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Student Number

Sydney Girls High School

2023

TRIAL
HSC
EXAMINATION

Biology

General Instructions

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

Total Marks:
100

Section I – 20 marks (pages 2-11)

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

Section II – 80 marks (pages 13-36)

- Attempt Questions 21-33
- 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.

1. Which of the following is considered to be a mutagen?
 - A. Adenine
 - B. Oestrogen
 - C. Ultraviolet light
 - D. Mitochondrial DNA

2. If 27% of a DNA sequence was found to be thymine, what percentage is cytosine?
 - A. 23%
 - B. 27%
 - C. 46%
 - D. 52%

3. Cells of the immune system that are involved in both cell-mediated immunity and the humoral response are:
 - A. Platelets
 - B. T helper cells
 - C. Cytotoxic T cells
 - D. Suppressor T cells

4. Sir Robert Bakewell was one of the first people in Europe to apply scientific principles to agriculture. He developed the New Leicester sheep from the old Lincolnshire sheep, by separating . animals with high-quality fleece and a good fatty shoulder that was popular at the time, from the rest of the flock. This is an example of:

- A. Selective breeding
- B. Natural selection
- C. Speciation
- D. Cloning

5. Which of the following is a correct role of the lymph system in the immune response?

- A. Initiating a fever response
- B. Triggering cell death around the pathogen
- C. Preventing entry of pathogen into the body
- D. Holding a record of previous infection by pathogens

6. Which of the processes below could cause an allele to be randomly lost from a population?

- A. Gene flow
- B. Genetic drift
- C. Mutation
- D. Reproduction

7. A park ranger was injected with an antivenom serum to treat a snakebite. The treating doctor explained that the injection would not protect him against future snakebites.

This is because antivenom serum is used to achieve

- A. Active and natural immunity
- B. Passive and natural immunity
- C. Active and induced (artificial) immunity
- D. Passive and induced (artificial) immunity

8. The steps of the polymerase chain reaction (PCR) are listed below:

- I. Anneal the primers at a low temperature
- II. Heat the sample to separate the DNA strands
- III. Amplify the sample through many rounds
- IV. Extend the sample using DNA polymerase

The correct order of steps is:

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

9. Which of the following correctly identifies male and female reproductive tissues and gametes in flowering plants?

	Female reproductive tissue	Female gamete	Male reproductive tissue	Male gamete
A.	Stamen	Ovary	Stigma	Anther
B.	Stigma	Ovum	Style	Pollen
C.	Stigma	Ovum	Stamen	Pollen
D.	Stamen	Ovary	Style	Anther

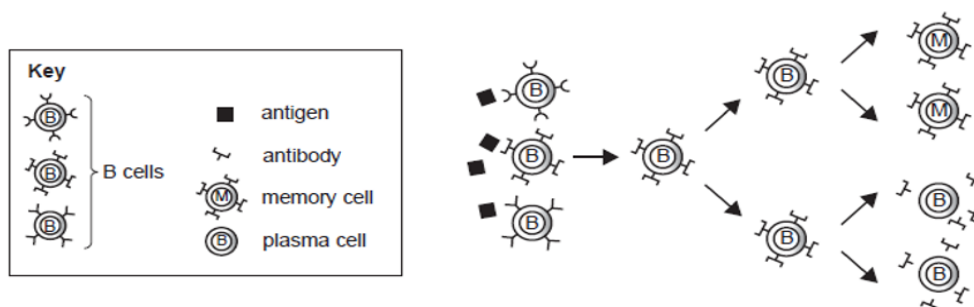
10. Which of the following best describes the Major Histocompatibility Complex (MHC) molecules?

- A. Release cytokines
- B. Release complement proteins
- C. Are found only on B and T cells
- D. Are found on antigen - presenting cells

11. Which of the following statements about proteins is correct?

- A. Each gene codes for a complete protein
- B. Altering the tertiary structure can affect function
- C. Denaturing a protein will alter its primary structure
- D. Proteins with a quaternary structure are more biologically active than those without

12. Consider the diagram below of clonal selection in B cells.

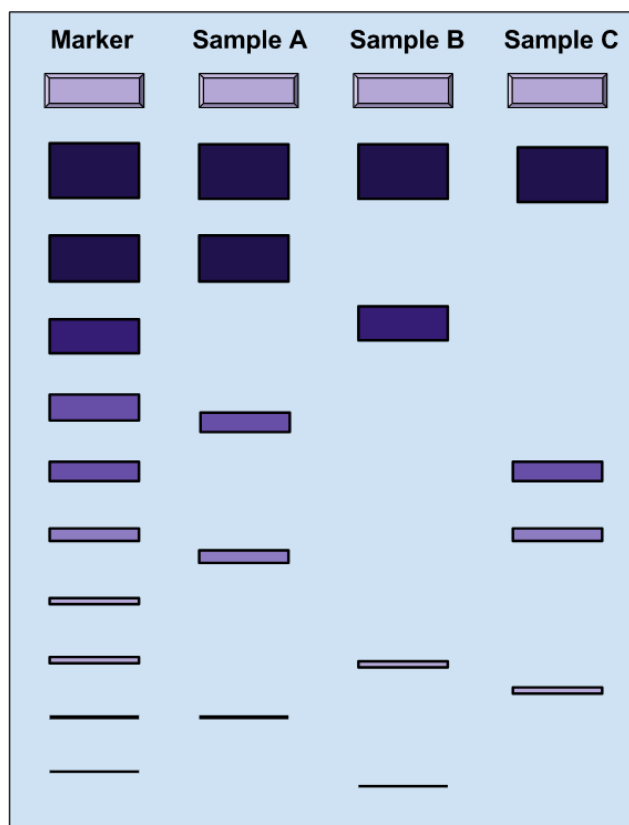


Source: adapted from Tang Zheng et al., 'An Improved Clonal Selection Algorithm and its Application to Traveling Salesman Problems', in *IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences*, vol. E90-A, no. 12, December 2007, p. 2931

In adaptive immunity, which part of this process allows long-term (sometimes lifetime) protection against pathogens?

- A. Production of plasma cells
- B. Generation of memory cells
- C. Production of specific antibodies
- D. Recognition of one antigen by one B cell clone

13. The diagram below represents the results of a gel electrophoresis



https://upload.wikimedia.org/wikipedia/commons/7/74/Gel_Electrophoresis.svg

Gel electrophoresis separates DNA, RNA or proteins based upon:

- A. Molecular size
- B. Molecular type
- C. Molecular charge
- D. Molecular concentration

Refer to the following information to answer Questions 14 - 15.

An experiment was carried out by students to test the effect of temperature on the growth of bacteria. Bacterial cells were spread onto plates of nutrient agar that were then kept at three different temperatures: -10°C , 15°C and 25°C .

All other variables were kept constant. The experiment was carried out over four days. The nutrient agar was observed every day at the same time and the percentage of nutrient agar covered by bacteria was recorded. At the conclusion of the experiment, the results were recorded in a table, which is shown below.

Time (days)	Percentage of nutrient agar covered by bacteria at three different temperatures		
	-10°C	15°C	25°C
0	0	0	0
1	0	5	10
2	0	10	20
3	0	15	40
4	0	20	60

- 14.** Which one of the following hypotheses is supported by the results?
- A. If the temperature increases, then the bacteria will grow more quickly
 - B. If the bacteria are kept in the dark, then the bacteria will grow more slowly
 - C. If the bacteria grow faster, then the temperature of the location will increase
 - D. If the bacteria grow for four days, then the nutrient agar will be completely covered in bacteria
- 15.** In this experiment, the independent variable is
- A. Time
 - B. Temperature
 - C. The number of bacterial cells
 - D. The percentage of nutrient agar covered by bacteria

16. One technique used in genetic profiling is the analysis of short tandem repeats (STRs). STRs can be used to determine the relationship between individuals. The STR profiles for six individuals are given in the table below. Individuals 1-3 are female, individuals 4-5 are male.

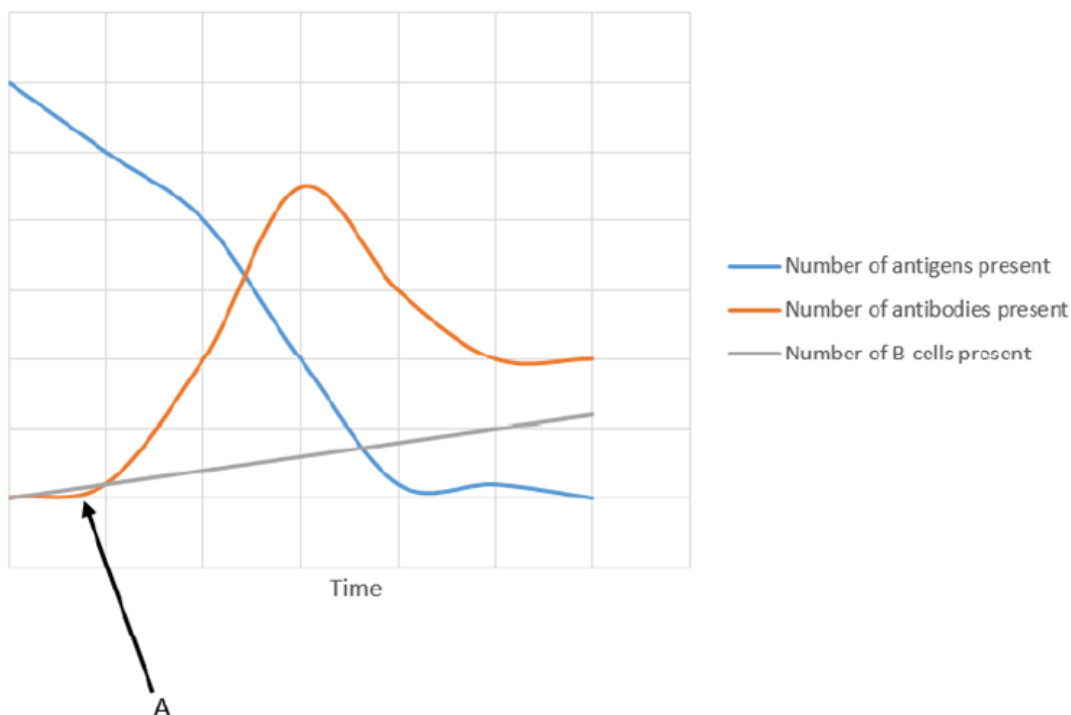
STR	Individual 1	Individual 2	Individual 3	Individual 4	Individual 5
D3S1565	9, 13	5, 13	5, 9	9, 14	5, 9
D14S617	12, 14	9, 11	10, 12	10, 14	10, 12
D18S858	6, 10	7, 11	6, 8	7, 14	8, 10
GATA168F06	25, 28	22, 24	24, 25	23, 28	22, 24
ATA7D07	16, 18	15, 16	16, 17	15, 17	15, 17

Which of the following conclusions can be reached based on these data?

- A. Individual 2 and Individual 4 could be siblings
- B. Individual 4 could be the father of Individual 5
- C. The parents of Individual 1 could be Individual 2 and Individual 3
- D. Individual 3 could be the child of Individual 1 and Individual 5

Refer to the following information to answer Questions 17 - 18.

17. Consider the graph below of an immune response to a specific antigen introduced at point A.



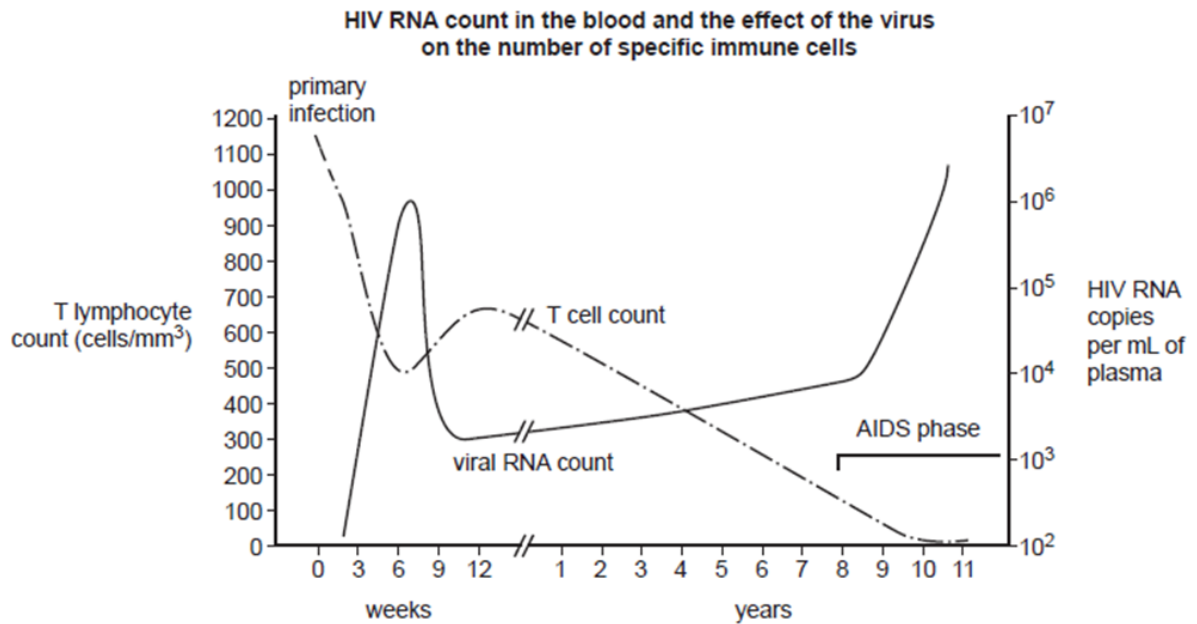
The type of immunity shown in the diagram is

- A. Artificial passive immunity involving the first line of defence
- B. Natural active immunity involving the third line of defence
- C. Natural passive immunity involving the third line of defence
- D. Artificial active immunity involving the second line of defence

18. Which type of cell would also be expected to be increasing after point A?

- A. Plasma cells as they secrete antibodies to neutralise the antigen
- B. Helper T lymphocytes that bind to the antigen
- C. Dendritic cells that are stimulated by the production of antibodies
- D. Cytotoxic T cells as they secrete cytokines that reduce the numbers of antigens present

19. The graph below shows the HIV RNA count in the blood and the effect of the virus on the number of specific immune cells in an untreated patient.

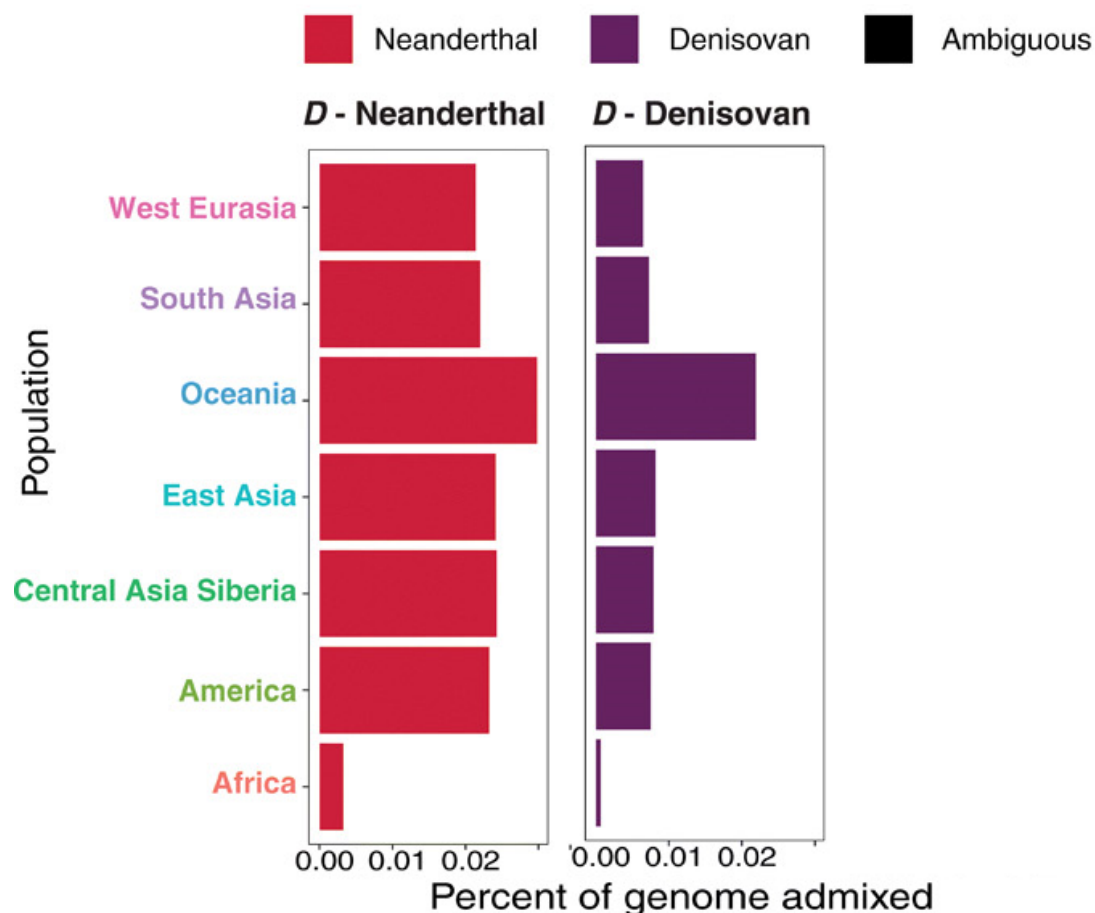


Source: adapted from Paola Paci et al., 'A Discrete/Continuous Model of Anti-HIV Response and Therapy', conference paper, Tenth International Conference on Computer Modeling and Simulation, May 2008, p. 484

Based on your knowledge and the information in the graph above, what is the effect of the change in the number of T cells over time?

- A. Failure of complement proteins
- B. Failure of macrophages to engulf HIV
- C. Loss of effective function of the adaptive immune system
- D. A decrease in the viral RNA count during the AIDS phase

20. Modern genetic techniques have allowed scientists to determine that modern human genomes contain genetic material from the extinct *Homo* species the Neanderthals and the Denisovans. The graph below shows the relative amount of Neanderthal and Denisovan DNA markers found in modern populations from around the world. Admixture of the genome indicates interbreeding between modern humans and the extinct *Homo* species.



[An ancestral recombination graph of human, Neanderthal, and Denisovan genomes | Science Advances](https://doi.org/10.1126/sciadv.abc0776)
<https://doi.org/10.1126/sciadv.abc0776>

From these data, it is reasonable to assume that:

- A. Modern humans originated in Oceania
- B. Modern Africans are the direct descendants of Denisovans
- C. Modern humans evolved in Africa after Neanderthal migration to Europe
- D. There was no interbreeding between *Homo sapiens* and either the Neanderthals or Denisovans in Africa

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Student Number

Biology

Section II A

Answer Booklet

TOTAL OF BOTH SECTIONS A and B
80 marks

Attempt Questions 21-29

Allow about 2 hours and 25 minutes for BOTH Sections A and B

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the 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.
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Question 21 (5 marks)

Some organisms reproduce sexually, others asexually.

- a) Describe one advantage and one disadvantage of asexual reproduction.

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- b) Compare the structure and location of DNA in prokaryotes and eukaryotes.

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Question 22 (3 marks)

Construct a table to compare and contrast the features of meiosis and mitosis.

Question 23 (4 marks)

Describe the role of the following in gene cloning:

Ligase, plasmid, restriction enzyme, vector

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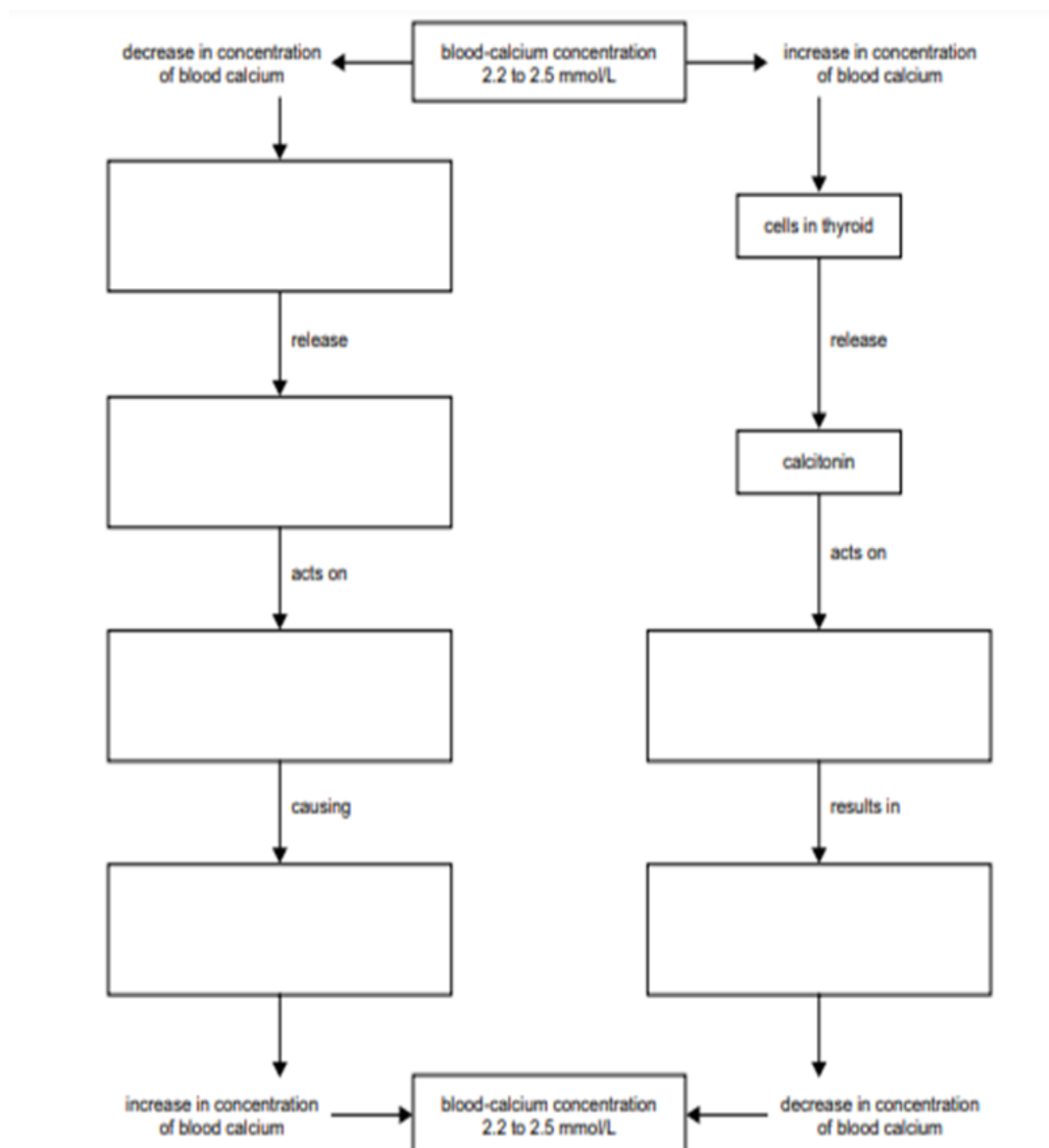
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Question 24 (3 marks)

Human blood-calcium concentrations are under homeostatic control. When the concentration of calcium in the blood begins to fall the parathyroid gland releases parathyroid hormone. This hormone stimulates bone cells called osteoclasts to break down bone and release calcium into the blood. When the concentration of calcium rises in the blood, specialised cells associated with the thyroid gland release the hormone calcitonin. Calcitonin acts on bone and increases the amount of calcium that is deposited into bone. This information can be presented in a flowchart such as that in the figure below. Note that some parts of the flowchart have been completed.

- a. Use the information given above to complete the flowchart by filling in the six empty boxes.

3



Question 25 (7 marks)

Although plants have no immune systems, they do have many chemical and physical methods of defence against microbial pathogens and attacks by insects.

- a. Identify one example of a physical method of defence in a plant and explain how it protects the plant.

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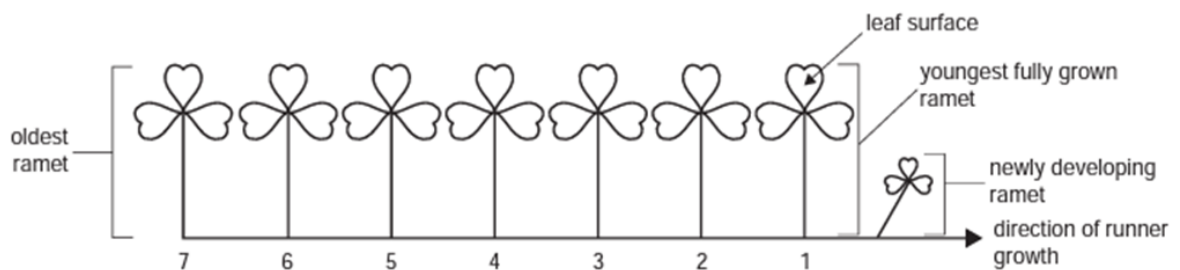
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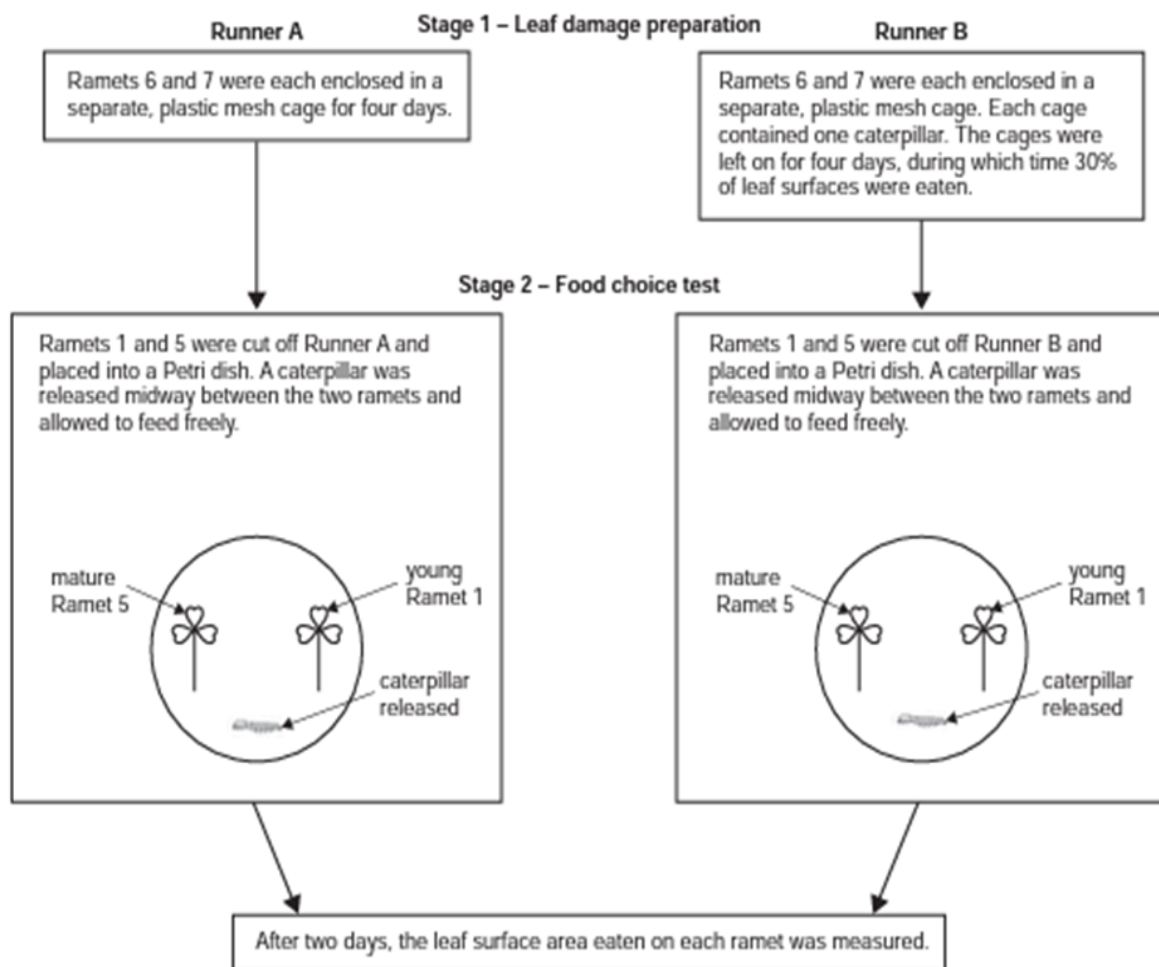
White clover (*Trifolium repens*) reproduces asexually from a runner that grows along the soil surface. The connected new plants are called ramets. The white clover plant in the diagram below is producing ramets in the direction left to right. The fully grown ramets are numbered 1 to 7, from the youngest ramet to the oldest ramet.



Source: adapted from S Gómez, Y Onoda, V Ossipov and JF Stuefer, 'Systemic induced resistance: A risk-spreading strategy in clonal plant networks?', *The New Phytologist*, vol. 179 no. 4 (September 2008), p. 1144

Scientists hypothesized that when white clover ramets are damaged by caterpillars of *Spodoptera exigua*, the damaged ramets stimulate other ramets to defend themselves against attack by the caterpillars. The scientists conducted an experiment to test their hypothesis. The experiment used two genetically identical runners, A and B. The method is outlined in the flowchart on page 16.

Question 25 continues on page 18



b. What is the role of the Runner A?

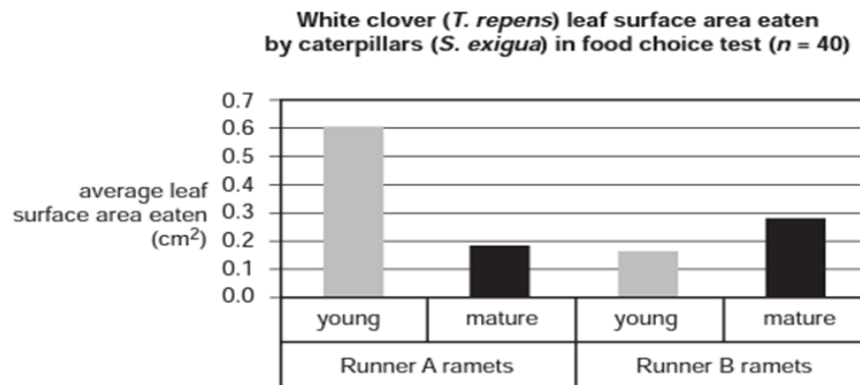
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Question 25 continues on page 19

The experiment was repeated 40 times. The average results obtained after Stage 2 are shown in the graph below.



Data: S Gómez, Y Onoda, V Ossipov and JF Stuefer, 'Systemic induced resistance: A risk-spreading strategy in clonal plant networks?', *The New Phytologist*, vol. 179 no. 4 (September 2008)

- c. Referring to the data, compare the average leaf surface area of young ramets eaten by the caterpillar in Runner A and Runner B. **2**

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After the experiments, the contents of the leaves were analysed. Significantly higher quantities of phenolic acid were found in the young ramets from Runner B. Phenolic acid acts as a signalling molecule that can act as an agent in plant defence to protect the plant from future attack.

It was noticed that the caterpillars preferred to eat the mature leaves in Runner B.

- d. Suggest an effect of the signaling molecule on cells of the young leaves that would account for the caterpillars' preference for eating the mature leaves in Runner B.

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End of Question 25

Question 26 (5 marks)

Assess the effect of cell replication processes on the genetic code and the continuity of a species.

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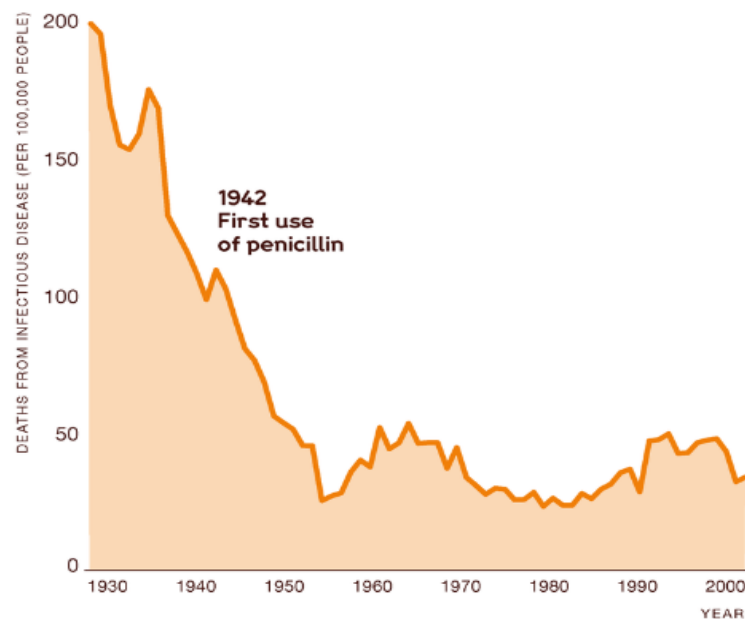
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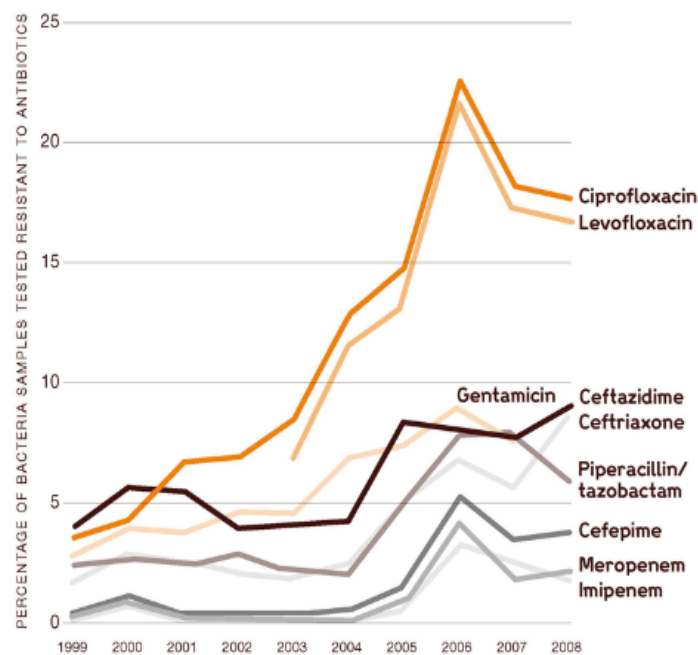
Question 27 (4 marks)

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

Antibiotic effectiveness in reducing global deaths from infectious diseases from the years 1930 to 2000



Increase in antibiotic resistance between 1999 and 2008



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

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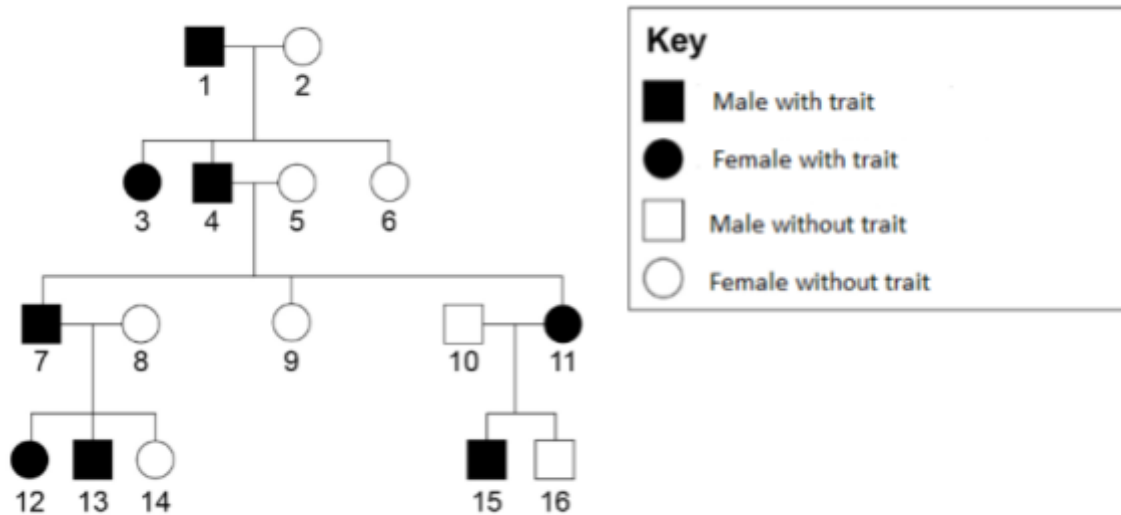
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Question 28 (8 marks)

The pedigree for a particular trait is shown below. The allele for the trait is dominant.



a) Explain why the trait is not sex-linked.

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Question 28 continues on page 24

b) Identify the genotype of Individual 1. Give a reason for your answer. **2**

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c) If Individuals 7 and 8 were to have another child, what is the likelihood of the child possessing the trait? Use a punnet square to illustrate your answer. **3**

TURN THE PAGE FOR Question 29

Question 29 (4 marks)

Scientists have used biotechnology to create herbicide resistant strains of canola. Explain one advantage of using biotechnology in place of artificial pollination, and explain the potential impact of biotechnology in farming on genetic diversity.

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Continue with Section II B Answer Booklet

Extra writing paper on back of Section II B Answer Booklet

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23

TRIAL
HSC
EXAMINATION

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Student Number

Biology

Section II B

Answer Booklet

Attempt Questions 30-33

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the 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 30 (6 marks)

A student investigated the effectiveness of hand washing. They recruited thirty students who then deliberately contaminated their hands with hard surfaces such as hand rails, desks and door knobs in the classrooms.

The students were then randomly assigned to one of three groups:

- 1: no hand washing
- 2: hand washing with tap water or
- 3: handwashing with soap and tap water.

Instructions were given as to how to wash their hands and for what length of time.

Swabs were then taken from the volunteers' hands and transferred to agar plates. The plates were incubated at 30°C for 48 hours.

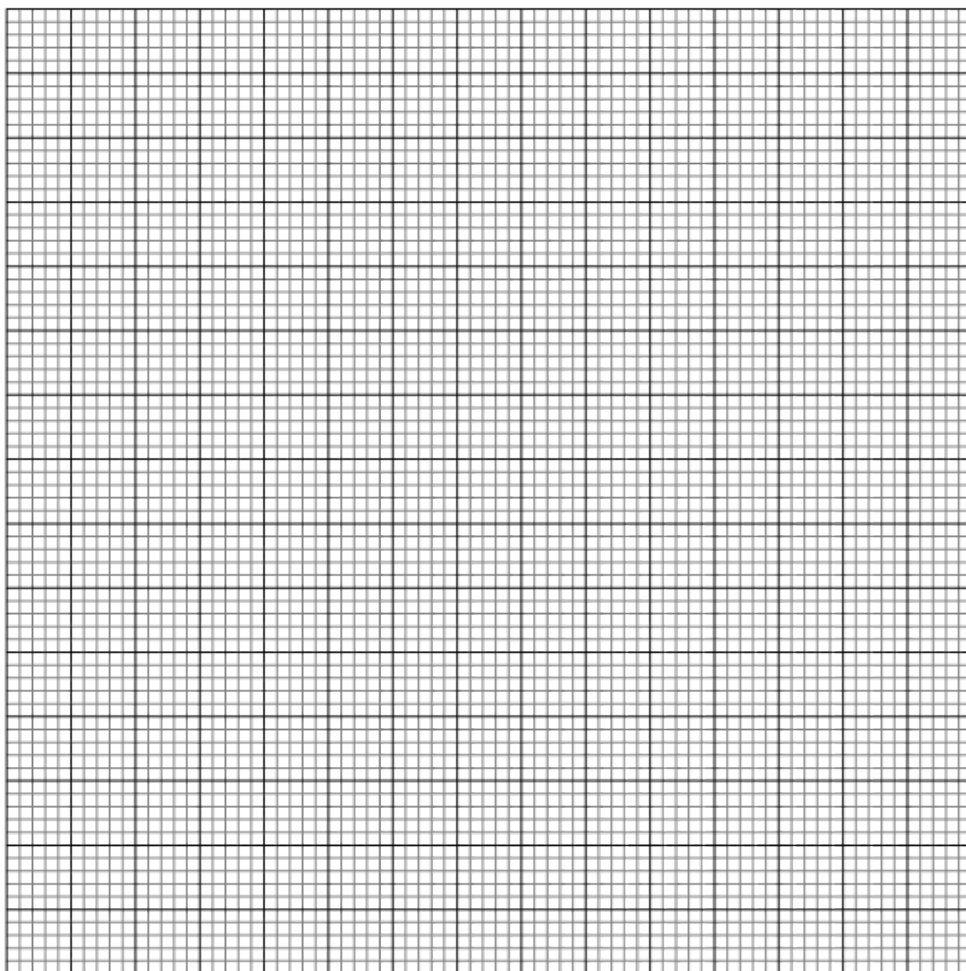
The percentage coverage of two types of bacteria that are found in the intestines of animal was calculated and recorded in the table below.

Hand washing technique	Percent of sample with <i>Enterococcus</i> spp. bacteria (%)	Percent of sample with <i>Enterobacter amnigenus</i> bacteria (%)
No hand washing	30	12
Water	15	3
Water and soap	5	3

Question 30 continues on page 28

- a. Draw an appropriate graph of the results.

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Question 30 continues on page 29

b. Explain the results in the graph.

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End of Question 30

Question 31 (11 marks)

Protein synthesis includes the processes of *transcription* and *translation*.

a) Describe the steps in transcription.

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b) Assess the significance of a mutation in a non-coding section of DNA.

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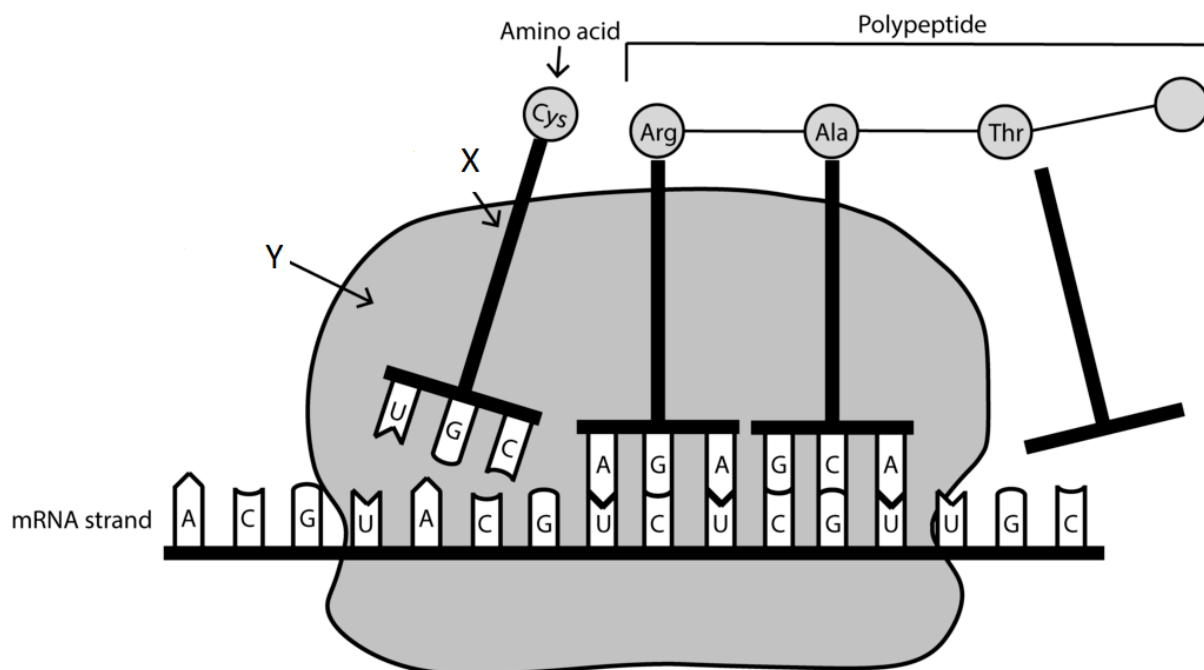
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Question 31 continues on page 31

c) The diagram below represents a part of protein synthesis.



d) Identify the structures labelled X and Y in the diagram, and the location in which the process takes place.

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X:

Y:

Location:

e) Describe the purpose of mRNA in this process.

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End of Question 31

Question 32 (13 marks)

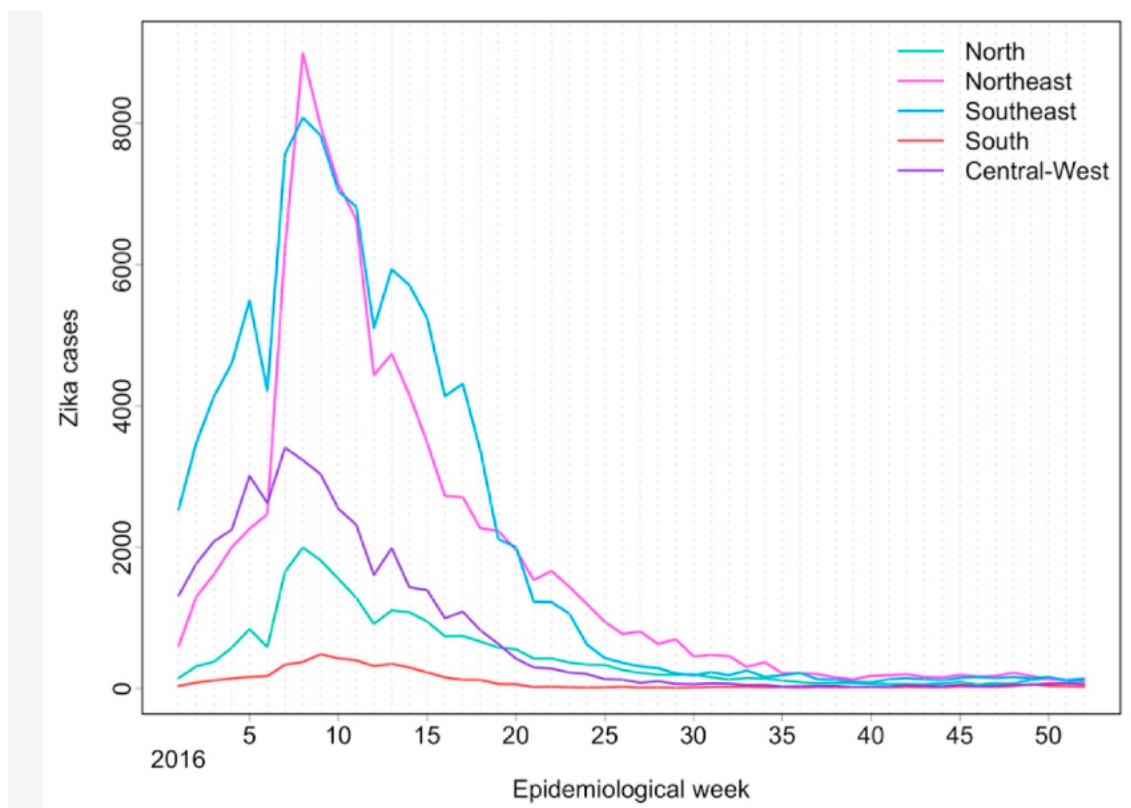
Zika fever is a rapidly emerging viral disease. It is most commonly transferred from one person to another through the bite of an infected *Aedes* mosquito but can also be transferred from an infected pregnant woman to her foetus, through sexual activity and blood transfusions.

Zika fever in people was first discovered in Uganda in 1947. It was thought that a bite from a mosquito had transferred the virus from monkeys to humans. Since then, it has spread slowly across the globe, with outbreaks most recently in the Americas in 2015 and 2016.

The symptoms of Zika fever are usually mild ranging from rash, headache, joint and muscle pain to fever. Approximately 80% of infected humans do not show symptoms. Infection of pregnant women, however, can cause severe defects in their babies.

When scientists attempt to identify a particular disease, they can look for specific antibodies in infected humans. Scientists trying to identify Zika infections found that testing for the antibodies produced against the Zika virus often gave them incorrect results. This was because the antibody tests that had been developed could not always identify the difference between the antibodies produced against the Zika virus and the antibodies produced against other viruses.

Below is a graph that shows the number of Zika virus cases across the regions of Brazil during 2016.



<https://www.mdpi.com/1660-4601/15/1/96>

Continue Question 32 on page 33

a) Describe the trend shown in the graph. 2

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b) Use the graph to determine the approximate number of Zika cases in the Northeast region in epidemiological week 15, 2016. Show working on the graph. 2

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c) Identify the main mode of transmission of the Zika virus. 1

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d) Explain how Koch's postulates can be used to establish a causal relationship between a microbe and a disease and identify ONE reason why it may not be possible to apply these postulates to the Zika virus. 3

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Continue Question 32 on page 34

- e) Provide an explanation as to why the antibody tests could not identify the difference between the antibodies produced against the Zika virus and the antibodies produced against other viruses. 2

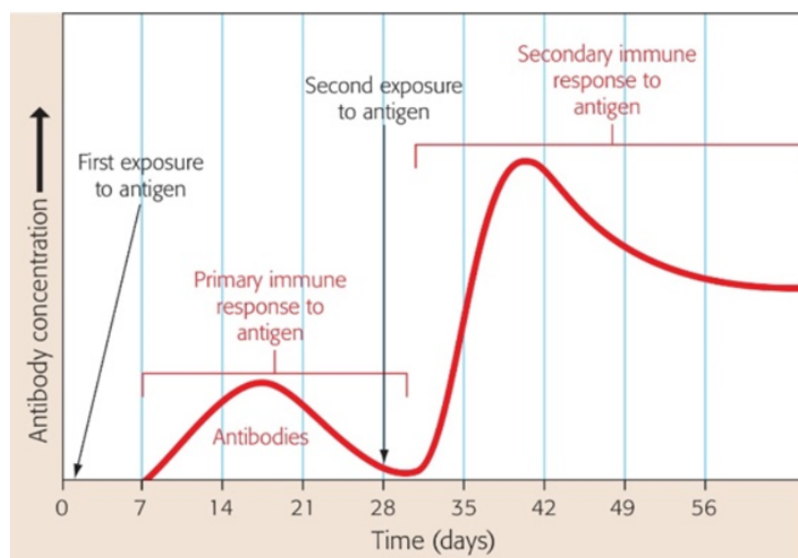
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The graph below shows the level of antibodies found in the blood after first and second exposure to an antigen such as the Zika virus.



- f) Compare the first exposure to the second exposure in terms of changes to antibody concentration. 3

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End of Question 32

TURN THE PAGE FOR Question 33

Question 33 (7 marks)

Explain why the combined use of public health campaigns and vaccination is a more effective way of controlling disease than using only one of these strategies. Support your answer using examples.

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Continue Question 33 on page 36

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SECTION II extra writing space

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

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SECTION II extra writing space

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

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Sydney Girls High School

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Section I

20 marks

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 - B. Oestrogen
 - C. Ultraviolet light
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4. Sir Robert Bakewell was one of the first people in Europe to apply scientific principles to agriculture. He developed the New Leicester sheep from the old Lincolnshire sheep, by

separating animals with high-quality fleece and a good fatty shoulder that was popular at the time, from the rest of the flock. This is an example of:

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The correct order of steps is:

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- B. I, II, IV, III
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	Female reproductive tissue	Female gamete	Male reproductive tissue	Male gamete
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B.	Stigma	Ovum	Style	Pollen
C.	Stigma	Ovum	Stamen	Pollen
D.	Stamen	Ovary	Style	Anther

10. Which of the following best describes the Major Histocompatibility Complex (MHC) molecules?

- A. Release cytokines
- B. Release complement proteins
- C. Are found only on B and T cells

D. Are found on antigen - presenting cells

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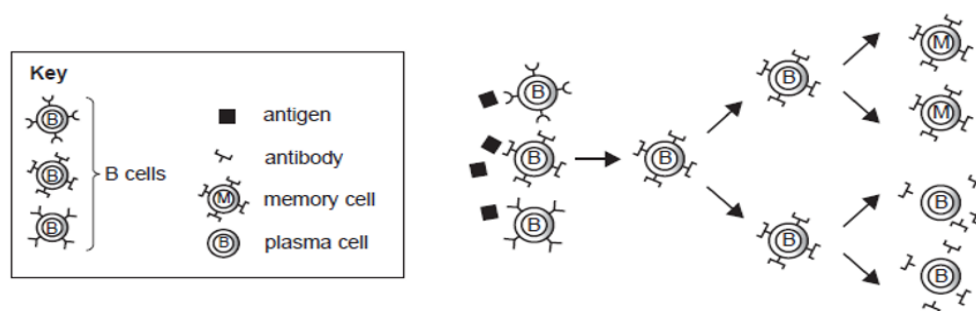
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B. Altering the tertiary structure can affect function

C. Denaturing a protein will alter its primary structure

D. Proteins with a quaternary structure are more biologically active than those without

12. Consider the diagram below of clonal selection in B cells.



Source: adapted from Tang Zheng et al., 'An Improved Clonal Selection Algorithm and its Application to Traveling Salesman Problems', in *IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences*, vol. E90-A, no. 12, December 2007, p. 2931

In adaptive immunity, which part of this process allows long-term (sometimes lifetime) protection against pathogens?

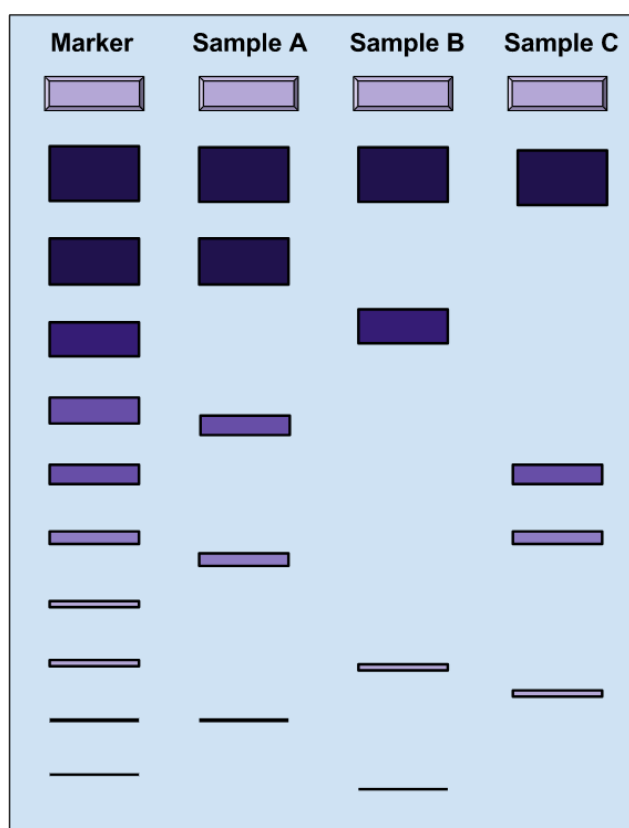
A. Production of plasma cells

B. Generation of memory cells

C. Production of specific antibodies

D. Recognition of one antigen by one B cell clone

13. The diagram below represents the results of a gel electrophoresis



https://upload.wikimedia.org/wikipedia/commons/7/74/Gel_Electrophoresis.svg

Gel electrophoresis separates DNA, RNA or proteins based upon:

- A. Molecular size
- B. Molecular type
- C. Molecular charge
- D. Molecular concentration

Refer to the following information to answer Questions 14 - 15.

An experiment was carried out by students to test the effect of temperature on the growth of bacteria. Bacterial cells were spread onto plates of nutrient agar that were then kept at three different temperatures: -10°C , 15°C and 25°C .

All other variables were kept constant. The experiment was carried out over four days. The nutrient agar was observed every day at the same time and the percentage of nutrient agar covered by bacteria was recorded. At the conclusion of the experiment, the results were recorded in a table, which is shown below.

Time (days)	Percentage of nutrient agar covered by bacteria at three different temperatures		
	-10 °C	15 °C	25 °C
0	0	0	0
1	0	5	10
2	0	10	20
3	0	15	40
4	0	20	60

14. Which one of the following hypotheses is supported by the results?

A. If the temperature increases, then the bacteria will grow more quickly

B. If the bacteria are kept in the dark, then the bacteria will grow more slowly

C. If the bacteria grow faster, then the temperature of the location will increase

D. If the bacteria grow for four days, then the nutrient agar will be completely covered in bacteria

15. In this experiment, the independent variable is

A. Time

B. Temperature

C. The number of bacterial cells

D. The percentage of nutrient agar covered by bacteria

16. One technique used in genetic profiling is the analysis of short tandem repeats (STRs). STRs can be used to determine the relationship between individuals. The STR profiles for six individuals are given below. Individuals 1-3 are female, individuals 4-5 are male.

STR	Individual 1	Individual 2	Individual 3	Individual 4	Individual 5
D3S1565	9, 13	5, 13	5, 9	9, 14	5, 9
D14S617	12, 14	9, 11	10, 12	10, 14	10, 12
D18S858	6, 10	7, 11	6, 8	7, 14	8, 10

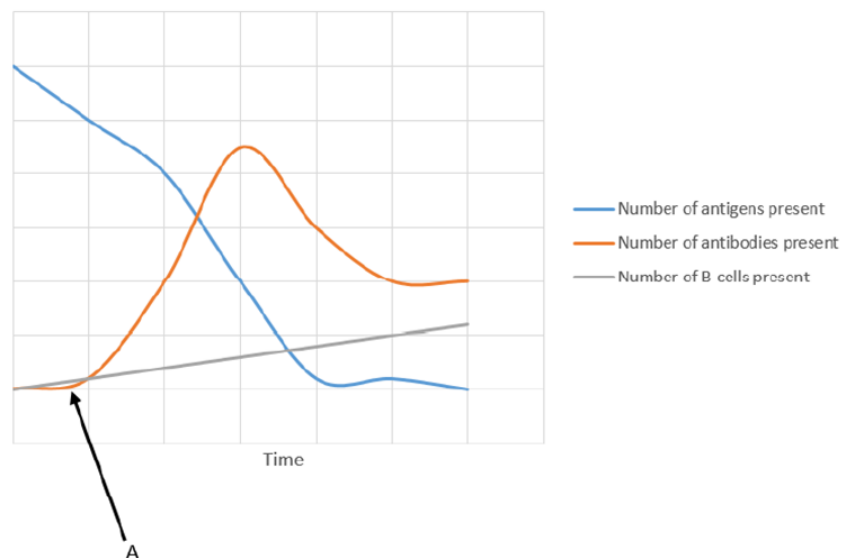
GATA168F06	25, 28	22, 24	24, 25	23, 28	22, 24
ATA7D07	16, 18	15, 16	16, 17	15, 17	15, 17

Which of the following conclusions can be reached based on these data?

- A. Individual 2 and Individual 4 could be siblings
- B. Individual 4 could be the father of Individual 5
- C. The parents of Individual 1 could be Individual 2 and Individual 3
- D. Individual 3 could be the child of Individual 1 and Individual 5**

Refer to the following information to answer Questions 17 - 18.

17. Consider the graph below of an immune response to a specific antigen introduced at point A.



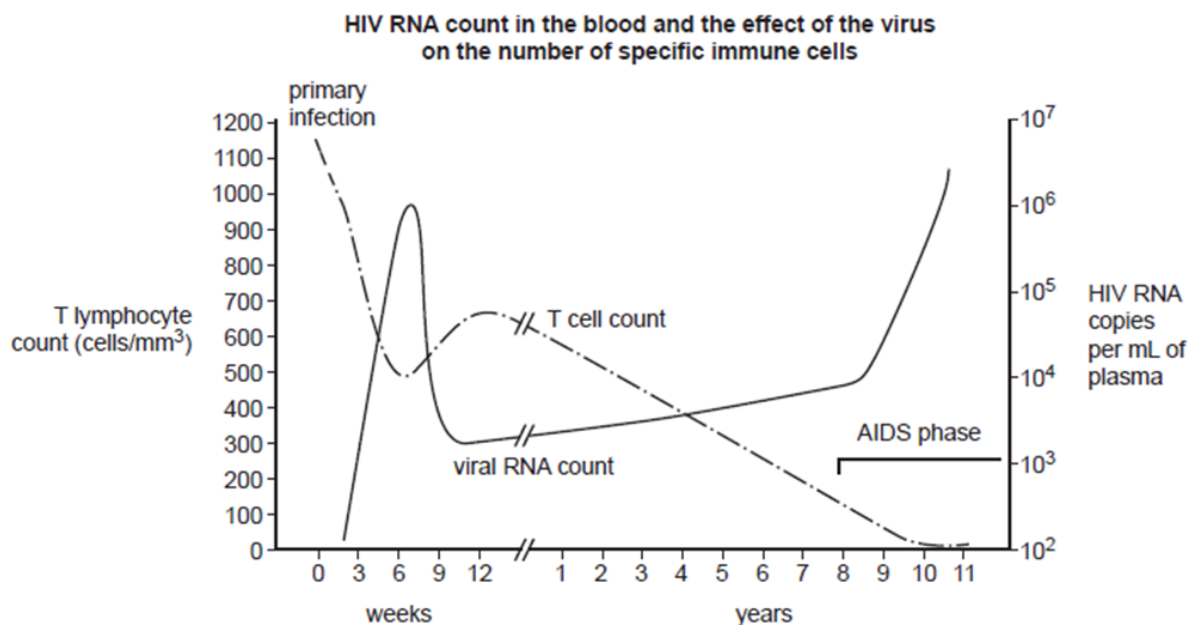
The type of immunity shown in the diagram is

- A. Artificial passive immunity involving the first line of defence
- B. Natural active immunity involving the third line of defence**
- C. Natural passive immunity involving the third line of defence
- D. Artificial active immunity involving the second line of defence

18. Which type of cell would also be expected to be increasing after point A?

- A. Plasma cells as they secrete antibodies to neutralise the antigen
- B. Helper T lymphocytes that bind to the antigen
- C. Dendritic cells that are stimulated by the production of antibodies
- D. Cytotoxic T cells as they secrete cytokines that reduce the numbers of antigens present

19. The graph below shows the HIV RNA count in the blood and the effect of the virus on the number of specific immune cells in an untreated patient.

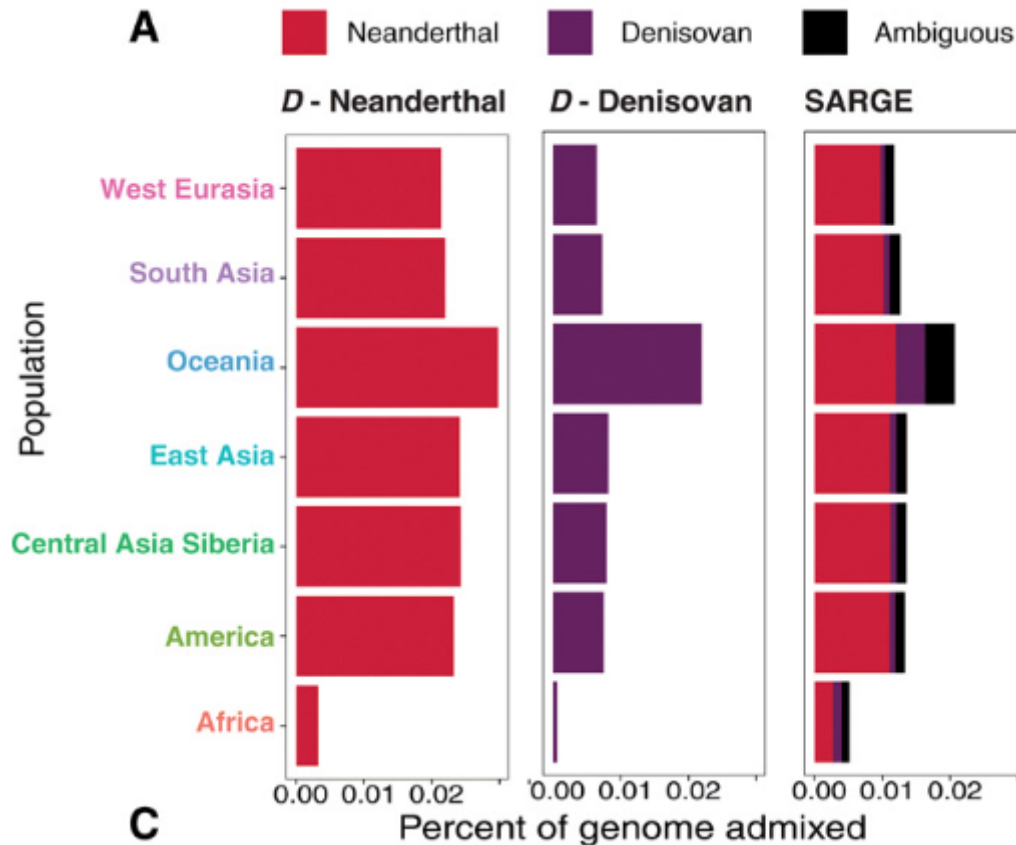


Source: adapted from Paola Paci et al., 'A Discrete/Continuous Model of Anti-HIV Response and Therapy', conference paper, Tenth International Conference on Computer Modeling and Simulation, May 2008, p. 484

Based on your knowledge and the information in the graph above, what is the effect of the change in the number of T cells over time?

- A. Failure of complement proteins
- B. Failure of macrophages to engulf HIV
- C. Loss of effective function of the adaptive immune system
- D. A decrease in the viral RNA count during the AIDS phase

20. Modern genetic techniques have allowed scientists to determine that modern human genomes contain genetic material from the extinct *Homo* species the Neanderthals and the Denisovans. The graph below shows the relative amount of Neanderthal and Denisovan DNA markers found in modern populations from around the world.



[An ancestral recombination graph of human, Neanderthal, and Denisovan genomes | Science Advances](https://doi.org/10.1126/sciadv.abc0776)
<https://doi.org/10.1126/sciadv.abc0776>

From these data, it is reasonable to assume that:

- A. Modern humans originated in Oceania
- B. Modern Africans are the direct descendants of Denisovans
- C. Modern humans evolved in Africa after Neanderthal migration to Europe
- D. There was no interbreeding between *Homo sapiens* and either the Neanderthals or Denisovans in Africa

20

23

TRIAL
HSC
EXAMINATION

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Student Number

Biology

Section II

Answer Booklet

80 marks

Attempt Questions 21-34

Allow about 2 hours and 25 minutes for this section

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the 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 (5 marks)

Some organisms reproduce sexually, others asexually.

- a) Describe advantage of asexual reproduction, and one disadvantage.

3

Criteria	Marks
• Correctly identifies one advantage and one disadvantage	2
• Correctly identifies one advantage OR • Correctly identifies disadvantage	1

Sample answer:

Advantage: No need to attract a mate

Disadvantage: Little genetic diversity in a population

- b) Compare the structure and location of DNA in prokaryotes and eukaryotes.

2

Criteria	Marks
• Correctly compares structure and location of DNA in prokaryotes and eukaryotes	2
• Correctly compares structure of DNA in prokaryotes and eukaryotes OR • Correctly compares location of DNA in prokaryotes and eukaryotes	1

Sample answer:

In eukaryotes, the DNA is found in linear chromosomes and inside a membrane-bound nucleus. In contrast, DNA in prokaryotes is circular, and located in a region of the cell called the nucleoid. Additionally, prokaryotes

may possess extrachromosomal DNA in the form of a plasmid, whereas eukaryotes have mtDNA in the mitochondria and cpDNA in the chloroplasts.

Question 22 (3 marks)

Construct a table to compare and contrast the features of meiosis and mitosis.

Criteria	Marks
• Compares and contrasts features of meiosis and mitosis, including ploidy, number of cell divisions, number of daughter cells	3
• Compares some features of meiosis and mitosis	2
• Some relevant information	1

Sample answer:

Advantage:

Question 23 (4 marks)

Describe the role of the following in gene cloning:

Ligase, plasmid, restriction enzyme, vector

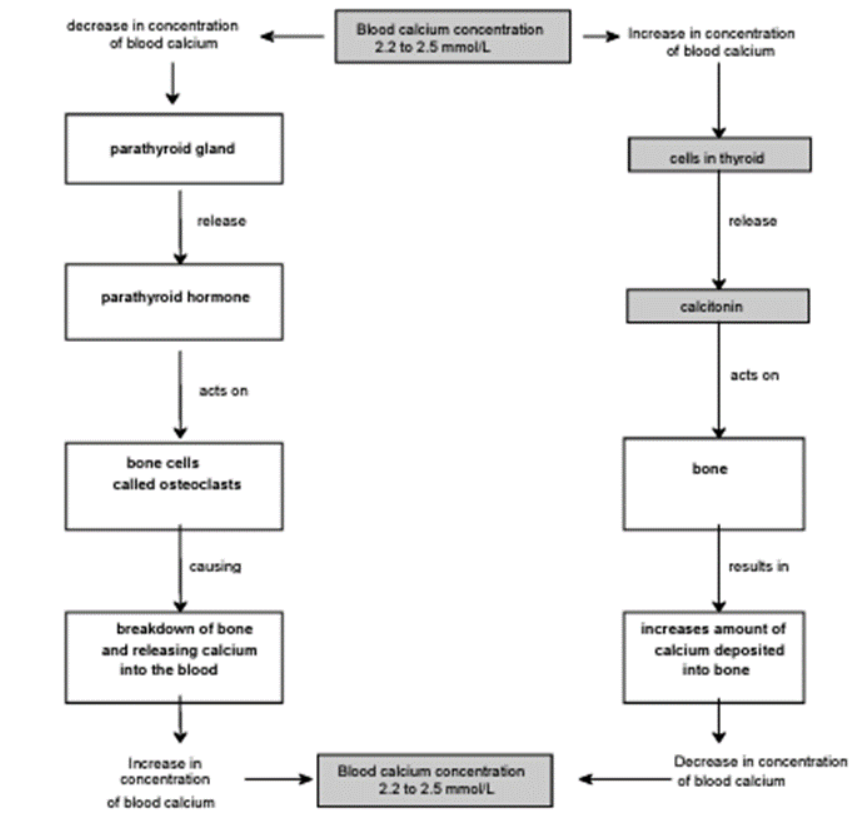
Criteria	Marks
• Correctly describes the role of each in gene cloning	4
• Correctly describes the role of two of the above in gene cloning AND identifies the other two OR • Correctly describes the role of three of the above in gene cloning	3
• Correctly describes the role of two of the above in gene cloning OR • Correctly identifies the role of all four in gene cloning	2
• Some relevant information	1

Sample answer:

Advantage:

Question 24 (3 marks)

• All 6 boxes correct	3
• 4-5 boxes correct	2
• Provides some relevant information	1



Question 25 (7 marks)

a)

• Identify one correct physical method of defence • explain its role in protection	2
• Provides some relevant information	1

For example: • waxy cuticle of leaves creates a barrier to or traps pathogens • thick bark creates a barrier to pathogens • formation of galls limits the spread of pathogens

b) What is the role of the Runner A?

Correct identification as control	1
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It acts as a control to compare the effect of the independent variable.

c) Referring to the data, compare the average leaf surface area of young ramets eaten by the caterpillar in Runner A and Runner B.

• Refer to data for BOTH runners A and B • Correct comparison	2
• Provides some relevant information	1

An average of 0.6 cm² was eaten in Runner A, compared with an average of 0.15 cm² in Runner B.

Approximately four times as much young leaf area was eaten in Runner A (or vice versa).

d) Suggest an effect of the signaling molecule on cells of the young leaves that would account for the caterpillars' preference for eating the mature leaves in Runner B.

• Identify effect of signalling molecule • Explain the effect in terms of preference	2
• Provides some relevant information	1

For example, phenolic acid may make these leaves less tasty/digestible to the caterpillar thus selectively repels herbivores

Question 26 (5 marks)

Assess the effect of cell replication processes on the genetic code and the continuity of a species

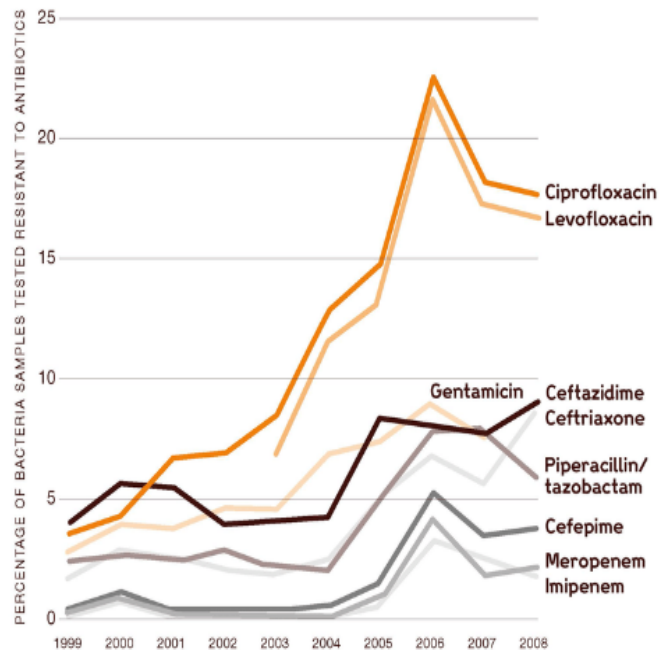
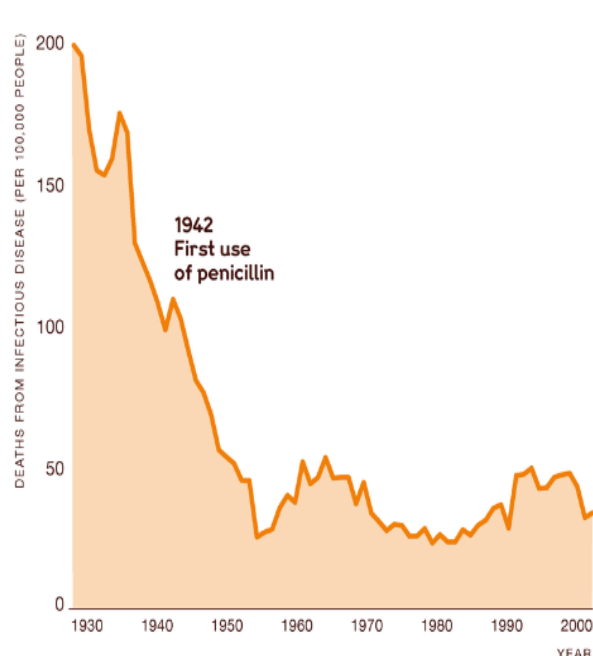
Criteria	Marks
- Explains how the genetic code is maintained during cell replication - Explains how processes such as crossing over increase genetic diversity - Assesses the effect of these processes on the continuity of a species - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	5
- Describes how the genetic code is maintained during cell replication - Explains how processes such as crossing over increase genetic diversity - Explains the effect of these processes on the continuity of a species - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	4
- Describes how the genetic code is maintained during cell replication - Describe show processes such as crossing over increase genetic diversity - Describes the effect of these processes on the continuity of a species OR - Explains how processes such as crossing over increase genetic diversity - Explains the effect of these processes on the continuity of a species OR - Explains how the genetic code is maintained during cell replication - Explains the effect of these processes on the continuity of a species	3
Describes some processes during cellular replication	2
Some relevant information	1

Sample answer:

Advantage:

Question 27 (4 marks)

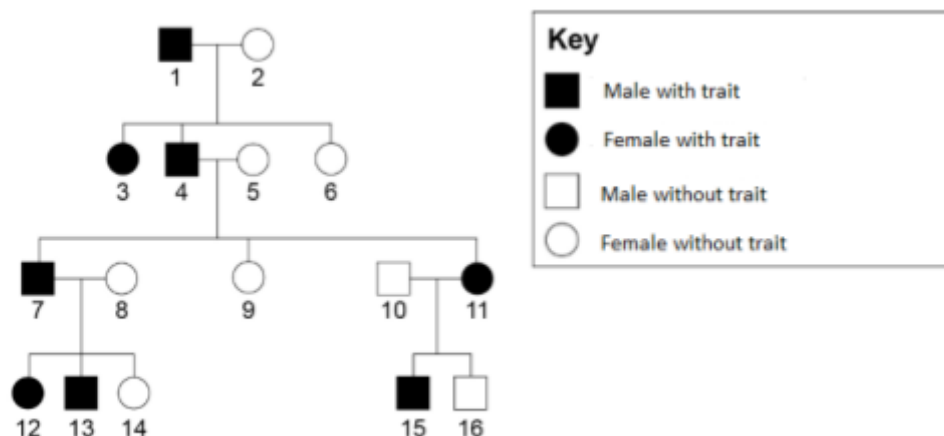
Using the information provided in the graphs and your knowledge, discuss the effectiveness of antibiotics as a treatment strategy for infectious diseases.



• explain how antibiotics work as a treatment for infectious diseases • discuss trends in BOTH graphs and relate to effectiveness of antibiotics • refer to data from BOTH graphs	4
• describe how antibiotics work as a treatment for infectious diseases • outline trends in BOTH graphs and relate to effectiveness of antibiotics • refer to data from graph(s)	3
• outline how antibiotics work as a treatment for infectious diseases • outline trend in graph(s) * refer to data from graph(s)	2
• Provides some relevant information	1

Question 28 (8 marks)

The pedigree for a particular trait is shown below. The allele for the trait is dominant.



a) Explain why the trait is not sex-linked.

3

Criteria	Marks
Explains why the trait is not sex-linked, with reference to Y linkage, X-linked dominant and X-linked recessive	3
Describes why the trait is not sex-linked	2
Identifies why the trait is not sex-linked	1

Sample answer:

Advantage:

b) Identify the genotype of Individual 1. Give a reason for your answer.

2

Criteria	Marks
Correct identification, with valid reason	2
Correct identification	1

Sample answer:

Advantage:

- c) If Individuals 7 and 8 were to have another child, what is the likelihood of the child possessing the trait?
Use a punnet square to illustrate your answer. **3**

Criteria	Marks
• Correct calculation • Correct Punnet square	3
• As above, but with one error or oversight	2
• Some relevant information	1

Sample answer:

Advantage:

Question 29 (4 marks)

Scientists have used biotechnology to create herbicide resistant strains of canola. Explain one advantage of using biotechnology in place of artificial pollination, and explain the potential impact of biotechnology in farming on genetic diversity.

Criteria	Marks
- Explains one advantage - Explains potential impact - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	4
- Explains one advantage - Describes potential impact - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas OR - Describes one advantage - Explains potential impact - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	3
- Describes one advantage - Describes potential impact	2
- Describes one advantage OR - Describes potential impact	1

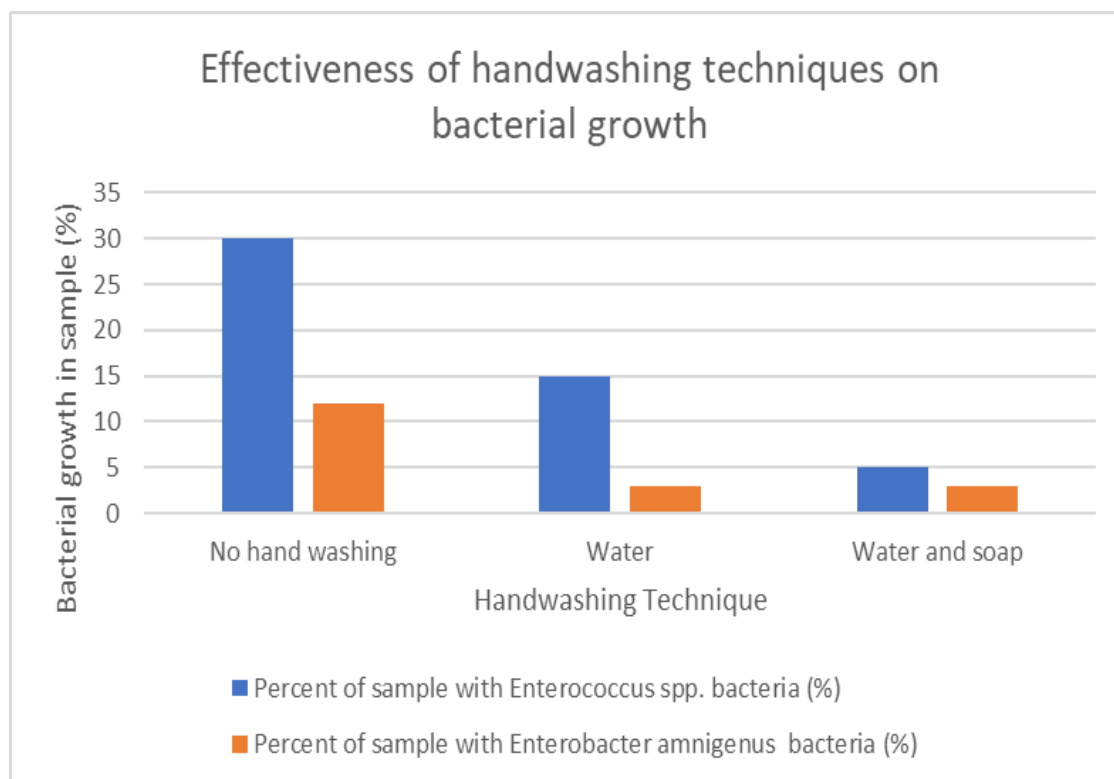
Sample answer:

Advantage:

Question 30 (6 marks)

a. Draw an appropriate graph of the results.

3



• Column graph • Axes labelled with units • Correct plotting of data • Distinguish two different graphs with shading or pattern • key	3
• Any of 3 above	2
• Any 2 of above	1

b) Explain the results in the graph.

• Explain results for both graphs in relation to which method is most effective for each type of bacteria • Justify with reference to data for both bacteria	3
• Describe results for both graphs in relation to which method is most effective for each type of bacteria • Justify with reference to data for ONE bacteria	2
• Provides some relevant information	1

Question 31 (11 marks)

Protein synthesis includes the processes of *transcription* and *translation*.

a) Describe the steps in transcription.

3

Criteria	Marks
- Describes all steps in transcription - Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	3
Identifies all steps in transcription, and describes some	2
Some relevant information	1

Sample answer:

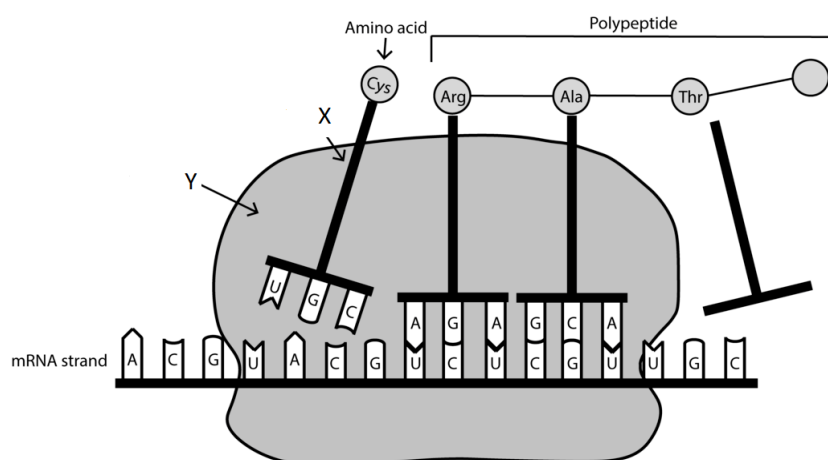
Advantage:

b) Assess the significance of a mutation in a non-coding section of DNA.

3

Criteria	Marks
Assesses the effect of a mutation in a non-coding section of DNA	3
Explains the effect of a mutation in a non-coding section of DNA	2
Some relevant information	1

c) The diagram below represents a part of protein synthesis.



d) Identify the structures labelled X and Y in the diagram, and the location in which the process takes place

3

X:

Y:

Location:

Criteria	Marks
Correctly identifies X and Y and location	3
Correctly identifies X and Y and location	2
Correctly identifies X or Y	1

Sample answer:

Advantage:

e) Describe the purpose of mRNA in this process.

2

Criteria	Marks
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Describes purpose	2
Identifies purpose	1

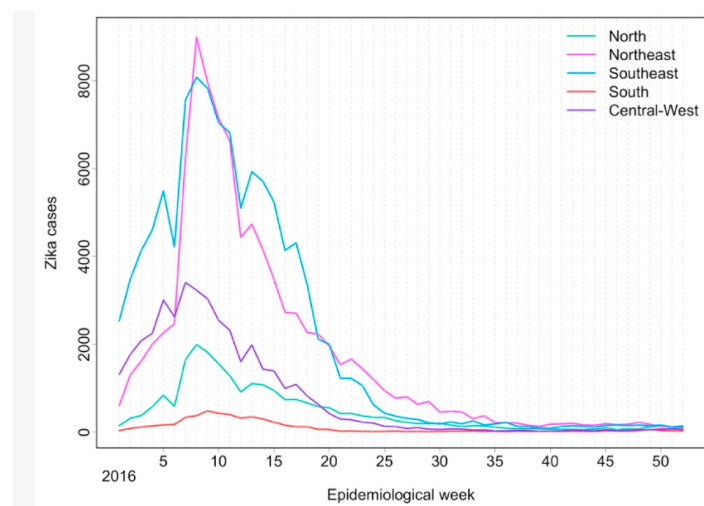
Sample answer:

Advantage:

Question 32 (13 marks)

Zika Virus

a) Describe the trend shown in the graph.



- Describe trends in graph for 5 regions - Refer to data for when cases are highest and region and when start to decline	2
Provides some relevant information	1

Graph shows number of Zika cases in 1000's in 2016 across 5 Brazilian regions. Cases highest in week 10 more than 8000 cases in Northeast Brazil and cases significantly decline after week 20

b) Use the graph to determine the approximate number of Zika cases in the Northeast region in epidemiological week 15, 2016. Show working on the graph.

- Correct approximation for the region stated - Show working on graph	2
Provides one of the points above	1

Approx 4000 cases

c) Identify the main mode of transmission of the Zika virus.

Correct identification	1
------------------------	---

Contact vector transmission

d) Explain how Koch's postulates can be used to establish a causal relationship between a microbe and a disease and identify ONE reason why it may not be possible to apply these postulates to the Zika virus.

• Explain how Koch's 4 postulates are used to identify cause of a disease • limitation related to viruses	3
• Explain some of Koch's postulates • limitation related to viruses	2
• Provides some relevant information	1

(1) The microorganism must be found in diseased but not healthy individuals;

(2) The microorganism must be cultured from the diseased individual;

(3) Inoculation of a healthy individual with the cultured microorganism must recapitulated the disease; and finally

(4) The microorganism must be re-isolated from the inoculated, diseased individual and matched to the original microorganism.

Koch's postulates, which require the presence of an infectious agent in cases with disease, and its absence in those without, and the isolation of the agent in pure cultures, were initially very important to identify infectious etiologies. However, it had limitations. Many organisms cannot be readily grown in cultures such as viruses.

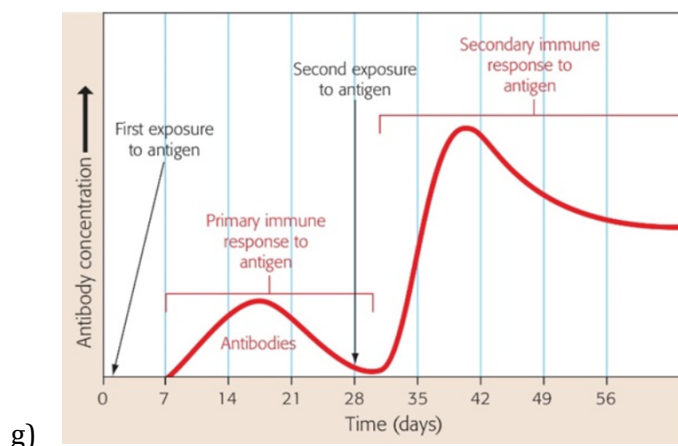
e) Provide an explanation as to why the antibody tests could not identify the difference between the antibodies produced against the Zika virus and the antibodies produced against other viruses.

• Explain specificity of antibodies	2
• Provides some relevant information	1

The shape of the Zika and other viruses' antigen are similar, enabling them both to bind on to the same antibody. The viruses bind to the antigen-binding site of the antibody.

f) Compare the first exposure to the second exposure in terms of changes to antibody concentration.

• 3 correct differences	3
• 2 correct differences	2
• Provides some relevant information	1



First	Second exposure
Antibodies start to be produced around day 7 after exposure	Antibodies start to be produced a few days after second exposure
Peak around day 18	Peak reached in shorter time around 10 days after exposure
Reduction in levels after peak	Levels continue at a high level for longer period

Question 33 (7 marks)

Explain why the combined use of public health campaigns and vaccination is a more effective way of controlling disease than using only one of these strategies. Support your answer using examples.

- Describes features of vaccination and public health programs in the prevention of disease - Explains the effectiveness of the combined use of the programs	6-7
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• Supports with related example of a disease for each method	
• Describes features of vaccination and public health programs in the prevention of disease • Outlines the effectiveness of the combined use of the programs • Supports with related example of a disease for ONE method	4-5
• Outlines information relevant to the effectiveness of vaccination and public health programs • Provides an example of a disease for each method but doesn't directly relate it to the either method of control	2-3
• Provides some relevant information	1

Sample answer:

Public health programs are useful in the prevention of disease because it educates people on how to reduce their exposure to the pathogen eg hand washing to prevent spread of disease, covering mouth when coughing, preparation and storage of food. Vaccination is useful because it prepares the person's immune system to respond to the pathogen meaning disease does not develop. However, public health programs don't provide any immunity against the disease, so if a person is exposed to the pathogen they can develop disease. Vaccination will prevent infection but immunity takes time to develop, so people may be infected before the vaccine has an effect.

Neither strategy alone is guaranteed to prevent the disease. The most effective strategy to prevent the disease would be to use a combination of vaccination and public health programs simultaneously.