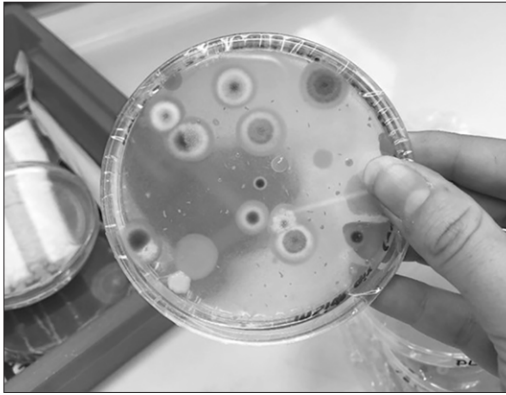
16. Colon cancer is one of the main types of cancer affecting the Australian population. The graph below shows the effect of body mass on the relative risk of contracting colon cancer for men and women.



Which of these statements is best supported by these data?

- A. Gender is not a factor which affects the relative risk of developing colon cancer.
 - B. Gaining weight increases the colon cancer risk for men more than it does for women.
 - C. The increased risk is most likely due to other health effects of obesity.
 - D. Men and women of normal weight are at no risk of developing colon cancer.
17. Throughout human history, epidemics have resulted in the deaths of many people. For example, the 'Black Death' in the 14th Century caused the death of one quarter of the population of Europe. Which of the following statements is always true of epidemics?
- A. They are caused by virulent viruses.
 - B. They occur in populations that have been immunised.
 - C. They involve infectious disease that can be transmitted easily.
 - D. They always occur in winter when a population has lowered resistance to infection.

18. A group of Biology students investigated microbes in a variety of water samples taken from a pool, a household tap and a local dam. The students added a few drops of each water sample to different agar plates, taped the lids to the plates and left them in an incubator for 48 hours. The photograph shows one of the agar plates after 48 hours.



Source: Reproduced with permission from Litchfield, Catherine (2024).

Why did the students tape the lids to the agar plates?

- A. It ensured that the students collected reliable data.
- B. It prevented the transmission of potentially pathogenic microbes.
- C. It enabled the plates to be organised more neatly in the incubator.
- D. It prevented heat loss and thus promoted the growth of microbes.

19. Which of the following best describes the transmission of a nerve impulse along a neuron?
- A nerve impulse travels along the axon and neurotransmitters carry it across the synapse.
 - Nerve impulses are carried by red blood cells through the nervous system.
 - Nerve impulses only travel towards the cell body and stop at the dendrites.
 - Electrical signals jump across the synapse from one neuron to another without chemical involvement.
20. Feather colour in some chickens is controlled by multiple alleles, as shown below.

Genotype	Phenotype
E	Black
E^R	Birchen
e^+	Wild-type
e^{Wh}	Dominant wheaten
e^b	Partridge
e^s	Speckled
e^{bc}	Buttercup
e^y	Recessive wheaten

The order of dominance of these alleles is $E > E^R > e^+ > e^{Wh} > e^b > e^s > e^{bc} > e^y$.

A rooster with black feathers and a hen with partridge feathers produce some chicks with black feathers, some chicks with partridge feathers and some chicks with buttercup feathers.

Which of the following rows identifies possible genotypes of the rooster and the hen?

	Genotype of the Rooster	Genotype of the Hen
A.	Ee^b	$e^b e^{bc}$
B.	Ee^b	$e^b e^y$
C.	Ee^{bc}	$e^b e^b$
D.	Ee^{bc}	$e^b e^y$

End of Section I

BLANK PAGE

--	--	--	--	--	--	--	--

Student Number



Barker
College

Biology

Section II Answer Booklet

80 marks*

Attempt Questions 21 - 32

Allow about 2 hours and 25 minutes for this part

Instructions:

- Write your student number at the top of every answer page.
 - 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)

50,000 years ago cheetah (*Acinonyx jubatus*) populations existed in Africa, Asia, Europe and North America. However, approximately 10,000 years ago, at the end of the last ice age, there was a mass extinction of large mammals and the North American and European populations of cheetahs died out. The number of surviving cheetahs dwindled and today the cheetah is an endangered animal with fewer than 8,000 African cheetahs living in the wild and only about 50 Asian cheetahs left.

Explain the process that occurred 10,000 years ago affecting cheetah populations and describe its effect on the gene pool of the surviving cheetahs.

3

Marking criteria:

Criteria	Marks
Clearly identifies and explains the bottleneck effect as the process, and accurately describes the resulting reduction in genetic diversity in the surviving population's gene pool. Provides clear linkage between the event and its genetic consequence.	3
Identifies the bottleneck effect (or describes the extinction event and reduced population) and partially explains its effect on the gene pool, such as mentioning reduced variation or impact on adaptability. May lack detail or clarity.	2
Mentions a population reduction or extinction event with minimal or vague reference to genetic consequences. May contain inaccuracies or lack relevant terminology.	1

Markers Notes:

It was important to mention bottle neck effect in your response with a clear link to the stimulus.

Sample answer:

--	--	--	--	--	--	--	--

Student Number

Explain the process that occurred 10,000 years ago affecting cheetah populations and describe its effect on the gene pool of the surviving cheetahs.

3

The Bottleneck effect (form of genetic drift) could have occurred meaning the sudden change in environment caused most of the population to die, leaving only a few 8000 African and 50 Asian cheetahs. However, the ones that survived only survived due to chance, not because they had more favourable conditions to the new environment. This effects the gene pool as this causes many alleles to be lost, causing the surviving population to not represent the original alleles, as some would be overexpressed and some would be underexpressed, leading to less genetic variety and potentially making the population more vulnerable to further environmental change.

Question 22 (3 marks)

Question 22 (3 marks)

Complete the table below comparing the adaptations of pathogens that assist their transmission between hosts.

3

Type of Pathogen		
Description of adaptation to assist transmission		

Marking criteria:

Criteria	Marks
Identifies type of pathogen e.g. virus, bacteria, protozoan for both columns and describes a valid adaptation for each	3
Identifies type of pathogen and valid adaptation for one column	2
Some relevant information provided	1

Sample answer:

Complete the table below comparing the adaptations of pathogens that assist their transmission between hosts. 3

Type of Pathogen	Bacteria ✓	virus ✓
Description of adaptation to assist transmission	many bacteria's cause the irritation of a human's respiratory system, the human's response is to induce coughing to clear the pathogen, which also spreads the bacteria outside the body and over for distances so it can infect others. so bacteria's can induce coughing to assist their transmission ✓	many viruses can change the appearance of the antigen they express which tricks host cells into letting the virus in as the host cell thinks that doesn't recognise the antigen, so therefore the virus can easily transmit between hosts

protein coat

Markers comments: Surprisingly poorly done – as MANY people talked all about the mode of transmission (how it happens) and not the ADAPTATION that allowed the type of transmission to

--	--	--	--	--	--	--	--

Student Number

occur. MANY responses gave a disease name – and did not actually identify what TYPE of pathogen it was.

A simple dot point that needs to be learned : see text pg 358 for a great table full of all the info for this answer

Question 23 (4 marks)

In the 1860s, Louis Pasteur conducted an experiment using flasks with long, curved “swan necks”. He filled them with nutrient-rich broth, boiled them to kill any microorganisms and left them exposed to air. The broth remained free from microbial growth unless the neck of the flask was broken or tilted, allowing air-borne particles to enter.

Using the information provided, explain how Louis Pasteur’s work contributed to understanding the causes and transmission of infectious disease.

4

Marking criteria:

Criteria	Marks
Clearly explains the experiment, including the control of microbial contamination (boiling and swan-neck), and accurately links the results to disproving spontaneous generation and supporting the germ theory of disease. Explicitly connects findings to understanding both causes and transmission of infectious disease.	4
Describes the experiment and correctly explains its significance in disproving spontaneous generation and/or supporting germ theory. Addresses either cause or transmission , but not both in depth.	3
Provides a basic description of the experiment or its outcome. May mention microorganisms or germ theory, but explanation is limited or lacks clarity. May not link clearly to infectious disease .	2
Makes a general statement about Pasteur or microbes. Limited reference to the experiment or its significance. Minimal or no mention of disease causation or transmission.	1

Sample answer:

Student Number
In the 1800s, Louis Pasteur conducted an experiment using flasks with long, curved "swan necks". He filled them with nutrient-rich broth, boiled them to kill any microorganisms and left them exposed to air. The broth remained free from microbial growth unless the neck of the flask was broken or tilted, allowing air-borne particles to enter.

Using the information provided, explain how Louis Pasteur's work contributed to understanding the causes and transmission of infectious disease.

4

Pasteur's swan-neck flask experiment disproved the idea of spontaneous generation. By proving that microbial growth only appeared when allowing air-borne particles to enter, Pasteur demonstrated that infectious disease cannot be spontaneous and must originate from somewhere. Additionally, Pasteur highlighted the ease of airborne transmission showing it is one of the most difficult forms of transmission to stop. By conducting his experiment, Pasteur was able to show how in the swan neck flask dust & microorganisms got trapped in the bend so were not able to reach the broth as easily as when tilted or broken.

Markers comments: Students need to be careful to mention proving germ theory &/or disproving spontaneous generation as specific terms/concepts. In this instance I did not insist on it if they clearly indicated a link and understanding – but they are crucial terms and should be mentioned.

--	--	--	--	--	--	--	--

Student Number

Question 24 (5 marks)

Opitz-Kaveggia (or FG) syndrome is a sex-linked recessive condition caused by a chromosomal mutation known as an inversion mutation on the X chromosome. People with FG syndrome have a mild intellectual disability, weak muscle tone, and developmental delays.

(a) With the aid of a diagram explain what is meant by a chromosomal mutation.

2

Marking criteria:

Criteria	Marks
Provides a definition of a chromosomal mutation and includes a relevant diagram of one type of chromosomal mutation	2
Provides a diagram with minimal or no explanation or provides an explanation with no diagram	1

Sample answer:

(a) With the aid of a diagram explain what is meant by a chromosomal mutation.

A chromosomal mutation is the change to the structure of a chromosome

In this case it is inversion meaning a section (ABC) has been inverted (CBA)

Markers comments:

Refer to page 238 of textbook:

Chromosomal mutations are large scale changes where either the overall structure of a chromosome or the entire number of chromosomes in a cell is altered, therefore it is a change in number of chromosomes or structure.

This was poorly completed by students with a lack of understanding of the different between a gene mutation and a chromosomal mutation.

Diagrams were very difficult to interpret with no linking to description.

M = correct definition

D = correct diagram

Many students used the letter assigned to nucleotides ATCG, this could be misleading as it might just be indicating a section of a gene. So careful to select different letters.

(b) A married couple are wanting to start a family and are wondering what their chances are of having a child with FG syndrome. Neither the man or woman have FG syndrome, but the woman's father suffered from the condition.

Use a Punnett square to determine the chances of the couple having a child with FG syndrome. Show ALL working.

3

Marking criteria:

Criteria	Marks
Draws the correct punnett square showing parents, identifying the child with FG syndrome and showing the chances of the couple having a child with FG	3
Missing one of the above criteria	2
Missing two of the above criteria	1

Sample answer:

Use a Punnett square to determine the chances of the couple having a child with FG syndrome. Show ALL working.

Key:
 X^F = unaffected by FG syndrome (dominant)
 X^f = Affected by FG syndrome (recessive)

Man genotype must be $X^F Y$, as he is unaffected by FG
 Woman must be $X^F X^f$, as father expressed FG syndrome

Man	X^F	Y
Woman	X^F	X^f
X^F	$X^F X^F$	$X^F Y$
X^f	$X^F X^f$	$X^f Y$

∴ 75% of offspring ~~express~~ do not have FG syndrome ($X^F X^F, X^F X^f, X^F Y$)
 25% of offspring ~~will~~ will be male affected with FG syndrome ($X^f Y$)

Therefore, there is a 25% (1/4) chance that the couple will have a child with FG syndrome

16

Markers Comments:

P = correct Punnett square

C = identifying the correct proportion

L = linking the correct genotype of the child in the answers in Punnett square to the phenotype.

Reasonably well done.

Easiest marks were lost as student did not link the Punnett square to their answer – just having a punnet square and writing a 25% chance of a child did not receive the 'L' mark. You needed to clearly demonstrate link the phenotype of the child with the condition genotype. The better answers had a simple sentence stating this.

Many students did not use a key for the symbols for the traits, those that did demonstrated better understanding how to determine a Punnett Square.

--	--	--	--	--	--	--	--

Student Number

Several students struggled with the concept of X-linked Punnett Square, and many just used autosomal Punnett Squares. If you were able to demonstrate a correctly solved punnett square you were able to receive 1 mark.

Question 25 (5 marks)

Lactase is necessary for the digestion of lactose and without this enzyme, a person cannot tolerate lactose in their diet.

FIGURE 1: is an mRNA codon table

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

The normal lactase enzyme has the following partial DNA sequence:

C C A T A G C A C G T T A C A

This codes for the amino acid sequence: Gly, Ile, Val, Gln, Cys

(a) Complete the following table for a *mutated* partial DNA sequence for lactase.

4

DNA read strand sequence	C C A A A G C A C G T T A C A				
mRNA					
Amino acids					
Type of mutation (circle only one)	deletion duplication substitution insertion				
How did the mutation affect the amino acid sequence?	Premature stop signal	1 amino acid is changed	1 amino acid is	All the amino acids change	

(circle all that are appropriate)			added/ deleted	after the mutation
-----------------------------------	--	--	-------------------	-----------------------

Marking criteria:

Criteria	Marks
Correct mRNA sequence, correct amino acids, Correct type of mutation, correct effect on sequence	4
3 out of 4 correct	3
2 out of 4 correct	2
1 out of 4 correct	1

Sample answer:

C C A T A G C A C G T T A C A

This codes for the amino acid sequence: Gly, Ile, Val, Gln, Cys

(a) Complete the following table for a *mutated* partial DNA sequence for lactase.

4

DNA read strand sequence	C C A A A G C A C G T T A C A				
mRNA	G G U U U C G U G C A A U G U				
Amino acids	Gly	Phe	Val	Gln	Cys
Type of mutation (circle only one)	deletion	duplication	<u>substitution</u>	insertion	
How did the mutation affect the amino acid sequence? (circle all that are appropriate)	Premature stop signal	<u>1 amino acid is changed</u>	1 amino acid is added/deleted	All the amino acids change after the mutation	

✓ 4

Markers Comments: The majority of students achieved 100% on this question.

This process is well understood.

Errors were the transcription of mRNA into amino acids and reading the mRNA table to translate codons into amino acids.

--	--	--	--	--	--	--	--

Student Number

Note, for Gln – some student's n look like a u – which is a different amino acid Glu- careful to check that your writing is clear.

For students that made an error in reading DNA and converting to mRNA so that they got a stop code, they then indicate later in the table that a stop codon was produced. No error carried forward but max mark for the question was 2.

(b) Will this person be lactose intolerant? _____ 1

Marking criteria:

Criteria	Marks
Correct answer – “Yes”	1

Sample answer:

(b) Will this person be lactose intolerant? yes ✓ 1

Markers comments: Well understood.

Question 26 (7 marks)

Panama disease is considered one of the most destructive diseases of banana plants worldwide. It is caused by a soil borne fungus, *Fusarium oxysporum*. The disease enters the plants through the roots and blocks the vascular system, preventing water and nutrient transport, leading to wilting, yellowing and eventual death of the plant. The fungus survives in the soil for long periods and is spread through contaminated soil, water and plant materials.



Bananas affected by Panama disease caused by the fungus *Fusarium oxysporum*.
Source: ABC News

- (a) From the photo, identify a symptom of Panama disease in bananas.

1

Marking criteria:

Criteria	Marks
Identifies a symptom of Panama disease e.g. black spots on bananas	1

Sample answer:

- (a) From the photo, identify a symptom of Panama disease in bananas.

Cell death on the banana skin peel.

✓ 1

Markers Comments: Students were confident in responding to this question but their description had to be from the photo. You cannot see wilting in the leaves.

- (b) Plants do not have complex immune systems in the same way animals do, but they have developed physical and chemical barriers in response to pathogenic infections.

Outline a response that plants have to defend themselves against disease.

2

Marking criteria:

Criteria	Marks
----------	-------

--	--	--	--	--	--	--	--

Outlines a response and links to disease prevention	Student Number	2
Identifies a response		1

Sample answer:

Outline a response that plants have to defend themselves against disease.
 Programmed cell death to ^{try and} prevent the spread of the pathogenic infection.
 They do this by purposely killing the infected cells to hopefully kill the pathogens host and stop the spread of it.

✓ 2

Markers Comments: Well done, with an overall sound understanding of the processes used in a plant. Needed to link response to stop/killing/preventing pathogen into plant for the second mark.

Question 26 (continued)

(c) Assess the effects of plant diseases on agricultural production in Australia.

4

Marking criteria:

Criteria	Marks
Provides a comprehensive assessment of the effects of disease on agricultural production, showing clear understanding of multiple interrelated impacts (e.g. yield, economy, food security at least 2). Includes some judgement or evaluation of severity or significance.	4
Provides a detailed description of several effects with some implicit assessment. Shows good understanding of key impacts, though judgement or evaluation may be limited or general. May lack depth	3
Identifies some effects with basic explanation. Lacks depth or detail. Response may be descriptive rather than analytical. Assessment is limited or superficial.	2
Limited response – lists an effect or two with little or no explanation. Minimal understanding of how disease affects agricultural production. No assessment.	1

Sample answer:

Question 26 (continued)

↑ time + cost treating
↓ yield
↓ productivity
→ e.g. citrus canker

3	8	7	7	2	9	9	6
---	---	---	---	---	---	---	---

Student Number

- (c) Assess the effects of plant diseases on agricultural production in Australia.

Plant diseases have a significant effect on
agricultural production in Australia. These
effects include reduced productivity due to
increased time and cost spent treating and
managing the disease, as well as reduced yield
of production to sell. For example, citrus canker is
a plant disease which causes lesions that make plants
lose their leaves and drop fruit prematurely. This
significantly negatively affects agriculture production,
putting a large mental impact on farmers as well.

End of Question 26

expand more detail

4/4

J

E2 L2

E1 L1

--	--	--	--	--	--	--	--

Student Number

- (c) Assess the effects of plant diseases on agricultural production in Australia.

4 4

Plant diseases have a detrimental effect on agricultural production. Plant disease likely causes plant death, e.g. Panama disease, and thus will result in the loss of functionality in agricultural plots as they cannot be harvested. Further, they have an economic effect as agricultural producers will experience a decrease in revenue as they have a loss of supply in plants. The producers will have to spend their time growing new plants in order to increase the supply of plants, increasing costs per plant production. Finally, plant diseases can result in the removal of the species-specific plants in production, where farmers may choose to produce a plant which is not susceptible to the disease to prevent outbreaks of disease. Thus, plant diseases have a detrimental effect on agricultural production, as it results in the loss of plant population and causing farmers to have to reallocate their resources.

End of Question 26

Markers comments:

A straight forward question, which many students waffle through as they were unsure of how to answer, those that planned out a response performed better as they were able to show clear links. Dip doubling for marks was not paid, as selling the produce equated to increased profits – all taken as monetary gain.

An assess question requires a judgement. Many students said ‘significant’ effect and I paid this as there responses indicated a negative impact. The better responses clearly gave a valued judgement like – detrimental, significantly negative etc.

Basically, looking for an effect in the following areas due to the presence of disease

- Change in plant- dies
- Change in amount of produce
- Change in quality of produce

J = judgment

E1, E2 = effect

L1, L2 = clear link to an impact

Impacts	
Economic	Decrease in yield, unable to be sold, increased in production cost due to fungicides/pesticides. Market restriction, trade bans etc
Environments	Increase in chemicals entering food chain Pathogens remain in the soil for extended periods of time and thus the soil/area is unusable
Social	Reduced income for farmer, increase in price for consumers, impact supply chain.

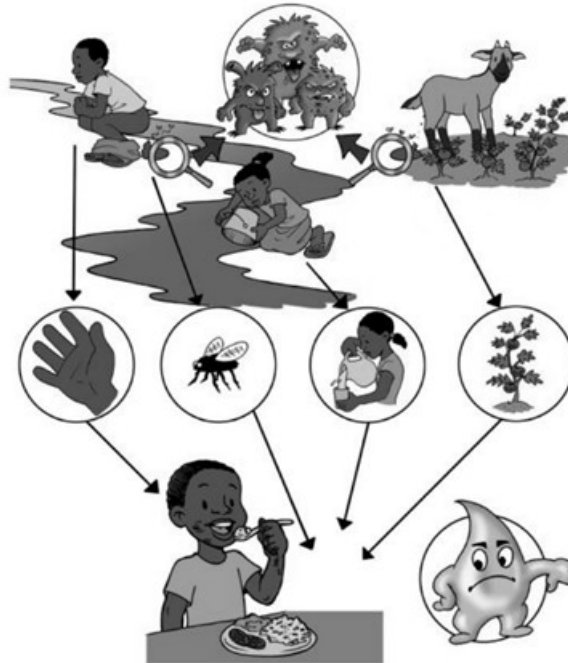
End of Question 26

--	--	--	--	--	--	--	--

Student Number

Question 27 (11 marks)

Cholera is a bacterial disease that causes vomiting, diarrhoea, dehydration and death in humans. The diagram below shows the Five “Fs” of transmission of cholera: fluids, fingers, flies, foods, and fields.



- (a) Using the diagram, describe procedures that could be employed to prevent the spread of cholera at a local level.

6

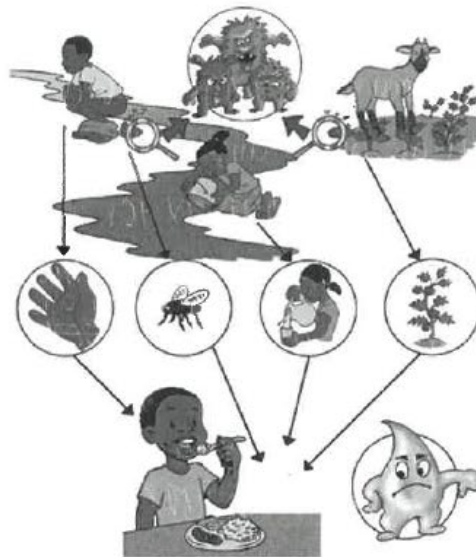
Marking criteria:

Criteria	Marks
Provides a comprehensive and accurate description of procedures targeting all or most of the Five “Fs” (fluids, fingers, flies, foods, fields). Uses specific, scientifically accurate actions (e.g. water purification, handwashing, sanitation). Clearly shows how each procedure prevents transmission.	6
Describes multiple relevant procedures targeting at least four of the Five “Fs”. Procedures are mostly accurate, with clear links to cholera prevention. Minor omissions or simplifications may be present.	5
Describes three or more accurate procedures, some of which are linked to different “Fs”. Explanation may lack depth or clarity in places, but shows sound understanding of how to prevent cholera.	4
Identifies and describes two or three valid procedures, though explanations may be general, vague or incomplete. Some link to cholera prevention is shown.	3
Mentions one or two relevant procedures, but with minimal detail or unclear links to cholera transmission. Shows limited understanding.	2
Makes one basic or vague statement related to hygiene or disease prevention with little or no relevance to cholera specifically.	1

Sample answer:

Question 27 (11 marks)

Cholera is a bacterial disease that causes vomiting, diarrhoea, dehydration and death in humans. The diagram below shows the Five "Fs" of transmission of cholera: fluids, fingers, flies, foods, and fields.



- (a) Using the diagram, describe procedures that could be employed to prevent the spread of cholera at a local level.

① Use of ~~the~~ ^{fly} nets ~~when~~ to cover food prior to eating → this will help prevent ~~disease~~ as fly can act as vectors in spreading the disease to other organisms, thus reducing ~~the~~ ^{net} spread of disease to food.

② washing hands after defecating and before eating food → prevent build up of pathogenic material (Cholerae vibrio) on body and therefore avoid infection of contaminating foods which will be ingested.

③ Use of toilets → implementation of infrastructure and communal toilets, to ensure that individuals do not defecate in open streams of water, helping prevent likelihood of ingesting contaminated water.

Question 27 continues on page 21

④ Boil and sterilise water ^{possibly} with chlorine to remove any microbes which may be present in water → ~~that~~ ^{prevent} reducing likelihood of ~~the~~ consuming, thus preventing spread.

I think you mean defecate

--	--	--	--	--	--	--	--

Student Number

Markers comments:

In order to gain full marks students needed to address most of the five “Fs” in the diagram. That means each procedure need to be described and you needed to show how the procedure prevented the spread of disease.

Fingers – washing hands after going to the toilet or before eating as this removes pathogens from hands and decrease chances of infection and transmission

Fluids – boiling water before drinking it or using it for cooking as this kills bacteria.

Therefore less chance of infection and less chance of transmission.

Flies – cover food with netting or a cloth to protect it from flies who could be carrying the bacteria. In this way food is free from contamination and the disease cannot be transmitted.

Food – make sure vegetables are washed in clean, sterile water to remove pathogens and make sure food is cooked properly to kill pathogens. This reduces chances of infection and transmission.

Fields – don’t use human waste to fertilise crops as it could contaminate crops with cholera.

Treat any waste before using it on crops.

Many students talked about features that were not on the diagram like vaccination, preventing travel and quarantine. You have to use the stimulus to answer the question.

Question 27 continues on page 21

Question 27 (continued)

- (b) Analyse the range of interrelated factors involved in limiting the regional and global spread of cholera.

5

Marking criteria:

Criteria	Marks
- Explains a wide range (3 or more) of interrelated factors. - Clearly shows how the factors interact to limit spread. - Uses relevant examples, data, or mechanisms at both regional and global scales.	5
- Explains at least three factors. - Some links between factors identified. - Includes examples or mechanisms to support points.	4
- Explains at least two factors with some detail. - Limited reference to how factors interrelate. - May include examples.	3
- Identifies two factors with minimal explanation or one factor explained in some detail. - No clear link between factors. - Few or unclear examples.	2
- Identifies one factor with little or no explanation. - No mention of interrelation.	1

Sample answer:

--	--	--	--	--	--	--	--	--	--

Student Number

- (b) Analyse the range of interrelated factors involved in limiting the regional and global spread of cholera.

5

F₁ Regionel: regional factors involved in limiting cholera spread involve increased funding for reliable, good quality clean water supplies throughout the regions, to reduce the shared water source between drinking water and bathroom water, thus reducing infected faecal transmission via infected water.

A • Regional factors would be interrelated to this by more appropriate hygiene facilities set up and funded for, such as public indoor restrooms which relates to water contamination by preventing faecal contaminated water.

End of Question 27

F₂ • Another regional factor would involve funding hospitals to be set up in communities or health clinics and practitioners to help treat the disease and identify symptoms early to effectively prevent the level of transmission.

L • Global: in relation to this, such health clinics could be set up with international aid as sending educated health workers to countries of lower socioeconomic status can allow doctors to share their expertise and teach local doctors and villagers how to control disease spread.

F₃ In extreme cases border closures can be utilised to manage disease spread globally, as it can be contained and reduced in a specific region preventing its global spread. Regionally vaccination can also be effective by isolating the infectious individuals.

→ Clean water sources
→ Crops - transfer of crops
→ Global - int. aid, border closures if extreme
→ Regionel - funding, hospitals set up
→ Regionel - hygiene

A range of interrelated factors limit the regional and global spread of cholera. Firstly, improved water treatment infrastructure ensures access to clean drinking water, which directly reduces the risk of faecal-oral transmission through contaminated fluids. Secondly, effective sanitation systems, such as proper sewage disposal, prevent contamination of water sources and agricultural fields. These systems are often supported by government investment and international aid programs.

Thirdly, public health education campaigns play a critical role by teaching communities about hygiene practices such as handwashing, safe food preparation, and the importance of boiling or treating water. These behavioural changes reduce transmission via fingers and food.

At the regional level, cross-border surveillance systems and rapid response teams help detect and contain outbreaks quickly, especially in refugee camps or disaster zones. Globally, the World Health Organization and NGOs coordinate vaccine distribution and monitor outbreaks, providing resources to high-risk areas. All these factors are interconnected; for example, health education increases the community's use of clean water and sanitation, which amplifies the effectiveness of infrastructure investments. Together, they form a coordinated effort to reduce the spread of cholera across local, regional, and global scales.

Markers Comments:

In order to gain full marks in this question students needed to write about regional strategies and global strategies for dealing with cholera. There needed to be analysis of the reason for the factor as well as a clear indication showing the link between global and regional factors. Many students talked about local factors. Other errors were quarantine and food exports. These are not used in the case of cholera. Some students referred back to the question on ebola from a previous assessment. Factors from one assessment do not necessarily apply to another. Regional and global factors include:

- water treatment, sanitation systems provided by government investment or international aid
- public health programs
- surveillance and rapid response
- vaccine distribution from WHO/governemnts
- travel/migration restrictions
- misuse of antibiotics
- communication

Letters on the paper were:

F1, F2, F3 – relevant factors involved in limiting the spread of cholera

A – analysis of the factors saying how they affect the spread

L – a link between regional and global to show interrelatedness.

End of Question 27

--	--	--	--	--	--	--	--

Student Number

Question 28 (5 marks)

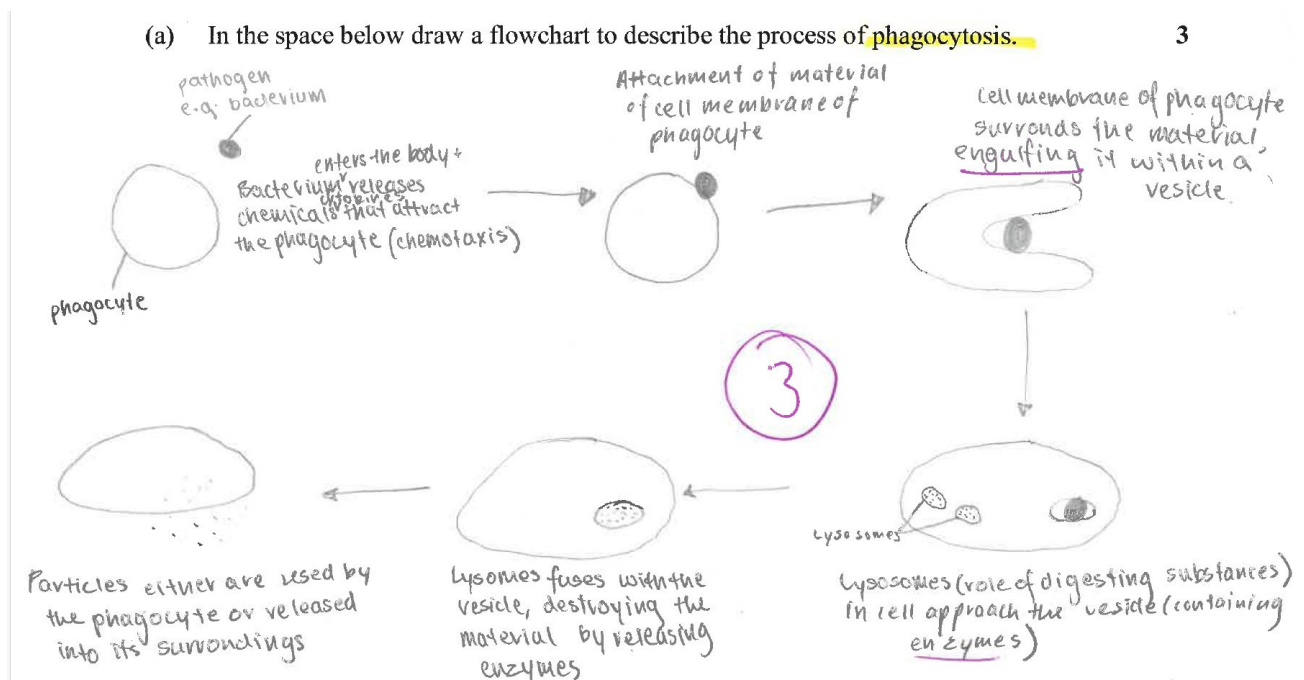
(a) In the space below draw a flowchart to describe the process of phagocytosis.

3

Marking criteria:

Criteria	Marks
Flowchart includes all key stages of phagocytosis in correct order: recognition, engulfment, and digestion of the pathogen. Diagram is clearly labelled and easy to follow.	3
Flowchart shows some understanding of phagocytosis with at least two correct steps in appropriate order. May be missing detail or clear labelling.	2
Flowchart includes one correct step of phagocytosis or shows basic understanding (e.g., engulfment only) but lacks structure or clarity.	1

Sample answer:



Markers comments:

In order to gain full marks students needed to draw a flowchart and include **DETAIL** on the phagocyte **detecting** the pathogen; the phagocyte moving towards and **engulfing** the pathogen and; lysosomes fusing with the vesicle and releasing **enzymes to digest** the pathogen. It isn't enough to just draw pictures with no description.

(b) Explain how phagocytosis protects the body against infection.

2

Marking criteria:

Criteria	Marks
Clear and accurate explanation of how phagocytosis protects the body. Includes destruction of the pathogen to prevent infection.	2

Basic or partially correct explanation. Mentions engulfing or destroying pathogens but lacks detail or clarity.	1
---	---

Sample answer:

- (b) Explain how phagocytosis protects the body against infection.

2

where phagocytes
 Phagocytosis... is... the... process... ~~not~~ recognises that
 (macrophages, long lasting or neutrophils, short term). recognises
 antigens on pathogens which enable them to engulf and
 destroy the pathogen which protects the body against
 infection as destroying pathogens will prevent the
 pathogen from being able to replicate / reproduce
 and spread causing more severe infections.

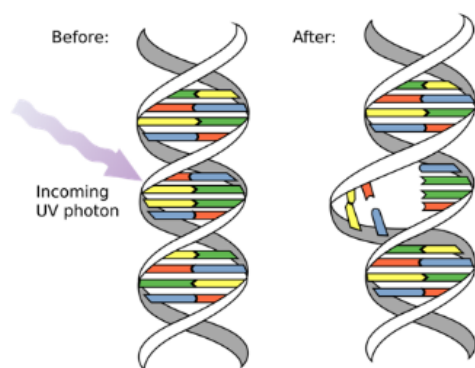


Markers comments:

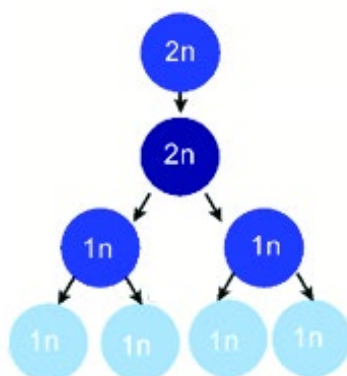
In order to gain full marks students needed to talk about phagocytosis killing the pathogen, halting replication of the pathogen and preventing the pathogen from infecting other cells and progressing the disease.

Question 29 (8 marks)

The diagrams below show key stages in the production of gametes and their fusion during fertilisation in sexually reproducing organisms.



Mutation



Meiosis



Fertilisation

Referring to the diagrams above, explain how meiosis, fertilisation and mutation each contribute to genetic variation in sexually reproducing populations. In your answer, include specific references to the processes occurring and evaluate their relative importance in contributing to genetic diversity. 8

Marking criteria:

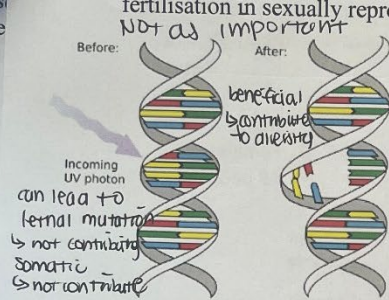
Criteria	Marks
Includes reference to all three diagrams	7-8
Thoroughly describes all three processes	

--	--	--	--	--	--	--	--

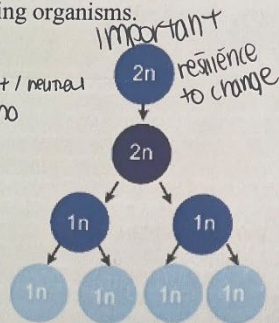
Student Number	
Thoroughly explains how all three processes introduce variation Evaluates the contribution of all three processes to genetic diversity	
Provides a judgment for at least one process Explains three processes Refers to at least two diagrams	6
Explains three processes Refers to at least 2 diagrams	5
Explains two processes	4
Explains at least one process	3
Describes one process	2
Some relevant information	1

Sample answer: This person has neat legible writing, used sub-headings and made a plan for the answer AND wrote that extra paper was used. Well done!

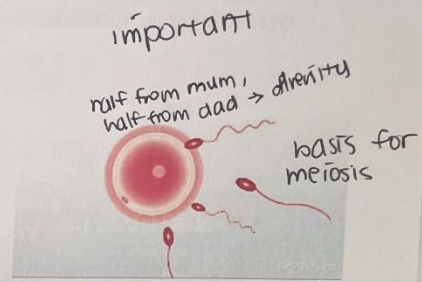
The diagrams below show key stages in the production of gametes and their fusion during fertilisation in sexually reproducing organisms.



Mutation



Meiosis



Fertilisation

Referring to the diagrams above, explain how meiosis, fertilisation and mutation each contribute to genetic variation in sexually reproducing populations. In your answer, include specific references to the processes occurring and evaluate their relative importance in contributing to genetic diversity. 8

MEIOSIS

Meiosis is the process when a ^{diploid cell} ~~cell~~ undergoes 2 divisions to form 4 genetically different ^{haploid} daughter ~~cells~~ ^{gametes as shown in the diagram}. During prophase I, ~~the~~ crossing over occurs, which is when ~~a~~ a section of chromatids from non-homologous chromosomes break off and attach to another chromatid. This causes genetic recombination as the daughter cells ~~will~~ will have different chromosomes than the parent. During metaphase I, independent assortment occurs, which is when the tetrads ~~line~~ line up randomly along the equator, and break apart randomly. In telophase I, this also causes genetic recombination, as the ~~cells~~ resulting daughter cells are genetically different from each other and the parent cell, shown in the different coloured cells in the diagram. Together, these cause genetic variation in the offspring, which is very important in contributing to genetic diversity as it ensures that the individuals in a population are all different, increasing the chance of survival during ~~the~~ environmental changes to ensure the continuity of species.

Continued on extra writing space

--	--	--	--	--	--	--	--	--	--

Student Number

If you choose to use this space, clearly indicate which question you are answering.

29. Fertilisation

Fertilisation refers to the fusing of haploid male and female gametes to produce a diploid zygote. ^{as seen in the diagram} This happens through the process of acrosome reaction, which is when the sperm releases ~~digestive~~ ^{destructive} enzymes to overcome the barriers of ^(they physically push through) corona radiata, zona pellucida and the cell membrane to finally fuse with the egg's nucleus. ^{as seen in the diagram where 1 sperm enters the egg} Then, the zygote undergoes numerous cell divisions to become an embryo after implantation (attaching to uterus wall). Therefore, fertilisation ~~is a result of~~ ^{is the basis of} sexual reproduction and meiosis to ~~introduce~~ ^{contribute to} genetic variation in the population since the offspring gets half the genes from the mother and half from the father. This makes it very important in genetic diversity, and without fertilisation the gametes produced in meiosis are ~~not~~ put to use.

Mutation

Mutation is a permanent change in the nucleotide sequence of DNA. This can be random, or caused by environmental factors, as shown in the diagram of UV photon. ~~The~~ All mutations, except silent mutations, lead to genetic diversity as the protein produced will be somewhat different from other members of the population. For example, like the diagram, UV photons cause dimers to form in neighbouring nucleotides like T-T. This results in a different DNA that is going to be replicated, leading to genetic variation. However, some mutations, such as ^{harmful} ~~harmful~~ mutations ~~and~~ ^{and} somatic mutations will not cause long term genetic diversity as the harmful mutation ~~cause~~ ^{causes} individuals to

die, and somatic mutations do not get passed onto offspring (only exist for one generation). Beneficial ^{germline} mutations, on the other hand, enhance genetic diversity as the ~~varied~~ ^{various} favourable traits can be passed on to offspring. This is important as it preserves the continuity of species by promoting genetic diversity. Overall, mutations are not as important as meiosis and fertilisation in contributing to genetic diversity, as ~~they~~ ^{they} don't necessarily leave a long term impact on the population.

Markers Comments:

A number of students put forward strong responses to this question. To get full marks however you needed to include all parts as outlined in the question. A concerning large number of students did not plan their response and therefore missed key parts as outlined in the question. Better responses included sub headings – this helps the student AND the marker to keep track of their argument.

Some points to consider:

- If you have poor hand writing PLEASE slow down and spend more time on ensuring your letters are written correctly. Also please use sub headings or other scaffolds that will help the marker read your work. Some answers had to be read 4 or 5 times in order to give a mark.

- I feel like I have said this before (???)**YOU MUST**

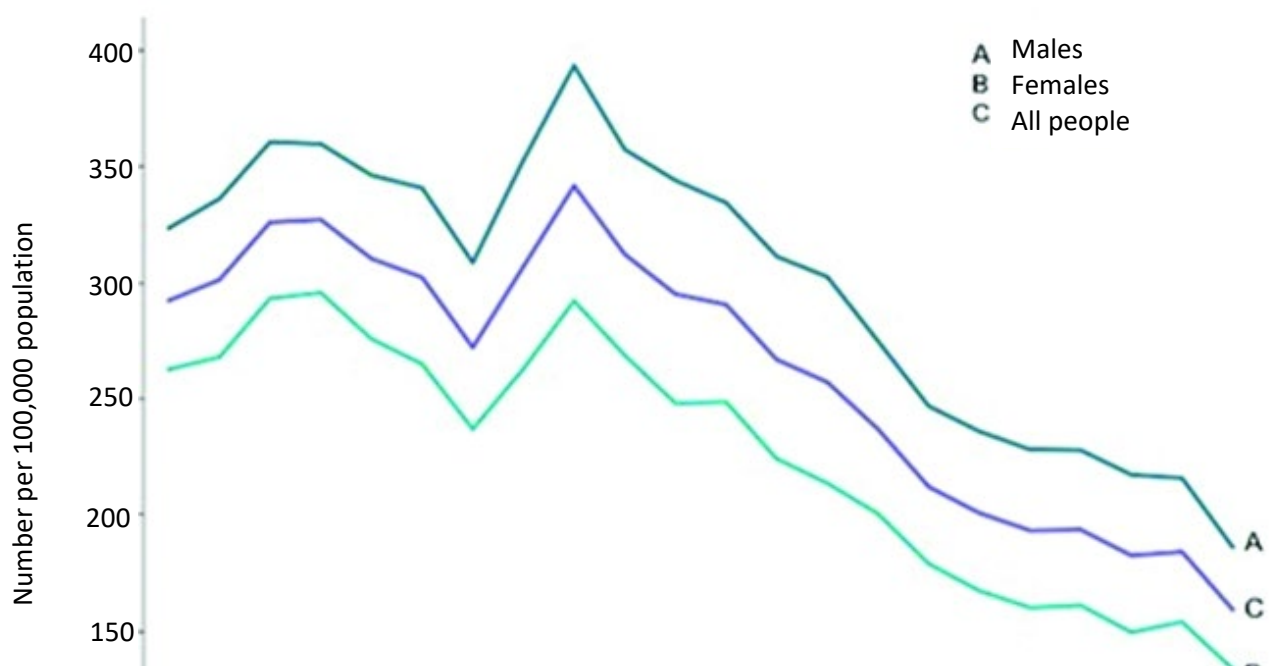
**PLAN
YOUR RESPONSE –
IN WRITING.**

The wording in this question was very straight forward and provided an outline of everything you needed to include in your answer. Many people wrote excellent science BUT did not address the verb evaluate and so could not get more than 5 marks.

- Some students added in content that was not relevant – try to stick to what the question is asking.

Question 30 (13 marks)

Type 2 diabetes is a condition in which the body becomes resistant to the normal effects of insulin and gradually loses the capacity to produce enough insulin in the pancreas. Symptoms include excessive thirst, feeling tired and hungry, slow healing cuts and weight gain. There is no cure for type 2 diabetes, the condition is managed through lifestyle modifications and medication.



--	--	--	--	--	--	--	--

Student Number

Figure 1: Incidence of type 2 diabetes, by age and sex, 2000-2021 Australia
Source: www.aihw.gov.au

Question 30 continues on page 25

Question 30 (continued)

A ■ Males **B** ■ Females **C** ■ All people

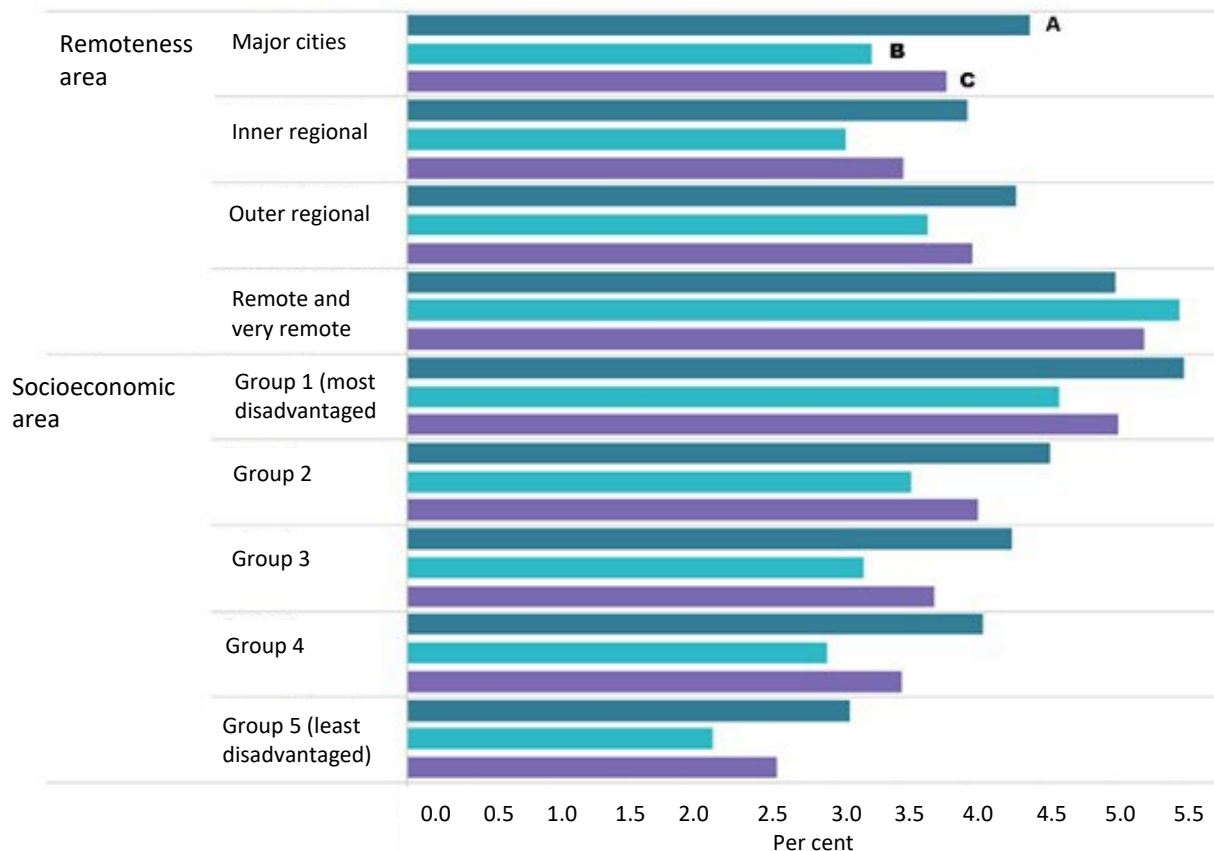


Figure 2: Prevalence of type 2 diabetes, by selected population group and sex, 2021

Source: www.aihw.gov.au

Refer to Figures 1 and 2 to answer the following questions

- (a) The “Life!” Program was introduced in Australia in 2008 and was aimed at helping Australians reduce the risk of developing type 2 diabetes through group sessions and telephone health coaching. Using data from the graphs, evaluate the effectiveness of this program.

3

Marking criteria:

Criteria	Marks
Includes a clear judgement. Detailed description of at least one figure. Includes relevant data.	3
Includes a judgment and description of relevant figure. May include data.	2
Describes a feature of at least one figure	1

Sample answer:

Note the clear judgement at the start of this response:

--	--	--	--	--	--	--	--

Student Number

Refer to Figures 1 and 2 to answer the following questions

- (a) The "Life!" Program was introduced in Australia in 2008 and was aimed at helping Australians reduce the risk of developing type 2 diabetes through group sessions and telephone health coaching. Using data from the graph, evaluate the effectiveness of this program.

3

Overall, this program ~~was~~ is effective in reducing the risk of developing type 2 diabetes. In Figure 1, the no. of new cases of type 2 diabetes in 2008 hit a peak of 340 cases per 100,000 population of all people. After 2008, the no. of new cases gradually decreases to a low of approx. 160 cases per 100,000 population of all people. This significant decrease proves the effectiveness of the program as it has been able to reduce the risk of developing diabetes. However, inequalities still persist amongst less fortunate people, such as remote and low income inhabitants, as they have high prevalence percentages of 4.8-5.3%. ~~However~~ Therefore, some strategies should be implemented in less fortunate areas, but overall for the general population, the program is effective.

Question 30 continues on page 26

Markers Comments:

Overall answered well by students. A few reminders:

- The verb evaluate requires a judgement. Make your judgement OBVIOUS eg the first sentence. You could not get more than 1 mark without a judgement.
- Some of you still need to work on your hand writing. It is going to be even harder to read your paper in the final exam as it will be scanned. This is going to cost you marks. Please slow down so you can write each letter properly.
- You need to include DATA in your response. Ideally this question should have been answered with reference to Figures 1 and 2 but given the way the question was worded we decided to accept answers that only referred to Figure 1. This won't always be the case.
- Some of you included VERY brief reference to data. This made it unclear what you were writing about. Eg you need to say Figure 1 gave INCIDENCE data. Take the time to write that incidence was given per 100,000 people. If you abbreviate too much your answer won't necessarily make sense.

Question 30 (continued)

- (b) Compare the prevalence of type 2 diabetes in males and females in major cities and remote and very remote areas.

4

Marking criteria:

Criteria	Marks
Clearly compares prevalence between males and females, and across both major cities and remote/very remote areas. Includes the use of relevant data accurately. Makes a correct value judgment for both males and females in both major cities AND remote/very remote areas.	4

Clearly compares prevalence between males and females, and across both major cities and remote/very remote areas. Makes a correct value judgment for both males and females in both major cities OR remote/very remote areas.	3
Provides a value judgement with no data for all demographics OR Presents all data correctly with no value judgement/comparison. OR Provides some data and some value judgements.	2
Relevant information	1

Sample answer:

The prevalence of type 2 diabetes in males in major cities is less than (4.4%) the prevalence in males living in remote/very remote areas (5%).

The prevalence of type 2 diabetes in females living in major cities is also less than (3.2%) than females living in remote/very remote areas (5.4%).

Markers Comments:

Answered quite well across the cohort.

- When quoting data, be careful to make sure the references are correct, particularly when reading graphs. It may be easier to rule a line on the graph to make sure the numbers are correct and don't appear as guesses.
- Prevalence is not the chance of developing a disease. It is important to let the marker know what you understand about the question and not just use words randomly.
- When asked to compare, you need to include a value statement. Words like increase, decrease, more less, are all helpful when answering these questions.
- PLAN YOUR ANSWER! This response did not require a lot of writing and could have been quite concise if planned properly.

(c) Suggest possible reasons for any differences observed.

2

Marking criteria:

Criteria	Marks
Provides 2 valid reasons for the differences	2
Provides only one valid reason for the differences	1

Sample answer:

Provides 2 clear, valid reasons

The number of people diagnosed with type 2 diabetes in major cities would be greater than those in remote areas as the population size tend to be greater.

People in major cities would have greater access to medical care that could be accessed earlier as type 2 diabetes is a nutritional disease, it can be reduced earlier with preventative action.

--	--	--	--	--	--	--	--

Student Number

Less access to medical care in remote/very remote areas which may lead to action being taken after diagnosis rather than taking preventative action.

Markers Comments:

Most were able to identify 1 reason for the differences. There were many responses that restated the same reason over again.

Again, planning is key. Set out your response in dot points if you must so that the marker can identify the reasonS you have identified.

Question 30 continues on page 27

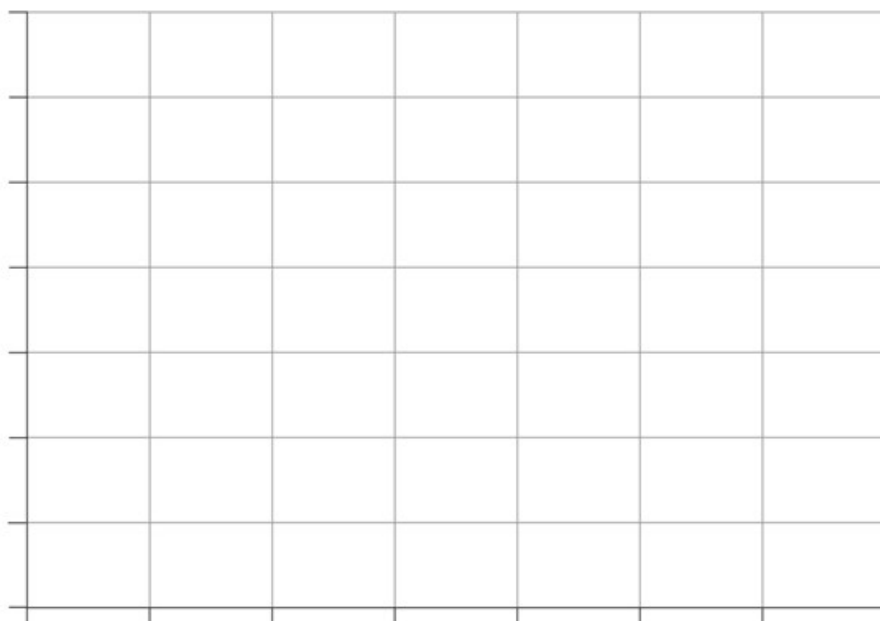
Question 30 (continued)

- (d) Glaucoma is a disease that damages the optic nerve in the eye. A group of researchers conducted a study to investigate a potential link between diabetes and glaucoma. The researchers selected a sample of participants who have diabetes and recorded the amount of time that had passed since each participant was diagnosed with diabetes. They also recorded the percentage of participants who had experienced glaucoma.

The results are shown in the table.

<i>Duration of diabetes (years)</i>	0	5	10	15	20	25	30	35
<i>Percentage of participants with glaucoma</i>	0	2	3	4	6	8	11	13

- (i) On the axes provided, draw and label a graph of the data. 3



Criteria	Marks
- Provides a suitable graph - Provides a graph that is correctly drawn including labels and scale for axes, points plotted correctly, appropriate line of best fit	3
Provides a graph that includes most aspects correctly	2
Provides suitable aspects of a graph	1

Markers Comments:

Done quite well.

- There are still some dot to dot and sketchy lines being drawn. This has been marked down at HSC marking in the past which is why I marked this way. A graph is to show an overall pattern or trend in data; one definite line in a curve or a straight line is enough.
- This was a curve. As it was only subtle, a straight line of best fit was accepted.
- Go over graphing basics: mark an x for your plot. If a part of the X touches the point you will get the mark. Marks are deducted at HSC if your plot is not correct (only needs to be 1 point).
- IV on X axis, DV on Y axis. Be careful to include an even scale. One mistake with counting grids will also lose marks.

(ii) Construct a hypothesis for this investigation.

1

--	--	--	--	--	--	--	--

Student Number

Marking criteria:

Criteria	Marks
Provides a hypothesis that includes correct mention relationship between dependent and independent variable	1

Sample answer:

As the time since diabetes diagnosis increases so do the number of glaucoma cases.

Markers Comments:

Done very well. Just needed to identify a link between the IV and DV.

End of Question 30

Question 31 (9 marks)

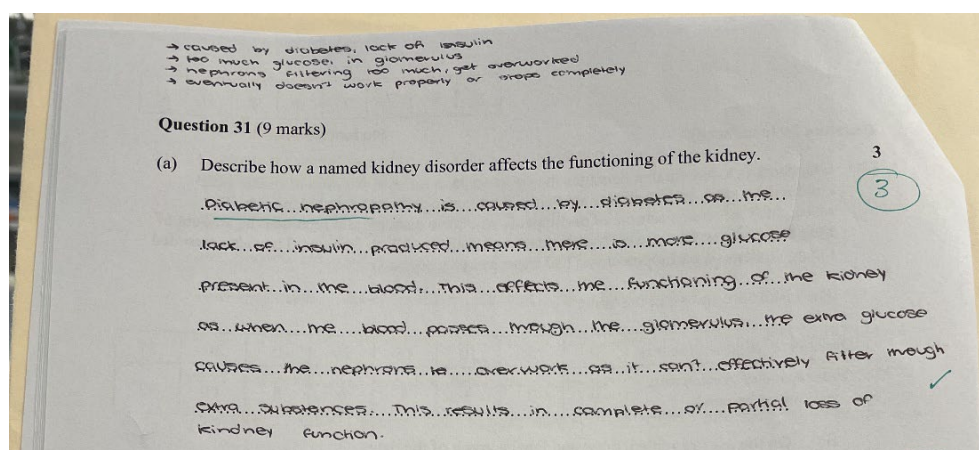
(a) Describe how a named kidney disorder affects the functioning of the kidney.

3

Marking criteria:

Criteria	Marks
Identifies a specific kidney disorder (e.g. glomerulonephritis, polycystic kidney disease) and clearly describes how it affects kidney function, including effects (e.g. filtration, reabsorption, urine production). Uses accurate scientific terminology, such as “urea”.	3
Names a kidney disorder and provides a basic description of how it affects kidney function. May include only one clear effect or limited detail.	2
Mentions a kidney disorder or gives a general effect on kidney function without clear description.	1

Sample answer:



Markers Comments:

Generally well attempted. Refer to the marking criteria.

(b) Describe a treatment option available to a patient with kidney disease and evaluate the effectiveness of this treatment to assist with the management of this disorder.

6

Marking criteria:

Criteria	Marks
Clearly identifies and accurately describes a specific treatment option using correct biological terminology. Includes detailed explanation of how the treatment supports or replaces kidney function. Provides a thorough and balanced evaluation, discussing both benefits (e.g., symptom relief, survival rate, quality of life) and limitations (e.g., risks, lifestyle changes, costs, access). Shows a high level of insight into the management of kidney disease and how the treatment improves patient outcomes.	6
Describes a relevant treatment with mostly accurate and appropriate detail. Includes a clear explanation of how the treatment manages kidney disease.	5

--	--	--	--	--	--	--	--

Student Number	
Evaluation includes both strengths and weaknesses, though may lack some depth or balance. Demonstrates a solid understanding of the treatment's purpose and outcomes.	
Treatment is identified and described with some biological detail, though may be incomplete. Explanation of how the treatment works is adequate but not comprehensive. Evaluation includes at least one benefit and one limitation, but may be general or lack detail. Demonstrates a sound understanding of the role of the treatment in disease management.	4
Treatment is mentioned and superficially described, possibly with minor errors or vague statements. Limited explanation of how the treatment works or supports kidney function. Evaluation is present but superficial, may include only a benefit or only a drawback, or may be simplistic. Shows a basic understanding of kidney disease treatment.	3
Treatment is named but description is minimal or mostly inaccurate. Evaluation is vague, incorrect, or barely relevant. Limited or no link to kidney function or disease management.	2
Treatment may be named but with no relevant detail. Evaluation is absent or incorrect. Very limited understanding of kidney disease or treatment.	1

Sample answer:

(b) Describe a treatment option available to a patient with kidney disease and evaluate the effectiveness of this treatment to assist with the management of this disorder.

Handwritten notes:
 → haemodialysis
 → dialysis outside body
 → ureters receive functioning kidney
 → at hospital
 → long time, many times per week

Handwritten answer:
 Haemodialysis is the process in which all of the patient's blood is filtered outside the body through a machine. It works similarly to the kidney function as the blood is taken from arteries, is taken out of the body and passed through tubes in the machine that are surrounded by dialysis fluid, which mimics the concentration gradient of the loop of Henle within the kidney, which forces all toxic wastes including excess salts (Na^+ and K^+) to be filtered out of the blood before being returned to the body via a vein. The treatment option is very effective in managing diabetic nephropathy as it does not require any previous remaining functioning of the kidney as the machine takes the blood directly from the arm. This means that this treatment would be equally effective for if the disease caused partial or complete loss of kidney function. However, this treatment must be completed in a hospital, and due to the disease causing complete loss of kidney function, meaning no blood filtering is occurring in the body at all, this process needs to occur 3-4 times a week and takes between 4-6 hours. Although this treatment is extremely effective, it cannot be managed from home.

28

Markers Comments:

Generally well attempted. Refer to the marking criteria.

Specific details such as the removal of “urea” or “nitrogenous wastes” or “waste products” were required.

In your answer, feel free to underline important points to draw the attention of the marker. You could underline the name of the treatment and your judgement statement.

Question 32 (7 marks)

Tim Friede is an enthusiastic, but unusual, member of the Science community who has been “self-immunising” against different types of venom from some of the world’s deadliest snakes for nearly 20 years.

The process involves milking venom from the snakes and injecting tiny – followed by increasingly larger – doses into his body over months and years, eventually building up immunity to more than a dozen venomous snakes. Then he lets the venomous snakes bite him.

He has logged 202 snakebites in total. Without that slow buildup over 20 years, bites by most of these snakes would kill him.

Using your knowledge of the human immune response, explain how Tim’s body has responded over time to this program of self-immunisation.

7

Marking Criteria:

Criteria	Marks
Demonstrates a comprehensive and accurate explanation of both primary and secondary immune responses, including the roles of B lymphocytes, antibodies, memory cells, and the concept of active immunity. Clearly explains how repeated venom exposure leads to immunity. Links are logical, sequential, and scientifically precise.	7
Provides a detailed and mostly accurate explanation of the immune response, with correct reference to antibody production, memory cells, and adaptive immunity. Minor omissions or simplifications may be present but overall shows strong understanding of the immunological process.	6
Demonstrates a sound understanding of the immune response. Identifies key concepts such as antigens, antibodies, and memory cells, but may lack full clarity or depth in linking repeated exposure to immunity. Some terms may be used vaguely or partially explained.	5

--	--	--	--	--	--	--	--

Student Number	
Provides a basic explanation of the immune response with some accurate components (e.g., mentions antibodies or immunity) but lacks depth or contains minor misconceptions. Limited use of correct terminology.	4
Shows limited understanding, with minimal correct references to immune system processes. May mention exposure and immunity but lacks clarity or contains significant errors.	3
Very general or vague explanation. May refer to "body getting used to venom" or "building resistance" without correct scientific terminology or explanation.	2
Makes one relevant statement about immunity or the immune system, but is mostly incorrect or incomplete.	1

Sample Answer:

- working same as vaccine, each venom specific to type of snake
- small amount wasn't enough to induce symptoms but enough for immune response
- develops immune response, cell + antibody
- reexposure to increasingly larger amounts, memory cells already recognise and quicker response, but also makes more memory cells
- now when bitten, memory cells activate so no symptoms

3	8	7	7	3	4	9	6
---	---	---	---	---	---	---	---

Question 32 (7 marks)

Student Number

Tim Friede is an enthusiastic, but unusual, member of the Science community who has been "self-immunising" against different types of venom from some of the world's deadliest snakes for nearly 20 years.

The process involves milking venom from the snakes and injecting tiny – followed by increasingly larger – doses into his body over months and years, eventually building up immunity to more than a dozen venomous snakes. Then he lets the venomous snakes bite him.

He has logged 202 snakebites in total. Without that slow buildup over 20 years, bites by most of these snakes would kill him.

Using your knowledge of the human immune response, explain how Tim's body has responded over time to this program of self-immunisation.

7

By initially injecting small doses of various snake venoms, Tim mirrored the process of immunisation through vaccines. Although the dose of venom was not enough to induce symptoms, it still caused the human immune response. Firstly, cell-mediated immunity would have occurred where the venom self with presenting antigens would have been engulfed and destroyed through phagocytosis and the antigen would be presented on the MHC II molecule of the phagocyte to help the T-helper cell recognise it and activate the next process. The T-helper cell then releases interleukin-2 which activates the rapid multiplication into of T-cells into cytotoxic T-cells which then attack directly onto antigen presenting on the venom cells and release cytotoxins to kill them and into memory T-cells which stay in the body. Antibody-mediated immunity also occurs in which antibodies on B-cells attach to the antigen on the venom cells, process the antigen through their cell and then present it on their MHC II molecule to be presented to the T-helper cells receptors for recognition. This then leads to activation through the release of interleukin-2 of rapid multiplication of B-cells into plasma cells which secrete antibodies that can attach to antigens creating an

End of Paper

more on extra writing paper

--	--	--	--	--	--	--	--

Student Number

Section II Extra writing space

If you choose to use this space, clearly indicate which question you are answering.

Question 32

antibody-antigen complex which then releases an enzyme to inhibit the antigen and marks the cell for destruction by phagocytes, and also into memory B-cells that stay in the body. These memory B and T cells are the most essential response to Tim's self-immunisation program as the next time he injects a slightly larger dose of venom into his body, his immune system, the memory B and T cells, will automatically recognise the venom antigens and be able to coordinate a quicker response, while developing more and more memory B and T cells. So by the slow buildup over 30 years, Tim has ~~created~~ allowed memory B and T cells to continuously build up, with his ~~whole~~ process being repeated ^{for} for each type of snake venom he injects as memory cells ^{be} are only made for a specific antigen on a specific venom cell. Therefore, when Tim gets bitten by a snake, his body does not go through the usual symptoms as his body already has a plethora of memory B and T cells that instantly recognise the antigen and can rapidly coordinate a response ~~to~~ without having to go through the process of T-helper cell recognition to activate cytotoxic-T cells and plasma cells from B-cells. As now each time Tim gets bitten by snakes, his body will recognise the antigen and continue to produce more and more memory T and B cells, meaning the snake venom will not affect his body.

32

Markers Comments:

This question was attempted very well across the cohort.

A reminder to plan your answer – this will help you avoid an introductory waffle, which seems to equate to “getting your thoughts down on paper”, but does not provide any relevant information.

Another reminder to read the question carefully and this will allow you to include all relevant aspects. The most common example being – “Tim’s process of self immunisation is repeated for different venom types (from different species of snake), until Tim has numerous Memory B cells, specific for each type, allowing for a quick production of antibodies.”

The other common omission was a reference to the start of the whole process, a minimum being “macrophages and/or B cell presents antigen to Helper T cell”.

Below are the elements of the question that should be in the answer.

Snake venom components can be recognized by the immune system as foreign substances, triggering an inflammatory response.

Blood vessels increase in permeability – swelling, redness, pain. Macrophages attack snake venom components and destroy them by phagocytosis.

Venom antigen – picked up by macrophages and/or B cell.

Macrophages and/or B cell presents antigen to Helper T cell.

Helper T cell is activated.

Cytokines (interleukin 2) activate B cells to produce plasma cells.

Plasma cells clone and produce antibodies.

Antibodies find snake venom antigen and produce antigen-antibody complex. Snake venom antigens may then be destroyed by macrophages.

Memory B cells, specific to that snake venom are produced.

When further doses of the same snake venom are injected, Memory B cells are activated to produce a higher concentration of antibodies after each dose. This causes more rapid destruction of the venom, before it has time to cause symptoms.

This process is repeated for different venom types (from different species of snake), until Tim has numerous Memory B cells, specific for each type, allowing for a quick production of antibodies.

This now means Tim is effectively immune to any venomous snake bite.

If venom antigens invade body cells, Cytotoxic T cells would be activated by the Helper T cells and they would destroy those body cells that have been invaded. Specific Memory T cells would also be produced, and these would activate the rapid production of Cytotoxic T cells after each subsequent injection of snake venom.

End of Paper