

Hornsby Girls High School



TRIAL HSC EXAMINATION 2020

HSC Biology

BOOKLET 1

Student Number

Total Assessment Weighting 40%

General Instructions

- Reading time – **5 minutes**
- Working time – **3 hours**
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Student Number on the front of this booklet and on the multiple choice answer sheet.
- **Do NOT write in the margins – there is additional writing space at the back of each booklet.**
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Total marks: 100

This exam has TWO sections has two parts: Section I and Section II

Section I – 20 marks (Multiple Choice)

- Attempt Questions 1–20.
- Allow about 35 minutes for this part.
- Section I is in Booklet 1

Section II – 80 marks (Short Answers)

- Attempt Questions
- Allow about 1 hour 55 minutes for this part.
- Section II is spread across Booklet 1 and Booklet 2

----- **Teacher Use Only** -----

Multiple Choice Marks

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Total MC

Booklet 2

Booklet 1

Question	Out of	Your Mark
21	8	
22	4	
23	4	
24	5	
25	5	
26	4	
27	5	
28	6	

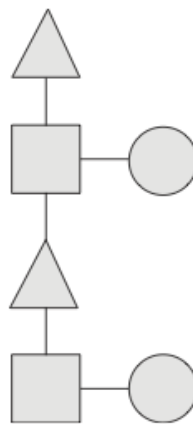
Question	Out of	Your Mark
29	6	
30	9	
31	5	
32	7	
33	4	
35	8	
Total	100	

Section 1

Part A – Multiple Choice 20 Marks (1 mark each)

Answer on the separate Multiple Choice Answer Sheet.

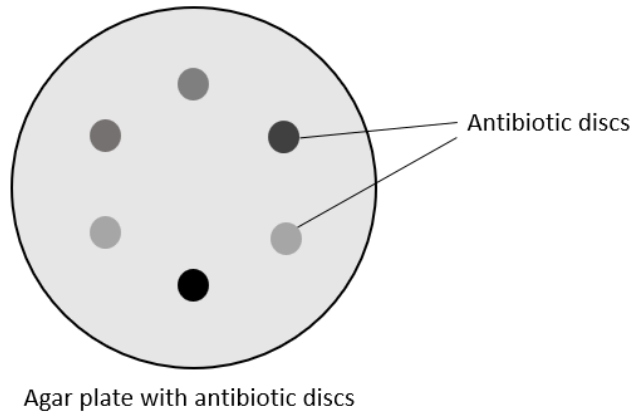
- 1 Which of the following is an example of physiological adaptation in an endotherm that assists in maintaining homeostasis?
- a) a dog moving into the shade to keep cool on a hot day
 - b) lizards moving into sunlight to raise body temperature
 - c) surface blood vessels in a human constricting on a cold day
 - d) animals in cold climates having thick fur coats
- 2 The diagram shows a model of DNA.



Which key correctly shows the parts of a nucleotide?

(A)		phosphate		sugar		base
(B)		sugar		phosphate		base
(C)		sugar		base		phosphate
(D)		base		phosphate		sugar

- 3 A bacterial culture was spread across an agar plate. Six absorbent paper discs soaked in different antibiotics were placed on the agar.



The agar plate was incubated overnight and the bacterial growth was examined the next day.

Which of the following would make a suitable control for this experiment?

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- 4 The secretion of specific hormones is carefully regulated during the ovulation cycle to prepare the uterus for the implantation of an embryo. After ovulation the corpus luteum enlarges and starts to secrete hormones X and Y.

If fertilisation and implantation occur, the pregnancy is controlled by hormone Y, which is secreted from the corpus luteum in the first three months and later from the placenta.

Hormone Z controls birth by causing coordinated contractions of uterine muscles.

What are hormones X, Y and Z respectively?

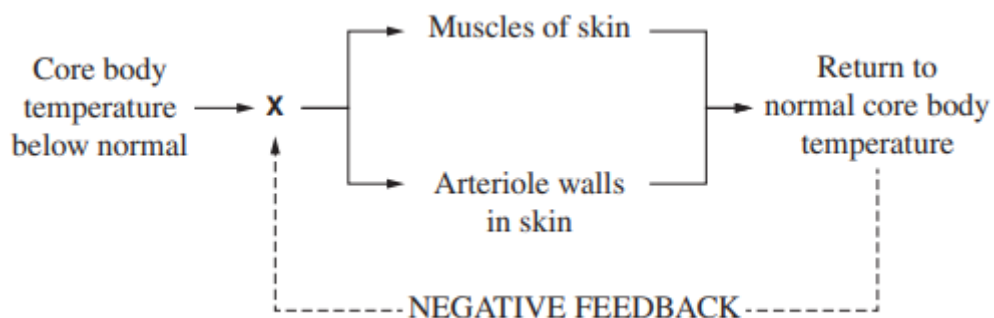
- a) Oestradiol, oxytocin, progesterone
- b) Oxytocin, oestradiol, progesterone
- c) Oestradiol, progesterone, oxytocin
- d) Prolactin, progesterone, oxytocin

- 5 A geneticist compared the sequences of two genes (I and II) from a bacterium. Gene I contained 32% cytosine and Gene II contained 14% cytosine.

Which of the following statements about the chemical makeup of the genes can be deduced from these data?

- a) Gene I contained 32% adenine.
- b) Gene II contained 36% adenine.
- c) No conclusion can be drawn as the base pairing in bacterial DNA is not the same as in eukaryote DNA.
- d) Gene I contained more thymine than Gene II.

- 6 Refer to the following information to answer Questions 6 and 7. The diagram shows a homeostatic mechanism in a mammal



What does 'X' represent in the diagram?

- a) The heart
 - b) A thermoreceptor in the skin
 - c) The brain
 - d) A pressure receptor in a blood vessel
- 7 Which of the following describes what happens to the muscles and the arteriole walls in the skin when the core body temperature is below normal?

	<i>Muscles of skin</i>	<i>Arteriole walls in skin</i>
(A)	Relax to lower epidermal hairs	Expand
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- 8 Homologous chromosomes:
- a) are present in pairs in all cells.
 - b) have identical alleles.
 - c) contain only coding regions of DNA.
 - d) can exchange sections during meiosis.
- 9 Emmanuel has been playing the saxophone in jazz and rock bands since his high school days and now, in his fifties, has noticed that he has difficulty hearing, especially the higher-pitched notes of his jazz vocalist. Which of the following most likely explains his hearing loss?
- a) Damage to the cochlear hair cells
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- 10 A study was conducted on identical twins where twins were separated at birth. After 10 years of living on different continents, the identical twins looked different to each other.

What is this study investigating?

- a) The effect of genetic factors on genotype
 - b) The effect of genetic factors on phenotype
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- 11 In mice, agouti (light brown) coat colour is dominant to black coat colour. A mouse, which is heterozygous for agouti coat-colour, is crossed with a black-coated mouse.

What are the possible genotypes for their offspring?

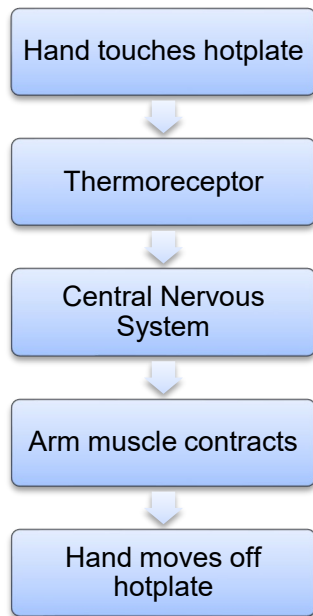
- a) Bb
 - b) Bb, bb
 - c) BB, bb
 - d) BB, Bb
- 12 The Anopheles mosquito transmits the malaria parasite from one infected person to another.

What is the best classification of this mode of transmission?

- a) Direct contact
- b) Indirect contact
- c) Vector transmission
- d) Host transmission

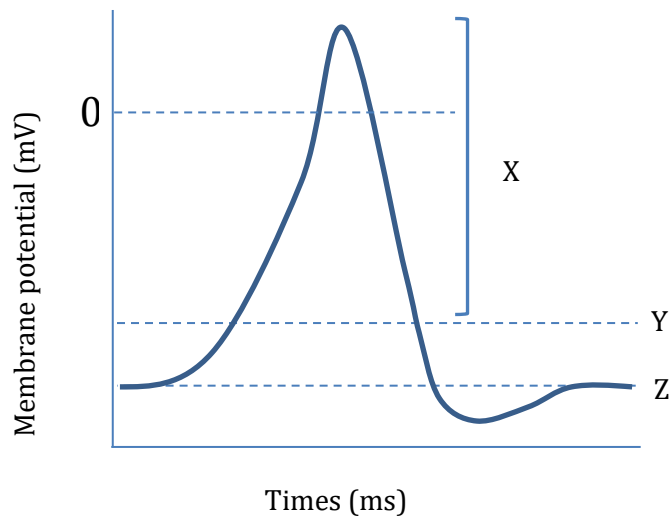


13 Identify the *effector* in the negative feedback loop below.



- a) Hand
- b) Arm muscle
- c) Thermoreceptor
- d) Central nervous system

14 Use the graph for Question 14.



At what point has the action potential reached its threshold on the graph?

- a) X
- b) Y
- c) Z
- d) 0

15 Consider the diagram. Which type of reproduction in cells is shown in the diagram?



- a) budding
- b) sporulation
- c) binary fission
- d) fertilisation

16 Which of the following statements about 'non-coding' DNA segments is correct?

- a) They are less common than 'coding' DNA segments.
- b) They are structural mirror images of 'coding' DNA.
- c) They have some functions, however not all of these are currently understood.
- d) They only occur in the DNA of humans.

17 Which of the following is correct of polypeptide synthesis?

	<i>Transcription</i>	<i>Translation</i>
(A)	occurs in the cytoplasm and results in the production of a single strand of a peptide chain	occurs in the nucleus and results in the production of a peptide chain
(B)	occurs in the nucleus and results in the production of a single strand of mRNA	occurs in the cytoplasm and results in the production of a peptide chain
(C)	occurs in the nucleus and results in the production of a single strand of mRNA	occurs in the cytoplasm and results in the production of a single strand of mRNA
(D)	occurs in the cytoplasm and results in the production of several peptide chains	occurs in the nucleus and results in the production of a single strand of mRNA

18 The following paragraph describes a body response.

The response is protective, and it makes nearby blood vessels leak. Plasma and white cells move into the affected area, diluting and destroying the infectious agent. This is why the infection site swells, reddens and feels hot. Although we tend to think of this response in terms of annoyance, soreness and pain, it is actually a beneficial response.

What response does this paragraph describe?

- a) Cell differentiation
- b) The action of antibodies
- c) The activation of helper T-cells
- d) Inflammation

- 19 An experiment was conducted to examine the effect of ultraviolet radiation on the development of antibiotic resistance in a strain of bacteria. The table summarises the outcomes of this experiment.

<i>Treatment</i>	<i>Antibiotic resistance</i>				
	<i>Antibiotic P</i>	<i>Antibiotic Q</i>	<i>Antibiotic R</i>	<i>Antibiotic S</i>	<i>Antibiotic T</i>
No exposure to ultraviolet radiation	✓	✓	✗	✗	✗
Exposure to ultraviolet radiation	✓	✓	✗	✓	✗

✓ = resistant ✗ = not resistant

Which of the following statements best summarises the stages in the development of the new strain of bacteria that was resistant to antibiotic S?

- a) Hybridisation → Mutation → Natural Selection
- b) Replication → Mutation → Natural Selection
- c) Mutation → Natural Selection → Replication
- d) Mutation → Hybridisation → Natural Selection

- 20 The tortoiseshell cat has a combination of black and orange fur. The gene for black fur is represented by X^b and the gene for orange fur is represented by X^o . A tortoiseshell female cat ($X^b X^o$) mates with an orange male cat ($X^o Y$).

Which alternative shows the probable percentages of coat colours in the litter of kittens?

- a) 50% tortoiseshell females and 50% orange males
- b) 50% orange females and 50% tortoiseshell males
- c) 25% black females, 25% orange females, 25% black males, 25% orange males
- d) 25% tortoiseshell females, 25% orange females, 25% black males, 25% orange males

Answer the questions in the space provided.

Question 21 (8 marks)

a) Outline a safety process that the scientists experimenting on salmonella could use to minimise the risk of infection.

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- b) In order for the scientist's experiment to be useful to the scientific community, their experiment needs to have a level of validity. Outline and justify two details/steps that the scientists could include as part of their experiment to increase the validity of their method.

[illegible]

- c) Discuss the role that quarantine plays in preventing the spread of disease, demonstrate your answer with a specific example. 3

This image shows a full page of white paper with ten horizontal dashed lines, evenly spaced from top to bottom. These lines are typical of primary-ruled notebook paper used for teaching handwriting or basic writing skills. There are no margins, text, or other markings on the page.

Question 22 (4 marks)

In 2013, researchers reported on a child suffering from *mitochondrial encephalomyopathy*, which they were able to determine was caused by a mutation in the anticodon region of the tRNA coding for the amino acid tryptophan. The disease causes stroke like symptoms and affects all major organs of the body.

- Using your knowledge of the role of tRNA in cell function, and the information provided above, discuss the potential impact this mutation would have on normal cell function.

[illegible]

Question 23 (4 marks)

A female who is heterozygous for a trait reproduces with a male who has the dominant allele for that trait. The likelihood of producing a female with a dominant trait expressed in the phenotype is 100%. The likelihood of producing a male with the dominant trait expressed in the phenotype is 50%.

- a) Identify the pattern of inheritance in this example. 1
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- b) Construct a model to support your answer to part (a). 3

Two different mutations are shown. It is possible that each mutation may harm the cell or have no impact on the cell.

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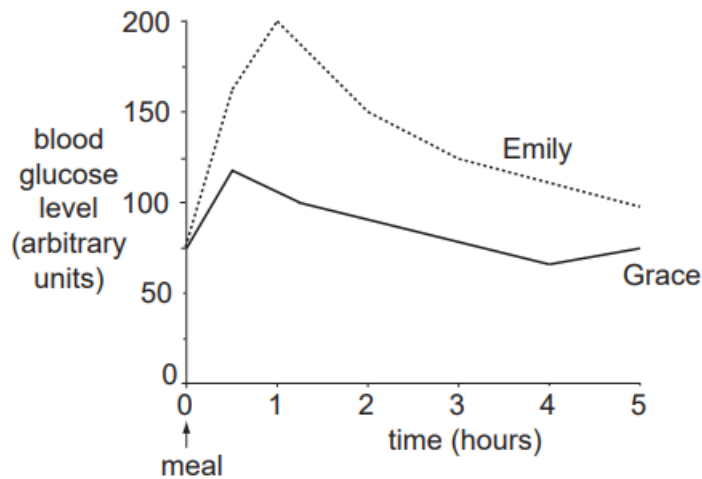
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[illegible]

Question 25 (5 marks)

Blood glucose levels are controlled by a homeostatic mechanism. Two females of the same age and similar body structure were each given an identical meal. The following graph shows the level of blood glucose in each female for the five-hour period after eating the meal.



- a) Explain whether Emily or Grace had a defect/disorder in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer.

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Name of female:

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- b) Explain the small rise in Grace's level of glucose between four and five hours after the meal.

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Question 26 (4 marks)

The Tasmanian Devil is a native marsupial found mainly in coastal forests of Tasmania. It is at risk of extinction from the contagious devil facial tumour disease (DFTD) cancer. Devil numbers have been reducing to less than 10 percent of the original population in some parts of Tasmania. With no vaccine or cure for DFTD currently available, a breeding program is the key to the devil's survival.



Tasmanian Devil (no facial disease)



Tasmanian Devil (facial tumour)

The facial cancer spreads because nearly all the devils have very similar MHCs (genes that allow the immune system to recognise foreign molecules). When the devils fight, cancer cells get transferred from an infected devil to an uninfected devil. Because of the similar MHCs, the immune system doesn't recognise the invader and the cancer easily spreads.

Some scientists propose introducing MHC diversity into the devil population through genetic engineering, via a virus vector. In this way, scientists could create Tasmanian devils with different MHC complexes and introduce them back into the population.

- a) Suggest an explanation for most devils having very similar MHC immunity.

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- b) The Tasmanian research team has provided some hope that the disease may be halted and the devil population saved from extinction. By comparing over 90,000 single nucleotide polymorphisms (SNPs) between pre- and post-infection populations, they have discovered two genomic regions that contain genes related to immune function and these genes appear to be undergoing strong selection.

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Explain the advantages of using SNP sequences in genetic analyses.

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Question 27 (5 marks)

Plant species have evolved to maintain suitable water conservation strategies. Crassulacean acid metabolism (CAM) plants, such as pineapple (*Ananas comosus*), absorb carbon dioxide at night and convert it into malic acid for storage. During the day, the malic acid is converted back into carbon dioxide and used for photosynthesis.



Pineapple

- a) Using your understanding of plant structure and function, explain how the CAM process, outlined above would help *Ananas comosus* maintain water balance. 3

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- b) Identify and describe a DIFFERENT feature or mechanism to (a) that helps a named plant to maintain water balance. 2

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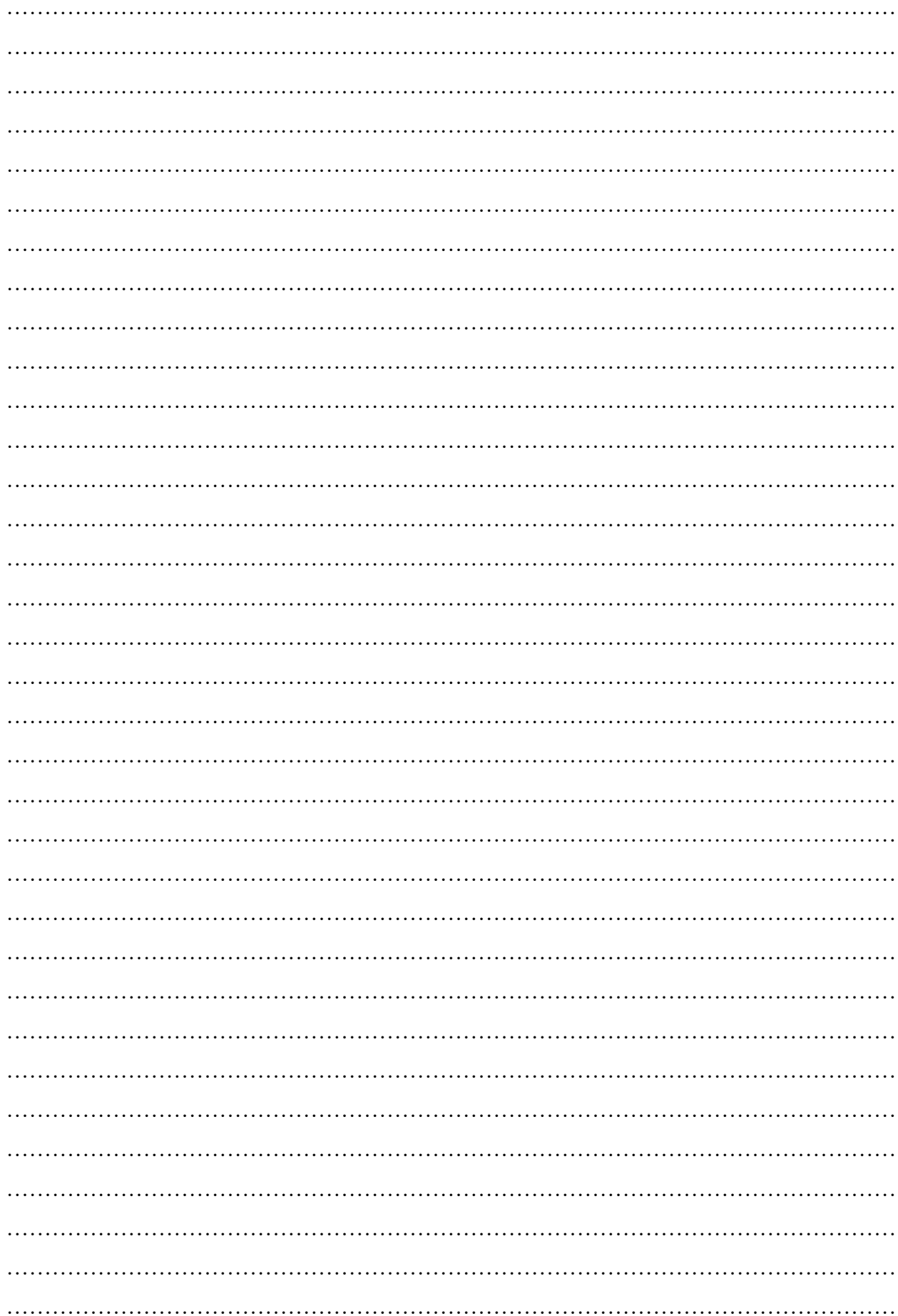
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This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dotted lines spaced evenly down the page, providing a guide for handwriting practice. The paper is otherwise blank, with no margins, text, or other markings.

Additional Writing Space – Booklet 1

Please **clearly** identify the number of the question you are using the additional space for.

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Hornsby Girls High School



TRIAL HSC EXAMINATION 2020

HSC Biology

BOOKLET 2

Student Number

Answer Questions 29 – 35 in this booklet

Section II

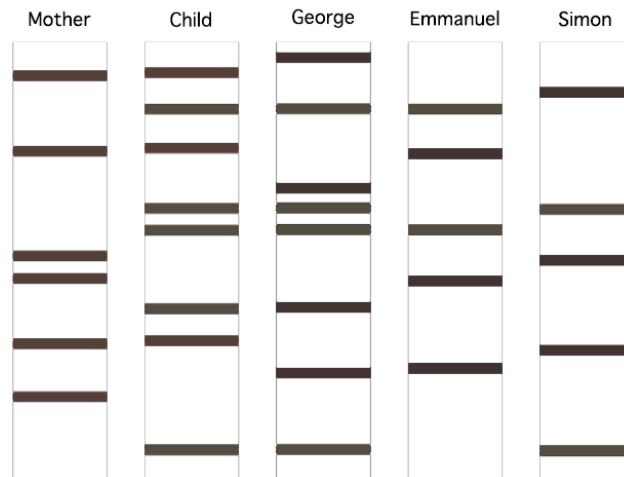
Attempt Questions 29 – 35 in this booklet.

Answer the questions in the space provided.

Do not write in the margins - if you require more space to complete a question, clearly note on the question that the answer continues then complete the question at the back of the section on the spare lined pages.

Question 29 (6 marks)

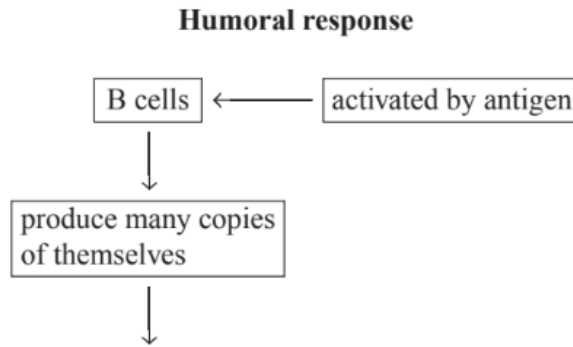
DNA profiling can be used to test for paternity. Three men (George, Emmanuel and Simon) were tested to determine the paternity of a child and the following banding patterns were produced.



- a) Identify which man is most likely to be the father of the child. 1
-
- b) With reference to the DNA profile provided, justify your answer to a). 2
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-
- c) DNA profiling is a technique that can also be used to match DNA from a crime scene with that of potential suspects. Outline the techniques used in DNA profiling. 3
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Question 30 (9 marks)

The diagram shows details of the humoral response that occurs when B cells respond in the presence of antigens.



- a) Describe how the human body would respond after these steps and explain how this would reduce the impact of the pathogen.

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- b) The acquired immune response involves more than just B cells. Construct a table to compare and contrast B cells and T cells.

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Question 31 (5 marks)

A common way to show the inheritance of characteristics is a pedigree (family tree).

- a) Draw a pedigree that illustrates the following information. Show the conventions you have used. A family had a history of a particular genetic disease. Adrian (male) showed signs of the disease and married Betty who did not display the disease. They had three children, Charles (male), David (male) and Ellen (female). Both Charles and David were genetically healthy, but Ellen may have been a carrier for the disease. Ellen married Freddy (male) who did not have the disease. They had two male children Geoff (who displayed the disease) and Harry (who was disease-free).

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- b) Could this be a sex-linked disorder? Outline the reasons for your answer.

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Below is a diagram of an eye.

A diagram of a human eye in cross-section, labeled with letters a through f. 'a' points to the cornea, 'b' to the iris/pupil area, 'c' to the lens, 'd' to the retina, 'e' to the vitreous body, and 'f' to the optic nerve.

- | Letter from diagram | Name of eye structure | Function of the structure |
|---------------------|-----------------------|---------------------------|
| | | |
| | | |

- The optometrist concluded that Alex suffered with myopia.

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

Question 33 (4 marks)

A gene has three alleles in a population: G1, G2 and G3. The frequency of G1 in that population is 60% or 0.6. G2 has a frequency of 0.25

- a) What is the frequency of G3? 1

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- b) A person who is homozygous for the G2 trait reproduces with a person who is homozygous for the G3 trait. It was stated that they have a 25% chance of producing a person with the G2 trait in their phenotype. 3

Determine the validity of this analysis. Provide evidence to support your answer.

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Question 34 (8 marks)

Biotechnology has affected Earth's biodiversity for many years. Prior to the development of genetic engineering, farmers and scientists used many different methods to increase food production.

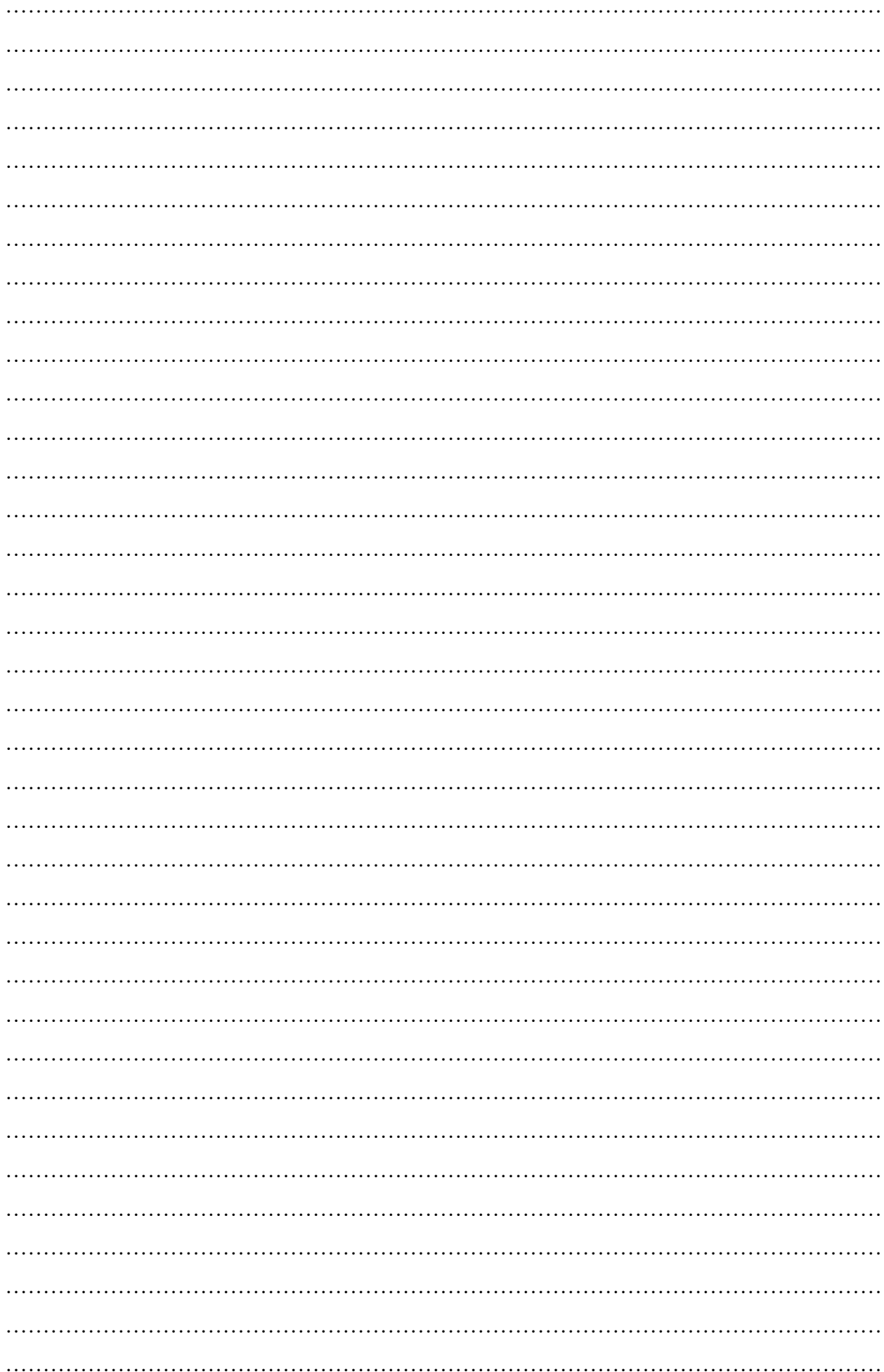
Outline ONE example of biotechnology from the past, ONE from the present and ONE potential future example. Evaluate their effects on biodiversity.

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Additional Writing Space – Booklet 2

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Hornsby Girls High School



TRIAL HSC EXAMINATION 2020

HSC Biology

BOOKLET 1

ANSWERS

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Booklet 2

Booklet 1

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

Section 1

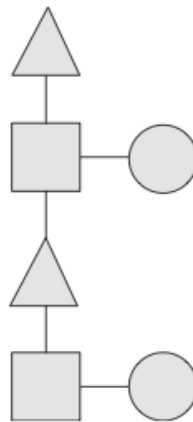
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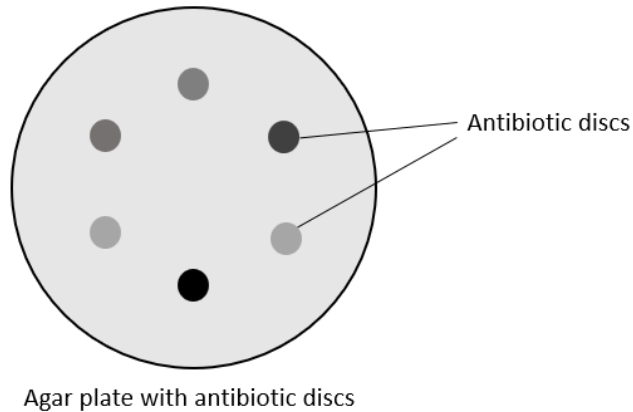
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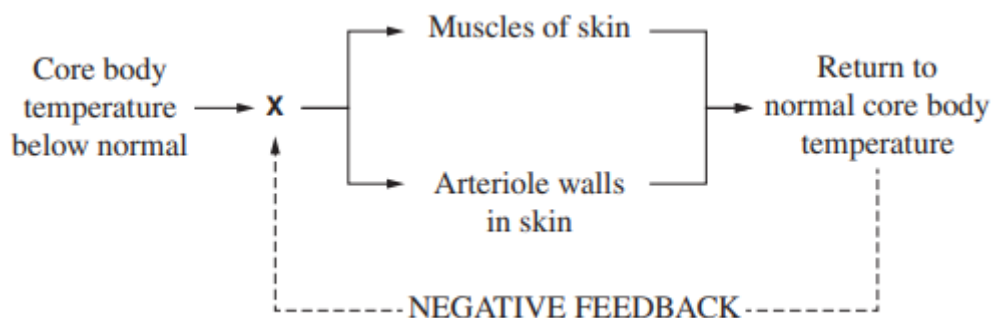
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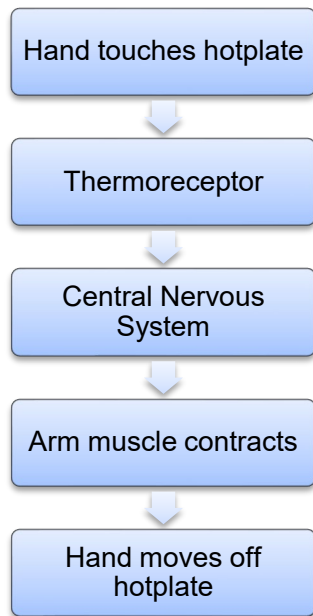
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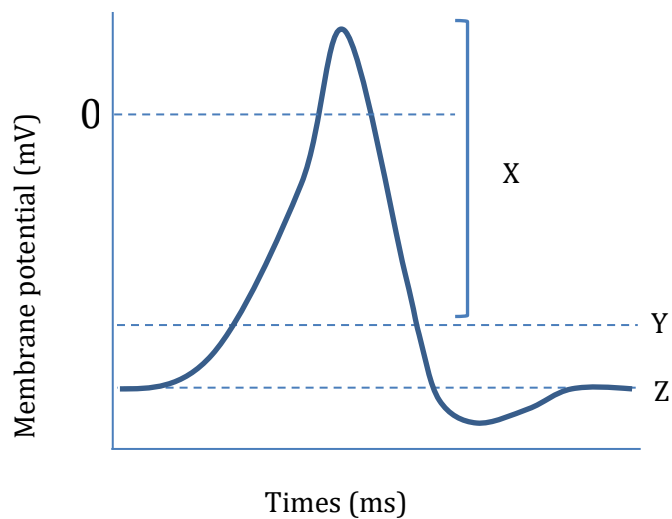


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- h) Central nervous system

14 Use the graph for Question 14.



At what point has the action potential reached its threshold on the graph?

- e) X
- f) **Y**
- g) Z
- h) 0

- 15 Consider the diagram. Which type of reproduction in cells is shown in the diagram?



- e) budding
f) sporulation
g) binary fission
h) fertilisation
- 16 Which of the following statements about 'non-coding' DNA segments is correct?
- e) They are less common than 'coding' DNA segments.
f) They are structural mirror images of 'coding' DNA.
g) They have some functions, however not all of these are currently understood.
h) They only occur in the DNA of humans.
- 17 Which of the following is correct of polypeptide synthesis? **B**

	<i>Transcription</i>	<i>Translation</i>
(A)	occurs in the cytoplasm and results in the production of a single strand of a peptide chain	occurs in the nucleus and results in the production of a peptide chain
(B)	occurs in the nucleus and results in the production of a single strand of mRNA	occurs in the cytoplasm and results in the production of a peptide chain
(C)	occurs in the nucleus and results in the production of a single strand of mRNA	occurs in the cytoplasm and results in the production of a single strand of mRNA
(D)	occurs in the cytoplasm and results in the production of several peptide chains	occurs in the nucleus and results in the production of a single strand of mRNA

- 18 The following paragraph describes a body response.

The response is protective, and it makes nearby blood vessels leak. Plasma and white cells move into the affected area, diluting and destroying the infectious agent. This is why the infection site swells, reddens and feels hot. Although we tend to think of this response in terms of annoyance, soreness and pain, it is actually a beneficial response.

What response does this paragraph describe?

- e) Cell differentiation
f) The action of antibodies
g) The activation of helper T-cells
h) **Inflammation**
- 19 An experiment was conducted to examine the effect of ultraviolet radiation on the development of antibiotic resistance in a strain of bacteria. The table summarises the outcomes of this experiment.

	<i>Antibiotic resistance</i>				
<i>Treatment</i>	<i>Antibiotic P</i>	<i>Antibiotic Q</i>	<i>Antibiotic R</i>	<i>Antibiotic S</i>	<i>Antibiotic T</i>
No exposure to ultraviolet radiation	✓	✓	✗	✗	✗
Exposure to ultraviolet radiation	✓	✓	✗	✓	✗

✓ = resistant

✗ = not resistant

Which of the following statements best summarises the stages in the development of the new strain of bacteria that was resistant to antibiotic S?

- e) Hybridisation → Mutation → Natural Selection
- f) Replication → Mutation → Natural Selection
- g) Mutation → Natural Selection → Replication
- h) Mutation → Hybridisation → Natural Selection

- 20 The tortoiseshell cat has a combination of black and orange fur. The gene for black fur is represented by X^b and the gene for orange fur is represented by X^o . A tortoiseshell female cat ($X^b X^o$) mates with an orange male cat ($X^o Y$).

Which alternative shows the probable percentages of coat colours in the litter of kittens?

- e) 50% tortoiseshell females and 50% orange males
- f) 50% orange females and 50% tortoiseshell males
- g) 25% black females, 25% orange females, 25% black males, 25% orange males
- h) 25% tortoiseshell females, 25% orange females, 25% black males, 25% orange males

Section II

Attempt Questions 21 – 28 in this booklet.

Answer the questions in the space provided.

Do not write in the margins - if you require more space to complete a question, clearly note on the question that the answer continues then complete the question at the back of the section on the spare lined pages.

Question 21 (8 marks)

Salmonella enterica is a pathogen that causes food poisoning. In 2006 scientists sent a batch of salmonella to space and kept an identical batch on Earth under similar temperature conditions. Bacteria from both strains were fed to mice, and the ‘space germs’ were reported to be three times more likely to make the mice sick. The research facility was under strict quarantine regulations during the investigation.

- a) Outline a safety process that the scientists experimenting on salmonella could use to minimise the risk of infection. 1

Criteria	Marks
• Identifies ONE clear safety procedure identified for the risk of infection	1

Suggested Answer

- Use of protective clothing eg. Gloves
- Correct disposal of bacteria after investigation eg. Heat/UV treatment to kill
- Hygiene practice eg. Wipe down work surfaces with disinfectant; wash hands

- b) In order for the scientist’s experiment to be useful to the scientific community, their experiment needs to have a level of validity. Outline and justify two details/steps that the scientists could include as part of their experiment to increase the validity of their method. 4

Criteria	Marks
• Outlines TWO details/procedures/steps that will assist in the experiment being valid	4
• Provides a logical justification of each of the details/procedures/steps	
• Outlines TWO details/procedures/steps that will assist in the experiment being valid	3
• Provides a logical justification for ONE of the details/procedures/steps	
• Outlines ONE details/procedures/steps that will assist in the experiment being valid	2
• Provides a logical justification of the details/procedure/step	
OR	
• Outlines TWO details/procedures/steps that will assist in the experiment being valid	1
• Provides some relevant information that links to validity	

Suggested Answers

- Same species of bacteria (even better clones) – this will ensure that the IV (space bacteria vs Earth bacteria) is the only variable that is changing. Different bacteria species could cause different levels of illness in the mice.

- Mice fed the same amount of bacteria – if mice are fed differing amounts of bacteria this could impact their level of illness. The same amount of bacteria ensures that only the IV changes.
- Same amount of time bacteria given to impact mice – differing amounts of time would add another variable thus impact the validity of the experiment

There will be many other answers, marker will need to consider if the answer will actually impact the validity to a reasonable level before awarding marks.

- c) Discuss the role that quarantine plays in preventing the spread of disease, demonstrate your answer with a specific example. 3

Criteria and Suggested Answer

Quarantine prevents the introduction and spread of disease by control of movement. Fruit flies cause problems with citrus fruit. States try to control the spread of fruit flies by forbidding the transport of fruit across state lines by individuals. This has been successful in the main.	9.4.7	H8
	• Gives discussion that includes meaning of quarantine, gives an example and mentions the success/failure of that example.	3
	• Gives the meaning of quarantine and an example	2
	• Gives the meaning of quarantine	1

Question 22 (4 marks)

In 2013, researchers reported on a child suffering from *mitochondrial encephalomyopathy*, which they were able to determine was caused by a mutation in the anticodon region of the tRNA coding for the amino acid tryptophan. The disease causes stroke like symptoms and affects all major organs of the body.

- Using your knowledge of the role of tRNA in cell function, and the information provided above, discuss the potential impact this mutation would have on normal cell function. 4

Criteria	Marks
• Provides a clear summary of polypeptide synthesis • Describes the role of tRNA molecules in bringing amino acids into the correct order in a polypeptide • Clearly outlines the effect that a mutation in the anticodon region of a tRNA molecule would have	4
• Provides some detail of polypeptide synthesis • Describes the role of tRNA molecules in bringing amino acids into the correct order in a polypeptide • Clearly outlines the effect that a mutation in the anticodon region of a tRNA would have	3
• Two of the above	2
• Provides some relevant information	1

Sample answer:

tRNA plays a role in polypeptide synthesis. Genes are transcribed from DNA to mRNA in the nucleus by complementary base pairing and the mRNA moves to the cytoplasm. The genetic code is in the form of codons, which are triplets of bases that code for a specific amino acid. Transfer RNA (tRNA) molecules carrying specific amino acids bind to the mRNA by the pairing of their anticodon region with the codons on the mRNA to bring amino acids into the correct order on the polypeptide. If a mutation occurs in the anticodon region of a tRNA molecule it could end up carrying the wrong amino acid (or be unable to bind to the mRNA at all) so the amino acid sequence of the resultant polypeptide would be incorrect and a functional protein would not be produced.

Question 23 (4 marks)

A female who is heterozygous for a trait reproduces with a male who has the dominant allele for that trait. The likelihood of producing a female with a dominant trait expressed in the phenotype is 100%. The likelihood of producing a male with the dominant trait expressed in the phenotype is 50%.

a) Identify the pattern of inheritance in this example.

1

Criteria	Marks
Identifies correct pattern of inheritance	1

Suggested Answer

- Sex-linked

b) Construct a model to support your answer to part (a).

3

Criteria and Suggested Answer

	X^D	Y
X^D	$X^D X^D$	$X^D Y$
X^d	$X^D X^d$	$X^d Y$

Mod 5 Heredity
BIO12–12, 12–5, 12–6 Bands 3–4

- Constructs an appropriate model.

AND

- Demonstrates likelihood of producing a male with dominant trait is 50%

AND

- Demonstrates likelihood of producing a female with dominant trait is 100% 3

- Constructs an appropriate model.

AND

- Demonstrates likelihood of producing a male with dominant trait to is 50%

OR

- Demonstrates likelihood of producing a female with dominant trait is 100% 2

- Constructs an appropriate model. 1

Question 24 (5 marks)

Two different mutations are shown. It is possible that each mutation may harm the cell or have no impact on the cell.

ATACTCAGATTACGT

Mutation I



ATACTCAAATTACGT

ATACTCAGATTACGT

Mutation II



ATACTCAAGATTACGT

- a) Outline the difference between the two mutations.

2

Criteria and Suggested Answer

Mutation I is a point mutation where guanine is substituted with adenine. Mutation II is a frameshift mutation that shifts the reading frame of the triplet codes.	Mod 5 Cell Replication BIO12–12 Band 3–5 - Identifies that mutation I is a point mutation and mutation II is a frameshift mutation. AND - Differentiates between point mutation and frameshift mutation 2 - Identifies that mutation I is a point mutation and mutation II is a frameshift mutation 1
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- b) Which mutation is most likely to have the greater effect on a cell? Give evidence to support your answer.

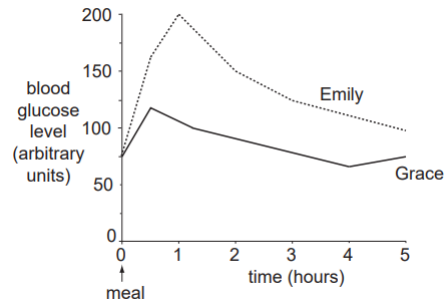
3

Criteria and Suggested Answer

Mutation II is most likely to have the greater effect. Mutation II has a base inserted, resulting in a frameshift mutation that will shift the reading frame for the rest of the DNA sequence, changing the amino acids that are brought to the ribosome during protein synthesis. This may result in the polypeptide chain not forming. Mutation I is a substitution and may affect only one amino acid.	Mod 5 Cell Replication BIO12–12 Bands 3–4 - Correctly identifies mutation II. AND - Describes the effect of BOTH mutations on the amino acid sequence 3 - Correctly identifies mutation II. AND - Describes the effect of ONE of the mutations on the amino acid sequence 2 - Correctly identifies mutation II 1
--	--

Question 25 (5 marks)

Blood glucose levels are controlled by a homeostatic mechanism. Two females of the same age and similar body structure were each given an identical meal. The following graph shows the level of blood glucose in each female for the five-hour period after eating the meal.



- a) Explain whether Emily or Grace had a defect/disorder in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer.

3

Criteria	Marks
- Identifies 'Emily' as the student most likely to have a defect/disorder in BG mechanism - Provides TWO reasons for this choice based on evidence from the graph	3
- Identifies 'Emily' as the student most likely to have a defect/disorder in BG mechanism - Provides ONE reason for this choice based on the graph OR - Identifies 'Grace' as the student most likely to have a defect/disorder in BG mechanism - AND provides some logical reason for this based on the graph	2
Provides some relevant information based on the information in the graph	1

Suggested Answer

It is most likely that Emily has a defect/disorder in her B-G homeostatic mechanism. This is because, as shown in the graph, Emily's B-G spikes in the 30 mins after eating and then continues to rise until 1 hour after eating. The spike in B-G is also much greater than Grace's. This suggests that the homeostatic mechanism that should release insulin to bring her B-G back to the homeostatic set-point (or equilibrium in the system) is not functioning correctly. The graph also shows that it takes Emily much long for her B-G to decrease, and that it does not quite reach its start point. This again suggests that the homeostatic mechanism to remove excess B-G from the bloodstream is not functioning correctly.

- b) Explain the small rise in Grace's level of glucose between four and five hours after the meal.

2

Criteria	Marks
- Shows an understanding of homeostasis in relation to this example - Links to negative feedback as a mechanism to help maintain homeostasis	2
One of the above	1

Suggested Answer

The regulation of blood glucose level is an example of a homeostatic mechanism in that it is a process that maintains a relatively stable internal environment. In order to maintain this environment, negative feedback is a mechanism that ensures that the system remains at a homeostatic set-point. The slight increase in Grace's B-G between 4-5 hours shown in the graph could be accounted for by the liver releasing glycogen as her B-G was starting to drop away from the 'ideal' set point.

Question 26 (4 marks)

The Tasmanian Devil is a native marsupial found mainly in coastal forests of Tasmania. It is at risk of extinction from the contagious devil facial tumour disease (DFTD) cancer. Devil numbers have been reducing to less than 10 percent of the original population in some parts of Tasmania. With no vaccine or cure for DFTD currently available, a breeding program is the key to the devil's survival.



Tasmanian Devil (no facial disease)



Tasmanian Devil (facial tumour)

The facial cancer spreads because nearly all the devils have very similar MHCs (genes that allow the immune system to recognise foreign molecules). When the devils fight, cancer cells get transferred from an infected devil to an uninfected devil. Because of the similar MHCs, the immune system doesn't recognise the invader and the cancer easily spreads.

Some scientists propose introducing MHC diversity into the devil population through genetic engineering, via a virus vector. In this way, scientists could create Tasmanian devils with different MHC complexes and introduce them back into the population.

- a) Suggest an explanation for most devils having very similar MHC immunity.

1

Criteria and Suggested Answer

Question 22(a)

Criteria	Mark
Provides a logical reason to explain why most devils have very similar MHC immunity	1

Sample answer: The Tasmanian Devil population is relatively isolated (to an island). Isolated populations often result in inbreeding and a lack of genetic diversity, which could result in similar MHC immunity.

- b) The Tasmanian research team has provided some hope that the disease may be halted and the devil population saved from extinction. By comparing over 90,000 single nucleotide polymorphisms (SNPs) between pre- and post-infection populations, they have discovered two genomic regions that contain genes related to immune function and these genes appear to be undergoing strong selection.

3

Explain the advantages of using SNP sequences in genetic analyses.

Criteria	Marks
Explains the advantages of using SNPs in genetic analyses in terms of their presence outside coding regions	2
Provides some relevant information	1

Suggested Answer:

SNPs are single nucleotide changes that occur in at least 1% of a population and are known to be associated in humans and other species with disease susceptibility. The vast majority (99%) of SNPs occur outside coding areas of DNA so they can persist in a population as indicators of genetic variability but do not affect function. SNP analysis is very efficient as it can be used to compare genetic similarities and differences within a population without having to sequence the entire genome.

Question 27 (5 marks)

Plant species have evolved to maintain suitable water conservation strategies. Crassulacean acid metabolism (CAM) plants, such as pineapple (*Ananas comosus*), absorb carbon dioxide at night and convert it into malic acid for storage. During the day, the malic acid is converted back into carbon dioxide and used for photosynthesis.



Pineapple

- a) Using your understanding of plant structure and function, explain how the CAM process, outlined above, would help *Ananas comosus* maintain water balance. 3

Criteria and Suggested Answer

Criteria	Mark
- Identifies relationship between stomata and absorption of carbon dioxide and evapotranspiration - Relates stomata opening at night to decrease in water loss by plant - Clear link between cause and effect	3
- Identifies relationship between stomata and absorption of carbon dioxide or evapotranspiration - Relates stomata opening at night to decrease in water loss by plant	2
Some relevant information provided	1

Sample answer: Plants must open their stomata in order to absorb the carbon dioxide needed for photosynthesis; however, this also allows the loss of water through evapotranspiration. By only opening their stomata at night, CAM plants get the carbon dioxide they need, but reduce the amount of water they lose because evapotranspiration rates will be lower at night when temperatures are cooler. This allows CAM plants to survive in hot, arid environments.

- b) Identify and describe a DIFFERENT feature or mechanism to (a) that helps a named plant to maintain water balance. 2

Criteria and Suggested Answer

Criteria	Mark
- Plant named and correctly identifies a feature/mechanism - Outlines how this feature helps to maintain water balance	2
ONE of the above	1

Sample answer: *Ficus carica* has stomata sunken into tiny pockets on the leaf. Each pocket traps a layer of air next to the stomatal pore, forming a protective barrier between it and the air around the leaf. The air in the pocket becomes humid (due to transpiration), preventing a concentration gradient forming between the inside of the leaf and the air in the pocket, reducing further transpiration and therefore reducing water loss from the plant.

Question 28 (6 marks)

6

“Prevention is better than cure” is a statement that can be applied to infectious diseases.

Evaluate this statement by outlining FOUR strategies that can be used to prevent/control the spread of infectious disease.

Criteria	Marks
- Clearly links the idea of prevention rather than treatment (or cure) to the spread of disease in populations - Refers to at least FOUR specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides - Provides a clear evaluation statement based on the evidence presented - Presents answer in a concise, logical way using appropriate biological language	6
- Links the idea of prevention rather than treatment (or cure) to the spread of disease in populations - Refers to at least FOUR specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides - Provides an evaluation statement based on the evidence presented - Presents answer in a logical way using appropriate biological language	5
- Refers to at least THREE specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides - Provides an evaluation statement based on the evidence presented OR - Refers to at least FOUR specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides	4
- Refers to at least TWO specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering	3

-use of pesticides • Provides an evaluation statement based on the evidence presented OR • Refers to at least THREE specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides	
• Refers to at least ONE specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides • Provides an evaluation statement based on the evidence presented OR • Refers to at least TWO specific examples of infectious disease and outlines in detail strategies used for prevention, which may include: -hygiene practices -vaccination -quarantine -genetic engineering -use of pesticides	2
• Provides some relevant information	1

Suggested Answer:

This is more a very quick draft based on ‘suggested answer’ to the original question from the NEAP paper that compared infectious to non-infectious disease – I think looking at some student response will be necessary to mark this question – it is probably going to be a bit more holistic.

Infectious diseases are caused by pathogens, such as bacteria, viruses and macroscopic parasites. These pathogens are transmitted between individuals in a variety of ways, including ingestion of infected food or water, inhalation of droplets sneezed out by infected individuals and transfer of bodily fluids such as blood or semen. Prevention of infectious diseases involves mechanisms either to prevent transmission of the pathogen between hosts or to enhance a host’s immune system to destroy the pathogen after infection.

Waterborne bacterial diseases such as cholera can be prevented by ensuring water is disinfected and human waste is not allowed to enter waterways. Simple procedures such as washing hands after going to the toilet and before eating, and covering one’s nose and mouth when coughing, can help to prevent the spread of infectious diseases such as Hepatitis A and respiratory tract infections.

Vaccination has been used for over a century to prevent the spread of infectious diseases such as smallpox and polio. Vaccines contain a weakened form of the pathogen or sometimes simply the antigens associated with a specific disease. The antigens stimulate the immune system to produce antibodies, memory B-cells and memory T-cells that are able to quickly combat the disease if the vaccinated person is subsequently infected with the live pathogen. The response is immediate and rapid so the infection is defeated before symptoms can develop.

Preventing the spread of infectious disease is a more effective strategy than relying on treatments of the disease.

Hornsby Girls High School



TRIAL HSC EXAMINATION 2020

HSC Biology

BOOKLET 2

Student Number

Answer Questions 29 – 35 in this booklet

Section II

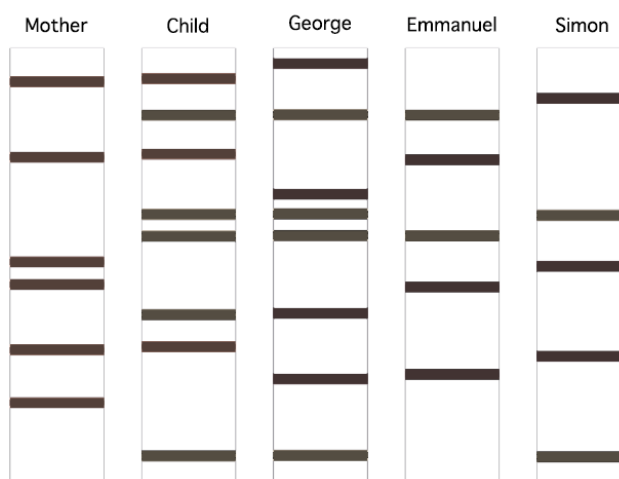
Attempt Questions 29 – 35 in this booklet.

Answer the questions in the space provided.

Do not write in the margins - if you require more space to complete a question, clearly note on the question that the answer continues then complete the question at the back of the section on the spare lined pages.

Question 29 (6 marks)

DNA profiling can be used to test for paternity. Three men (George, Emmanuel and Simon) were tested to determine the paternity of a child and the following banding patterns were produced.



- a) Identify which man is most likely to be the father of the child.

1

Criteria	Marks
• Identifies most likely father of child (George)	1

Suggested Answer

George is the most likely father.

- b) With reference to the DNA profile provided, justify your answer to a).

2

Criteria	Marks
• Provides TWO reasons based on the DNA profile above	2
• Provides ONE reason based on the DNA profile above	1

Suggested Answer could include

- Bands are in the most similar locations between George and the child.
- Approx six bands show the same or very close location.

- c) DNA profiling is a technique that can also be used to match DNA from a crime scene with that of potential suspects. Outline the techniques used in DNA profiling.

3

Criteria

Criteria	Marks
- Provides a clear explanation of the processes involved in DNA profiling including: - the use of restriction enzymes, primers, free nucleotides and DNA polymerase - electrophoresis - comparison of banding patterns between two samples	3
- Provides some explanation of the processes involved in DNA profiling including at least two of: - the use of restriction enzymes, primers, free nucleotides and DNA polymerase. - electrophoresis - comparison of banding patterns between the two samples	2
Provides some relevant information	1

Suggested Answer

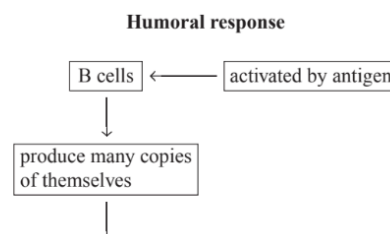
Sample answer:

The DNA taken from a crime scene is compared to the DNA taken from a suspect. Both samples of DNA are cut up by restriction enzymes into segments. Each sample is loaded into a separate well in an electrophoresis gel and a current is run through the gel to separate the different-sized fragments.

Smaller fragments move more quickly through the gel than larger fragments, so the bands on the gel are arranged by size. If the two samples of DNA are from the same individual the restriction enzyme would have cut the two samples into similar-sized fragments, and there would be multiple bands that line up on the two gels.

Question 30 (9 marks)

The diagram shows details of the humoral response that occurs when B cells respond in the presence of antigens.



- a) Describe how the human body would respond after these steps and explain how this would reduce the impact of the pathogen. 4

Criteria and Suggested Answer

The B cells are exposed to cytokines produced by helper T cells, which stimulate differentiation of the B cells. The B cells then become plasma cells and produce antibodies specific to the antigen. Some B cells differentiate to become helper B cells. This has a great impact on the individual's ability to fight diseases, as the helper B cells will rapidly become plasma B cells on any subsequent exposure to the antigen.	Mod 7 Infectious Disease BIO12–14	Bands 4–5
	Describes the response in relation to plasma cells AND helper B cells.	
	AND	
	Links the response to the reduced impact of the pathogen	4
	Describes the response in relation to plasma cells OR helper B cells.	
	AND	
	Links the response to the reduced impact of the pathogen	3
	Identifies a response.	
	AND	
	Links the response to the reduced impact of the pathogen	2
	Identifies a response	1

- b) The acquired immune response involves more than just B cells. Construct a table to compare and contrast B cells and T cells. 5

Criteria	Marks
- Logical table format, fully enclosed using a ruler and ruled off sections - FOUR similarities and/or differences between B cells and T cells (eg. 1 similarity and 3 differences OR 2 similarities and 2 differences etc.)	5
- Logical table format, fully enclosed using a ruler and ruled off sections - THREE similarities and/or differences between B cells and T cells (eg. 1 similarity and 3 differences OR 2 similarities and 2 differences etc.) OR - FOUR similarities and/or differences between B cells and T cells (eg. 1 similarity and 2 differences OR 2 similarities and 1 differences etc.) - Table with formatting/logic etc. errors	4
- Logical table format, fully enclosed using a ruler and ruled off sections - TWO similarities and/or differences between B cells and T cells (eg. 1 similarity and 1 differences OR 2 similarities but no differences etc.) OR - THREE similarities and/or differences between B cells and T cells (eg. 1 similarity and 2 differences OR 3 similarities and no differences etc.) - Table with formatting/logic etc. errors	3
- Logical table format, fully enclosed using a ruler and ruled off sections - Some useful information presented about B cells and T cells	2
Some useful information presented but not in a table format	1

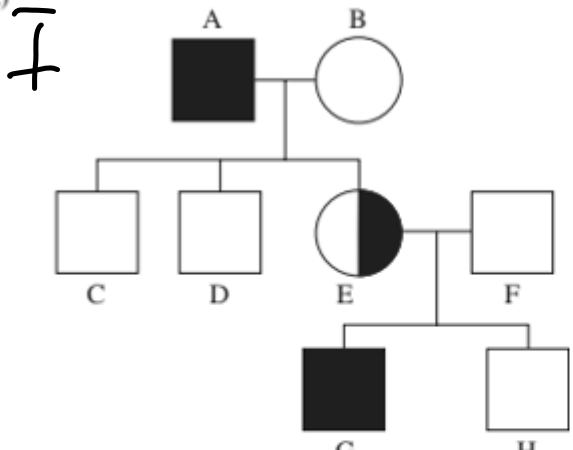
Question 31 (5 marks)

A common way to show the inheritance of characteristics is a pedigree (family tree).

- a) Draw a pedigree that illustrates the following information. Show the conventions you have used. A family had a history of a particular genetic disease. Adrian (male) showed signs of the disease and married Betty who did not display the disease. They had three children, Charles (male), David (male) and Ellen (female). Both Charles and David were genetically healthy, but Ellen may have been a carrier for the disease. Ellen married Freddy (male) who did not have the disease. They had two male children Geoff (who displayed the disease) and Harry (who was disease-free).

3

Criteria and Suggested Answer

(a)  Circles = female Square = males Unfilled = healthy Shaded = diseased Half-shaded = carriers	9.3.2 H2, H14 • Draws appropriate pedigree using correct conventions, three generational lines, symbols, order of offspring and correctly identifies genetic status of each family member using a key 3 • Draws appropriate pedigree using mostly correct conventions, three generational lines, symbols and correctly identifies genetic status of most family members 2 • Draws a simple pedigree displaying some knowledge of conventions and some formatting and symbols correct to this particular family tree 1
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*note: different symbol/notation for 'carriers' will be accepted assuming it is noted in the key

b) Could this be a sex-linked disorder? Outline the reasons for your answer.

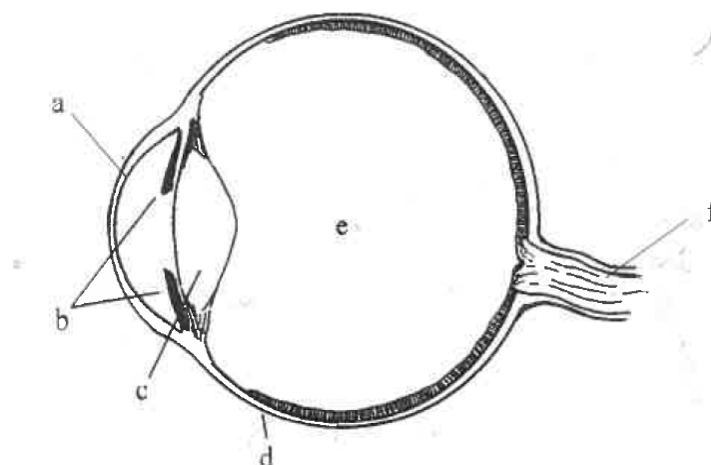
2

Criteria and Suggested Answer

Yes, likely. This pedigree chart is typical of X-linked disorders that often skip generations (although female carriers such as Ellen may be present) and appear mainly in males.	9.3.3	H2, H14
	• Gives correct reason and justification . 2	
	• Gives a reason. 1	

Question 32 (7 marks)

Below is a diagram of an eye.



a) Choose TWO parts of the eye identified with letters **above** and identify the function of each part in the table below. 4

Criteria	Marks
- Provides correct structure name for TWO of the letters identified in the diagram - Provides a correct function for each of the TWO identified structures	4
Is missing or has incorrect ONE of the above (note: if the structure is labelled incorrectly for the letter chosen but the function for the structure named is correct then student should only lose the mark for the incorrect structure)	3
Is missing or has incorrect TWO of the above (note: if the structure is labelled incorrectly for the letter chosen but the function for the structure named is correct then student should only lose the mark for the incorrect structure)	2
Has identified a correct structure based on the letter selected OR has correctly linked a correct function to its corresponding structure	1

b) Alex visited an optometrist after finding his vision was blurry in certain situations. 3

The optometrist concluded that Alex suffered with myopia.

Distinguish between the vision conditions myopia and hyperopia and outline how a technology can be used to correct Alex's condition.

Criteria	Marks
Distinguishes between myopia and hyperopia correctly and shows a good understanding of the two disorders	3

- Identifies ONE technology that could be used to correct Alex's myopia - Briefly outlines how this technology works/could be used to correct the vision	
TWO of the above	2
ONE of the above	1

Suggested Answer

Myopia and hyperopia are both refractive disorders of the eye that cause blurred vision because images/light do not focus on the retina. With hyperopia, the shape of the eye prevents light from focusing on the retina because the eyeball is too short. Instead the focal point falls behind the retina. Myopia is the opposite of hyperopia and results in "near sightedness". In effect then it causes distant objects to appear blurred, while close up objects appear in full focus. This is because the eyeball is too long and the image focal point is in front of the retina. Alex has myopia and this can be corrected with spectacles (glasses). This technology involves biconcave glass lens held in a glasses frame that sit on the face in front of the eye. This lens changes the way the light refracts such that the light/image falls on the retina, thus creating an image without blurriness.

Question 33 (4 marks)

A gene has three alleles in a population: G1, G2 and G3. The frequency of G1 in that population is 60% or 0.6. G2 has a frequency of 0.25

a) What is the frequency of G3?

1

Criteria and Suggested Answer

0.15	Mod 5 Genetic Variation BIO12–12 • States the correct frequency 1	Band 3
------	---	--------

b) A person who is homozygous for the G2 trait reproduces with a person who is homozygous for the G3 trait. It was stated that they have a 25% chance of producing a person with the G2 trait in their phenotype.

3

Determine the validity of this analysis. Provide evidence to support your answer.

Criteria and Suggested Answer

The statement is invalid because the frequency of alleles in a population cannot be used to determine the likelihood of offspring with those alleles in individual crosses where the genotypes are known. The frequency data is applied at the population level. Information about the pattern of inheritance is not provided in the question. For example, it is not known if the gene is sex-linked or if the alleles are co-dominant.	Mod 5 Genetic Variation BIO12–12 • Assesses the validity of the statement. AND • Demonstrates that population data is NOT linked to individual crosses. AND • Demonstrates the absence of information about the pattern of inheritance 3	Band 4
	• Assesses the validity of the statement. AND • Demonstrates the absence of information about the pattern of inheritance 2	
	• Assesses the validity of the statement ... 1	

Question 34 (8 marks)

Biotechnology has affected Earth's biodiversity for many years. Prior to the development of genetic engineering, farmers and scientists used many different methods to increase food production.

Outline ONE example of biotechnology from the past, ONE from the present and ONE potential future example. Evaluate their effects on biodiversity.

8

Criteria and Suggested Answer

Since the beginning of agriculture the genetic make-up of populations has been changing. When farmers started gathering animals – for example, cows and goats – close to where they lived rather than hunting and gathering their food, they started to limit opportunities for these animal populations to reproduce. This meant that the gene pool available was reduced. The variation in the genes reduced even further when farmers started to select individuals within a population to breed based on their desired traits. This means biodiversity was reduced to artificial selection rather than natural selection. Over centuries farming intensified, causing habitat destruction. This resulted in less biodiversity in agricultural populations and a reduction in wild populations of organisms that evolved through natural selection. More recently, genetic engineering has further reduced biodiversity. Organisms are engineered to have genes that produce desired characteristics. Once the desired product is designed, the organisms are cloned. This practice is used more often in plants than animals and produces crops where every plant is genetically identical. This is a dramatic reduction in biodiversity. Emission of green-house gases increases the concentration of carbon dioxide in the atmosphere and contributes to global warming. Current research is investigating possible ways for crops to have higher yields in this environment. For example, crops could be genetically engineered to withstand higher temperatures. While scientists may be able to engineer these crops, the biotechnology would still reduce the genetic variation in a species, because the crops would be genetically engineered with highly specific traits (such as tolerance to higher temperatures).	Mod 6 Biotechnology BIO12–13 Bands 3–6 - Describes an example of biotechnology from the past. AND - Describes an example of biotechnology from the present. AND - Describes a possible example of biotechnology for the future. AND - Describes the effect of the biotechnology from the past on biodiversity. AND - Describes the effect of the biotechnology from the present on biodiversity. AND - Describes the possible effect of the biotechnology for the future on biodiversity. AND - Evaluates the effect of the biotechnology from the past on biodiversity. AND - Evaluates the effect of the biotechnology from the present on biodiversity. AND - Evaluates the possible effect of the biotechnology on biodiversity now and in the future. 9 - Any EIGHT of the above points. 8 - Any SEVEN of the above points 7 - Any SIX of the above points 6 - Any FIVE of the above points 5 - Any FOUR of the above points 4 - Any THREE of the above points 3 - Any TWO of the above points 2 - Any ONE of the above points. 1
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