NSW Education Standards Authority

Biology

Additional sample examination questions

Effective from	2019 HSC Examination
Publication date	Feb 2019
Updated	June 2019 – Mod 8 Question 15 July 2019 – Mod 6 Question 8, Mod 8 Question 10 July 2020 – Mod 6 Question 8

Contents

Introduction

The first HSC examination for the new Biology Stage 6 syllabus will be held in 2019.

The syllabus and related assessment materials are available on the syllabus page of the NESA website.

The *Assessment and Reporting in Biology Stage 6* document provides the Biology HSC examination specifications. The *Biology – Sample examination materials* document indicates the layout and format of the HSC examination and provides examples of questions that may be found in HSC examinations, with annotations.

This document, *Biology – Additional sample examination questions*, provides additional examples of questions that may be found in HSC examinations for Biology. The document comprises new questions, as well as questions that have been published in the sample examination materials and some questions that have been drawn from previous HSC examinations.

The document has been developed to assist teachers to:

- create sample HSC examination papers
- prepare revision exercises
- model question design
- consolidate understanding of the syllabus.

The sample questions are arranged by module. Examples of both objective-response questions and short-answer questions for each of the modules, Heredity, Genetic Change, Infectious Disease, and Non-infectious Disease and Disorders, are provided.

Each sample question has been mapped to show how the question relates to content, syllabus outcomes and bands. Questions may require candidates to integrate knowledge, understanding and skills from different content areas. Each question is mapped to the main content area(s) being assessed but may be relevant to one or more content areas. When a question has been mapped to multiple content areas, it has been placed under the topic deemed to be most relevant.

Answers for the objective-response questions and marking guidelines for the short-answer questions are also provided. The sample questions, sample answers and marking guidelines provide teachers and students with guidance as to the types of questions that may be included in the examination and how they may be marked. They are not meant to be prescriptive.

Note:

- In this set of sample questions, some stimulus material is used in more than one question. This illustrates how the same content area can be examined in different ways.
- The new Biology Stage 6 syllabus includes content areas that were also part of previous syllabuses. Where this occurs, teachers and students may still refer to past HSC examination papers for examples of other types of questions that are relevant.
- In this document, ‘Bands’ means the performance bands targeted by the question.

Question List

* denotes a multiple–choice question

Module 5 Heredity

Question	Marks	Content	Syllabus Outcomes	Bands
Mod 5 – 1*	1	Mod 5 Reproduction	BIO12–12	2–3
Mod 5 – 2*	1	Mod 5 Cell Replication	BIO12–5, BIO12–12	2–3
Mod 5 – 3*	1	Mod 5 DNA and Polypeptide Synthesis	BIO12–6, BIO12–12	4–5
Mod 5 – 4*	1	Mod 5 DNA and Polypeptide Synthesis	BIO12–4, BIO12–12	5–6
Mod 5 – 5*	1	Mod 5 Genetic Variation	Bio12–4, BIO12–12	2–3
Mod 5 – 6*	1	Mod 5 Genetic Variation	BIO12–12	3–4
Mod 5 – 7*	1	Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–5
Mod 5 – 8*	1	Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–5
Mod 5 – 9*	1	Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	5–6
Mod 5 – 10*	1	Mod 5 Inheritance Patterns in a Population	BIO12–2, BIO12–6, BIO12–12	4–5
Mod 5 – 11 (a)	3	Mod 5 Reproduction	BIO12–4, BIO12–12	2–4
Mod 5 – 11 (b)	3	Mod 5 Reproduction	BIO12–12	2–4
Mod 5 – 12	5	Mod 5 Reproduction	BIO12–6, BIO12–12	2–6
Mod 5 – 13 (a)	3	Mod 5 Cell Replication	BIO12–4, BIO12–12	2–5
Mod 5 – 13 (b)	1	Mod 5 Cell Replication	BIO12–5, BIO12–12	4–5
Mod 5 – 13 (c)	3	Mod 5 Cell Replication	BIO12–5, BIO12–6, BIO12–12	4–6
Mod 5 – 14 (a)	3	Mod 5 Cell Replication	BIO12–4, BIO12–12	4–6
Mod 5 – 14 (b)	2	Mod 5 Cell Replication	BIO12–5, BIO12–6, BIO12–12	5–6
Mod 5 – 15	3	Mod 5 DNA and Protein Synthesis	BIO12–7, BIO12–12	2–4
Mod 5 – 16 (a)	3	Mod 5 Genetic Variation	BIO12–4, BIO12–6, BIO12–7, BIO12–12	2–4
Mod 5 – 16 (b)	2	Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–6
Mod 5 – 17	4	Mod 5 Genetic Variation	BIO12–4, BIO12–5, BIO12–6, BIO12–12	2–5
Mod 5 – 18 (a)	2	Mod 5 Inheritance Patterns in a Population	BIO12–1, BIO12–12	4–5
Mod 5 – 18 (b)	4	Mod 5 Inheritance Patterns in a Population	BIO12–2, BIO12–12	3–6

Module 6 Genetic Change

Question	Marks	Content	Syllabus Outcomes	Bands
Mod 6 – 1*	1	Mod 6 Mutation	BIO12–6, BIO12–13	3–4
Mod 6 – 2*	1	Mod 6 Mutation	BIO12–6, BIO12–13	4–5
Mod 6 – 3*	1	Mod 6 Mutation	BIO12–5, BIO12–13	4–5
Mod 6 – 4*	1	Mod 6 Mutation	BIO12–6, BIO12–13	4–5
Mod 6 – 5*	1	Mod 6 Biotechnology	BIO12–7, BIO12–13	2–3
Mod 6 – 6*	1	Mod 6 Biotechnology	BIO12–6, BIO12–13	3–4
Mod 6 – 7*	1	Mod 6 Genetic Technologies	BIO12–7, BIO12–13	2–3
Mod 6 – 8 (a)	3	Mod 6 Mutation	BIO12–4, BIO12–13	2–5
Mod 6 – 8 (b)	2	Mod 6 Mutation	BIO12–6, BIO12–13	2–4
Mod 6 – 8 (c)	3	Mod 6 Mutation	BIO12–4, BIO12–6, BIO12–7, BIO12–13	2–5
Mod 6 – 9	8	Mod 6 Mutation	BIO12–4, BIO12–6, BIO12–13	2–6
Mod 6 – 10	6	Mod 6 Biotechnology Mod 6 Genetic Technologies	BIO12–6, BIO12–7, BIO12–13	2–6
Mod 6 – 11 (a)	2	Mod 6 Biotechnology Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–13	4–6
Mod 6 – 11 (b)	3	Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–13	3–6
Mod 6 – 12 (a)	2	Mod 6 Biotechnology	BIO12–5, BIO12–6, BIO12–13	4–6
Mod 6 – 12 (b)	3	Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–13	3–6
Mod 6 – 13	4	Mod 6 Genetic Technologies	BIO12–4, BIO12–5, BIO12–7, BIO12–13	2–6
Mod 6 – 14	7	Mod 5 Heredity Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–12, BIO12–13	2–6

Module 7 Infectious Disease

Question	Marks	Content	Syllabus Outcomes	Bands
Mod 7 – 1*	1	Mod 7 Causes of Infectious Disease	BIO12–7, BIO12–14	2–3
Mod 7 – 2*	1	Mod 7 Causes of Infectious Disease	BIO12–5, BIO12–14	3–4
Mod 7 – 3*	1	Mod 7 Causes of Infectious Disease	BIO12–6, BIO12–14	4–5
Mod 7 – 4*	1	Mod 7 Responses to Pathogens	BIO12–5, BIO12–14	2–3
Mod 7 – 5*	1	Mod 7 Responses to Pathogens	BIO12–7, BIO12–14	4–5
Mod 7 – 6*	1	Mod 7 Immunity	BIO12–5, BIO12–14	3–4
Mod 7 – 7*	1	Mod 7 Immunity	BIO12–5, BIO12–14	5–6
Mod 7 – 8*	1	Mod 7 Immunity	BIO12–5, BIO12–14	5–6
Mod 7 – 9*	1	Mod 7 Prevention, Treatment and Control	BIO12–1, BIO12–14	4–5

Mod 7 – 10*	1	Mod 7 Prevention, Treatment and Control	BIO12–14	4–5
Mod 7 – 11*	1	Mod 7 Causes of Infectious Disease Mod 7 Prevention, Treatment and Control	BIO12–2, BIO12–6, BIO12–14	5–6
Mod 7 – 12	3	Mod 7 Causes of Infectious Disease	BIO12–4, BIO12–14	2–4
Mod 7 – 13	3	Mod 7 Causes of Infectious Disease	BIO12–2, BIO12–3, BIO12–6, BIO12–14	2–4
Mod 7 – 14	5	Mod 7 Causes of Infectious Disease Mod 7 Responses to Pathogens	BIO12–6, BIO12–14	2–6
Mod 7 – 15 (a)	2	Mod 7 Responses to Pathogens	BIO12–1, BIO12–14	4–6
Mod 7 – 15 (b)	4	Mod 7 Responses to Pathogens	BIO12–6, BIO12–14	3–6
Mod 7 – 16 (a)	2	Mod 7 Immunity	BIO12–4, BIO12–14	2–3
Mod 7 – 16 (b)	4	Mod 7 Immunity	BIO12–6, BIO12–14	3–6
Mod 7 – 17 (a)	3	Mod 7 Immunity	BIO12–6, BIO12–14	3–6
Mod 7 – 17 (b)	3	Mod 7 Immunity	BIO12–6, BIO12–14	3–6
Mod 7 – 18	9	Mod 7 Causes of Infectious Disease Mod 7 Prevention, Treatment and Control Mod 8 Causes and Effects Mod 8 Epidemiology Mod 8 Prevention	BIO12–4, BIO12–5, BIO12–6, BIO12–7, BIO12–14, BIO12–15	2–6

Module 8 Non-infectious Disease and Disorders

Question	Marks	Content	Syllabus Outcomes	Bands
Mod 8 – 1*	1	Mod 8 Homeostasis	BIO12–5, BIO12–15	3–4
Mod 8 – 2*	1	Mod 8 Homeostasis	BIO12–5, BIO12–15	3–4
Mod 8 – 3*	1	Mod 8 Homeostasis	BIO12–2, BIO12–6, BIO12–15	4–5
Mod 8 – 4*	1	Mod 8 Causes and Effects	BIO12–7, BIO12–15	2–3
Mod 8 – 5*	1	Mod 8 Epidemiology	BIO12–7, BIO12–15	2–3
Mod 8 – 6*	1	Mod 8 Epidemiology	BIO12–6, BIO12–15	3–4
Mod 8 – 7*	1	Mod 8 Prevention	BIO12–7, BIO12–15	2–3
Mod 8 – 8*	1	Mod 8 Technologies and Disorders	BIO12–7, BIO12–15	3–4
Mod 8 – 9*	1	Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	3–4
Mod 8 – 10 (a)	3	Mod 8 Homeostasis	BIO12–4, BIO12–7, BIO12–15	3–6
Mod 8 – 10 (b)	3	Mod 8 Homeostasis	BIO12–4, BIO12–6, BIO12–7, BIO12–15	3–6
Mod 8 – 11	5	Mod 8 Epidemiology	BIO12–2, BIO12–5, BIO12–7, BIO12–15	2–6
Mod 8 – 12	3	Mod 8 Prevention, Treatment and Control	BIO12–6, BIO12–7, BIO12–15	2–5
Mod 8 – 13 (a)	2	Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	2–4
Mod 8 – 13 (b)	4	Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	2–6

Mod 8 – 14	7	Mod 8 Technologies and Disorders	BIO12–6, BIO12–7, BIO12–15	2–6
Mod 8 – 15	7	Mod 8 Epidemiology	BIO12–2, BIO12–4, BIO12–5, BIO12–6, BIO12–7, BIO12–15	2–6

Module 5 Heredity

Mod 5 – Question 1

A strawberry plant will send out over the ground runners which will take root and grow a new plant as shown.

This method of growing a new plant is an example of

A. budding.

B. germination.

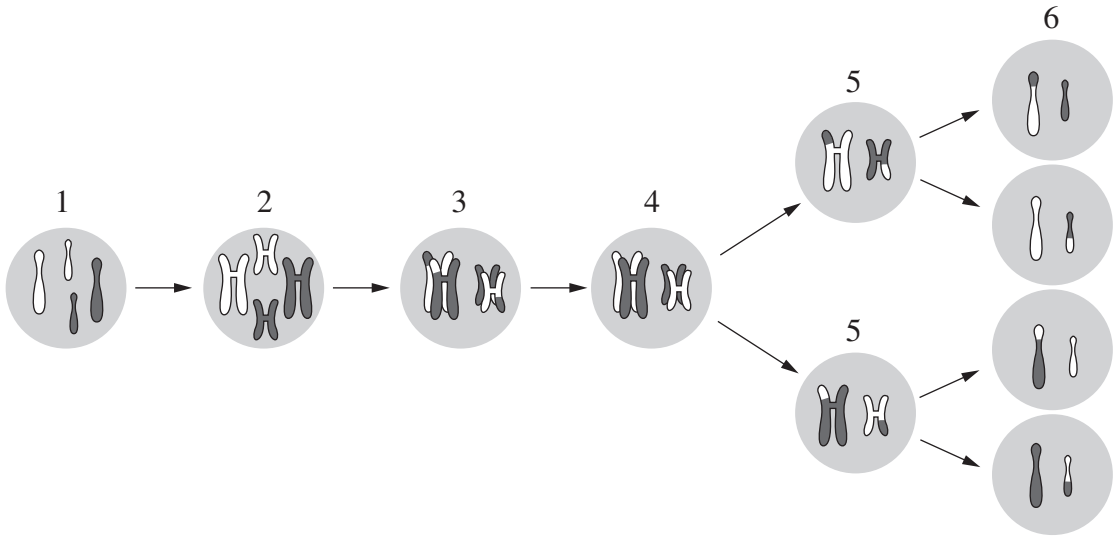
C. external fertilisation.

D. asexual reproduction.

Content	Syllabus outcomes	Bands	Key
Mod 5 Reproduction	BIO12–12	2–3	D

Mod 5 – Question 2

A student constructed a model of meiosis as shown. However, there is an error in the model.



Which aspect of this model does NOT fit with observations of meiosis?

A. Separation of chromatids has not been shown in the model.

B. The chromosomes have not independently assorted in stage 2.

C. The chromosomes in stage 4 should have duplicated before stage 5.

D. The chromosomes have undergone crossing over before sister chromosome alignment in stage 3.

Content	Syllabus outcomes	Bands	Key
Mod 5 Cell Replication	BIO12–5, BIO12–12	2–3	D

Mod 5 – Question 3

Haemophilia A is a blood clotting disorder that arises from a defect in the gene F8 which is carried on the X chromosome. The disorder affects the production of a glycoprotein that is one of many components needed to form the platelets which form blood clots when a bleed occurs. It is typically treated with infusions of FVIII product, an inactive single chain polypeptide of 2332 amino acids, which is manufactured using DNA technology on human endothelial cells.

Why is the inactive FVIII polypeptide chain used in the treatment of Haemophilia A?

A. It will prevent bleeds from occurring.

B. It can take the place of platelets in clotting blood.

C. It can be used to manufacture the glycoprotein that is affected by the defective F8 gene.

D. It is used as a gene therapy to help the patient manufacture FVIII in their own endothelial cells.

Content	Syllabus outcomes	Bands	Key
Mod 5 DNA and Polypeptide Synthesis	BIO12–6, BIO12–12	4–5	C

Mod 5 – Question 4

The table shows the base triplets in mRNA for amino acids.

From the table, the amino acid Tryptophan (Trp) can be coded for by the base triplet UGG.

Base triplets found in messenger RNA

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	Phe	Ser	Tyr	Cys	**U**
	Phe	Ser	Tyr	Cys	**C**
	Phe	Ser	Stop	Stop	**A**
	Phe	Ser	Stop	Trp	**G**
C	Leu	Pro	His	Arg	**U**
	Leu	Pro	His	Arg	**C**
	Leu	Pro	Gln	Arg	**A**
	Leu	Pro	Gln	Arg	**G**
A	Ile	Thr	Asn	Ser	**U**
	Ile	Thr	Asn	Ser	**C**
	Ile	Thr	Lys	Arg	**A**
	Met	Thr	Lys	Arg	**G**
G	Val	Ala	Asp	Gly	**U**
	Val	Ala	Asp	Gly	**C**
	Val	Ala	Glu	Gly	**A**
	Val	Ala	Glu	Gly	**G**

Which base triplet could code for the amino acid Arginine (Arg)?

A. AAU

B. GAC

C. GCC

D. CGG

Content	Syllabus outcomes	Bands	Key
Mod 5 DNA and Polypeptide Synthesis	BIO12–4, BIO12–12	5–6	D

Mod 5 – Question 5

A student completed a genetics exercise by preparing a Punnett square. *T* represents a dominant allele and *t* represents a recessive allele.

	Parent 1 gametes	
Parent 2 gametes	*TT*	*Tt*
	Tt	*tt*

What were the likely genotypes of these parents?

A. Both parents were homozygous.

B. Both parents were heterozygous.

C. Parent 1 was homozygous, Parent 2 was heterozygous.

D. Parent 1 was heterozygous, Parent 2 was homozygous.

Content	Syllabus outcomes	Bands	Key
Mod 5 Genetic Variation	BIO12–4, BIO12–12	2–3	B

Mod 5 – Question 6

In which of the following do both processes result in genetic variation of offspring?

A. DNA mutation and gamete formation

B. Cell differentiation and gamete formation

C. DNA mutation and polypeptide production

D. Cell differentiation and polypeptide production

Content	Syllabus outcomes	Bands	Key
Mod 5 Genetic Variation	BIO12–12	3–4	A

Mod 5 – Question 7

Colour blindness is a sex-linked recessive trait.

Susan is not colourblind but her father is. Susan is married to James who is also not colourblind. Susan and James are expecting twins, a boy and a girl.

Which row in the table shows the probability of colourblindness in the boy and the girl?

	Boy	*Girl*
A.	0%	0%
B.	50%	0%
C.	0%	50%
D.	50%	50%

Content	Syllabus outcomes	Bands	Key
Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–5	B

Mod 5 – Question 8

Haemophilia A is a blood clotting disorder that arises from a defect in the gene which is carried on the X chromosome.

A couple is considering starting a family. However, the father suffers from Haemophilia A. The mother is healthy with no family history of the disease.

What is the probability that a potential grandson will have Haemophilia A if they have a daughter who partners with an unaffected man?

A. 0%

B. 25%

C. 50%

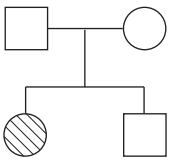
D. 100%

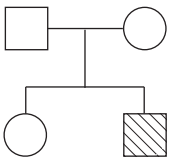
Content	Syllabus outcomes	Bands	Key
Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–5	C

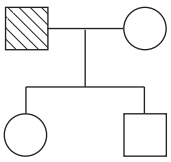
Mod 5 – Question 9

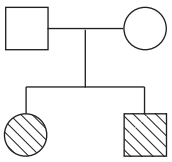
It is suspected that a child has a recessive, sex-linked condition. An initial pedigree was developed.

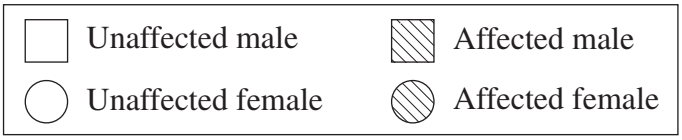
Which of the following is most likely to depict this initial pedigree?

A. 

B. 

C. 

D. 



Content	Syllabus outcomes	Bands	Key
Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	5–6	B

Mod 5 – Question 10

A student conducted a survey to determine the phenotype prevalence of cats that had long hair in comparison to the number that had short hair in a population of cats. She asked her classmates to describe the coat length of their cats and tallied the results. Out of 26 cats that were counted, she found that 42% of the cats had long hair and 58% had short hair, and that the trait did not follow a Mendelian ratio.

Which of the following best explains why the results did not follow a Mendelian ratio?

A. The student tallied the numbers incorrectly.

B. The length of cat hair may be determined by more than one gene.

C. The student cannot determine the genotype from the phenotype alone.

D. The students were unclear about whether their cat had long or short hair.

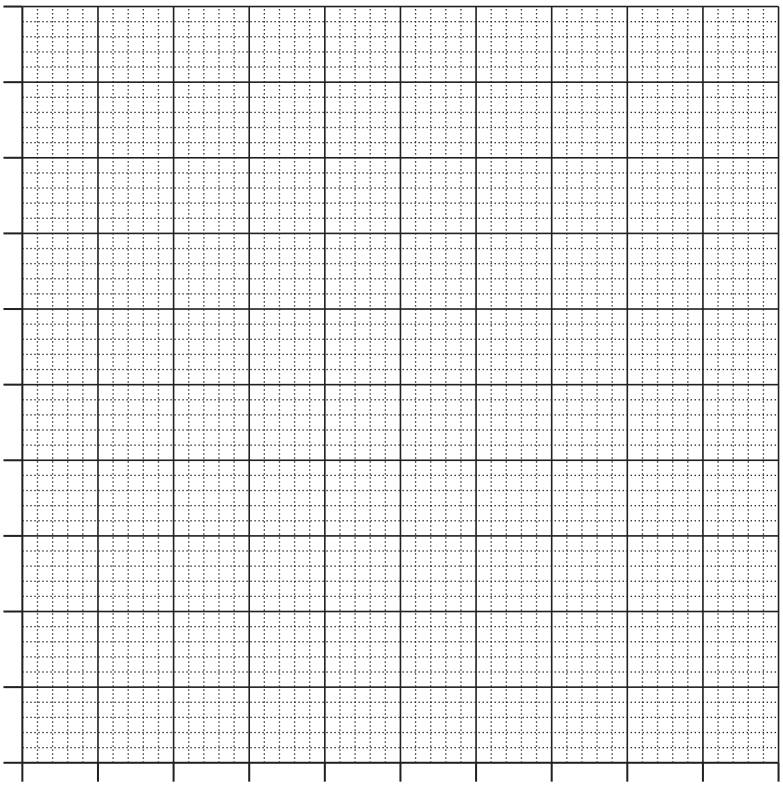
Content	Syllabus outcomes	Bands	Key
Mod 5 Inheritance Patterns in a Population	BIO12–2, BIO12–6, BIO12–12	4–5	B

Mod 5 – Question 11 (6 marks)

(a) The following data shows the average amount of Human Chorionic Gonadotropin (hCG) produced by pregnant women. **3**

Weeks of pregnancy	*hCG* (ng/mL)
0	0
4	85
8	185
12	185
16	80
20	65
24	60
28	65
32	75
36	65
40	35

Use the information provided to graph the levels of hCG in a normal pregnancy.



Question 11 continues on page 17

Question 11 (continued)

(b) Describe the role and changes in levels of a hormone in pregnancy. **3**

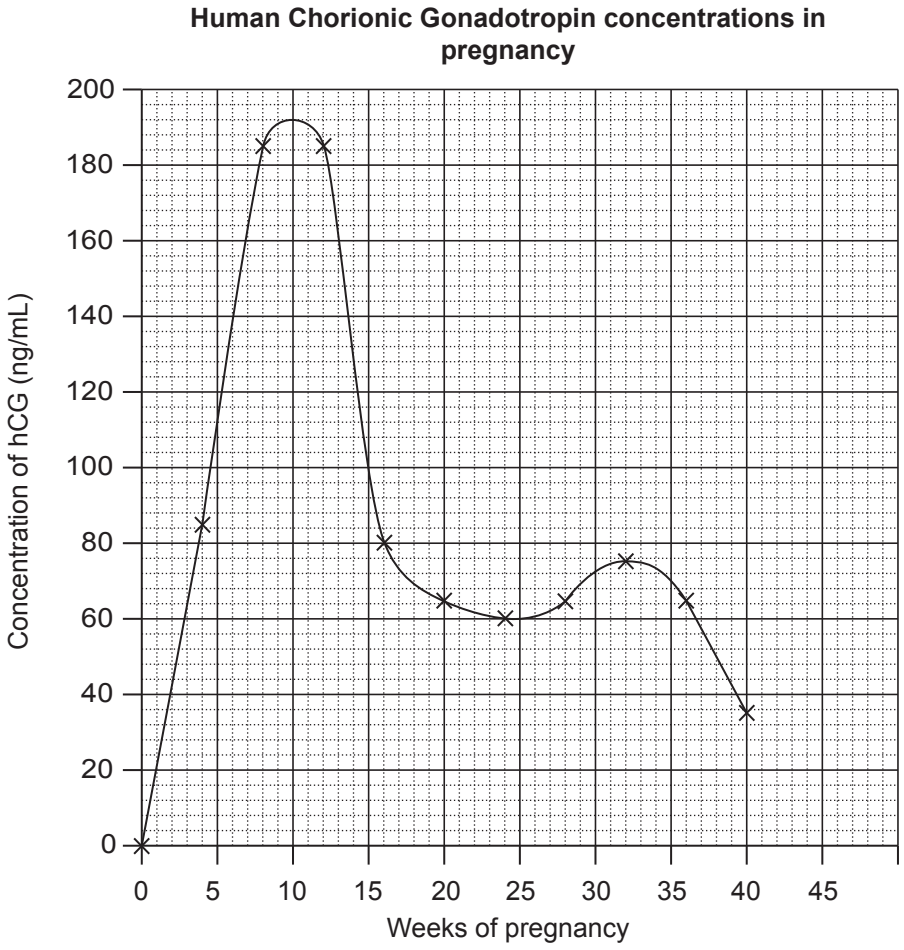
Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 5 Reproduction	BIO12–4, BIO12–12	2–4

Marking guidelines (a):

Criteria	Marks
• Labels axes correctly including units • Uses appropriate scale • Plots points correctly • Draws appropriate graph	3
• Provides some correct steps in completing the graph	2
• Provides some relevant information	1

Sample answer:



Question 11 continues on page 18

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 5 Reproduction	BIO12–12	2–4

Marking guidelines (b):

Criteria	Marks
• Describes the role and changes in levels of a hormone in pregnancy	3
• Outlines the role and/or levels of a hormone in pregnancy	2
• Provides some relevant information	1

Sample answer:

A hormone that is important in pregnancy is progesterone. Progesterone is initially produced by the corpus luteum in the ovary and causes the endometrium to thicken, which helps to support and maintain the pregnancy in the first weeks when the placenta is still developing. The developed placenta then produces progesterone at significantly higher levels to maintain the pregnancy. Prior to birth progesterone levels drop significantly to facilitate labour.

End of Question 11

Mod 5 – Question 12 (5 marks)

Justify why internal fertilisation is more advantageous than external fertilisation in ensuring the continuity of a species. **5**

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 5 Reproduction	BIO12–6, BIO12–12	2–6

Marking guidelines:

Criteria	Marks
• Provides a thorough justification • Shows a thorough understanding of both internal fertilisation and external fertilisation in terms of ensuring the continuity of a species • Shows clear understanding of the advantages of internal fertilisation over external fertilisation	5
• Shows a sound understanding of both internal fertilisation and external fertilisation • Links both to ensuring the continuity of a species • Outlines benefits and/or weaknesses of internal and external fertilisation	4
• Outlines features of both internal fertilisation and external fertilisation	3
• Identifies some features of internal fertilisation and/or external fertilisation	2
• Provides some relevant information	1

Sample answer:

For the continuity of a species, each generation must successfully reproduce to produce sufficient numbers of the next generation. A critical number of embryos must survive to gestational maturity. This is less likely with external fertilisation.

Organisms that reproduce by external reproduction spend a substantial amount of energy and resources in the production and release of very large numbers of sperm and eggs. This is because each sperm and egg and the resulting embryos have limited chances of survival, not being protected by the parent for example in the open ocean. Chances of successful fertilisation are low in such vast aquatic environments. Larger numbers ensure some will be fertilised.

Internal fertilisation provides a smaller safer environment for release of gametes, fertilisation and maturation of the embryos. Chances of successful fertilisation are increased and embryos are protected from predators within the body of the parent. Even after birth/egg laying parental care assists survival of the offspring.

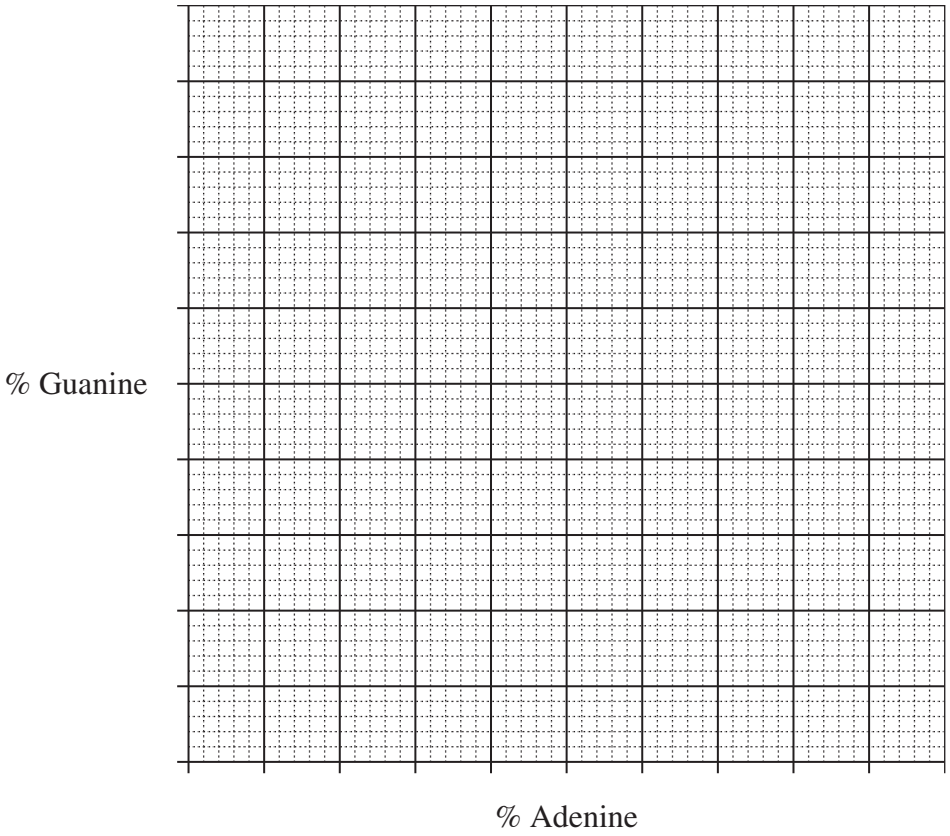
Mod 5 – Question 13 (7 marks)

Students conducted preliminary experiments to analyse the DNA base composition of five different species.

The table shows the experimental data collected.

Species	*% Adenine*	*% Guanine*
A	38	12
B	26	22
C	8	40
D	20	32
E	33	18

(a) On the grid provided, plot the % Guanine against % Adenine of the species analysed and draw a suitable line of best fit. **3**



(b) Identify the relationship shown by the data. **1**

(c) Explain the relationship shown by the data. **3**

Question 13 continues on page 21

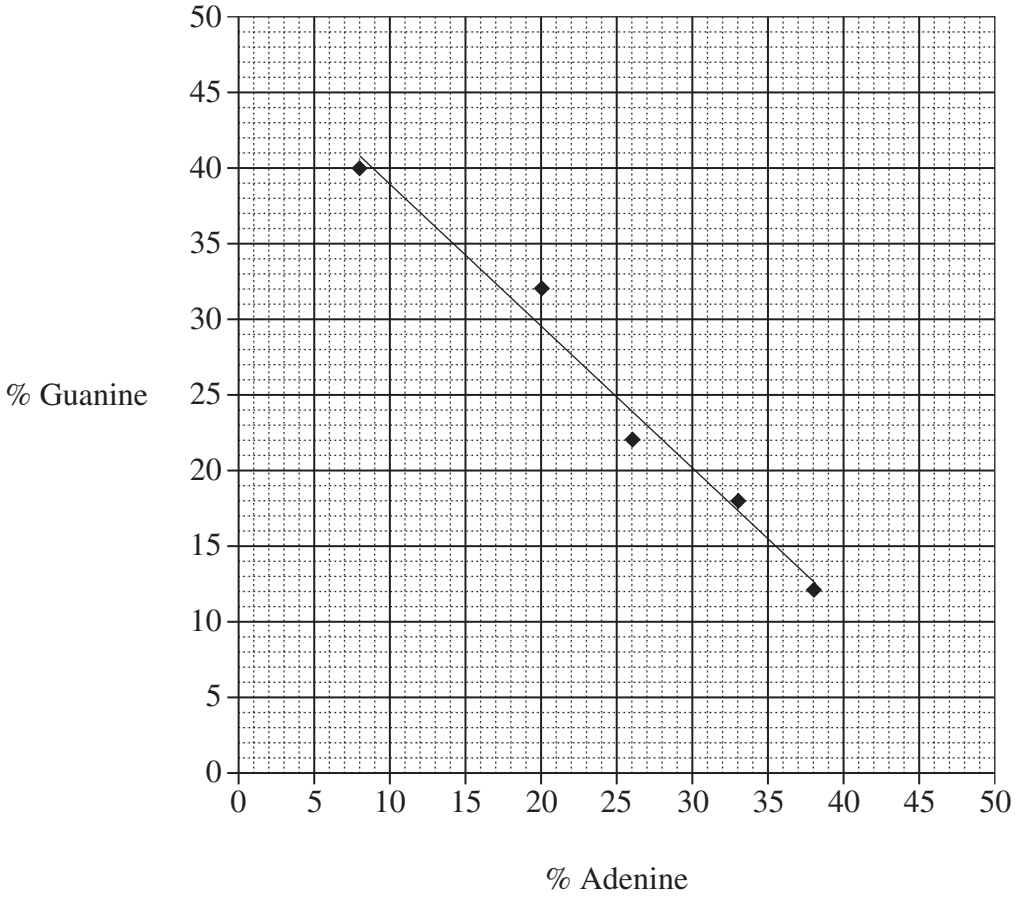
Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 5 Cell Replication	BIO12–4, BIO12–12	2–5

Marking guidelines (a):

Criteria	Marks
• Uses appropriate scale • Plots points correctly • Draws an appropriate line of best fit	3
• Draws a substantially correct graph	2
• Provides some relevant information	1

Sample answer:



Question 13 continues on page 22

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 5 Cell Replication	BIO12–5, BIO12–12	4–5

Marking guidelines (b):

Criteria	Marks
• Identifies a correct relationship	1

Sample answer:

As the % of Adenine increases, the % of Guanine decreases.

Mapping grid (c):

Content	Syllabus outcomes	Bands
Mod 5 Cell Replication	BIO12–5, BIO12–6, BIO12–12	4–6

Marking guidelines (c):

Criteria	Marks
• Explains the relationship • Makes clear reference to the data	3
• Demonstrates some understanding of the relationship	2
• Provides some relevant information	1

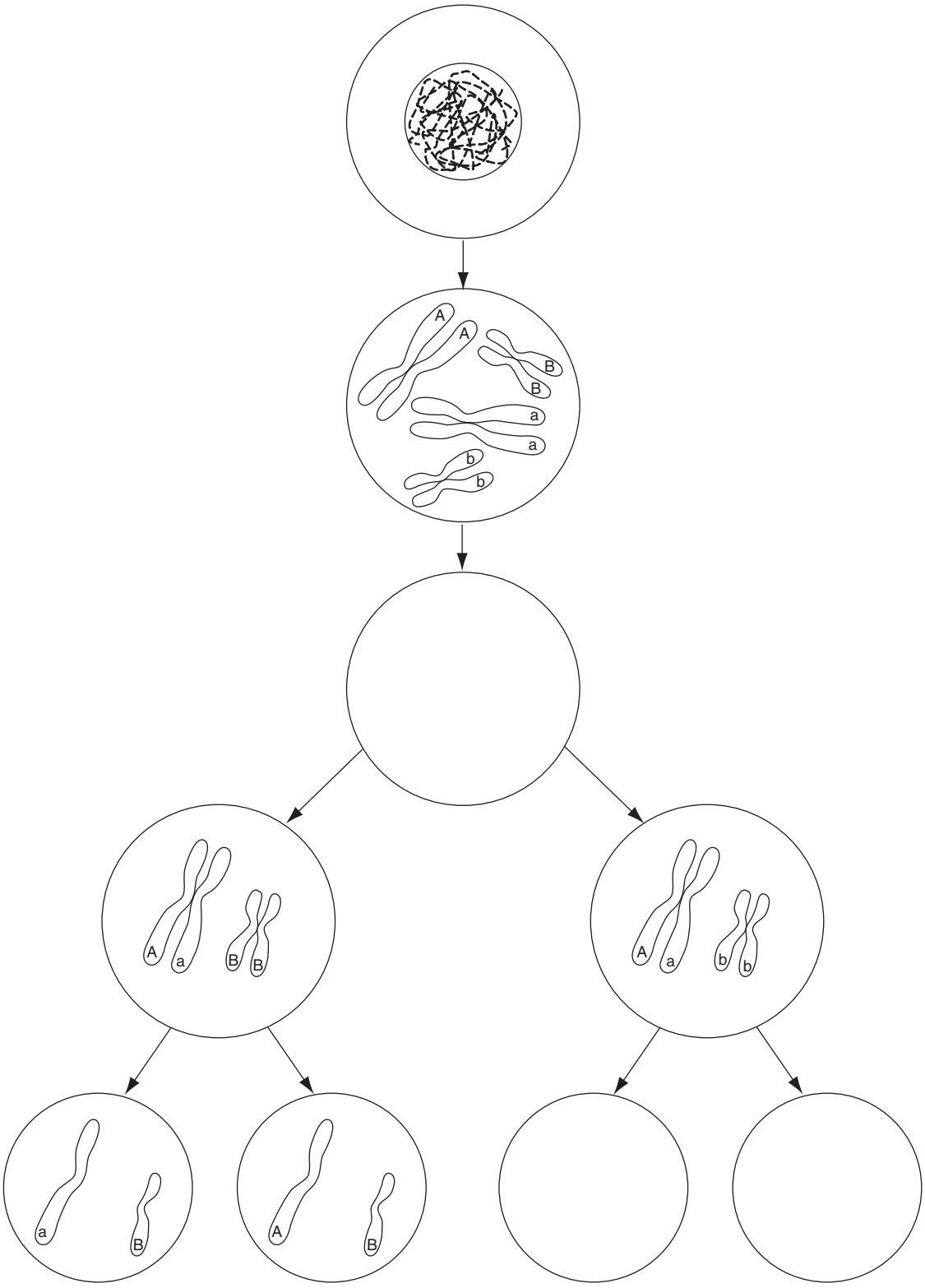
Sample answer:

The percentage of A = T is related to the percentage of G = C due to the base pairing rule. This means as A goes up, T will also go up because A = T and A + T + C + G should equal 100%. Therefore as A increases, the amount of G should decrease as there is a smaller proportion available.

End of Question 13

Mod 5 – Question 14 (5 marks)

(a) Complete the following diagram to show the process by which gametes are formed. **3**



Question 14 continues on page 24

Question 14 (continued)

(b) How does the segregation of chromosomes during meiosis lead to a wide variety of gametes being produced? **2**

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 5 Cell Replication	BIO12–4, BIO12–12	4–6

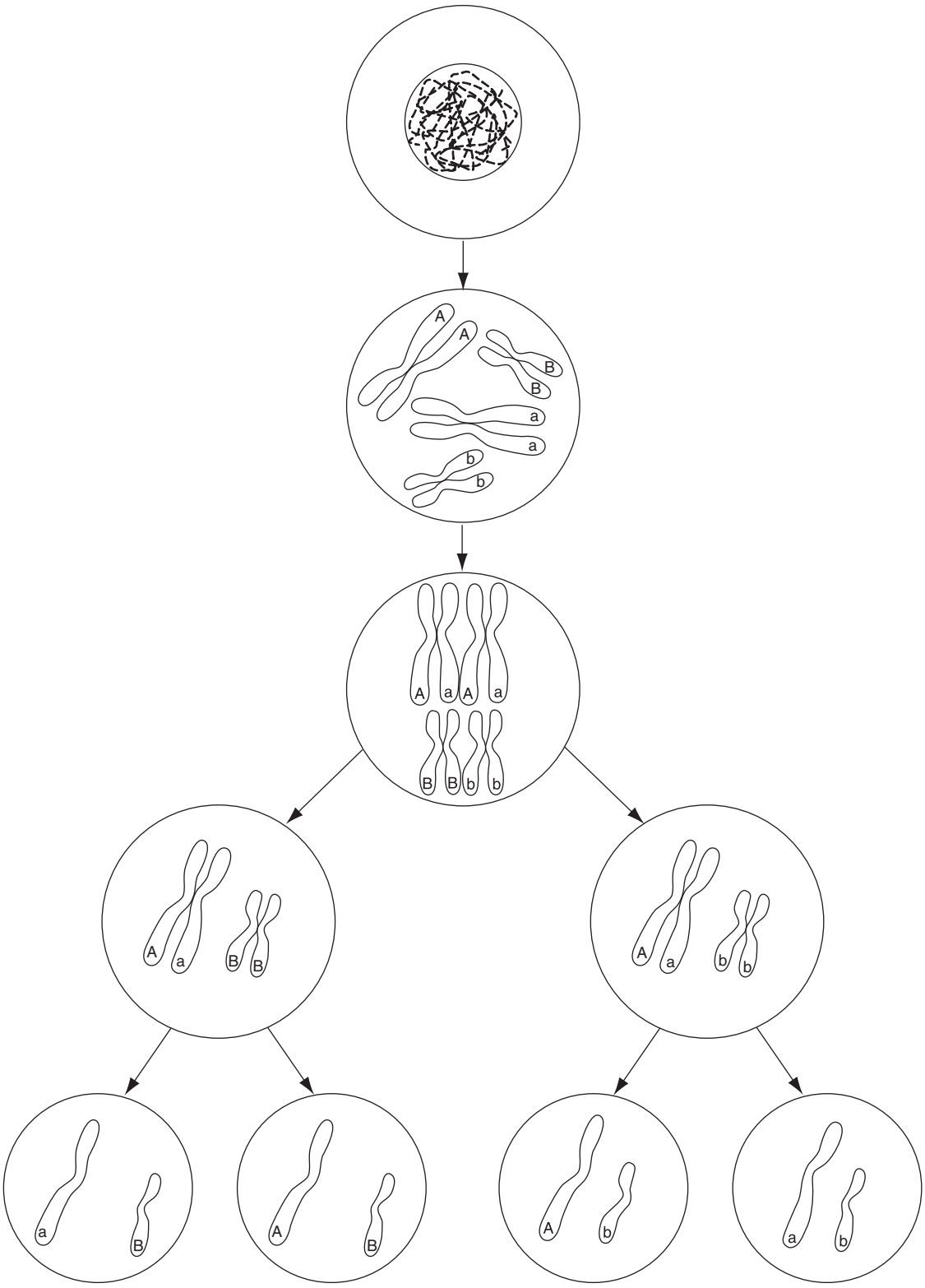
Marking guidelines (a):

Criteria	Marks
• Diagram 1: tetrads line up correctly, alleles in correct position, homologous chromosomes paired and joined correctly and crossing over has occurred • Diagram 2: haploid, with appropriate chromosomes and alleles in both	3
• Completes Diagram 1 OR • Shows some elements of Diagram 1 and Diagram 2	2
• Provides some relevant information	1

Question 14 continues on page 25

Question 14 (continued)

Sample answer:



Question 14 continues on page 26

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 5 Cell Replication	BIO12–5, BIO12–6, BIO12–12	5–6

Marking guidelines (b):

Criteria	Marks
• Demonstrates a sound knowledge of independent assortment during gamete formation and relates to a range of gamete combinations	2
• Provides some relevant information	1

Sample answer:

In meiosis, there is a reduction division. Chromosome pairs line up together and one of each pair goes into the daughter cells. For each pair, this process is independent – hence a large number of combinations is possible.

End of Question 14

Mod 5 – Question 15 (3 marks)

There are some significant differences in the form that DNA has in prokaryotic and eukaryotic cells. **3**

In the space provided draw a labelled diagram demonstrating the difference in the form of DNA between prokaryotic and eukaryotic cells.

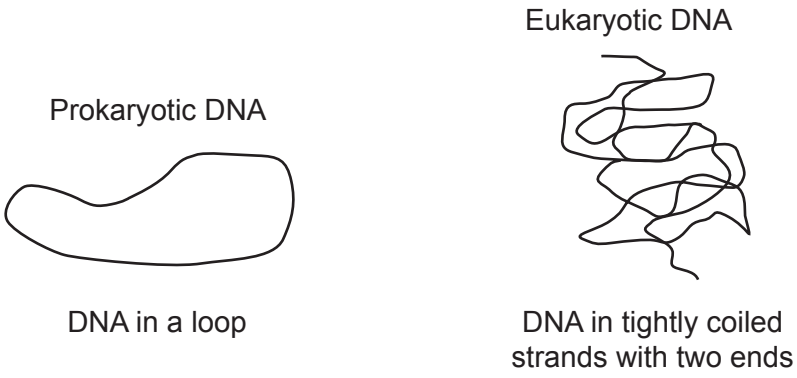
Mapping grid:

Content	Syllabus outcomes	Bands
Mod 5 DNA and Protein Synthesis	BIO12–7, BIO12–12	2–4

Marking guidelines:

Criteria	Marks
• Draws prokaryotic DNA form as loop and eukaryotic DNA form as a strand with distinct ends • Provides relevant labels that convey understanding of DNA forms	3
• Draws prokaryotic DNA form as loop and eukaryotic DNA as a strand with distinct ends OR • Draws and labels EITHER prokaryotic DNA form or eukaryotic DNA form	2
• Provides some relevant information	1

Sample answer:



Mod 5 – Question 16 (5 marks)

A non-infectious disease was observed in a mother and her four sons who live with her. She has no daughters. The father of these children does not have the disease and does not live with them. The woman's parents and her two sisters who live overseas do not have the disease.

A geneticist suspects that the disease is inherited.

(a) Draw the family pedigree for this disease. **3**

(b) From the evidence, what indicates that the disease could be the result of a recessive allele and not be sex-linked? **2**

Mapping grid (a):

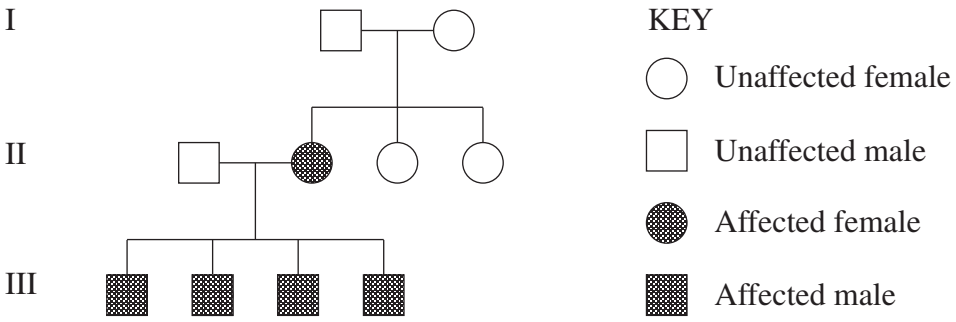
Content	Syllabus outcomes	Bands
Mod 5 Genetic Variation	BIO12–4, BIO12–6, BIO12–7, BIO12–12	2–4

Question 16 continues on page 29

Marking guidelines (a):

Criteria	Marks
• Provides a pedigree showing THREE generations • Uses common structure OR key • Clearly shows sufferers	3
• Provides a clear pedigree showing sufferers	2
• Provides some relevant information	1

Sample answer:



Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 5 Genetic Variation	BIO12–5, BIO12–6, BIO12–12	4–6

Marking guidelines (b):

Criteria	Marks
• Provides evidence that indicates why the gene is recessive • Provides evidence that indicates why the gene cannot be sex-linked	2
• Provides evidence that indicates why the gene is recessive OR • Provides evidence that indicates why the gene cannot be sex-linked	1

Sample answer:

The grandparents do not have the disease while the mother has the disease (recessive) and the disease is not found in the grandfather while the mother has the disease (not sex-linked).

End of Question 16

Mod 5 – Question 17 (4 marks)

The diagram shows a model developed in the early 20th century of crossing over of homologous chromosomes. **4**

Explain how the difference between this model and our current model of crossing over reflects an increased understanding of the way in which new combinations of genotypes are produced. Support your answer with a diagram.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 5 Genetic Variation	BIO12–4, BIO12–5, BIO12–6, BIO12–12	2–5

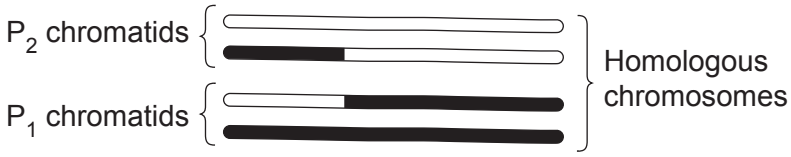
Marking guidelines:

Criteria	Marks
• Outlines gamete formation in the old and current models clearly showing the difference • Relates the difference between the models to gamete production and genetic variation in potential offspring	4
• Outlines gamete formation in the old and current models • Makes some link to gamete production and/or genetic variation in potential offspring	3
• Outlines gamete formation in the old and/or current model AND/OR • Outlines some implication in terms of gamete production and/or genetic variation in potential offspring	2
• Provides some relevant information	1

Question 17 continues on page 31

Sample answer:

The old model shows one strand of each homologous chromosome. This means that when gametes are produced they would only contain the chromosomes showing the products of crossing over, ie showing the recombined genetic information. Our current model shows that DNA replication has occurred before crossing over takes place. Replicated homologous chromosomes line up in tetrads. Cross over happens between two chromatids within the tetrad, not between all chromatids. Therefore, there are parental chromatids that have undergone crossing over and parental chromatids that have not.



This means that when gametes are made, some will get unchanged parental chromosomes and some will get the chromatids that have undergone crossing over. This means that the range of gametes produced, and thus individuals produced through fertilisation, will show much greater variation.

End of Question 17

Mod 5 – Question 18 (6 marks)

A student plans to investigate whether the development of insulin has affected the prevalence of Type 1 diabetes in the human population and subsequently influenced human evolution. She has access to data on Australians with diabetes extending back to 1973.

(a) Propose a suitable hypothesis for this investigation. **2**

(b) Identify TWO variables that need to be controlled for this investigation and explain their importance. **4**

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 5 Inheritance Patterns in a Population	BIO12–1, BIO12–12	4–5

Marking guidelines (a):

Criteria	Marks
• Proposes a suitable hypothesis	2
• Provides some relevant information	1

Sample answer:

The use of insulin, by people who have Type 1 diabetes, has increased the prevalence of Type 1 diabetes in the human population.

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 5 Inheritance Patterns in a Population	BIO12–2, BIO12–12	3–6

Marking guidelines (b):

Criteria	Marks
• Identifies TWO variables that could affect findings and explains their importance	4
• Identifies TWO variables that could affect findings and outlines their importance	3
• Identifies ONE variable that could affect findings and outlines its importance	2
• Provides some relevant information	1

Question 18 continues on page 33

Sample answer:

One variable the student will need to control for is the increase in the Australian population since 1973. Just counting the increase in numbers without taking into account population increases will give a biased result as even without an increase in prevalence it would be expected that the total numbers will increase as the population increases. The prevalence will need to be measured using a rate such as number of people with Type 1 diabetes per 100 000 people.

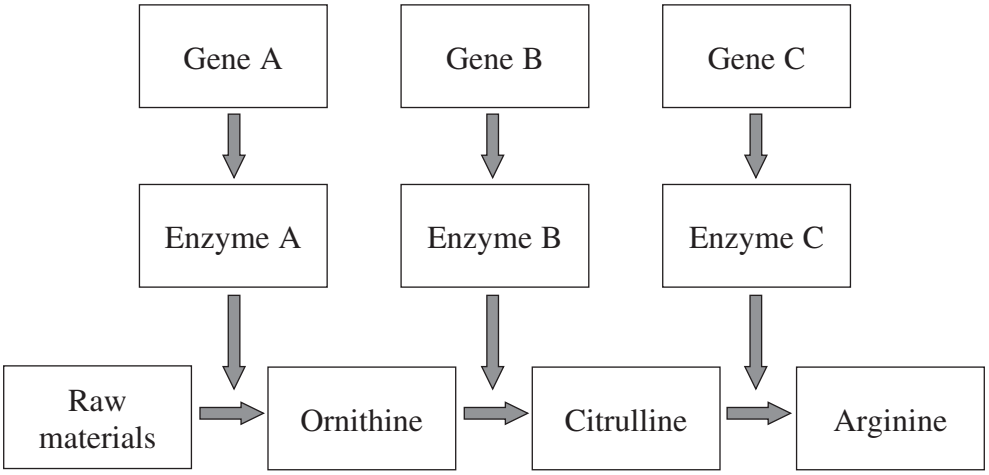
Another variable that may affect results, and therefore reduce the validity of the data, is the length of time the subject has used insulin or since diagnosis. This data may also be useful if determining whether the prevalence of Type 1 diabetes is caused by more people being diagnosed or more people surviving for a longer time.

End of Question 18

Module 6 Genetic Change

Mod 6 – Question 1

The bread mould, *Neurospora crassa*, normally produces its own amino acids from raw materials through a system of enzymes.



If a mutation occurred in gene B, the bread mould would still produce arginine if supplied with

A. citrulline.

B. ornithine.

C. enzyme C.

D. raw materials.

Content	Syllabus outcomes	Bands	Key
Mod 6 Mutation	BIO12–6, BIO12–13	3–4	A

Mod 6 – Question 2

An evolutionary biologist was investigating the timeframes of genetic divergence between different species of Acacia. She hypothesised that she would get a better indication of the time at which Acacia species diverged by using non-coding DNA segments rather than coding DNA segments.

Why is this hypothesis most likely to be supported by the evidence?

A. Coding DNA segments never undergo mutation.

B. Coding DNA segments are less stable over time due to the selection pressures of the environment.

C. Non-coding DNA segments are stable over time and cannot be used as evidence of genetic divergence.

D. Non-coding DNA segments will show greater diversity after divergence as they are not exposed to selection pressures.

Content	Syllabus outcomes	Bands	Key
Mod 6 Mutation	BIO12–6, BIO12–13	4–5	D

Mod 6 – Question 3

The following events occur after DNA is subjected to radiation. The events are listed in no specific order.

P: Mutation
Q: Change in cell activity
R: Change in protein structure
S: Change in polypeptide sequence

What is the correct sequence of steps?

A. P, Q, R, S

B. S, Q, P, R

C. S, R, Q, P

D. P, S, R, Q

Content	Syllabus outcomes	Bands	Key
Mod 6 Mutation	BIO12–5, BIO12–13	4–5	D

Mod 6 – Question 4

Which of the following is true of a mutation that produces an allele that is dominant?

A. It would be expected to cause death.

B. It could give an observable phenotype in a heterozygous genotype.

C. It could give an observable phenotype only in a homozygous genotype.

D. It would be expected to spread more quickly through a population than a recessive mutation.

Content	Syllabus outcomes	Bands	Key
Mod 6 Mutation	BIO12–6, BIO12–13	4–5	B

Mod 6 – Question 5

A student was doing a literature review on biotechnology and wanted to see how biotechnology research could positively benefit people who suffered from Type 1 diabetes. He found several potential measures that were being explored to help people with diabetes.

Which of the following measures does NOT use biotechnology?

A. Gene therapy in which genetic information is introduced into the cells of the pancreas

B. The screening of genes to inform potential parents of the risk of their child developing Type 1 diabetes

C. The use of auto-monitoring insulin pumps that can detect when a patient's insulin levels are dropping too low

D. Collecting survey data on the prevalence of Type 1 diabetes in different communities to ensure insulin supplies are maintained at sufficient levels

Content	Syllabus outcomes	Bands	Key
Mod 6 Biotechnology	BIO12–7, BIO12–13	2–3	D

Mod 6 – Question 6

Glofish are a genetically-modified organism in which the gene that causes fluorescence in jellyfish has been inserted into a tropical fish species, typically Zebra fish. These fish are sold commercially for home aquariums. Some sectors of the community have said that humans do not have the right to make genetically-modified organisms for this purpose.

What is the main nature of their concern?

A. The limited application the Glofish have in society

B. The risks to the biodiversity of the Zebra fish species

C. The ethics of manipulating an organism's genes for commercial gain

D. That the Glofish may interbreed with other species causing serious mutations in the future

Content	Syllabus outcomes	Bands	Key
Mod 6 Biotechnology	BIO12–6, BIO12–13	3–4	C

Mod 6 – Question 7

A New Zealand research team inserted a single gene into an onion to reduce the activity of the enzyme that makes your eyes water, resulting in an onion that you can cut without crying.

Which term best describes this team's process?

A. Cloning

B. Artificial pollination

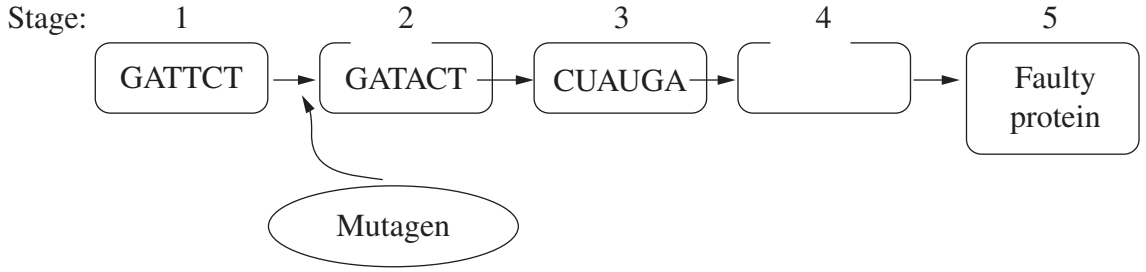
C. Genetic engineering

D. Artificial insemination

Content	Syllabus outcomes	Bands	Key
Mod 6 Genetic Technologies	BIO12–7, BIO12–13	2–3	C

Mod 6 – Question 8 (8 marks)

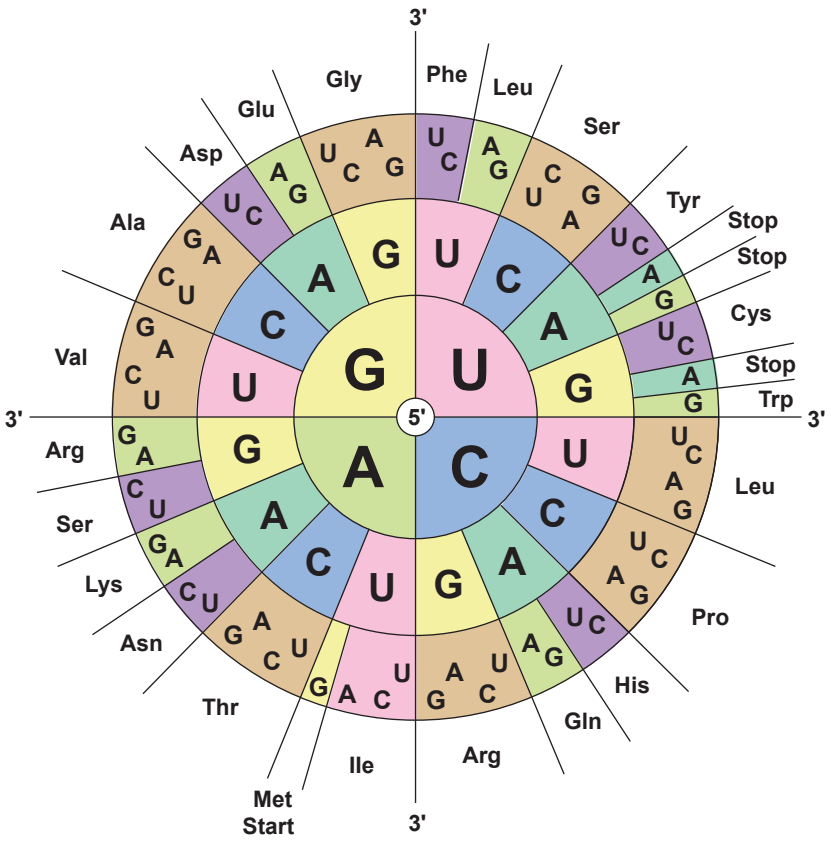
The flow chart illustrates the effect of a point mutation on an organism.



(a) Outline the series of events from stages 2 to 4 that resulted in the faulty protein. **3**

(b) Describe how a type of mutagen may have caused the changes observed in stage 2. **2**

(c) Given the information in the chart shown, describe the effect caused by the mutation in stage 4 and the effect this would have on the organism. **3**



Question 8 continues on page 39

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 6 Mutation	BIO12–4, BIO12–13	2–5

Marking guidelines (a):

Criteria	Marks
• Outlines the series of events from stages 2 to 4	3
• Outlines some events from stages 2 to 4	2
• Provides some relevant information	1

Sample answer:

Stage 2 represents the mutation that occurred in the DNA.

Stage 3 represents the transcription of the mutated DNA into RNA.

Stage 4 represents the translation of the RNA into a polypeptide chain that cannot be made into a functional protein.

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 6 Mutation	BIO12–6, BIO12–13	2–4

Marking guidelines (b):

Criteria	Marks
• Describes how a type of mutagen may have caused the change in DNA	2
• Provides some relevant information	1

Sample answer:

A mutagen that may have caused the mutation in stage 2 is UV radiation. It has high energy photons that can cause the misalignment or change in the DNA when it is undergoing replication. In this case the mutation resulted in a substitution change, switching a thymine base for an adenine base.

Question 8 continues on page 40

Mapping grid (c):

Content	Syllabus outcomes	Bands
Mod 6 Mutation	BIO12–4, BIO12–6, BIO12–7, BIO12–13	2–5

Marking guidelines (c):

Criteria	Marks
• Describes the effect of the mutation on the polypeptide • Describes the effect that this change will have on the organism	3
• Outlines the effect of the mutation on the polypeptide and/or the effect that this change will have on the organism	2
• Provides some relevant information	1

Sample answer:

Stage 4 would have the Leu (Leucine) amino acid and a Stop codon. The original DNA strand had a Leu (Leucine) and an Arg (Arginine) amino acid. The Arg (Arginine) has been replaced with a STOP as a result of the mutation. This will cause the translation process to end, causing the polypeptide chain to terminate prematurely. This will result in an incomplete chain that cannot be made into a functional protein. The non-functioning protein has implications for the health of the organism.

End of Question 8

Mod 6 – Question 9 (8 marks)

Compare the processes and effects of point mutations and chromosomal mutations. Include examples in your answer. **8**

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 6 Mutation	BIO12–4, BIO12–6, BIO12–13	2–6

Marking guidelines:

Criteria	Marks
• Provides a comprehensive comparison • Shows a thorough understanding of the processes and effects of point mutations and chromosomal mutations • Includes examples of both point mutations and chromosomal mutations	8
• Shows a sound understanding of the processes and effects of point mutations and chromosomal mutations • Includes examples of point mutations and/or chromosomal mutations	6–7
• Outlines some processes and/or effects of point mutations and chromosomal mutations • Includes example(s) of point mutations and/or chromosomal mutations	4–5
• Identifies some features of point mutations and/or chromosomal mutations	2–3
• Provides some relevant information	1

Sample answer:

All mutations make changes to DNA. They occur in DNA replication during:

- mitosis (for cell proliferation and growth of the organism)
- meiosis (for the production of gametes).

Point mutations are changes that occur in a single nucleotide. These changes can be substitution with the wrong nucleotide, an extra nucleotide added (addition) or a nucleotide not included (deletion). It is possible to have multiple point mutations along a chromosome.

The order of nucleotide bases determines the protein that is produced by the cell. The point mutation may have no effect on the protein produced as the change may still enable a triplet code for the same amino acid, or the change of one amino acid might not have a significant effect on the resulting protein.

The point mutation may mean that the triplet code initiates a stop sequence, in which case the protein will not be produced, or it may mean that a range of proteins is not produced at all or that greater quantities of protein are produced.

Question 9 continues on page 42

A frameshift point mutation is caused by an addition or deletion. Every triplet on the DNA after the point mutation is affected. This can radically change the protein product of the cell.

Chromosomal mutations involve large sections of the chromosome breaking off completely (deletion), or breaking off and reassembling in reverse order (inversion) or breaking off and adhering to another chromosome (translocation).

These breakups of chromosomes move genes to new loci and can break up genes by splitting the chromosome in the middle of the gene sequence.

These types of chromosome changes can radically affect cell activity.

Chromosomal mutations can also include non-disjunction of homologous chromosomes at anaphase, resulting in cells with too many or too few chromosomes. These mutations can have radical effects on cell activity and the organism.

Both point mutations and chromosomal mutations can cause disease. For example, point mutations: cystic fibrosis, sickle cell anaemia; chromosomal mutations: Down's syndrome, Turner's syndrome.

Both kinds of mutations have also generated new alleles which have in some cases been adaptive and contributed to evolution.

End of Question 9

Mod 6 – Question 10 (6 marks)

'The application of reproductive technologies in plant and animal breeding limits genetic diversity.' **6**

To what extent is this statement correct?

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 6 Biotechnology Mod 6 Genetic Technologies	BIO12–6, BIO12–7, BIO12–13	2–6

Marking guidelines:

Criteria	Marks
• Makes an informed judgement about the correctness of the statement • Shows comprehensive understanding of genetic diversity and the application of reproductive technologies in plant and animal breeding • Shows a clear connection between genetic diversity and the application of reproductive technologies in plant and animal breeding	6
• Makes a judgement about the correctness of the statement • Shows thorough understanding of genetic diversity and the application of reproductive technologies in plant and animal breeding • Shows a connection between genetic diversity and the application of reproductive technologies in plant and animal breeding	5
• Shows a sound understanding of genetic diversity and the application of reproductive technologies in plant and animal breeding • Makes a link between genetic diversity and the application of reproductive technologies in plant and animal breeding	4
• Shows some understanding of genetic diversity and/or reproductive technologies	2–3
• Provides some relevant information	1

Sample answer:

Artificial pollination is the transfer of pollen from the anther of one plant to the stigma of another. Artificial insemination is the collection of semen and its delivery into the reproductive system of a female, using equipment.

Both technologies can be used to increase the number of offspring with the desired characteristics that can be generated by one parent and therefore can result in decreased genetic diversity in the population. Other individuals in the population do not contribute to the next generation. For example semen from the same bull can be used to impregnate hundreds of cows, or pollen from one male flower is more likely to be transferred to a female flower.

Question 10 continues on page 44

However, reproductive technologies can overcome geographical barriers and therefore allow genes to be spread more widely across the world. These techniques could increase genetic diversity by allowing interbreeding between geographically separated organisms, and generating new hybrids.

Answers could include:

Banks of sperm and pollen can be created to preserve endangered genes and allow them to be more prevalent in subsequent generations. This helps to prevent the loss of genetic diversity.

End of Question 10

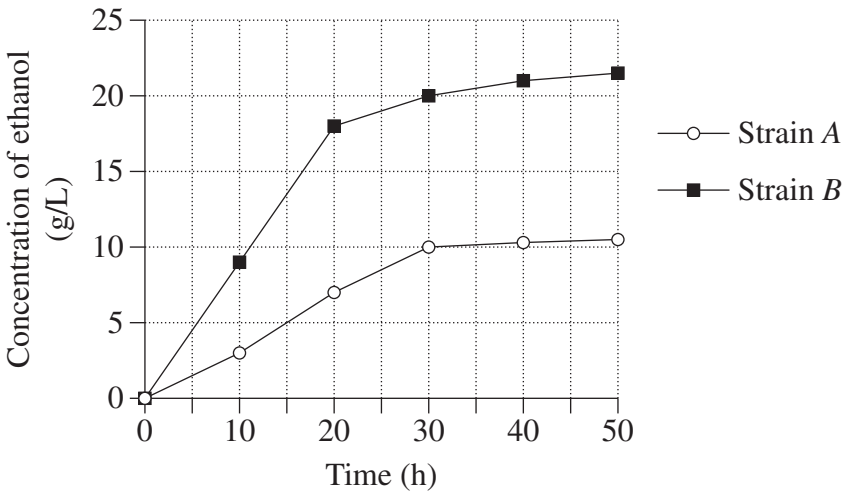
Mod 6 – Question 11 (5 marks)

The yeast *Saccharomyces cerevisiae* cannot naturally ferment the sugar xylose. Low value biomass, such as straw and wood fibres, contains up to 20% xylose. *S. cerevisiae* was modified to enable it to produce ethanol from xylose. Information on the two species involved in making the modified *S. cerevisiae* is shown in the table.

Type of organism	*Species*	*Relevant reaction*	*End product*
Bacteria	*Burkholderia cenocepacia*	Utilises xylose in metabolism	Fructose
Yeast	*Saccharomyces cerevisiae*	Utilises fructose in metabolism	Ethanol

(a) Explain why biotechnology was needed to modify *S. cerevisiae*. **2**

(b) Two strains of genetically modified *S. cerevisiae* were produced. The two strains were compared under the same conditions. The results are shown. **3**



Justify which of these two strains would be better to use to produce commercial quantities of ethanol using low value biomass. In your answer, refer to information from the graph.

Question 11 continues on page 46

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 6 Biotechnology Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–13	4–6

Marking guidelines (a):

Criteria	Marks
• Relates the use of biotechnology to crossing the species barrier	2
• Provides some relevant information	1

Sample answer:

The organisms are from different genera so genetic material is not usually transferred between them. The desired genetic material is cut out from the bacteria and inserted into the yeast genome.

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–13	3–6

Marking guidelines (b):

Criteria	Marks
• Justifies why one of the strains is more suitable to use, with reference to information from the graph • Links the justification to commercial operation	3
• Identifies the strain more suited • Outlines why the strain chosen is preferred, based on information from the graph	2
• Provides some relevant information	1

Sample answer:

Strain *B* would be the better strain to use. Strain *B* has a higher rate of ethanol production than Strain *A*. The graph shows that Strain *B* consistently produced significantly more ethanol than Strain *A*. For example, at time 30 hours, Strain A produced 10 g/L concentration of ethanol and Strain B produced 20 g/L concentration of ethanol. This means the strain is more efficient and, for the production of commercial quantities, more ethanol will be produced within a given time frame.

End of Question 11

Mod 6 – Question 12 (5 marks)

A woman recently conceived a baby guaranteed to be free from hereditary breast cancer. Doctors screened for an embryo that was free from a gene that can cause breast cancer.

The screening was performed due to the long history of this form of cancer in the family and the fact that any daughter born with the gene would have a 50–80% chance of developing breast cancer.

(a) Explain the possible impact of this reproductive technology on the genetic composition of the population. **2**

(b) Discuss the use of this genetic technology in the treatment of medical conditions. **3**

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 6 Biotechnology	BIO12–5, BIO12–6, BIO12–13	4–6

Marking guidelines (a):

Criteria	Marks
• Correctly relates use of the reproductive technology to changes in the genetic composition of the population	2
• States ONE possible impact of the reproductive technology on the genetic composition of the population	1

Sample answer:

In the long term, the gene which has a higher chance of developing breast cancer will become less common in the population, as the gene is selected against. So, fewer people will suffer breast cancer and because fewer people will have the gene, their offspring are also more likely not to have the gene.

Question 12 continues on page 48

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–13	3–6

Marking guidelines (b):

Criteria	Marks
• Identifies issues associated with the use of the genetic technology • Provides points for and/or against the use of the genetic technology	3
• Outlines issue(s) associated with the use of the genetic technology	2
• Provides some relevant information	1

Sample answer:

Genetic technologies may reduce the number of people suffering from certain medical conditions, enable them to increase their contribution to society and reduce the medical costs of treatment. This technology may also have some undesired effects.

If pre-fertilisation genetic manipulation were to become more widespread, it would affect human evolution, as genomes could be chosen and manipulated. Insurance companies may insist on genetic screening before they would insure and vary insurance conditions according to the results of the screening.

Ethical guidelines concerning genetic manipulation must be made clear and adhered to so that personal choice and liberties are not compromised by government or corporations, for this type of genetic manipulation to result in real positive outcomes.

End of Question 12

Mod 6 – Question 13 (4 marks)

Draw a flow chart showing the sequence of events that results in the formation of recombinant DNA. **4**

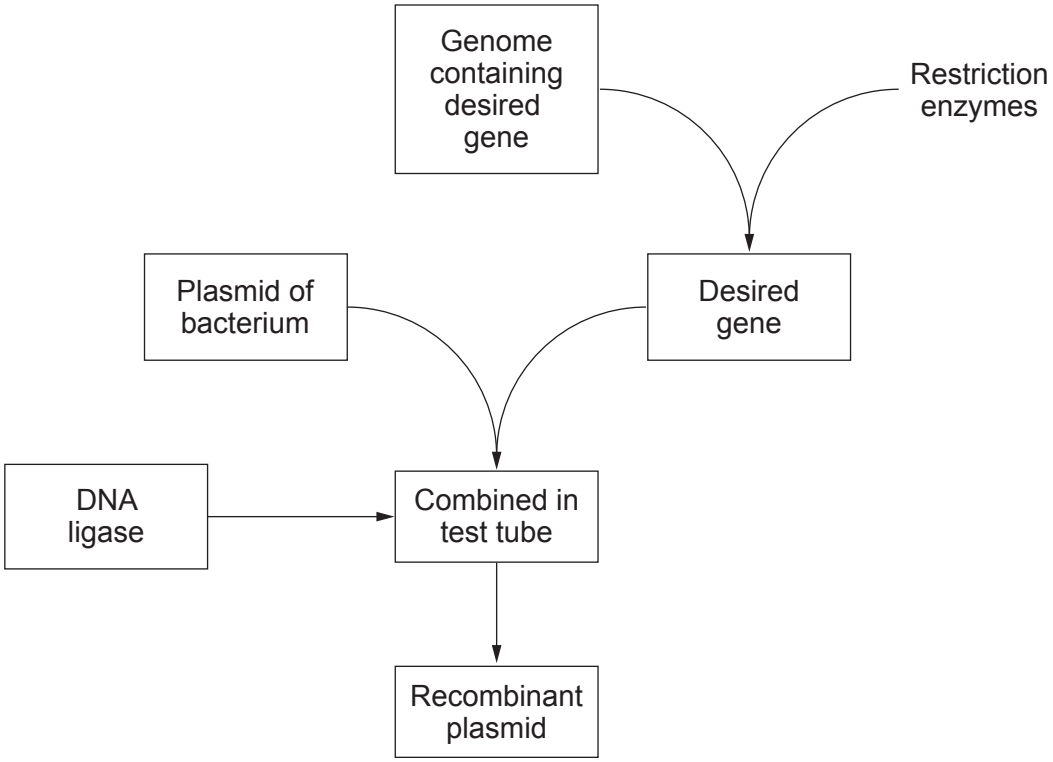
Mapping grid:

Content	Syllabus outcomes	Bands
Mod 6 Genetic Technologies	BIO12–4, BIO12–5, BIO12–7, BIO12–13	2–6

Marking guidelines:

Criteria	Marks
• Draws a flow chart that clearly shows the sequence of events in the formation of recombinant DNA	4
• Draws a substantially correct flow chart	3
• Shows some steps in the formation of recombinant DNA	2
• Provides some relevant information	1

Sample answer:



Mod 6 – Question 14 (7 marks)

Describe how technological developments led to the advancement of our knowledge and understanding of inheritance. Support your answer with examples. **7**

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 5 Heredity Mod 6 Genetic Technologies	BIO12–5, BIO12–6, BIO12–7, BIO12–12, BIO12–13	2–6

Marking guidelines:

Criteria	Marks
• Shows a comprehensive understanding of how technological developments led to the advancement of knowledge and understanding of inheritance • Supports answer with examples	7
• Identifies relevant technological developments • Describes their contributions to knowledge and understanding of inheritance • Shows a sound understanding of the knowledge and understanding before and after the technological developments • Supports answer with examples	6
• Identifies relevant technological developments • Outlines their contributions to knowledge/understanding of inheritance • Shows some understanding of the knowledge/understanding before and after the technological developments • Supports answer with an example	4–5
• Identifies a technological development • Outlines its contribution(s) to knowledge/understanding of inheritance	2–3
• Provides some relevant information	1

Answers could include:

- Artificial pollination – Mendel's Laws
- Microscopy and staining – behaviour of chromosomes – work of Sutton and Boveri
- X-ray crystallography – structure of DNA – work of Rosalind Franklin
- Use of isotopes – show semi-conservative DNA replication – work of Meselson and Stahl
- Radiation – one gene, one polypeptide – work of Beadle and Tatum
- Gene manipulation
- Gene editing – CRISPR.

Module 7 Infectious Disease

Mod 7 – Question 1

All pathogens can be described as

A. infectious.

B. macroscopic.

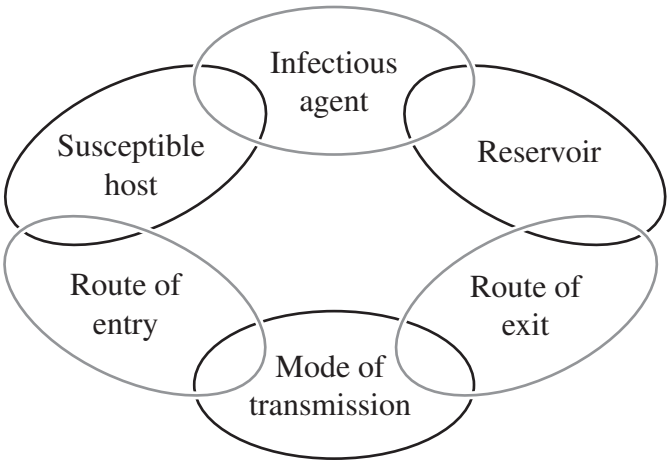
C. microscopic.

D. viral.

Content	Syllabus outcomes	Bands	Key
Mod 7 Causes of Infectious Disease	BIO12–7, BIO12–14	2–3	A

Mod 7 – Question 2

The diagram shows a model of disease transmission.



A pathogen was identified as being unadapted to dry conditions and as having the gastrointestinal tract as the 'route of entry' and the 'route of exit'.

Using this information, what is the most likely mode of transmission?

A. Skin to skin contact

B. Coughing or sneezing

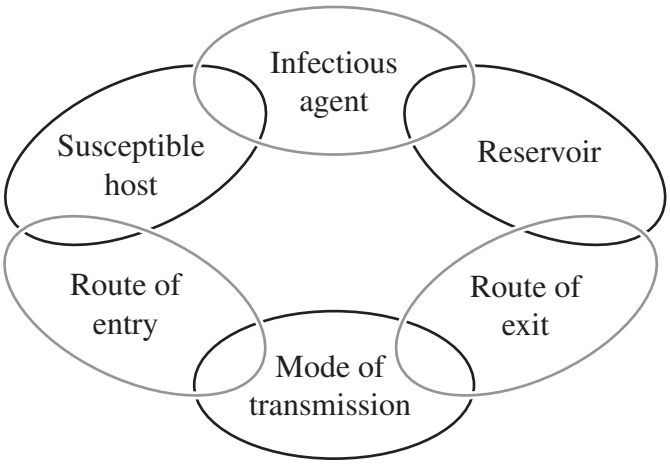
C. Contaminated water supplies

D. Transmission of infected blood products

Content	Syllabus outcomes	Bands	Key
Mod 7 Causes of Infectious Disease	BIO12–5, BIO12–14	3–4	C

Mod 7 – Question 3

The diagram shows a model of disease transmission.



An epidemiologist suspected that bats were acting as a reservoir for an infectious disease in humans.

Which condition would need to be met to confirm the epidemiologist's suspicion?

A. The infectious agent would need to have a mode of entry into humans.

B. The infectious agent would need a mode of transmission from bats to humans.

C. The bats would have to be able to transmit the infectious agent between each other.

D. The susceptible human host must be able to transmit the infectious agent to the reservoir of bats.

Content	Syllabus outcomes	Bands	Key
Mod 7 Causes of Infectious Disease	BIO12–6, BIO12–14	4–5	B

Mod 7 – Question 4

The runny nose and coughing that is symptomatic of having a cold is an example of the body's response to a pathogen.

How does this response protect the body?

A. By heating the body to try to kill the virus

B. By trying to spread the virus to other people

C. By preventing the virus from entering the body

D. By attempting to rapidly expel the virus from the airways

Content	Syllabus outcomes	Bands	Key
Mod 7 Responses to Pathogens	BIO12–5, BIO12–14	2–3	D

Mod 7 – Question 5

When a foreign body breaches the first line of defence the mast cells produce histamines in response.

What is the role of histamines in the defence of the body?

A. To attack the invading pathogen

B. To activate B and T lymphocytes of the specific immune response

C. To activate the inflammation response and increase blood flow to the affected area

D. To retain information on a pathogen's antigen so that the immune system can respond quickly to any subsequent infection

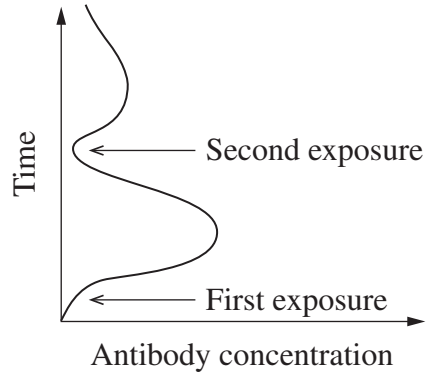
Content	Syllabus outcomes	Bands	Key
Mod 7 Responses to Pathogens	BIO12–7, BIO12–14	4–5	C

Mod 7 – Question 6

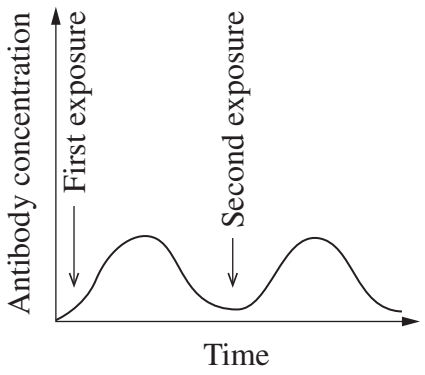
A student was vaccinated for rubella when they were 13. Three years later, they were exposed to the active rubella virus.

Which graph best represents the student's production of antibodies over time?

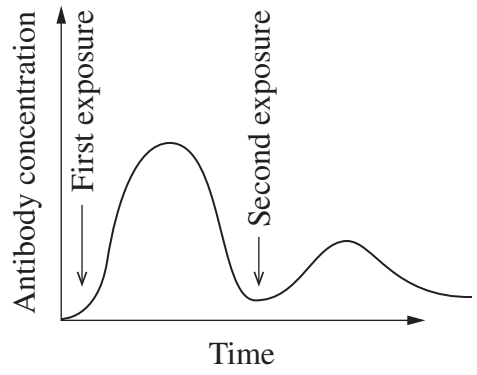
A.



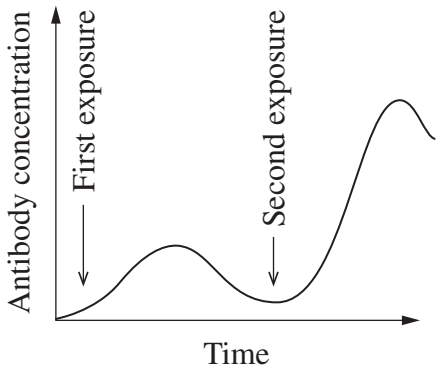
B.



C.



D.



Content	Syllabus outcomes	Bands	Key
Mod 7 Immunity	BIO12–5, BIO12–14	3–4	D

Mod 7 – Question 7

Melanomas are characterised by uncontrolled cell division caused by mutations that continue to occur once the tumour has developed. Scientists have discovered that vaccines produced using antigens extracted from the patient's own melanoma cells can be useful in treating melanoma. When injected, the vaccines stimulate an immune response.

What can be inferred from the scientists' discovery?

A. Cancer cells carry unique antigens.

B. Self-antigens are not present on cancer cells.

C. The melanoma patient has a dysfunctional immune system.

D. The body cannot mount an immune response against cancer cells.

Content	Syllabus outcomes	Bands	Key
Mod 7 Immunity	BIO12–5, BIO12–14	5–6	A

Mod 7 – Question 8

Melanomas are characterised by uncontrolled cell division caused by mutations that continue to occur once the tumour has developed. Scientists have discovered that vaccines produced using antigens extracted from the patient's own melanoma cells can be useful in treating melanoma. When injected, the vaccines stimulate an immune response.

The effect of the melanoma vaccine is to stimulate

A. T cells which produce antibodies.

B. cytotoxic T cells which activate B cells.

C. cell division to produce more lymphocytes.

D. production of B cells which destroy melanoma cells.

Content	Syllabus outcomes	Bands	Key
Mod 7 Immunity	BIO12–5, BIO12–14	5–6	C

Mod 7 – Question 9

The map shown was drawn by Dr John Snow during the 1854 London cholera epidemic.

The dots indicate people who died from cholera and the crosses indicate the location of water pumps.

Which of the following is the most likely hypothesis for which Dr John Snow was gathering evidence?

A. That the outbreak of cholera was caused by people living near each other

B. That the people who died from cholera drank water from the Broad Street pump

C. That cholera was caused by an infectious agent that can be found and transmitted in water

D. That the cause of a disease can be determined by mapping the location of infected patients

Content	Syllabus outcomes	Bands	Key
Mod 7 Prevention, Treatment and Control	BIO12–1, BIO12–14	4–5	C

Mod 7 – Question 10

How do vaccinations prevent disease?

A. They increase the inflammation process.

B. They enable the infected cells to seal off the pathogen.

C. They increase the number of antibodies against the pathogen.

D. They decrease the number of antigens that trigger the immune response.

Content	Syllabus outcomes	Bands	Key
Mod 7 Prevention, Treatment and Control	BIO12–14	4–5	C

Mod 7 – Question 11

Eight sick animals had the same symptoms. Blood tests showed that they were infected with the same type of bacterium.

Which of the following would be the best course of action to determine if this particular type of bacterium is the cause of the symptoms?

A. Treat all eight animals with the antibiotic known to kill this type of bacterium. Check if they recover.

B. Find other animals with the same symptoms. Attempt to isolate the same type of bacterium from their blood.

C. Inject blood from animals with the symptoms into suitable host individuals. Check if they develop the same symptoms.

D. Use bacteria from the blood of affected animals to inoculate healthy animals. If these healthy animals develop the symptoms, attempt to isolate the same bacterium from their blood.

Content	Syllabus outcomes	Bands	Key
Mod 7 Causes of Infectious Disease Mod 7 Prevention, Treatment and Control	BIO12–2, BIO12–6, BIO12–14	5–6	D

Mod 7 – Question 12 (3 marks)

Complete the following table to show the distinguishing characteristic of each pathogen and a disease caused by each. **3**

Pathogen	*Distinguishing characteristic of the pathogen*	*Disease caused by the pathogen*
Bacteria		
Fungi		
Protozoans		

Mapping grid:

Content	**Syllabus outcomes**	**Bands**
Mod 7 Causes of Infectious Disease	BIO12–4, BIO12–14	2–4

Marking guidelines:

Criteria	**Marks**
• Provides a correct distinguishing characteristic for each pathogen • Provides a correct disease caused by each pathogen	3
• Provides a correct distinguishing characteristic for TWO pathogens • Provides a correct disease caused by TWO pathogens	2
• Provides some relevant information	1

Sample answer:

Pathogen	*Distinguishing characteristic of the pathogen*	*Disease caused by the pathogen*
Bacteria	DNA not enclosed by a nuclear membrane	Whooping cough
Fungi	Have a cell wall but never contain chlorophyll	Tinea
Protozoans	Single cell, eukaryotic organism	Malaria

Mod 7 – Question 13 (3 marks)

A practical investigation is to be carried out to test for the microbes found in food. **3**

Complete the table to show how to minimise risks that are likely to arise in carrying out this investigation.

Risk	*Procedure to minimise it*

Mapping grid:

Content	**Syllabus outcomes**	**Bands**
Mod 7 Causes of Infectious Disease	BIO12–2, BIO12–3, BIO12–6, BIO12–14	2–4

Marking guidelines:

Criteria	**Marks**
• Correctly completes the table	3
• Shows how some relevant risks can be minimised	2
• Shows how a relevant risk can be minimised	1

Sample answer:

Risk	*Procedure to minimise it*
Cross-contamination from bench	Use antiseptic to clean bench and work area
Growth of microbes harmful to humans	Incubate agar plates at below 35°C, so microbes dangerous to humans will not grow
Infection	Wear protective clothing, eg gloves, masks, lab coat

Mod 7 – Question 14 (5 marks)

Scientific advances have resulted in new methods of managing plant diseases and insect pests. **5**

Describe how TWO of these methods have changed the management of plant diseases and/or insect pests.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 7 Causes of Infectious Disease Mod 7 Responses to Pathogens	BIO12–6, BIO12–14	2–6

Marking guidelines:

Criteria	Marks
• Names TWO relevant methods • Describes how the TWO methods have changed the management of plant diseases and/or insect pests	5
• Names TWO relevant methods • Desribes how ONE method has changed the management of plant diseases and/or insect pests and outlines how the other method is used	4
• Identifies TWO relevant methods and outlines how one of these methods is used	3
• Identifies TWO relevant methods OR • Outlines how a relevant method is used	2
• Provides some relevant information	1

Answers could include:

Genetic engineering of plants with particular characteristics: The finding that a combination of certain genetic characteristics can provide insect-resistant crops has led to the insertion of genes for desirable characteristics into plants to produce insect-resistant plants. This has resulted in less need for insecticides.

Quarantine restrictions: Based on our understanding of disease transmission, the isolation of diseased plants has prevented the spread of plant diseases into and around Australia. This has led to a change from the treatment of diseased plants to preventing the spread of disease.

Mod 7 – Question 15 (6 marks)

The image shows a lemon-scented gum tree, *Corymbia citriodora*, which has been attacked by a fungal stem canker. Fungal cankers are opportunistic plant pathogens that gain access to the inner layers of the stem as a result of damage to the protective outer layer of bark. The inner layers provide suitable conditions for the fungus to grow. Once established it destroys the bark cells that protect the tree. The tree responds to the presence of the canker under its bark by producing an excess of resinous sap at the wound site.

(a) Using the information provided, suggest a hypothesis to explain how the tree is responding to the presence of the canker. **2**

(b) Consider another plant with a different response to a specific pathogen. **4**

Compare the necessity and limitations of this plant's response with the response of the lemon-scented gum tree described above.

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 7 Responses to Pathogens	BIO12–1, BIO12–14	4–6

Marking guidelines (a):

Criteria	Marks
• Provides a suitable hypothesis	2
• Provides some relevant information	1

Sample answer:

Hypothesis: That excess sap production alters the conditions where the canker is, thus making it difficult for the canker to survive. Sap may increase the osmotic pressure gradient and the quantity of chemicals that may be toxic to the canker.

Question 15 continues on page 63

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 7 Responses to Pathogens	BIO12–6, BIO12–14	3–6

Marking guidelines (b):

Criteria	Marks
• Shows a thorough understanding of another plant's response to a specific pathogen • Shows how the necessity and limitations of the two responses are similar and/or different	4
• Shows a sound understanding of another plant's response to a specific pathogen • Shows sound understanding of the necessity and limitations of the two responses	3
• Shows some understanding of another plant's response to a specific pathogen • Shows some understanding of the necessity and/or limitations of the response(s)	2
• Provides some relevant information	1

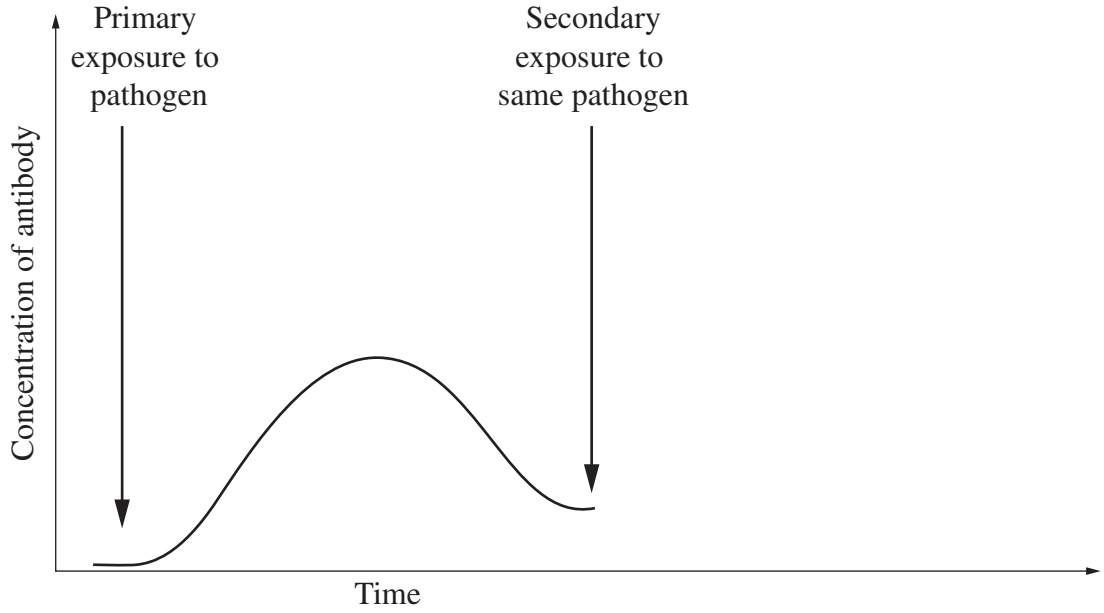
Sample answer:

The river red gum can most effectively rid itself of the halo leaf spot canker by dropping its leaves, though this means new leaves will have to be made. The halo leaf spot will prevent the river red gum from being able to photosynthesise if too many leaves are infected and this would kill the tree. The fungal canker stem affects the ability of the lemon-scented gum to effectively transport material via the xylem and phloem, thus weakening the tree. As the canker affects the lemon-scented gum's stem it is not possible to eliminate or 'drop' that part of the tree, though if it was on a branch this response could be possible. The lemon-scented gum must use a method that will isolate the infected area as much as possible, however, it may not be possible to kill the canker completely.

End of Question 15

Mod 7 – Question 16 (6 marks)

The diagram shows the immune response after primary exposure to a pathogen.



(a) On the diagram, continue the graph to show the immune response upon secondary exposure to the same pathogen. **2**

(b) Using annotations on the diagram, explain the shape of the entire graph. **4**

Question 16 continues on page 65

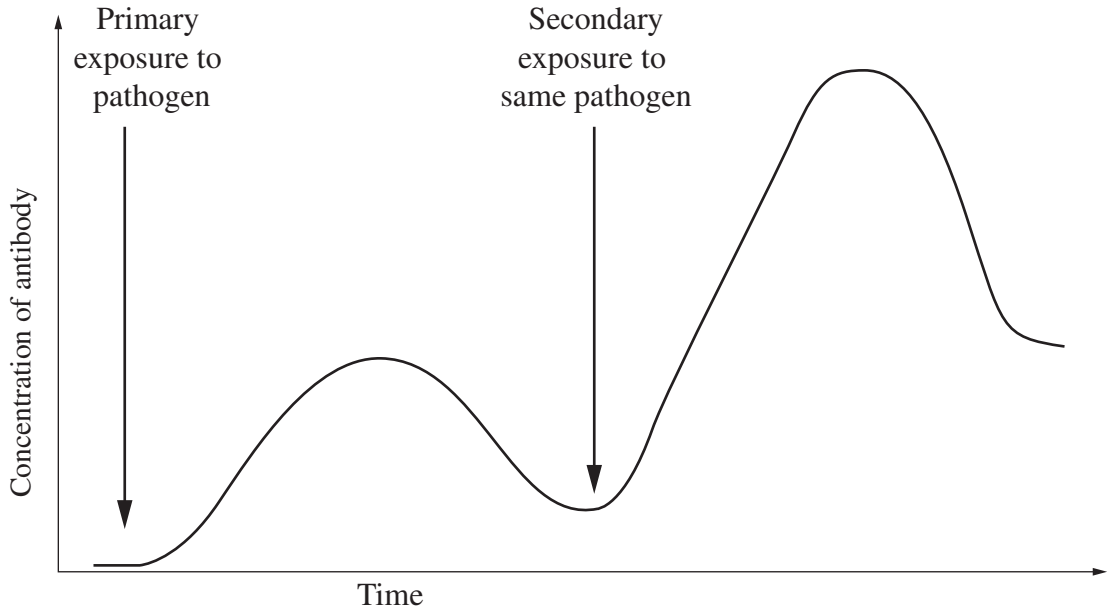
Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 7 Immunity	BIO12–4, BIO12–14	2–3

Marking guidelines (a):

Criteria	Marks
• Shows increase in concentration of antibody, peak and decline and a greater level of antibody at the end of the process	2
• Shows an increase in concentration	1

Sample answer:



Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 7 Immunity	BIO12–6, BIO12–7, BIO12–14	3–6

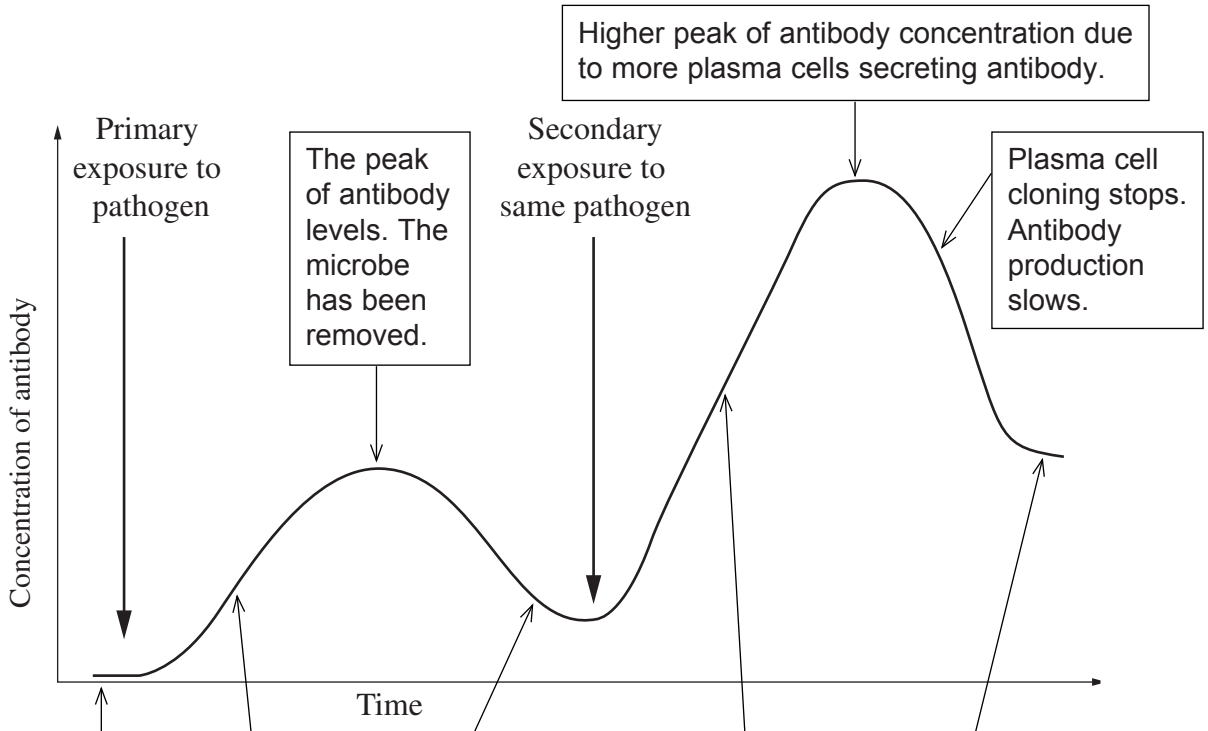
Question 16 continues on page 66

Question 16 (continued)

Marking guidelines (b):

Criteria	Marks
• Explains the shape of the entire graph considering response of cells to antigens, antibody production and change in the level of immunity	4
• Provides some explanation of the shape of the graph considering response of cells to antigens and/or the antibody production and/or change in the level of immunity	2–3
• Provides some relevant information	1

Sample answer:



Before exposure, there is a negligible amount of antibody in the system and no memory cells for this microbe.

Eventually the antibody production decreases, as fewer antigens are present. Memory cells are still present.

Memory T cells activate the memory B cells which quickly differentiate into antibody-secreting plasma cells producing large amounts of antibody very quickly.

Eventually the antibody production decreases, as fewer antigens are present. A higher level of immunity is gained as more memory B and T cells are formed.

Once the body is exposed to antigens (through disease or vaccine), the B cells are activated and produce antibodies. They divide to produce plasma cells and memory cells. As the number of plasma cells increases, the concentration of antibodies increases.

End of Question 16

Mod 7 – Question 17 (6 marks)

The immune system's primary role is to defend against pathogens. For this to be effective the immune system must be able to recognise cells that belong to the body and cells that do not.

(a) Describe the mechanism that the immune system uses to distinguish between body cells and potential pathogens. Support your answer with an example. **3**

(b) Explain why this mechanism means that patients who receive an organ donation require immune suppression drugs. **3**

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 7 Immunity	BIO12–6, BIO12–14	3–6

Marking guidelines (a):

Criteria	Marks
• Describes antigens as markers on the surface of a cell that the immune system can classify as self or foreign • Outlines that the immune system learns which antigens are self • Provides an example of an antigen the immune system will recognise as either self or foreign	3
• Describes antigens as markers on the surface of a cell that the immune system can recognise • Provides an example of an antigen	2
• Provides some relevant information	1

Sample answer:

The body's immune system recognises its own cells by the presence of particular antigens on the surface of the cell. All cells have these antigens which act as markers or flags. The immune system has 'learned', during embryonic development, which antigens belong to the body and which do not. An example of antigens that the immune system can recognise as belonging to the body are the antigens displayed on the surface of red blood cells. These cells are typically classified as A and/or B blood types, or O blood type if no antigens are present. Substances or cells that enter the body that do not have antigens recognised as belonging to the body, such as the wrong blood type or bacterial cells, are attacked by the immune system.

Question 17 continues on page 68

Question 17 (continued)

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 7 Immunity	BIO12–6, BIO12–14	3–6

Marking guidelines (b):

Criteria	Marks
• Identifies that the donated organ's antigens and the recipient's antigens are different • Explains that the difference in antigens will result in the recipient's immune system attacking the donated organ	3
• Shows some understanding that the difference in antigens will result in the recipient's immune system attacking the donated organ	2
• Provides some relevant information	1

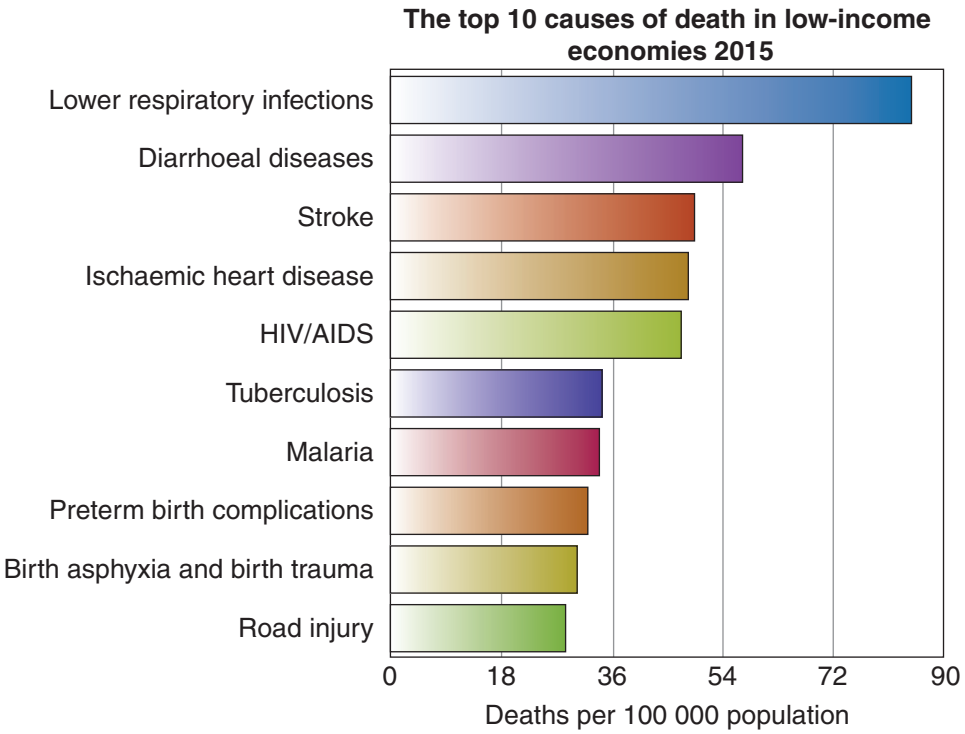
Sample answer:

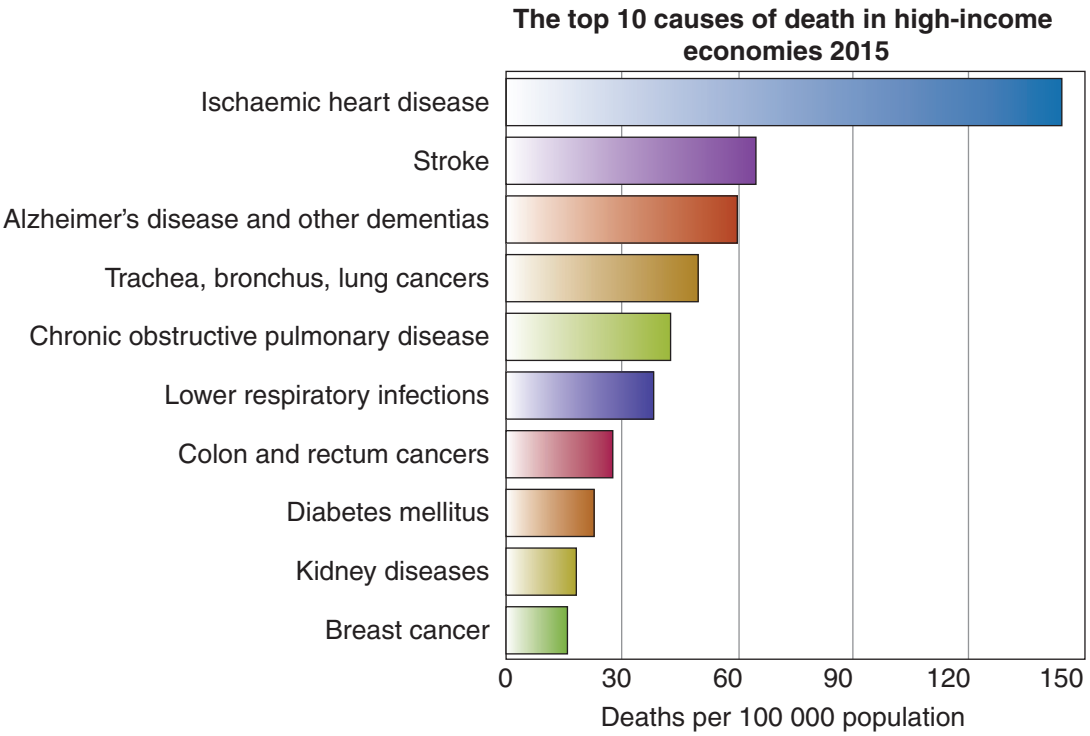
The fact that the immune system is capable of recognising which cells belong to the body and which do not, can be very problematic for people who require organ donations. Due to the presence of antigens on the surface of all cells, the recipient's immune system will not recognise the transplant as belonging to their own body because the cells of the donated organ will have different antigens from those of the recipient. Consequently, the recipient's immune system will start to attack the transplant. To prevent this from happening the donor's antigens are matched as closely as possible to the recipient and the recipient is given immune suppression drugs to prevent (or slow down) the recipient's immune system from attacking the donated organ. Immune suppression drugs are often the only way to ensure the donated organ remains functional for the recipient.

End of Question 17

Mod 7 – Question 18 (9 marks)

The graphs show the top 10 causes of death in low- and high-income economies in 2015. **9**





Source: www.who.int/mediacentre/factsheets/fs310/en/index1.html (assessed 10/09/2017)

Note: Ischaemic heart disease is also known as coronary heart disease.

Question 18 continues on page 70

Question 18 (continued)

Suggest why the top 10 causes of death differed between low- and high-income economies in 2015. Justify your answer with analysis of the graphs and your knowledge of diseases and disease categories.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 7 Causes of Infectious Disease Mod 7 Prevention, Treatment and Control Mod 8 Causes and Effects Mod 8 Epidemiology Mod 8 Prevention	BIO12–4, BIO12–5, BIO12–6, BIO12–7, BIO12–14, BIO12–15	2–6

Marking guidelines:

Criteria	Marks
• Comprehensively analyses the data in areas such as types of disease, numbers of people succumbing to the diseases and socioeconomic distribution of diseases • Provides possible reasons for why the prevalent causes of death differed between low- and high-income economies in 2015 • Shows clear relationship between the suggested reasons and the results of analysis displaying a thorough understanding of infectious and non-infectious diseases	9
• Provides a high level of data analysis in some areas such as types of disease, numbers of people succumbing to the diseases and socioeconomic distribution of diseases • Relates the results of analysis to why the prevalent causes of death differed between low- and high-income economies • Shows a sound understanding of infectious and non-infectious diseases	7–8
• Provides a sound level of data analysis in some areas such as types of disease, numbers of people succumbing to the diseases and socioeconomic distribution of diseases • Links the results of the analysis to some reasons for the prevalent causes of death in low- and/or high-income economies • Shows a sound understanding of infectious and/or non-infectious diseases	5–6

Question 18 continues on page 71

Criteria	Marks
• Provides some analysis of data in areas such as types of disease and/or numbers of people succumbing to the diseases and/or socioeconomic distribution of diseases AND/OR • Outlines reason(s) for the prevalent causes of death in low- and/or high-income economies AND/OR • Shows some understanding of infectious and/or non-infectious diseases	3–4
• Identifies relevant information from the graph(s) AND/OR • Shows an understanding of infectious and/or non-infectious diseases	1–2

Sample answer:

Types of diseases listed in decreasing prevalence for income groups:

Low Income		*High Income*	
Infectious	*Non-infectious*	*Infectious*	*Non-infectious*
Lower respiratory infections	Stroke	Lower respiratory infections	Coronary heart disease
Diarrhoeal diseases	Coronary heart disease		Stroke
HIV/AIDS	Preterm birth complications		Dementias
Tuberculosis	Birth trauma		Lung cancers
Malaria	Road injury		Pulmonary disease
			Colon and rectum cancers
			Diabetes mellitus
			Kidney diseases
			Breast cancer

Common diseases: (deaths per 100 000 population) for income groups

Low Income		*High Income*	
Infectious	*Non-infectious*	*Infectious*	*Non-infectious*
Lower respiratory infections (85)	Stroke (50)	Lower respiratory infections (40)	Coronary heart disease (142)
	Coronary heart disease (48)		Stroke (65)

Question 18 continues on page 72

In assessing this data, it is clear that the lower income economies are more likely to die from infectious diseases (approx. 240/100 000) than non-infectious diseases (approx. 180/100 000). The infectious diseases are generally those that can be relatively easily eliminated or treated, eg diarrhoeal diseases are preventable by providing clean water supplies, malaria is preventable by providing nets, insecticides, draining swamps or using preventative medicine, and TB can be inoculated against. These diseases are not represented at all in the data for high-income economies because clean water and preventative medical procedures are in place due to socioeconomic factors.

The only common infectious disease among low and high-income economies is lower respiratory tract infections. These infections are essentially influenza type diseases, pneumonias and bronchitis. While influenza is a viral infection, the others are usually bacterial and can be treated with antibiotics. Many at-risk people in the high-income economies are encouraged to get preventative flu injections. These are often provided free for the elderly who are most at risk and those who work in confined spaces where infection is likely to occur, eg schools, hospitals and office environments. The effect on mortality in low-income economies is more than two times as great as in high-income economies.

The greatest killers in high-income economies are heart disease and stroke. Combined, they kill approximately twice as many people per 100 000 as in low-income economies. These are often seen to be ‘lifestyle diseases’ that are greatly affected by diet and exercise. When we compare the number of deaths attributed to non-infectious diseases in high-income economies they are more than 2.5 times more prevalent (approx. 445:185/100 000) than low-income economies, but there are also dementias and cancers which are often diseases of old age, indicating that those living in high-income economies live longer. This is probably due to levels of sanitation and consistent health care.

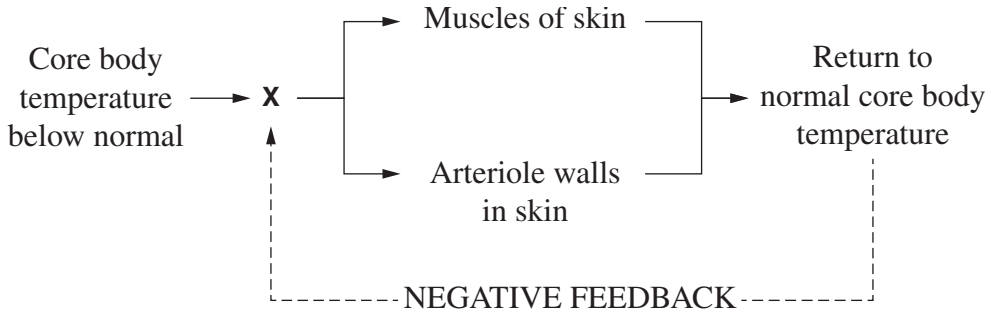
The data provided indicates many differences between the two economies, but also provides suggestions on how these differences can be addressed, eg provision of a clean water supply which would greatly improve the quality of health and life in low-income economies.

End of Question 18

Module 8 Non-infectious Disease and Disorders

Mod 8 – Question 1

The diagram shows a homeostatic mechanism in a mammal.



What does **X** represent in the diagram?

A. The brain

B. The heart

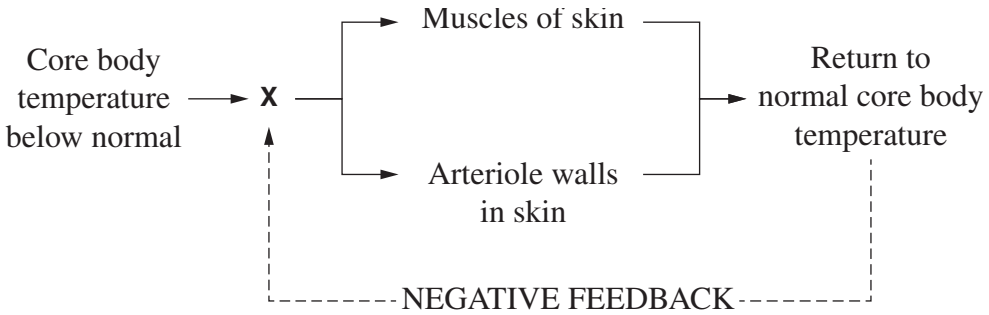
C. A thermoreceptor in the skin

D. A pressure receptor in a blood vessel

Content	Syllabus outcomes	Bands	Key
Mod 8 Homeostasis	BIO12–5, BIO12–15	3–4	A

Mod 8 – Question 2

The diagram shows a homeostatic mechanism in a mammal.



Which row of the table describes what happens to the muscles and the arteriole walls in the skin when the core body temperature is below normal?

	Muscles of skin	*Arteriole walls in skin*
A.	Relax to lower epidermal hairs	Expand
B.	Contract to raise epidermal hairs	Contract
C.	Relax to raise epidermal hairs	Expand
D.	Contract to lower epidermal hairs	Contract

Content	Syllabus outcomes	Bands	Key
Mod 8 Homeostasis	BIO12–5, BIO12–15	3–4	B

Mod 8 – Question 3

A student wanted to test the claim, made by an agricultural seed company, that their variety of wheat was more salt tolerant than other wheat varieties on the market. The company explained that their variety can better maintain water balance by increasing the organic salt concentration in the roots of the plants which increases osmotic pressure.

Which row of the table shows the independent and dependent variables that the student should use to test the company's claim?

	Independent	*Dependent*
A.	Salt concentration	Leaf turgor
B.	Salt concentration	Growth rate
C.	Variety of wheat plant	Organic salt concentration in roots
D.	Variety of wheat plant	Leaf turgor

Content	Syllabus outcomes	Bands	Key
Mod 8 Homeostasis	BIO12–2, BIO12–6, BIO12–15	4–5	D

Mod 8 – Question 4

What is the main focus of the study of epidemiology?

A. Skin diseases

B. Changes in the characteristics of a species

C. Factors involved in the occurrence, prevalence and spread of disease

D. How the body maintains its functions in response to variations in the environment

Content	Syllabus outcomes	Bands	Key
Mod 8 Causes and Effects	BIO12–7, BIO12–15	2–3	C

Mod 8 – Question 5

An investigation was undertaken to examine the cause of lactose intolerance, a non-infectious condition found in some humans who cannot digest milk. The investigation found variation in the occurrence of lactose intolerance in human populations from different parts of the world.

What is this investigation an example of?

A. A study of ecosystems

B. A microbiological study

C. An epidemiological study

D. A study of the human immune system

Content	Syllabus outcomes	Bands	Key
Mod 8 Epidemiology	BIO12–7, BIO12–15	2–3	C

Mod 8 – Question 6

For many years, some cigarette companies have denied that there were increased risks of lung cancer as a result of cigarette smoking.

How can an epidemiological study into lung cancer be useful in this situation?

A. It can show that the chemicals in cigarette smoke cause cancer.

B. It can demonstrate that second-hand smoke has no impact on lung cancer rates.

C. It can provide evidence that people who smoke are more likely to develop lung cancer.

D. It can show that the cigarette companies have been lying about the cause of lung cancer.

Content	Syllabus outcomes	Bands	Key
Mod 8 Epidemiology	BIO12–6, BIO12–15	3–4	C

Mod 8 – Question 7

Which of the following is an example of an educational program to reduce the incidence of skin cancer?

A. An advertising campaign on TV to promote sun safety

B. Making sunscreen freely available at pools and beaches

C. Increasing the availability of skin checks in regional centres

D. Providing free training to doctors to help them diagnose skin cancers

Content	Syllabus outcomes	Bands	Key
Mod 8 Prevention	BIO12–7, BIO12–15	2–3	A

Mod 8 – Question 8

A patient has been diagnosed with severe hearing loss in the inner ear.

Which type of hearing technology can be used to help restore the patient's hearing?

A. Hearing aid

B. Cochlear implant

C. Artificial ear drum

D. Bone conduction implant

Content	Syllabus outcomes	Bands	Key
Mod 8 Technologies and Disorders	BIO12–7, BIO12–15	3–4	B

Mod 8 – Question 9

A patient has experienced an injury that affected the retina of her eye. She asked her doctor if LASIK eye surgery could help restore her sight. The doctor said that LASIK eye surgery would have no impact on her condition.

Why did the doctor give this advice?

A. LASIK eye surgery is a replacement of the lens in the eye and cannot repair a retina

B. LASIK eye surgery will only temporarily repair her retina and her vision problems would return

C. LASIK eye surgery is only used for people who have a damaged cornea and cannot repair a retina

D. LASIK eye surgery is only used to change the shape of the cornea to enhance vision and cannot repair a retina

Content	Syllabus outcomes	Bands	Key
Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	3–4	D

Mod 8 – Question 10 (6 marks)

Glucose is a chemical that must be maintained at concentrations between 70 to 130 mg/dL in the blood in order for the body to function normally.

(a) Draw a diagram that illustrates how the body maintains blood glucose within this range. **3**

(b) Sketch a graph on the axes provided showing the expected blood glucose levels of both a healthy person and a diabetic person after consuming a fruit juice. On the same graph, show what would happen when the diabetic person injects themself with insulin 20 minutes after consuming the fruit juice. **3**

Mapping grid (a):

Content	Syllabus outcomes	Bands
Mod 8 Homeostasis	BIO12–4, BIO12–7, BIO12–15	3–6

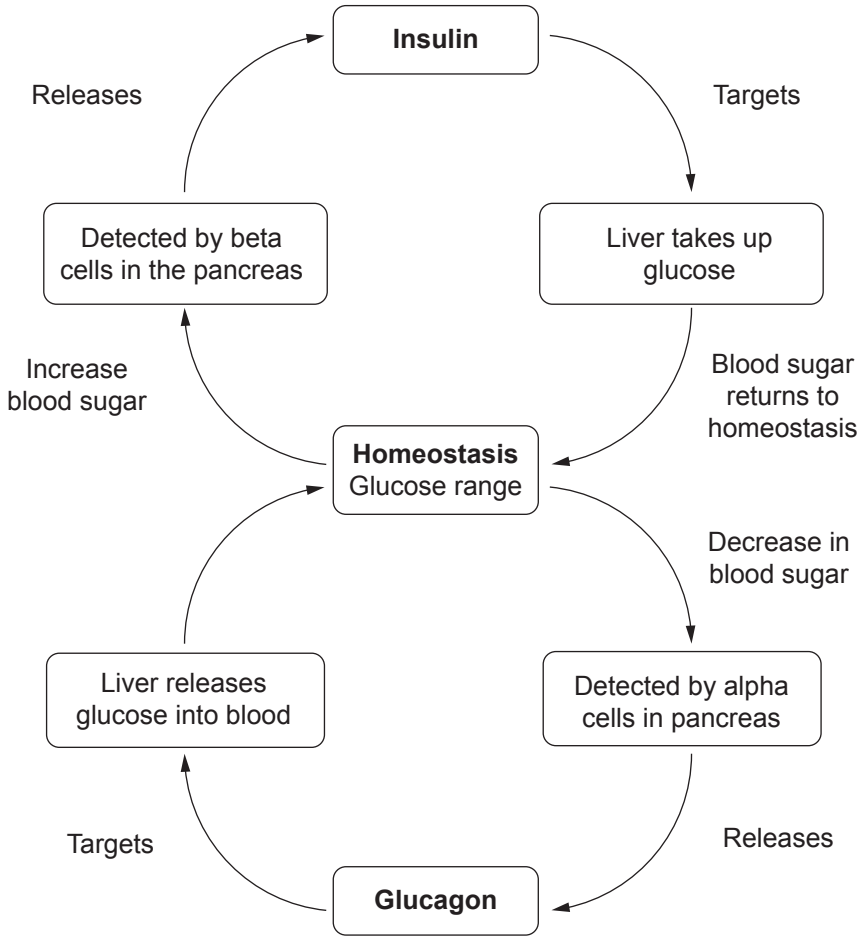
Marking guidelines (a):

Criteria	Marks
• Provides all relevant components ie pancreas, liver, relevant hormones • Draws appropriate sequence in feedback for both high and low blood sugar	3
• Draws relevant sequence of feedback for either high or low blood sugar OR • Draws a feedback system of both high and low blood sugar with missing components	2
• Provides some relevant information	1

Question 10 continues on page 80

Question 10 (continued)

Sample answer:



Question 10 continues on page 81

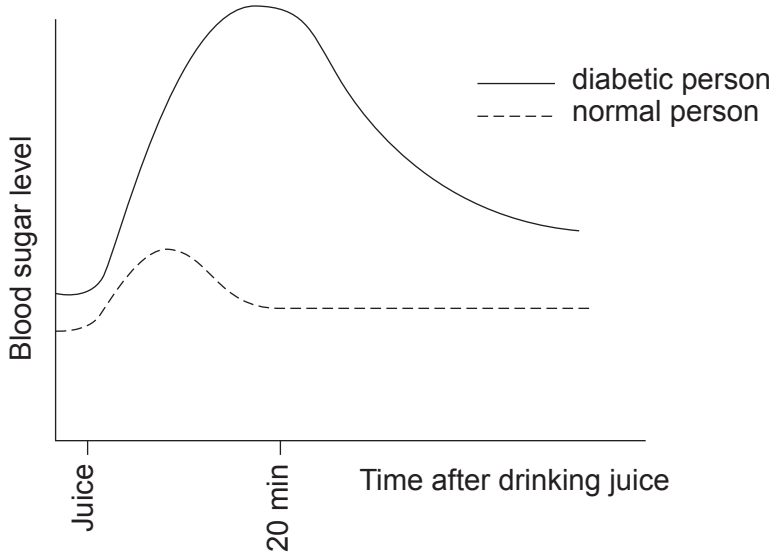
Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 8 Homeostasis	BIO12–4, BIO12–6, BIO12–7, BIO12–15	3–6

Marking guidelines (b):

Criteria	Marks
• Provides correctly labelled axes and key • Draws representation of diabetic person with rapidly increasing blood glucose that decreases only after 20 minutes when insulin is taken • Draws representation of normal person with relatively low increase in blood glucose with decrease beginning before 20 minutes have elapsed	3
• Provides correctly labelled axes and key • Draws representation of diabetic person with rapidly increasing blood glucose in comparison to normal person	2
• Provides some relevant information	1

Sample answer:



End of Question 10

Mod 8 – Question 11 (5 marks)

A scientist performed an epidemiological study to investigate the cause and effect relationship of smoking and lung cancer as follows. **5**

1. Handed out a scientifically valid questionnaire to all colleagues (n = 144) at work
2. Checked that there were an equal number of male and female respondents
3. Discovered that there were more non-smoking respondents than smoking respondents. Removed some of the non-smokers until both groups had equal numbers
4. Checked that all the respondents had a medical check-up in the past year
5. Analysed data, wrote the paper and published it in a scientific blog

From the information provided, assess the suitability of the methodology for this investigation.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 8 Epidemiology	BIO12–2, BIO12–5, BIO12–7, BIO12–15	2–6

Marking guidelines:

Criteria	Marks
• Makes an informed judgement of the suitability of the methodology • Outlines strengths and/or weaknesses in each part of the study	5
• Makes a judgement of the suitability of the methodology • Outlines strengths and/or weaknesses in some parts of the study	4
• Identifies strengths and/or weaknesses of the methodology • Outlines at least one strength or weakness	3
• Identifies strengths and/or weaknesses of the methodology OR • Outlines a weakness or a strength of the method	2
• Provides some relevant information	1

Sample answer:

The design of this study cannot validly lead to a link between disease and its likely causes. A valid questionnaire is good but the number of subjects is low and only confined to the workplace. The sample should be larger and broader. Ideally, the study should have a variety of equal categories, eg age, ethnicity, not just males: females equal. Participants should not be eliminated on the basis of their answers as this reduces the scientific validity. Any checks should be consistent, with a definite purpose related to the study, eg lungs checked. The final data should be peer reviewed for publication.

Mod 8 – Question 12 (3 marks)

Polio is a potentially life-threatening disease that can leave people permanently disabled. The poster shown is an example of an educational program that targets polio. **3**

Explain the benefits of such campaigns to the broader society.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 8 Prevention, Treatment and Control	BIO12–6, BIO12–7, BIO12–15	2–5

Marking guidelines:

Criteria	Marks
• Explains benefits of such campaigns	3
• Explains a benefit of such campaigns OR • Outlines benefits of such campaigns	2
• Provides some relevant information	1

Sample answer:

Education programs designed to control and prevent the spread of a debilitating disease like polio have significant benefits to the broader society as they provide people with the education and information they need to help them to not contract polio in the first place. Because of this the government can save considerable amounts of money as education campaigns are typically much cheaper to run than supplying treatment and medical assistance to people ill with polio. Another benefit of education campaigns that prevent polio is that even after people are no longer sick with polio they can be left with significant disabilities that make it very difficult for them to work and as such they have a limited capacity to contribute to the economy and instead are often reliant on government assistance.

Mod 8 – Question 13 (6 marks)

(a) Identify a disorder or disease, and describe how it affects the normal function of an organ. **2**

(b) Evaluate the effectiveness of a technology in managing the disorder or disease described in part (a). **4**

Mapping grid :

Content	Syllabus outcomes	Bands
Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	2–4

Marking guidelines:

Criteria	Marks
• Identifies a disorder or disease and describes how it affects the normal function of an organ	2
• Provides some relevant information	1

Sample answer:

Polycystic kidney disease is a disease in which fluid-filled cysts grow in the kidney, interfering with the normal kidney tissue and limiting the kidney's ability to filter the blood. The number of cysts builds up over time, enlarging the kidney and reducing function. The disease is typically genetic in nature.

Question 13 continues on page 85

Mapping grid (b):

Content	Syllabus outcomes	Bands
Mod 8 Technologies and Disorders	BIO12–6, BIO12–15	2–6

Marking guidelines (b):

Criteria	Marks
• Describes the circumstances in which an appropriate technology would be used • Describes how the technology functions to fulfil the normal function of the damaged organ • Outlines the benefits and limitations of the technology • Makes an informed judgement about the effectiveness of the technology	4
• Outlines the circumstances in which an appropriate technology would be used • Outlines how the technology functions to fulfil the normal function of the damaged organ • Identifies the benefits and limitations of the technology	3
• Outlines an appropriate technology • Identifies benefits and/or limitations of the technology	2
• Provides some relevant information	1

Sample answer:

People with polycystic kidney disease will typically progress to a point where kidney failure has occurred, at which point dialysis is required or the patient will die unless given a transplant. Dialysis technology works by taking over the normal function of the kidney, cleaning the patient's blood. There are two types of dialysis: haemodialysis and peritoneal dialysis. Haemodialysis is where the blood is removed from the patient and passed through the dialysis machine which uses osmosis to remove excess fluid, salts and toxins from the blood. This form of dialysis needs to be done 3 to 4 times a week and can take up to 4 hours. Patients typically need to go to a dialysis clinic for these treatments. Peritoneal dialysis in contrast uses the fluid in the peritoneal cavity and the systems of blood vessels lining the cavity to clean the blood. This is done by exchanging the fluid in the peritoneal cavity. Clean fluid is transferred into the peritoneal cavity and osmosis causes the excess salts and toxins to move from the blood into the fluid in the cavity. This fluid is then drained. This type of dialysis requires initial surgery to place the required catheter but has the benefit that the patient can manage the process themself in many instances.

Either form of dialysis is exceptionally effective, allowing people to live until such times as a kidney transplant becomes available. Without such technology people with kidney failure resulting from polycystic kidney disease would not survive beyond a week or so. As such, despite the inconvenience of having to visit haemodialysis clinics or manage peritoneal dialysis, this is a life-saving technology.

End of Question 13

Mod 8 – Question 14 (7 marks)

Evaluate the effectiveness of renal dialysis in managing the loss of kidney function. **7**

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 8 Technologies and Disorders	BIO12–6, BIO12–7, BIO12–15	2–6

Marking guidelines:

Criteria	Marks
• Provides a clear and accurate description of the processes used by the kidney and in renal dialysis, using scientific terminology • Makes an informed judgement about the effectiveness of renal dialysis	7
• Provides a description of the processes used by both the kidney and in renal dialysis, using scientific terminology • Makes a judgement about the effectiveness of renal dialysis	6
• Provides an outline of some of the processes used by the kidney and in renal dialysis • Provides an advantage and a disadvantage of renal analysis	5
• Provides an outline of a process used by the kidney and/or in renal dialysis • Provides an advantage and/or a disadvantage of renal analysis	3–4
• Identifies a process used by the kidney and/or in renal dialysis OR • Identifies an advantage and/or a disadvantage of renal analysis	2
• Provides some relevant information	1

Answers could include:

Describes normal kidney function concerning:
- filtration
- selective reabsorption
- secretion
- hormonal control and feedback.

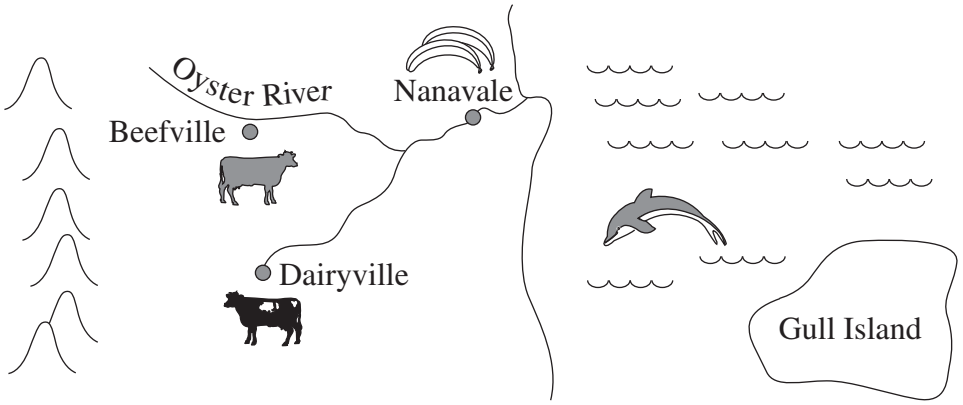
Describes renal dialysis with regard to need for:
- dialysis tubing
- countercurrent flow
- dialysis fluid.

Describes advantages and limitations of each process.

Makes a final judgement.

Mod 8 – Question 15 (7 marks)

The diagram shows a rural coastal area and the towns, rivers and associated industry for each of the townships. **7**



An epidemic of a disease has broken out in Nanavale. The symptoms are stomach ache, vomiting and tiredness. Many families in Nanavale have only one member with the disease, therefore it appears to be non-infectious. The symptoms are worse in infants than in adults.

Isolated cases of this disease have occurred in the nearby towns of Dairyville and Beefville. No cases have been reported on Gull Island.

Design an epidemiological study to investigate the origin of the disease. Refer to features of validity and reliability in your answer.

Mapping grid:

Content	Syllabus outcomes	Bands
Mod 8 Epidemiology	BIO12–2, BIO12–4, BIO12–5, BIO12–6, BIO12–7, BIO12–15	2–6

Question 15 continues on page 88

Question 15 (continued)

Marking guidelines:

Criteria	Marks
• Shows thorough understanding of designing an investigation that takes into account validity and reliability • Shows thorough understanding of how an epidemiological study can be carried out in this scenario to investigate the origin of the disease • Shows thorough understanding of analysing patterns of non-infectious diseases, gathering data and analysing results in this investigation	7
• Shows sound understanding of designing an investigation that takes into account validity and reliability • Shows sound understanding of how an epidemiological study can be carried out in this scenario • Shows sound understanding of analysing patterns of non-infectious diseases, gathering data and analysing results in this investigation	6
• Shows sound understanding of the main features of an epidemiological study • Shows some understanding of analysing patterns of non-infectious diseases, gathering data and/or analysing results in this investigation • Shows some consideration of validity and/or reliability in the design	4–5
• Shows some understanding of an epidemiological study and/or validity and/or reliability	2–3
• Provides some relevant information	1

Sample answer:

In order to plan an epidemiological study it is important to look at all the evidence available.

As mentioned, it does not seem to be infectious yet we do not know whether this is the case. One would expect symptoms to be worse in children than in adults, as they will very quickly dehydrate, regardless of the cause.

We are probably looking for some chemical (possibly toxic) or radiation to which the sufferers have been exposed. Initially we would want to interview all families with affected individuals. By interviewing all affected families, we would gather data on:

- What they have been doing
- Where they have been
- Where they have eaten
- What they have eaten
- What they have drunk
- Whether (and where) they have been swimming over the past few days.

Question 15 continues on page 89

Question 15 (continued)

We would try to correlate the data to find any common features or activities.

While we are interviewing the affected families, we would want to collect water and soil specimens, Geiger readings and blood samples to look for a common substance by undertaking a chemical analysis or an analysis of radioactive data.

If we find common features, we would then interview a number of unaffected families to see whether they had been to the same places or done the same things but not been affected. This would increase the validity of our study. The more people we are able to interview the more reliable our study becomes.

Our investigations may identify a common substance or exposure, for which we may be able to suggest antidotes or remedies. If there is no common substance, it may be that the cause is a pathogen.

The more data we can accumulate the more likely we are to find the root cause of the affliction.

End of sample questions